ENVIRONMENTAL PARAMETERS MONITORING; AIR QUALITY, NOISE LEVEL, MARINE WATER, SEABED SEDIMENT, MARINE ECOLOGY AND STAKEHOLDERS' ENGAGEMENT FOR THE DREDGING OF THE ENTRANCE CHANNEL AND PORT TURNING BASIN AT TANGA PORT, TANZANIA

Environmental Monitoring Report

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immunodeficiency syndrome
ANSI	American National Standards Institute
AQS	Air Quality Standards
BS	British Standards
%	Percentage
CO	Carbon monoxide
CO_2	Carbon dioxide
CH_4	Methane
CHEC	China Harbour Engineering Co. Limited
EIA	Environmental Impact Assessment
EMA	Environmental Management Acts
EMR	Environmental Management Regulations
EMP	Environmental Management Plan
EN	European Nations for Standard
ESMP	Environmental and Social Management Plan
ESIA	Environmental and Social Impact Assessment
EU	European Union
HIV	Human Immunodeficiency Virus
H2S	Hydrogen Sulfide
HSMP	Health and Safety Management Plan
ISO	International Organization for Standardization
$\mu g/m^3$	Microgram per cubic meter
NEMC	National Environment Management Council
NESC	National Environmental Standards Committee
NGOs	Non-Governmental Organizations
NO	Nitric Oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen Oxides
O_2	Oxygen
PPM	Parts per million
$PM_{2.5}$	Particulate Matter 2.5 micrometers or less in diameter
PM_{10}	Particulate Matter 10 micrometers or less in diameter
SO_2	Sulphur Dioxide
TBS	Tanzania Bureau of Standards
TANROADS	Tanzania National Roads Agency
TPA	Tanzania Port Authority
TZS	Tanzania Standards
URT	United Republic of Tanzania
VOCs	Volatile Organic Compounds
WHO	World Health Organization

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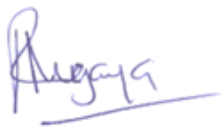
2	Rashda Mgaya	Sociologist	
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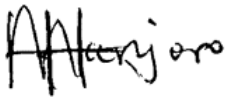
6	MR. HERFRED MANJORO	Social Safeguard Specialist	
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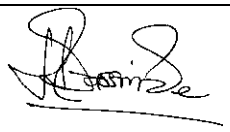
8	MR. RICHARD MASINDE	Marine Diver	

CHAPTER ONE: INTRODUCTION

1.1 GENERAL BACKGROUND

Tanzania Ports Authority (TPA) is a parastatal public corporation acting under the aegis of the Ministry of Works and Transport. The Tanzania Ports Authority (TPA) was established by the Ports Act No. 17 of 2004 as landlord port authority. It operates a system of ports serving the Tanzania hinterland and the landlocked countries of Malawi, Zambia, Democratic Republic of Congo (DRC), Burundi, Rwanda and Uganda. Tanzania Ports Authority (TPA) is currently developing the existing Tanga Port in order to increase the Port's cargo handling Capacity. The current works involve strengthening, deepening and modernization of the existing berth no. 1 and 2. The China Harbour Engineering Limited (CHEC) was contracted by TPA to undertake this construction works as well as monitoring and reporting to the project Consultant and TPA on the implementation of the Environmental Management and Monitoring Plan (EMMP) for the project.

In execution of the contract, CHEC contracted STEM Consulting (T) Limited (NEMC Registered and Certified Environmental Firm with registration number: NEMC/EIA/00117 for EIA and NEMC/EA/1113 for EA) to undertake environmental monitoring and reporting on the same to in fulfilment of the project contractual requirements and compliance with the Environmental Management Act, Cap 191 (No. 20 of 2004). Therefore, this report presents findings of air quality monitoring, noise and vibrations levels monitoring, marine water and sediment quality monitoring for the month of March 2023 of which project works are ongoing.

1.2 SCOPE OF THE ESMP MONITORING

The purpose of this environmental monitoring exercise is to ensure that the conditions of the baseline environmental condition as well as mitigation measures and key performance targets outlined in the approved Environmental and Social Management Plan (ESMP) monitoring are adhered to. The ESMP monitoring focuses on various environmental media which are marine water and sediment quality, biological monitoring, air quality, noise and vibration measurements. Specifically, this environmental monitoring is aimed:

- To assess the marine water and sediment quality, marine ecology, ambient air quality, noise and vibrations levels due to project activities which could alter the environmental characteristics at Tanga port area and vicinity.
- To compare the current levels of environmental parameters against the baseline conditions and acceptable local (TZS) and/or international environmental standards and make some key recommendations on how to ameliorate their impacts.

On another note, the scope of this monitoring exercise doesn't include occupational Health and Safety (OHS) issues. These issues are separately dealt with and reported accordingly in the monthly OHS Compliance report prepared by the Contractor Health, Safety and Environment (HSE) officer (s), to that end, the OHS issues are not incorporated into this monitoring report.

1.3 REGULATORY COMPLIANCE STATUS WITH THE ESMP MONITORING

The Contractor ESMP monitoring is geared towards improving the project environmental performance on required levels of legislative and regulatory compliance with the

Environmental Quality Standards prescribed under the Environmental Management Act, Cap 191 (No. 20 of 2004) for different environmental media such as marine water, marine sediment, ambient air quality, noise and vibrations levels as well as marine ecosystem during the project implementation. The status of project compliance to the country relevant environmental rules and regulations is summarized in Table 1.1.

Table 1.1: Compliance Status of Environmental Legislative and Regulatory

Compliance Status	**General Conditions**	**Status**	**Remarks**
Environmental Management Act No. 20 of 2004	The contractor shall ensure strictly implementation of the approved ESMP of the project EIA report.	Complied	Monthly Environmental Monitoring measurements and reporting on the same are carried out and submitted to Project Consultant and NEMC
The Occupational Health and Safety No. 5 of 2003	Compliance with the Occupational Health and Safety procedures, norms and guidelines shall be compulsory ensured	Compliant	Adequate occupational Health and Safety measures as per approved ESMP are taken. The workers are provided with personal protective equipment's.
The Environmental Management (Air Quality Standards) Regulations, 2007	The contractor shall ensure strict adherence the provisions of this regulations	Compliant	The Ambient air quality monitoring is being carried out regularly as per approved ESMP and comparison with the permissible limits as per this regulation is done and reported accordingly
Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015	The contractor shall ensure strict adherence the provisions of this regulations	Compliant	The Noise and Vibration monitoring is being carried out regularly as per approved ESMP and comparison with the permissible limits as per this regulation is done and reported accordingly

CHAPTER TWO: DESCRIPTION OF ESTABLISHED SAMPLING STATIONS

2.1 AMBIENT AIR QUALITY, VIBRATION AND NOISE MEASUREMENTS

During environmental monitoring, twelve ambient air quality & noise monitoring stations (AQNMS) and vibration levels were established to monitor levels of $PM_{2.5}$, PM_{10}, ambient pollutant gases, noise and vibration levels (Figure 2.1). The monitoring stations were selected based on the norms prescribed by local standards (TBS and National Environmental Air Quality regulations) and international guidelines and predominant wind direction at the area during the study.

Furthermore, the factors like nearby emissions source (example areas that gaseous pollutants point sources, noise, vibration and generated dust from the dredging facilities are likely to disperse) and nearby receptors (example settlements) were considered.

Table 2.1: Describe a measured ambient air quality, vibration and noise levels monitoring stations

Location Code	Measuring location	GPS Coordinates		Description
		Latitude (S)	Longitude (E)	
MS1	Container Yard	5.067148	39.104326	Monitoring Station one (MS1) is located within Port area, it is found within the project where dredging and construction activities are taking place. TPA office found approximately about 110 meters from monitoring station
MS2	Berth 1	5.064387	39.106815	This station is located within Port area about 5 meters from project area where leveling work is done. Receptors (TPA godown) found approximately about 8 meters from monitoring station
MS3	Berth 2	5.065112	39.106014	This station is located within Port area about 5 meters from project area where leveling work is done. Receptors (TPA godown) found approximately about 15 meters from monitoring station.
MS4	Batching Plant	5.068925	39.102021	Monitoring Station four is an onsite station located within Port area, found about 5 meters from emission source (i.e., Plant) and about 200 meters west of the project area, also it is found approximately 20 meters from Gate 2 (Security area-Receptors). Receptors (Temporary operators office) found approximately about 3 meters from monitoring station
MS5	Gate 1	5.067497	39.105531	Monitoring Station five) is located within Port area, whereby mostly the emission generated from automobiles; it is found approximately 300meters southwest of the project area. Receptors (Security office) found approximately about 15 meters from monitoring station.

Location Code	Measuring location	GPS Coordinates		Description
		Latitude (S)	Longitude (E)	
MS6	Gate 2	5.068708	39.103491	Monitoring Station six (MS6) is an onsite station located within Port area, found about 25 meters from emission source (i.e., Batching Plant and Automobiles), also it is found approximately 400 meters west of the project area. Receptors (Security Office) found approximately about 1.5m from monitoring station. Receptors (Security office) found approximately about 5 meters from monitoring station.
MS7	Sediment Dumping	5.064329	39.108106	Monitoring Station seven (MS7) is an onsite station located within Port area, found about 70 meters southeast from the project area. Receptors (TPA godown) found approximately about 50 meters from monitoring station
MS8	Rebars Processing Yard	5.068577	39.105728	Monitoring Station eight (MS8) is an offsite station found 5 meters from emission source (i.e., Rebars welding area), also it is found about 45 meters southwest from Gate 1 and approximately 800 meters west of the project area. Receptors (Temporary operators office) found approximately about 15 meters from monitoring station
MS9	Along the Road near TPA Office	5.0695684	39.105267	Monitoring Station nine (MS9) is an offsite station, whereby mostly emission was generated from automobiles, also it is found about 60 meters southwest from Gate 1 and approximately 900 meters west of the project area. Receptors (TPA Offices) found approximately about 5 meters from monitoring station
MS10	Deep Sea	5.067053	39.097393	Monitoring Station ten (MS10) is an offsite station, whereby mostly emission was generated from normal marine operation, also it is found about 500 meters north from Gate 2 and approximately 1,200 meters northwest of the project area. Receptors (Fisheries Supervisors office) found approximately about 12 meters from monitoring station
MS11	Canteen Area	5.069209	39.102705	This is an offsite station found 15 meters from emission source (i.e., Batching Plant), also it is found about 20 meters north from Gate 2 and approximately 500 meters west of the project area. Receptors (Cafe) found approximately about 6 meters from monitoring station
MS12	Nearby Receptors	5.06875	39.10583	Monitoring Station twelve (MS12) is located at residential area, whereby mostly emission was generated from automobiles, also it is found approximately 800 meters south of the project area. Receptors (Residents) found approximately about 10 meters from monitoring station

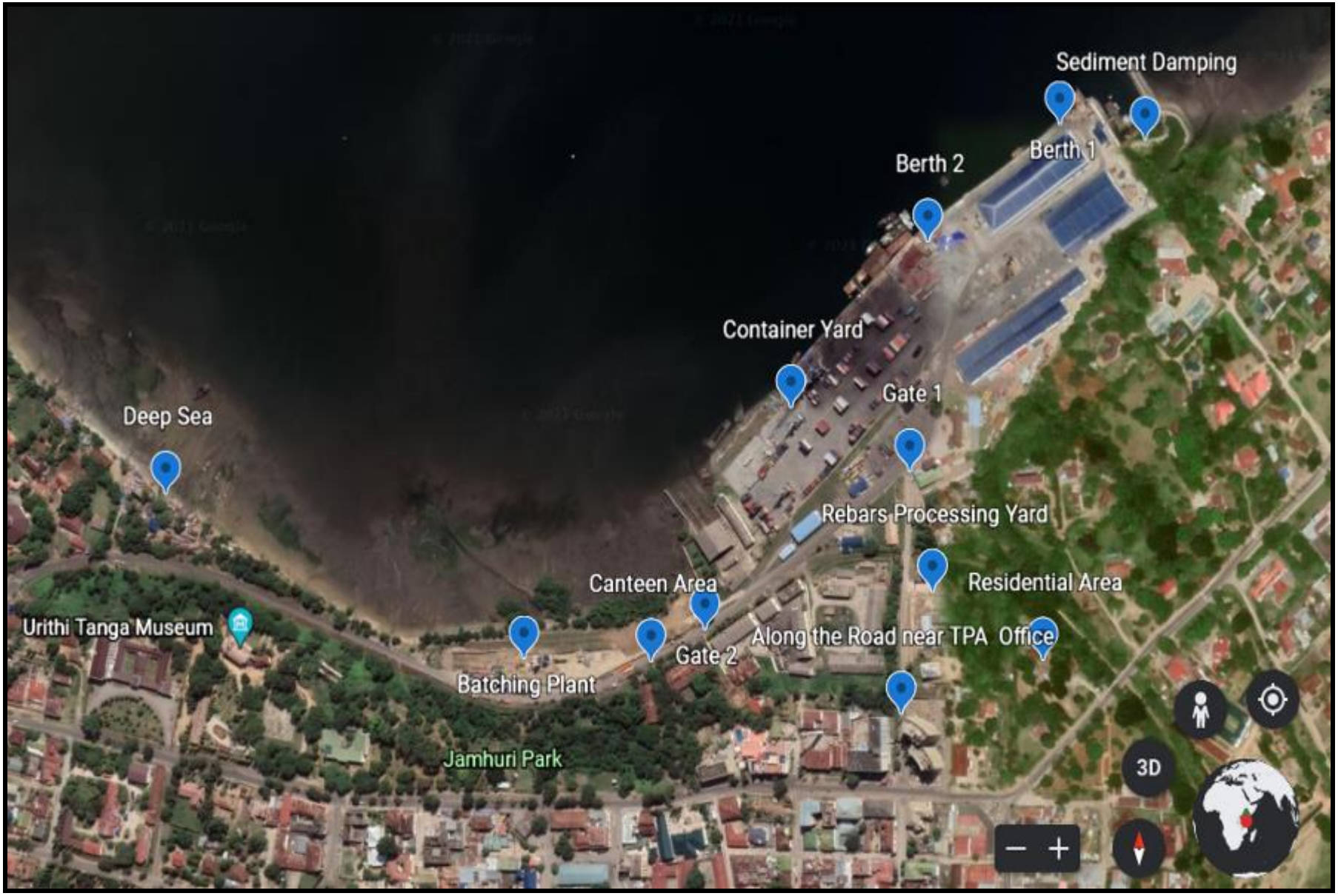


Figure 2.1: A Map of Tanga showing Air quality, vibration and Noise levels monitoring stations in blue mark points.

2.2 MARINE WATER AND SEDIMENT QUALITY

Five sampling sites were established around the project area in order to monitor water quality parameters and sediment characteristics of interest. The description of each monitoring site is given in Table 2.2 and the location map is presented in Figure 2.2.

Table 2.2: Describe surveyed water and sediment quality monitoring stations

Location Code	Monitoring location	Coordinates		Site description	On-going Activities
		Latitude (S)	Longitude (E)		
MS1	Berth 1	5.06364208	39.1064828	Berth construction site	Dredging
MS2	Berth 2	5.06475412	39.10571033	Berth Construction site	Jet grouting, Dredging, revetment & laying pipe
MS3	Turn basin	5.06401015	39.1041716	Open water	None
MS 4	Port entrance	5.05523515	39.1155767	Open water between Totten Island & Ras Kazone peninsular	None
MS5	Disposal Site	5.045278	39.174028	Boats movements	None

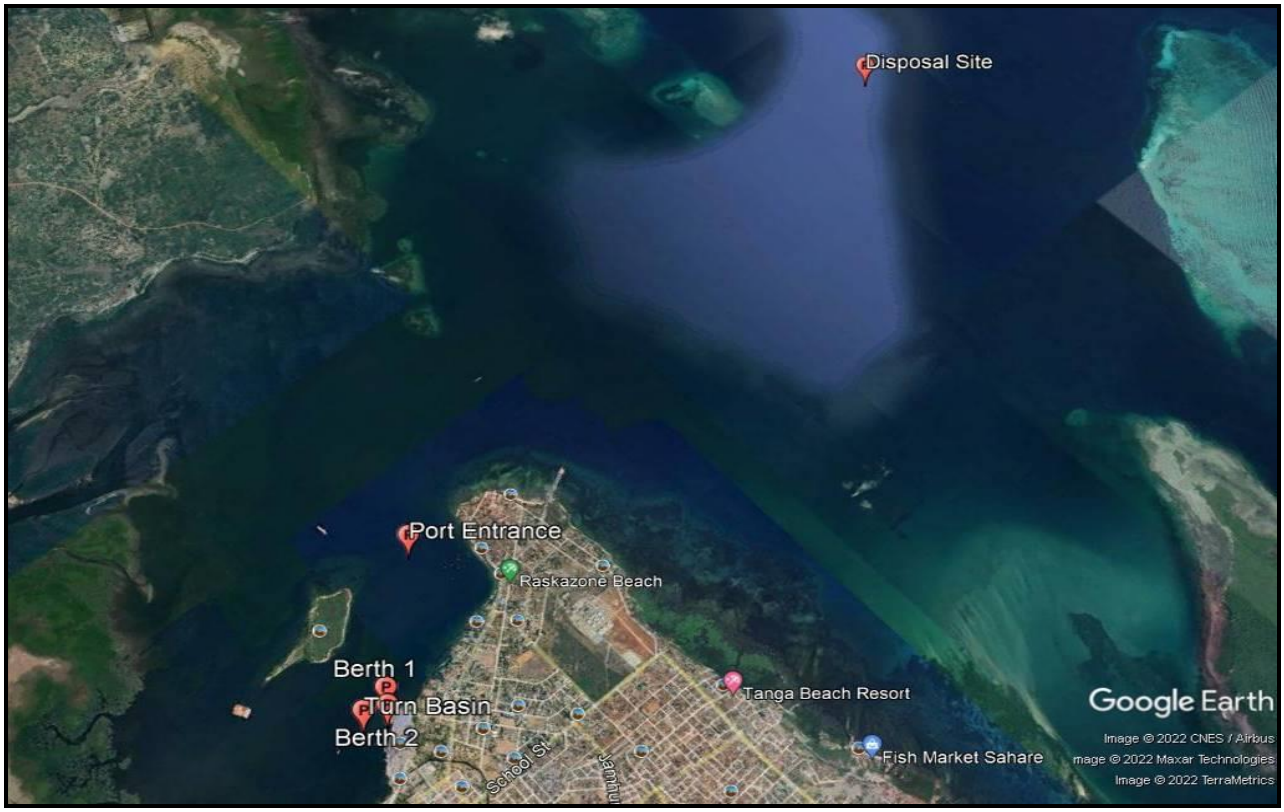


Figure 2.2: A Map showing marine water and sediment monitoring points in yellow mark point

CHAPTER THREE: MONITORING METHODOLOGY

3.1 INTRODUCTION

The methods used for this environmental monitoring to quantify ambient air quality, vibration and noise levels for twelve selected monitoring stations, are those established by local and international environmental governing bodies, proposed procedures by equipment's' manufacturers and environmental expert's knowledge in analytical chemistry with field experience in the Harbour projects. Furthermore, the context of this study, the time-based approach was ensured, the data are collected to cover all kind of traffic congestions, normal port activities and ongoing project activities for four days throughout 24hours (DAY and NIGHT) sessions for vibrations, noise levels and ambient air quality data ($PM_{2.5}$, PM_{10}, O_2, CO_2, NO, NO_2, NOx, SO_2, CO, CH_4, VOC and H_2S). The data were collected on maximum of 1-hour basis or as per the requirement of standard limit used. Similarly, a location-based approach was considered to ensure that all sets of distances to and from the expected pollutant sources, topography of the project influence area, densely populated areas within the region, avoidance of construction activity or any other activity which may be temporary in nature, the nearest receptors and the furthest control point are covered/ included during the measurement.

3.2 AIR QUALITY

Air pollution is a major environmental risk to health. By reducing air pollution levels, country can reduce burden of disease, from stroke, heart disease, lung cancer and both chronic and acute respiratory diseases, including asthma. The lower the levels of air pollution, the better the cardiovascular and respiratory health of the population will be both long and short - term. Exposure in the workplace can occur through inhalation, absorption through the skin or ingestion. Most exposure occurs through the inhalation of vapors, dusts, fumes or gases. The extent to which a person is exposed depends on the concentration of the substance or mixture in the air, the amount of time exposed and the effectiveness of controls. Substances and mixtures may cause immediate acute health effects or it may be decades before effects on the body become evident.

3.2.1 Dust–Suspended Particulate Matter

Particulate matters emission concentration at established seven sampling stations were determined using a TSI DustTrak™ 8530 Aerosol Particulate Monitor. The TSI DustTrak™ 8530 Aerosol Particulate Monitor has a capability of testing dust particles of different dimensions (microns of 10, 2.5, <1, 1 and >10) simultaneously. It is the digital signal processing, light mechanical and electrical integration of high– tech products. Its sampling principle is light scattering. When the installed pump sucks in the dust particles, the light is scattered, and amount of scattered light is equal dust concentration in microgram per cubic meter ($\mu g/m^3$). On taking measurement, the instrument was held vertically at a breathing height of 1.0–1.5 m above the ground level. This position is assumed to be a relatively the breathing zone of the workers at their respective working stations. Five runs were recorded for each point; where by average value was used as representative value and then compared with national/local and/or International (WHO) standards.

3.2.2 Ambient Pollutant Gaseous Emissions

Measurement of air emission concentration of pollutant gases at selected stations were determined using two portable gas detectors of type GMI PS. The GMI model PS200 with

serial number 218338 is of capable to detect gases of oxygen (O_2), carbon monoxide (CO), hydrogen sulfide (H_2S) and methane (CH_4). The GMI model PS500 with serial number 250678 is capable to detect carbon dioxide (CO2), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and nitric oxide (NO). The gas detectors conform to European standard EN 50104 and comply with EN 61779 (flammable) and EN 45544 (toxic). Also, NOx levels were measured using a portable Gas Analyzer from E-Instrument with the lowest detection limits of 0.01 as per manufacturer's procedure. On taking measurement, the instruments were held vertically at a workplace breathing height of about 1.0-1.5 m above the ground level. This position is assumed to be a relatively the breathing zone of the workers at their respective working stations. Five runs were recorded for each point; where by average value was used as representative value and then compared with national/local and/or International (WHO) standards.

Plate 3.1: Air quality measurements for onsite and offsite stations for both sessions

3.3 NOISE LEVELS

Twelve noise monitoring stations representing both potential onsite and offsite noise receptors found within 1km from the proposed project site were recorded to represent the noise data. At each station, day (Lday) and night (Lnight) noise levels measured in accordance to ISO 1996 -1:2003 using a digital sound level meter *Sper Scientific* type 850069 with measurement range of 30 to 130dB (A). On taking measurements, the device-meter scale was set to the "A" weighed measurement scale to enable it to respond in the same manner as the human ear. During measurement, the device was fixed and/or held approximately 1.5m above the ground and at least 3m away from hard reflecting surfaces or objects. Noise levels were recorded at each identified station in the morning, afternoon, evening and mid-night; in which Lday and Lnight mean values were calculated and then compared with local standards and international guidelines. Moreover, the peak (maximum) noise levels associated with port and selected area daily normal operations were also targeted and recorded during the study period.

