ENVIRONMENTAL MONITORING REPORT

HALDIA DOCK COMPLEX
SYAMA PRASAD MOOKERJEE PORT, KOLKATA

6TH QUARTER REPROT
Mar 2023 – May 2023

श्यामा प्रसाद मुखर्जी पोर्ट, कोलकाता
SYAMA PRASAD MOOKERJEE PORT, KOLKATA
Formerly Kolkata Port Trust

HECS

HUBERT ENVIRO CARE SYSTEMS (P) Ltd

(An ISO 9001:2015 Company)

(Accredited by NABL, Recognized by MoEF & CC)

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CONTENTS

ABBREVIATIONS

CPCB	Central Pollution Control Board
HDC	Haldia Dock Complex
HECS	Hubert Enviro Care Systems (P) Ltd
KDS	Kolkata Dock System
SMPK	Syama Prasad Mookerjee Port, Kolkata
MoEF & CC	Ministry of Environment, Forest & Climate Change
WBPCB	West Bengal Pollution Control Board
APHA	American Public Health Association
NAAQ	National Ambient Air Quality
PM	Particulate Matter
NO	Nitrogen Oxide
CO	Carbon Monoxide
SO_2	Sulfur Dioxide
NO_2	Nitrogen Dioxide

FOREWORD

M/s. Syama Prasad Mookerjee Port, Kolkata (SMPK)has Port Operation in West Bengal State. Syama Prasad Mookerjee Port, Kolkata comprises two dock systems namely Kolkata Dock System (KDS) and Haldia Dock Complex (HDC). SMP, Kolkata has planned to monitor the current environmental status at the Haldia Dock Complex. They entrusted the work of environmental quality monitoring to M/s. Hubert Enviro Care Systems (P) Ltd., Chennai having an Environmental Laboratory approved by the Central Pollution Control Board (CPCB)/Ministry of Environment, Forest & Climate Change (MoEF & CC) through their Work Order No. I&CF/IZ&R/T/345/1205dated 25.10.2021.

A comprehensive environmental monitoring program has been planned to monitor data for the Quarter of **Mar 2023 – May2023.** The monitored data on Ambient Air Quality, Ambient Noise Quality, Water Quality, Sediment Quality in river and Green Belt Development are collected and presented in this report.

Our sincere thanks to **Haldia Dock Complex, SMP, Kolkata** for awarding this work and Haldia DockAuthorities for their kind co-operation during the study period.

Date: 10/06/2023

Place: Chennai – 600 083

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

(M.Sivaprakasam)

Laboratory Manager

1st AAQM stationwas set up at a height of 6 meter from BGL (Below Ground Level)at **Top of 3rd Oil Jetty.**The 2nd and 3rd AAQM station were set up at a height of 8 Meter from BGL at**Top of Marine House** and **Top of Electrical Maintenanceoffice building** at Haldia Township.The 4th location was collectedat a height of 10 Meter fromBGLat**Top of Chiranjibpur Operational Building.** The air quality status is presented in this report. While comparing with NAAQ norms for industrial and mixed-use environment, all PM_{10}, $PM_{2.5}$, SO_2, NO_x, and CO values were well within the limits.

3.2 Noise Monitoring

Ambient noise monitoring was conducted using Extech sound level meter during day time and night time at twelvelocations. Noise level recorded at all locations was within the day time and night time noise criteria as per CPCB (Central Pollution Control Board) norms.

3.3 Water Quality Monitoring

3.3.1 Marine Water:

Marine water samples collected from four locations namely **Near 1st Oil Jetty (Upstream), Near Outer Terminal – II, Near Lock Approach**and**Near HFTPL Jetty (Downstream).** One sample collected at 0.3meter below from the surface and another sample collected at depth 7 meter at each location and tested as per IS: 3025 and APHA 23rd Edition. In general, Water Quality of 8 samples* were well within the prescribed limits with respect to Primary Water Quality Criteria for Class SW-IV (for Harbour Waters).

3.4 Marine Water Biological Quality

Marine water samples from four locations namely **Near 1st Oil Jetty (Upstream), Near Outer Terminal – II, Near Lock Approach** and **Near HFTPL Jetty (Downstream)** were collected and tested as per APHA method and the results recorded. Further, biological parameters such as light penetration, chlorophyll and primary productivity were measured and the results are recorded. Phytoplankton and Zooplankton species were also reported in various locations and results are reported.It

is inferred from the test results that all the tested marine water quality parameters from four locations were within the marine water quality standards.

3.5 Sediment Quality

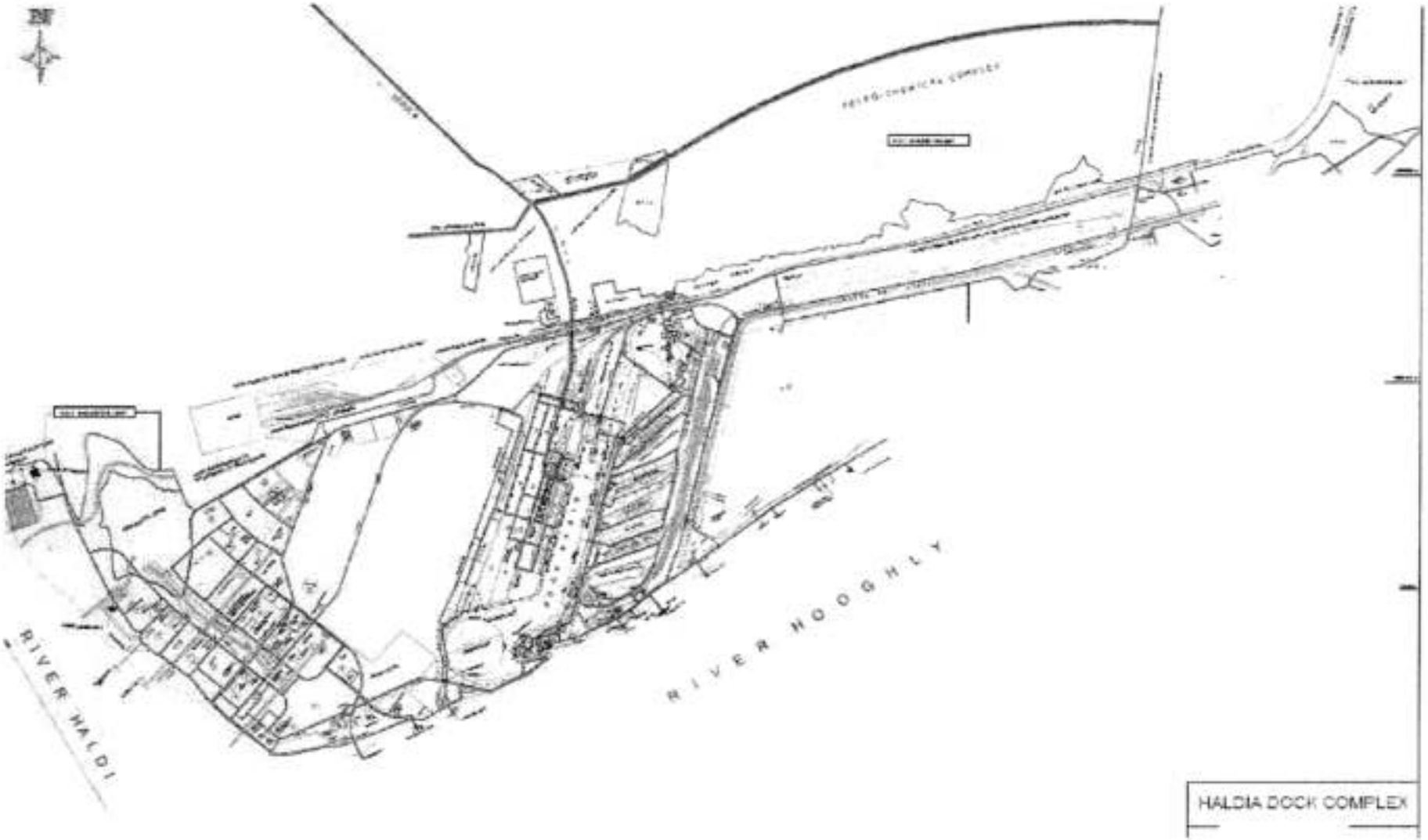
Marine sediment samples were collected from four locations namely **Near 1st Oil Jetty (Upstream), Near Outer Terminal – II, Near Lock Approach** and **Near HFTPI. Jetty (Downstream)**,tested for the given parameters and results recorded.Microbenthos, meiobenthos and macrobenthos organisms were identified in the marine sediment samples and recorded in the report.

3.6 Green Belt Development

Green belt surveys were conducted within the industry and township area of Haldia Dock Complex. The main objective of the green belt development is to absorb the dust and gaseous pollutants; ultimately it increases CO_2 absorption and releasing of O_2 for a better environment besides providing an aesthetic view.

3.7 Conclusion

Ambient air quality values recorded were within the stipulated NAAQ/ CPCB norms for industrial and mixed-use environment. Marine water quality was within the prescribed limits as per Primary Water Quality Criteria for ClassSW-IV (for Harbour Waters). All tested marine sediments adhered to the marine sediment quality standards. The recorded noise level in the day time and night time were compared with the CPCB standards and the results found – were within the limit. Biodiversity in green belt area was observed. Species diversity, richness, abundance and evenness values were Calculated.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RIVER HOOGHLY
RIVER HALDI
HALDIA DOCK COMPLEX

1.0 INTRODUCTION

1.1 Background

Syama Prasad Mookerjee Port, Kolkata is the only river line port and one of the major ports in the country. Syama Prasad Mookerjee Port, Kolkata is established in 1870 and is presently serving a vast hinterland that comprises the entire Eastern India including Bihar, Jharkhand, Uttar Pradesh, Madhya Pradesh, Assam, Chhattisgarh, North-East Hill states and the land-locked countries of Nepal & Bhutan. Syama Prasad Mookerjee Port, Kolkata is often called the gateway to Eastern India. Syama Prasad Mookerjee Port, Kolkata comprises of two dock systems viz. Kolkata Dock System (KDS) and Haldia Dock Complex (HDC). The pilotage distance from Haldia to sand heads is 130 km and from HDC to Kolkata is 104 km upstream.

In order to assess the efficacy of the present environmental management particularly at Haldia Dock Complex and to further improve the air and water quality, Syama Prasad Mookerjee Port, Kolkata desired to carry out a detailed study on environmental management at Haldia Dock Complex. Haldia Dock Complex (HDC) is located on the western bank of river Hooghly at about 104 km downstream of Kolkata and 130 km upstream of sand heads.

1.2 Environmental Management Plan

Being concerned towards Environmental Protection, Syama Prasad Mookerjee Port, Kolkata has prepared an extensive Environmental Management Plan for port operations. The work was entrusted to **Hubert Enviro Care Systems Pvt. Ltd, Chennai** vide **Tender No. KoPT/Haldia Dock Complex/I&CF /IZ&R/T/345.**

The field monitoring studies were carried out for ambient air quality, ambient noise level, water quality, sediment quality, and green belt development, and their results are presented in this report.

1. Ambient Air Quality Monitoring
2. Noise Level Monitoring
3. Marine / Riverine Water Analysis: Physio-Chemical Parameters
4. Marine / Riverine Water Analysis: Biological Parameters
5. Marine / Riverine Sediment Analysis: Physio-Chemical parameters
6. Marine/Riverine Sediment Analysis: Biological Parameters
7. Green Belt Study

2.0 SCOPE AND METHODOLOGY

2.1 Scope & Methodology

The scope of the study and the present report covers the detailed characterisation of the existing environmental status in the project area for major environmental components namely Ambient Air Quality, Ambient Noise Level, Water Quality, Sediment Quality including Marine Biological analysis and Green Belt Development.

3.0 AMBIENT AIR QUALITY STATUS

3.1 Selection of Monitoring Stations

Ambient Air Quality Monitoring (AAQM) stations were set up at four locations with due consideration of Meteorological conditions on synoptic basis, Topography of the study area Representatives of regional background air quality for obtaining baseline status Representatives of likely impact areas and consultation with Halia Dock Complex officials. The monitoring locations are given in **Table 3.1**.

Table 3.1: Details of Ambient Air Quality Monitoring Locations

S. No.	Name of Location and Code	Code	Approximate Height (m)
1	Top of 3rd Oil Jetty office building	AAQ 1	6
2	Top of Marine House office building	AAQ 2	8
3	Top of Electrical Maintenance office building) at Haldia Township	AAQ 3	8
4	Top of Chiranjibpur Operational Building	AAQ 4	10

3.2 Sampling and Analytical Techniques:

With a view to collecting the samples, Envirotech make calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment and Fine Particulate Sampler (FPS-APM 550) have been used. The RDS is capable of drawing air at a flow rate of 0.95 to 1.3 m^3/min with very little pressure drop for RDS and FPS is designed to operate at an air flow rate of $1m^3$/hr. Filter papers (EPM 2000, Whattmann & Whattmann 46.2 dia) were used for the collection of particulate matters and heavy metals. SO_2& NOx were collected by drawing air at a flow-rate of 0.5 liters per minute (lpm) through an absorbing solution for the duration of 24 hrs. Details procedures are discussed below.

