

# Environmental Monitoring Report

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Project Number: 51077-003  
Quarterly Report (October to December 2022)  
March 2023

## Maldives: Greater Male Waste-to-Energy Project

### Part B: Appendices

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## 1. INTRODUCTION

This report has been prepared with the aim of determining the air quality in the sensitive receptors located in the impact area of the The Greater Malé Waste to Energy Project. Air quality results were determined for PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, TSP and O<sub>3</sub> parameters.

## 2. MEASUREMENT METHODS

PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>2</sub> and O<sub>3</sub> parameters were monitored by using air quality monitoring stations based on sensor technology. TSP's were measured by dust sampling devices conforming to the international HSE-MDHS 14/3. Ideally as recommended in the EIA report air quality should be measured 24 hours at each station, all measurements were made at each point within this framework 24 hours a day.

The US EPA refers to the term 'air sensor' as a class of non-regulatory technology that is low-cost, portable, capable of measuring several pollutants simultaneously, and often easier to operate than regulatory stations. For example, monitoring air pollution with reference measurement methods (regulatory stations) requires skilled operators to maintain and calibrate measuring instruments. On the other hand, air sensors describe the hardware and software set that can be operated without human intervention and enable unskilled users to monitor air pollution without additional technical knowledge.

Sensor specifications which are used for measurement study are shown below.

Sensor Name	Sensor Type	Accuracy r <sup>2</sup> -score*	Range
PM2.5	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
PM10	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
NO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
SO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
Temperature	CMOS IC	0.9	-20°C to 60°C
Humidity	CMOS IC	0.9	5% to 95%

The accuracy of these low-cost sensors is as critical as measuring the air quality. With the smart calibration process, low-cost sensors are corrected and accurate compared to reference stations. The Smart Calibration Algorithm consists of the below operational steps shown figure below.



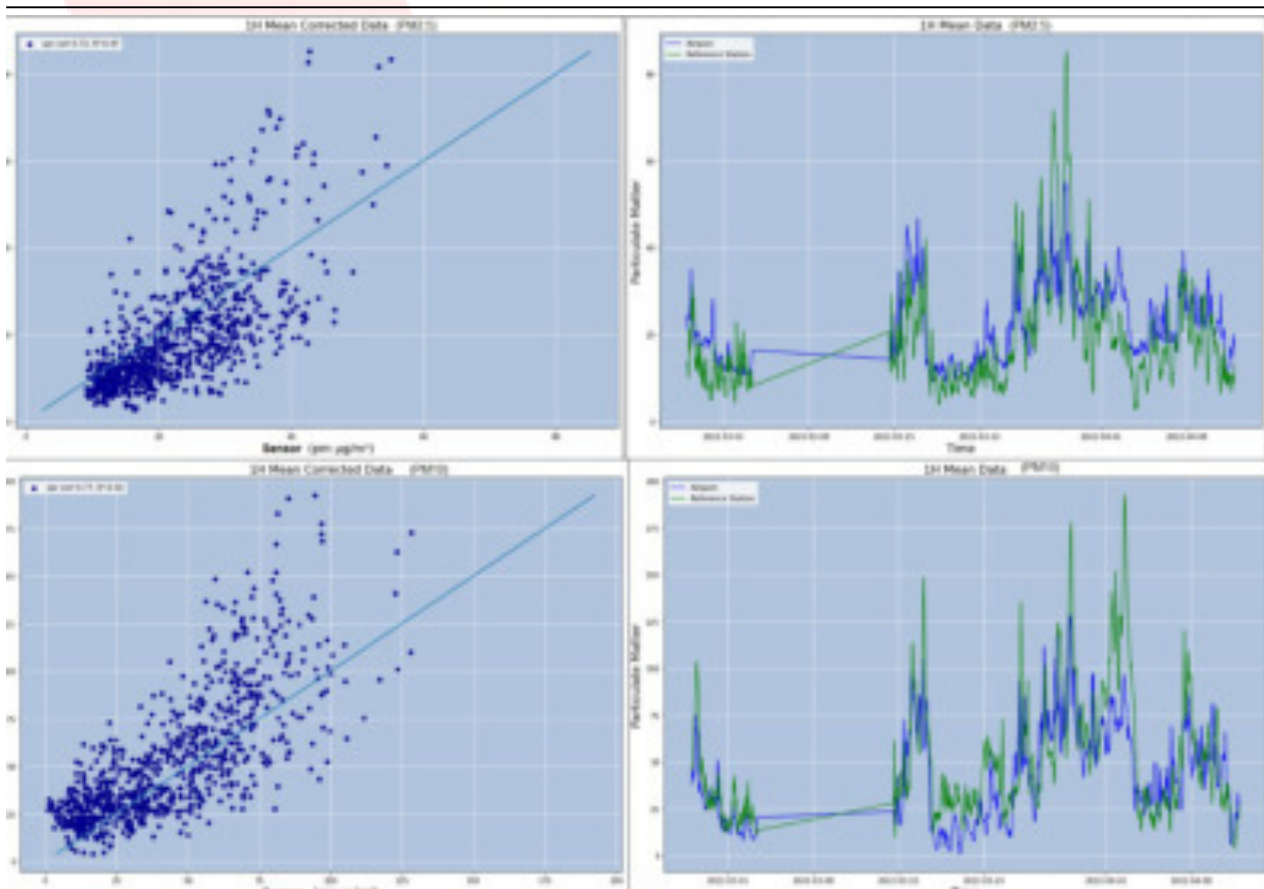
Sensor Units were calibrated using reference stations for a period before the deployment. The calibration process for particle matter and gas pollutants measurement is explained below.

**Table 1 Calibration Process for Pollutants**

Description	Methodology	
	NO <sub>2</sub> -SO <sub>2</sub> -O <sub>3</sub>	PM <sub>10</sub> -PM <sub>2.5</sub>
Installation	Near Reference Station (3/4 meters)	Near Reference Station (3/4 meters)
Pre-Test	Quality Check in zero air conditions	Quality Check in zero air conditions
Co-Located Period	4-5 weeks	8 weeks
Sampling Period	30 seconds. Hourly mean is used because the reference station measurements are hourly.	60 seconds. Hourly mean is used because the reference station measurements are hourly.
Validation	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.
Calibration Procedure	is obtained via R <sup>2</sup> and spearman correlation	is obtained via R <sup>2</sup> and spearman correlation

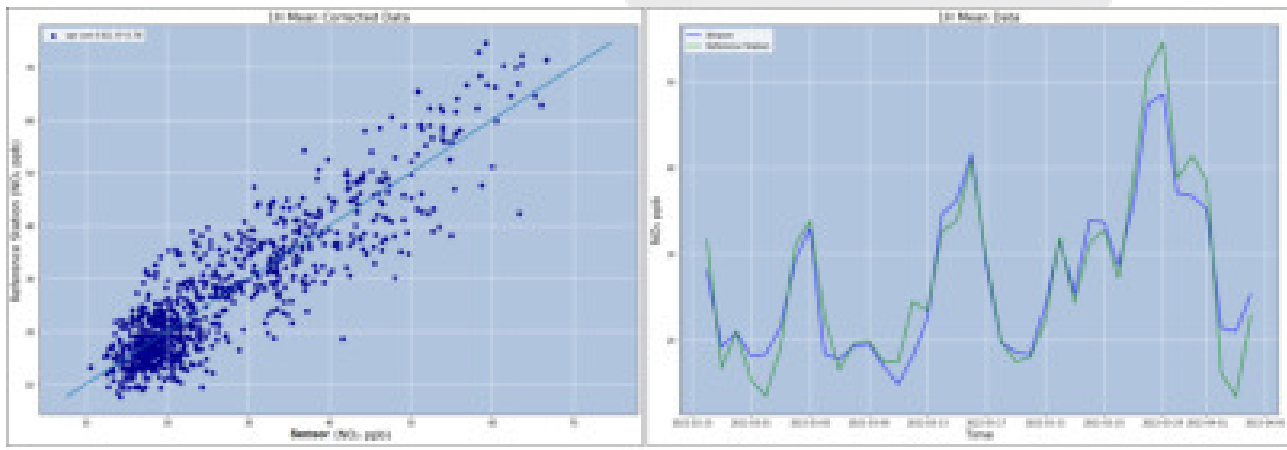
**Calibration Result for PM**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit’s PM<sub>2.5</sub> measurements between Reference Station’s PM<sub>2.5</sub> measurements for hourly and daily mean of data is 0.73, and the correlation between Sensor Unit’s PM<sub>10</sub> measurements between Reference Station’s PM<sub>10</sub> measurements for hourly and daily mean of data is 0.77.



**Calibration Result for Gases**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit's NO<sub>2</sub> measurements between Reference Station's NO<sub>2</sub> measurements for hourly and daily mean of data is respectively 0.823, 0.898



### 3. MEASUREMENT LOCATION

For the Preconstruction baseline environmental assessment of the ambient air quality was conducted at seven locations: 6 locations at Thilafushi (AQ1, AQ2, and AQ3 in the EIA and the ASR 2, ASR3 and ASR5 recommended for monitoring in the EIA Report) and one location at Villingili (AQ4).

**Table 2 Sampling Point Coordinates and Sampling dates**

No	Location	Description	Distance to Source (meters)
1	AQ1	Represents dense industrial area	650
2	AQ2	Represents dense industrial area	1000
3	AQ3	Represents dense industrial area	500
4	ASR2	Represents dense industrial area	700
5	ASR3	Represents dense industrial area	500
6	ASR5	Represents dense industrial area	1000
7	AQ4	Represents dense housing and population area	4500



Figure 1 Sampling Points on satellite Map

#### 4. LEGAL FRAMEWORK

Within the scope of the project, particle matter (PM<sub>10</sub>-PM<sub>2.5</sub>), NO<sub>2</sub>, SO<sub>2</sub> AND TSP emissions were measured. It is known that Maldives does not have a national air quality policy. Therefore, international standards were used for the evaluation. WHO defines limit values in “Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide” document. The Industrial Emissions Directive (IED) (2010/ 75/ EU, 2010) has determine emission limit values for NO<sub>x</sub>, CO, total dust, HCl, HF, SO<sub>2</sub>, organic substances, trace metals, and dioxins and furans. Germany has an air pollution control regulation titled "Technical Instructions on Air Quality Control" (Technische Anleitung zur Reinhaltung der Luft) and commonly referred to as the TA Luft and determines the limit values to protect the general public and the neighborhood against harmful effects of air pollution on the environment. Comparison of these limit values and chosen parameters and values for the modeling study according to these standards are shown in Table 3.

