Fourth Quarterly Progress Report of Environmental Monitoring

for

April to June 2019

October 2019

Prepared

by

Project Management Unit of Nacala Port Development

for

Japan International Cooperation Agency

Executive summary

This quarterly progress report ("Report") demonstrates the environmental monitoring results of the fourth quarter of the Nacala Port Development Project Phase I and II ("Project"). It covers a period from April to June 2019.

Monitoring Item	Monitoring Results during Report Period
1. Fishing Resources 2. Benthic Macrofauna 3. Marine mammals with emphasis to dolphins	There was no monitoring activity for these three items during this report period as these items are monitored only twice per year. The next monitoring will be conducted in July 2019.
4. Erosion and Sedimentation	There was no monitoring activity for this item during this report period. The next monitoring is scheduled right before the dredging activities, which are planned for 2020.
5. Currents Circulation	There was no monitoring activity for this item during this report period. The next monitoring is scheduled after the expansion of the port, which is planned for 2021.
6. Change in the prism tidal volume	There was no monitoring activity for this item during this report period. The change in the prism tidal volume will be calculated based on the average tidal range and the surface area of Nacala Bay before and after expansion of the port by using the data from the National Institute of Fisheries Research (IIP).
7. Increased water turbidity in the Bay	The turbidity of the second, third and fourth monthly monitoring (M2, M3 and M4) at four monitoring locations (dredging area 1&2 (WQM1&2) and unaffected areas 1&2 (WQM3&4)) were compared with the results of the baseline survey (BL). High turbidities (e.g. double or triple of the BL results) were monitored at all the four monitoring points (i.e. both project and control areas) especially during M2. This issue was assumed to be caused by heavy rainfall which occurred before the monitoring activities.
8. Water Pollution	At the afore-mentioned locations (WQM1, 2, 3 and 4), ten parameters, i.e. water temperature, pH, dissolved oxygen (DO), total suspended solids (TSS), total nitrogen (TN), total phosphorus (TP), total hydrocarbons (THH), chemical oxygen demand (COD), biological oxygen demand (BOD) and total and fecal coliforms) were monitored during M2, M3 and M4 at two depths (0.2m from the water surface and at the mid-depth of the water surface and sea bottom) and compared with the standards set by the "*Technical Specifications, Part 1: General Requirements*". All the parameters were within the said standards expect for DO, COD and total coliforms. - DO: During M2, it exceeded at both depths about 30-50% at all the four monitoring points, i.e. both project and control areas. Therefore, it was not assumed to be caused by the project activities. - COD: During M2, M3 and M4, high COD concentrations (double or triple of the BL or the said standard) were recorded at all the four monitoring points (i.e. both project and control areas). The reasons could not be identified or reasonably assumed. However, it was extremely high at both the project and control areas, so it was unlikely that the project works would have caused it. Moreover, the dredging works and the construction of the bypass access road have not started yet, so the project works can most likely not be the reason for this COD increase. - Total coliforms: It was detected at the water surface of WQM1 and 2 during M3 although it should be virtually absent. During the BL, it had already been detected at both depths of all four monitoring locations, except at the water surface of WQM4.
9. Bottom sediments (Re-suspension of sediments)	There was no monitoring activity for this item during this report period. The next monitoring is scheduled after the completion of the dredging work, which is planned for 2020.
10. Water pollution and impact on marine resources	There was no monitoring activity for this item during this report period. The next monitoring is scheduled during the dredging and reclamation operation, which is planned for 2020.
11. Air quality	There was no monitoring activity for this item during this report period. This monitoring is subject to the operation phase only.
12. Noise Levels	Noise was monitored at Nacala 1 (northeast from the port), Nacala 2 (adjacent to the eastern edge of the port) and Nacala 3 (southeast from the port) twice in the daytime (Daytime 1 and 2) and twice at nighttime (Nighttime 1 and 2). Nighttime monitoring was conducted for the first time as baseline data for future monitoring activity because no project work at night had started yet during this report period. - Nacala 1:The average equivalent noise level (Leq) of the second quarterly monitoring (Q2) during Daytime 1 and 2 exceeded the World Health Organization (WHO) standard for residential areas by 5 and 19 dBA (A-weighted decibel) while the average Leq at BL exceeded the said standard in the daytime by 6dBA. - Nacala 2: The average Leq of Q2 during the Daytime 1 and 2 were all below the said standard for industrial and commercial areas.

	- Nacala 3: : The average Leq of Q2 during the Daytime 1 and 2exceeded the said standard for residential areas by 12 and 13 dBA respectively while the average Leq during BL exceeded the said standard by 11dBA in the daytime. Based on the field notes of the monitoring staffs, the increased noise at Nacala 1 and 3 is unlikely from the port, but most likely due to the heavy traffic of motor vehicles, which were not observed during BL.
13. Road Accident	There took place 2 accidents involving vehicles within the Port, none of which resulted in injury or fatality. There was no traffic accident surrounding the Port during this reporting period.

Table of Contents

List of Acronyms

Acronym	Description
BTEX	Benzene, Toluene, Ethylbenzene &Xylene
BOD	Biochemical Oxygen Demand
CDN	North Development Corridor
CFU	Colony-forming Unit
COD	Chemical Oxygen Demand
CPUE	Catch Per Unit of Effort
Cr	Chromium
dBA	A-weighted Decibel
DDT	Dichloro- diphenyl- trichloroethane
DO	Dissolved Oxygen
EIS	Environmental Impact Study
EMP	Environmental Management Plan
IDEPA	National Institute for Fisheries Development and Aquaculture
IIP	National Institute of Fisheries Research
INAHINA	National Institute for Hydrography and Navigation
INAMAR	National Maritime Institute
INIP	National Institute for Fish Inspection and Quality Control
JICA	Japan International Cooperation Agency
Leq	Equivalent Noise Levels
Lmax	Maximum Sound Pressure Level
Lmin	Minimum Sound Pressure Level
MD	Minutes of Discussions
MdP	Ministry of Fisheries
MICOA	Ministry for the Coordination of Environmental Affairs of Mozambique (Former MITADER)
MITADER	Ministry of Land, Environment and Rural Development of Mozambique
MTC	Ministry of Transports and Communications of Mozambique
ND	Not Detected
Ni	Nickel
NO2	Nitrogen Dioxide
NTU	Nephelometric Turbidity Unit
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyl
PM 10	Particulate matter 10 micrometers or less in diameter
PTJV	Penta-Ocean Construction Co., Ltd. & Toa Corporation Joint Venture