Table-3.2: Sampling & Analysis Methodology

Sl. No.	Parameter	Methodology
1	Particulate Matter 10 (PM_{10}) ($\mu g/m^3$)	IS: 5182 (Part -23):2006
2	Particulate Matter 2.5 ($PM_{2.5}$) ($\mu g/m^3$)	IS: 5182 (Part -24):2019
3	Sulphur Dioxide SO_2 ($\mu g/m^3$)	IS: 5182 (Part -2):2001 West and Gaeke Method

Sl. No.	Parameter	Methodology
4	Oxides of Nitrogen ($\mu g/m^3$)	IS: 5182 (Part - 6):2006, Jacob & Hochheiser modified Method
5	CO	IS: 5182 (Part - 10):1999

PM_{10}: A calibrated RDS (Respirable Dust Sampler) is used for the determination of PM_{10}. PM_{10} is a measure of particulate matter having size up to 10 µ.Air is sampled isokinetically through a cyclone where particles greater than 10 µ are separated and then passed through a glass microfiber filter. The difference in weight before and after sampling is determined and is divided by the volume of air.

$PM_{2.5}$: $PM_{2.5}$ is a measure of particulate matter having size up to 2.5 µ. APM 550 fine particles sampler is based on Wind Impactor design standardized by USEPA for ambient air quality monitoring. Calibrated APM 550 fine particle sampler with PTFE 47 mm diameter filter media was used for the determination of fine particulate matter, $PM_{2.5}$.

SO_2: **Modified West-Geake Spectrophotometric Method**: Sulphur dioxide (SO_2) was absorbed in a scrubbing solution of potassium tetrachloro-mercurate (K_2HgCl_4) and was allowed to react with HCHO and then with Pararosaniline Hydrochloride ($C_{19}H_{18}ClN_3$). The absorbance of the product, red-violet dye was measured using Digital Spectrophotometer (Agilent – cary60) at a wavelength of 560 nm.

NO_2: Jacob and Hochheiser modified Method: Nitrogen oxides as NO_2 (Nitrogen dioxide) were collected by bubbling air through sodium arsenate solution to form a stable solution of sodium nitrite. The nitrite ion produced during sampling is converted into a colour complex and by reaction of the exposed absorbing reagent with phosphoric acid, sulfanilamide and N (1-naphthyl) ethylamine dihydrochloride, and nitrogen dioxide concentration is determined using digital spectrophotometer (Agilent – cary60) at a wavelength of 540 nm.

3.3 Analytical Result and Interpretation

The ambient air quality monitoring analytical results and interpretation are given in the following **Test Report and Figure.**

TEST REPORT-1

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ 1 -Top of 3rd Oil Jetty office building(Height – 6.0m) Lat: 22°01'01.07"N Long: 88°04'06.56"E**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	CO (mg/m^3)
1	24	10.04.2023	12.39	23.56	87.25	41.22	0.07
2	24	13.04.2023	13.05	24.99	83.07	43.51	0.06
3	24	17.04.2023	13.61	24.32	84.76	42.87	0.08
4	24	20.04.2023	12.23	23.13	90.29	47.04	0.08
5	24	25.04.2023	13.45	24.86	78.22	33.91	0.06
6	24	27.04.2023	13.84	25.09	88.31	43.16	0.07
7	24	02.05.2023	11.98	22.28	81.74	42.95	0.08
8	24	05.05.2023	12.73	23.20	89.46	44.05	0.07
		Min	**11.98**	**22.28**	**78.22**	**33.91**	**0.06**
		Max	**13.84**	**25.09**	**90.29**	**47.04**	**0.08**
		Avg	**12.91**	**23.93**	**85.39**	**42.34**	**0.07**
NAAQ –National Ambient Air Quality Standards (2009)			**80**	**80**	**100**	**60**	**2**

Note: SO_2–Sulphur dioxide, NO_x- Nitrogen oxide, PM_{10} - (Particulate Matter size less than 10 µm), $PM_{2.5}$ - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.

Analyst

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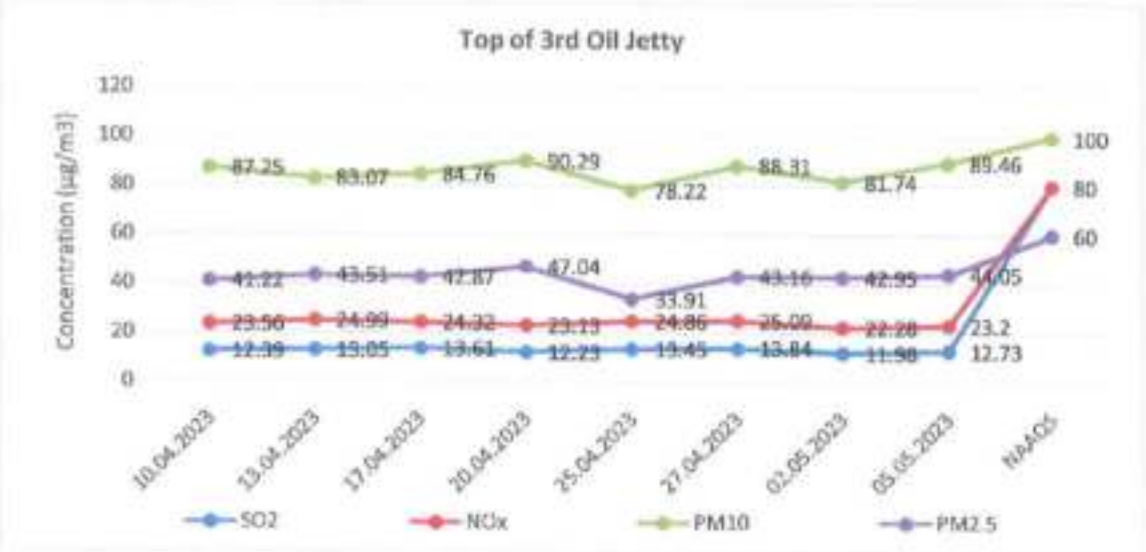
FIGURE 1

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ 1 - Top of 3rd Oil Jetty office building (Height ~ 6.0m) Lat: 22°01'01.07"N Long: 88°04'06.56"E**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**



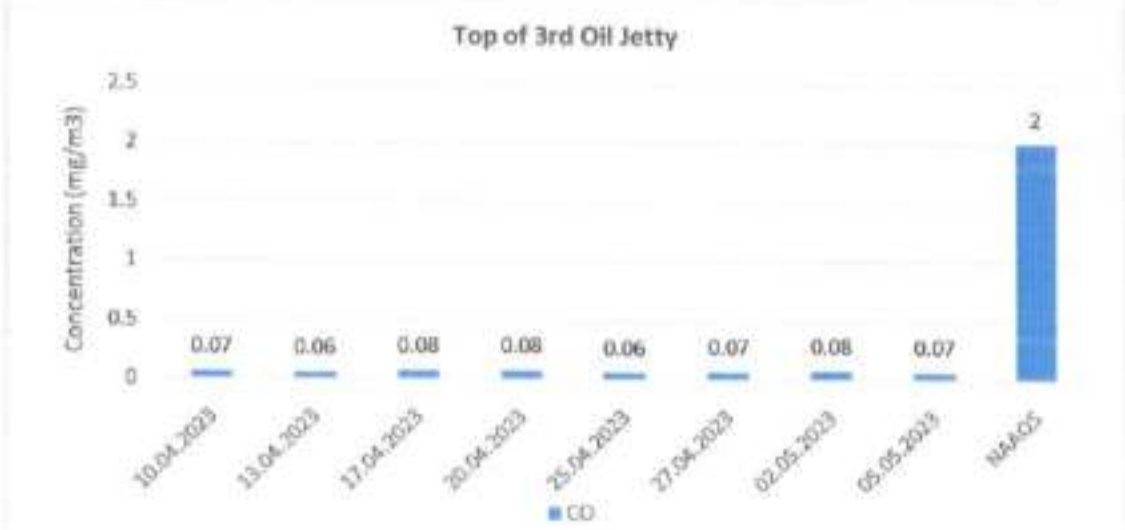


Figure 1. Graphical representation-1 of Ambient Air Quality 1 (Date **Vs.**Pollutant concentration (µg/m^3))
Graphical representation-2 of Ambient Air Quality 1 (Date **Vs.**Pollutant concentration (mg/m^3))

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TEST REPORT-2

Name of the Client :M/s. Haldia Dock Complex, SMP, Kolkata
Sample Description : Ambient Air Quality
Sample Mark:AAQ 2 –Top of Marine House office Building (Height~8m)
Lat: 22°01'32.55"N Log: 88°05'17.88"E
Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO_2	NO_x	PM_{10}	$PM_{2.5}$	CO
			($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(mg/m^3)
1	24	10.04.2023	13.97	26.77	84.33	37.13	0.08
2	24	13.04.2023	15.33	28.12	80.17	34.08	0.07
3	24	17.04.2023	12.61	28.05	93.42	36.81	0.06
4	24	20.04.2023	13.38	24.29	74.55	32.04	0.08
5	24	25.04.2023	14.19	26.41	82.58	34.72	0.06
6	24	27.04.2023	13.03	23.22	91.24	41.55	0.08
7	24	02.05.2023	12.61	28.83	80.63	35.10	0.09
8	24	05.05.2023	12.22	26.34	87.40	41.26	0.06
		Min	**12.22**	**23.22**	**80.17**	**32.04**	**0.06**
		Max	**15.33**	**28.83**	**93.42**	**41.55**	**0.09**
		Avg	**13.42**	**26.50**	**84.93**	**36.59**	**0.07**
NAAQ –National Ambient Air Quality Standards (2009)			**80**	**80**	**100**	**60**	**2**

Note: SO_2–Sulphur dioxide, NO_x- Nitrogen oxide, PM_{10}– (Particulate Matter size less than 10 µm), $PM_{2.5}$– (Particulate Matter size less than 2.5 µm) CO – Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.

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FIGURE 2

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark :**AAQ 2 –Top of Marine House Office Building (Height ~ 8m) Lat: 22°01'32.55"N Log: 88°05'17.88"E**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

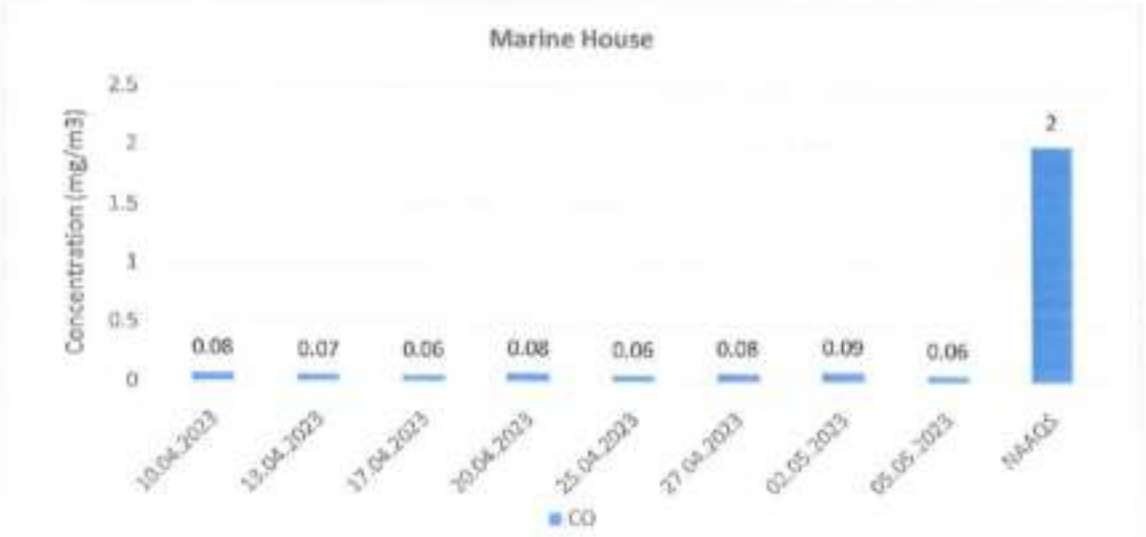

Figure 2. Graphical representation-1 of Ambient Air Quality 2 (Date **Vs.**Pollutant concentration (µg/m^3))
Graphical representation-2 of Ambient Air Quality 2 (Date **Vs.**Pollutant concentration (mg/m^3))

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TEST REPORT-3

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ3 - Top of Electrical Maintenance office building at Haldia Township(Height ~8m)**
Lat: 22°01'21.80"N, Log: 88°03'43.83"E
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO_2	NO_x	PM_{10}	$PM_{2.5}$	CO
			($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(mg/m^3)
1	24	10.04.2023	13.26	25.49	76.83	30.79	0.05
2	24	13.04.2023	13.11	24.21	78.17	28.16	0.07
3	24	17.04.2023	13.62	25.93	83.82	37.52	0.06
4	24	20.04.2023	14.19	26.05	80.24	32.15	0.04
5	24	25.04.2023	13.48	25.22	74.35	37.30	0.06
6	24	27.04.2023	13.55	26.58	85.61	43.91	0.08
7	24	02.05.2023	14.36	26.34	72.50	45.88	0.06
8	24	05.05.2023	12.73	25.67	78.48	36.48	0.07
		Min	**12.73**	**24.21**	**72.50**	**28.16**	**0.04**
		Max	**14.36**	**26.58**	**85.61**	**45.88**	**0.08**
		Avg	**13.68**	**25.96**	**79.20**	**25.95**	**0.06**
NAAQ –National Ambient Air Quality Standards (2009)			**80**	**80**	**100**	**60**	**2**

Note: SO_2–Sulphur dioxide, NO_x- Nitrogen oxide, PM_{10} - (Particulate Matter size less than 10 µm), $PM_{2.5}$ - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.