**Table 3.** Limit Values Stipulated in the International Legislation

Pollutant	Averaging Period	TA Luft	EU	WHO Ambient Air Quality Guideline Value	Project Standards
Particular Matter <10 µm (PM <sub>10</sub> )	24 hours	50 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	-	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
Particular Matter <2.5 µm (PM <sub>2.5</sub> )	24 hours	-	-	15 (not to be exceeded more than 3-4 times a year)	15
	1-year	-	20	5	5
Nitrogen Dioxide (NO <sub>x</sub> )	1-hour	200 µg/m <sup>3</sup>	-	-	200 µg/m <sup>3</sup>
	24 hours	-	200 mg/m <sup>3</sup>	25 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	-	10 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>
Sulphur Dioxide (SO <sub>2</sub> )	1-hour	350 µg/m <sup>3</sup>	-	-	350 µg/m <sup>3</sup>
	24 hours	125 µg/m <sup>3</sup>	50 µg /Nm <sup>3</sup>	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>
	1-year	50 µg/m <sup>3</sup>	-	-	50 µg/m <sup>3</sup>
TSP*	-	-	-	-	-

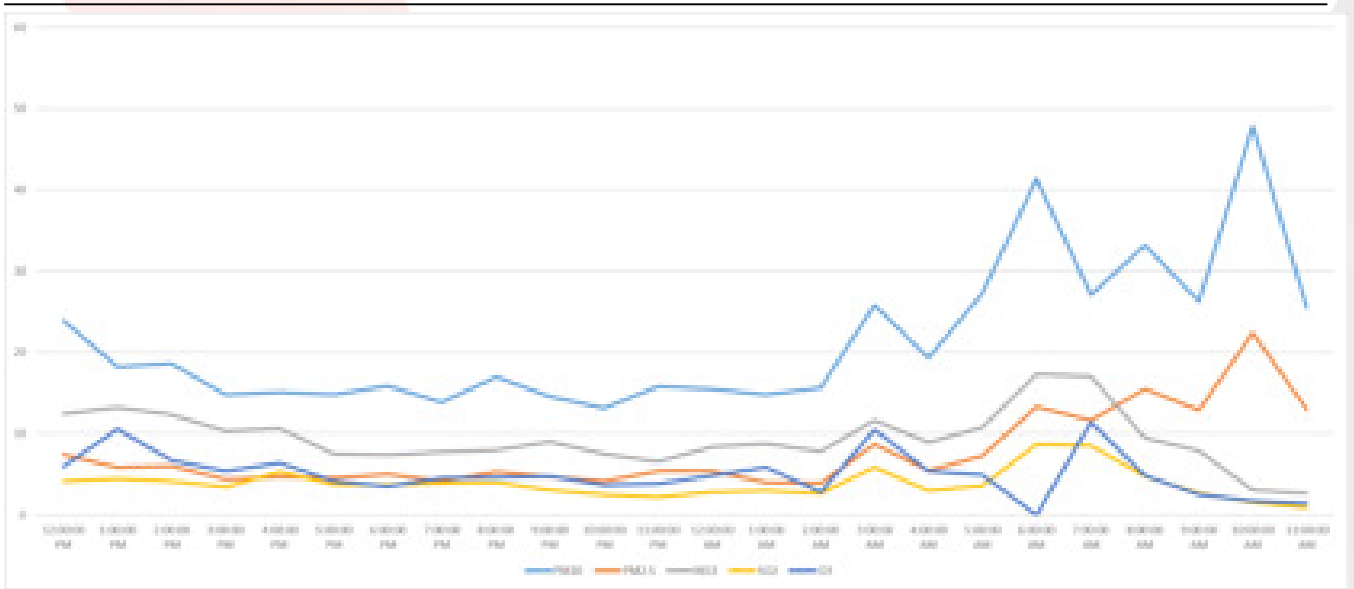
\*There is no limit value for TSP.



## 5. RESULTS

Table 4 Measurement Results for Location 1

Location	Sampling Date	Air Quality Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ1	2022-10-17 12:00:00	23.9	7.43	12.39	4.13	41.4	86.4	26.6
	2022-10-17 13:00:00	18.2	5.83	13.20	4.40		85.8	26.7
	2022-10-17 14:00:00	18.6	5.96	12.34	4.11		85.4	26.3
	2022-10-17 15:00:00	14.8	4.39	10.32	3.44		86.2	26.3
	2022-10-17 16:00:00	15.1	4.65	10.63	5.32		86.6	26.3
	2022-10-17 17:00:00	14.8	4.53	7.51	3.76		86.5	25.6
	2022-10-17 18:00:00	15.9	5.01	7.36	3.68		86.3	25.6
	2022-10-17 19:00:00	13.8	4.08	7.70	3.85		88.1	25.5
	2022-10-17 20:00:00	17	5.31	7.98	3.99		90.1	24.6
	2022-10-17 21:00:00	14.5	4.66	8.97	2.99		90.2	24.5
	2022-10-17 22:00:00	13.1	4.15	7.51	2.50		90.7	25.3
	2022-10-17 23:00:00	15.8	5.35	6.58	2.19		92.0	25.3
	2022-10-18 00:00:00	15.5	5.35	8.38	2.79		93.2	26.2
	2022-10-18 01:00:00	14.8	3.94	8.76	2.92		84.9	29.4
	2022-10-18 02:00:00	15.6	3.91	7.76	2.59		73.1	30.7
	2022-10-18 03:00:00	25.8	8.64	11.67	5.84		68.7	31.7
	2022-10-18 04:00:00	19.3	5.45	8.92	2.97		72.6	30.0
	2022-10-18 05:00:00	27.3	7.24	10.77	3.59		73.6	29.8
	2022-10-18 06:00:00	41.3	13.3	17.25	8.63		80.1	27.7
	2022-10-18 07:00:00	27.1	11.6	17.03	8.52		81.1	27.6
	2022-10-18 08:00:00	33.2	15.5	9.46	4.73		83.4	27.6
2022-10-18 09:00:00	26.3	12.9	7.84	2.61	82.3	27.6		
2022-10-18 10:00:00	47.8	22.4	3.03	1.52	82.5	27.5		
2022-10-18 11:00:00	25.5	13	2.61	0.87	83.2	27.4		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
<b>24 h Average</b>		<b>21.46</b>	<b>7.69</b>	<b>9.42</b>	<b>3.83</b>	41.4	<b>83.9</b>	<b>27.2</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 2** Measurement Graphs for Location AQ1

**Table 5 Measurement Results for Location 2**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ2	2022-10-17 12:00:00	14.2	4.37	2.57	5.96	27.1	81.7	26.7
	2022-10-17 13:00:00	11.3	3.13	3.60	0.00		82.1	26.9
	2022-10-17 14:00:00	11.4	3.32	3.85	0.00		81.1	26.5
	2022-10-17 15:00:00	11	3.11	0.00	0.00		81.8	26.5
	2022-10-17 16:00:00	10.2	2.8	0.00	0.00		81.9	26.5
	2022-10-17 17:00:00	11.7	3.61	0.00	0.00		81.9	25.8
	2022-10-17 18:00:00	11.3	3.67	0.00	0.00		82.4	25.8
	2022-10-17 19:00:00	11.7	3.78	0.00	0.00		83.2	25.7
	2022-10-17 20:00:00	10	3.11	0.00	0.00		85.1	24.9
	2022-10-17 21:00:00	11.3	3.7	0.00	0.00		85.0	24.6
	2022-10-17 22:00:00	12.6	3.73	0.00	0.00		84.8	25.5
	2022-10-17 23:00:00	16.6	2.74	0.00	0.00		84.4	25.4
	2022-10-18 00:00:00	20.6	3.17	3.85	1.63		91.0	26.5
	2022-10-18 01:00:00	23	5.01	3.79	2.55		80.9	32.5
	2022-10-18 02:00:00	25.9	4.78	3.85	0.00		76.1	30.5
	2022-10-18 03:00:00	39.8	12.7	2.18	0.00		75.4	29.3
	2022-10-18 04:00:00	38.9	15.8	10.16	0.00		73.6	29.9
	2022-10-18 05:00:00	31.6	14.7	3.73	0.00		73.1	29.9
	2022-10-18 06:00:00	28.8	14.1	6.95	11.98		66.6	31.1
	2022-10-18 07:00:00	14.8	3.13	0.04	0.00		70.8	29.7
	2022-10-18 08:00:00	15.9	3.91	0.56	0.00		74.0	28.6
	2022-10-18 09:00:00	13.9	3.62	0.47	0.00		78.3	28.0
2022-10-18 10:00:00	13.1	3.55	0.64	0.00	79.2	28.3		
2022-10-18 11:00:00	12.7	3.54	1.30	0.00	78.1	27.9		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>14.2</b>	<b>4.37</b>	<b>2.57</b>	<b>5.96</b>	<b>27.1</b>	<b>79.7</b>	<b>27.6</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