Plate 3.2: Noise levels measurements for onsite and offsite stations for both sessions

3.4 GROUND VIBRATION LEVELS

Twelve ground vibration stations were determined by using XTECH SDL-800 vibration meter data logger that represents onsite and offsite receptors. The instrument has a resolution value of 0.1 mm/s, accuracy of ±5%, velocity up to 199.9 mm/s, frequency range of 10 Hz to 1 kHz for capturing almost all possible vibrations for workplace assessments. It complies with European standard EN 14253:2003. On taking measurements, the accelerometer transducer was mounted on the ground. Day and Night (24 hourly) vibration were recorded to represent that particular station.

3.5 MARINE WATER QUALITY

The sampling was undertaken to assess the water quality in and around the project area. The monitoring was two folds: daily insitu measurements and monthly sampling and laboratory analysis. The in-situ measurement was done using a portable Multiparameter Horiba water quality checker three times a day to cover a range of the tidal and current conditions. The in-situ parameters (pH Value, Conductivity, Salinity, Turbidity, Temperature and Dissolved Oxygen) were measured three times a day (four hours intervals). Marine water was also collected once a monthly in one-liter clear bottle and sent to the University of Dar es Salaam laboratory for comprehensive analysis.

3.6 MARINE SEDIMENT QUALITY

A 5kg open jaw grab with a closing mechanism was used to sample marine sediments. The sampler was lowered to the sea bottom while the jaws were open then a wite was pulled that triggered a release closing mechanism that enabled collection of the sediment sample that was carefully hauled to the deck of the boat where it was immediately transferred to labeled zip-lock nylon bags which were stored in a cooler box before being sent to the laboratory of the University of Dar es salaam for chemical composition analysis. Trace metals as well as oil and grease in the sediment samples were analyzed.

3.7 PLANKTON ASSESSMENT

Plankton samples were collected by towing plankton nets through a column of water for five minutes. Both phyto and zooplankton nets were used to collect samples. The collected samples were stored in sample bottles fixed either by lugol solution for phytoplankton or 70% alcohol for zoo plankton before being taken to the laboratory of the University of Dare s salaam for further analysis where the plankton were identified to the possible lower taxonomic level.

3.8 MACROBENTHIC BENTHIC ORGANISMS

A walk-through survey was conducted at low tide to identify benthic organisms (sea grasses, see weds, and macro-invertebrates) on the shore intertidal and subtidal zones. The areas surveyed included the shores surrounding the Tanga port including the eastern shore north of the port area at the swimming and Yatch club beaches, west of Tanga port along the Totten Island beach and south of Tanga port around the Deep-sea fish landing site. The animal and plant organisms found were identified basing on Field Key guides including Richmond (2002), and Oliveira et al., (2005). After identification later on the organisms was checked whether they belonged to any of the ecologically threatened species as per IUCN Red List and CITES categories. According to IUCN animals are categorized into either Extinct (E), Extinct in the wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT), Least concern (LC), Data deficient (DD) and Not evaluated.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 AIR QUALITY, NOISE AND VIBRATIONS

The environmental monitoring data, air quality, noise and vibrations measured at twelve identified monitoring stations for day and night sessions conducted for four days were analyzed with spreadsheet software and MS Excel. The averaged measured parameters were then compared with the available limits set by local standards and international guidelines to check their levels of compliance.

4.2 AMBIENT AIR QUALITY EMISSIONS LEVELS

4.2.1 Ambient Particulate Matters ($PM_{2.5}$ and PM_{10}) Concentration

The dust levels in PM_{10} and $PM_{2.5}$ were measured from twelve different monitoring stations and compared with prescribed available limits to check for their compliance with the local standards and international guidelines. The major point sources due to ongoing construction and dredging activities were cement mixer at berths, cement offloading (at Batching Plant), trucks movement and welding. Not only were those but also normal port operations (i.e., Automobiles, Ship loading and offloading) were among the contributors. The dust meter used sampled or detected dust particles suspended in breathing air in which the employees/workers breathe in when they are working on the respective area.

Based on the results summarized in table 4.1a all twelve assessed onsite and offsite monitoring stations were recorded with ambient particulate matter ($PM_{2.5}$ and PM_{10}) within the limit value established by both Local standards: EMR (AQS), 2007] and International Guideline; WHO [2005] for ambient particulate matter. Container Yard and Berth 2 were recorded with averaged significant dust levels compared to other assessed monitoring stations for day and night sessions respectively but it is within both local and international quoted ceiling limits. The maximum dust levels of (12μg/m^3 $PM_{2.5}$ and 25 μg/m^3 PM_{10}) for day session was recorded at Container Yard while the maximum dust levels of (9μg/m^3 $PM_{2.5}$ and 18 μg/m^3 PM_{10}) for night session was recorded at Berth 2 contributed by truck offloading cement and dispersion of cement dust from Cement mixer machine respectively while the minimum dust levels of (3 μg/m^3 $PM_{2.5}$ and 6μg/m^3 PM_{10}) was recorded at Sediment Damping.

Since the project area is not degraded it can therefore withstand an increase of dust that will be generated during project execution even if recorded dust levels may increase from time to time and be high for a variety of reasons including increased automobiles, dust generating activities and construction activities as well as natural occurrences like wind. Figure 4.1a & 4.1b below summarize on ambient particulate matter ($PM_{2.5}$ & PM_{10} Concentration in μg/m^3) respectively for day session.

Table 4.1a: Summary on ambient particulate matter (dust) concentrations for day session

Category	Location Code	Measuring Location	GPS Coordinates		$PM_{2.5}$ Levels [µg/m³]			PM_{10} Levels [µg/m³]			Standards	
			Latitude (S)	Longitude (E)	Minimum	Average	Maximum	Minimum	Average	Maximum	$PM_{2.5}$ Levels [µg/m3]	PM_{10} Levels [µg/m3]
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	9	11	12	18	21	25	**25**	**60 to 90**
	MS2	Berth 1	5.064387	39.106815	5	6	7	10	12	14	**25**	**60 to 90**
	MS3	Berth 2	5.065112	39.106014	2	2	3	6	7	8	**25**	**60 to 90**
	MS4	Batching Plant	5.068925	39.102021	6	7	8	12	15	17	**25**	**60 to 90**
	MS5	Gate 1	5.067497	39.105531	2	3	3	5	6	7	**25**	**60 to 90**
	MS6	Gate 2	5.068708	39.103491	5	6	7	10	13	15	**25**	**60 to 90**
	MS7	Sediment Dumping	5.064329	39.108106	2	3	3	4	5	6	**25**	**60 to 90**
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	6	7	8	12	14	17	**25**	**60 to 90**
	MS9	Along the Road near TPA Office	5.0695684	39.105267	5	6	7	10	12	14	**25**	**60 to 90**
	MS10	Deep Sea	5.067053	39.097393	5	6	7	10	12	15	**25**	**60 to 90**
	MS11	Canteen Area	5.069209	39.102705	4	5	6	8	11	12	**25**	**60 to 90**
	MS12	Residential Areas	5.06875	39.10583	8	9	10	16	18	19	**25**	**60 to 90**

Source: *Air Quality Field measurement by STEM Consult (T) Limited: January, 2023*
Note: *For PM_{10} -The Environmental Management (Air Quality Standards) Regulations, 2007; $PM_{2.5}$ – International Ambient Air Quality Standards, WHO, 2005*

From table 4.1a above, the onsite particulate matter scores are within the acceptable limit. MS1-Container Yard recorded with significant dust of 25µg/m³ PM10 compared to other onsite monitoring stations due to cement mixing machine at that location as the result to dispersion of dust. All offsite scores are within the acceptable limit, MS12-Residential Areas recorded with significant dust levels of 19µg/m³ PM10 compared to other offsite monitoring stations due vehicles movement and other human activities.

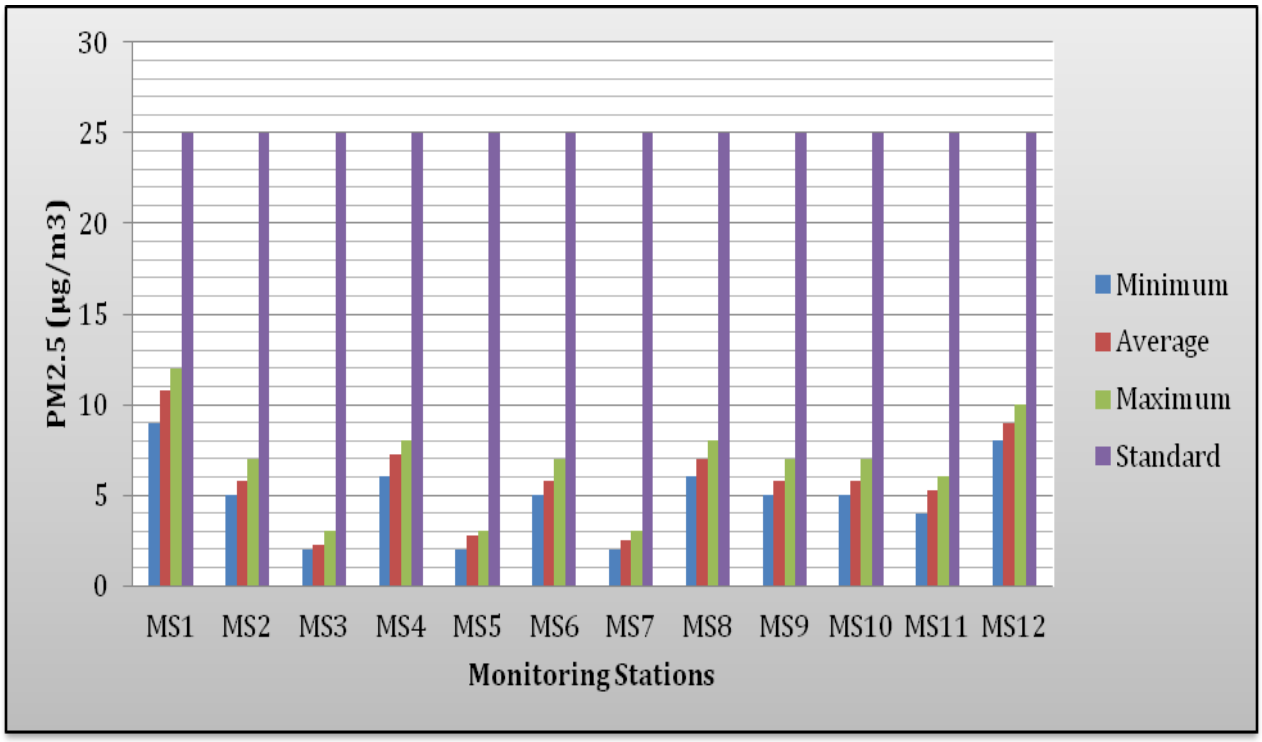


Figure 4.1a: Ambient particulate matter ($PM_{2.5}$ Concentration in µg/m^3) for day session

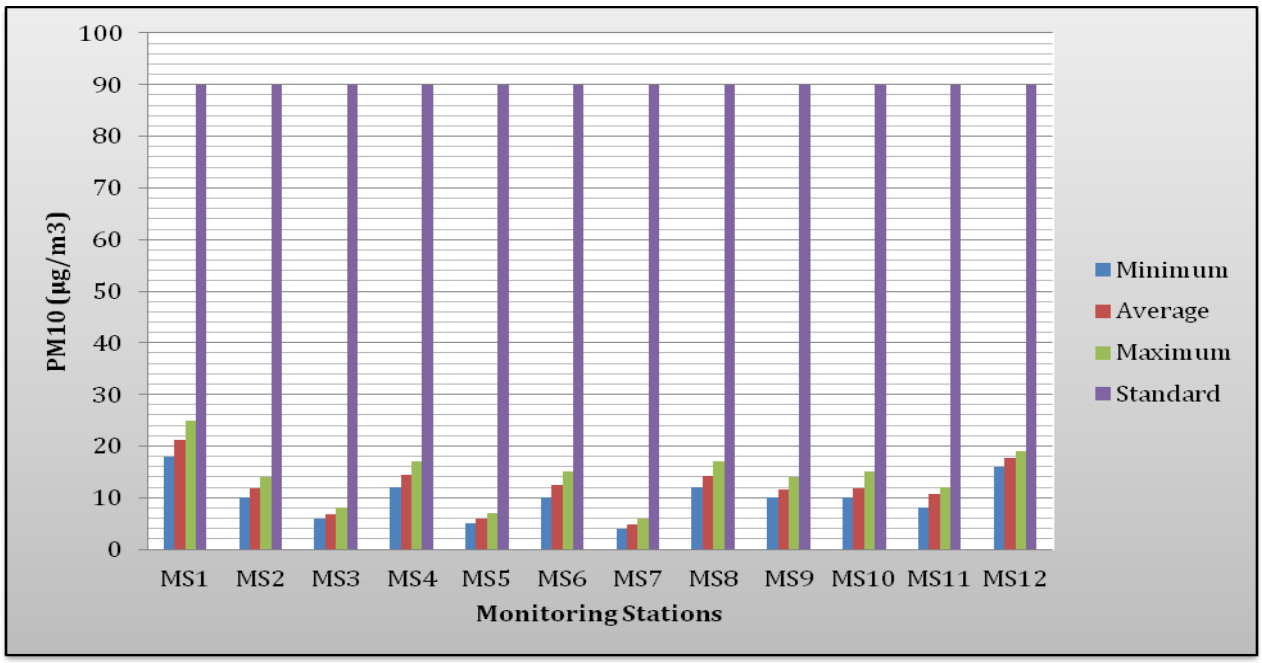


Figure 4.1b: Ambient particulate matter (PM_{10} Concentration in µg/m^3) for day session

Figure 4.1a and 4.1b respectively present the findings measured during day session. All assessed onsite and offsite monitoring stations were recorded with ambient particulate matter ($PM_{2.5}$ and PM_{10}) within the limit value established by both Local standards: EMR (AQS), 2007] and International Guideline: WHO [2005] for ambient particulate matter. MS1-Container Yard recorded with highest score for $PM_{2.5}$ and PM_{10} compared to other monitoring stations due to ongoing activities at that location as the result to dispersion of dust from cement mixer and trucks movement but it is within ceiling values.

Table 4.1b: Summary on ambient particulate matter (dust) concentrations for night session

Category	Location Code	Measuring Location	GPS Coordinates		$PM_{2.5}$ Levels [µg/m³]			PM_{10} Levels [µg/m³]			Standards	
			Latitude (S)	Longitude (E)	Minimum	Average	Maximum	Minimum	Average	Maximum	$PM_{2.5}$ Levels [µg/m³]	PM_{10} Levels [µg/m³]
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	6	7	8	12	15	17	**25**	**60 to 90**
	MS2	Berth 1	5.064387	39.106815	3	4	5	6	8	10	**25**	**60 to 90**
	MS3	Berth 2	5.065112	39.106014	5	7	9	10	13	18	**25**	**60 to 90**
	MS4	Batching Plant	5.068925	39.102021	3	5	6	7	10	12	**25**	**60 to 90**
	MS5	Gate 1	5.067497	39.105531	2	2	3	4	5	6	**25**	**60 to 90**
	MS6	Gate 2	5.068708	39.103491	3	4	5	6	8	10	**25**	**60 to 90**
	MS7	Sediment Dumping	5.064329	39.108106	2	2	3	4	4	5	**25**	**60 to 90**
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	4	5	6	10	10	12	**25**	**60 to 90**
	MS9	Along the Road near TPA Office	5.0695684	39.105267	3	5	7	11	11	14	**25**	**60 to 90**
	MS10	Deep Sea	5.067053	39.097393	6	7	8	14	14	18	**25**	**60 to 90**
	MS11	Canteen Area	5.069209	39.102705	3	4	5	8	8	10	**25**	**60 to 90**
	MS12	Residential Areas	5.06875	39.10583	4	6	7	11	11	14	**25**	**60 to 90**

Source: *Air Quality Field measurement by STEM Consult (T) Limited: January, 2023*
Note: *For PM_{10} -The Environmental Management (Air Quality Standards) Regulations, 2007; $PM_{2.5}$ – International Ambient Air Quality Standards, WHO, 2005*

From the above table, the onsite maximum particulate matter (dust) concentration for night session was below standards. This indicates that there was no substantial dust at the worksite location throughout the night session. MS3-Berth 2 (9µg/m³ $PM_{2.5}$ and 18µg/m³ PM_{10}) recorded with significant dust levels compared to other onsite monitoring stations due to cement mixing machine and truck movement though it is within both local and international standards. Furthermore, all offsite monitoring station recorded with maximum particulate matter below both local and international quoted ceiling limits. MS10-Deep Sea (8µg/m³ $PM_{2.5}$ and 18µg/m³ PM_{10}) recorded with significance dust compared to other offsite stations due to dispersion of smoky dust from fisheries wood stoves during fish frying activities, the measurements was taken when daily fisheries activities taking place.

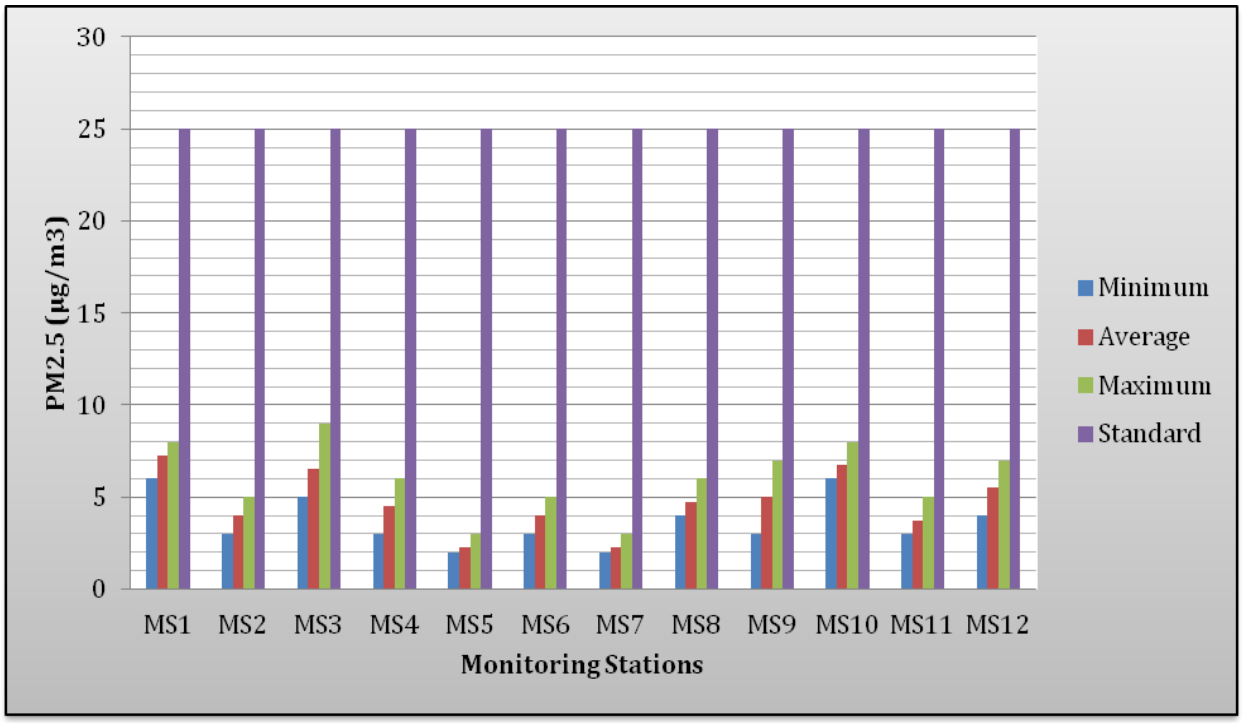


Figure 4.1c: Ambient particulate matter ($PM_{2.5}$ Concentration in µg/m^3) for night session

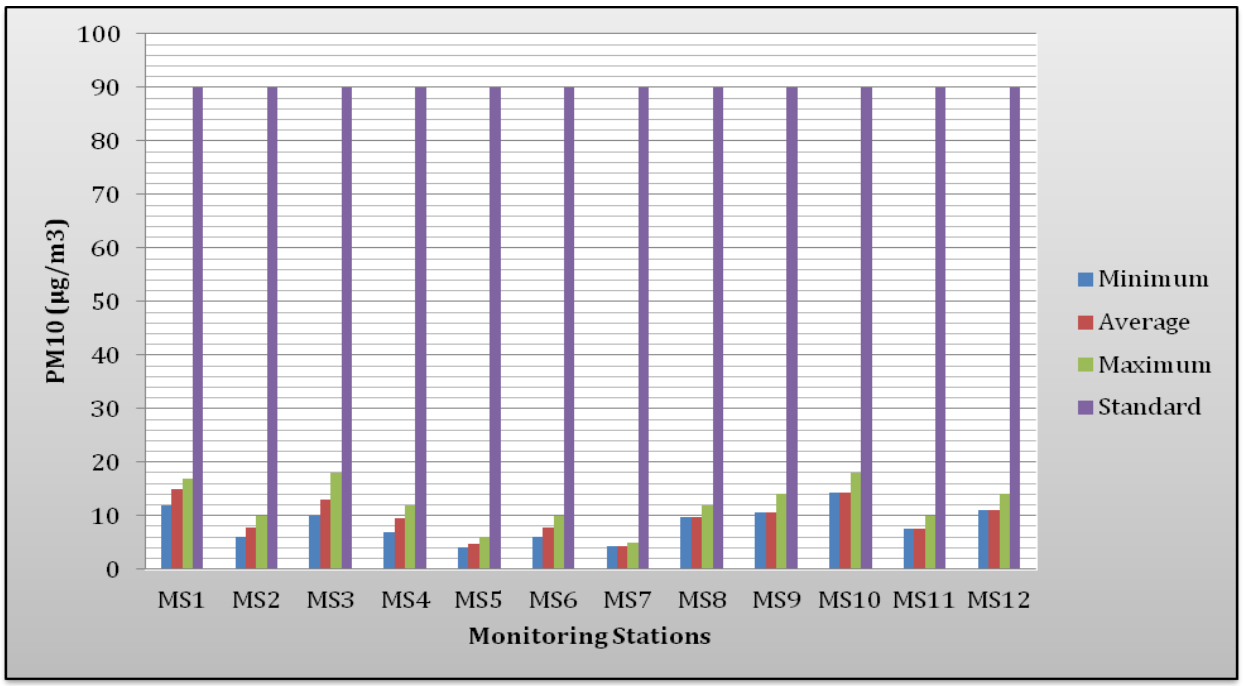


Figure 4.1d: Ambient particulate matter (PM_{10} Concentration in µg/m^3) for night session

Figure 4.1c and 4.1d respectively present the findings measured during night session. All assessed onsite and offsite monitoring stations were recorded with ambient particulate matter ($PM_{2.5}$ and PM_{10}) within the limit value established by both Local standards: EMR (AQS), 2007] and International Guideline: WHO [2005]. MS3-Berth 2 for onsite and MS10-Deep Sea for offsite were recorded with significance value for $PM_{2.5}$ and PM_{10} compared to other monitoring stations due to trucks movement and dispersion of smoky dust from fisheries wood stoves during fish frying activities respectively.