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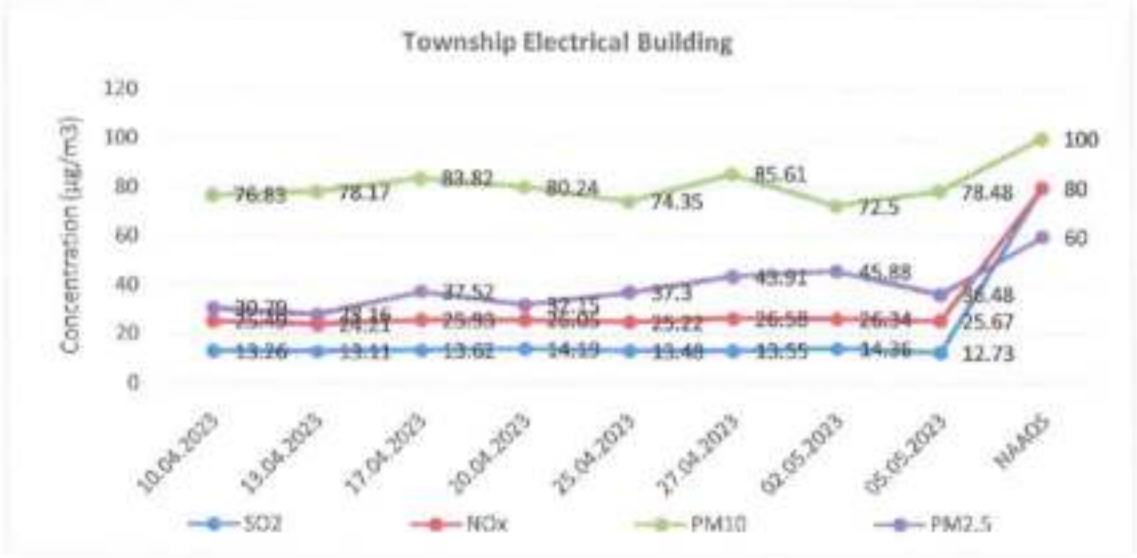
FIGURE 3

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ3 - Top of Electrical Maintenance office building at Haldia Township (Height ~8m)**
Lat: 22°01'21.80"N, Log: 88°03'43.83"E
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**



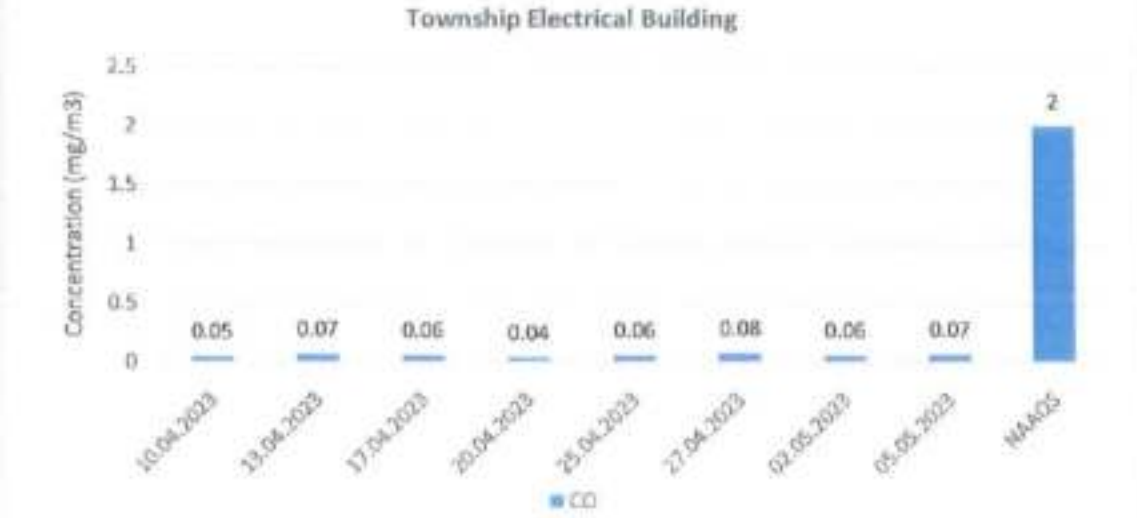


Figure 3. Graphical representation-1 of Ambient Air Quality 3 (Date **Vs.**Pollutant concentration (µg/m^3))
Graphical representation-2 of Ambient Air Quality 3 (Date **Vs.**Pollutant concentration (mg/m^3))

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TEST REPORT-4

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ 4 - Top of Chiranjibpur Operational Building (Ht – 10m) Lat: 22°03'08.55"N Log:88°05'48.64"E**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO_2	NO_x	PM_{10}	$PM_{2.5}$	CO
			(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(mg/m³)
1	24	10.04.2023	14.51	25.25	90.01	44.15	0.06
2	24	13.04.2023	13.43	25.82	86.31	47.73	0.08
3	24	17.04.2023	12.88	24.93	85.58	39.56	0.06
4	24	20.04.2023	13.70	25.51	86.37	44.17	0.07
5	24	25.04.2023	13.25	25.48	83.62	43.41	0.06
6	24	27.04.2023	12.13	26.32	91.21	43.20	0.05
7	24	02.05.2023	14.04	28.66	82.14	43.22	0.07
8	24	05.05.2023	12.97	27.08	89.43	42.34	0.08
		Min	**12.13**	**24.93**	**82.14**	**39.56**	**0.05**
		Max	**14.51**	**28.66**	**91.21**	**47.73**	**0.08**
		Avg	13.36	26.13	86.83	43.47	0.07
NAAQ –National Ambient Air Quality Standards (2009)			**80**	**80**	**100**	**60**	**2**

Note: SO_2–Sulphur dioxide, NO_x- Nitrogen oxide, PM_{10} - (Particulate Matter size less than 10 µm), $PM_{2.5}$ - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.

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FIGURE 4

Name of the Client :**M/s. Haldia Dock Complex, SMP, Kolkata**
Sample Description : **Ambient Air Quality**
Sample Mark : **AAQ 4 - Top of ChiranjibpurOperational Building (Ht ~ 10m) Lat: 22°03'08.55"N Log:88°05'48.64"E**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

Figure 4. Graphical representation-1 of Ambient Air Quality 4 (Date **Vs.**Pollutant concentration (µg/m^3))
Graphical representation-2 of Ambient Air Quality 4 (Date **Vs.**Pollutant concentration (mg/m^3))

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Table-3.4: Sulphur Dioxide(SO_2)(µg/m^3)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - Top of 3rd Oil Jetty office building	11.98	13.84	0.69	13.81	12.91
AAQ 2 –Top of Marine House office building	12.22	15.33	1.03	15.17	13.42
AAQ3 - Top of Electrical Maintenance office building at Haldia Township	12.73	14.36	0.54	14.34	13.54
AAQ 4 - Top of Chiranjibpur Operational Building	12.13	14.51	0.74	14.44	13.36

Table-3.5: Nitrogen Dioxide (NO_2)(µg/m^3)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - Top of 3rd Oil Jetty office building	22.28	25.09	1.04	25.08	23.93
AAQ 2 –Top of Marine House office building	23.22	28.83	1.93	28.73	26.50
AAQ3 - Top of Electrical Maintenance office building at Haldia Township	24.21	26.58	0.74	26.55	25.69
AAQ 4 - Top of Chiranjibpur Operational Building	24.93	28.66	1.22	28.44	26.13

Table-3.6: Particulate Matter (PM_{10}) (µg/m^3)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - Top of 3rd Oil Jetty office building	78.22	90.29	4.19	90.17	85.39
AAQ 2 –Top of Marine House office building	74.55	93.42	6.20	93.11	84.29
AAQ3 - Top of Electrical Maintenance office building at Haldia Township	72.5	85.61	4.43	85.36	78.75
AAQ 4 - Top of Chiranjibpur Operational Building	82.14	91.21	3.17	91.04	86.83

Table-3.7: Particulate Matter ($PM_{2.5}$) (µg/m^3)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - Top of 3rd Oil Jetty office building	33.91	47.04	3.78	46.62	42.34
AAQ 2 –Top of Marine House office building	32.04	41.55	3.37	41.51	36.59
AAQ3 - Top of Electrical Maintenance office building at Haldia Township	28.16	45.88	6.16	45.60	36.52
AAQ 4 - Top of Chiranjibpur Operational Building	39.56	47.73	2.26	47.23	43.47

4.0 AMBIENT NOISEQUALITY

4.1 Monitoring Station Selection Criteria

The 12 monitoring stations were selected as per the noise source identified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 4.1.

Table 4-1: Noise Quality Monitoring Stations

S. No.	Location	Code
1	Chiranjibpur Operational Building	N1
2	Jawahar Tower	N2
3	Township Gate No - 04	N3
4	Port Hospital	N4
5	DAV School	N5
6	Port House	N6
7	GCBerth Main Gate	N7
8	HFTPL (MBC) Jetty	N8
9	Chiranjibpur Operational Building Gate	N9
10	Lock Gate	N10
11	Marine House	N11
12	Master Control	N12

4.2 Monitoring Methodology

Ambient noise level measurements in four identified cardinal directions were carried out using Extech sound level meter during daytime and night time. Noise measurements were made at 1.5 m above ground and about 3 m away from walls, buildings or other sound reflecting sources. In order to reduce the disturbances from standing waves, the noise level measured were averaged over + 0.5 m each of at least three positions. The mean values were taken for reporting.

Instrument The noise was monitored by digital sound level meter, MakeExtech, Model/ SL: 407780/100813422

Sound Level Meter is an instrument designed to respond to sound in approximately the same way as the human ear and to give objective reproducible measurements of sound pressure level. The system consists of a microphone, a processing section and a readout unit.

Procedure

- Press → **DATE TIME** + **POWER** → Hold for 3 Seconds
  - Display → Date 11-07-01
- Press → **DATE TIME**
  - Display → Time 00 in minutes
- Press → **INTEG TIME**
- Press → Adjust Minute using ↑ → to set required time in minutes (10sec to 24hrs)
  - Display → 03
- Press → **LEQ SEL SPL** → to set SPL
- Press → **RECORD**
- Press → **PLAY** → to save the data
- Connect the meter to a pc via the RS - 232 cable
- Open to isound software
- Press → **DATA LOGGER**
- Press → **I / I**
- Press → **READ / SAVE**
- Press → **ERASE**

4.3 Analytical Result:

The noise levels in different locations were recorded and compared to the specifications of CPCB norms and the results are shown in following**Test reports andFigures.**

TEST REPORT-5

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Noise Monitoring
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date : 01/03/2023 02/03/2023 03/032023 04/03/2023

S. No		Monitoring Location & Hourly Leq Noise Level in dB(A)			
		Chiranjibpur Operational Building	Jawahar Tower	Township Gate No - 04	Port Hospital
	Monitoring Date / Time (Hrs)	01/03/2023	02/03/2023	03/03/2023	04/03/2023
1	06-07	52.7	51.7	55.9	51.1
2	07-08	53.1	53.6	56.2	52.3
3	08-09	53.2	54.1	60.7	53.4
4	09-10	54.7	56.4	61.6	54.0
5	10-11	56.8	58.8	64.6	57.4
6	11-12	60.9	60.2	68.4	61.1
7	12-13	58.9	59.4	65.9	63.5
8	13-14	56.4	60.5	65.7	61.6
9	14-15	54.6	60.0	60.4	60.0
10	15-16	52.9	57.2	64.7	58.2
11	16-17	53.1	60.1	62.5	56.0
12	17-18	58.4	61.1	63.4	58.7
13	18-19	59.0	59.8	67.1	55.6
14	19-20	61.0	59.2	67.9	55.3
15	20-21	60.2	55.3	64.8	54.8
16	21-22	59.2	57.0	61.7	55.0
17	22-23	54.4	56.5	60.9	54.2
18	23-24	52.0	55.3	56.5	52.3
19	00-01	53.6	54.7	54.0	50.6
20	01-02	52.4	53.1	53.3	50.7
21	02-03	50.2	51.2	51.1	50.8
22	03-04	50.1	50.3	51.0	49.5
23	04-05	50.7	52.2	51.3	49.7
24	05-06	50.3	52.5	51.7	51.4
I	Ld	**56.6**	**57.8**	**63.2**	**56.8**
II	Ln	**51.7**	**53.2**	**53.7**	**51.1**
II	Ldn	**55.0**	**56.3**	**60.1**	**54.9**
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note:MonitoringDaterepresents24hoursfrom6:00amnextday. Legend:Leq-EquivalentNoiseLevel(hourly); Ld-DayTimeEquivalentNoiseLevel(06:00-22:00hrs);Ln-NightTimeEquivalentNoiseLevel (22:00-06:00hrs);and Ldn-24hourlyEquivalentNoiseLevel.
*:CPCB-Norms-AmbientNoiseNorms(Leq);Daytimeisrecordedinbetween6a.mand10p.m.andNight timeisrecordedinbetween10 p.mand6a.m.
AwarninglimitofS5dB(A)issetastbelevelbelowwhichverylittlerisktounprotectedearofcarringimpairmentexistsforaneight hourexposure

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FIGURE-5

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **01/03/2023 02/03/2023 03/03/2023 04/03/2023**