SO2	Sulfur Dioxide
THH	Total Hydrocarbons
TN	Total Nitrogen
TP	Total Phosphorus
TechSpec	Technical Specifications.
TS	Total Sulphur
TSS	Total Suspended Solids
UIPRPN	Unit for the Implementation of the Project for the Rehabilitation of the Port of Nacala

1 Background of this Environmental Monitoring

This environmental monitoring is stipulated by environmental monitoring program stated in *Volume 3: Environmental Management Plan (EMP) and Subsidiary Plans (Environmental Education Program, Port Emergency Management Plan, Waste Management Plan and Communication Plan)* of *Rehabilitation and Expansion of Nacala Port: Environmental Impact Study (EIS)* from September 2012.

From the perspective of the bilateral government agreement, a consent for this monitoring was given by *Minutes of Discussions on Nacala Port Development Project Phase II between Ministry of Transport and Communications of the Government of the Republic of Mozambique and Japan International Cooperation Agency (JICA)* ("MD"). It was duly agreed between and signed by JICA and responsible authorities of Government of the Republic of Mozambique on 2 September 2014 in Maputo, Mozambique.

The attachment 11-1 of MD requires Project Management Unit of Nacala Port Development / Unit for the Implementation of the Project for the Rehabilitation of the Port of Nacala (UIPRPN: "Project Owner") to conduct environmental monitoring by collecting results from monitoring entities and report the results to JICA as a part of the Progress Report (quarterly basis). This attachment provides the monitoring form, which stipulates the following items to be reported for this environmental monitoring.

(a) Description of general impact.
(b) Objective.
(c) Parameters to be monitored.
(d) Frequency of monitoring.
(e) Monitoring location.
(f) Implementing institution.
(g)Supervising / auditing institution.

This attachment also states that the above-mentioned reporting items (a) to (g) are due for each of the thirteen monitoring topics below.

1. Fishing Resources.
2. Benthic Macrofauna.
3. Marine mammals with emphasis to dolphins.
4. Erosion and sedimentation.
5. Currents Circulation.
6. Change in the prism tidal volume.
7. Increased water turbidity in the Bay.
8. Water Pollution.
9. Bottom sediments.
10. Water pollution and impact on marine resources.
11. Air quality.
12. Noise Levels.
13. Road Accident.

This attachment 11-1 also requires comments from Mozambican Ministry of Environment ("MITADER" standing for Ministério da Terra, Ambiente e Desenvolvimento Rural, which was formerly called Ministry for the Coordination of Environmental Affairs (MICOA) at the preparation phase of the Project) on the monitoring results.

The attachment 11-2 of MD is based on the attachment 11-1 and illustrates the actual monitoring activities, which reflects the monitoring program stated in the said EMP of EIS.

2 Responses / Actions to Comments and Guidance from MICOA (MITADER)

All the comments and guidance given by MITADER are to be summarized in the table below:

Monitoring Item / Comments from MITADER	Monitoring Results during Report Period

UIPRPN requested MITADER to provide the above-mentioned comments and guidance based on a prepared quarterly progress report of environmental monitoring covering a period from July to September 2018. However, it rejected the request and instead notified the Ministry of Transports and Communications of Mozambique (MTC) / UIPRPN that it is obliged to conduct an environmental audit first and complete an environmental license renewal process next following the revised environmental impact assessment regulations (Decree No. 54/2015 dated 31st December 2015). When all the steps of this environmental license renewal process should be completed, UIPRPN/MTC will obtain comments from MITADER on the quarterly progress reports of environmental monitoring.

3 Monitoring Results

Monitoring results for each of the 13 environmental monitoring programs are presented in the following sub chapters.

3.1 Fishing Resources

3.1.1 Control of Chemical and Microbiological Fishery Products Program

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Consultant's Sub-consultant	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. The next monitoring will be conducted in July 2019.
		(b) Objective	Reduction of the impact on fish stocks.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters:** - Chemical parameters (heavy metals (mercury, lead and cadmium), pH and total volatile nitrogen) in sampled fish bodies. - Biological parameters (Coliforms (total& fecal), *Escherichia coli*, *Salmonella spp.*, *Staphylococcus aureus*, *Vibrio cholera* and *Vibrio parahaemolyticus*) in sampled fish bodies. **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Periodical surveillance (twice per year) based on the discussion with INIP.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Consultant's Sub-consultant (BioGlobal Consultoria e Serviços Lda.) in collaboration with the National Institute of Fish Inspection (INIP) represented in Nacala
		(g) Supervision / Auditing Institution	CDN/MTC, MICOA (MITADER), INIP, INAMAR and MdP.

3.1.2 Fisheries Resources Monitoring Program

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Consultant's Sub-consultant	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. The next monitoring will be conducted in July 2019.
		(b) Objective	Reduction of the impact on fish stocks.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters**: Estimated catch (tons /year), mean fishing effort, and Catch per Unit Effort (CPUE) for four (4) types of representative fishers (trawling, surface gillnet, bottom gillnet and line fishing). **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Twice per year based on the discussion with IIP while a desk review of publicly available data from IDEPA & IIP will be conducted monthly.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Consultant's Sub-consultant (BioGlobal Consultoria e Serviços Lda.) in collaboration with National Institute for Fisheries Research (IIP)
		(g) Supervision / Auditing Institution	CDN/MTC, MICOA (MITADER), MdP& IIP

3.2 Benthic Macrofauna

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Consultant's Sub-consultant	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. The next monitoring will be conducted in July 2019.
		(b) Objective	Control of benthic macro-fauna.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters**: Abundance (density) and diversity of macro fauna. **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	One before construction; twice per year during construction and once after construction.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Consultant's Sub-consultant (BioGlobal Consultoria e Serviços Lda.)
		(g) Supervision / Auditing Institution	CDN/MTC, MICOA (MITADER) & IIP.