4.2.2 Ambient Gaseous Emission Concentration

During measurement, the major point sources due to ongoing construction and dredging activities were trucks movement, welding and construction machines. Not only were those but also normal port operations (i.e., Automobiles, Ship loading and offloading) were among the contributors. The fuel (mostly diesel and petrol) reacts with oxygen (O_2) to produce heat energy, which enables the operations. When oxygen and fuel (hydrocarbon diesel and petrol) react, result into the formation of byproducts of carbon monoxide (CO), nitrogen of oxides, sulfur dioxide (SO_2) and others. These gases become emitted from combustion chamber to the air environment through exhaust tailpipes/chimney. The gases remain suspended in air unless otherwise, they react with water vapors to form acids products. Oxygen (O_2) and carbon dioxide (CO_2) normally exist in air. But their concentration in air may change depending on human activities carried on and time.

The emission limits for some ambient gases i.e., CO_2, Methane (CH_4), VOC, are not legislated in WHO regulations or local standards but this however, does not imply that they should be emitted freely. The preoccupying issues here are the emissions of ambient pollutant gases like Oxides of Nitrogen, CO and those of SO_2. Although small amounts of CO_2 ranging from (300 to 400) ppm were noted in assessed monitoring stations, its impact is counterbalanced naturally in the atmosphere as it forms part of the carbon recycling process. Likewise, recorded zero values of H_2S doesn't mean the absence of the named parameters but might suggest their presence below equipment's detection limits. Despite not being regulated by either local or international standards; the recorded levels for H_2S have no significant affects to the environment.

Furthermore, the monitoring stations was recorded with CO ranging from (0.0 to 1.5) ppm, NO ranging from (0.0 to 0.1) ppm, NO_2 ranging from (0.0 to 0.1) ppm and NOx ranging from (0.0 to 0.02) ppm, CH_4 ranging from (0.0 to 2.8) ppm and VOC ranging from (0.0 to 0.2) ppm in air environment for both day and night sessions. These pollutant gases were mostly emitted from automobiles. Based on those findings it can be concluded that, generally the onsite and offsite air quality in the area is adequate since all monitoring stations recorded its parameter values are within available local and international limits for both day and night sessions. It implies the atmospheric air around the project area is not degraded and thus, with proper air quality management plan can withstand manageable increase in ambient pollutant gases emissions associated with construction and dredging activities. The results summarized in table 4.2a and 4.2b below for day and night session.

Table 4.2a: Summary on ambient gaseous concentrations for day session

Category	Location Code	Measuring Location	GPS Coordinates		CO_2 (%)	NO_2 (ppm)	CO (ppm)	SO_2 (ppm)	O_2 (%)	CH_4 (%)	H_2S (ppm)	NO (ppm)	NOx (ppm)	VOC (ppm)
			Latitude (°S)	Longitude (°E)										
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	0.04	0.1	1.5	0.0	20.9	0.0	0.0	0.08	0.01	0.0
	MS2	Berth 1	5.064387	39.106815	0.04	0.1	0.5	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS3	Berth 2	5.065112	39.106014	0.04	0.1	1.0	0.0	20.9	0.0	0.0	0.08	0.02	0.1
	MS4	Batching Plant	5.068925	39.102021	0.04	0.1	0.3	0.0	20.9	0.0	0.0	0.08	0.02	0.1
	MS5	Gate 1	5.067497	39.105531	0.04	0.1	0.5	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS6	Gate 2	5.068708	39.103491	0.04	0.1	1.0	0.0	20.9	0.0	0.0	0.10	0.02	0.1
	MS7	Sediment Dumping	5.064329	39.108106	0.04	0.1	0.0	0.0	20.9	0.8	0.0	0.00	0.00	0.0
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	0.04	0.1	0.0	0.0	20.9	0.0	0.0	0.03	0.01	0.0
	MS9	Along the Road near TPA Office	5.0695684	39.105267	0.04	0.1	0.5	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS10	Deep Sea	5.067053	39.097393	0.04	0.1	1.5	0.0	20.9	2.8	0.0	0.00	0.00	0.0
	MS11	Canteen Area	5.069209	39.102705	0.04	0.1	1.0	0.0	20.9	0.0	0.0	0.10	0.02	0.0
	MS12	Residential Area	5.06875	39.10583	0.04	0.1	1.0	0.0	20.9	0.0	0.0	0.10	0.02	0.0
Gas Emission Guideline	**Local Standard [EMR [(AQS), 2007]**				**N.M**	**N.M**	**9.0**	**0.2**	**N.M**	**N.M**	**N.M**	**0.1**	**0.08**	**N.M**
	International Standards: WHO [2005]				**N.M**	**0.2**	**N.M**	**0.25**	**N.M**	**N.M**	**0.03**	**N.M**	**N.M**	**N.M**

Source: Air Quality Field measurement by STEM Consult (T) Limited: January, 2023. N.M-Not Mentioned

From the above table4.2a, the score of all ambient gaseous for both onsite and offsite stations are bearable and within the permissible local and international standards due to improved port daily operations and contractor best operation practices.

Table 4.2b: Summary on ambient gaseous concentrations for night session

Category	Location Code	Measuring Location	GPS Coordinates		CO_2 (%)	NO_2 (ppm)	CO (ppm)	SO_2 (ppm)	O_2 (%)	CH4 (%)	H_2S (ppm)	NO (ppm)	NOx (ppm)	VOC (ppm)
			Latitude (°S)	Longitude (°E)										
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	0.04	0.1	0.5	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS2	Berth 1	5.064387	39.106815	0.04	0.1	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS3	Berth 2	5.065112	39.106014	0.04	0.1	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS4	Batching Plant	5.068925	39.102021	0.04	0.1	0.5	0.0	20.9	0.0	0.0	0.00	0.00	0.2
	MS5	Gate 1	5.067497	39.105531	0.04	0.0	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS6	Gate 2	5.068708	39.103491	0.04	0.1	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.1
	MS7	Sediment Dumping	5.064329	39.108106	0.04	0.0	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	0.04	0.1	0.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS9	Along the Road near TPA Office	5.0695684	39.105267	0.04	0.0	0.8	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS10	Deep Sea	5.067053	39.097393	0.04	0.1	1.3	0.0	20.9	1.5	0.0	0.00	0.00	0.0
	MS11	Canteen Area	5.069209	39.102705	0.04	0.1	1.0	0.0	20.9	0.0	0.0	0.00	0.00	0.0
	MS12	Residential Area	5.06875	39.10583	0.04	0.0	0.8	0.0	20.9	0.0	0.0	0.00	0.00	0.0
Gas Emission Guideline	**Local Standard [EMR [(AQS), 2007]**				**N.M**	**N.M**	**9.0**	**0.2**	**N.M**	**N.M**	**N.M**	**0.1**	**0.08**	**N.M**
	International Standards: WHO [2005]				**N.M**	**0.2**	**N.M**	**0.25**	**N.M**	**N.M**	**0.03**	**N.M**	**N.M**	**N.M**

Source: Air Quality Field measurement by STEM Consult (T) Limited: January, 2023. N.M-Not Mentioned

From the above table4.2b, the score of all ambient gaseous for both onsite and offsite stations are tolerable and within the permissible local and international standards due to improved port daily operations and contractor best operation practices.

4.3 NOISE LEVELS

4.3.1 Weekly Noise Levels

The weekly noise levels were measured for both onsite and offsite monitoring stations to check the inclination and compliance status by considering ESIA agreement, regulations, workplace receptors and nearby receptors. The averaged noise levels for day (Lday), night (Lnight) and peak were compared by the present national ceiling limits (table 4.3a and 4.3b) and figures (4.3a to 4.3d). From measurements and findings, it shows that the averaged and peak noise levels were dependent to present project activities on a specific monitoring station except for stations which depends on normal port operations (i.e., Along the Road near TPA Office, Canteen Area and Deep Sea) whereby these stations were recorded with weekly averaged noise levels above the local ceiling limits. Thus, those stations found onsite (within project site) was recorded with noise levels within the local ceiling limits [EMR (2015)]. Generally, from measurement it shows that there is increase in noise levels during daytime than during night time this is due to decrease in noise influence sources to some stations during nighttime.

Table 4.3a: Average noise levels (in dB (A)) recorded at onsite and offsite stations for both sessions

Category	Location Code	Measuring Location	Category of Location	GPS Coordinates		Week 1		Week 2		Week 3		Week 4		Standards dB(A)		Source of Noise
						Day time	Night time	Day time	Night time	Day time	Night time	Day time	Night time			
				Latitude (°S)	Longitude (°E)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	LAeq, (1h)	Day time	Night time	
Onsite (Port Compound)	MS1	Container Yard	Port Area	5.067148	39.104326	68.3	59.2	67.9	63.8	70.7	63.5	68.2	60.4	68.3	59.2	Trucks movement, cement mixer and cranes,
	MS2	Berth 1	Port Area	5.064387	39.106815	60.2	55.6	57.2	55.8	61.7	57.7	60.8	54.7	60.2	55.6	Trucks, reflection of sound from Berth 2
	MS3	Berth 2	Port Area	5.065112	39.106014	66.1	58.0	63.5	63.1	69.6	62.6	67.8	61.9	66.1	58.0	Trucks movement
	MS4	Batching Plant	Port Area	5.068925	39.102021	69.1	62.5	69.7	64.5	69.6	60.5	70.9	64.0	69.1	62.5	Trucks during cement offloading and stone pebbles loading
	MS5	Gate 1	Port Area	5.067497	39.105531	63.3	58.6	64.8	57.1	64.5	57.5	67.3	56.5	63.3	58.6	Trucks movements
	MS6	Gate 2	Port Area	5.068708	39.103491	67.0	45.3	64.8	59.3	62.8	59.3	71.5	57.9	67.0	45.3	
	MS7	Sediment Dumping	Port Area	5.064329	39.108106	45.2	43.2	42.5	42.2	45.1	43.0	44.3	42.4	45.2	43.2	Reflection of sound from Berth 1
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	Port Area	5.068577	39.105728	46.3	45.3	50.5	44.9	50.2	45.5	49.9	46.5	46.3	45.3	Welding activities
	MS9	Along the Road near TPA Office	Residential Area	5.0695684	39.105267	58.2	56.6	60.0	54.6	57.3	54.7	61.1	55.8	58.2	56.6	Trucks &human activities
	MS10	Deep Sea	Residential Area	5.067053	39.097393	51.9	50.9	58.1	46.2	57.4	47.0	56.4	45.4	51.9	50.9	Wind, Water waves & Human activities
	MS11	Canteen Area	Residential Area	5.069209	39.102705	54.2	42.5	63.5	59.4	61.9	56.2	69.0	54.4	54.2	42.5	Trucks and human activities
	MS12	Residential Areas	Residential Area	5.06875	39.10583	55.8	50.7	54.0	48.4	57.7	47.3	56.2	44.2	55.8	50.7	Human activities

Source: *Noise field measurement by STEM Consult (T) Limited: January, 2023*

From the above table4.3b, all onsite monitoring stations recorded with noise levels within the ceiling upper limit. Four offsite monitoring site (MS9-along the road near TPA Office, MS10-Deep Sea, MS11-Canteen Area and Residential Areas) had average noise levels that were above the acceptable limit on all the four weeks due to vehicular movement and human activities in and around these monitoring stations.

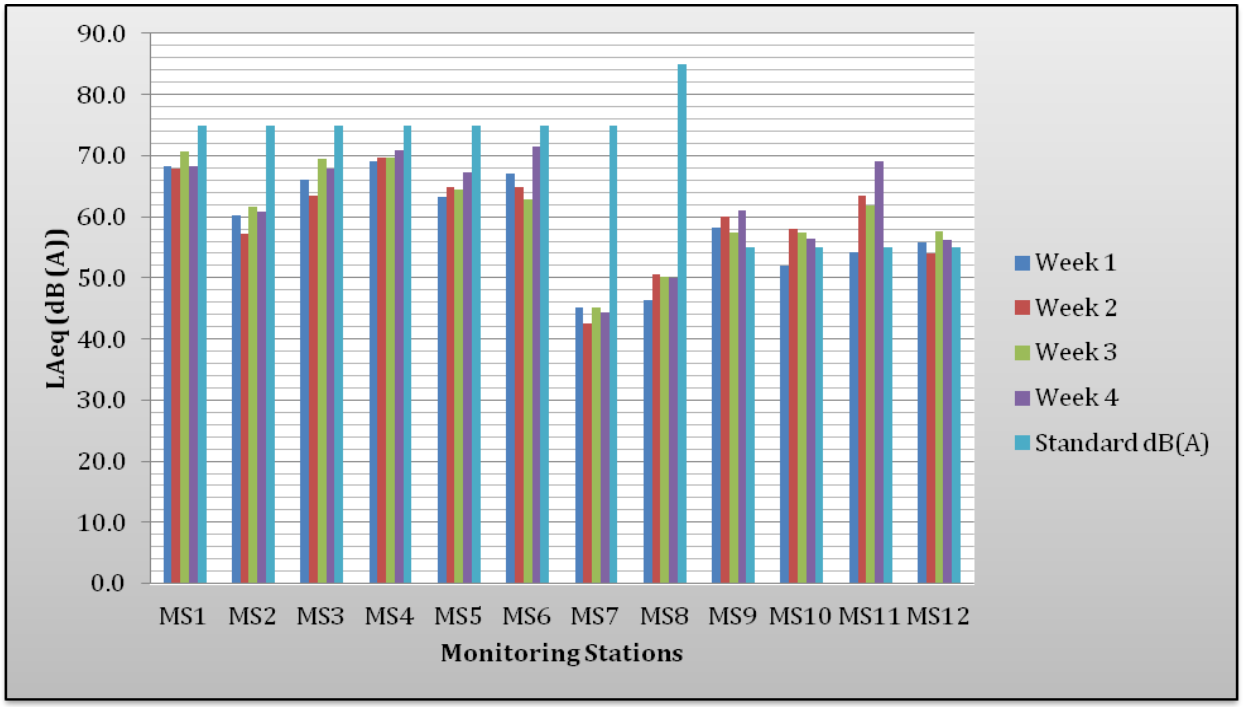


Figure 4.3a: Average noise levels (in dB (A)) recorded at onsite and offsite stations for day session

From figure 4.3a above, MS4-Batching Plant (onsite monitoring station) recorded with highest average noise levels compared to all other monitoring locations due to plant operations, trucks movement and offloading stone pebbles in and around the monitoring station.

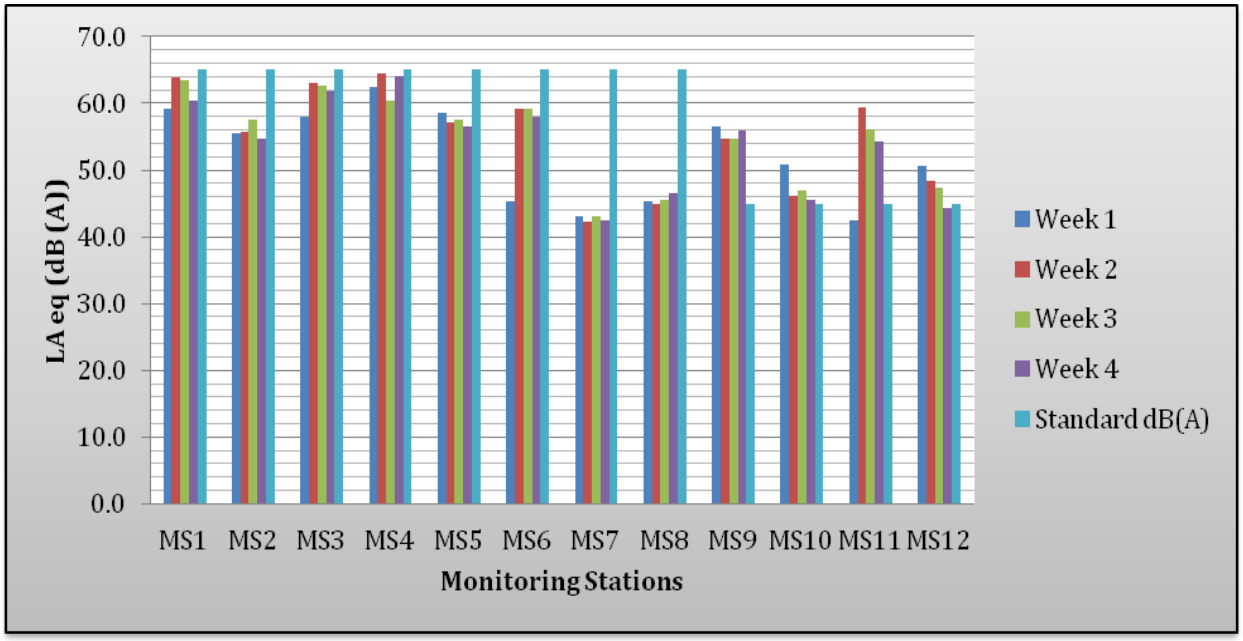


Figure 4.3b: Average noise levels (in dB (A)) recorded at onsite and offsite stations for night session

From figure 4.3b above, stipulates that MS9-along the road near TPA Office, MS10-Deep Sea, MS11-Canteen Area and MS12-Residential Area are above noise level prescribed standards due to automobile movement and human activities.

Table 4.3b: Maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for both sessions

Category	Location Code	Measuring Location	GPS Coordinates		Week 1		Week 2		Week 3		Week 4		Source of Noise
					Day time	Night time	Day time	Night time	Day time	Night time	Day time	Night time	
			Latitude (°S)	Longitude (°E)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	Peak/ Max, dB(A)	
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	69.2	60.4	68.9	64.5	73.1	64.5	69.6	63.1	Trucks movement, cement mixer and cranes,
	MS2	Berth 1	5.064387	39.106815	61.2	57.2	58.7	56.9	62.7	59.1	62.3	55.6	Trucks, reflection of sound from Berth 2
	MS3	Berth 2	5.065112	39.106014	68.7	60.7	65.9	64.5	69.9	63.4	68.9	62.8	Trucks movement
	MS4	Batching Plant	5.068925	39.102021	69.9	66.2	70.2	65.6	71	62.3	72.4	65.1	Trucks during cement offloading and stone pebbles loading
	MS5	Gate 1	5.067497	39.105531	64.9	60.1	65.3	58.9	65.2	59.4	72.3	58.6	Trucks movements
	MS6	Gate 2	5.068708	39.103491	71.7	48.7	65.8	61.2	64.5	60.6	74.6	58.7	
	MS7	Sediment Dumping	5.064329	39.108106	46.5	44.3	43.2	43.2	46.1	43.6	44.5	43.1	Reflection of sound from Berth 1
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	47.1	46.2	52.3	46.2	51.2	47.8	51.2	47.4	Welding activities
	MS9	Along the Road near TPA Office	5.0695684	39.105267	60.2	57.4	61.2	56.7	58.7	55.6	62.3	56.4	Automobile movement (Trucks) and human activities
	MS10	Deep Sea	5.067053	39.097393	52.9	52.6	59.6	48.7	59.8	48.6	58.6	46.6	Wind, Water waves & Human activities
	MS11	Canteen Area	5.069209	39.102705	58.6	46.1	64.3	60.1	63.1	57.4	69.9	56.3	Trucks and human activities
	MS12	Residential Areas	5.06875	39.10583	56.8	51.2	54.6	50.2	59.8	48.7	57.6	45.7	Human activities
Guidelines	**Local standard: (EMR, 2015] for vehicles of different engine power**				**<84**								
	Local standard (EMR, 2015] for workshop areas				**85**								

Source: *Noise field measurement by STEM Consult (T) Limited: January, 2023*
Note: *Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015*

From the above table 4.3b, maximum (Peak) noise levels (in dB(A)) recorded at onsite and offsite stations for both sessions are within prescribed limits due to improved port daily operations and contractor best operation practices even if its varies depends on daily activities.

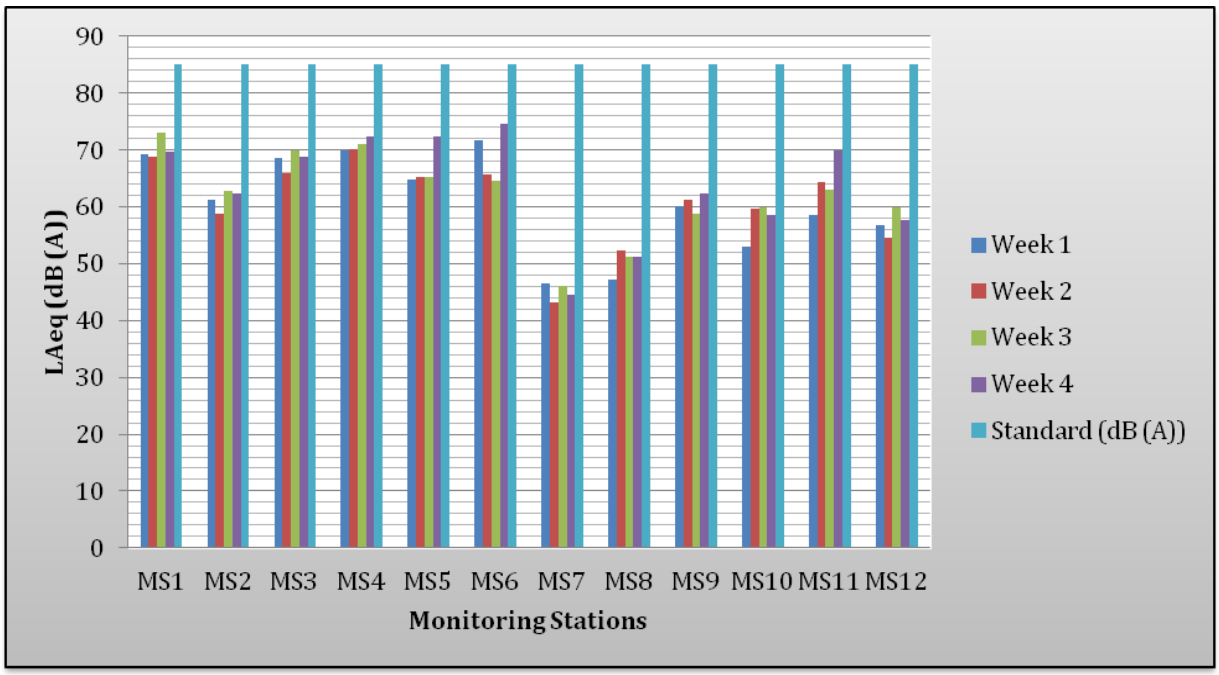


Figure 4.3c: Maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for day session

From the above figure the maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for day session are within acceptable limits due to improved port daily operations and contractor best operation practices not only that but also good noise source management (servicing of trucks and construction equipments) lead to noise compliant.