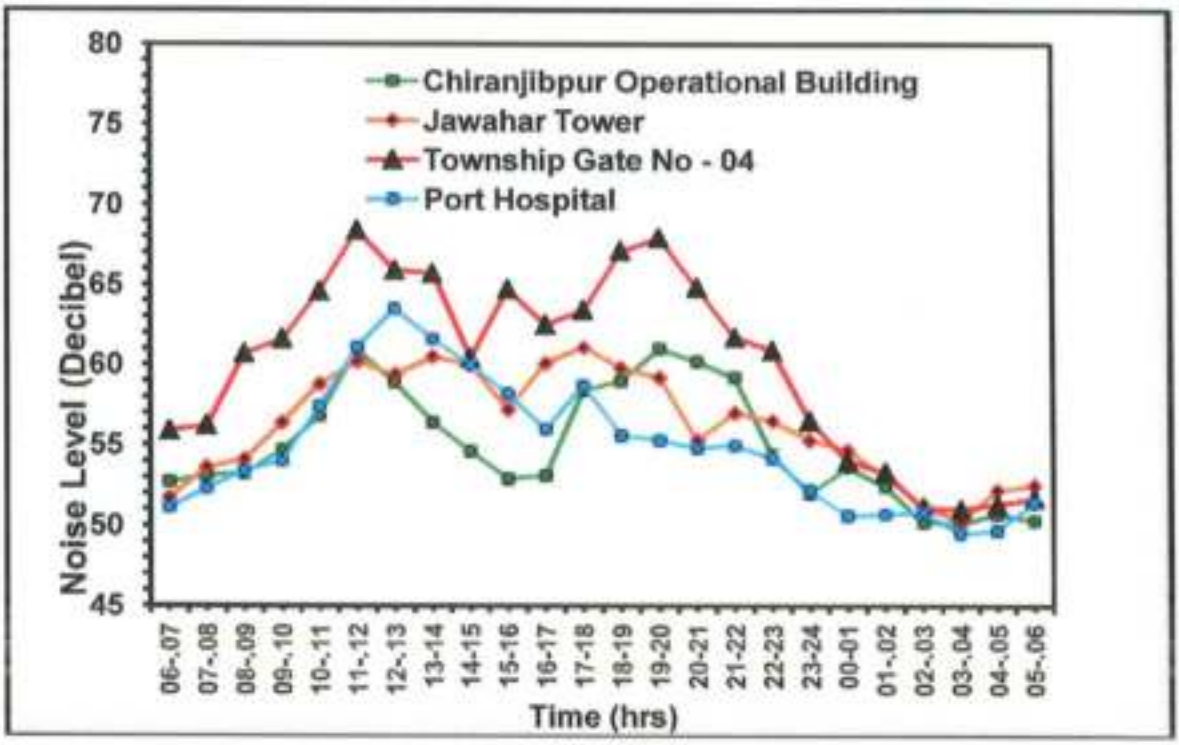

Figure 5: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)

TEST REPORT-6

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems PvtLtd**

S.No	Location	Day Time (06.00 – 22.00 hrs.) Noise Level, dB (A)						Night Time (22.00 – 06.00 hrs) Noise Level dB (A)						Ldn
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	Chiranjibpur Operational Building	52.7	53.1	56.4	60.2	61.0	57.6	50.1	52.0	52.4	50.7	54.4	52.0	56.4
2	Jawahar Tower	51.7	53.6	60.5	55.3	61.1	58.5	50.3	55.3	53.1	52.2	56.5	53.7	57.4
3	Township Gate No - 04	55.9	56.2	65.7	64.8	68.4	64.5	51.0	56.5	53.3	51.3	60.9	55.2	62.9
4	Port Hospital	51.1	52.3	61.6	54.8	63.5	58.1	49.5	52.2	50.7	49.7	54.2	51.4	56.8

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area	: Day Time-75 dB (A);	Night Time-70 dB (A).
Commercial Area	: Day Time-65 dB (A);	Night Time-55 dB (A).
Residential Area	: Day Time-55 dB (A);	Night Time-45 dB (A).
Silence Zone	: Day Time-50 dB (A);	Night Time-40 dB (A).

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TEST REPORT-7

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

Sampling Date : **02/04/2023 03/04/2023 04/04/2023 05/04/2023**

S. No		Monitoring Location & Hourly Leq Noise Level in dB(A)			
		DAV School	Port House	CJP Gate	GCB Main Gate
	Monitoring Date / Time (Hrs)	02/04/2023	03/04/2023	04/04/2023	05/04/2023
1	06-07	50.0	51.2	48.8	52.6
2	07-08	50.2	52.8	49.6	55.7
3	08-09	51.5	53.2	51.1	58.8
4	09-10	52.3	54.5	54.3	60.3
5	10-11	56.3	56.2	56.2	63.8
6	11-12	57.9	57.3	59.1	67.4
7	12-13	56.7	57.6	60.6	65.2
8	13-14	53.8	58.4	59.4	62.6
9	14-15	52.5	56.6	58.4	59.3
10	15-16	52.3	54.8	56.3	63.3
11	16-17	52.3	57.7	54.7	61.1
12	17-18	56.6	60.0	57.1	62.7
13	18-19	57.5	59.1	54.1	64.8
14	19-20	60.3	57.7	55.2	65.0
15	20-21	59.6	54.7	54.8	63.0
16	21-22	57.7	56.0	53.1	61.8
17	22-23	54.5	56.0	53.1	59.0
18	23-24	51.7	53.9	50.7	54.8
19	00-01	50.6	50.6	49.1	52.5
20	01-02	50.2	50.8	49.2	51.8
21	02-03	49.5	48.8	49.4	49.6
22	03-04	48.4	47.5	48.1	49.5
23	04-05	47.9	49.2	48.2	50.1
24	05-06	50.2	51.1	49.9	48.8
I	Ld	**54.8**	**56.1**	**55.2**	**61.7**
II	Ln	**50.4**	**51.0**	**49.7**	**52.0**
II	Ldn	**53.4**	**54.4**	**53.4**	**58.5**
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note:MonitoringDaterepresents24hoursfrom6:00amnextday. Legend:Leq-EquivalentNoiseLevel(hourly); Ld-DayTimeEquivalentNoiseLevel(06:00-22:00hrs);Ln-NightTimeEquivalentNoiseLevel (22:00-06:00hrs);and Ldn-24hourlyEquivalentNoiseLevel.

*:CPCB-Norms-AmbientNoiseNorms(Leq):Daytimeisrecordedinbetween6a.mand10p.m.andNight timeisrecordedinbetween10 p.mand6a.m.

AwarninglimitofI85dB(A)isusetasthelevelbelowwhichverylittlepopulationprotectedagainstlearningimpairmentexistsforaneight hourexposure

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FIGURE-6

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **02/04/2023 03/04/2023 04/04/2023 05/04/2023**

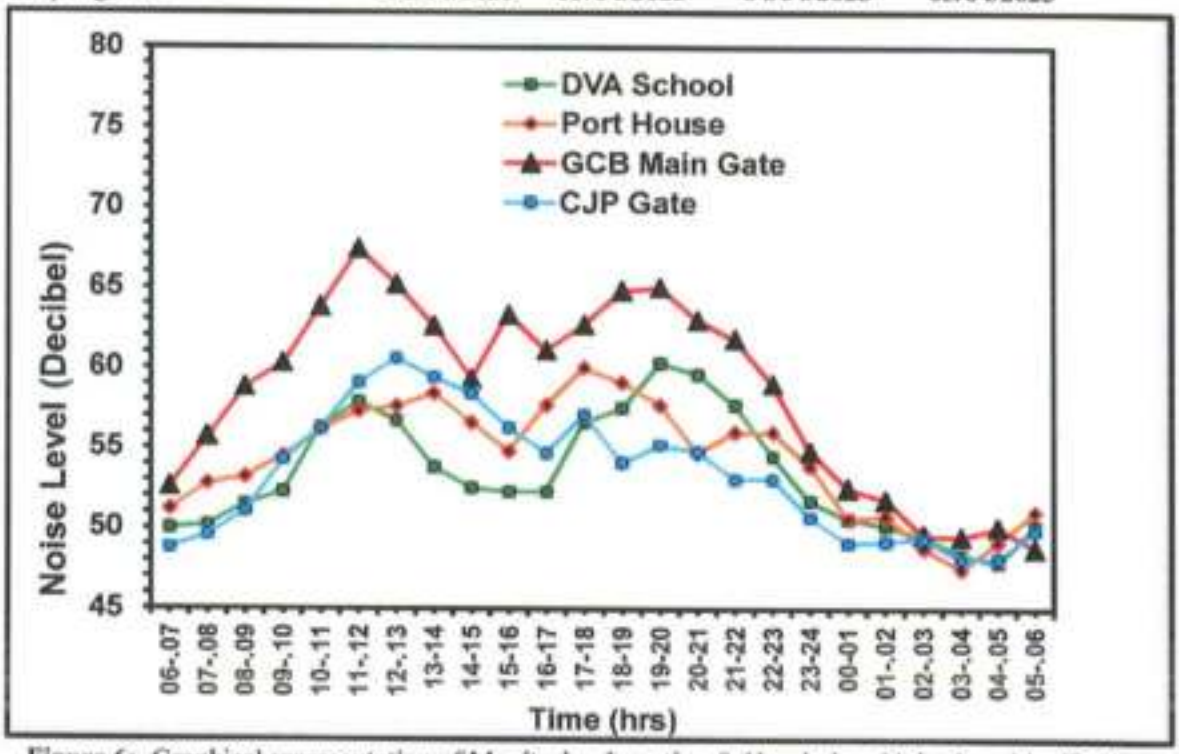

Figure 6: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)

TEST REPORT-8

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

S.No	Location	Day Time (06.00 – 22.00 hrs.) Noise Level, dB (A)						Night Time (22.00 – 06.00 hrs) Noise Level dB (A)						Ldn
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	DAV School	50.0	50.2	53.8	59.6	60.3	54.8	47.9	51.7	50.2	47.9	54.5	50.4	53.4
2	Port House	51.2	52.8	58.4	54.7	60.0	56.1	47.5	53.9	50.8	49.2	56.0	51.0	54.4
3	GCB Main Gate	52.6	55.7	62.6	63.0	67.4	61.7	48.8	54.8	51.8	50.1	59.0	52.0	58.5
4	CJP Gate	48.8	49.6	59.4	54.8	60.6	55.2	48.1	50.7	49.2	48.2	53.1	49.7	53.4

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area	: Day Time-75 dB (A);	Night Time-70 dB (A).
Commercial Area	: Day Time-65 dB (A);	Night Time-55 dB (A).
Residential Area	: Day Time-55 dB (A);	Night Time-45 dB (A).
Silence Zone	: Day Time-50 dB (A);	Night Time-40 dB (A).

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TEST REPORT-9

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

Sampling Date : **03/05/2023 04/05/2023 05/05/2023 06/05/2023**

S. No		Monitoring Location & Hourly Leq Noise Level in dB(A)			
		MBC Jetty	Lock Gate	Marine House	Master Control
	Monitoring Date / Time (Hrs)	03/05/2023	04/05/2023	05/05/2023	06/05/2023
1	06-07	51.6	52.9	53.7	50.7
2	07-08	52.5	54.6	57.1	51.5
3	08-09	54.4	55.5	60.2	54.2
4	09-10	55.9	57.7	63.2	57.3
5	10-11	58.0	58.4	65.3	59.7
6	11-12	60.6	61.1	70.1	61.9
7	12-13	59.2	61.1	68.7	65.2
8	13-14	57.9	61.1	66.3	61.7
9	14-15	56.3	60.0	61.9	59.9
10	15-16	54.1	58.2	65.1	59.5
11	16-17	54.7	62.5	64.2	57.2
12	17-18	57.7	63.2	66.6	60.4
13	18-19	60.3	61.1	68.4	58.0
14	19-20	62.6	60.6	68.6	56.8
15	20-21	61.7	56.4	66.4	56.4
16	21-22	60.5	58.5	65.4	57.4
17	22-23	55.3	56.9	62.3	53.5
18	23-24	53.9	56.4	57.7	53.5
19	00-01	53.4	54.3	53.7	53.0
20	01-02	51.6	53.2	52.8	51.8
21	02-03	52.0	53.9	53.7	50.6
22	03-04	49.5	52.0	51.6	49.1
23	04-05	49.5	52.1	52.4	52.2
24	05-06	51.6	51.8	52.1	51.3
I	Ld	59.0	60.1	66.2	59.2
II	Ln	53.1	54.7	57.0	52.2
II	Ldn	57.8	58.9	64.7	57.9
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note:MonitoringDatarepresents24hoursfrom6:00amnextday. Legend:Leq-EquivalentNoiseLevel(hourly): Ld-DayTimeEquivalentNoiseLevel(06:00-22:00hrs);Ln-NightTimeEquivalentNoiseLevel (22:00-06:00hrs);and Ldn-24hourlyEquivalentNoiseLevel.

*:CPCB-Norms-AmbientNoiseNorms(Leq):Daytimeisrecordedinbetween6a.mand10p.m.andNight timeisrecordedinbetween10 p.mand6a.m.