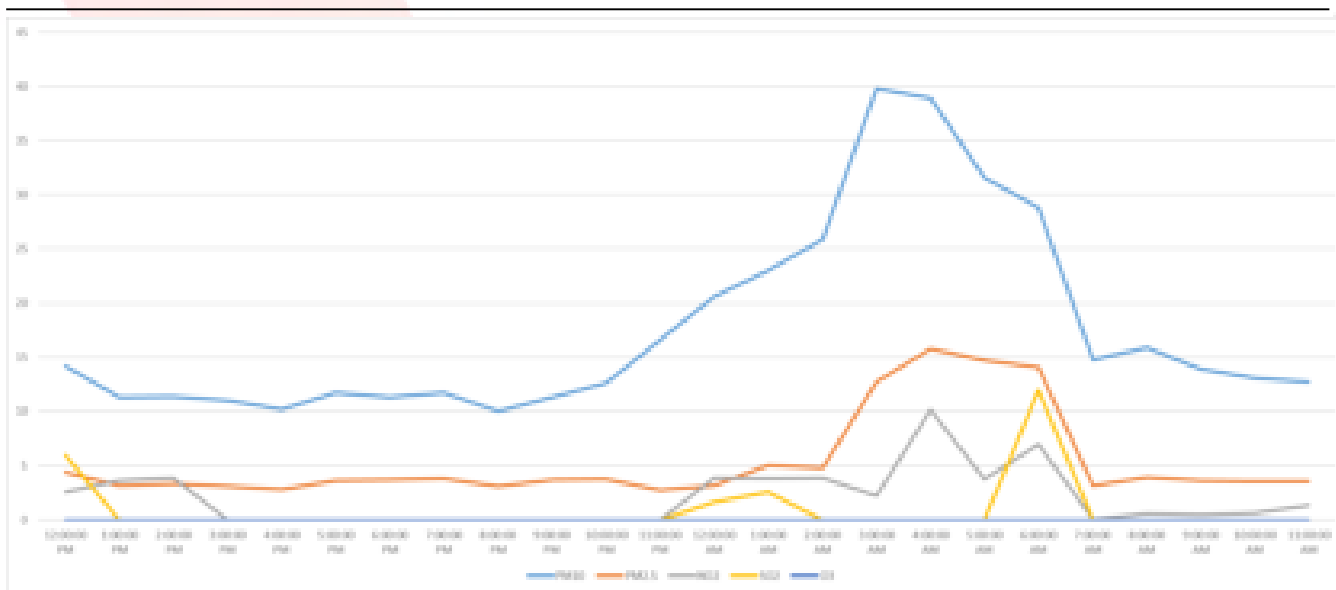


Figure 3 Measurement Graphs for Location AQ2

**Table 6 Measurement Results for Location 3**

Location	Sampling Date	Results (µg/m <sup>3</sup> )				Ambient Conditions		
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ3	2022-10-17 12:00:00	30.5	7.81	0	0	38.6	86.5	26.6
	2022-10-17 13:00:00	30.8	8.69	0	0		85.9	26.6
	2022-10-17 14:00:00	26	8.69	0	0		85.8	26.3
	2022-10-17 15:00:00	22.9	7.94	0	3.6		86.4	26.2
	2022-10-17 16:00:00	21.3	7.31	0	0		86.7	26.3
	2022-10-17 17:00:00	21.8	7.5	0	0		87.0	25.7
	2022-10-17 18:00:00	21.7	7.5	0	0		87.9	25.6
	2022-10-17 19:00:00	20.6	7.09	0	0		88.3	25.5
	2022-10-17 20:00:00	20.8	7.24	0	1.25		89.9	24.8
	2022-10-17 21:00:00	20.2	7.1	0	0		90.9	24.6
	2022-10-17 22:00:00	18.7	6.48	0	0		89.8	25.4
	2022-10-17 23:00:00	21.2	7.58	0	0		90.3	25.4
	2022-10-18 00:00:00	21.8	7.85	0	0		92.8	27.2
	2022-10-18 01:00:00	20.7	7.32	0	0		88.5	30.3
	2022-10-18 02:00:00	21.3	7.59	0	0		83.0	31.8
	2022-10-18 03:00:00	21.6	7.59	0	0		76.1	30.8
	2022-10-18 04:00:00	20.7	6.86	0	0		72.6	31.7
	2022-10-18 05:00:00	23.7	7.7	0	0		68.7	32.4
	2022-10-18 06:00:00	25	8.1	0	0		68.8	31.7
	2022-10-18 07:00:00	27.9	9.04	0	0		71.3	30.2
	2022-10-18 08:00:00	49.5	14.8	0	0		76.8	28.5
	2022-10-18 09:00:00	35.6	12.9	9.5	3.16		81.5	27.9
2022-10-18 10:00:00	31.2	13.9	4.5	1.5	83.5	27.8		
2022-10-18 11:00:00	27.9	13.4	2.6	0.86	81.4	27.8		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	
	EU	-	-	200	350	-	-	
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	
Average		<b>25.14</b>	<b>8.67</b>	<b>0.69</b>	<b>0.50</b>	<b>83.3</b>	<b>27.8</b>	
Daily Limit Values	TA Luft	50	-	-	-	-	-	
	EU	50	-	-	-	-	-	
	WHO Ambient Air Quality Guideline Value	45	15	25	-	-	-	

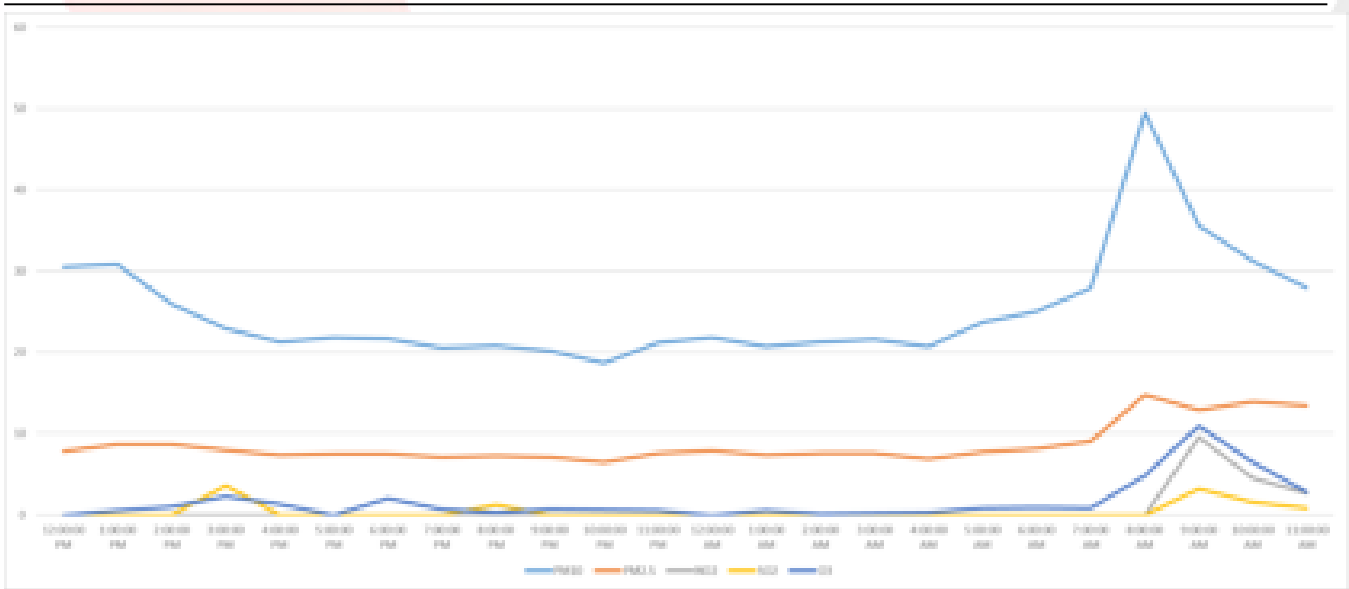


Figure 4 Measurement Graphs for Location AQ3

**Table 7 Measurement Results for Location 4**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR2	2022-10-17 12:00:00	26.9	7.52	10.18	5.1	30.9	69.7	26.1
	2022-10-17 13:00:00	18.9	4.56	11.22	5.6		69.5	26.3
	2022-10-17 14:00:00	23.9	7.43	12.38	4.1		69.5	25.9
	2022-10-17 15:00:00	18.5	5.96	13.42	6.7		70.0	25.9
	2022-10-17 16:00:00	18.3	5.79	11.66	3.9		70.2	25.9
	2022-10-17 17:00:00	14.8	4.39	10.31	5.2		70.1	25.2
	2022-10-17 18:00:00	15.6	4.88	10.00	5.0		70.2	25.2
	2022-10-17 19:00:00	14.9	4.56	7.51	3.8		71.0	25.1
	2022-10-17 20:00:00	14.8	4.52	7.13	2.4		72.6	24.2
	2022-10-17 21:00:00	13.8	4.12	7.82	2.6		73.1	23.9
	2022-10-17 22:00:00	16.4	5.13	8.13	2.7		73.2	24.8
	2022-10-17 23:00:00	14.8	4.84	8.75	4.4		73.0	24.9
	2022-10-18 00:00:00	13.4	4.28	6.99	2.3		74.4	25.8
	2022-10-18 01:00:00	12.8	4.05	10.00	5.0		74.9	28.2
	2022-10-18 02:00:00	16.2	5.68	7.97	2.7		74.0	30.1
	2022-10-18 03:00:00	15.1	4.02	8.44	2.8		64.8	30.9
	2022-10-18 04:00:00	15.7	3.87	7.67	3.8		55.4	32.6
	2022-10-18 05:00:00	22.1	6.99	10.37	5.2		51.2	33.1
	2022-10-18 06:00:00	20.1	5.56	8.76	4.4		50.8	32.8
	2022-10-18 07:00:00	31.2	8.57	12.22	4.1		52.4	30.8
	2022-10-18 08:00:00	35.6	12.7	16.43	5.5		59.5	28.2
	2022-10-18 09:00:00	26.8	11.7	16.37	5.5		64.5	27.5
2022-10-18 10:00:00	31.8	14.9	8.93	4.5	66.4	27.4		
2022-10-18 11:00:00	26.1	13	5.82	2.9	65.1	27.5		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		19.94	6.63	9.94	4.18	30.9	66.9	27.4
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