3.3 Marine Mammals with Emphasis to Dolphins

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Consultant's Sub-consultant	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. The next monitoring will be conducted in July 2019.
		(b) Objective	Reduce impact on abundance of dolphin /whale population in the area.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters**: Distribution and abundance of marine mammals (especially whales & dolphins). **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Once before construction; twice per year during construction and once after construction.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Consultant's Sub-consultant (BioGlobal Consultoria e Serviços Lda.)
		(g) Supervision / Auditing Institution	CDN, MTC, MICOA (MITADER) & IIP.

3.4 Erosion and Sedimentation

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Contractor's subcontractor	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. Therefore, no impact can be described. The next monitoring is scheduled right before the dredging activities (see the item (d) below), which is planned for 2020.
		(b) Objective	Erosion and / or sedimentation control.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameter**: Sea floor topography in the dredging area. **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Five times: Before construction works, right before, during and after the dredging activities and also after the completion of construction works.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Contractor's subcontractor (COWI Moçambique Lda.)
		(g) Supervision/Auditing Institution	CDN, MTC, MICOA (MITADER), INAMAR and INAHINA.

3.5 Currents Circulation

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Contractor's subcontractor	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. Therefore, no impact can be described. The next monitoring is scheduled after the expansion of the port (see the item (d) below), which is planned for 2021.
		(b) Objective	Control of the circulation pattern of currents area.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitored parameter**: Circulation pattern of currents in Nacala Bay (i.e direction of the flow and current speed). **Measurement equipment and procedure**: This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Before and after the expansion of the port.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Contractor's subcontractor (COWI Moçambique Lda.).
		(g) Supervision/Auditing Institution	CDN, MTC, MICOA (MITADER), INAMAR and INAHINA.

3.6 Change in the Prism Tidal Volume

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Consultant's Sub-consultant		**Nacala Bay**
		(a) Description of General Impact	The initial prism tidal volume has not yet been calculated. It will be undertaken after the expansion of the port based on the data from the National Institute of Fisheries Research (IIP).
		(b) Objective	Control of the tidal prism volume.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitored parameter was as follows:** Bay topography. **Measurement Equipment & Procedure**: The assessment of the change in the prism tidal volume will be conducted as follows. 1. Calculation of the average tidal range: The heights for the average low and high spring tide of Nacala Bay will be obtained from publicly available data. Then, the average tidal range (the height difference between the low and high spring tide) will be calculated. 2. Calculation of the surface area of Nacala Bay: The remote sensing data of the coast line (high resolution coastline bathymetry) of Nacala Bay will be obtained from IIP. Then, the data will be imported into the GIS system by using a special software to define the water surface as a polygon. After that, another polygon defining the water surface will be generated by using recent satellite imagery which will take into considerations other aspects which were covered by the first polygon, such as erosion, land reclamation, etc. Finally, these two polygons will be combined, and the average surface area between the low and high tide height will be calculated. 3. Calculation of the prism tidal volume: The prism tidal volume (P) will be calculated by multiplying the average tidal range (ΔH) with the average surface area of the bay (A), and the equation will be indicated as follows. $P=\Delta H \times A$. 4. Assessment of the change in tidal prism volume: The calculation of the prism tidal volume will be conducted twice (once before and once after the expansion of the port), and the change in the tidal volume will be assessed by comparing the results from the first and second calculation.
		(d) Frequency of Monitoring	Before and after the expansion of the port.
		(e) Monitoring Location	The entire Nacala Bay.
		(f) Implementing Institution	Consultant's Sub-consultant (BioGlobal Consultoria e Serviços Lda.)
		(g) Supervision / Auditing Institution	CDN, MTC, MICOA (MITADER), INAMAR & INAHINA.

3.7 Increased Water Turbidity in the Bay

Monitoring Date	Implementing Agency	Monitoring Results during Report Period
06/05/2019 31/05/2019 and 28/06/2019	Contractor's subcontractor	**(a) Description of General Impact** BL stands for baseline monitoring (average &maximum turbidity results and the range of pH and temperature); M2, M3 and M4 for second, third and fourth monthly monitoring; 0.2m for 0.2 meters from the water surface; mid-depth for the mid-depth between the water surface and sea bottom; and T for Temperature. - The turbidity result for each month is compared with the maximum turbidity result recorded during the BL.

Dredging Area 1

Monitoring results 1: The seabed depth in this area was about 11m for BL, M2, M3 and M4 (see the explanation from left). The results in the table below demonstrate the turbidity increase for M2 by about 160% and 30% at 0.2m and mid-depth respectively against BL without major changes of pH and temperature. For M3, turbidity did not increase at both depths from BL while temperature and pH did not significantly change. For M4, turbidity increased by 60% at mid-depth against BL without major changes of pH and temperature. The exceedance of the turbidity from the set standard and BL data will be discussed at the end of this section.

Parameter	Depth	BL	M2	M3	M4
Turbidity (NTU)	0.2m	14.0 / 20.1	52.6	14.2	17.3
	Mid-depth	12.2 / 12.8	17.1	1.3	21.1
pH	0.2m	7.4 ~ 7.8	8.2	8.2	7.5
	Mid-depth	8.2	8.0	8.3	7.7
T (°C)	0.2m	29.2 ~ 29.3	26.6	26.8	24.8
	Mid-depth	28.7 ~ 29.2	27.6	26.2	24.9