Awarninglimitof85dB(A)issetasthelevelbelowwhichverylittlerisktounprotectedearoflearringimpairmentexistsforaneight hourexposure

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FIGURE-7

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **03/05/2023 04/05/2023 05/05/2023 06/05/2023**

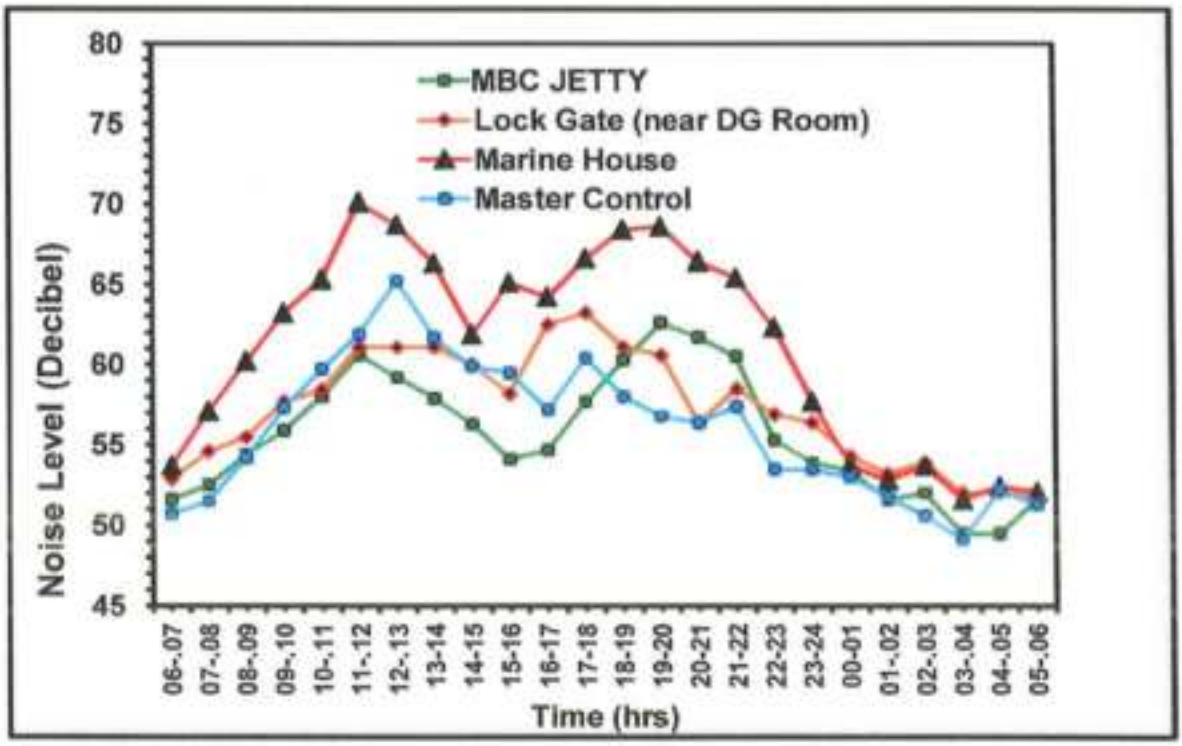

Figure 7: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)

TEST REPORT-10

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Noise Monitoring**

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

S.No	Location	Day Time (06.00 – 22.00 hrs.) Noise Level, dB (A)						Night Time (22.00 – 06.00 hrs) Noise Level dB (A)						Ldn
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	MBC Jetty	51.6	52.5	57.9	61.7	62.6	58.5	49.5	53.9	51.6	49.5	55.3	52.5	57.2
2	Lock Gate	52.9	54.6	61.1	56.4	63.2	59.7	51.8	56.4	53.2	52.1	56.9	54.2	58.6
3	Marine House	53.7	57.1	66.3	66.4	70.1	66.0	51.6	57.7	52.8	52.4	62.3	56.3	64.4
4	Master Control	50.7	51.5	61.7	56.4	65.2	59.4	49.1	53.5	51.8	52.2	53.5	52.1	58.0

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area	: Day Time-75 dB (A);	Night Time-70 dB (A).
Commercial Area	: Day Time-65 dB (A);	Night Time-55 dB (A).
Residential Area	: Day Time-55 dB (A);	Night Time-45 dB (A).
Silence Zone	: Day Time-50 dB (A);	Night Time-40 dB (A).

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5.0 WATER QUALITY STATUS

5.1 Monitoring Station Selection Criteria

The water monitoring stations were selected as per the water source of marine water isidentified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 5.1.

Table 5.1: Water Quality Monitoring Stations

Sl. No.	Water Sampling Station	Sample Code
	Marine Water	
1	Near HFTPL Jetty (Downstream) –Surface (0.3 m)	MW1
2	Near HFTPL Jetty –Bottom (7m)	MW2
3	Near 1st Oil Jetty (Upstream) – Surface (0.3 m)	MW3
4	Near 1st Oil Jetty (Upstream) – Bottom (7m)	MW4
5	Near Outer Terminal – II- Surface (0.3 m)	MW5
6	Near Outer Terminal – II- Bottom (7m)	MW6
7	NearLock Approach- Surface (0.3 m)	MW7
8	NearLock Approach- Bottom (7m)	MW8

5.2 Monitoring Methodology

Water samples were collected and analyzed as per the procedures outlined in IS: 3025/ APHA. Sterilized bottles were used for collection of water samples for bacteriological analysis, stored in ice box and transported to the laboratory for analyses. Parameters like pH, Temperature, Dissolved Oxygen, Residual Chlorine, Conductivity, Free Ammonia, Total Hardness, Calcium Hardness and Magnesium Hardness were measured in the field while collecting the samples. MPN index (APHA Standard Method, 1992) of coliforms was determined in the laboratory as per standard methods.

Table 5.2: Analytical Procedure

S.No.	Parameters	Analytical Methods	Reference
1	pH (at 25 °C)	By pH meter	IS 3025 (Part - 11):1983
2	Colour	Visual comparison using Platinum - Cobalt	IS 3025(Part - 4):1983
3	Total Hardness as $CaCO_3$	Titrometric Method	IS 3025 (Part - 21):1983
4	Calcium as Ca	Titrometric Method	IS 3025 (Part - 40):1991
5	Chloride as Cl	Argentometric Titration	IS 3025 (Part - 32):1988
6	Magnesium as Mg	EDTA Method	IS 3025 (Part - 46) 1994
7	Total Dissolved Solids	By Gravimetric	IS3025(Part-16):1984(Reaff2014)
8	Sulphate as SO_4	By UV- Spec	IS 3025(Part - 24):1986
9	Fluoride	By UV- Spec	IS 3025 (Part - 60):2008
10	Nitrate as NO_3	By UV- Spec	ASTM(Part - 31)1978
11	Iron as Fe	By UV- Spec	IS 3025 (Part - 53):2003
12	Hexavalent Chromium as Cr 6+	By UV- Spec	IS3025Part(52):2003(ReaffE2014)
13	Zinc as Zn	ICPMS	IS 3025 (Part49)-1994(Reaff 2009)
14	Copper as Cu	ICPMS	IS 3025 (Pt 42)-1992(Reaff 2009)
15	Manganese as Mn	ICPMS	IS 3025:(Part - 59):2006
16	Cadmium as Cd	ICPMS	IS 3025 (Part - 41)1991
17	Lead as Pb	ICPMS	IS 3025(Part - 47)1994(Reaff 2009)
18	Arsenic as As	ICPMS	IS 3025:(Part-37):1988(Reaff 2009)
19	Mercury as Hg	ICPMS	IS3025(Part48):1994RA1999
20	Sodium as Na	Flame Photometer	IS3025 (Part - 45):1993
21	Potassium as K	Flame Photometer	IS3025 (Part - 45):1993
22	BOD, 5 days @ 20°C as O_2	BOD Incubator	IS 3025 (Part - 44):1993
23	Dissolved Oxygen	Titrimetric Method	IS 3025 (Part - 38):1989
24	Nitrite as NO_2	By UV- Spec	IS 3025(Part- 34):1988
25	Salinity	Argentometric Titration	2520AAPHA22ndEdn.2012

Table 5.3: Onsite parameters for analysis

S.No.	Parameters	Analytical Methods	Reference
1	pH (at 25 °C)	By Hand Meter	IS 3025 (Part - 11):1983
2	Dissolved oxygen	Iodimetry (Fixing & Titration)	IS 3025 (Part - 38):1989
3	Electrical Conductivity	Conductivity meter	IS 3025(Part-14):2013
4	Total Dissolved Solids	By Hand Meter	IS3025(Part-16):1984(ReaffE2014)

5.3 Sampling

Any adverse impact of water pollution will have serious effect on the environment. Hence, it becomes important to monitor the water quality periodically in the port area. The samples were analyzed **as per IS: 3025,**and compared to the specifications Primary Water Quality Criteria for Class SW- IV (For Harbour Waters).

5.4 Analytical Result:

The water levels in different locations were recorded and compared to the specifications of CPCB norms and the results are shown in Test report.

TEST REPORT-11

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Marine Water Quality
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date :17/05/2023

S. No.	Parameters	Units	Primary Water Quality Criteria for Class SW- IV (for Harbour Waters)	Near HFTPL Jetty (Downstream) Lat: 22° 0' 53.85895" N Log: 88° 4' 5.79562" E		Near 1st Oil Jetty (Upstream) Lat: 22° 1' 6.43649" N Log: 88° 4' 49.17749" E	
				Surface at 0.3m	Bottom at 7m	Surface at 0.3m	Bottom at 7m
1	pH (at 25 °C)	-	6.5 – 9.0	7.74	7.70	7.67	7.63
2	Colour	Hazen Unit	No visible colour	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)	BLQ(LOQ:1)
3	Turbidity	NTU	-	47.8	57.6	38.6	84.3
4	Odour	-	No offensive odour	Agreeable	Agreeable	Agreeable	Agreeable
5	Chloride as Cl	mg/l	-	2000	1930	2120	1820
6	Total Suspended Solids	mg/l	-	817	788	866	743
7	Salinity	ppt	-	9.33	9.00	9.89	8.49
8	Total Dissolved Solids	mg/l	-	10386	10022	11009	9451
9	Sulphate as SO_4	mg/l	-	556.82	537.34	590.23	506.71
10	Nitrate as NO_3	mg/l	-	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
11	Iron as Fe	mg/l	-	0.61	0.55	0.31	0.52
12	Zinc as Zn	mg/l	-	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)
13	Chromium as Cr	mg/l	-	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)
14	Copper as Cu	mg/l	-	BLQ(LOQ 0.01)	0.0193	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
15	Cadmium as Cd	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
16	Lead as Pb	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
17	Arsenic as As	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
18	Mercury as Hg	mg/l	-	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)
19	Phosphate as PO_4	mg/l	-	0.13	0.14	0.08	0.12
20	BOD, 5 days @ 20°C as O_2	mg/l	5 mg/l	7.0	8.0	9.0	7.0
21	Oil and Grease	mg/l	-	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)	BLQ(LOQ 4.0)	BLQ(LOQ:4)
22	Dissolved Oxygen	mg/l	3.0 mg/l or 40% saturation value whichever is higher	6.6	6.8	6.1	6.8
23	Nitrite as NO_2	mg/l	-	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.005)
24	Ammoniacal Nitrogen as NH_3-N	mg/l	-	2.27	0.34	0.18	0.37
25	Petroleum Hydrocarbons	mg/l	-	LQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)
26	Floating Matters	mg/l	10 mg/l	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)
27	Electrical Conductivity	µS/cm	-	15273	14738	16189	13898
28	COD	mg/l	-	44	42	46	40
29	Alkalinity as CaCO3	mg/l	-	277	267	294	252
30	Total Hardness as CaCO3	mg/l	-	677	653	717	616
31	Calcium as Ca	mg/l	-	196	189	208	178
32	Magnesium as Mg	mg/l	-	75	73	80	68
33	Sodium as Na	mg/l	-	1041	1004	1103	947
34	Potassium as K	mg/l	-	93	92	101	86
35	Flouride as F	mg/l	-	0.73	0.71	0.78	0.67
36	Phenolic compound as C6H5OH	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
37	Cyanide	mg/l	-	Absent	Absent	Absent	Absent
38	Aluminium	mg/l	-	9.69	9.35	10.3	8.82
39	Total coliforms	MPN/100 ml	-	1000	1200	1300	900

Note: BLQ- Below the Limit of Quantification; LOQ- Limit of Quantification.

Analyst

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TEST REPORT-12

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Marine Water Quality
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date : 17/05/2023

S.No.	Parameters	Units	Primary Water Quality Criteria for Class SW- IV (for Harbour Waters)	Near Outer Terminal – II Lat: 22° 1' 9.82758" N Log: 88° 4' 42.09802" E		Near Lock Approach Lat: 22° 1' 28.54146" N Log: 88° 5' 14.06292" E	
				Surface at 0.3m	Bottom at 7m	Surface at 0.3m	Bottom at 7m
1	pH (at 25 °C)	-	6.5 – 9.0	7.72	7.65	7.82	7.91
2	Colour	Hazen Unit	No visible colour	BLQ(LOQ:1)	BLQ(LOQ:1)	BLQ(LOQ:1)	BLQ(LOQ:1)
3	Turbidity	NTU	-	151.0	95.2	57.0	98.0
4	Odour	-	No offensive odour	Agreeable	Agreeable	Agreeable	Agreeable
5	Chloride as Cl	mg/l	-	2146	2042	1846	2216
6	Total Suspended Solids	mg/l	-	646	756	689	804
7	Salinity	ppt	-	9.22	9.12	9.06	10.14
8	Total Dissolved Solids	mg/l	-	10264	9856	9646	110262
9	Sulphate as SO_4	mg/l	-	542.36	568.2	524.6	621.5
10	Nitrate as NO_3	mg/l	-	BLQ(LOQ 1)	BLQ(LOQ 1)	5.35	6.2
11	Iron as Fe	mg/l	-	1.51	0.48	1.46	BLQ(LOQ:0.02)
12	Zinc as Zn	mg/l	-	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)
13	Chromium as Cr	mg/l	-	BLQ(LOQ:0.01)	BLQ(LOQ:0.01)	BLQ(LOQ:0.01)	BLQ(LOQ:0.01)
14	Copper as Cu	mg/l	-	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)	0.041	0.082
15	Cadmium as Cd	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
16	Lead as Pb	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
17	Arsenic as As	mg/l	-	BLQ(LOQ0.0005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	0.021
18	Mercury as Hg	mg/l	-	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)
19	Phosphate as PO_4	mg/l	-	0.11	0.13	0.10	0.12
20	BOD, 5 days @ 20°C as O_2	mg/l	5 mg/l	8.0	7.0	6.0	8.0
21	Oil and Grease	mg/l	-	BLQ(LOQ:4)	BLQ(LOQ:4)	BLQ(LOQ:4)	BLQ(LOQ:4)
22	Dissolved Oxygen	mg/l	3.0 mg/l or 40% saturation value whichever is higher	6.7	6.9	6.7	6.3
23	Nitrite as NO_2	mg/l	-	BLQ(LOQ:0.005)	BLQ(LOQ:0.005)	BLQ(LOQ:0.005)	BLQ(LOQ:0.005)
24	Ammoniacal Nitrogen as NH_3-N	mg/l	-	0.42	1.42	1.62	2.47
25	Petroleum Hydrocarbons	mg/l	-	BLQ(LOQ0.00001)	BLQ(LOQ0.00001)	BLQ(LOQ 0.00001)	BLQ(LOQ 0.00001)
26	Floating Matters	mg/l	10 mg/l	BLQ(LOQ:1)	BLQ(LOQ:1)	BLQ(LOQ:1)	BLQ(LOQ:1)
27	Electrical Conductivity	µS/cm	-	16456	15948	15264	17285
28	COD	mg/l	-	42	38	48	52
29	Alkalinity as CaCO3	mg/l	-	278	265	246	298
30	Total Hardness as CaCO3	mg/l	-	646	652	614	716
31	Calcium as Ca	mg/l	-	192	188	176	208
32	Magnesium as Mg	mg/l	-	72	78	69	82
33	Sodium as Na	mg/l	-	1038	1012	988	1124
34	Potassium as K	mg/l	-	92	86	72	98
35	Flouride as F	mg/l	-	0.63	071	0.76	0.68
36	Phenolic compound as C6H5OH	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
37	Cyanide	mg/l	-	Absent	Absent	Absent	Absent
38	Aluminium	mg/l	-	9.56	10.26	8.46	11.52
39	Total coliforms	MPN/100 ml	-	1000	980	980	1200

Note: BLQ- Below the Limit of Quantification; LOQ- Limit of Quantification.