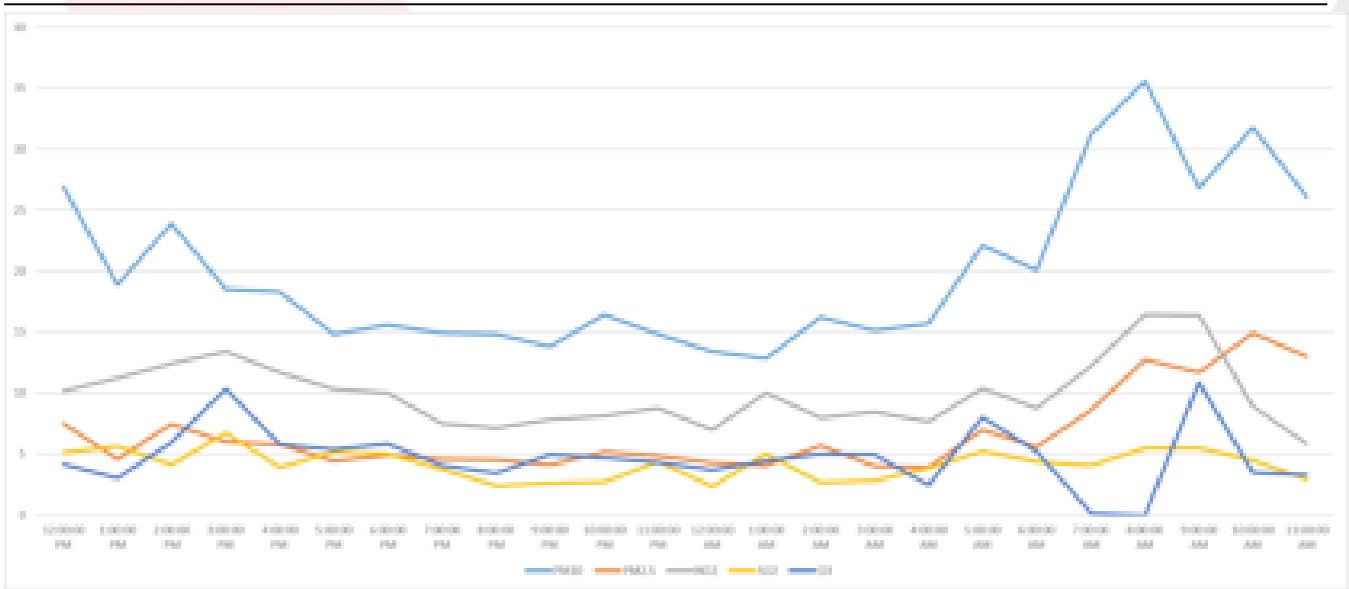


Figure 5 Measurement Graphs for Location ASR2



**Table 8 Measurement Results for Location 5**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR3	10/18/2022 12:00	15.9	3.91	0.0	0.0	40.3	81.1	27.6
	10/18/2022 13:00	13.9	3.62	0.0	0.0		83.4	27.6
	10/18/2022 14:00	13.1	3.55	0.0	0.0		82.3	27.6
	10/18/2022 15:00	12.7	3.54	0.0	0.0		82.5	27.5
	10/18/2022 16:00	12.8	3.64	0.0	0.0		83.2	27.4
	10/18/2022 17:00	12.8	3.65	0.0	0.0		85.2	27.2
	10/18/2022 18:00	13.4	3.9	0.0	0.0		84.4	27.2
	10/18/2022 19:00	10.7	2.86	0.0	0.0		85.5	27.2
	10/18/2022 20:00	12	3.56	0.0	0.0		84.1	27.9
	10/18/2022 21:00	10.8	3.24	0.0	0.0		73.6	31.4
	10/18/2022 22:00	9.84	2.8	0.0	0.0		70.0	32.0
	10/18/2022 23:00	9.53	2.65	0.0	0.0		68.3	32.7
	10/19/2022 0:00	7.61	1.75	0.0	0.0		69.0	33.2
	10/19/2022 1:00	10.1	2.93	0.0	0.0		72.6	30.1
	10/19/2022 2:00	10.1	2.81	0.0	0.0		59.2	25.0
	10/19/2022 3:00	12.4	3.23	0.0	0.0		59.1	21.0
	10/19/2022 4:00	14.5	3.43	0.0	0.0		79.9	24.1
	10/19/2022 5:00	17.7	2.63	0.0	0.0		76.1	29.8
	10/19/2022 6:00	21.6	2.91	0.0	0.0		76.7	29.3
	10/19/2022 7:00	23.2	3.72	0.0	0.0		79.7	28.4
	10/19/2022 8:00	21.7	2.9	0.0	0.0		80.3	28.2
	10/19/2022 9:00	22.2	2.92	0.0	0.0		81.4	28.0
10/19/2022 10:00	17	3.25	0.0	0.0	81.8	28.0		
10/19/2022 11:00	25.5	7.72	0.0	0.0	81.4	28.0		
Hourly Limit Values	TA Luft	-	-	200	200	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		14.63	3.38	0.00	0.00	40.3	77.5	28.2
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

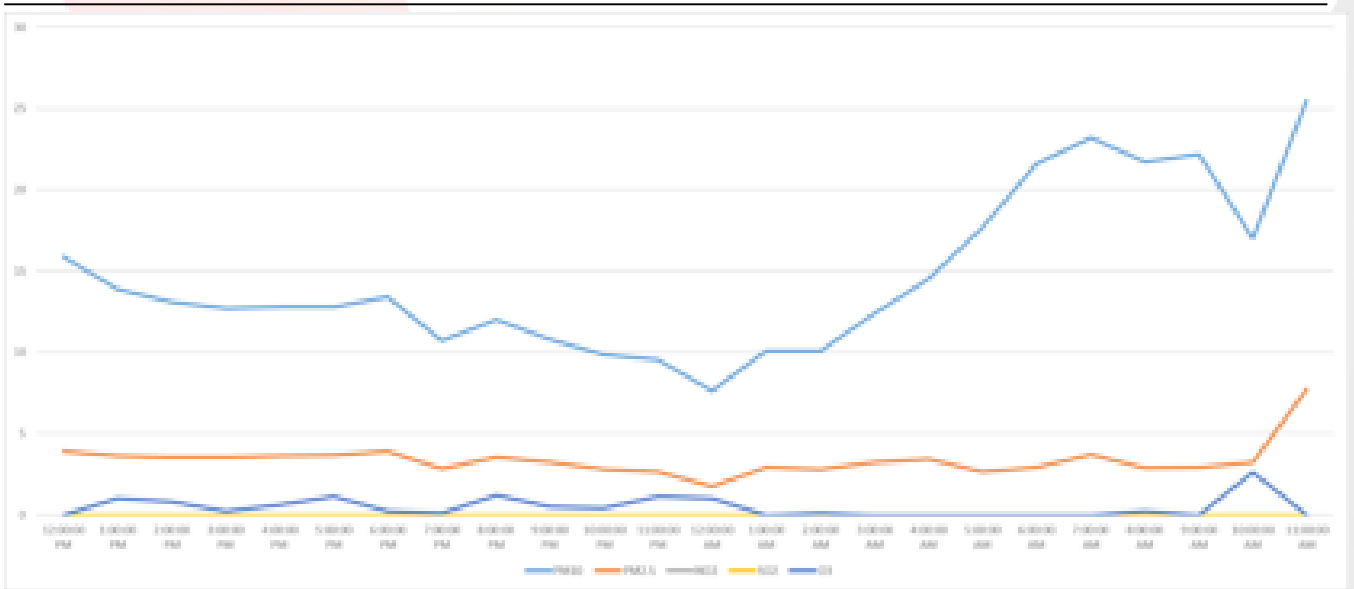


Figure 6 Measurement Graphs for Location ASR3

**Table 9 Measurement Results for Location 6**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR5	10/18/2022 12:00	16.5	6.41	10.09	3.36	28.0	70.7	29.5
	10/18/2022 13:00	15	5.52	10.74	3.58		74.2	28.5
	10/18/2022 14:00	15.7	5.74	10.05	3.35		78.1	28.1
	10/18/2022 15:00	17.9	6.65	8.40	4.20		79.0	28.4
	10/18/2022 16:00	15.9	5.9	8.65	2.88		78.3	27.8
	10/18/2022 17:00	15.4	5.75	6.11	3.06		79.5	27.9
	10/18/2022 18:00	16.8	6.39	5.99	2.00		79.7	27.9
	10/18/2022 19:00	15.5	6.15	6.27	2.09		78.7	27.9
	10/18/2022 20:00	13.1	5.11	6.49	2.16		79.0	27.9
	10/18/2022 21:00	18.4	7.6	7.30	3.65		78.9	27.8
	10/18/2022 22:00	16.4	7.24	6.12	2.04		81.4	27.4
	10/18/2022 23:00	14.9	6.8	5.35	1.78		80.9	27.3
	10/19/2022 0:00	8.87	3.45	6.82	2.27		81.9	27.3
	10/19/2022 1:00	13.3	5.53	7.13	3.57		82.7	27.3
	10/19/2022 2:00	4.78	1.5	6.32	3.16		78.5	28.8
	10/19/2022 3:00	7.16	1.5	9.50	4.75		76.2	29.3
	10/19/2022 4:00	26.2	7.43	7.26	2.42		77.4	29.0
	10/19/2022 5:00	22.3	6.78	8.76	2.92		73.7	30.0
	10/19/2022 6:00	21.7	6.08	14.04	4.68		71.1	32.7
	10/19/2022 7:00	21.2	5.78	13.87	4.62		56.8	26.6
10/19/2022 8:00	26.9	7.52	7.70	3.85	57.8	22.4		
10/19/2022 9:00	18.9	4.56	6.38	2.13	59.2	20.8		
10/19/2022 10:00	23.9	7.43	2.47	0.82	59.3	19.3		
10/19/2022 11:00	18.5	5.96	2.13	1.07	62.7	19.0		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
<b>Average</b>		<b>16.88</b>	<b>5.78</b>	<b>7.66</b>	<b>2.93</b>	<b>28.0</b>	<b>74</b>	<b>27</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

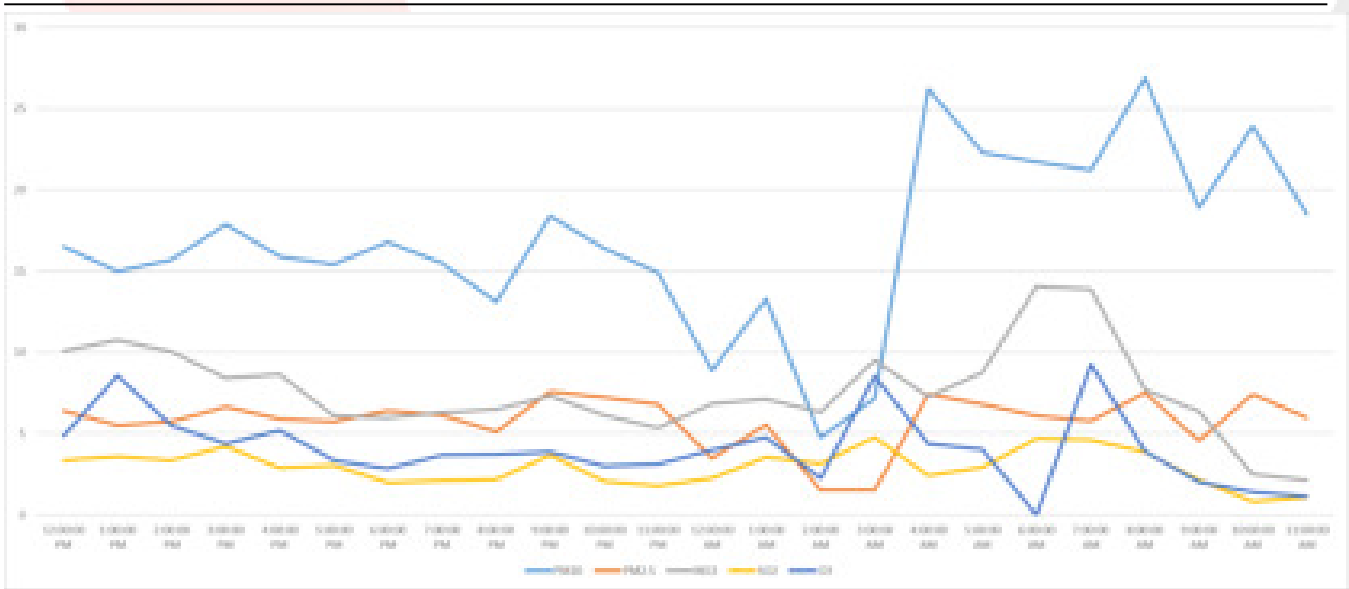
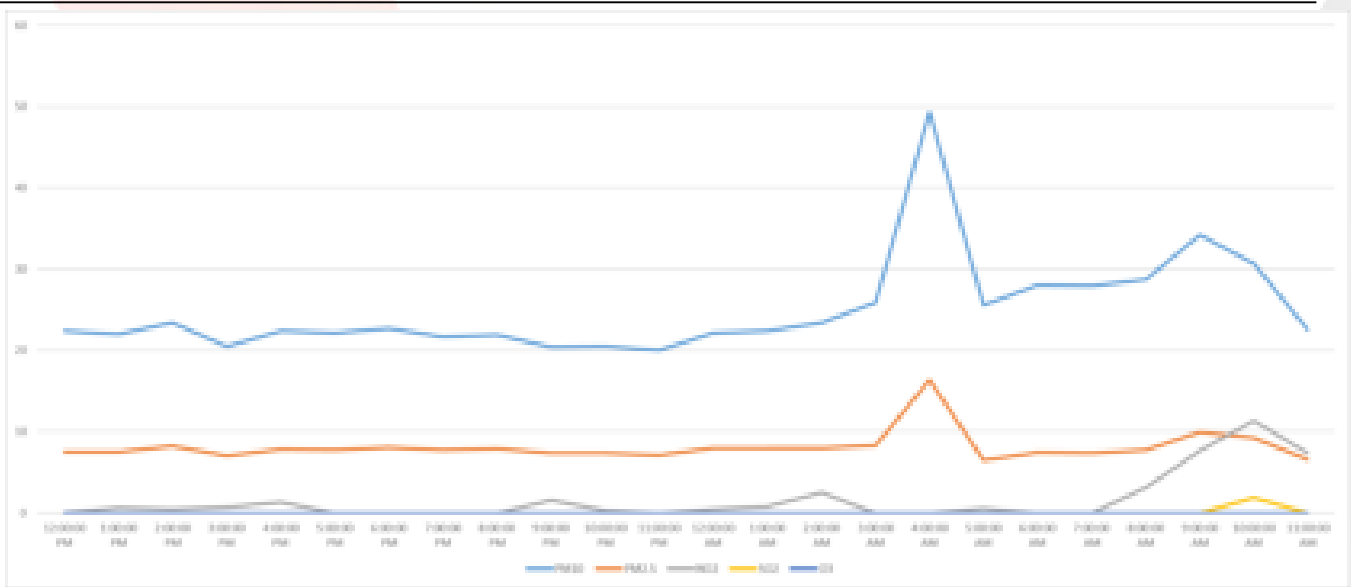