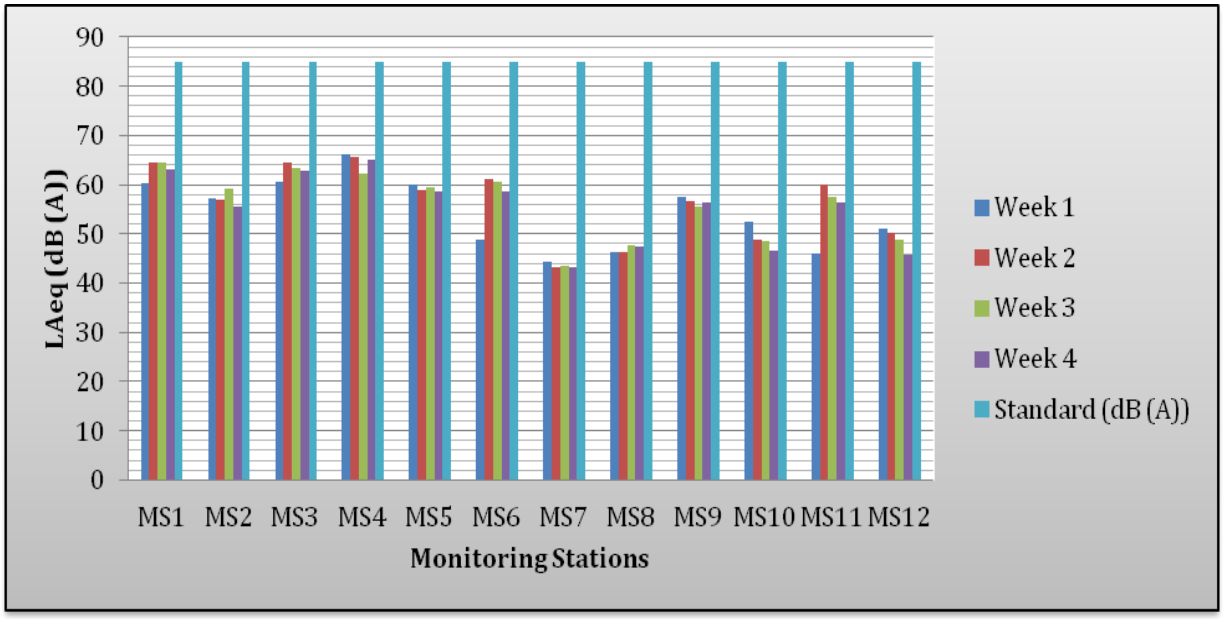


Figure 4.3d: Maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for night session

From the above figure the maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for night session are within acceptable standards due to improved port daily operations and contractor best operation practices.

4.3.2 Average and Maximum Noise Levels

Noise levels were measured at different stations along the project site (onsite) and nearby receptors (offsite). Averaged day (Lday), night (Lnight) and maximum (Peak) noise levels at different stations are shown in Tables 4.3c and 4.3f respectively and figures (4.3e to 4.3f). Generally, the averaged noise levels recorded at onsite stations during night time were noted to be significantly lower than those recorded during day time.

Furthermore, all onsite stations were recorded with averaged noise levels within local standards [EMR (2015)] while only one out of five offsite stations were recorded with averaged noise levels within local standards [EMR (2015)] in case of night-session, those noncompliance to these stations were not caused by ongoing activities rather it is automobile movement and human activities. The offsite noise levels were ranging between 46.3dB (A) and 58.2 dB (A) during the daytime and 42.5 dB (A) and 56.6 dB (A) at night with the highest and the lowest values recorded at Along the road near TPA offices and Canteen Area respectively. Along the road near TPA offices was found to demonstrate increased noise levels due to human activities and automobiles movement. Likewise, the onsite noise levels shows that Lday and Lnight were ranging between {45.2 dB (A) and 69.1 dB (A)} and {43.2 dB (A) and 62.5 dB (A)} respectively, with highest value at Batching Plant and the lowest at Sediment Dumping. The noted significant Lday and Lnight noise values at Batching Plant were contributed by Trucks movement, Plant and offloading of stone pebbles. On the other hand, peak noise levels ranging between 46.5 dB (A) and 71.7 dB (A) for daytime and 44.6 dB (A) and 66.2 dB (A) for night time were recorded at different stations when there are traffics and peak port operations.

Table 4.3c: Average noise levels (in dB (A)) recorded at onsite and offsite stations for both sessions

Category	Location Code	Measuring Location	Category of Location	GPS Coordinates		Session		Standards dB(A)		Source of Noise
						Day time	Night time	Day time	Night time	
				Latitude (°S)	Longitude (°E)	LAeq, (1h)	LAeq, (1h)			
Onsite (Port Compound)	MS1	Container Yard	Port Area	5.067148	39.104326	68.3	59.2	**75.0**	**65.0**	Trucks and cement mixer,
	MS2	Berth 1	Port Area	5.064387	39.106815	60.2	55.6	**75.0**	**65.0**	Trucks, reflection of sound from Berth 2
	MS3	Berth 2	Port Area	5.065112	39.106014	66.1	58.0	**75.0**	**65.0**	Trucks and cement mixer,
	MS4	Batching Plant	Port Area	5.068925	39.102021	69.1	62.5	**75.0**	**65.0**	Trucks offloading and stone pebbles loading
	MS5	Gate 1	Port Area	5.067497	39.105531	63.3	58.6	**75.0**	**65.0**	Trucks movements
	MS6	Gate 2	Port Area	5.068708	39.103491	67.0	45.3	**75.0**	**65.0**	
	MS7	Sediment Dumping	Port Area	5.064329	39.108106	45.2	43.2	**75.0**	**65.0**	Reflection of sound from Berth 1
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	Port Area	5.068577	39.105728	46.3	45.3	**85.0**	**65.0**	Welding activities
	MS9	Along the Road near TPA Office	Residential Area	5.0695684	39.105267	58.2	56.6	**55.0**	**45.0**	Automobile movement and human activities
	MS10	Deep Sea	Residential Area	5.067053	39.097393	51.9	50.9	**55.0**	**45.0**	Wind, Water waves & Human activities
	MS11	Canteen Area	Residential Area	5.069209	39.102705	54.2	42.5	**55.0**	**45.0**	Trucks and human activities
	MS12	Residential Areas	Residential Area	5.06875	39.10583	55.8	50.7	**55.0**	**45.0**	Human activities

Source: *Noise field measurement by STEM Consult (T) Limited: January, 2023*
Note: *Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015.*

From the above table 4.3c, the average noise levels to all onsite port compounds are within the standard. Four offsite locations (MS9-Along the Road near TPA Office, MS10-Deep Sea and MS11-Canteen Area, MS12-Residential Area) recorded value above the standards for day and night session while only one location (MS8-Rebars Processing Yard) score below the standards for both day and night session.

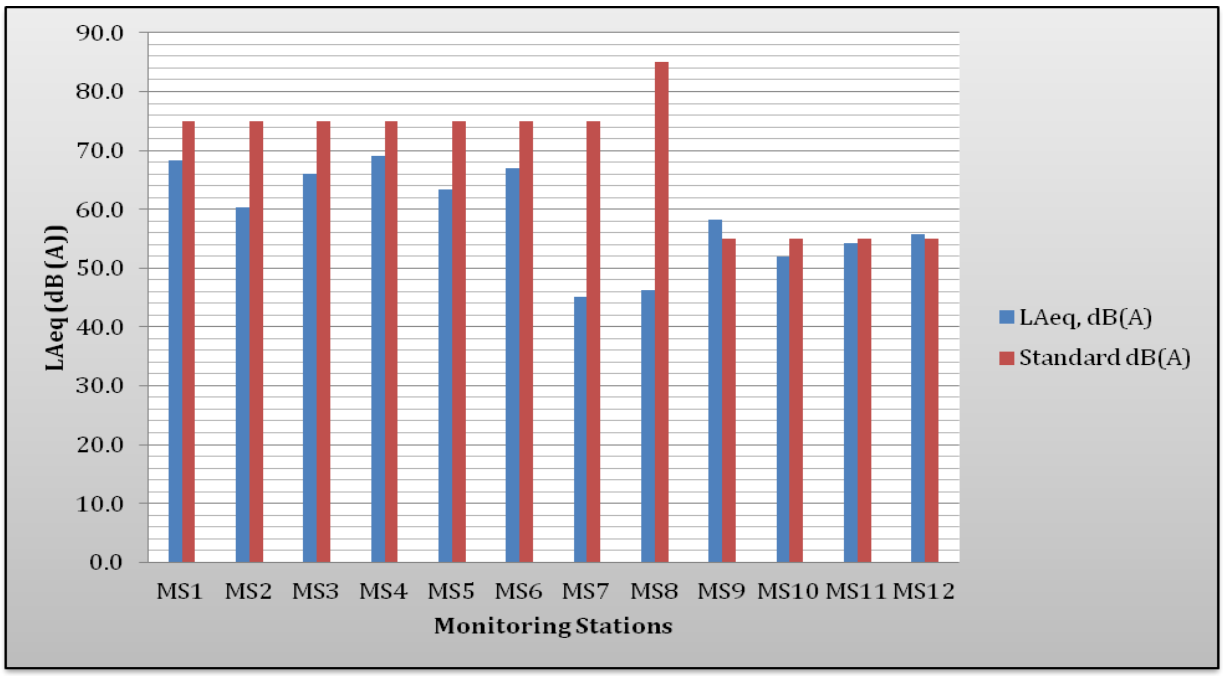


Figure 4.3e: Average noise levels (in dB (A)) recorded at onsite and offsite stations for day session

From figure 4.3e above, the average noise levels to all onsite port compounds are within prescribed standard while two offsite locations (MS9-Along the Road near TPA office, and MS11-Canteen Area) score above prescribed standards for day session due to human activities and automobile movement.

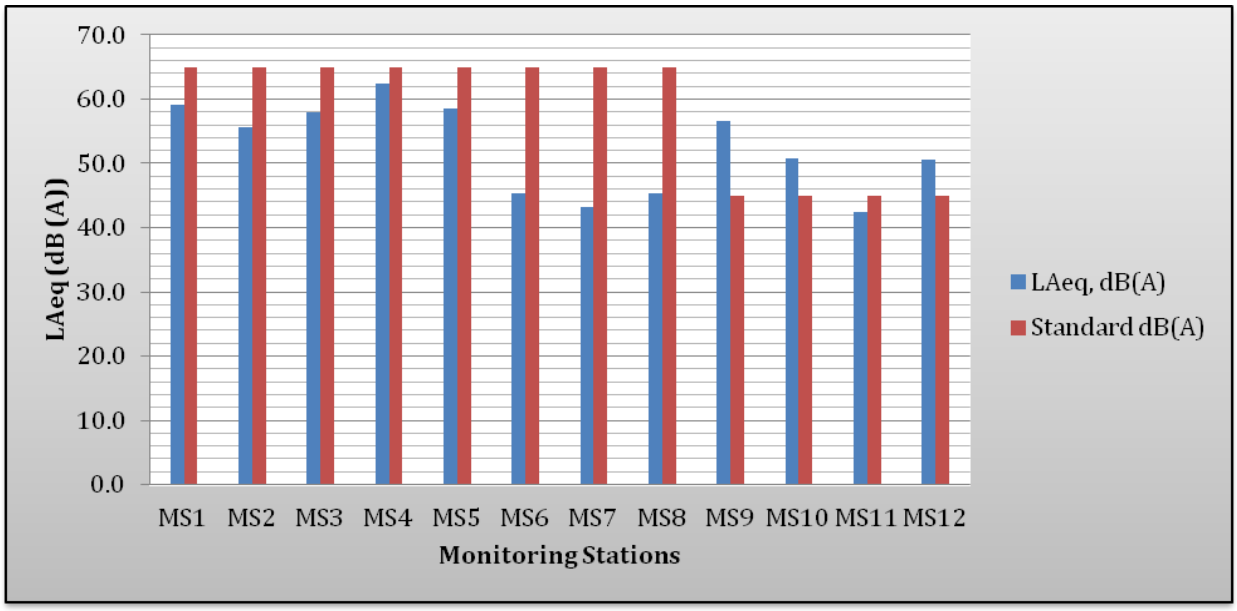


Figure 4.3f: Average noise levels (in dB (A)) recorded at onsite and offsite stations for night session

From the above table 4.3f, the average noise levels to all onsite port compounds are within prescribed standard. Four offsite locations (MS9-Along the Road near TPA Office, MS10-Deep Sea and MS12-Residential Area) recorded value above prescribed standards for night session.

Table 4.3d: Maximum Permissible Noise levels for general environment

FACILITY	Noise limits in dBA (L_{eq})	
	Day	**Night**
Any building used as a hospital, convalescence home, home for the aged, sanatorium, and learning institutions, conference rooms, public library, and environmental and recreational site.	45	35
Residential building	50	35
Mixed residential (with some commercial and entertainment)	55	45
Residential and Industry/small scale production and commerce	60	50
Industrial area	70	60
Time frame	**6:00 am -10:00 pm**	**10:00 pm-6:00 am**

Source: *Tanzania Environmental Management (Standards for The Control of Noise and Vibration Pollution) Regulations, 2015*

Table 4.3e: Maximum Permissible Noise levels for construction site

FACILITY	Noise limits in dBA (L_{eq})	
	Day	**Night**
(i) Hospital, school, institutions of higher learning, homes for the disabled	60	50
(ii) Building other than those described in (i) above	75	65
Time frame	**6:00 am -10:00 pm**	**10:00 pm-6:00 am**

Source: *Tanzania Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015*

Table 4.3d and 4.3e presents the maximum allowed noise limits general environment and construction sites for day session and night session respectively. The project operations noise emission levels are within/ below limit standards.

Table 4.3f: Maximum (Peak) noise levels (in dB (A)) recorded at onsite and offsite stations for both sessions

Category	Location Code	Measuring Location	GPS Coordinates		Session		Source of Noise
					Day time	Night time	
			Latitude (°S)	Longitude (°E)	Peak/Max, dB(A)	Peak/ Max, dB(A)	
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	69.2	60.4	Trucks and cement mixer
	MS2	Berth 1	5.064387	39.106815	61.2	57.2	Trucks, reflection of sound from Berth 2
	MS3	Berth 2	5.065112	39.106014	68.7	60.7	Trucks and cement mixer
	MS4	Batching Plant	5.068925	39.102021	69.9	66.2	Trucks offloading stone pebbles
	MS5	Gate 1	5.067497	39.105531	64.9	60.1	Trucks movements
	MS6	Gate 2	5.068708	39.103491	71.7	48.7	
	MS7	Sediment Dumping	5.064329	39.108106	46.5	44.3	Reflection of sound from Berth 1
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	47.1	46.2	Welding activities
	MS9	Along the Road near TPA Office	5.0695684	39.105267	60.2	57.4	Automobile movement and human activities
	MS10	Deep Sea	5.067053	39.097393	52.9	52.6	Wind, Water waves & Human activities
	MS11	Canteen Area	5.069209	39.102705	58.6	46.1	Trucks and human activities
	MS12	Residential Areas	5.06875	39.10583	56.8	51.2	Human activities
Guidelines	**Local standard: (EMR, 2015] for vehicles of different engine power**				**<84**		
	Local standard: (EMR, 2015] for workshop areas				**85**		

Source: *Noise field measurement by STEM Consult (T) Limited: January, 2023*
Note: *Environmental Management (Standards for The Control of Noise and Vibration Pollution) Regulations, 2015*

From the above table 4.3f, the peak noise levels recorded at onsite and offsite stations for both sessions are within acceptable standards due to improved port daily operations and contractor best operation practices. Gate2 scored the highest (71.7 dB(A)) due to Trucks movement regardless it is within the acceptable local standards.

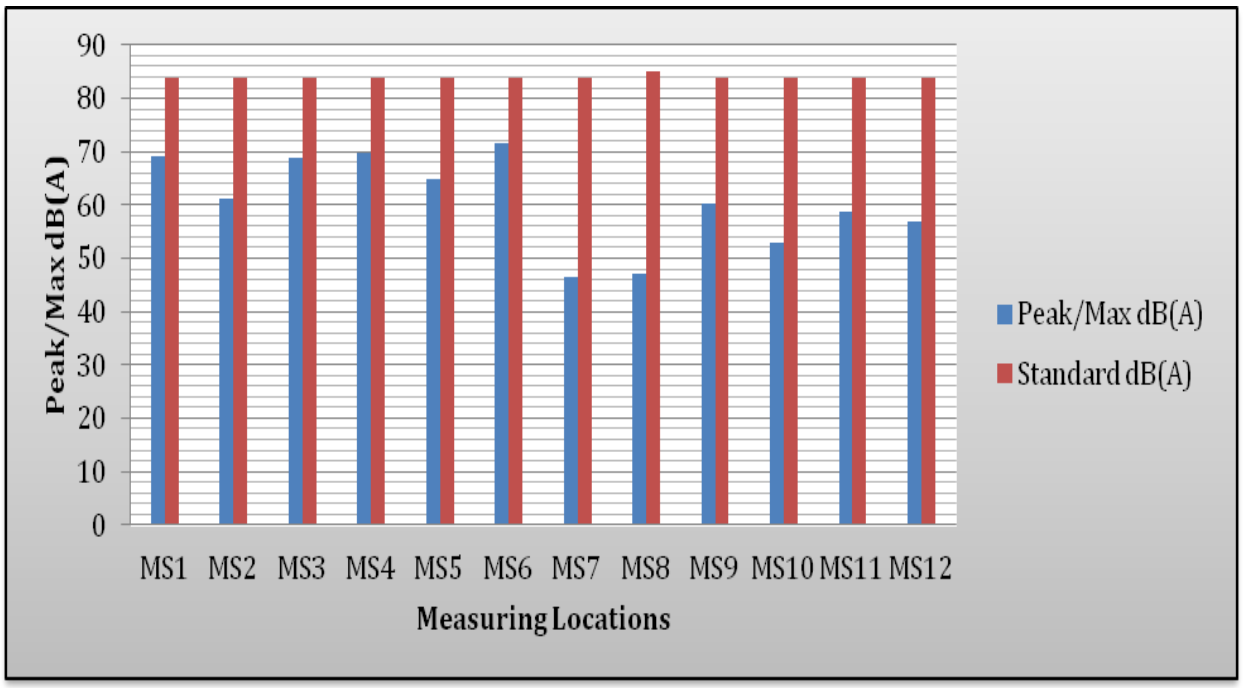


Figure 4.3g: Peak/Max noise levels (in dB (A)) recorded at onsite and offsite stations for day session

From figure 4.3g above the peak noise levels for all monitoring site on day session are below the local and international standards due to improved contractor's trucks and other construction equipments including best operation practices.

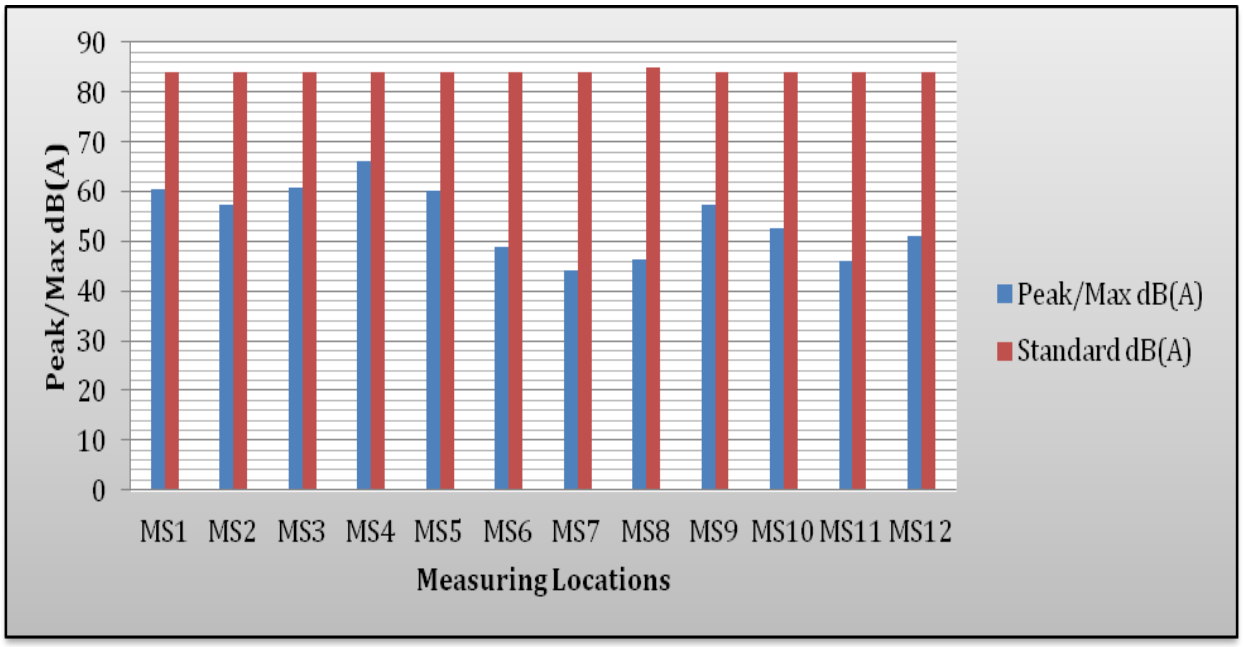


Figure 4.3h: Peak/Max noise levels (in dB (A)) recorded at onsite and offsite stations for night session

From figure 4.3h above the peak noise levels for all monitoring site on night session are below prescribed local and international standards due to improved contractor's trucks and other construction equipments including best operation practices.

4.4 GROUND VIBRATION LEVELS

Ground vibration was mostly generated by vehicles (especially trucks and construction machines) moving along the surveyed project area. During conducting survey, physical sensing of ground vibration was noted at some stations. Referring to the findings summarized in the table 5.4 below, it implies that all onsite and offsite stations were found with vibration levels below the prescribed Local: TZS: [1471: 2011] and International: BS ISO [4866:2010] Standard limits. However, the highest ground vibration of 0.3mm/s recorded at Berth 2 and Container Yard (onsite stations) was associated with soil compaction and automobile (especially heavy Trucks). The averaged ground vibration levels were in the range of (0.0–0.3 mm/s) for both day and night sessions. The high vibration is possible to cause ill health effects and in most cases destruct buildings/structures. It is possible to do this by well-planned engineering designs and controls, and safe work practices to the ongoing construction and operation activities.