Analyst

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TEST REPORT-13

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Marine Water Biological Analysis (0.3 meter)**

Sample Mark : **Near1st Oil Jetty (Downstream)**
(Lat: 22° 1' 6.43649'' N Log: 88° 4' 49.17749'' E)

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Phytoplankton (64µm mesh)**		
	Total Cell Count	7100 cells/L	APHA 24th Edition Part 10000
	Total Genus	08	
	Genus	Ceratiumspp, Peridiniumspp, Chaetocerosspp, Triodesmiumspp, Pyroystisspp, Noctiluaspp, Biddulphiaspp.,Odontellaspp	
2	**Zooplankton (200µm mesh)**		
	Total Cell Count	3300 cells/L	APHA 24th Edition Part 10000
	Total Genus	04	
	Genus	Ceratiumspp,Thalassiosiraspp,Ceratiumspp,Rhizosoleniaspp	

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TEST REPORT-14

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Marine Water Biological Analysis (0.3 meter)**
Sample Mark : **Near Lock Approach (Lat: 22° 1' 28.54146" N Log: 88° 5' 14.06292" E)**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Phytoplankton (64µm mesh)**		
	Total Cell Count	5700 cells/L	APHA 24th Edition Part 10000
	Total Genus	08	
	Genus	BiddulphiaSpp,PhaeocystisSpp,ScripsssiellaSpp, NaviculaeSpp,ThalassiosiraSpp.RhizoseleniaSpp,GymnodiumSpp,Dinoflagellates	
2	**Zooplankton (200µm mesh)**		
	Total Cell Count	2800 cells/L	APHA 24th Edition Part 10000
	Total Genus	05	
	Genus	TitinopsisSpp,AcartiaSpp,Oithanarigida,Copepods,CrabZoae	

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TEST REPORT-15

Name of the Client :**M/s Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Marine Water Biological Analysis (0.3 meter)**
Sample Mark : **Near Outer Terminal– II (Lat: 22° 1' 9.82758" N Log: 88° 4' 42.09802" E)**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Phytoplankton (64µm mesh)**		
	Total Cell Count	6100 cells/L	APHA 24th Edition Part 10000
	Total Genus	08	
	Genus	ThalassiosiraSpp,RhizosceleniaSpp,GymnodiumSpp, Dinoflagellates,Ceratumfuscus,Coscinodiscusspp,Corethronspp,MelosiraSpp	
2	**Zooplankton (200µm mesh)**		
	Total Cell Count	3000 cells/L	APHA 24th Edition Part 10000
	Total Genus	05	
	Genus	Crab, Zoea,AcartiaSpp,EucalanusSpp,TitinopsisSpp,	

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TEST REPORT-16

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Marine Water Biological Analysis (0.3 meter)**

Sample Mark : **Near HFTPL Jetty (Downstream)**
(Lat: 22° 0' 53.85895" N Log: 88° 4' 5.79562" E)

Sample Drawn By : **Hubert Enviro Care Systems Private Limited**

Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Phytoplankton (64µm mesh)**		
	Total Cell Count	6000 cells/L	APHA 24th Edition Part 10000
	Total Genus	07	
	Genus	OdontellaSpp,BiddulphiaSpp,PhaeocystisSpp,ScrippssiellaSpp,NaviculaeSpp,ThalassiosiraSpp,RhizoseleniaSpp	
2	**Zooplankton (200µm mesh)**		
	Total Cell Count	2500 cells/L	APHA 24th Edition Part 10000
	Total Genus	05	
	Genus	OheliaSpp,AcartiaSpp,EucalanusSpp,TitinopsisSpp,MetacalanusSpp	

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5.5 Light

The amount of light that phytoplankton are accumulated to not only affect their growth but also their fluorescence output. Phytoplankton situated at the top of the water column on a bright sunny day can get over-saturated with light energy thereby decreasing the amount of fluorescence that their cells give off. Conversely, phytoplankton deeper in the water column where there is minimal light may adapt their shapes to maximize processing light energy for growth, which in turn increases the amount of fluorescence per cell. The light penetration found near HFTPL Jetty, 1st oil jetty, near OT-II and Lock approach location were moderate to low. As high turbidity of water may affect the light penetration into the water body.

5.6 Chlorophyll Content Estimation

Chlorophyll-containing phytoplankton was measured; 25 ml of sample water are concentrated by filtration at low vacuum through a glass fiber filter. The pigments are extracted from the phytoplankton in 90% acetone with the aid of a mechanical tissue grinder and are allowed to steep 2-24 hours. The resulting slurry is centrifuged to clarify the solution, and the absorbance of the supernatant liquid was measured at different wavelengths to determined chlorophylls a, b, and c (630, 647 and 664) respectively. Absorbance values was entered into a set of equations to that utilize the extinction coefficients of the pure pigments in 90% acetone to simultaneously calculate the concentrations of the pigments in a mixed solution.

In the optical methods the pigments such as (Chlorophyll a, b, and c) were identified. The phyto plankotonic community of the Haldia Port reservoir is composed predominantly by Chlorophyceae and Bacillariphyceae. Phytoplanktonic community is dominated by cyanobacteria being the Chlorophyceae is the second most abundant group. Results are shown in **Figure 8 and 9,** respectively for the month of **Mar'2023– May'2023**in the place of near HFTPL Jetty, 1st oil jetty, near OT-II and Lock approach location of Hooghly river.

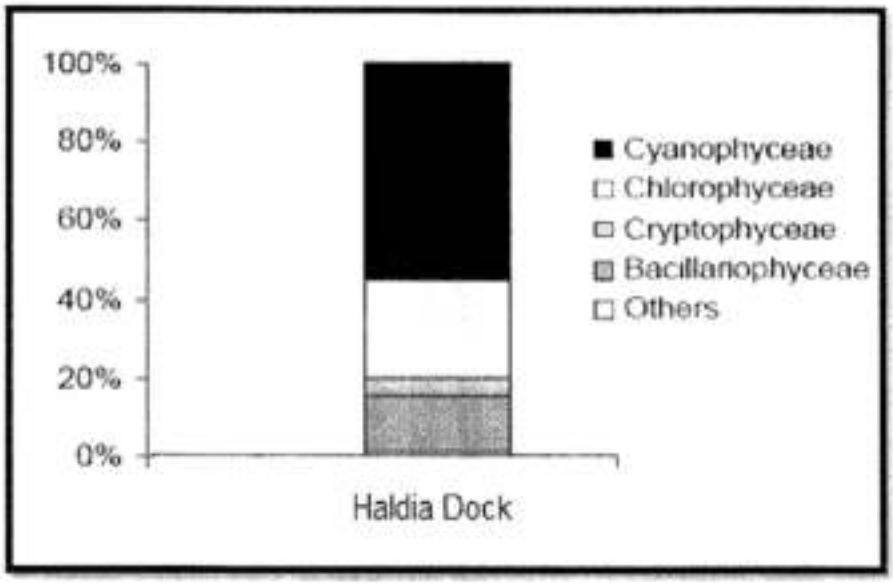

Figure 8. The Average phytoplankton distribution in the Haldia port during the period **Mar 2023 – May 2023**

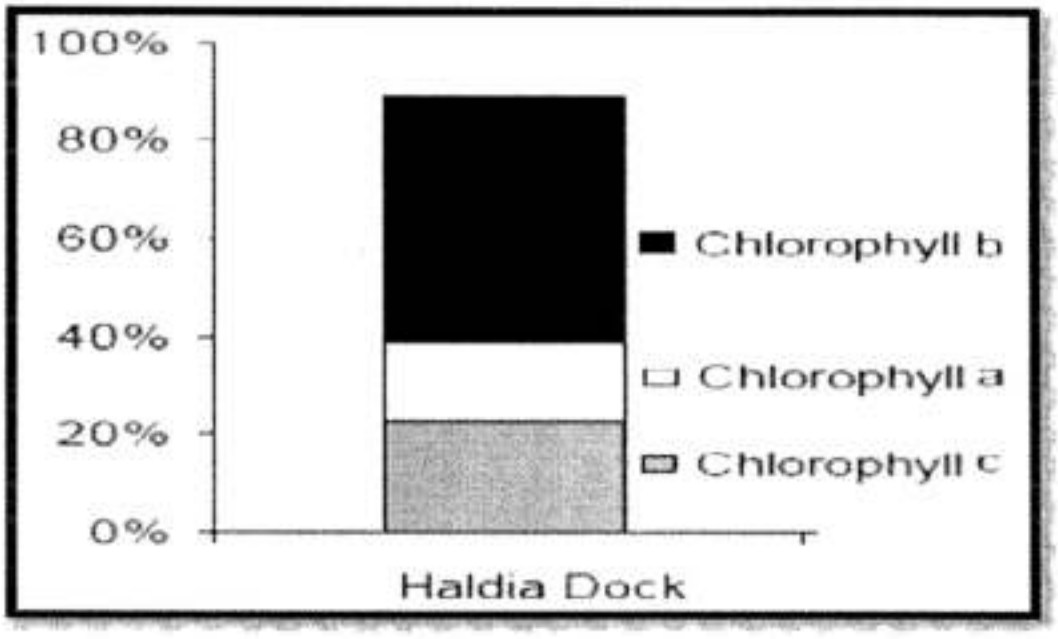

Figure 9. The Average concentration of Chlorophyll a, b and c in the Haldia port during the period **Mar2023 – May 2023**

5.7 Primary Productivity

Productivity refers to the rate of production on a unit area basis. The total amount of solar energy converted to chemical energy by green plant is gross primary production.The estimation of primary productivity is predicted on the relationship between oxygen evolution and carbon fixation. Primary productivity varies from freshwater to estuarine and from estuarine to marine water body like 3rd oil Jetty, 1st oil jetty, Project site and Lock Approach.

The data was observed for monthly variation from **Mar'2023 -May'2023**of gross primary productivity (GPP), net primary productivity (NPP) and community respiration (CR) along with mean standard deviation from **Mar'2023 -May'2023**as shown in **Figure 4.**

Table 5.4. MeanMonthlyVariationsof GPP,NPPandRESValuesing$Cm^{-2}day^{-1}$(Mean± SD)atHaldia Dock Complex during**Mar'2023 -May'2023.**

Months	Temperature ofWaterin^{0}C	GPP $gCm^{-2}day^{-1}$	NPP $gCm^{-2}day^{-1}$	RES(CR) $gCm^{-2}day^{-1}$	IS:10500 - 2012	
					Acceptable Limits	Permissible Limits
Mar	28.6	161.04 ±4.05	121.9 ± 5.47	38.14 ± 4.27	NA	NA
April	29.4	171.12 ± 2.57	130.5± 2.68	41.05 ± 2.56	NA	NA
May	29.9	176.76 ± 2.72	142.9 ± 2.89	42.07 + 3.64	NA	NA

Note: GPP - Gross Primary Productivity, NPP - Net Primary Productivity, CR - Community Respiration, NA – Not Applicable.

5.8Shell Fish and Fin Fish

During water quality monitoring near HFTPL Jetty, 1st oil jetty, Outer Terminal II and Lock Approach 2 species of shell fishes i.e. Penaeus monodon and Penaeus indicus and 3 species of fin fishes like Labeo bata, Puntius sophore and Tenualosa toil were found.

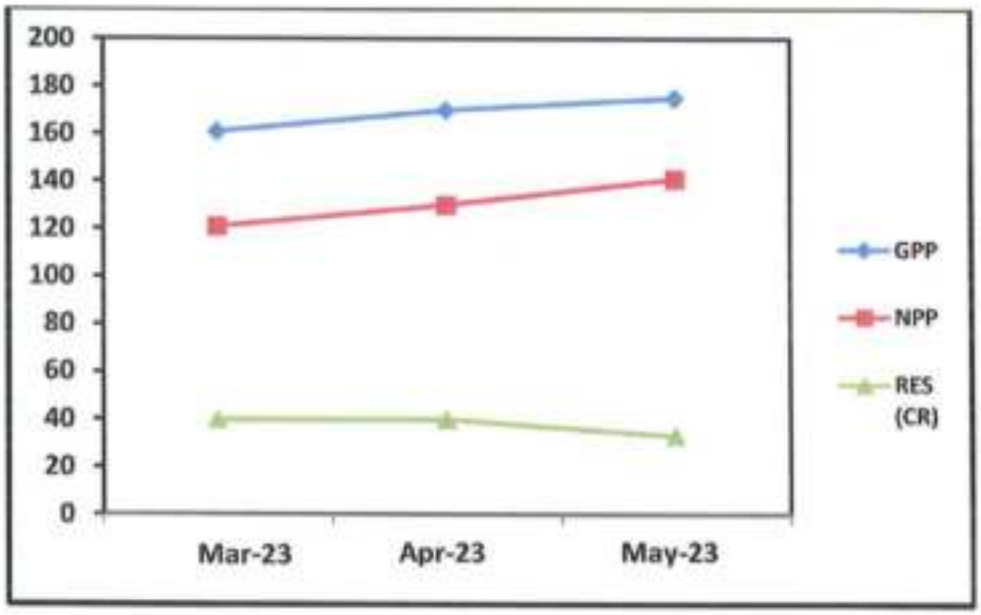

Figure 10. Monthly variations in Primary Productivity (GPP, NPP & CR) of Haldia Port 2022 ($gCm^{-2}day^{-1}$).