Dredging Area 2

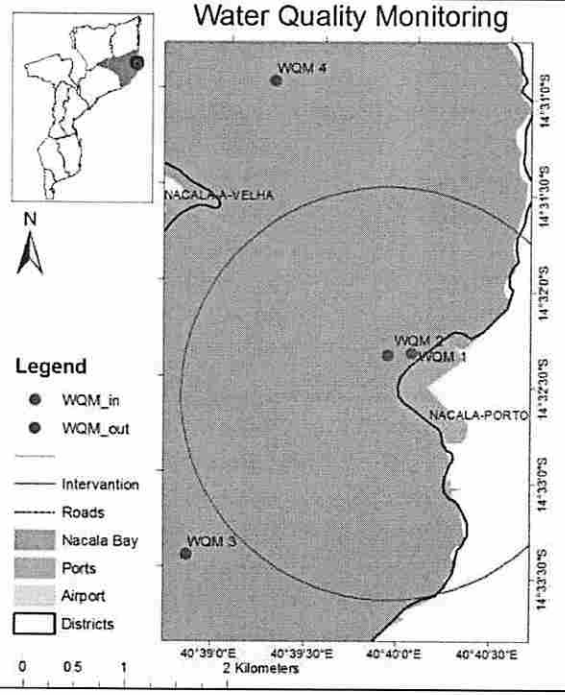
Monitoring results 2: The seabed depth in this area was about 24m for BL, M2, M3 and M4. The results in the table below demonstrate the turbidity increase for M2 by about 100% and 10% at 0.2m and mid-depth respectively against BL without major changes of pH and temperature. For M3, turbidity did not increase at both depths from BL while temperature and pH did not change significantly. For M4, turbidity increased by10% at mid-depth against the BL without major changes of pH and temperature. The exceedance of the turbidity from the set standard and BL data will be discussed at the end of this section.

Parameter	Depth	BL	M2	M3	M4
Turbidity (NTU)	0.2m	14.3 / 14.7	29.0	14.2	14.6
	Mid-depth	14.0 / 15.3	17.5	12.9	16.6
pH	0.2m	7.6 ~ 7.8	7.5	8.1	7.7
	Mid-depth	8.2	7.5	8.2	7.7
T (°C)	0.2m	27.8 ~ 29.1	27.3	25.6	25.2
	Mid-depth	27.3 ~ 28.1	26.8	25.8	25.1

<table>
<tr><th>Monitoring Date</th><th>Implementing Agency</th><th colspan="2">Monitoring Results during Report Period</th></tr>
<tr><td></td><td></td><td></td><td>
Unaffected Area 1
Monitoring results 3: The seabed depth in this area was about 11m for BL, M2, M3 & M4. The results in the table below demonstrate the turbidity increase for M2 by about 40% and 30% at 0.2m and mid-depth respectively against BL without major changes of pH and temperature. For M3, turbidity increased by about 20% at mid-depth against BL without major changes of pH and temperature. For M4, turbidity did not increase at both depths from BL while temperature and pH did not change significantly.
<table>
<tr><th>Parameter</th><th>Depth</th><th>BL</th><th>M2</th><th>M3</th><th>M4</th></tr>
<tr><td>Turbidity (NTU)</td><td>0.2m</td><td>14.2 / 15.9</td><td>21.7</td><td>15.5</td><td>11.6</td></tr>
<tr><td></td><td>Mid-depth</td><td>14.7 / 16.4</td><td>21.2</td><td>20.3</td><td>12.0</td></tr>
<tr><td>pH</td><td>0.2m</td><td>7.6 ~ 7.8</td><td>7.4</td><td>7.5</td><td>7.5</td></tr>
<tr><td></td><td>Mid-depth</td><td>8.1 ~ 8.2</td><td>7.7</td><td>8.0</td><td>7.8</td></tr>
<tr><td>T (°C)</td><td>0.2m</td><td>29.2 ~ 29.6</td><td>28.3</td><td>25.2</td><td>24.2</td></tr>
<tr><td></td><td>Mid-depth</td><td>28.8 ~ 29.0</td><td>27.2</td><td>25.7</td><td>24.5</td></tr>
</table>
Unaffected Area 2
Monitoring results 4: The seabed depth in this area was about 8m for BL, M2, M3 & M4. The results in the table below demonstrate the turbidity increase for M2 by about 260% at both depths against BL without major changes of pH and temperature. For M3 and M4, turbidity did not increase at both depths from BL while temperature and pH did not change significantly. The exceedance of the turbidity from the set standard and BL data will be discussed at the end of this section.
<table>
<tr><th>Parameter</th><th>Depth</th><th>BL</th><th>M2</th><th>M3</th><th>M4</th></tr>
<tr><td>Turbidity (NTU)</td><td>0.2m</td><td>14.4 / 16.8</td><td>60.0</td><td>9.9</td><td>13.5</td></tr>
<tr><td></td><td>Mid-depth</td><td>14.3 / 15.9</td><td>57.2</td><td>6.3</td><td>14.3</td></tr>
<tr><td>pH</td><td>0.2m</td><td>7.2 ~ 8.0</td><td>8.2</td><td>8.3</td><td>7.3</td></tr>
<tr><td></td><td>Mid-depth</td><td>8.2</td><td>8.2</td><td>8.2</td><td>7.1</td></tr>
<tr><td>T (°C)</td><td>0.2m</td><td>27.8 ~ 29.0</td><td>26.6</td><td>25.6</td><td>24.9</td></tr>
<tr><td></td><td>Mid-depth</td><td>27.3 ~ 28.9</td><td>26.6</td><td>26.6</td><td>24.7</td></tr>
</table>
Consideration about high turbidity
The high turbidity (e.g. double or triple of the baseline result) was recorded at all the four monitoring points especially during M2 and this issue was maybe caused by heavy rainfall which occurred before the measurement (refer to the attached precipitation data for the relevant months, Annex-1 Weather Report for Relevant Month).
</td></tr>
<tr><td></td><td></td><td>(b) Objective</td><td>Monitoring the turbidity.</td></tr>
<tr><td></td><td></td><td>(c) Monitored Parameters with Measurement Equipment & Procedure</td><td>Monitored parameters: Turbidity with temperature (T) and pH.