Figure 7 Measurement Graphs for Location ASR2

**Table 10 Measurement Results for Location 7**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					TSP (24 Hours Average)	Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	O <sub>3</sub>		Humidity (%)	Temperature (°C)
AQ4	10/18/2022 12:00	22.4	7.45	0.04	0.00	0.00	39.4	71.1	30.4
	10/18/2022 13:00	22	7.5	0.56	0.00	0.00		76.7	28.3
	10/18/2022 14:00	23.4	8.22	0.47	0.00	0.00		81.6	27.7
	10/18/2022 15:00	20.5	6.99	0.64	0.00	0.00		83.4	27.7
	10/18/2022 16:00	22.4	7.79	1.30	0.00	0.00		81.6	27.9
	10/18/2022 17:00	22.1	7.7	0.00	0.00	0.00		83.5	27.8
	10/18/2022 18:00	22.7	8.06	0.00	0.00	0.00		83.9	27.7
	10/18/2022 19:00	21.7	7.75	0.00	0.00	0.00		84.9	27.5
	10/18/2022 20:00	21.9	7.89	0.00	0.00	0.00		84.8	27.4
	10/18/2022 21:00	20.4	7.3	1.54	0.00	0.00		85.0	27.3
	10/18/2022 22:00	20.5	7.31	0.25	0.00	0.00		85.9	27.2
	10/18/2022 23:00	20	7.09	0.00	0.00	0.00		85.4	27.3
	10/19/2022 0:00	22.1	7.98	0.46	0.00	0.00		85.8	27.3
	10/19/2022 1:00	22.4	7.97	0.77	0.00	0.00		85.2	27.3
	10/19/2022 2:00	23.4	7.95	2.44	0.00	0.00		83.9	27.9
	10/19/2022 3:00	25.9	8.3	0.00	0.00	0.00		80.6	29.0
	10/19/2022 4:00	49.3	16.3	0.00	0.00	0.00		79.7	29.4
	10/19/2022 5:00	25.6	6.49	0.51	0.00	0.00		83.0	28.8
	10/19/2022 6:00	28	7.44	0.00	0.00	0.00		76.5	30.1
	10/19/2022 7:00	27.9	7.33	0.00	0.00	0.00		72.9	31.6
10/19/2022 8:00	28.7	7.71	3.08	0.00	0.00	59.1	26.8		
10/19/2022 9:00	34.2	9.91	7.67	0.00	0.00	58.8	21.5		
10/19/2022 10:00	30.7	9.19	11.3 1	1.85	0.00	60.9	20.6		
10/19/2022 11:00	22.5	6.56	7.32	0.00	0.00	60.7	19.3		
Hourly Limit Values	TA Luft	-	-	200	350	-		-	-
	EU	-	-	200	350	-		-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-		-	-
Average		25.03	8.09	1.60	0.08	0.00	39.4	78.1	27.2
Daily Limit Values	TA Luft	50	-	-	125	-		-	-
	EU	50	-	-	125	120		-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	100		-	-



**Figure 8** Measurement Graphs for Location AQ4

## **6. ASSESSMENT**

The air quality measurement study was carried out with the aim of determining the air pollutants on ambient air quality. Results were assessed according to the TA LUFT, EU Council Directive 2008/50/EC and WHO limit values and this report was prepared. According to air quality measurement studies, background air quality values are comply with air quality standards.

# GOVERNMENT of MALDIVES

WtE Energy Facility Project

## BACKGROUND AIR QUALITY MEASUREMENT REPORT



Thilafushi Island/MALDIVES





**AIRS Air Quality Management Services Ltd**  
Mustafa Kemal Mah. Via Green Is Mrk. B-36  
Cankaya Ankara TURKEY  
Tel: +90 312 221 02 45 Fax: +90 312 221 02 45  
[www.airsaqms.com](http://www.airsaqms.com)

**Test Report**

<b>Customer Name/Address</b>	Alke Alkatas Joint Venture Pvt Ltd H.H.Moomiyaage 5A Asaree Hingun K.Male 20265 MALDIVES
<b>Order No.</b>	EN-M/2207/417_01
<b>Name and identity of test item</b>	Immission (Air Quality)
<b>Remarks</b>	-
<b>Date of Test</b>	29.11.2022-30.11.2022
<b>Number of Pages of the Report</b>	27 Pages
<b>Test Method</b>	Air Quality Sensors HSE-MDHS 14/3
<b>Test results</b>	The test results are given in the measurement result tables.
<b>Environmental conditions</b>	Environmental conditions during the measurement are given in the measurement result tables.
<b>Comments</b>	-

The test and/or measurement results, the uncertainties (if applicable) with confidence probability and test methods are given on the following pages which are part of this report.

Reporter and Approval
Ismail Ulusoy Environmental Engineer

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## 1. INTRODUCTION

This report has been prepared with the aim of determining the air quality in the sensitive receptors located in the impact area of the The Greater Malé Waste to Energy Project. Air quality results were determined for PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, TSP and O<sub>3</sub> parameters.

## 2. MEASUREMENT METHODS

PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> parameters were monitored by using air quality monitoring stations based on sensor technology. TSP's were measured by dust sampling devices conforming to the international HSE-MDHS 14/3. Ideally as recommended in the EIA report air quality should be measured 24 hours at each station, all measurements were made at each point within this framework 24 hours a day.

The US EPA refers to the term 'air sensor' as a class of non-regulatory technology that is low-cost, portable, capable of measuring several pollutants simultaneously, and often easier to operate than regulatory stations. For example, monitoring air pollution with reference measurement methods (regulatory stations) requires skilled operators to maintain and calibrate measuring instruments. On the other hand, air sensors describe the hardware and software set that can be operated without human intervention and enable unskilled users to monitor air pollution without additional technical knowledge.

Sensor specifications which are used for measurement study are shown below.

Sensor Name	Sensor Type	Accuracy r <sup>2</sup> -score*	Range
PM2.5	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
PM10	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
NO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
SO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
Temperature	CMOS IC	0.9	-20°C to 60°C
Humidity	CMOS IC	0.9	5% to 95%

The accuracy of these low-cost sensors is as critical as measuring the air quality. With the smart calibration process, low-cost sensors are corrected and accurate compared to reference stations. The Smart Calibration Algorithm consists of the below operational steps shown figure below.