6.0 SEDIMENT QUALITY RESULTS

6.1 Monitoring Location Selection Criteria

The sediment sampling locations were selected as per the identified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 6.1.

Table 6.1: Sediment Quality Monitoring Locations

Sl. No.	Sediment Sampling Location	Sample Code
1	Near 1st Oil Jetty	S1
2	Near HFTPL Jetty	S2
3	Near Lock Approach	S3
4	Near Outer Terminal – II	S4

6.2 Monitoring Methodology

Sediment samples were collected at four locations and analyzed as per the standard existing procedures. Sterilized canisters were used for collection of sediment samples, stored in ice box and transported to laboratory for chemical analysis as per APHA Standard Method and results recorded for chemical parameters like pH, Texture, Sodium, Potassium, Phosphate, Chlorides and Sulphates.

Sediment grab samples were also collected using a Petersen grab, sieved and processed for biological analysis – microbenthic, meiobenthic and macrobenthic community structure analyses in laboratory and results reported in line with the procedures of APHA 22nd Edition 2012 and referring standard species identification references. The benthos samples processing is described below:

The collected wet sediment samples are sieved with varying mesh sizes for segregating the organisms. Macrobenthos are organisms which are retained in the sieve having mesh size between 0.5 and 1 mm. The term meiofauna loosely defines a group of organisms by their size, larger than microfauna but smaller than macrofauna, rather than a taxonomic grouping. In practice, that is organisms that can pass through a 1 mm mesh but will be retained by a 45 µm mesh. Organisms below size of 45 µm are regarded as microbenthos. The sieved organisms are then stained with Rose Bengal and sorted into different groups. The number of organisms in each grab sample is expressed in number per meter square.

6.3 Sampling

The marine sediment sampling in different locations were conducted and chemical analyses for various parameters were completed as per APHA methods and the results are provided in the following report.

Microbenthos, meiobenthos, macrobenthos were recorded in marine sediment samples collected from four locations namely **Near1st Oil Jetty (Upstream), Near Lock Approach, Near Outer Terminal – Hand Near HFTPL Jetty (Downstream)** and results are recorded in Annexure.

In microbenthos, organisms recorded included diatoms, ciliates, Amoeba, protozoans and flagellates. Groups including bivalves, echinoderms, sea anemones, sea squirts, turbellarians, and polychaete worms were recorded under macrobenthos.

TEST REPORT-17

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Sediment Analysis
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date : 17/05/2023

S.No.	Parameters	Units	Near 1st Oil Jetty (Upstream)	Near HFTPL Jetty (Downstream)	Near Lock Approach	Near Outer Terminal – II
1	pH	-	7.26	7.14	6.82	7.17
2	Texture		Clay Loam	Clay	Clay Loam	Clay
	Sand	%	33.9		25.1	27.9
	Silt	%	39.3	28.3	42.8	30.5
	clay	%	26.8	38.5	32.1	41.6
3	Sodium	mg/kg	802.40	436.71	860.15	890.45
4	Potassium	mg/kg	56.1	22.45	60.35	85.4
5	Phosphate	mg/kg	3.21	4.35	9.35	5.46
6	Chlorides	mg/kg	1508.45	492.45	1657.0	1944.50
7	Sulphates	mg/kg	1754	1024.5	1154.22	590.45
8	Cadmium as Cd	mg/kg	<1.0	<1.0	<1.0	<1.0
9	Copper as Cu	mg/kg	<1.0	<1.0	<1.0	<1.0
10	Lead as Pb	mg/kg	<1.0	<1.0	<1.0	<1.0
11	Zinc as Zn	mg/kg	6.58	7.26	8.01	6.52
12	Magnesium as Mg	mg/kg	852	754	901	843
13	Arsenic as As	mg/kg	<1.0	<1.0	<1.0	<1.0

Analyst Signatory

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TEST REPORT-18

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Sediment Biological Analysis**
Sample Mark : **Near1st Oil Jetty**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
	Microbenthos		
	Total Genus	04	
1	Genus	Diatoms,Ciliates,Amoeba,Flagellates	APHA 22nd Edition 2012
	MacroBenthos		
	Total Genus	04	
2	Genus	Bivalves,Echinoderms,Sponges,Sea Squirts	APHA 22nd Edition 2012
	Meiobenthos		
	Total Genus	06	
3	Genus	Navicula Spp, Eucalanus Spp,Obelia Spp,Titinopsis cylindrica,Globigerina Spp, Rhincalanus spp	APHA 22nd Edition 2012

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TEST REPORT-19

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Sediment Biological Analysis**
Sample Mark : **Near Lock Approach**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Microbenthos**		
	Total Genus	05	APHA 22nd Edition 2012
	Genus	Diatoms,Ciliates,Amoeba,Flagellates,Protozoans	
2	**MacroBenthos**		
	Total Genus	06	APHA 22nd Edition 2012
	Genus	Bivalves,Echinoderms,Sea anemones,Sponges,Sea Squirts, Crustceans	
3	**Meiobenthos**		
	Total Genus	5	APHA 22nd Edition 2012
	Genus	Obelia Spp,Acartia Spp,Titinopsis Spp,Copepods, Gymnodium Spp.	

Analyst Signatory

HUBERT ENVIRO CARE SYSTEMS (P) LTD. Chennai 600 083

Authorized Signatory

TEST REPORT-20

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Sediment Biological Analysis**
Sample Mark : **Near Outer Terminal – II**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Microbenthos**		
	Total Genus	04	APHA 22nd Edition 2012
	Genus	Diatoms,Ciliates,,Flagellates,Protozoans	
2	**MacroBenthos**		
	Total Genus	07	APHA 22nd Edition 2012
	Genus	Bivalves,Echinoderms,Sea anemones,Corals,Sponges,Turbellarians,crustceans	
3	**Meiobenthos**		
	Total Genus	05	APHA 22nd Edition 2012
	Genus	odontella Spp, Copepod nauplii,Titinopsis cylindrica,Globigerina Spp, Dinophysis Spp	

Analyst Signatory

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Authorized Signatory

TEST REPORT-21

Name of the Client :**M/s.Haldia Dock Complex, SMP, Kolkata**

Sample Description : **Sediment Biological Analysis**
Sample Mark : **Near HFTPL Jetty**
Sample Drawn By : **Hubert Enviro Care Systems Private Limited**
Sampling Date : **17/05/2023**

S.No	Parameters	Values	Test Method
1	**Microbenthos**		
	Total Genus	05	APHA 22nd Edition 2012
	Genus	Diatoms,Ciliates,,Flagellates,Protozoans,Amoeba	
2	**MacroBenthos**		
	Total Genus	08 No's	APHA 22nd Edition 2012
	Genus	Bivalves,Echinoderms,Sea anemones,Corals,Sponges,Sea squirts,Polychaeteworms,crustceans	
3	**Meiobenthos**		APHA 22nd Edition 2012
	Total Genus	06	
	Genus	Rhizosolenia Spp,Dinophysis Spp ,Thalassiosira Spp,Obelia Spp,Eucalanus Spp,Crab Zoea.	

Analyst Signatory

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Authorized Signatory

7.0 GREEN BELT DEVELOPMENT

7.1 Biodiversity Assessment of Green belt trees

The main objectives of Green Belt development within industrial premises are to absorb the dust and gaseous pollutants, increasing CO_2 absorption and releasing of O_2 for better environment besides providing aesthetic view. It is mandatory that all industrial units have to maintain at least 33 % of Green belt area of the total plot area. Biodiversity encompasses the variety of life at all levels of organization, from genetic diversity within a species to diversity within entire regions or ecosystems. Biodiversity has to be assessed quantitatively with proper scientific, ecological and statistical methods like Quadrat sampling, enumeration of species list, counting and mapping of vegetation. The green belt development has to be maintained regularly within the periphery of the area by the industrial unit as per the statutory requirements of pollution control authorities.

The existing Green Belt area in the industrial premises was physically surveyed in every month during the study period. The Mangroves species were not found in the study location however, terrestrial tree species were found in the study area and the list of available tree species has been enumerated and presented below.

Table 7.1 Illustrates the list of tree species observed overall. Species counted at specific location (Chairmen House/Cluster IV/DAV School/Cluster VIII)around 5 Kilometers in the **M/s. Haldia Dock Complex, SMP, Kolkata** area during the **Mar'2023 -May'2023** biodiversity survey has been given.

S. No.	Scientific Name	Common/Local Name	Family	Count	pi	lnpi	(-) pi*lnpi
1	*Acacia auriculiformis*	Akasmoni	Mimosaceae	27	0.0123	-4.3990	0.054062
2	*Acacia nilotica*	Babul	Mimosaceae	29	0.0132	-4.3276	0.0571
3	*Achras sapota*	Sapeda	Zapotaceae	5	0.0023	-6.0854	0.0138
4	*Adina cordifolia*	Haldu	Rubiaceae	0	0.0000	0.0000	0.0000
5	*Aegle marmelos*	Wood Apple	Rutaceae	73	0.0332	-3.4044	0.1131
6	*Albizzia lebbeck*	Siris	Mimosaceae	37	0.0168	-4.0839	0.0688
7	*Alstonia scholaris*	Chatim	Apocyanaceae	135	0.0614	-2.7896	0.1714
8	*Anacardium occidentale*	Cashew nut	Anacardiaceae	0	0.0000	0.0000	0.0000
9	*Anthocephalus chinensis*	Kadam	Rubiaceae	11	0.0050	-5.2970	0.0265
10	*Areca catechu*	Betel nut Palm	Palmaceae	17	0.0077	-4.8616	0.0376
11	*Artocarpus integrifolia*	Jackfruit	Moraceae	35	0.0159	-4.1395	0.0659
12	*Azadirachta indica*	Neem	Meliaceae	17	0.0077	-4.8616	0.0376
13	*Bauhinia acuminata*	Camel's foot tree	Caesalpiniaceae	0	0.0000	0.0000	0.0000
14	*Bombax malabaricum*	Red Silk Cotton tree	Bombacaceae	15	0.0068	-4.9868	0.0340
15	*Borassus flabellifer*	Palmyra palm	Palmae	49	0.0223	-3.8030	0.0848
16	*Callistemon speciosus*	Bottle brush tree	Myrtaceae	133	0.0605	-2.8045	0.1698
17	*Callophyllum inophyllum*	Indian Laurel	Callophyllaceae	0	0.0000	0.0000	0.0000
18	*Cassia fistula*	Indian Laburnum, Golden shower tree	Caesalpiniaceae	22	0.0100	-4.6038	0.0461
19	*Cassia siamea*	Chakunda	Caesalpiniaceae	47	0.0214	-3.8447	0.0822
20	*Casuarina equisetifolia*	Australian pine tree, Jhau	Casuarinaceae	147	0.0669	-2.7044	0.1810
21	*Cocos nucifera*	Coconut palm	Palmae	41	0.0187	-3.9813	0.0743
22	*Dalbergia sissoo*	Indian Rosewood, Sishu	Fabaceae	12	0.0055	-5.2099	0.0285
23	*Delonix regia*	Flame tree, Gulmohar	Caesalpiniaceae	39	0.0178	-4.0313	0.0716
24	*Dillenia indica*	Elephant Apple, Chalta	Dilleniaceae	12	0.0055	-5.2099	0.0285
25	*Eriodendron anfractuosum*	White Silk Cotton tree	Bombacaceae	19	0.0086	-4.7504	0.0411
26	*Eucalyptus globulus*	Eucalyptus	Myrtaceae	15	0.0068	-4.9868	0.0340
27	*Excoecaria agallocha*	Geanoa	Euphorbiaceae	0	0.0000	0.0000	0.0000
28	*Feronia elephantum*	Elephant apple	Rutaceae	9	0.0041	-5.4976	0.0225
29	*Ficus bengalensis*	Banyan tree	Moraceae	28	0.0127	-4.3626	0.0556
30	*Ficus cunia*	Fig tree	Moraceae	7	0.0032	-5.7489	0.0183
31	*Ficus religiosa*	Peepul tree	Moraceae	12	0.0055	-5.2099	0.0285
32	*Gliricidia sepium*	Gliricidia, Quickstick	Fabaceae	17	0.0077	-4.8616	0.0376
33	*Gmelina arborea*	Gamhar	Verbanaceae	15	0.0068	-4.9868	0.0340
34	*Grevillea robusta*	Silver fir, Silky Oak	Proteaceae	0	0.0000	0.0000	0.0000
35	*Grewia asiatica*	Phalsa	Tiliaceae	0	0.0000	0.0000	0.0000
36	*Holarrhena antidysenterica*	Kurchi	Apocynaceae	0	0.0000	0.0000	0.0000