Measurement equipment and procedures: Water samples were collected at 0.2m from the water surface and at the mid-depth between the water surface and sea bottom at four locations. For each depth, two samples were collected through Niskin bottle. The above-mentioned parameters were measured in situ by portable multi-parameter meter (AP-800 Aquaprobe) and recorded. Before each sampling, sampling bottles were properly cleaned. These results were compared with the ones of the baseline monitoring in order to verify if the construction activity is causing an increase of turbidity (temperature and pH).</td></tr>
<tr><td></td><td></td><td>(d) Frequency of</td><td>Prior to construction (once in four sampling sites - two points in the water column), and during construction (monthly for four sampling</td></tr>
</table>

<table>
<tr><th>Monitoring Date</th><th>Implementing Agency</th><th colspan="2">Monitoring Results during Report Period</th></tr>
<tr><td></td><td></td><td>Monitoring</td><td>sites - two points in the water column).</td></tr>
<tr><td></td><td></td><td>(e) Monitoring Location</td><td>All the four monitoring locations (dredging area 1, dredging area 2, unaffected area 1and unaffected area 2) are illustrated as WQM1, WQM2, WQM3 and WQM4 respectively on the map at the right side.

Their geographical coordinates are summarized in the table below.
<table>
<tr><th rowspan="2">Stations</th><th colspan="2">Position</th></tr>
<tr><th>Latitude S</th><th>Longitude E</th></tr>
<tr><td>WQM 1</td><td>14° 32' 20.32"</td><td>40° 40' 01.39"</td></tr>
<tr><td>WQM 2</td><td>14° 32' 21.29"</td><td>40° 39' 53.61"</td></tr>
<tr><td>WQM 3</td><td>14° 33' 26.28"</td><td>40° 38' 50.99"</td></tr>
<tr><td>WQM 4</td><td>14° 30' 56.61"</td><td>40° 39' 14.17"</td></tr>
</table>

</td></tr>
<tr><td></td><td></td><td>(f) Implementing Institution</td><td>Contractor's subcontractor (COWI Moçambique Lda.).</td></tr>
<tr><td></td><td></td><td>(g) Supervision / Auditing Institution</td><td>CDN, MTC, MICOA (MITADER) and INAMAR.</td></tr>
</table>

3.8 Water Pollution

Monitoring Date	Implementing Agency	Monitoring Results during Report Period
06/05/2019 31/05/2019 and 28/06/2019	Contractor's subcontractor during construction phase only	**(a) Description of General Impact** BL stands for baseline monitoring; M2, M3, and M4 for second, third and fourth monthly monitoring; T for Temperature; DO for dissolved oxygen; TSS for total suspended solids; TN for total nitrogen; TP for total phosphorus; THH for total hydrocarbons; COD for chemical oxygen demand; BOD for biochemical oxygen demand; 0.2m for 0.2 meters from the water surface; mid-depth for the mid-depth between the water surface and sea bottom; both / two depths for 0.2m and mid-depth; and ND for not detected as neither Gasoline nor Diesel Range Organics which make the THH results.

Dredging Area 1

Monitoring results 1: The seabed depth in this area was about 11m during BL, M2, M3 and M4 (see the explanation on the left side). The results in the table below demonstrate that DO exceeded the standards set in the Technical Specifications by about 50% and 30% at 0.2m and mid-depth respectively during M2 and by 2% at 0.2m during M3 and COD's exceedance was about 220%, 90% and 50% during M2, M3 and M4 respectively at 0.2m and 160%, 100% and 100%during M2, M3 and M4 respectively at mid-depth while the total colifom was detected at 0.2m during M3 although it should be virtually absent. Out of these three, DO and COD already exceeded during BL. The set standard by 2% at 0.2m and by 3% and 30% at 0.2m and mid-depth respectively while coliform was already detected at 0.2m. The extra-ordinary exceedance of COD against the standard and BL will be discussed at the end of this section.

Depth	Month	T (°C)	pH	DO (mg/l)	TSS (mg/l)	TN (mg/l)	TP (mg/l)	THH (mg/l)	COD (mg/l)	BOD (mg/l)	Coliform (CFU)	
											Total	Fecal
0.2m	BL	29.3	7.4	5.7	11.0	1.2	<0.04	0.8	154	<0.1	111	0
	M2	26.6	8.2	8.7	19.0	<1.0	<0.04	ND	482	2.8	0	0
	M3	26.8	8.2	6.1	12.0	<1.0	0.3	ND	283	<0.1	2	0
	M4	24.8	7.5	5.2	15.0	1.1	0.1	ND	222	2.8	0	0
Mid-Depth	BL	28.7	8.2	5.9	7.0	1.0	0.1	0.3	104	<0.1	4	0
	M2	27.6	8.0	7.6	26.0	<1.0	<0.04	ND	392	0.1	0	0
	M3	26.2	8.3	6.0	<1.0	<1.0	0.3	ND	304	<0.1	0	0
	M4	24.9	7.7	5.3	15.0	1.0	0.1	ND	300	3.1	0	0

Monitoring Date	Implementing Agency	Monitoring Results during Report Period

Dredging Area 2

Monitoring results 2: The seabed depth in this area was about 24m during BL M1, M2, M3 and M4. The results in the table below demonstrate that DO exceeded the said standards by about 40% at both depths during M2 and by 2% at 0.2m during M3 and COD's exceedance was about 140%, 90% and 130% during M2, M3 and M4 respectively at 0.2m and 90%, 80% and 80% during M2, M3 and M4 respectively at mid-depth while the total colifom was detected at 0.2m during M3 although it should be virtually absent.
Out of these three, COD already exceeded the set standard by about 10 % at both depths during BL while coliform was already detected at 0.2m. The extra-ordinary exceedance of COD will be discussed at the end of this section.

Depth	Month	T (°C)	pH	DO (mg/l)	TSS (mg/l)	TN (mg/l)	TP (mg/l)	THH (mg/l)	COD (mg/l)	BOD (mg/l)	Coliform (CFU)	
											Total	Fecal
0.2m	BL	27.8	7.6	5.9	15.0	1.0	0.1	0.3	162	<0.1	>150	24
	M2	27.3	7.5	8.4	18.0	<1.0	0.1	ND	356	0.9	0	0
	M3	25.6	8.1	6.1	12.0	<1.0	0.3	ND	282	<0.1	1	0
	M4	25.2	7.7	5.1	19.0	1.3	0.1	ND	343	2.1	0	0
Mid-Depth	BL	27.3	8.2	6.0	2.0	1.0	0.1	1.0	112	<0.1	109	15
	M2	26.8	7.5	8.4	23.0	<1.0	0.1	ND	282	0.1	0	0
	M3	25.8	8.2	5.9	23.0	<1.0	0.2	ND	263	<0.1	0	0
	M4	25.1	7.7	5.3	10.0	1.1	0.04	ND	274	2.4	0	0

Monitoring Date	Implementing Agency	Monitoring Results during Report Period

Unaffected Area 1

Monitoring results 3: The seabed depth in this area was about 11m during BL, M2, M3 and M4. The results in the table below demonstrate that DO exceeded the said standards by about 30% and 40% at 0.2m and mid-depths respectively during M2 while COD's exceedance was about 130%, 90% and 90% during M2, M3 and M4 respectively at 0.2m and 190%, 100% and 100% during M2, M3 and M4 respectively at mid-depth. Out of these two, COD already exceeded the set standard by about 30% at mid-depth during BL. The extra-ordinary exceedance of COD will be discussed at the end of this section.