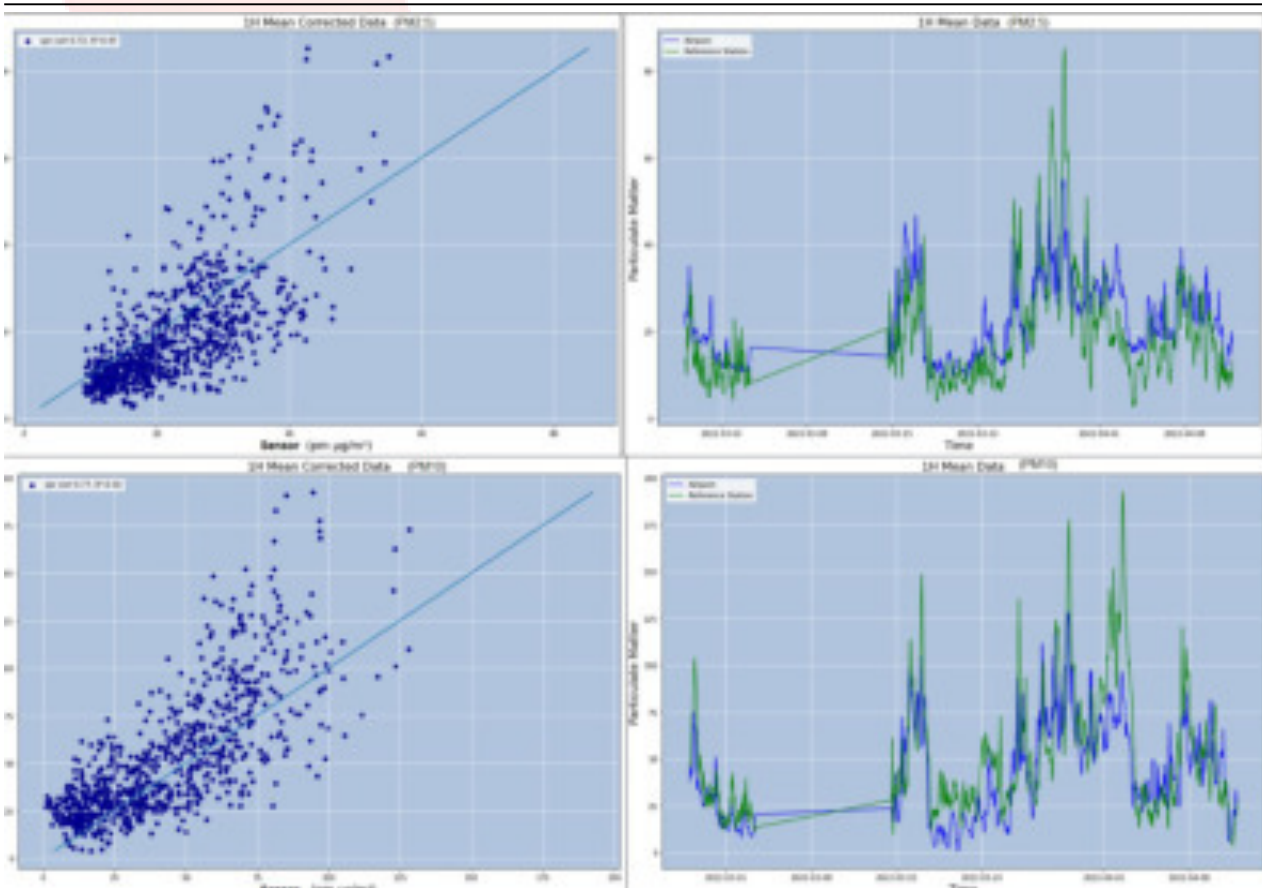
Sensor Units were calibrated using reference stations for a period before the deployment. The calibration process for particle matter and gas pollutants measurement is explained below.

**Table 1 Calibration Process for Pollutants**

Description	Methodology	
	NO <sub>2</sub> -SO <sub>2</sub> -O <sub>3</sub>	PM <sub>10</sub> -PM <sub>2.5</sub>
Installation	Near Reference Station (3/4 meters)	Near Reference Station (3/4 meters)
Pre-Test	Quality Check in zero air conditions	Quality Check in zero air conditions
Co-Located Period	4-5 weeks	8 weeks
Sampling Period	30 seconds. Hourly mean is used because the reference station measurements are hourly.	60 seconds. Hourly mean is used because the reference station measurements are hourly.
Validation	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.
Calibration Procedure	is obtained via R <sup>2</sup> and spearman correlation	is obtained via R <sup>2</sup> and spearman correlation

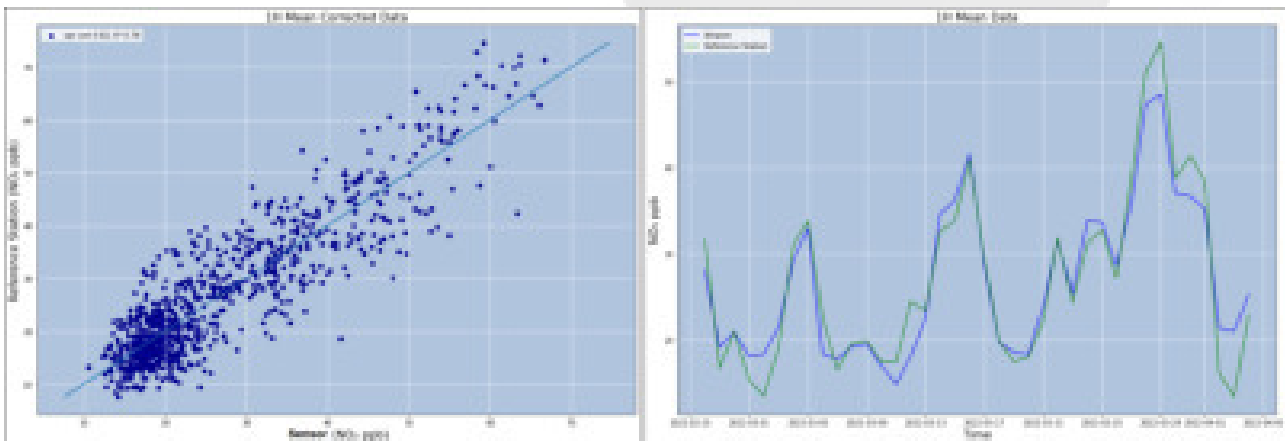
**Calibration Result for PM**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit’s PM<sub>2.5</sub> measurements between Reference Station’s PM<sub>2.5</sub> measurements for hourly and daily mean of data is 0.73, and the correlation between Sensor Unit’s PM<sub>10</sub> measurements between Reference Station’s PM<sub>10</sub> measurements for hourly and daily mean of data is 0.77.



**Calibration Result for Gases**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit's NO<sub>2</sub> measurements between Reference Station's NO<sub>2</sub> measurements for hourly and daily mean of data is respectively 0.823, 0.898



## **2.1. FIELD APPLICATION**

This section describes how the measurements, the general methodology of which is given above, are applied in the field.

### **Preliminary Preparations**

Preliminary preparations for air quality measuring stations with sensors include factory calibrations and field calibrations. Factory calibrations are provided by the sensor manufacturer. Stations capable of making reference measurements were used for field calibrations, as described above. For this purpose, a 1-month comparison measurement was carried out at a reference station in the Turkish air quality monitoring network and the calibration factors were applied.

For TSP measurements, filter conditioning was carried out in the laboratory. For this purpose, cassettes and filters were conditioned for 24 hours in a room conditioned at 25 degrees Celsius and 50% humidity and were tared.

### **During Measurements**

Air quality measurements were made with four sets of devices. AQ1, AQ2, AQ3 and ASR2 measurements were made with these devices on the first day, and ASR 3, ASR5 and AQ4 points were measured on the second day.

The locations of the sampling points are determined in the macro scale ESIA report. A site visit was made and a location was determined at the micro scale where the devices would be placed.

Measurements were made at a height of 1.5 to 4 meters from the ground, depending on the suitability of the sampling point.

24-hour measurements were made at each point. Parameters measured with sensor devices consist of the averages of instantaneous measurements taken at 10-minute intervals. For TSP measurements, 24-hour uninterrupted sampling was carried out.

### **After Measurements**

The values after the measurements were taken by reading directly on the air quality measuring devices with sensors.

In TSP measurements, the filters were brought to the laboratory, conditioned for 24 hours at 25 degrees Celsius and 50% humidity for 24 hours and weighed. The 24-hour dust amount was found by subtracting the last weighing result from the first weighing result.



### 3. MEASUREMENT LOCATION

For the Preconstruction baseline environmental assessment of the ambient air quality was conducted at seven locations: 6 locations at Thilafushi (AQ1, AQ2, and AQ3 in the EIA and the ASR 2, ASR3 and ASR5 recommended for monitoring in the EIA Report) and one location at Villingili (AQ4).

**Table 2 Sampling Point Coordinates and Sampling dates**

No	Location	Description	Distance to Source (meters)
1	AQ1	Represents dense industrial area	650
2	AQ2	Represents dense industrial area	1000
3	AQ3	Represents dense industrial area	500
4	ASR2	Represents dense industrial area	700
5	ASR3	Represents dense industrial area	500
6	ASR5	Represents dense industrial area	1000
7	AQ4	Represents dense housing and population area	4500



Figure 1 Sampling Points on satellite Map

#### 4. LEGAL FRAMEWORK

Within the scope of the project, particle matter (PM<sub>10</sub>-PM<sub>2.5</sub>), NO<sub>2</sub>, SO<sub>2</sub> AND TSP emissions were measured. It is known that Maldives does not have a national air quality policy. Therefore, international standards were used for the evaluation. WHO defines limit values in “Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide” document. European Union directives also have limit values for air pollution prevention (EU Council Directive 2008/50/EC relating to health based standards and objectives for a number of pollutants in ambient air). Germany has an air pollution control regulation titled "Technical Instructions on Air Quality Control" (Technische Anleitung zur Reinhaltung der Luft) and commonly referred to as the TA Luft and determines the limit values to protect the general public and the neighborhood against harmful effects of air pollution on the environment. Comparison of these limit values and chosen parameters and values for the modeling study according to these standards are shown in Table 3.

**Table 3.** Limit Values Stipulated in the International Legislation

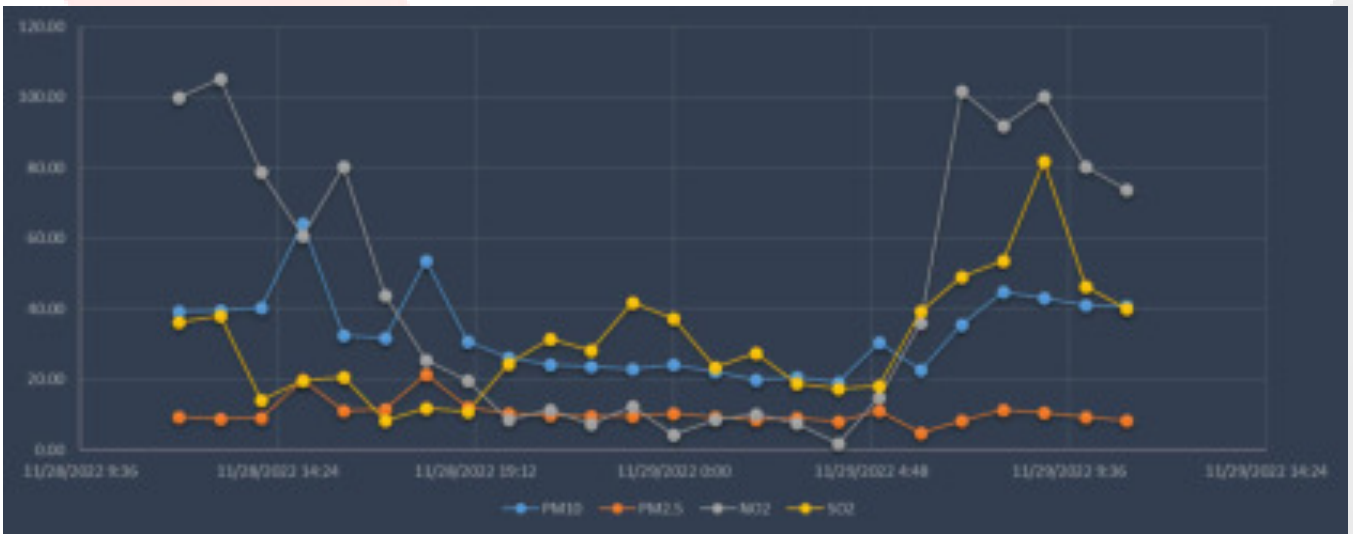
Pollutant	Averaging Period	TA Luft	EU	WHO Ambient Air Quality Guideline Value	Project Standards
Particular Matter <10 µm (PM <sub>10</sub> )	24 hours	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
Particular Matter <2.5 µm (PM <sub>2.5</sub> )	24 hours	-	-	15 (not to be exceeded more than 3-4 times a year)	15
	1-year	-	20	5	5
Nitrogen Dioxide (NO <sub>x</sub> )	1-hour	200 µg/m <sup>3</sup>	200 µg/m <sup>3</sup>	-	200 µg/m <sup>3</sup>
	24 hours	-	-	25 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>
Sulphur Dioxide (SO <sub>2</sub> )	1-hour	350 µg/m <sup>3</sup>	350 µg/m <sup>3</sup>	-	350 µg/m <sup>3</sup>
	24 hours	125 µg/m <sup>3</sup>	125 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>
	1-year	50 µg/m <sup>3</sup>	-	-	50 µg/m <sup>3</sup>
TSP*	-	-	-	-	-

\*There is no limit value for TSP.