Table 4.4: Summary on ground vibration levels for all locations and sessions

Category	Location Code	Measuring Location	GPS Coordinates (ITM)		Session		Source of Noise
					Day time	Night time	
			Latitude (°S)	Longitude (°E)	Averaged vibration (mm/s)	Averaged vibration (mm/s)	
Onsite (Port Compound)	MS1	Container Yard	5.067148	39.104326	0.2	0.2	Trucks and cement mixer
	MS2	Berth 1	5.064387	39.106815	0.0	0.0	
	MS3	Berth 2	5.065112	39.106014	0.3	0.1	
	MS4	Batching Plant	5.068925	39.102021	0.1	0.1	
	MS5	Gate 1	5.067497	39.105531	0.0	0.0	
	MS6	Gate 2	5.068708	39.103491	0.1	0.1	
	MS7	Sediment Dumping	5.064329	39.108106	0.0	0.0	
Offsite (Nearby Receptors)	MS8	Rebars Processing Yard	5.068577	39.105728	0.0	0.0	
	MS9	Along the Road near TPA Office	5.0695684	39.105267	0.0	0.0	Automobile movement
	MS10	Deep Sea	5.067053	39.097393	0.0	0.0	
	MS11	Canteen Area	5.069209	39.102705	0.0	0.0	Automobile movement
	MS12	Residential Areas	5.06875	39.10583	0.0	0.0	
Vibration Guidelines	**Local: TZS: [1471: 2011]**				**5**		
	International: BS ISO [4866:2010]				5		

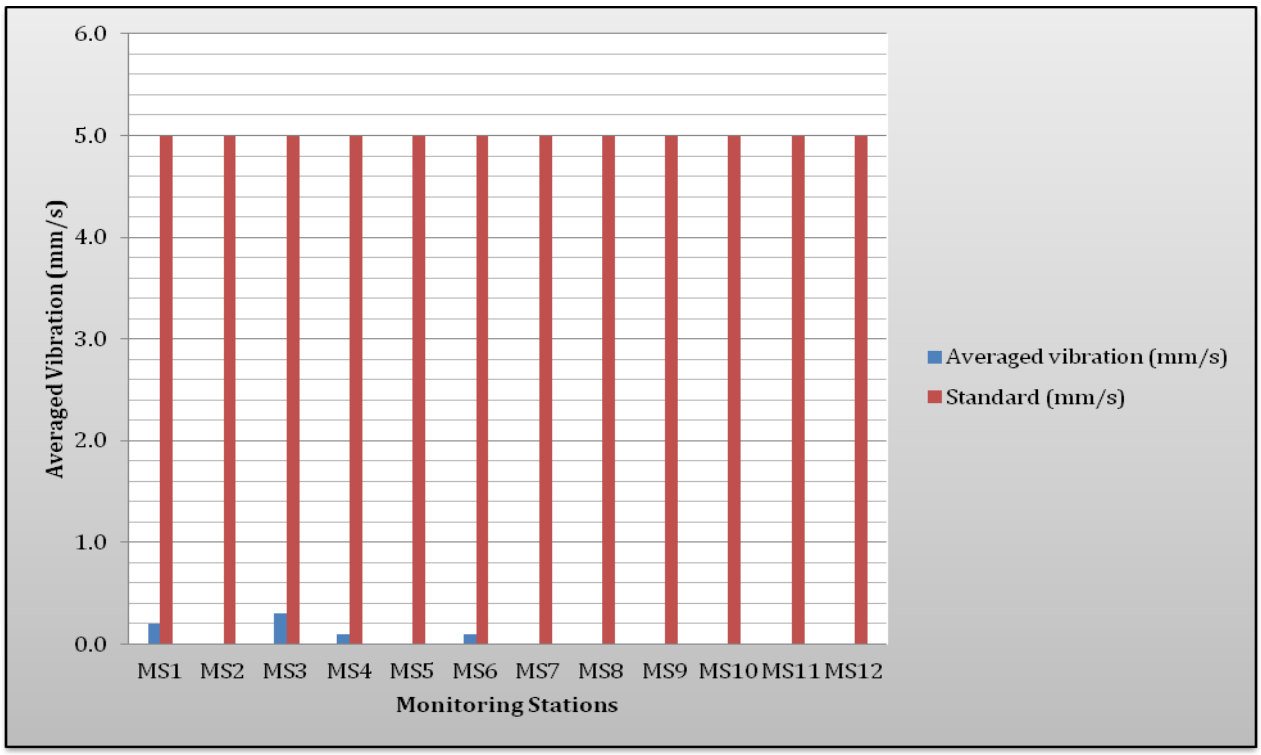


Figure 4.4a: Vibration levels (mm/s) for day session

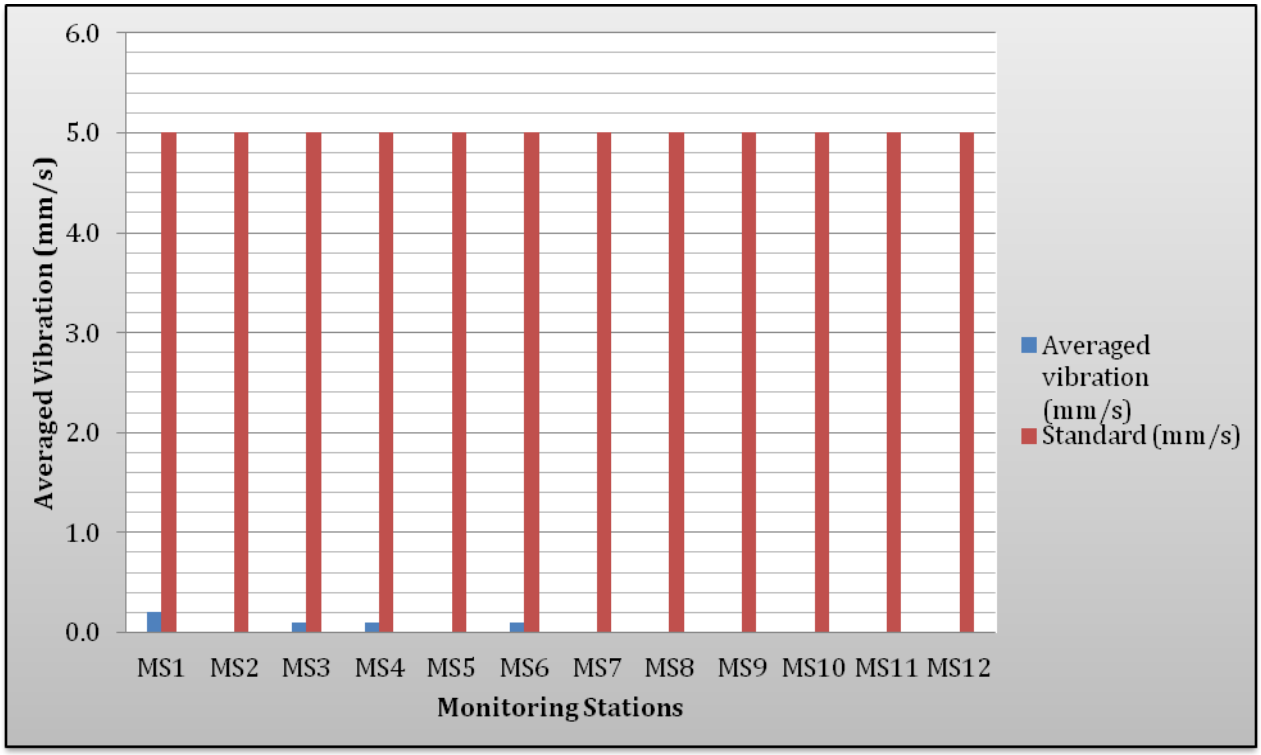


Figure 4.4b: Vibration levels (mm/s) for night session

From figure 4.4a and 4.4b respectively, the vibration levels for all monitoring site on both day and night session are below the local and international standards due to improved port daily operations and contractor best operation practices.

MARINE WATER QUALITY

4.5.1 Weekly Marine Water Quality

The in-situ water quality parameters (pH Value, Conductivity, Salinity, Turbidity, Temperature and Dissolved Oxygen) were measured on four hours intervals and the average weekly results are as presented in Table 4.5 below (Refer to Appendix 3 for the Daily Water Quality Monitoring Data). In general, most of the in-situ measured parameters were noted to be within the permissible limits. The pH values in the month of March, 2023 (refer to Table 4.5) are within the range of 6.5-9.0 which is tolerable by the majority of aquatic organisms. Furthermore, dissolved oxygen (DO) concentrations slightly increased (refer to Table 4.6 and Figure 4.5) and continue to be within range supportive for aquatic life. The observed pH values and dissolved oxygen (DO) levels may be contributed by a combination of many factors including improved port operations, storm water and waste water discharges into the ocean as well as contractor best operation practices.

Table 4.5: Average weekly in-situ water quality parameters for month of March, 2023

Monitoring Duration	Location Code	Sampling Station	Parameters					
			pH Value	Conductivity [mS/cm]	Salinity [%]	Turbidity [NTU]	Temperature (°C)	Dissolved Oxygen (mg/l)
Week 1	MS1	Berth 1	8.15	43.16	2.40	6.03	29.87	6.35
	MS2	Turn Basin	8.02	43.21	2.37	5.20	29.80	6.32
	MS3	Berth 2	8.14	43.52	2.42	6.17	29.83	6.34
	MS4	Port Entrance	8.08	43.37	2.52	5.27	29.70	6.55
	MS5	Disposal Site	8.12	43.40	2.48	5.77	29.67	6.23
Week 2	MS1	Berth 1	8.17	43.23	2.36	6.23	29.77	6.30
	MS2	Turn Basin	8.07	43.16	2.42	5.23	29.63	6.42
	MS3	Berth 2	8.18	43.26	2.35	6.13	29.73	6.35
	MS4	Port Entrance	8.14	43.17	2.43	5.33	29.77	6.46
	MS5	Disposal Site	8.21	43.37	2.53	5.03	29.73	6.30
Week 3	MS1	Berth 1	8.20	43.25	2.32	5.67	29.63	6.32
	MS2	Turn Basin	8.17	43.18	2.36	5.13	29.53	6.50
	MS3	Berth 2	8.13	43.24	2.43	5.77	29.53	6.31
	MS4	Port Entrance	8.24	43.28	2.40	5.53	29.37	6.69
	MS5	Disposal Site	8.27	43.38	2.58	5.13	29.50	6.31
Week 4	MS1	Berth 1	8.15	43.35	2.28	6.33	29.23	6.28
	MS2	Turn Basin	8.10	43.29	2.36	5.37	29.43	6.48
	MS3	Berth 2	8.12	43.32	2.32	6.47	29.37	6.31
	MS4	Port Entrance	8.16	43.19	2.52	5.37	29.33	6.46
	MS5	Disposal Site	8.15	43.26	2.57	5.23	29.37	6.29

From above table 4.5, the insitu water quality at MS1-Berth 1, MS2-turn basin, MS3-Berth 2 and MS5-disposal site, the score fluctuates for all parameters, higher and low for all the four weeks. Generally, pH and Dissolved Oxygen (DO) levels are within the normal ranges of healthy marine water.

Table 4.6: Comparison of the average in-situ water quality results for the month of February, 2023 and March, 2023

Month	Parameter	Berth 1	Berth 2	Turn Basin	Port Entrance	Disposal Site
February 2023	pH Value	7.99	8.02	8.07	8.00	8.04
	Conductivity [mS/cm]	43.56	43.53	43.54	43.44	43.56
	Salinity [‰]	2.52	2.46	2.48	2.42	2.55
	Turbidity [NTU]	4.85	4.78	4.80	4.69	5.12
	Temperature (°C)	29.50	29.61	29.45	29.54	29.43
	Dissolved Oxygen (mg/l)	6.33	6.29	6.35	6.39	6.13
March 2023	pH Value	8.17	8.14	8.09	8.16	8.19
	Conductivity [mS/cm]	43.25	43.34	43.21	43.25	43.35
	Salinity [‰]	2.34	2.38	2.38	2.47	2.54
	Turbidity [NTU]	6.07	6.13	5.23	5.38	5.29
	Temperature (°C)	29.63	29.62	29.60	29.54	29.57
	Dissolved Oxygen (mg/l)	6.31	6.33	6.43	6.54	6.28

From table 4.6, there is a slight increase Dissolved Oxygen (DO), pH values and turbidity scores for the month of March, 2023 as compared to February,2023. The observed DO and pH values continue to be within standard limits indicating healthy waters that supports aquatic life.

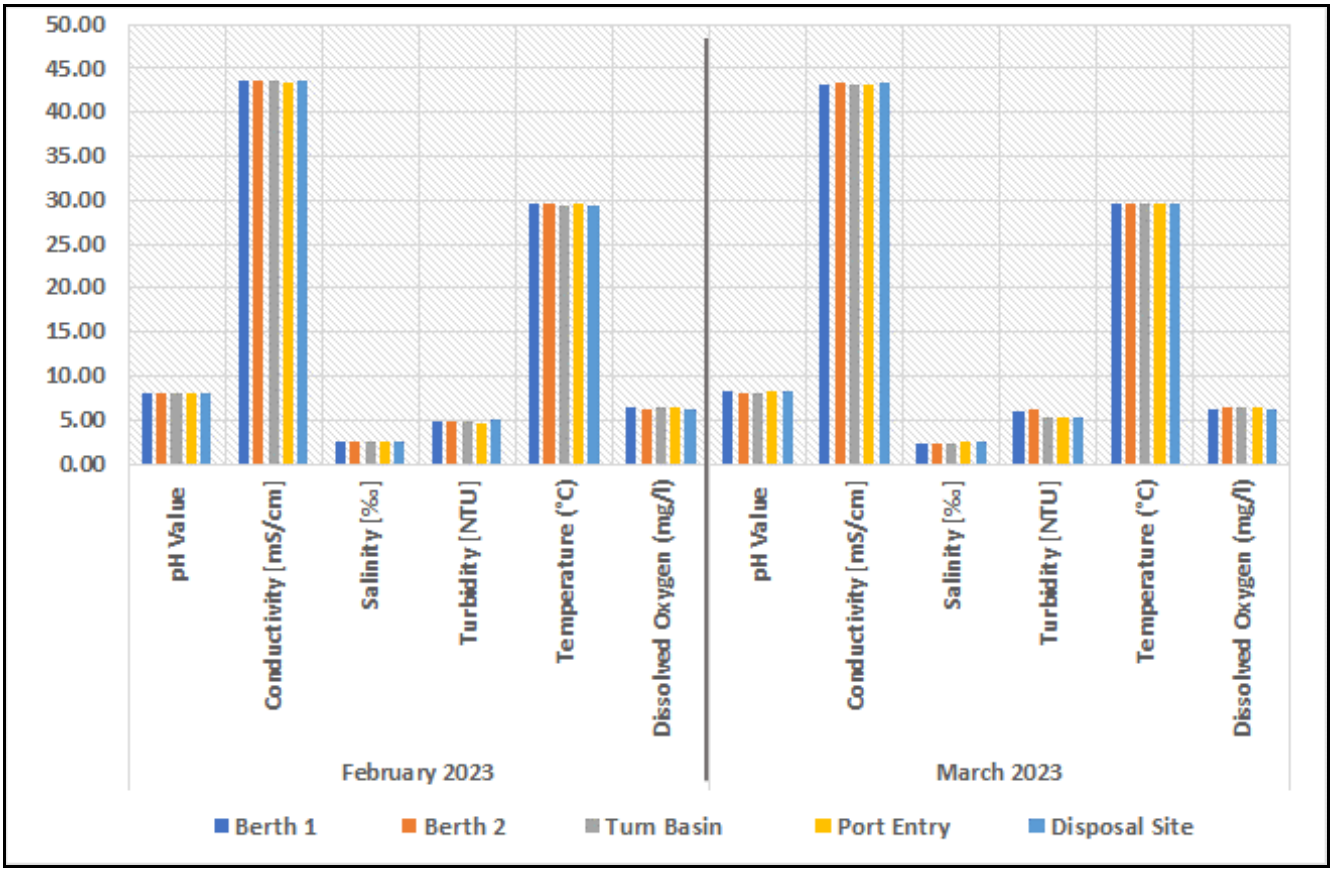


Figure 4.5: Comparison of Insitu water quality results for the month of February, 2023 and March, 2023

From table 4.6, there is a slight increase Dissolved Oxygen (DO) scores, pH value and turbidity scores for the month of March, 2023 as compared to February,2023. The observed levels are within standard limits indicating healthy waters that supports aquatic life. The observed levels may be contributed by a combination of many factors including daily port operations, offshore storm discharges into the ocean as well as contractor best operation practices.

4.5.2 Monthly Marine Water Quality

In situ measurement was supplemented with comprehensive monthly laboratory analysis of marine water quality parameters. Again, the results indicates that most of the marine water quality parameters to be within the permissible limits when compared with the prescribed upper limit standards as summarised in Table 4.7 (Refer to Appendix 2 for the Laboratory marine water and sediment analysis results). The pH values in the month of March, 2023 (refer to Table 4.7) are within the range of 6.5-9.0 which is tolerable by the majority of aquatic organisms. Nitrate and Iron levels were detected to be within the acceptable limits (refer to Table 4.7). Mercury (Hg) was not detectable in all monitoring locations while other heavy metals (Lead, Manganese, Nickel, Arsenic, Zinc) were observed to be within the acceptable upper limits (refer to Table 4.7).

Table 4.7: Marine water quality laboratory results for the Month of March, 2023

Parameter	Sampling Station					Upper limit EU (2006)
	Berth 1	Berth 2	Turn Basin	Port Entry	Disposal Site	
pH Value	8.21	8.12	8.15	8.16	8.18	6.0-9.0
Conductivity [mS/cm]	54.34	52.56	54.36	51.58	53.27	N.M
Salinity [ppm]	14102.44	13307.41	12890.37	13452.10	13126.56	N.M
Carbonates (CO_3^{2}) [mg/l]	14.20	14.50	28.86	26.88	30.07	N.M
Turbidity [NTU]	7.50	7.25	7.22	7.12	7.12	N.M
Total Dissolved Solids [mg/l]	16307	13650	14820	13205	13480	N.M
Total Suspended Solids [mg/l]	104.00	122.00	142.00	121.00	143.00	N.M
Total Organic Carbon [%]	0.06	0.04	0.05	0.06	0.05	N.M
Nitrate [mg/l]	4.86	4.74	4.58	5.74	5.72	10
Ammonium (NH_4) [mg/l]	0.86	0.88	1.00	1.15	1.20	0.66
Total Kjeldahl Nitrogen [mg/l]	4.91	4.68	6.02	5.56	5.28	N.M
Phosphorus [mg/l]	0.001	NIL	0.001	0.002	0.001	N.M
Oil & Grease [mg/l]	0.02	0.04	0.03	0.03	0.04	10
Manganese [mg/l]	<0.0001	<0.0001	0.0004	<0.0001	NIL	0.1
Zinc mg/l]	<0.001	<0.001	<0.001	<0.001	NIL	5
Arsenic [mg/l]	0.00002	0.00001	<0.00001	0.00001	NIL	0.5
Cadmium [mg/l]	0.0001	0.0002	0.0001	0.0002	NIL	0.005
Chromium 6+ [mg/l]	0.0001	0.0001	0.0001	0.0001	0.0001	0.5
Iron [mg/l]	0.046	0.062	0.056	0.058	0.058	0.3
Mercury [mg/l]	NIL	NIL	NIL	NIL	NIL	0.0005
Lead [mg/l]	0.0002	0.0001	0.0001	0.0002	NIL	0.5
Nickel [mg/l]	0.0001	0.0001	0.0001	0.0002	0.0002	0.5
Sulphate (SO_4^{2-}) [mg/l]	3,230.90	3,074.54	3,870.61	3,104.26	3,002.12	2700
Chloride (Cl^-)	11,159.84	12,020.27	12,316.34	12,065.53	11,956.64	19,400

***Note**: European Union Estuary and Harbour Basin Water Standards, 2006, N.M-Not Mentioned*

From table 4.7, pH, Nitrate, Oil and Grease, Manganese, Zinc, Arsenic, Cadmium, Chromium 6+, Iron, Lead, Nickel and Chloride scores were observed to be within the standard limits. On the other hand, Ammonium and Sulphate scores have slightly decreased as compared to February, 2023 scores and continues to be above the standard limits. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the ocean.

Table 4.8: Marine water laboratory results for the month of February, 2023 and March, 2023

Monitoring		Sampling Station					Upper limit EU (2006)
Month	**Parameters**	**Berth 1**	**Berth 2**	**Turn Basin**	**Port Entrance**	**Disposal Site**	
February 2023	pH Value	7.95	8.12	8.02	7.88	8.04	6.0-9.0
	Conductivity [mS/cm]	51.02	50.73	49.82	50.25	51.46	N.M
	Salinity [ppm]	16,262.21	12,274.42	13,320.23	14,990.13	14,570.21	N.M
	Carbonates [mg/l]	18.00	16.00	27.00	28.00	34.00	N.M
	Turbidity [NTU]	7.62	7.12	7.04	7.12	7.14	N.M
	Total Dissolved Solids [mg/l]	15,217	14,950	15,780	14,415	14,906	N.M
	Total Suspended Solids [mg/l]	124.00	149.00	162.00	152.00	158.00	N.M
	Total Organic Carbon [%]	0.04	0.05	0.05	0.07	0.05	N.M
	Nitrate [mg/l]	4.54	4.59	5.52	5.67	6.17	10
	Ammonium (NH_4) [mg/l]	0.83	1.03	1.02	1.05	1.02	0.66
	Total Kjeldahl Nitrogen [mg/l]	4.82	4.56	5.87	4.15	4.18	N.M
	Phosphorus [mg/l]	0.002	NIL	0.01	0.002	0.002	N.M
	Oil & Grease [mg/l]	0.04	0.05	0.03	0.03	0.05	10
	Manganese [mg/l]	<0.0001	<0.0001	0.0004	<0.0001	NIL	0.1
	Zinc [mg/l]	<0.001	<0.001	<0.001	<0.001	NIL	5
	Arsenic [mg/l]	0.00002	0.00001	<0.00001	0.00001	NIL	0.5
	Cadmium [mg/l]	0.0001	0.0002	0.0001	0.0002	NIL	0.005
	Chromium 6+ [mg/l]	0.0001	0.0001	0.0001	0.0001	0.0001	0.5
	Iron [mg/l]	0.041	0.054	0.050	0.053	0.056	0.3
	Mercury [mg/l]	NIL	NIL	NIL	NIL	NIL	0.0005
	Lead [mg/l]	0.0002	0.0001	0.0001	0.0002	0.0002	0.5
	Nickel [mg/l]	0.0001	0.0001	0.0001	0.0002	0.0002	0.5
	Sulphate [mg/l]	3,712.10	3,672.22	3,150.36	3,206.02	3,108.65	2700
	Chloride [mg/l]	10,890.47	11,404.21	12,970.06	10,175.32	11,106.43	19,400
March 2023	pH Value	8.21	8.12	8.15	8.16	8.18	6.0-9.0
	Conductivity [mS/cm]	54.34	52.56	54.36	51.58	53.27	N.M
	Salinity [ppm]	14102.44	13307.41	12890.37	13452.10	13126.56	N.M
	Carbonates [mg/l]	14.20	14.50	28.86	26.88	30.07	N.M
	Turbidity [NTU]	7.50	7.25	7.22	7.12	7.12	N.M
	Total Dissolved Solids [mg/l]	16307	13650	14820	13205	13480	N.M
	Total Suspended Solids [mg/l]	104.00	122.00	142.00	121.00	143.00	N.M
	Total Organic Carbon [%]	0.06	0.04	0.05	0.06	0.05	N.M
	Nitrate [mg/l]	4.86	4.74	4.58	5.74	5.72	10
	Ammonium (NH_4) [mg/l]	0.86	0.88	1.00	1.15	1.20	0.66
	Total Kjeldahl Nitrogen [mg/l]	4.91	4.68	6.02	5.56	5.28	N.M
	Phosphorus [mg/l]	0.001	NIL	0.001	0.002	0.001	N.M
	Oil & Grease [mg/l]	0.02	0.04	0.03	0.03	0.04	10

Monitoring		Sampling Station					Upper limit EU (2006)
Month	Parameters	Berth 1	Berth 2	Turn Basin	Port Entrance	Disposal Site	
	Manganese [mg/l]	<0.0001	<0.0001	0.0004	<0.0001	NIL	0.01
	Zinc [mg/l]	<0.001	<0.001	<0.001	<0.001	NIL	0.014
	Arsenic [mg/l]	0.00002	0.00001	<0.00001	0.00001	NIL	0.024
	Cadmium [mg/l]	0.0001	0.0002	0.0001	0.0002	NIL	0.01
	Chromium 6+ [mg/l]	0.0001	0.0001	0.0001	0.0001	0.0001	0.005
	Iron [mg/l]	0.046	0.062	0.056	0.058	0.058	0.02
	Mercury [mg/l]	NIL	NIL	NIL	NIL	NIL	0.005
	Lead [mg/l]	0.0002	0.0001	0.0001	0.0002	NIL	0.3
	Nickel [mg/l]	0.0001	0.0001	0.0001	0.0002	0.0002	0.0005
	Sulphate [mg/l]	3,230.90	3,074.54	3,870.61	3,104.26	3,002.12	2700
	Chloride [mg/l]	11,159.84	12,020.27	12,316.34	12,065.53	11,956.64	19,400

From table 4.8, Turbidity, Total Suspended Solids (TSS), Nitrate and Oil & Grease, Sulphate and Chloride scores have slightly decreased while on the other hand pH value, Ammonium and Iron has slightly increased in the month of, March 2023 as compared to February, 2023 respectively. The observed levels may be contributed by a combination of many factors including daily improved port operations as well as contractor best operation practices.