Depth	Month	T (°C)	pH	DO (mg/l)	TSS (mg/l)	TN (mg/l)	TP (mg/l)	THH (mg/l)	COD (mg/l)	BOD (mg/l)	Coliform (CFU)	
											Total	Fecal
0.2m	BL	29.2	7.6	5.9	9.0	1.0	0.2	0.3	148	<0.1	115	22
	M2	28.3	7.4	7.9	29.0	<1.0	<0.04	ND	348	0.1	0	0
	M3	25.2	7.5	5.8	1.0	<1.0	0.3	ND	285	<0.1	0	0
	M4	24.2	7.5	5.3	21.0	1.3	0.1	ND	288	2.9	0	0
Mid-Depth	BL	28.8	8.2	5.9	10.0	1.1	<0.04	1.0	116	<0.1	>150	27
	M2	27.2	7.7	8.4	32.0	<1.0	0.1	ND	430	0.3	0	0
	M3	25.7	8.0	5.9	8.0	<1.0	0.3	ND	297	<0.1	0	0
	M4	24.5	7.8	5.1	23.0	1.1	0.04	ND	299	2.0	0	0

Unaffected Area 2

Monitoring results 4: The seabed depth in this was about 8m during BL, M2, M3 and M4. The results in the table below demonstrate that DO exceeded the said standards by about 40% at both depths during M2 while COD's exceedance was about 140%, 160% and 60% during M2, M3 and M4 respectively at 0.2m and 170%, 100% and 120% during M2, M3 and M4 respectively at mid-depth. Out of these two, COD already exceeded the set standard by about 10% at mid-depth during BL. The extra-ordinary exceedance of COD will be discussed at the end of this section.

Depth	Month	T (°C)	pH	DO (mg/l)	TSS (mg/l)	TN (mg/l)	TP (mg/l)	THH (mg/l)	COD (mg/l)	BOD (mg/l)	Coliform (CFU)	
											Total	Fecal
0.2m	BL	27.8	7.2	6.0	2.0	1.0	<0.04	0.5	132	<0.1	0	0
	M2	26.6	8.2	8.4	17.0	<1.0	<0.04	ND	360	0.4	0	0
	M3	25.6	8.3	5.9	16.0	<1.0	0.3	ND	388	<0.1	0	0
	M4	24.9	7.3	5.1	30.0	1.1	0.04	ND	236	2.1	0	0
Mid-Depth	BL	27.3	8.2	5.8	17.0	1.1	<0.04	0.5	134	<0.1	3	0
	M2	26.6	8.2	8.5	24.0	<1.0	0.04	ND	402	0.2	0	0
	M3	26.6	8.2	6.0	7.0	<1.0	0.3	ND	299	<0.1	0	0
	M4	24.7	7.1	5.1	7.0	1.1	0.1	ND	335	2.5	0	0

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
			Consideration about high COD concentrations
			The reasons for extremely high COD concentrations (double or triple of the BL or the said standard) during M2, M3 and M4 at all the monitoring locations could not be identified or reasonably assumed. However, it was extremely high at both the project and control areas, so it was unlikely that our project works would have caused it. Moreover, the dredging works and the construction of the bypass access road have not started yet, so our project works can most likely not be the reason for this COD increase.
		(b) Objective	Monitoring of water quality in Nacala Bay.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitored parameters**: - Physical-chemical parameters: Temperature (T), pH and dissolved oxygen (DO). - Pollutants: Total suspended solids (TSS), total nitrogen (TN), total phosphorus (TP), total hydrocarbons (THH), chemical oxygen demand (COD) and biological oxygen demand (BOD5). - Microbiological parameters: Coliforms (total and fecal). **Measurement equipment and procedures:** For the parameters such as water temperature and pH, the measurement was conducted on site by using a portable multiparameter meter (AP-800 Aquaprobe) at 0.2m from the water surface and the mid-depth between the water surface and sea bottom at four locations. For the other parameters, it was first ensured that the sampling containers were not contaminated and also properly labeled. After that, water samples were taken from the same depths at the same locations as the ones for the on-site measurement through Niskin bottle. For each sample, spare samples were also taken. The regular and spare samples were put in cooler boxes with ice packs on boat, and then stored in the fridge at the end of the monitoring day. The regular samples were first transported to Bureau Veritas offices in Nacala Velha, and then re-packed in cooler boxes with ice packs to be sent to a laboratory, Bureau Veritas Laboratory, in South Africa for analysis. The laboratory analysis results were compared with the standards stipulated in the Clause "15.6.3 Marine Water Quality" of "Technical Specifications, Part 1: General Requirements" and also with the results of the baseline monitoring. Salinity and transparency monitoring will start in July 2019.
		(d) Frequency of Monitoring	Prior to construction (once for four sampling sites - two points in the water column) and during construction (monthly for four sampling sites - two points in the water column).
		(e) Monitoring Location	All the four monitoring locations (dredging area 1, dredging area 2, unaffected area 1 and unaffected area 2) are described under "(e) Monitoring Location" of "3.7 Increased water turbidity in the Bay" of this report.
		(f) Implementing Institution	Contractor's subcontractor, COWI Moçambique Lda. (during construction phase) and CDN (during operation phase).
		(g) Supervision / Auditing Institution	CDN, MTC and MICOA (MITADER).