37	*Holoptelea integrifolia*	Indian Elm	Ulmaceae	20	0.0091	-4.6991	0.0428
38	*Lagerstroemia flosreginae*	Jarul	Lythraceae	25	0.0114	-4.4760	0.0509
39	*Leucaena leucocephala*	White Lead tree, Subabul	Mimoaceae	55	0.0250	-3.6875	0.0923
40	*Mangifera indica*	Mango tree	Anacardiaceae	65	0.0296	-3.5205	0.1042
41	*Michelia champaca*	Champak	Magnoliaceae	0	0.0000	0.0000	0.0000
42	*Millingtonia hortensis*	Indian Cork tree	Bignoniaceae	0	0.0000	0.0000	0.0000
43	*Mimusops elengi*	Spanish Cherry, Bakul	Zapotaceae	85	0.0387	-3.2522	0.1258
44	*Morinda citrifolia*	Indian Mulberry	Rubiaceae	0	0.0000	0.0000	0.0000
45	*Moringa pterygosperma*	Drumstick tree, Sajina	Moringaceae	15	0.0068	-4.9868	0.0340
46	*Morus indica*	Mulberry	Moraceae	0	0.0000	0.0000	0.0000
47	*Nephelium litchi*	Litchi	Sapindaceae	3	0.0014	-6.5962	0.0090
48	*Peltophorum pterocarpum*	Radhachura	Fabaceae	227	0.1033	-2.2699	0.2345
49	*Phoenix sylvestris*	Date palm	Palmae	17	0.0077	-4.8616	0.0376
50	*Pithecellobium dulce*	Manila Tamarind	Fabaceae	15	0.0068	-4.9868	0.0340
51	*Plumeria acutifolia*	Pagoda tree	Apocynaceae	7	0.0032	-5.7489	0.0183
52	*Polyalthia longifolia*	False Ashoka, Debdaru	Annonaceae	33	0.0150	-4.1983	0.0631
53	*Pongamia glabra*	Pongam Oil Tree, Karang	Fabaceae	11	0.0050	-5.2970	0.0265
54	*Psidium guajava*	Guava	Myrtaceae	156	0.0710	-2.6450	0.1878
55	*Pterospermum acerifolium*	Muchkund	Sterculiaceae	0	0.0000	0.0000	0.0000
56	*Putranjiva roxburghii*	Putranjiva	Euphorbiaceae	0	0.0000	0.0000	0.0000
57	*Samanea saman*	Rain tree	Fabaceae	17	0.0077	-4.8616	0.0376
58	*Saraca indica*	Ashok	Fabaceae	155	0.0706	-2.6514	0.1871
59	*Sesbania grandiflora*	Hummingbird tree, Bakful	Fabaceae	9	0.0041	-5.4976	0.0225
60	*Sonneratia apetala*	Keora	Lythraceae	0	0.0000	0.0000	0.0000
61	*Spathodea campanulata*	Fountain tree	Bignoniaceae	5	0.0023	-6.0854	0.0138
62	*Swietenia mahagoni*	Mahogany	Meliaceae	149	0.0678	-2.6909	0.1825
63	*Syzygium cumini*	Jam, Java plum	Myrtaceae	35	0.0159	-4.1395	0.0659
64	*Syzygium samarangense*	Rose apple, Jamrul	Myrtaceae	11	0.0050	-5.2970	0.0265
65	*Tamarindus indica*	Tamarind	Fabaceae	3	0.0014	-6.5962	0.0090
66	*Tamarix dioica*	Nona Jhau	Tamaricaceae	15	0.0068	-4.9868	0.0340
67	*Tectona grandis*	Teak	Verbenaceae	9	0.0041	-5.4976	0.0225
68	*Terminalia arjuna*	Arjun	Combretaceae	16	0.0073	-4.9223	0.0358
69	*Terminalia catappa*	Indian Almond	Combretaceae	3	0.0014	-6.5962	0.0090
70	*Thespesia populnea*	Tulip Tree	Malvaceae	0	0.0000	0.0000	0.0000
71	*Trema orientalis*	Charcoal tree	Ulmaceae	11	0.0050	-5.2970	0.0265
72	*Trewia nudiflora*	Pituli	Euphorbiaceae	0	0.0000	0.0000	0.0000
			Total	2197			3.452

7.2 Biodiversity Indices

The field survey was completed by HECS team in covered location at Makhanbabur Bazaar to Jawahar Tower around 5 Kilometers in the **M/s. Haldia Dock Complex, SMP, Kolkata** during **Mar'2023 -May'2023**; a total number of 2197 trees (N) have been recorded in the green belt area which comprise 55 numbers of species (S).

Shannon-Wiener Diversity (Biological Diversity)

Shannon-Wiener Index, originally proposed by Claude Shannon, a physicist, is the most commonly used biodiversity indices. It is also called Shannon's diversity index. It is an index that is commonly used to characterize species diversity in a community.

Shannon-Wiener Index is defined by the following function:

$$H = \Sigma[(pi)x\ln(pi)]$$

H = 3.452 (As per the Table Calculation)

Where:

- $p\ i$ = proportion of total sample represented by species i. Divide no. of individuals of species i by total number of samples.

The biological diversity (Shannon-Weiner Index-H') value recorded is 3.452, which represents relatively good diversity among the green belt plant species.

Species Richness (D)

Species richness is the number of different species represented in an ecological community, landscape or region. Species richness is simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions.

The larger the sample, the more species we would expect to find.Species richness is calculated bydividing the number of species by the square root of the number of individuals in the sample. This particular measure of species richness is known as D, the Menhinick's index:

$$D = \frac{s}{\sqrt{N}}$$

D = 55/√2197= 1.17

Where s equals the number of different species represented in your sample, and N equals the total number of individual organisms in the sample.

Species Evenness(J')

Species evenness refers to how close in numbers each species in an environment is. Mathematically it is defined as a diversity index, a measure of biodiversity which quantifies how equal the community is numerically. Species evenness is used to assess how evenly the population is spread across the species in an area.

Species Evenness= H/H_{max}

H= 3.452

H_{max} = l.n(S) =ln(55) = 4.0

= 3.452/4.0 = 0.862

Significant species evenness (J') of 0.862has been recorded among all the species surveyed.

Depicts the biodiversity indices plot for the green belt tree species surveyed in and around the **M/s. Haldia Dock Complex, SMP, Kolkata**area. Based on the biodiversity, indices calculations was performed using software PRIMER for the trees surveyed at **M/s. Haldia Dock Complex, SMP, Kolkata** green belt areas, it is inferred that the areas indicate higher species richness (1.17), diversity (3.452) and significant evenness (0.862) as shown in **Figure 11.**

Girth Size: Girth is a measurement of the distance around the trunk of a tree measured perpendicular to the axis of the trunk. The girth size is measured on an average at the height of 1.5 m above the ground. The girth size varies 30 to 196 cm in the study area during the monitoring period.

Dust Deposition: Average dust deposition found in the area is 0.6 mg/cm^2.

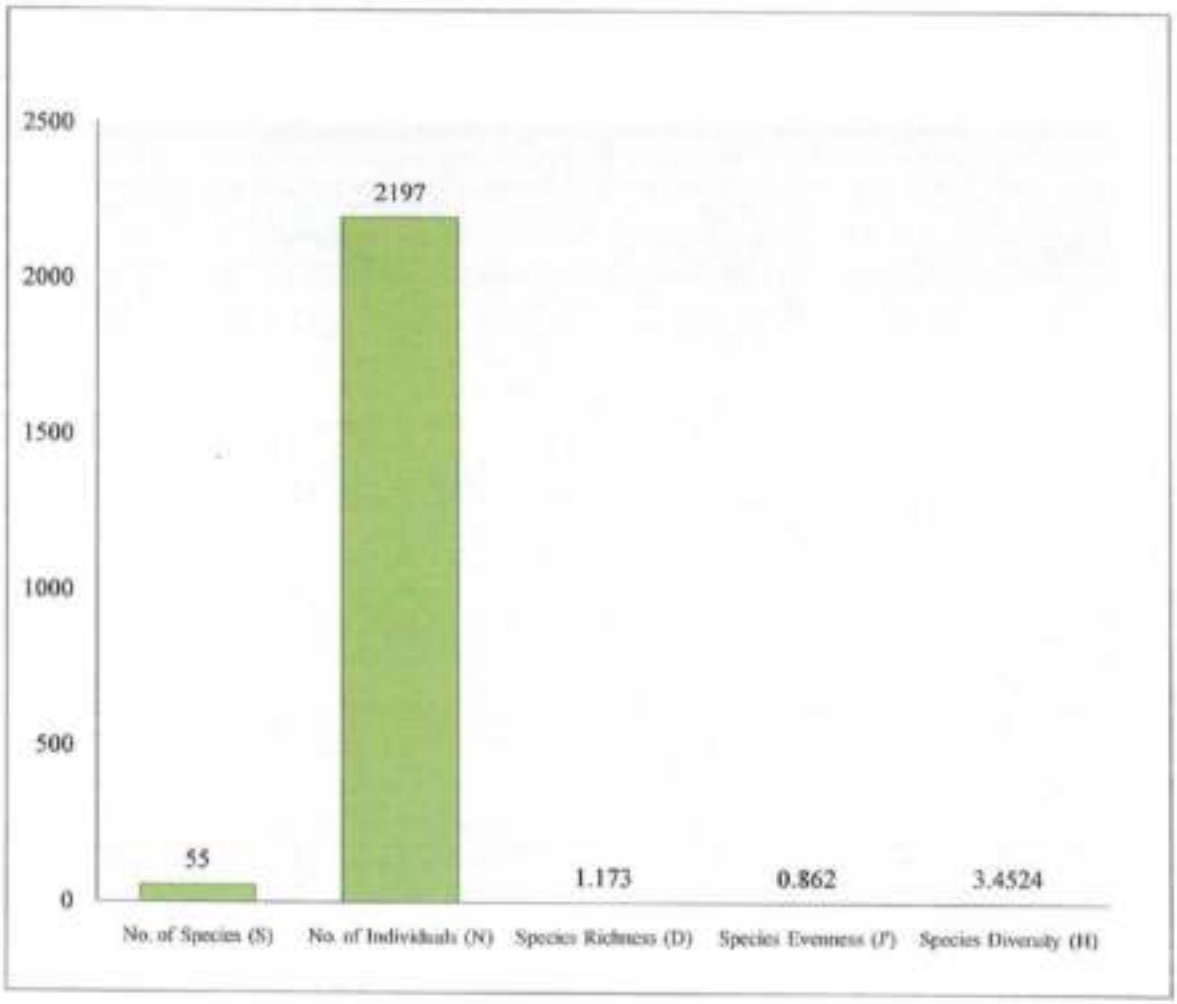

Figure 11. Biodiversity indices plot for the green belt tree species.

HaldiaDock Complex, SMP, Kolkata

Green Belt Survey

Covered Location at Makhanbabur Bazaar to Jawahar Tower

		
1. Akasmoni *Acacia auriculiformis*	2. Babul *Acacia nilotica*	3. Sapeda *Achras Sapota*
		
4.Wood Apple *Aegle Marmelos*	5.Siris *Albizzia lebbeck*	6. Chatim *Alstonia scholaris*

		
7.Kadam *Anthocephalus chinensis*	8.Betel Nut Palm *Areca Catechu*	9.Jack Fruit *Artocarpus Integrifolia*
		
10. Neem *Azadirachta Indica*	11. Red Silk Cotton Tree *Bombax malabaricum*	12. Palmyra palm *Borassus flabellifer*
		
13.Bottle brush tree *Callistemon speciosus*	14. Golden shower tree *Cassia fistula*	15. Chakunda *Cassia siamea*

		
16. Jhau *Casuarina equisetifolia*	17.Coconut palm *Cocos nucifera*	18.Indian Rosewood/Sishu *Dalbergia Sissoo*
		
19.Flame tree/Gulmohar *Delonix regia*	20.Elephant Apple/ Chalta *Dillenia Indica*	21.White silk cotton tree *Eriodendron anfractuosum*
		
22. Eucalyptus *Eucalyptus globulus*	23. Elephant apple *Feronia elephantum*	24. Banyan tree *Ficus bengalensis*

25. Fig tree
Ficus cunia

26. Peepul tree
Ficus religiosa

27. Gliricidia/Quickstick
Gliricidia sepium

28. Gumhar
Gmelina arborea

29. Indian Elm
Holoptelea integrifolia

30. Jarul
Lagerstroemia flosreginae

31. White Lead tree, Subabul
Leucaena leucocephala

32. Mango tree
Mangifera indica

33. Spanish Cherry, Bakul
Mimusops elengi

		
34. Drumstick tree/ Sajina *Moringa pterygosperma*	35. Litchi *Nephelium litchi*	36. Radhachura *Peltophorum pterocarpum*
		
37. Date palm *Phoenix sylvestris*	38. Manila Tamarind *Pithecellobium dulce*	39. Pagoda tree *Plumeria acutifolia*
		
40. False Ashoka, Debdaru *Polyalthia longifolia*	41. Pongam Oil Tree, Karang *Pongamia glabra*	42. Guava *Psidium guajava*

		
43. Rain tree *Samanea saman*	*44.* Ashok *Saraca indica*	45.Hummingbird tree, Bakful *Sesbania grandiflora*
		
46. Fountain tree *Spathodea campanulata*	47. Mahogany *Swietenia mahagoni*	48. Jam, Java plum *Syzygium cumini*
		
49. Rose apple, Jamrul *Syzygium samarangense*	50. Tamarind *Tamarindus indica*	51. Nona Jhau *Tamarix dioica*

52. Teak
Tectona grandis

53. Arjun
Terminalia arjuna

54. Indian Almond
Terminalia catappa

55. Charcoal tree
Trema orientalis