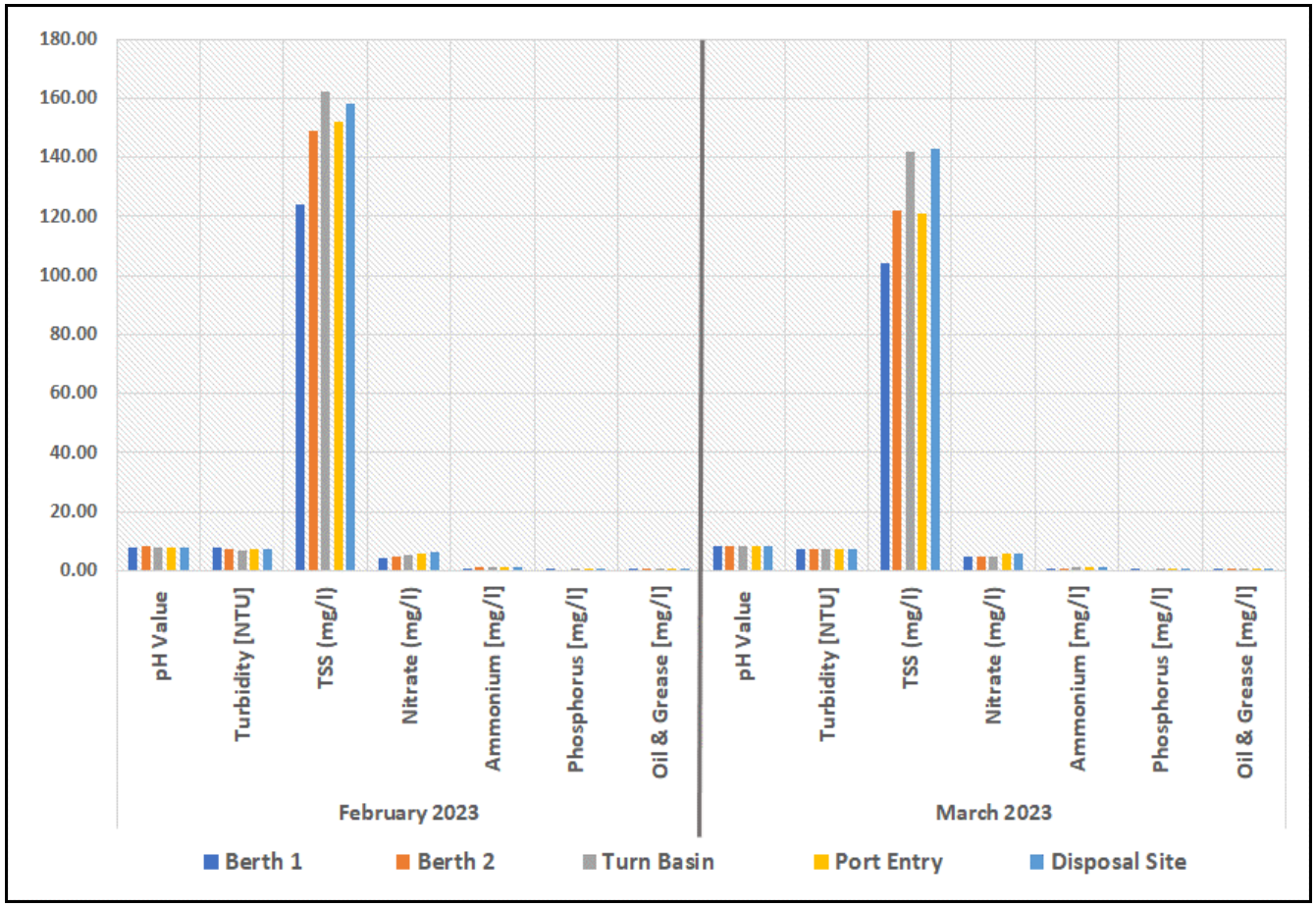


Figure 4.6: Comparison of marine water quality parameters results for the month of February, 2023 and March, 2023

From figure 4.6, there is a slight decrease in Turbidity, Total Suspended Solids (TSS), Nitrate and Oil & Grease scores for the month of March, 2023 as compared to February, 2023. The observed levels may be contributed by a combination of many factors including improved daily port operations and contractor best operation practices.

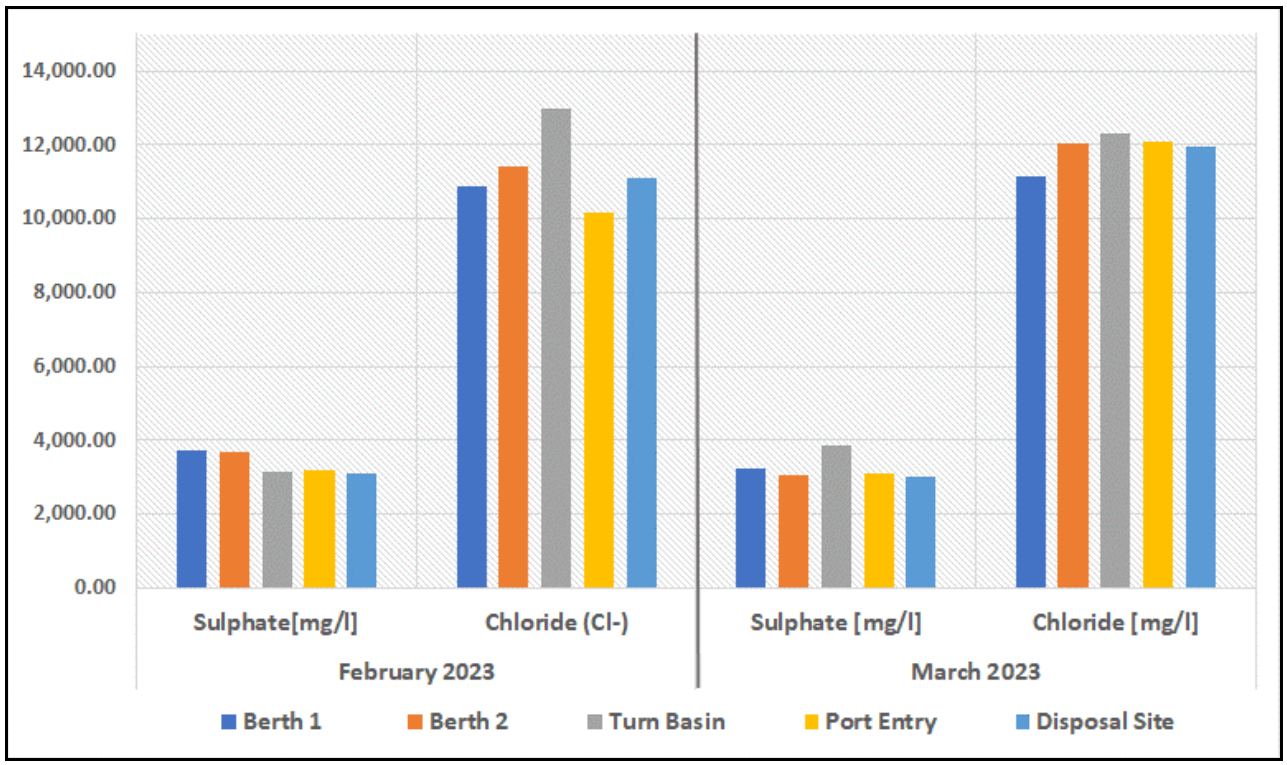


Figure 4.7: Comparison of Sulphate and Chloride marine water quality results for the month of February, 2023 and March, 2023

From figure 4.7 above, there is a slightly decrease of Sulphate and Chloride scores in the March, 2023 as compared to February, 2023. The observed levels may be contributed by a combination of many factors including improved port operations and the contractor best operation practices.

4.6 MARINE SEDIMENTS

The results for marine sediment quality analysis results are presented in Table 4.9 (Refer to Appendix 2 for the Laboratory marine water and sediment analysis results). The results indicates that the levels of analysed parameters to be within their respectively standard limits tolerable by the majority of aquatic organisms.

Table 4.9: Marine Sediment laboratory results for the Month of March, 2023

Parameter	Sampling Stations				EPA Standards
	Berth 1	Berth 2	Turn Basin	Port Entrance	
Moisture content [%]	52.22	51.50	49.14	57.43	**N.M**
pH value	8.44	8.18	8.19	8.24	**6.5-9.0**
Total Organic Carbon [%]	1.02	1.21	1.04	1.22	**N.M**
Carbonates (CO_3^{2-}) (%)	6.78	6.23	6.32	6.50	**N.M**

Parameter	Sampling Stations				EPA Standards
	Berth 1	Berth 2	Turn Basin	Port Entrance	
Nitrate [mg/kg]	5.72	5.02	6.01	5.34	**N.M**
Ammonium (NH_4) [mg/kg]	1.06	2.51	2.64	3.14	**N.M**
Total Kjeldahl Nitrogen [mg/kg]	6.52	6.44	5.74	5.82	**N.M**
Phosphorus(mg/kg)	2.34	2.39	2.26	2.65	**N.M**
Manganese [%]	0.0001	0.0002	0.0002	0.0002	**0.046**
Zinc [%]	NIL	0.001	0.001	0.001	**0.041**
Arsenic [%]	<0.001	<0.001	<0.001	<0.001	**0.0057**
Cadmium [%]	NIL	0.0001	0.0001	0.0001	**0.00051**
Chromium 6+ [%]	0.00001	0.00001	NIL	0.00002	**0.026**
Iron (%)	5.65	4.64	4.28	4.32	**N.M**
Mercury (%)	NIL	0.00001	NIL	0.00001	**0.000041**
Lead (%)	0.0001	0.0002	0.0002	0.0001	**0.045**
Nickel (%)	0.0001	0.0001	0.0001	NIL	**0.0094**
Copper (%)	0.0002	0.0001	0.0001	0.0001	**N.M**
Sulphate (SO_4^{2-}) (mg/kg)	4,218.43	4,319.64	3,890.42	4,551.43	**N.M**
Chloride (Cl^-) (mg/kg)	11,714.24	12,072.22	1,211.46	11,476.85	**N.M**

***Note**: European Union Estuary and Harbour Basin Water Standards, 2006, N.M-Not Mentioned*

From the above table 4.9, most of the monitored parameter's including pH, Manganese, Zinc, Arsenic, Cadmium, Chromium 6+, Lead and Nickel scores were within standards limit. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the marine environment as well as contractor best operation practices.

Table 4.10: Marine Sediment laboratory results for the month of February, 2023 and March, 2023

Month	Parameters	Sampling Station				EPA Standards
		Berth 1	Berth 2	Turn Basin	Port Entry	
February, 2023	Moisture content [%]	50.41	52.62	50.23	62.90	**N.M**
	pH value	8.12	8.05	8.11	8.14	**6.5-9.0**
	Total Organic Carbon [%]	1.52	1.43	1.16	1.28	**N.M**
	Carbonates (CO_3^{2-}) (%)	6.21	6.42	6.24	6.12	**N.M**
	Nitrate [mg/kg]	4.41	5.02	6.01	6.02	**N.M**
	Ammonium (NH_4) [mg/kg]	1.41	2.74	3.22	3.24	**N.M**
	Total Kjeldahl Nitrogen [mg/kg]	6.67	6.13	4.23	5.28	**N.M**
	Phosphorus(mg/kg)	2.92	2.31	2.56	3.01	**N.M**
	Manganese [%]	0.0001	0.0002	0.0002	0.0002	**0.046**
	Zinc [%]	NIL	0.001	0.001	0.001	**0.041**
	Arsenic [%]	<0.001	<0.001	<0.001	<0.001	**0.0057**
	Cadmium [%]	NIL	0.0001	0.0001	0.0001	**0.00051**

Month	Parameters	Sampling Station				EPA Standards
		Berth 1	Berth 2	Turn Basin	Port Entry	
	Chromium 6+ [%]	0.00001	0.00001	NIL	0.00001	**0.026**
	Iron (%)	5.21	4.42	4.62	4.21	**N.M**
	Mercury (%)	NIL	0.00001	NIL	0.00001	**0.000041**
	Lead (%)	0.0001	0.0002	0.0002	0.0001	**0.045**
	Nickel (%)	0.0001	0.0001	0.0001	NIL	**0.0094**
	Copper (%)	0.0002	0.0001	0.0001	0.0001	**N.M**
	Sulphate (mg/kg)	3,703.22	3,067.61	3,297.82	3,112.23	**N.M**
	Chloride (Cl^-) (mg/kg)	12,901.32	11,120.45	11,342.75	10,470.21	**N.M**
March, 2023	Moisture content [%]	52.22	51.50	49.14	57.43	**N.M**
	pH value	8.44	8.18	8.19	8.24	**6.5-9.0**
	Total Organic Carbon [%]	1.02	1.21	1.04	1.22	**N.M**
	Carbonates (CO_3^{2-}) (%)	6.78	6.23	6.32	6.50	**N.M**
	Nitrate [mg/kg]	5.72	5.02	6.01	5.34	**N.M**
	Ammonium (NH_4) [mg/kg]	1.06	2.51	2.64	3.14	**N.M**
	Total Kjeldahl Nitrogen [mg/kg]	6.52	6.44	5.74	5.82	**N.M**
	Phosphorus(mg/kg)	2.34	2.39	2.26	2.65	**N.M**
	Manganese [%]	0.0001	0.0002	0.0002	0.0002	**0.046**
	Zinc [%]	NIL	0.001	0.001	0.001	**0.041**
	Arsenic [%]	<0.001	<0.001	<0.001	<0.001	**0.0057**
	Cadmium [%]	NIL	0.0001	0.0001	0.0001	**0.00051**
	Chromium 6+ [%]	0.00001	0.00001	NIL	0.00002	**0.026**
	Iron (%)	5.65	4.64	4.28	4.32	**N.M**
	Mercury (%)	NIL	0.00001	NIL	0.00001	**0.000041**
	Lead (%)	0.0001	0.0002	0.0002	0.0001	**0.045**
	Nickel (%)	0.0001	0.0001	0.0001	NIL	**0.0094**
	Copper (%)	0.0002	0.0001	0.0001	0.0001	**N.M**
	Sulphate (mg/kg)	4,218.43	4,319.64	3,890.42	4,551.43	**N.M**
	Chloride (Cl^-) (mg/kg)	11,714.24	12,072.22	12,111.46	11,476.85	**N.M**

From table 4.10 above, there is a slightly increase in pH value, Nitrate and Sulphate scores with a slightly decrease Chloride and Iron scores for the month of March, 2023 as compared to February, 2023. Furthermore, there was no significant changes in concentrations of the heavy metals (Mercury, Manganese, Zinc, Arsenic, Cadmium, Chromium 6+, Lead and Nickel) in the month of March, 2023 as compared to February, 2023. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the marine environment as well as contractor best operation practices.

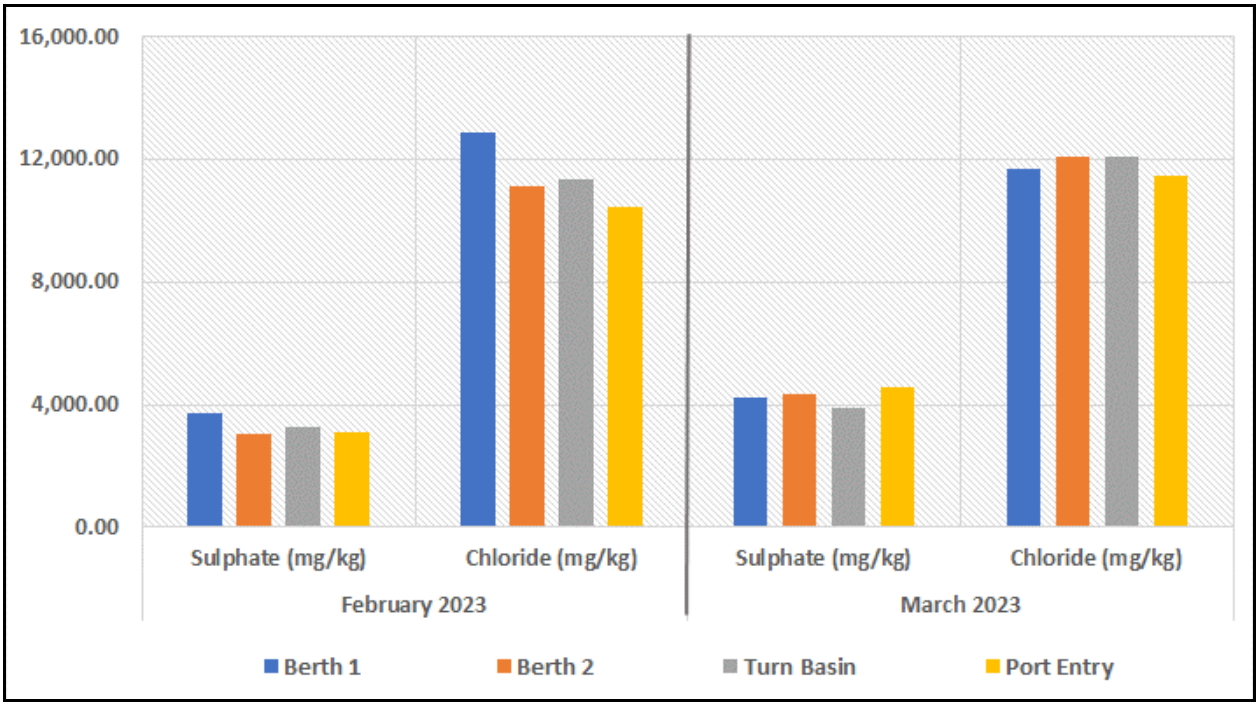


Figure 4.8: Comparison of Sulphate and Chloride results for the month of February, 2023 and March, 2023

From figure 4.8, there is a slightly decrease in Chloride scores and an increase in Sulphate scores for the month of March, 2023 as compared to February, 2023. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the marine environment and contractor best operation practices.

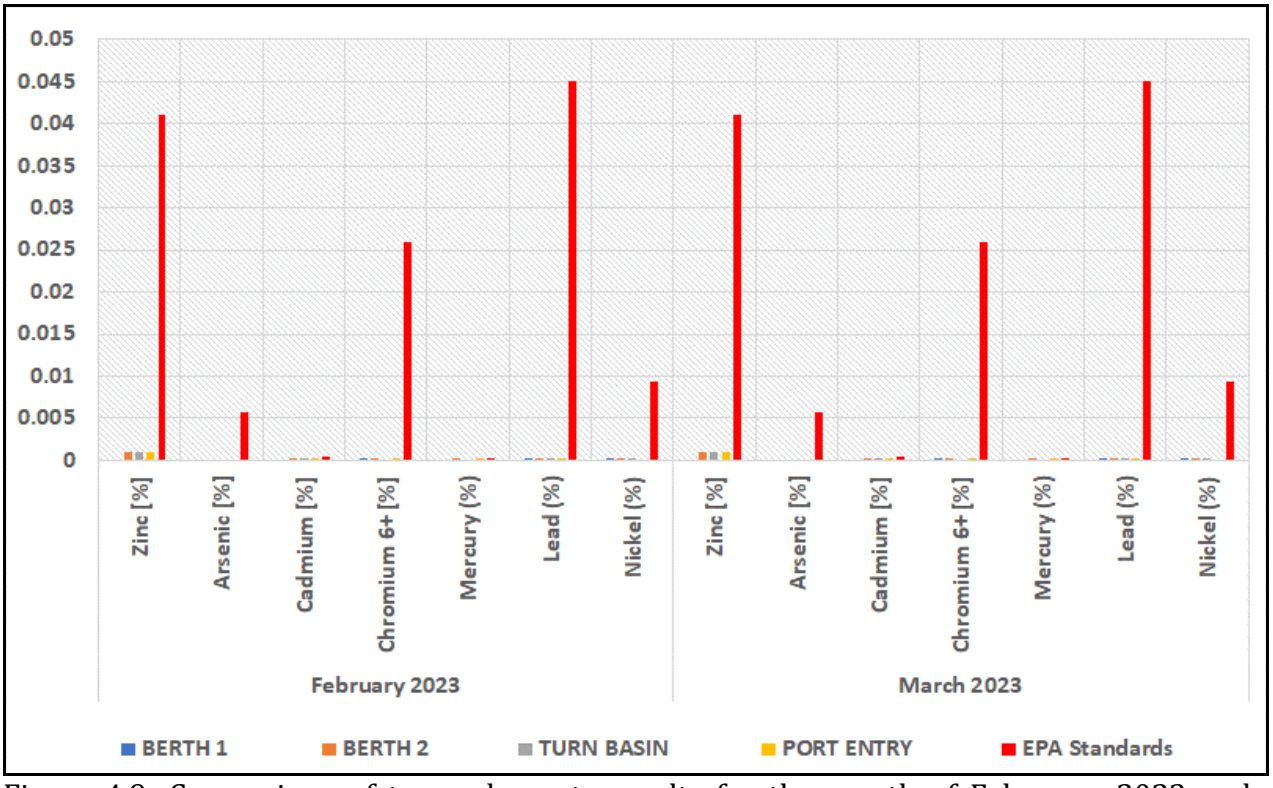


Figure 4.9: Comparison of trace elements results for the month of February, 2023 and March, 2023

From the figure 4.9, trace element (Zinc, Arsenic, Cadmium, Chromium 6+, Mercury, Lead and Nickel) scores in the month of March, 2023 have not significantly changed and remained to be on same levels as in February, 2023. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the marine environment as well as contractor best operation practices.

4.7 MACROBENTHIC ORGANISMS

All the monitoring sites are found in the subtidal oceanic area. None of them lies within the intertidal area. None the less these area are possible inhabited by some benthic organisms such as sea grasses. The microbenthic organisms observed includes submerged coral heads near the bathing club and near Totten Island, oysters (*Sarcostrea cuculata*) on the elevated pillar ruins and mangrove stems, roots and branches on Totten Island, Crabs (*Dotilla fenestrata)* that were found on the muddy beach at the Deep-sea fish landing site and seagrasses (*Halophila ovalis* and *Thalassia hemprechii)* that were found along the Totten Island seashore.

CHAPTER FIVE: STAKEHOLDERS/PUBLIC CONSULTATION

5.1 INTRODUCTION

Stakeholders play a vital role in project planning and management as well as in the success of the project. Stakeholders can both affect or be affected by the project. Along with project-affected communities, it may include individuals from regulatory and planning authorities. The perception and suggestions received during these consultations are provided in this chapter.

5.2 CONSULTATION

The following consultation-based methodologies was adopted for the Mobilization phase study:

- One to one meeting.
- Focus groups discussions (FGDs)

5.2.1 One to One Meetings

As per the scope of work, several one-to-one meetings was conducted in the area that will be affected by the project. This was essential for interacting with the Government bodies and other project-affected entities and to document their issues/concerns.