3.9 Bottom Sediments (Re-suspension of Sediments)

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Contractor's subcontractor	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. Therefore, no impact can be described. The next monitoring is scheduled after the completion of the dredging work (see the item (d) below), which is planned for 2020.
		(b) Objective	Monitoring water quality in the Bay.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters:** - Total nitrogen (TN), total phosphorus (TP) and total sulfur (TS). - Heavy metals (chromium (Cr), lead (Pb) and nickel (Ni)). - Dichloro-diphenyl-trichloroethane (DDT), total polychlorinated biphenyl (PCB) and total polycyclicaromatic hydrocarbons (PAHs). **Measurement equipment and procedure:** This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Once before and once after the dredging to be completed.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Contractor's subcontractor (COWI Moçambique Lda.).
		(g) Supervision / Auditing Institution	CDN, MTC and MICOA (MITADER).

3.10 Water Pollution and Impact on Marine Resources

Monitoring Date	Implementing Agency	Monitoring Results during Report Period	
None	Contractor's subcontractor	**(a) Description of General Impact**	This monitoring was not conducted in this reporting period. Therefore, no impact can be described. The next monitoring is scheduled during the dredging and reclamation operation (see the item (d) below), which is planned for 2020.
		(b) Objective	Monitoring of water quality in Nacala Bay and reduction of the impact on the marine environment.
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters:** Monitoring parameters will be as follows: - Sealing of the dredger vessel, sediment transport and efficiency of the sediment curtain. **Measurement equipment and procedure:** This section will be described in details when the monitoring result is reported.
		(d) Frequency of Monitoring	Daily during the dredging and reclamation phase.
		(e) Monitoring Location	The monitoring locations will be described when the monitoring result is reported.
		(f) Implementing Institution	Contractor's subcontractor (COWI Moçambique Lda.).
		(g) Supervision/Auditing Institution	CDN/MTC, MICOA (MITADER), MdP and IIP.

3.11 Air Quality (during the operation phase only)

Monitoring Date	Implementing Agency	Monitoring Results during Report Period		
None	CDN		**Main port gate**	**New access road gate**
		(a) Description of General Impact	**This monitoring is subject to the operation phase of the Project only.**	See the cell left.
		(b) Objective	Monitoring of emissions from vessels at berth and from the handling of dry bulk products.	
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitoring parameters:** - Meteorological data at Nacala Port. - Passive sampling data (sulfur dioxide (SO2), nitrogen dioxide (NO2) & benzene, toluene, ethylbenzene & xylene (BTEX)). - Active sampling data of PM 10 (Particulate matter 10 micrometers or less in diameter). **Measurement equipment and procedures:** This will be described when the first monitoring result is reported.	
		(d) Frequency of Monitoring	This monitoring will be conducted during the operation phase only and the frequency of each monitoring should be as follows. - Meteorological data: Hourly. - Other air quality data: The frequency should be determined by CDN in consultation with MTC and MITADER.	
		(e) Monitoring Location	- Meteorological data: Meteorology monitoring station at Nacala Port. - Other air quality data: Two sites on the eastern boundary (e.g. main port gate and the gate at the new access road).	
		(f) Implementing Institution	CDN.	
		(g) Supervision / Auditing Institution	MTC & MICOA (MITADER).	

3.12 Noise Levels

Monitoring Date	Implementing Agency	Monitoring Results during Report Period
06/06/2019	Contractor's subcontractor	

(a) Description of General Impact

- BL stands for baseline monitoring; Q1&Q2 for the first and second quarterly monitoring; max for maximum; and ave for average.
- Leq stands for equivalent noise levels; and Lmax for maximum sound pressure level.
- The unit of the result in the table is A-weighted decibel (dBA), which means that the noise result is adjusted for human hearing.
- The cells with dash (-) in the tables on the right side mean that no measurements were conducted.

Nacala 1

Monitoring results 1: The BL, Q1and Q2 (see the explanation on the left side) results for the daytime and the Q2 results for nighttime are presented in the table below. The average and maximum Leq results of Q2 during daytime (60&74and 66&78 dBA respectively) and nighttime (60&58 and 60&59dBA respectively) were all above the standard of World Health Organization (WHO) for residential area for daytime (55 dBA) and nighttime (45 dBA) while all the average and maximum Leq and Lmax for the daytime are higher than the ones of BL. The increased noise is unlikely from the port, but most likely due to the heavy traffic of motor vehicles, which were not observed during BL.

		Daytime 1 (8-10am)		Daytime 2 (2-4pm)		Nighttime 1 (5-7am)		Nighttime 2 (10pm-12am)	
		Average	Max	Average	Max	Average	Max	Average	Max
Leq	BL	55	55	61	63	-	-	-	-
	Q1	65	66	66	67	-	-	-	-
	Q2	60	66	74	78	60	60	58	59
Lmax	BL	61	63	74	78	-	-	-	-
	Q1	78	80	79	79	-	-	-	-
	Q2	70	76	85	90	70	75	75	83

Nacala 2

Monitoring results 2: The BL, Q1and Q2 results for the daytime and the Q2 results for nighttime are demonstrated in the table below. The average and maximum Leq results of Q2 during daytime (65 and 67&69 dBA respectively) and nighttime (60&56 and 63&58dBA respectively) were all below the standard of World Health Organization (WHO) for industrial and commercial area for daytime and nighttime (70 dBA) though all the average and maximum Leq and Lmax for the daytime are higher than the ones of BL.

		Daytime 1 (8-10am)		Daytime 2 (2-4pm)		Nighttime 1 (5-7am)		Nighttime 2 (10pm-12am)	
		Average	Max	Average	Max	Average	Max	Average	Max
Leq	BL	49	49	52	57	-	-	-	-
	Q1	59	60	53	55	-	-	-	-
	Q2	65	67	65	69	60	63	56	58
Lmax	BL	55	59	60	66	-	-	-	-
	Q1	65	68	57	60	-	-	-	-
	Q2	69	74	72	79	66	71	64	68

Monitoring Date	Implementing Agency	Monitoring Results during Report Period

Nacala 3

Monitoring results 3: The BL, Q1and Q2 results for the daytime and the Q2 results for nighttime are illustrated in the table below. The average and maximum Leq results of Q2 during daytime (67&68 and 70 dBA respectively) and nighttime (73&58 and 73&59dBA respectively) were all above the standard of World Health Organization (WHO) for residential area for daytime (55 dBA) and nighttime (45 dBA) while all the average and maximum Leq and Lmax for the daytime are higher than the ones of BL. The loud noise (Leq) is unlikely from the port, but most likely due to the noise from the nearby community and the excessive movement of trucks entering and leaving the port area.