## 5. RESULTS

Table 4 Measurement Results for Location 1

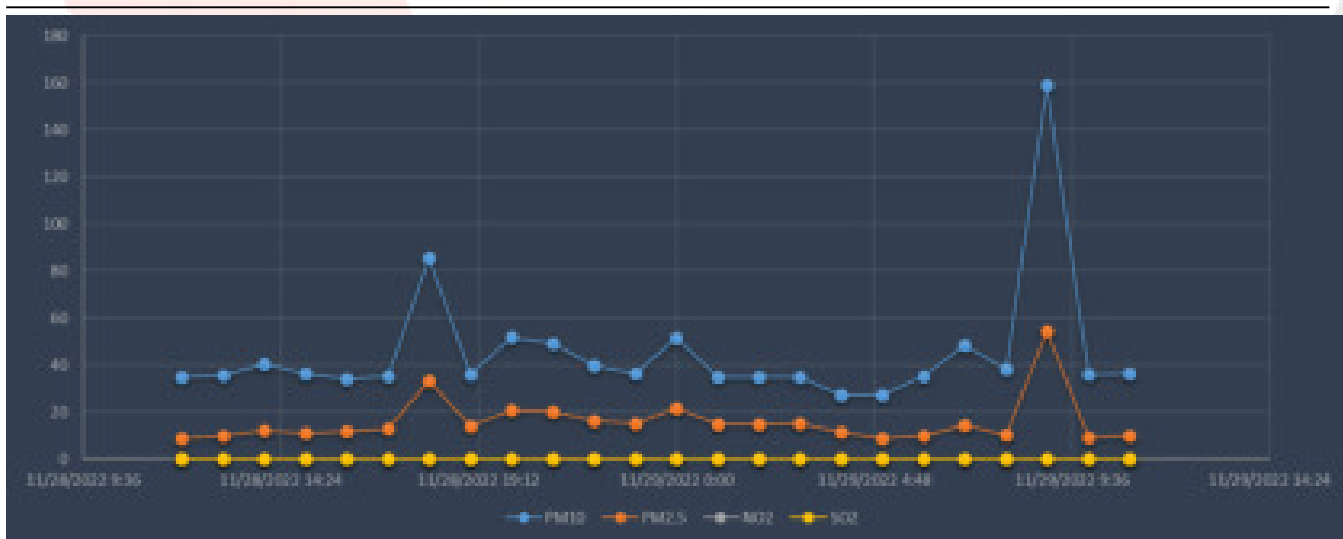
Location	Sampling Date	Air Quality Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ1	2022-11-28 12:00:00	39.40	9.36	100.00	36.35	121.14	48.08	36.81
	2022-11-28 13:00:00	39.50	8.75	105.13	38.14		52.07	35.03
	2022-11-28 14:00:00	40.30	8.98	78.64	14.22		50.72	35.88
	2022-11-28 15:00:00	64.10	19.90	60.71	19.63		49.49	36.03
	2022-11-28 16:00:00	32.50	11.10	80.30	20.60		53.42	33.39
	2022-11-28 17:00:00	31.70	11.70	43.75	8.23		60.93	28.95
	2022-11-28 18:00:00	53.70	21.30	25.36	11.87		65.20	27.35
	2022-11-28 19:00:00	30.80	12.20	19.55	10.93		67.87	26.58
	2022-11-28 20:00:00	26.30	10.40	8.70	24.32		70.14	26.16
	2022-11-28 21:00:00	24.10	9.75	11.27	31.43		71.71	25.89
	2022-11-28 22:00:00	23.70	9.72	7.30	28.19		73.18	25.56
	2022-11-28 23:00:00	23.00	9.61	12.38	41.85		74.69	25.35
	2022-11-29 00:00:00	24.10	10.30	4.28	37.32		75.95	25.12
	2022-11-29 01:00:00	22.10	9.40	8.70	23.44		77.16	24.94
	2022-11-29 02:00:00	20.00	8.59	10.18	27.51		78.42	25.01
	2022-11-29 03:00:00	20.70	9.10	7.60	19.00		79.07	24.84
	2022-11-29 04:00:00	19.10	8.20	1.80	17.40		80.35	24.57
	2022-11-29 05:00:00	30.40	11.00	14.97	18.15		81.13	25.00
	2022-11-29 06:00:00	22.80	4.93	36.02	39.22		78.56	28.28
	2022-11-29 07:00:00	35.40	8.46	101.55	49.17		68.75	31.86
	2022-11-29 08:00:00	44.90	11.40	91.89	53.55		62.93	33.89
	2022-11-29 09:00:00	43.10	10.60	100.17	81.78		58.81	34.92
2022-11-29 10:00:00	41.10	9.31	80.30	46.30	57.54	35.09		
2022-11-29 11:00:00	40.70	8.42	73.68	40.00	55.42	35.70		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
<b>24 h Average</b>		<b>33.06</b>	<b>10.52</b>	<b>45.18</b>	<b>30.78</b>	<b>121.14</b>	<b>66.32</b>	<b>29.68</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 2** Measurement Graphs for Location AQ1

**Table 5 Measurement Results for Location 2**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ2	2022-11-28 12:00:00	34.9	8.9	0.00	0.00	71.75	44.86	33.91
	2022-11-28 13:00:00	35.6	9.75	0.00	0.00		45.96	33.11
	2022-11-28 14:00:00	40.6	12.1	0.00	0.00		47.06	32.41
	2022-11-28 15:00:00	36.1	11.1	0.00	0.00		48.98	31.32
	2022-11-28 16:00:00	34	11.6	0.00	0.00		54.28	29.21
	2022-11-28 17:00:00	35	13	0.00	0.00		58.86	27.52
	2022-11-28 18:00:00	85.5	33.4	0.00	0.00		61.07	26.55
	2022-11-28 19:00:00	35.9	14.1	0.00	0.00		61.37	26.26
	2022-11-28 20:00:00	51.9	20.8	0.00	0.00		64.69	25.92
	2022-11-28 21:00:00	49	20.2	0.00	0.00		66.15	25.59
	2022-11-28 22:00:00	39.6	16.3	0.00	0.00		66.17	25.50
	2022-11-28 23:00:00	36.3	15	0.00	0.00		67.50	25.25
	2022-11-29 00:00:00	51.2	21.5	0.00	0.00		67.74	25.13
	2022-11-29 01:00:00	34.7	14.7	0.00	0.00		68.55	24.72
	2022-11-29 02:00:00	34.7	14.8	0.00	0.00		73.09	24.79
	2022-11-29 03:00:00	34.7	15	0.00	0.00		71.68	24.32
	2022-11-29 04:00:00	27.1	11.4	0.00	0.00		72.08	24.89
	2022-11-29 05:00:00	27.4	8.63	0.00	0.00		62.09	29.40
	2022-11-29 06:00:00	35.3	9.88	0.00	0.00		51.95	32.47
	2022-11-29 07:00:00	48.3	14.4	0.00	0.00		49.63	33.20
	2022-11-29 08:00:00	38	10.3	0.00	0.00		48.56	33.43
	2022-11-29 09:00:00	159	54.4	0.00	0.00		48.72	33.45
2022-11-29 10:00:00	35.9	9.31	0.00	0.00	47.73	33.72		
2022-11-29 11:00:00	36.2	9.78	0.00	0.00	48.97	33.18		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>44.87</b>	<b>15.85</b>	<b>0.00</b>	<b>0.00</b>	<b>71.75</b>	<b>58.24</b>	<b>28.97</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 3** Measurement Graphs for Location AQ2

**Table 6 Measurement Results for Location 3**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ3	2022-11-28 12:00:00	81.4	22.6	54.92	4.30	208.34	45.03	37.75
	2022-11-28 13:00:00	46.6	12.8	44.06	0.00		53.09	34.22
	2022-11-28 14:00:00	30.6	7.34	28.69	0.00		56.75	33.11
	2022-11-28 15:00:00	33.4	9.25	21.52	15.21		58.51	32.01
	2022-11-28 16:00:00	34.9	11.1	22.08	2.96		62.40	30.26
	2022-11-28 17:00:00	31.8	11.3	18.08	0.00		68.41	28.22
	2022-11-28 18:00:00	30.4	11.3	0.00	0.00		72.40	27.43
	2022-11-28 19:00:00	22.6	8.11	0.00	0.00		73.14	27.21
	2022-11-28 20:00:00	27.8	10.4	0.00	0.00		73.80	27.19
	2022-11-28 21:00:00	21	7.5	0.00	0.00		74.37	27.11
	2022-11-28 22:00:00	20.1	7.23	0.00	0.00		76.34	27.04
	2022-11-28 23:00:00	20.5	7.56	0.00	0.00		77.30	26.84
	2022-11-29 00:00:00	20.2	7.63	0.00	0.00		78.29	26.64
	2022-11-29 01:00:00	20.7	7.97	3.64	0.00		79.88	26.55
	2022-11-29 02:00:00	17.9	7.01	0.00	8.33		82.44	26.33
	2022-11-29 03:00:00	21.9	8.84	0.00	5.58		82.34	26.35
	2022-11-29 04:00:00	23.7	10	2.44	9.13		83.58	26.00
	2022-11-29 05:00:00	19.8	7.65	0.00	3.32		82.34	26.71
	2022-11-29 06:00:00	23.4	6.57	0.00	0.00		72.13	30.01
	2022-11-29 07:00:00	29.1	8.19	0.00	0.00		67.42	31.01
	2022-11-29 08:00:00	30	8.11	5.87	0.00		66.12	31.63
	2022-11-29 09:00:00	29.2	7.37	0.00	12.41		64.65	32.15
	2022-11-29 10:00:00	34.2	9.22	6.83	21.25		64.45	32.37
2022-11-29 11:00:00	30.2	6.91	28.25	8.86	62.03	33.26		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>29.23</b>	<b>9.25</b>	<b>9.85</b>	<b>3.81</b>	<b>208.34</b>	<b>69.88</b>	<b>29.48</b>
Daily Limit Values	TA Luft	50	-	-	-	-	-	-
	EU	50	-	-	-	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	-	-	-	-