5.2.2 Focus groups discussions

Focus groups discussions (FGDs) were carried out with local communities, local and regional authorities and other project stakeholders. In FGDs, discussions were held on the issues set out by the key expert of the team. The issues will be related to environment and social components in order to carry out the discussion more effectively and efficiently, the team will involve from 5 to10 participants at a time during the discussion. During the FGDs, precaution will be taken so that the discussion remains focused but open, not get influenced or structured by the interviewer/conductor. The one-to-one meeting and FGDs will be carried out throughout the project as per requirement to know the issues, concerns, suggestion of the local communities, local and regional authorities and other key stakeholders. Appendix 4 present the list stakeholders and community representatives who were consulted during this month monitoring exercise.

5.3 STAKEHOLDERS CONSULTATION OUTCOMES

Table below presents the summary of issues and concerns raised by the stakeholders during this reporting period respectively.

Table 5.1: Concerns/Issues raised by Stakeholders during Meetings/Consultations

No.	Stakeholders	Issues /Concerns/Suggestions
1.	Tanga City Council	▪ Provide all project workers with contracts that are consistent with national labour laws ▪ All applicable national laws, regulations and standards for the safe use, handling, storage and disposal of waste should be followed

No.	Stakeholders	Issues /Concerns/Suggestions
		▪ Only licensed waste management companies must be engaged to collect and dispose of waste collected from the site. ▪ Only trained and competent workers should be allowed to carry out work, and must be well briefed on safe working procedures. ▪ Mandatory and basic PPE including hardhat, hand gloves, safety goggles and safety boots must be provided to project workers
2	Occupational Health and Safety Authority	▪ Regular supervision of works to ensure that safety conditions are met while any deviation from safety regulations is immediately reclaimed following the best practices regarding safety at work ▪ Post in prominent places informative signage to inform of safety hazards and controls ▪ Provision of appropriate Personal Protective Equipment and enforce the use ▪ The project should have accident and incident reporting form available to record accidents and near-misses ▪ Provide information, instructions and trainings on STDs, drug abuse etc. to the workers to create awareness.
3	Tanga City Fisheries Office	▪ Conduct regular maintenance on project machinery and equipments to prevent oil leakages that could be washed together with sediment into the ocean ▪ The contractor should continue to dispose dredged materials to the approved disposal site ▪ Waste bins must be provided and well labelled for waste segregation and disposal.
4	Deep Sea Fishermen Community	▪ The contractor should continue to dispose dredged materials into TPA approved disposal site. ▪ The Contractor should consider donating new fishing gears to us so that we can also undertake our fishing activities in deep waters ▪ Our local youth should be given priority in project related employment opportunities
5	Central Ward and Sarakani Mtaa Offices	▪ The contractor prioritizes our youth and women in project related employment opportunities ▪ The Contractor should consider contributing to our development projects such as building of classrooms, donation of school desks etc.

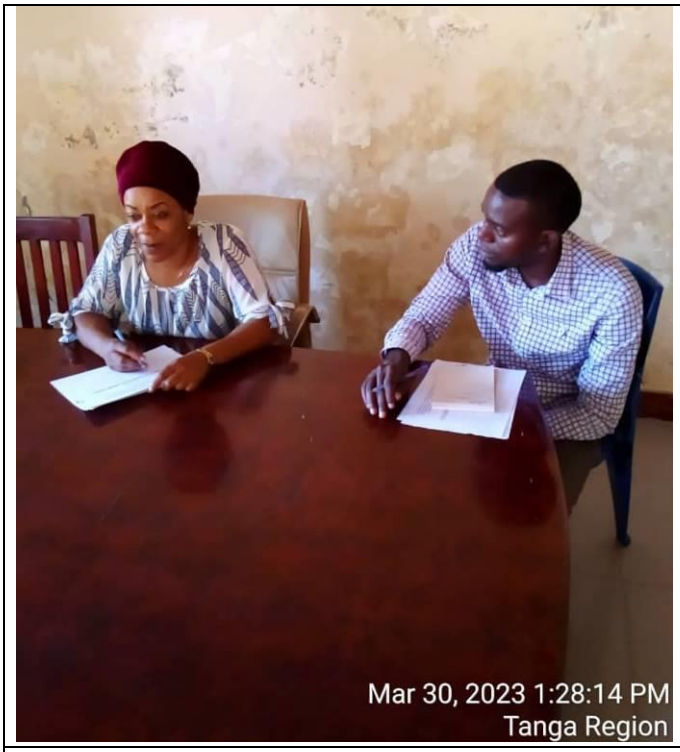


Plate 5-1: Consultation with Tanga City Official and local Leaders

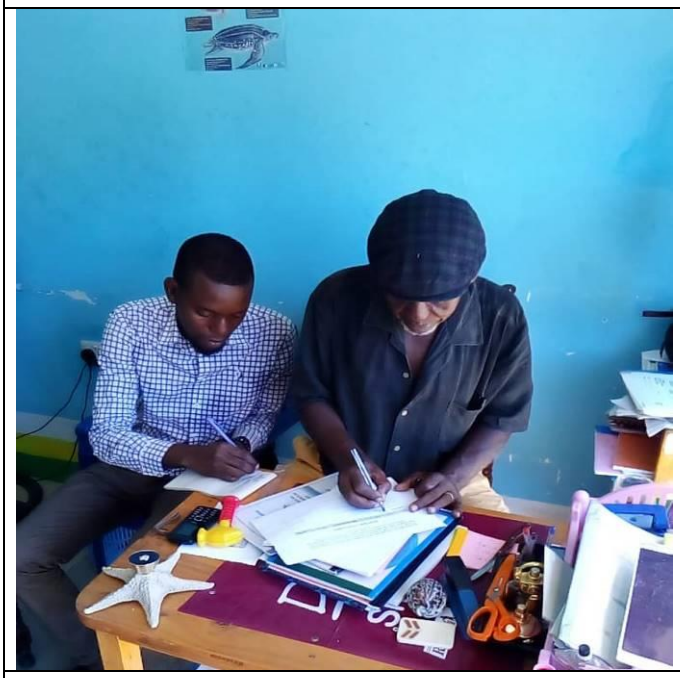


Plate 5-2: Consultation with Deep Sea Fishermen Community

CHAPTER SIX: CONCLUSSION AND RECOMMENDATIONS

6.1 CONCLUSION

During this month monitoring exercise, observations were made on the marine water and sediment quality, ambient air quality, noise and vibration levels respectively. The dust /particulate matters ($PM_{2.5}$ and PM_{10}) results indicates that the levels in most of the monitoring locations to be within prescribed standards. The pollutants gaseous (i.e., CO, NO, H_2S, NO_2 and NO_x) emissions were also noted to be within prescribed local and international standards. Noise levels in most of the monitoring locations were compliant to the ceiling limits. The averaged noise levels recorded during nighttime were lower than those recorded during day time due to decrease in noise influence sources during nighttime.

Furthermore, most of the in-situ water quality measured parameters were noted to be within the permissible limits. The Ph value and dissolved oxygen (DO) scores were within the normal ranges of healthy marine water. The monthly laboratory analysis results indicate that there is a slight decrease in pH value, Turbidity, Total Suspended Solids (TSS), Nitrate, Ammonium, Oil & Grease, Iron, Sulphate and Chloride scores for the month of March, 2023 as compared to February, 2023. With respect to marine sediment, there is a slightly decrease in pH value, Nitrate and Sulphate scores for the month of March, 2023 as compared to February, 2023. Furthermore, there was no significant changes in concentrations of the heavy metals (Mercury, Manganese, Zinc, Arsenic, Cadmium, Chromium 6+, Lead and Nickel) in the month of March, 2023 as compared to February 2023. The observed levels may be contributed by a combination of many factors including daily port operations, storm and waste water discharges into the marine environment as well as contractor best operation practices.

Therefore, the results of this environmental monitoring study provide a strong basis for further compliance, future monitoring for development of the project in the area and regulatory actions to reduce the risk associated with exposures to air, noise, water pollution and marine ecology at the project site and the nearby environment.

6.2 RECOMMENDATIONS

By referring to the conclusion above, the following are some recommendations to be considered and mitigated:

a) Implementation of the project should adhere to Local or international specific standards for environmental and human health protection requirements.
b) Continuous Environmental monitoring of marine water and sediment quality, ambient air quality, noise and vibration levels and monthly reporting throughout project
c) Personal protective equipment (PPE) such as masks, like gloves, goggles, masks, vests, shoes, helmets etc should be provided to project workforce and visitors
d) The Contractor should continue to undertake regular servicing and maintenance of project machines and equipments in order to keep the environmental impact on account of their exhaust emissions to its minimum level.
e) Ensure good housekeeping to maintain clean and orderly working environment as well as coaching positive attitude among employees

APPENDICES

APPENDIX 1: DAILY AMBIENT AIR QUALITY AND NOISE LEVELS MONITORING DATA

Appendix 1A: Details on Ambient Particulate Matters Emissions Levels for day-time

Category	Measuring Location	GPS Coordinates		PM2.5 Levels [µg/m3]					PM10 Levels [µg/m3]				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	12	11	11	9	**11**	25	20	22	18	**21**
	Berth 1	5.064387	39.106815	5	6	7	5	**6**	10	12	14	11	**12**
	Berth 2	5.065112	39.106014	3	2	2	2	**2**	8	7	6	6	**7**
	Batching Plant	5.068925	39.102021	6	7	8	8	**7**	12	13	16	17	**15**
	Gate 1	5.067497	39.105531	3	3	3	2	**3**	6	6	7	5	**6**
	Gate 2	5.068708	39.103491	5	6	7	5	**6**	10	13	15	12	**13**
	Sediment Damping	5.064329	39.108106	2	2	3	3	**3**	4	4	5	6	**5**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	7	7	8	6	**7**	14	14	17	12	**14**
	Along the Road near TPA Office	5.0695684	39.105267	5	7	6	5	**6**	10	14	12	10	**12**
	Deep Sea	5.067053	39.097393	6	5	7	5	**6**	12	10	15	10	**12**
	Canteen Area	5.069209	39.102705	4	5	6	6	**5**	8	11	12	12	**11**
	Residential Areas	5.06875	39.10583	9	8	10	9	**9**	18	16	19	18	**18**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1B: Details on Ambient Particulate Matters Emissions Levels for night-time

Category	Measuring Location	GPS Coordinates		PM2.5 Levels [µg/m3]					PM10 Levels [µg/m3]				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	6	7	8	8	**7**	12	15	16	17	**15**
	Berth 1	5.064387	39.106815	3	4	4	5	**4**	6	8	7	10	**8**
	Berth 2	5.065112	39.106014	6	5	6	9	**7**	12	10	12	18	**13**
	Batching Plant	5.068925	39.102021	6	5	4	3	**5**	12	10	9	7	**10**
	Gate 1	5.067497	39.105531	2	3	2	2	**2**	4	6	5	4	**5**

Category	Measuring Location	GPS Coordinates		PM2.5 Levels [µg/m3]					PM10 Levels [µg/m3]				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average	Value 1	Value 2	Value 3	Value 4	Average
	Gate 2	5.068708	39.103491	3	4	5	4	**4**	6	8	7	10	**8**
	Sediment Damping	5.064329	39.108106	2	2	3	2	**2**	4	4	5	4	**4**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	5	4	6	4	**5**	10	8	12	9	**10**
	Along the Road near TPA Office	5.0695684	39.105267	7	3	5	5	**5**	14	7	10	11	**11**
	Deep Sea	5.067053	39.097393	8	6	7	6	**7**	18	12	15	12	**14**
	Canteen Area	5.069209	39.102705	3	4	5	3	**4**	6	8	10	6	**8**
	Residential Areas	5.06875	39.10583	7	5	6	4	**6**	14	10	12	8	**11**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1C: **Details on Ambient gaseous emissions levels for day-time**

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
Onsite (Port Compounds)	Container Yard	5.067148	39.104326	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0	0.1	0.1	0.08
				Carbon Monoxide [CO] (ppm)	1	2	2	1	1.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0.1	0	0.2	0.08
				Nitrogen Oxides [NOx] (ppm)	0	0.02	0	0.02	0.01
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Berth 1	5.064387	39.106815	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	0	0	1	0.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Berth 2	5.065112	39.106014	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	1	1	1	1.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0.1	0.1	0.1	0.08
				Nitrogen Oxides [NOx] (ppm)	0	0.02	0.02	0.02	0.02
				Volatile Organic Compounds [VOC] (ppm)	0.1	0.1	0.1	0.1	0.10
	Batching Plant	5.068925	39.102021	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	1	0	0.25
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0.1	0	0.1	0.1	0.08
				Nitrogen Oxides [NOx] (ppm)	0.02	0	0.02	0.02	0.02
				Volatile Organic Compounds [VOC] (ppm)	0.1	0.1	0.1	0.1	0.10
	Gate 1	5.067497	39.105531	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	1	1	0.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Gate 2	5.068708	39.103491	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	1	1	1	1.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0.1	0.1	0.1	0.1	0.10
				Nitrogen Oxides [NOx] (ppm)	0.02	0.02	0.02	0.02	0.02
				Volatile Organic Compounds [VOC] (ppm)	0.1	0.1	0.1	0.1	0.10
	Sediment Damping	5.064329	39.108106	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0	0	0.1	0.05
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	1	1	1	0.75
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0.1	0.03
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0.02	0.01
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Along the Road near TPA Office	5.0695684	39.105267	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	1	1	0.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Deep Sea	5.067053	39.097393	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	2	2	1	1.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	3	3	3	2	2.75
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Canteen Area	5.069209	39.102705	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	1	1	1	1.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0.1	0.1	0.1	0.1	0.10
				Nitrogen Oxides [NOx] (ppm)	0.02	0.02	0.02	0.02	0.02
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Residential Area	5.06875	39.10583	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	1	1	1	1.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0.1	0.1	0.1	0.1	0.10
				Nitrogen Oxides [NOx] (ppm)	0.02	0.02	0.02	0.02	0.02
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1D: **Details on Ambient gaseous emissions levels for night-time**

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
Onsite (Port Compounds)	Container Yard	5.067148	39.104326	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0	0.08
				Carbon Monoxide [CO] (ppm)	1	0	0	1	0.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Berth 1	5.064387	39.106815	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Berth 2	5.065112	39.106014	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Batching Plant	5.068925	39.102021	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	1	1	0	0.50
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0.2	0.2	0.2	0.2	0.20
	Gate 1	5.067497	39.105531	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0	0	0	0	0.00

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Gate 2	5.068708	39.103491	Carbon dioxide [CO2] (%)	0.03	0.03	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0.1	0.1	0.1	0.1	0.10
	Sediment Damping	5.064329	39.108106	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0	0	0	0	0.00
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Carbon Monoxide [CO] (ppm)	0	0	0	0	0.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Along the Road near TPA Office	5.0695684	39.105267	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0	0	0	0	0.00
				Carbon Monoxide [CO] (ppm)	1	1	0	1	0.75
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Deep Sea	5.067053	39.097393	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10
				Carbon Monoxide [CO] (ppm)	1	1	1	20	5.75
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	2	2	1	1	1.50
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Canteen Area	5.069209	39.102705	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0.1	0.1	0.1	0.1	0.10

Category	Measuring Location	GPS Coordinates (UTM)		Gaseous Parameter	Reading 1	Reading 2	Reading 3	Reading 4	Average
		Latitude (S)	Longitude (E)						
				Carbon Monoxide [CO] (ppm)	1	1	1	1	1.00
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00
	Residential Area	5.06875	39.10583	Carbon dioxide [CO2] (%)	0.04	0.04	0.04	0.04	0.04
				Nitrogen dioxide [NO2] (ppm)	0	0	0	0	0.00
				Carbon Monoxide [CO] (ppm)	1	0	1	1	0.75
				Sulphur Oxides [SO2] (ppm)	0	0	0	0	0.00
				Oxygen [O2] (%)	20.9	20.9	20.9	20.9	20.90
				Methane [CH4] %	0	0	0	0	0.00
				Hydrogen Sulfide [H2S] (ppm)	0	0	0	0	0.00
				Nitrogen Monoxide [NO] (ppm)	0	0	0	0	0.00
				Nitrogen Oxides [NOx] (ppm)	0	0	0	0	0.00
				Volatile Organic Compounds [VOC] (ppm)	0	0	0	0	0.00

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1E: Details on Noise (Sound Pressure) Levels for 1st week at day-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	69.2	68.2	67.3	68.5	**68.3**
	Berth 1	5.064387	39.106815	60.2	59.8	59.7	61.2	**60.2**
	Berth 2	5.065112	39.106014	65.1	64.2	66.2	68.7	**66.1**
	Batching Plant	5.068925	39.102021	68.2	69.3	68.9	69.9	**69.1**
	Gate 1	5.067497	39.105531	64.9	61.7	62.7	63.8	**63.3**
	Gate 2	5.068708	39.103491	64.7	66.1	71.7	65.4	**67.0**

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
	Sediment Damping	5.064329	39.108106	45.6	45.8	46.5	42.9	**45.2**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	46.5	45.7	47.1	45.9	**46.3**
	Along the Road near TPA Office	5.0695684	39.105267	60.2	58.7	55.9	57.8	**58.2**
	Deep Sea	5.067053	39.097393	52	52.9	50.3	52.4	**51.9**
	Canteen Area	5.069209	39.102705	52.4	58.6	55.6	50.2	**54.2**
	Residential Areas	5.06875	39.10583	55.6	54.9	56.8	55.7	**55.8**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1F: Details on Noise (Sound Pressure) Levels for 1st week at night-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	58.1	59.1	60.4	59.1	**59.2**
	Berth 1	5.064387	39.106815	53.9	54.8	56.3	57.2	**55.6**
	Berth 2	5.065112	39.106014	60.7	58.7	56.9	55.6	**58.0**
	Batching Plant	5.068925	39.102021	57.5	66.2	65.2	61	**62.5**
	Gate 1	5.067497	39.105531	57.6	59.8	60.1	56.7	**58.6**
	Gate 2	5.068708	39.103491	45.4	43.9	48.7	43.1	**45.3**
	Sediment Damping	5.064329	39.108106	42.3	43.1	42.9	44.3	**43.2**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	45.2	45.7	46.2	43.9	**45.3**
	Along the Road near TPA Office	5.0695684	39.105267	56.7	56.9	55.3	57.4	**56.6**
	Deep Sea	5.067053	39.097393	51.1	52.6	48.9	50.8	**50.9**
	Canteen Area	5.069209	39.102705	46.1	40.9	41.3	41.5	**42.5**
	Residential Areas	5.06875	39.10583	49.8	51.2	51.2	50.4	**50.7**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1G: Details on Noise (Sound Pressure) Levels for 2nd week at day-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	68.7	65.9	68.9	67.9	**67.9**
	Berth 1	5.064387	39.106815	56.7	56.9	58.7	56.5	**57.2**
	Berth 2	5.065112	39.106014	59.8	62.5	65.8	65.9	**63.5**
	Batching Plant	5.068925	39.102021	70.2	69.8	68.7	70.2	**69.7**
	Gate 1	5.067497	39.105531	65.3	64.9	65.1	63.8	**64.8**
	Gate 2	5.068708	39.103491	65.4	63.5	64.6	65.8	**64.8**
	Sediment Damping	5.064329	39.108106	42.3	43.2	41.9	42.7	**42.5**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	52.3	49.8	51.2	48.7	**50.5**
	Along the Road near TPA Office	5.0695684	39.105267	59.8	60.2	61.2	58.9	**60.0**
	Deep Sea	5.067053	39.097393	56.8	59.6	57.6	58.4	**58.1**
	Canteen Area	5.069209	39.102705	63.5	64.3	62.5	63.8	**63.5**
	Residential Areas	5.06875	39.10583	53.6	54.6	53.9	53.7	**54.0**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1H: Details on Noise (Sound Pressure) Levels for 2nd week at night-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	63.5	64.3	64.5	62.9	**63.8**
	Berth 1	5.064387	39.106815	54.6	55.8	55.9	56.9	**55.8**
	Berth 2	5.065112	39.106014	62.3	61.9	64.5	63.7	**63.1**
	Batching Plant	5.068925	39.102021	65.6	64.3	62.9	65	**64.5**
	Gate 1	5.067497	39.105531	57.9	58.9	56.7	54.9	**57.1**
	Gate 2	5.068708	39.103491	61.2	60.2	58.7	56.9	**59.3**
	Sediment Damping	5.064329	39.108106	42.1	43.2	41.3	42.1	**42.2**
Offsite (Nearby	Rebars Processing Yard	5.068577	39.105728	45.7	46.2	43.9	43.8	**44.9**

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Receptors)	Along the Road near TPA Office	5.0695684	39.105267	54.3	52.6	54.8	56.7	**54.6**
	Deep Sea	5.067053	39.097393	43.5	46.7	45.9	48.7	**46.2**
	Canteen Area	5.069209	39.102705	59.8	57.8	59.8	60.1	**59.4**
	Residential Areas	5.06875	39.10583	46.8	47.9	48.5	50.2	**48.4**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1I: Details on Noise (Sound Pressure) Levels for 3rd week at day-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	69.8	73.1	71.3	68.7	**71.3**
	Berth 1	5.064387	39.106815	59.8	62.1	62.3	62.7	**63.1**
	Berth 2	5.065112	39.106014	69.8	68.9	69.6	69.9	**71.0**
	Batching Plant	5.068925	39.102021	69.8	71	68.9	68.7	**65.5**
	Gate 1	5.067497	39.105531	64.5	63.9	65.2	64.3	**66.8**
	Gate 2	5.068708	39.103491	63.2	61.2	62.3	64.5	**70.3**
	Sediment Damping	5.064329	39.108106	44.4	44.6	45.4	46.1	**45.3**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	51.2	50.9	48.9	49.7	**51.6**
	Along the Road near TPA Office	5.0695684	39.105267	58.7	56.9	57.8	55.9	**59.8**
	Deep Sea	5.067053	39.097393	54.6	59.8	56.7	58.3	**55.8**
	Canteen Area	5.069209	39.102705	61.2	60.9	62.5	63.1	**68.4**
	Residential Areas	5.06875	39.10583	56.7	59.8	57.6	56.7	**54.9**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1J: Details on Noise (Sound Pressure) Levels for 3rd week at night-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	62.1	63.8	63.5	64.5	**63.5**
	Berth 1	5.064387	39.106815	56.8	57.9	56.8	59.1	**57.7**
	Berth 2	5.065112	39.106014	62.3	61.8	63.4	62.8	**62.6**

	Batching Plant	5.068925	39.102021	62.3	59.8	59.6	60.3	**60.5**
	Gate 1	5.067497	39.105531	57.7	56.9	55.8	59.4	**57.5**
	Gate 2	5.068708	39.103491	59.8	58.9	60.6	57.8	**59.3**
	Sediment Damping	5.064329	39.108106	42.3	43.6	42.9	43.1	**43.0**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	43.6	44.6	45.9	47.8	**45.5**
	Along the Road near TPA Office	5.0695684	39.105267	55.6	55.4	53.9	53.7	**54.7**
	Deep Sea	5.067053	39.097393	48.6	45.9	46.5	47.1	**47.0**
	Canteen Area	5.069209	39.102705	54.6	55.8	56.9	57.4	**56.2**
	Residential Areas	5.06875	39.10583	48.7	46.9	45.8	47.9	**47.3**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1K: Details on Noise (Sound Pressure) Levels for 4th week at day-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	68.7	69.6	67.6	66.9	**68.2**
	Berth 1	5.064387	39.106815	62.3	59.8	59.7	61.2	**60.8**
	Berth 2	5.065112	39.106014	68.7	65.9	68.9	67.6	**67.8**
	Batching Plant	5.068925	39.102021	70.2	71.2	72.4	69.8	**70.9**
	Gate 1	5.067497	39.105531	64.8	69.8	72.3	62.1	**67.3**
	Gate 2	5.068708	39.103491	70.3	68.7	74.6	72.5	**71.5**
	Sediment Damping	5.064329	39.108106	44.5	43.9	44.5	44.4	**44.3**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	50.2	51.2	48.7	49.6	**49.9**
	Along the Road near TPA Office	5.0695684	39.105267	59.7	62.3	61	61.4	**61.1**
	Deep Sea	5.067053	39.097393	58.6	54.6	55.8	56.7	**56.4**
	Canteen Area	5.069209	39.102705	68.7	69.8	67.5	69.9	**69.0**
	Residential Areas	5.06875	39.10583	54.6	56.8	57.6	55.6	**56.2**