		Daytime 1 (8-10am)		Daytime 2 (2-4pm)		Nighttime 1 (5-7am)		Nighttime 2 (10pm-12am)	
		Average	Max	Average	Max	Average	Max	Average	Max
Leq	BL	66	67	-	-	-	-	-	-
	Q1	63	66	70	73	-	-	-	-
	Q2	67	70	68	70	73	73	58	59
Lmax	BL	73	74	-	-	-	-	-	-
	Q1	74	74	78	80	-	-	-	-
	Q2	76	80	76	77	80	81	75	83

(b) Objective

Noise control and minimization.

(c) Monitored Parameters with Measurement Equipment & Procedure

Monitored parameters: Noise (sound) level (dBA).
Measurement equipment and procedures: The used equipment was sound level meter (T325, IEC651 Type 2, ansi s1,4 type2) calibrated by EPACS ENGWNHARIA DE PROCESSOS, AMBIENTE, SONSULTORIA E SERVICOS.

Based on SANS 10103, 2008, the sound level meter was installed on a tripod at a height of 1.20 meters from the ground. After the installation of equipment, a 10-minute measurement was conducted for sound pressure level in dBA three times each at Daytime 1 (8-10am), Daytime 2 (2-4pm), Nighttime 1 (5-7am) and Nighttime 2 (10pm-12am) at each monitoring point. Nighttime monitoring was conducted for the first time as baseline data for future monitoring activity because no project work at night had started yet during this report period. After each measurement, the equipment was calibrated. During measurement, equivalent noise levels (Leq), maximum sound pressure levels (Lmax) and minimum sound pressure levels (Lmin) were recorded while accidental noise events (e.g. noise of large vehicles or pedestrians) were recorded manually. All measured values of the sound pressure level were approximated to the nearest integer value. The Leq results were compared with the standards stipulated by WHO in 1999 which stipulate 45 and 55dBA for night and daytime respectively for residential area, and 70dBA for both night and daytime for industrial and commercial area. There is no such standard for Lmax nor Lmin, but the results of Leq and Lmax of Q2 was compared with the ones from BL.

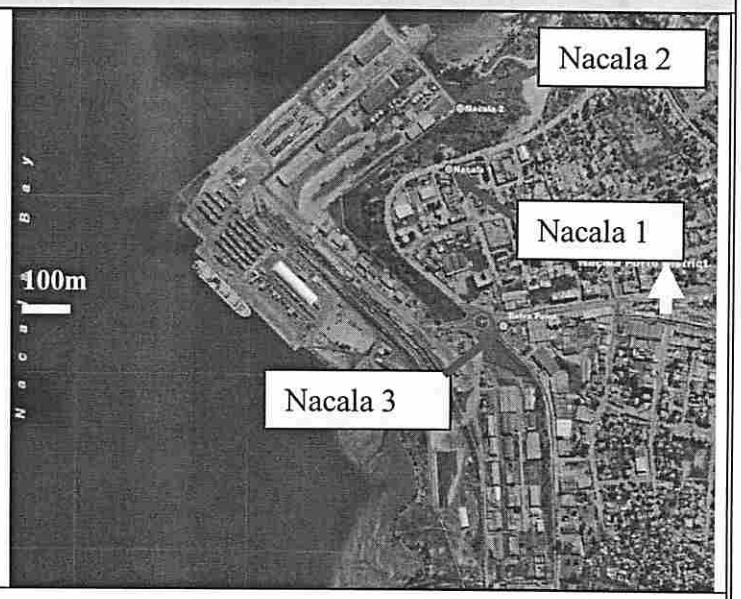
(d) Frequency of Monitoring

- Once before the construction.
- Quarterly during the construction period.

(e) Monitoring Location

- Nacala1 (14°32.456'S & 40°40.288'E): This point is located outside the Nacala Central Mosque and next to its associated school. The area is predominantly residential with sparse traffic.

- Nacala2 (14° 32.369'S & 40° 40.304'E): This point is distanced from residential areas, but located at the boundary of an industrial area.

Monitoring Date	Implementing Agency	Monitoring Results during Report Period		
			- Nacala 3 (also called "extra point": 14°32'40.58"S and 40°40'22.27"E): This point is located about 100 meters from the main entrance of the Port of Nacala, in front of Total fuel station. It is a mixed zone for commercial and residential areas.	
		(f) Implementing Institution	Contractor's subcontractor (COWI Moçambique Lda.).	
		(g) Supervision / Auditing Institution	CDN, MTC and MICOA (MITADER).	

3.13 Road Accident

Monitoring Date	Implementing Agency	Monitoring Results during Report Period		
None	CDN		**On-site highway network**	**External highway network**
		(a) Description of General Impact	There took place 2 traffic accidents involving vehicles within the Port, none of which resulted in injury or fatality.	No traffic accident was recorded surrounding the Port, according to the records of Nacala District Police.
		(b) Objective	Reduction of the number of road traffic accidents.	
		(c) Monitored Parameters with Measurement Equipment & Procedure	**Monitored parameters:** - Traffic accident data. **Measurement equipment and procedures:** On-site highway network: Daily accident records, including traffic accidents, of CDN External highway network: Report(s) on traffic accident, statistics etc., will be collected from relevant authorities/ regulators, such as police (Nacala District, Nampula Province, INATTER, etc.)	
		(d) Frequency of Monitoring	Before construction, during construction and during operations. Data collected on daily basis.	
		(e) Monitoring Location	On-site highway and external highway network, including main access points to the port	
		(f) Implementing Institution	CDN.	
		(g) Supervision / Auditing Institution	MTC.	