Source: *STEM Consult (T) Limited: March, 2023*

Appendix 1L: Details on Noise (Sound Pressure) Levels for 4th week at night-time

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
Onsite (Port Compound)	Container Yard	5.067148	39.104326	59.8	58.7	60.1	63.1	**60.4**
	Berth 1	5.064387	39.106815	55.6	54.6	53.6	54.8	**54.7**

Category	Measuring Location	GPS Coordinates		Noise Levels [dB (A)] Reading Value				
		Latitude (S)	Longitude (E)	Value 1	Value 2	Value 3	Value 4	Average
	Berth 2	5.065112	39.106014	62.3	61.3	62.8	61.2	**61.9**
	Batching Plant	5.068925	39.102021	65.1	63.6	64.2	63.1	**64.0**
	Gate 1	5.067497	39.105531	56.7	58.6	54.2	56.4	**56.5**
	Gate 2	5.068708	39.103491	58.7	57.9	56.5	58.4	**57.9**
	Sediment Damping	5.064329	39.108106	42.1	42.3	42.2	43.1	**42.4**
Offsite (Nearby Receptors)	Rebars Processing Yard	5.068577	39.105728	46.9	46.2	45.6	47.4	**46.5**
	Along the Road near TPA Office	5.0695684	39.105267	55.7	55.9	56.4	55.3	**55.8**
	Deep Sea	5.067053	39.097393	45.6	43.6	45.9	46.6	**45.4**
	Canteen Area	5.069209	39.102705	56.3	54.2	53.6	53.4	**54.4**
	Residential Areas	5.06875	39.10583	59.8	58.7	60.1	63.1	**60.4**

Source: *STEM Consult (T) Limited: March, 2023*

APPENDIX 2: MARINE WATER AND SEDIMENT LABORATORY RESULTS

UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
UNIVERSITY OF DAR ES SALAAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING

In replying please quote:

Ref. No. CPE/LABWORKS/21 **Date:** 30th March, 2023

REPORT ON ANALYSIS OF GROUND SOILS AND WATER SAMPLES

CLIENT	:	*STEM CONSULT (T) LTD, P. O. BOX 34780, DAR ES SALAAM, TANZANIA*
SAMPLE/SITE	:	*TANGA PORT*
DATE RECEIVED	:	*20/03/2023*
TEST METHOD	:	*STANDARD METHODS SUCH AS CHEMICAL ANALYSIS OF ECOLOGICAL MATERIALS HANDBOOK EDITED BY STEWART E.ALLEN, 1989; STANDARD METHOD FOR THE EXAMINATION OF WATER AND WASTEWATER 20TH EDITION, 1998*
TEST DESCRIPTION	:	*INSTRUMENTAL ANALYSIS BY ANALYTICAL BALANCE, ATOMIC ABSORPTION SPECTROMETRY (AAS), UV VIS SPECTROPHOTOMETER, ANALYTICAL BALANCE, AND OVEN METHOD*

Four soil samples (sediments)and five water samples were brought to Chemical & Process Engineering Laboratory for analysis of: Moisture content, pH, Organic Carbon, Salinity, Chloride (Cl^-), Sulphate (SO_4^{2-}), Ammonium (NH_4^+), Kjeldahl Nitrogen (N), Nitrate (NO_3^-), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Zinc (Zn), Iron (Fe), Manganese (Mn) and Nickel (Ni). Test results are as shown in Tables 1, 2 and 3.

ENGINEERS REGISTRATION BOARD
PEng. 3433
ENG. JOVINT L. KAMARA
Chemical
SIGN.
DATE: 31/03/2023
TANZANIA

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Table 1: Test Results for Sediment samples

S/No	SAMPLE CODE / PARAMETER	TANGA BERTH-1	BERTH -2 TANGA	TURN BASIN TANGA	PORT ENTRY TANGA
1.	MOISTURE CONTENT [%]	52.22	51.50	49.14	57.43
2.	pH value	8.44	8.18	8.19	8.24
3.	TOTAL ORGANIC CARBON [%]	1.02	1.21	1.04	1.22
4.	CARBONATES (CO_3^{2}), [%]	6.78	6.23	6.32	6.50
5.	NITRATE [mg/kg]	5.72	5.02	6.01	5.34
6.	AMMONIUN (NH_4) [mg/kg]	1.06	2.51	2.64	3.14
7.	TOTAL KJELDAHL NITROGEN [mg/kg]	6.52	6.44	5.74	5.82
8.	PHOSPHORUS [mg/kg]	2.34	2.39	2.26	2.65
9.	MANGANESE [%]	0.0001	0.0002	0.0002	0.0002
10.	ZINC [%]	NIL	0.001	0.001	0.001
11.	ARSENIC [%]	<0.001	<0.001	<0.001	<0.001
12.	CADMIUM [%]	NIL	0.0001	0.0001	0.0001
13.	CHROMIUM 6+ [%]	0.00001	0.00001	NIL	0.00002
14.	IRON [%]	5.65	4.64	4.28	4.32
15.	MERCURY [%]	NIL	0.00001	NIL	0.00001
16.	LEAD [%]	0.0001	0.0002	0.0002	0.0001
17.	NICKEL [%]	0.0001	0.0001	0.0001	NIL
18.	COPPER [%]	0.0002	0.0001	0.0001	0.0001
19.	SULPHATE (SO_4^{2-}) [mg/kg]	4,218.43	4,319.64	3,890.42	4,551.43
20.	CHLORIDE (Cl^-) [mg/kg]	11,714.24	12,072.22	12,11246	11,476.85

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Table 2: Test Results for water samples

S/No	SAMPLE CODE / PARAMETER	BERTH-1 TANGA	TANGA BERTH-2	TURN BASIN TANGA	PORT ENTRY TANGA	DISPOSAL SITE
1.	pH value	8.21	8.12	8.15	8.16	8.18
2.	Conductivity [mS/cm]	54.34	52.56	54.36	51.58	53.27
3.	Salinity [ppm]	14,102.44	13,307.41	12,890.37	13,452.10	13,126.56
4.	CARBONATE (CO_3^{2-}), [mg/l]	14.20	14.50	28.86	26.88	30.07
5.	Turbidity [NTU]	7.50	7.25	7.22	7.12	7.12
6	Total Dissolved Solids [mg/l]	16,307	13,650	14,820	13,205	13,480
7.	Total Suspended solids [mg/l]	104.00	122.00	142.00	121.00	143.00
8.	TOTAL ORGANIC CARBON [%]	0.06	0.04	0.05	0.06	0.05
9.	NITRATE [mg/l]	4.86	4.74	4.58	5.74	5.72
10.	AMMONIUN (NH_4) [mg/l]	0.86	0.88	1.00	1.15	1.20
11.	TOTAL KJELDAHL NITROGEN [mg/l]	4.91	4.68	6.02	5.65	5.28
12.	PHOSPHORUS [mg/l]	0.001	NIL	0.001	0.002	0.001
13.	OIL & GREASE [mg/l]	0.02	0.04	0.03	0.03	0.04
14.	MANGANESE [mg/l]	<0.0001	<0.0001	0.0004	<0.0001	NIL
15.	ZINC [mg/1]	<0.001	<0.001	<0.001	<0.001	NIL
16.	ARSENIC [mg/l]	0.00002	0.00001	<0.00001	0.00001	NIL
17.	CADMIUM [mg/l]	0.0001	0.0002	0.0001	0.0002	NIL
18.	CHROMIUM 6+ [mg/l]	0.0001	0.0001	0.0001	0.0001	0.0001
19.	IRON [mg/l]	0.046	0.062	0.056	0.058	0.058
20.	MERCURY [mg/l]	NIL	NIL	NIL	NIL	NIL
21.	LEAD [mg/l]	0.0002	0.0001	0.0001	0.0002	NIL
22.	NICKEL [mg/l]	0.0001	0.0001	0.0001	0.0002	0.0002
23.	COPPER [%]	<0.001	<0.001	<0.001	<0.001	<0.001
24.	SULPHATE (SO_4^{2-}) [mg/l]	3,230.90	3,074.54	3,870.61	3,104.26	3,002.12
25.	CHLORIDE (Cl^-) [mg/l]	11,159.84	12,020.27	12,316.34	12,065.53	11,956.64

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Table 3: Quantitative analysis of PAHs in Sediment samples

1.Tanga Berth-1

PAH	peak integration remarks	Conc (µg/g)
Acenaphthylene	Ratio of reference ion does not match.	
Fluorene	Ratio of reference ion does not match.	
Phenanthrene	Ratio of reference ion does not match.	
Anthracene		0.0100
Pyrene	Ratio of reference ion does not match.	
Benz[a]anthracene	Ratio of reference ion does not match.	
Chrysene	Ratio of reference ion does not match.	
Benzo[b]fluoranthene	Ratio of reference ion does not match.	
Benzo[k]fluoranthene	Ratio of reference ion does not match.	
Benzo[a]pyrene	Ratio of reference ion does not match.	
Benzo[ghi]perylene	Ratio of reference ion does not match.	
Indeno[1,2,3-cd]pyrene	No peak is found in Window/Band range.	

2.Tanga Berth-2

PAH	peak integration remarks	Conc (µg/g)
Acenaphthylene	Ratio of reference ion does not match.	
Fluorene	Ratio of reference ion does not match.	
Phenanthrene		0.0102
Anthracene		0.0101
Pyrene	Ratio of reference ion does not match.	
Benz[a]anthracene	Ratio of reference ion does not match.	
Chrysene	Ratio of reference ion does not match.	
Benzo[b]fluoranthene	Ratio of reference ion does not match.	
Benzo[k]fluoranthene	Ratio of reference ion does not match.	
Benzo[a]pyrene	Ratio of reference ion does not match.	
Benzo[ghi]perylene	Ratio of reference ion does not match.	
Indeno[1,2,3-cd]pyrene	No peak is found in Window/Band range.	

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3.Turn Tanga

PAH	peak integration remarks	Conc (µg/g)
Acenaphthylene	Ratio of reference ion does not match.	
Fluorene	Ratio of reference ion does not match.	
Phenanthrene	Ratio of reference ion does not match.	
Anthracene	Ratio of reference ion does not match.	
Pyrene	Ratio of reference ion does not match.	
Benz[a]anthracene	Ratio of reference ion does not match.	
Chrysene	Ratio of reference ion does not match.	
Benzo[b]fluoranthene	No peak is found in Window/Band range.	
Benzo[k]fluoranthene	Ratio of reference on does not match.	
Benzo[a]pyrene	Ratio of reference ion does not match.	
Benzo[ghi]perylene	Ratio of reference ion does not match.	
Indeno[1,2,3-cd]pyrene	Ratio of reference ion does not match.	

4.DISPOSAL SITE

PAH	peak integration remarks	Conc (µg/g)
Acenaphthylene	No peak is found in Window/Band range.	
Fluorene	Ratio of reference ion does not match.	
Phenanthrene	Ratio of reference ion does not match.	
Anthracene		0.0109
Pyrene	Ratio of reference ion does not match.	
Benz[a]anthracene	Ratio of reference ion does not match.	
Chrysene	Ratio of reference ion does not match.	
Benzo[b]fluoranthene	Ratio of reference ion does not match.	
Benzo[k]fluoranthene	No peak is found in Window/Band range.	
Benzo[a]pyrene	Ratio of reference ion does not match.	
Benzo[ghi]perylene	Ratio of reference ion does not match.	
Indeno[1,2,3-cd]pyrene	Ratio of reference ion does not match.	

COMMENT:

- These results pertain only to the ground soil samples and water samples brought by the client to Chemical and Process Engineering Laboratory for analysis.
- Sampling was done by client.
- NIL means nothing detected in the sample.

Signed by:

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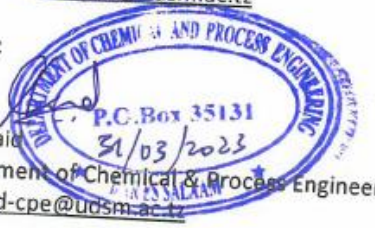
Approved by:



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APPENDIX 3: WEEKLY MARINE WATER QUALITY MONITORING DATA

Monitoring Duration	Location Code	Sampling Station	Monitoring Frequency	Parameters					
				pH Value	Conductivity [mS/cm]	Salinity [%]	Turbidity [NTU]	Temperature (°C)	Dissolved Oxygen (mg/l)
Week 1	MS1	Berth 1	Morning	8.14	43.16	2.39	5.9	29.85	6.35
			Mid-day	8.15	43.17	2.41	6.1	29.9	6.36
			Evening	8.15	43.16	2.41	6.1	29.85	6.35
			Average	**8.15**	**43.16**	**2.40**	**6.0**	**29.9**	**6.35**
	MS2	Turn Basin	Morning	8.02	43.21	2.36	5.2	29.8	6.31
			Mid-day	8.03	43.22	2.36	5.2	29.9	6.32
			Evening	8.01	43.21	2.38	5.2	29.7	6.33
			Average	**8.02**	**43.21**	**2.37**	**5.2**	**29.8**	**6.32**
	MS3	Berth 2	Morning	8.13	43.51	2.42	6.1	29.8	6.34
			Mid-day	8.14	43.53	2.42	6.2	30	6.35
			Evening	8.14	43.51	2.41	6.2	29.7	6.34
			Average	**8.14**	**43.52**	**2.42**	**6.2**	**29.8**	**6.34**
	MS4	Port Entrance	Morning	8.09	43.36	2.51	5.2	29.6	6.56
			Mid-day	8.08	43.38	2.52	5.3	29.8	6.56
			Evening	8.08	43.37	2.52	5.3	29.7	6.54
			Average	**8.08**	**43.37**	**2.52**	**5.3**	**29.7**	**6.55**
	MS5	Disposal Site	Morning	8.11	43.39	2.47	5.7	29.6	6.24
			Mid-day	8.12	43.41	2.48	5.8	29.7	6.23
			Evening	8.12	43.41	2.48	5.8	29.7	6.23
			Average	**8.12**	**43.40**	**2.48**	**5.8**	**29.7**	**6.23**
Week 2	MS1	Berth 1	Morning	8.16	43.22	2.36	6.2	29.8	6.29
			Mid-day	8.17	43.23	2.37	6.3	29.7	6.31
			Evening	8.17	43.23	2.36	6.2	29.8	6.31
			Average	**8.17**	**43.23**	**2.36**	**6.2**	**29.8**	**6.30**
	MS2	Turn Basin	Morning	8.07	43.15	2.41	5.2	29.6	6.41
			Mid-day	8.07	43.17	2.42	5.3	29.7	6.42
			Evening	8.06	43.17	2.42	5.2	29.6	6.43

Monitoring Duration	Location Code	Sampling Station	Monitoring Frequency	Parameters					
				pH Value	Conductivity [mS/cm]	Salinity [%]	Turbidity [NTU]	Temperature (°C)	Dissolved Oxygen (mg/l)
			Average	**8.07**	**43.16**	**2.42**	**5.2**	**29.6**	**6.42**
	MS3	**Berth 2**	Morning	8.17	43.26	2.34	6.1	29.7	6.35
			Mid-day	8.18	43.27	2.35	6.2	29.8	6.36
			Evening	8.18	43.26	2.35	6.1	29.7	6.35
			Average	**8.18**	**43.26**	**2.35**	**6.1**	**29.7**	**6.35**
	MS4	**Port Entrance**	Morning	8.13	43.17	2.43	5.4	29.8	6.45
			Mid-day	8.14	43.18	2.44	5.3	29.7	6.46
			Evening	8.15	43.17	2.43	5.3	29.8	6.46
			Average	**8.14**	**43.17**	**2.43**	**5.3**	**29.8**	**6.46**
	MS5	**Disposal Site**	Morning	8.21	43.36	2.53	4.9	29.7	6.29
			Mid-day	8.22	43.37	2.54	5.1	29.8	6.3
			Evening	8.21	43.37	2.53	5.1	29.7	6.3
			Average	**8.21**	**43.37**	**2.53**	**5.0**	**29.7**	**6.30**
Week 3	**MS1**	**Berth 1**	Morning	8.19	43.25	2.31	5.6	29.6	6.32
			Mid-day	8.2	43.26	2.32	5.7	29.7	6.32
			Evening	8.2	43.25	2.33	5.7	29.6	6.31
			Average	**8.20**	**43.25**	**2.32**	**5.7**	**29.6**	**6.32**
	MS2	**Turn Basin**	Morning	8.17	43.18	2.35	5.1	29.5	6.49
			Mid-day	8.17	43.19	2.36	5.2	29.6	6.51
			Evening	8.16	43.18	2.37	5.1	29.5	6.51
			Average	**8.17**	**43.18**	**2.36**	**5.1**	**29.5**	**6.50**
	MS3	**Berth 2**	Morning	8.14	43.24	2.42	5.8	29.4	6.3
			Mid-day	8.13	43.25	2.43	5.8	29.6	6.31
			Evening	8.13	43.24	2.43	5.7	29.6	6.31
			Average	**8.13**	**43.24**	**2.43**	**5.8**	**29.5**	**6.31**
	MS4	**Port Entrance**	Morning	8.23	43.27	2.39	5.5	29.3	6.68
			Mid-day	8.24	43.28	2.41	5.6	29.4	6.7
			Evening	8.24	43.28	2.41	5.5	29.4	6.7
			Average	**8.24**	**43.28**	**2.40**	**5.5**	**29.4**	**6.69**

Monitoring Duration	Location Code	Sampling Station	Monitoring Frequency	Parameters					
				pH Value	Conductivity [mS/cm]	Salinity [%]	Turbidity [NTU]	Temperature (°C)	Dissolved Oxygen (mg/l)
	MS5	Disposal Site	Morning	8.27	43.37	2.57	5.1	29.4	6.31
			Mid-day	8.27	43.38	2.59	5.1	29.6	6.32
			Evening	8.26	43.38	2.58	5.2	29..6	6.31
			Average	**8.27**	**43.38**	**2.58**	**5.1**	**29.5**	**6.31**
Week 4	MS1	Berth 1	Morning	8.16	43.35	2.27	6.3	29.1	6.27
			Mid-day	8.15	43.36	2.29	6.4	29.3	6.29
			Evening	8.15	43.35	2.28	6.3	29.3	6.29
			Average	**8.15**	**43.35**	**2.28**	**6.3**	**29.2**	**6.28**
	MS2	Turn Basin	Morning	8.09	43.28	2.35	5.3	29.4	6.47
			Mid-day	8.11	43.29	2.36	5.4	29.5	6.48
			Evening	8.11	43.29	2.36	5.4	29.4	6.48
			Average	**8.10**	**43.29**	**2.36**	**5.4**	**29.4**	**6.48**
	MS3	Berth 2	Morning	8.12	43.31	2.31	6.5	29.3	6.31
			Mid-day	8.12	43.32	2.33	6.4	29.4	6.31
			Evening	8.11	43.32	2.33	6.5	29.4	6.3
			Average	**8.12**	**43.32**	**2.32**	**6.5**	**29.4**	**6.31**
	MS4	Port Entrance	Morning	8.16	43.19	2.51	5.4	29.3	6.46
			Mid-day	8.16	43.18	2.52	5.4	29.4	6.46
			Evening	8.17	43.19	2.52	5.3	29.3	6.45
			Average	**8.16**	**43.19**	**2.52**	**5.4**	**29.3**	**6.46**
	MS5	Disposal Site	Morning	8.14	43.26	2.57	5.2	29.4	6.29
			Mid-day	8.16	43.27	2.58	5.3	29.3	6.28
			Evening	8.16	43.26	2.57	5.2	29.4	6.29
			Average	**8.15**	**43.26**	**2.57**	**5.2**	**29.4**	**6.29**

APPENDIX 4: STAKEHOLDERS SIGNATURES

ENVIRONMENTAL PARAMETERS MONITORING; AIR QUALITY, NOISE LEVEL, MARINE WATER, SEABED SEDIMENT, MARINE FAUNA AND STAKEHOLDERS' ENGAGEMENT FOR THE MODERNIZATION AND EXPANSION OF THE EXISTING TANGA PORT AT CENTAL WARD, TANGA CITY IN TANGA REGION
STATUS UPDATE

Name and Signature of Consulted Stakeholders

DATE	NAME	INSTITUTION AND POSITION	PHONE/ADDRESS	SIGNATURES
30/3/2023	MR BAHERO ADHIO	MKITI CHAMA CHA WANANCHI TANGA (W)	0716001431	30/3/23
30/03/2023	ZAHORONI M. MOHAMED	TANGA CC – CEMO	0713115461	
30/03/2023	AGNES C FALLE	NEO - SAKARANI	0714-344447	
30/03/2023	MOHAN SINGH NAGGI	M/KITI SAKARANI	0675726455	
30/3/2023.	NEEMA J. KIKETELO.	FISHERIES OFFICER.	0713-075119.	

ENVIRONMENTAL PARAMETERS MONITORING; AIR QUALITY, NOISE LEVEL, MARINE WATER, SEABED SEDIMENT, MARINE FAUNA AND STAKEHOLDERS' ENGAGEMENT FOR THE MODERNIZATION AND EXPANSION OF THE EXISTING TANGA PORT AT CENTAL WARD, TANGA CITY IN TANGA REGION
STATUS UPDATE

Name and Signature of Consulted Stakeholders

DATE	NAME	INSTITUTION AND POSITION	PHONE/ADDRESS	SIGNATURE
30/03/2023	CLARA M. MAYERU	TCC - WEO CENTRAL	0715-904083	
30/03/2023	THERESIA P. NKEMA	OSHA - HYGIENE INSPECTOR TANGA	06210136 19	

KATA YA CENTRAL
HALMASHAURI YA JIJI LA TANGA

OCCUPATIONAL SAFETY & HEALTH AUTHORITY
P. O. Box 3, TANGA

ENVIRONMENTAL PARAMETERS MONITORING; AIR QUALITY, NOISE LEVEL, MARINE WATER, SEABED SEDIMENT, MARINE FAUNA AND STAKEHOLDERS' ENGAGEMENT FOR THE MODERNIZATION AND EXPANSION OF THE EXISTING TANGA PORT AT CENTAL WARD, TANGA CITY IN TANGA REGION
STATUS UPDATE

Name and Signature of Consulted Stakeholders

DATE	NAME	INSTITUTION AND POSITION	PHONE/ADDRESS	SIGNATURES
30/3/2023	OMARY RAJABU	MUUVI	0684315868	
30/3/2023	OMARY SHABAN	MUUVI	0713207715	
30/03/2023	SHEHA MAKAME	MUUVI	0718579750	
30/03/2023	MBAROUKU BAKARI	MUUVI	0717793097	
30/03/2023	KINDOK John	MUUVI	0718153153	