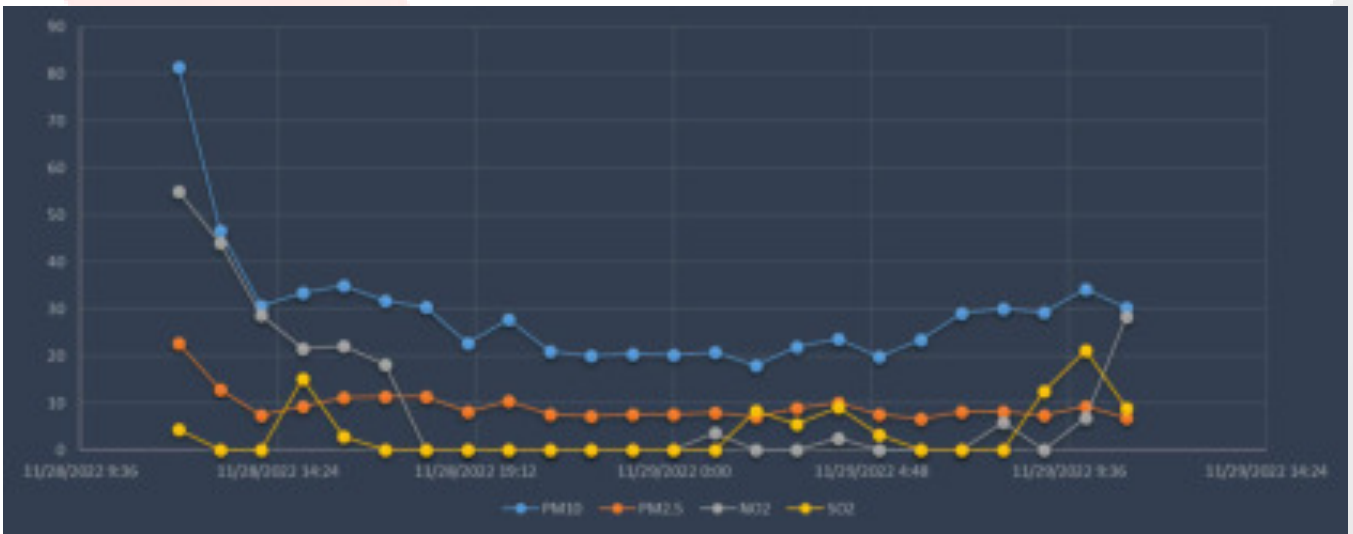


Figure 4 Measurement Graphs for Location AQ3

**Table 7 Measurement Results for Location 4**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR2	2022-11-28 12:00:00	31	5.92	0.00	0.00	57.08	54.97	35.11
	2022-11-28 13:00:00	32.6	6.77	0.00	0.00		54.67	34.87
	2022-11-28 14:00:00	29.5	6.29	0.00	0.00		57.21	33.86
	2022-11-28 15:00:00	29.2	7.28	0.00	0.00		60.63	32.33
	2022-11-28 16:00:00	43.5	14.1	0.00	0.00		63.30	30.94
	2022-11-28 17:00:00	92.4	35.2	0.00	0.00		69.59	27.76
	2022-11-28 18:00:00	24.2	9.19	0.00	0.00		73.88	26.62
	2022-11-28 19:00:00	61.4	25.5	0.00	0.00		75.67	26.33
	2022-11-28 20:00:00	33.4	13.9	0.00	0.00		78.15	26.03
	2022-11-28 21:00:00	18.2	7.25	0.00	0.00		79.84	25.84
	2022-11-28 22:00:00	22.3	9.31	0.00	0.00		80.59	25.58
	2022-11-28 23:00:00	27.9	12.2	0.00	0.00		82.51	25.40
	2022-11-29 00:00:00	17.6	7.69	0.00	0.00		84.94	25.30
	2022-11-29 01:00:00	14.5	6.26	0.00	0.00		84.50	25.16
	2022-11-29 02:00:00	12	5.33	0.00	0.00		86.76	25.09
	2022-11-29 03:00:00	10.5	4.86	0.00	0.00		88.46	24.95
	2022-11-29 04:00:00	11.4	5.42	0.00	0.00		89.06	24.81
	2022-11-29 05:00:00	8.94	3.94	0.00	0.00		89.34	25.39
	2022-11-29 06:00:00	18.7	4.24	0.00	0.00		74.08	30.52
	2022-11-29 07:00:00	42.2	11.8	0.00	0.00		64.96	32.86
	2022-11-29 08:00:00	32.7	7.01	0.00	0.00		60.12	34.40
	2022-11-29 09:00:00	32	6.3	0.00	0.00		58.01	35.00
	2022-11-29 10:00:00	50.1	13.2	0.00	0.00		57.65	35.26
2022-11-29 11:00:00	34.6	6.98	0.00	0.00	57.40	35.42		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>30.45</b>	<b>9.83</b>	<b>0.00</b>	<b>0.00</b>	<b>57.08</b>	<b>71.93</b>	<b>29.37</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

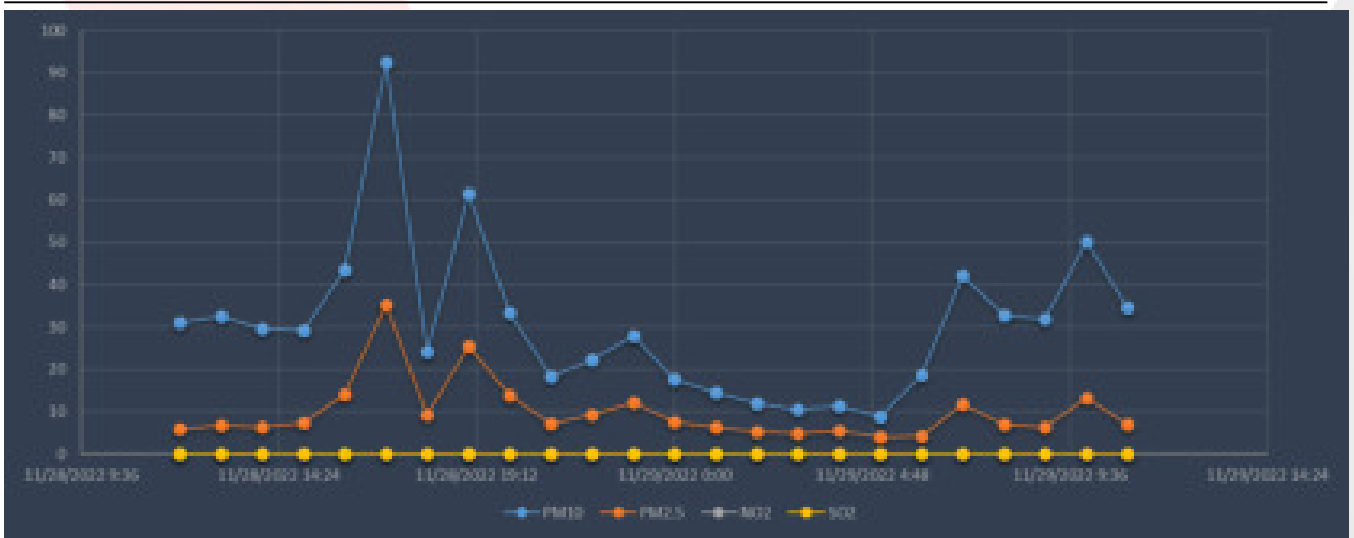
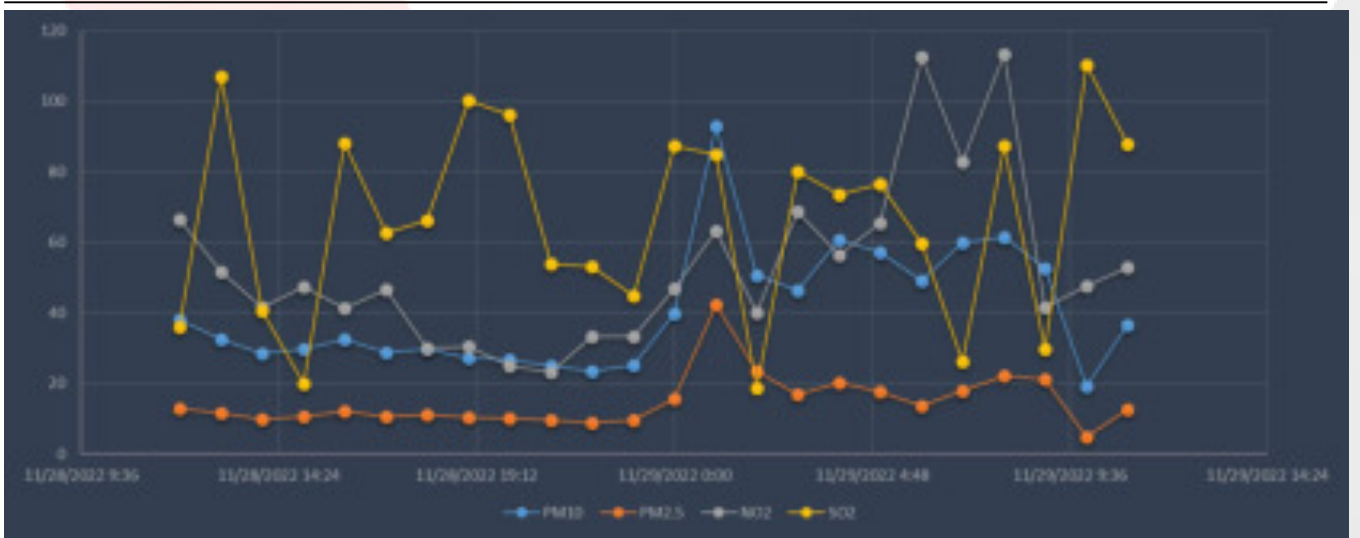


Figure 5 Measurement Graphs for Location ASR2

**Table 8 Measurement Results for Location 5**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR3	11/29/2022 15:00	38.1	13	66.43	36.03	119.33	63.92	29.45
	11/29/2022 16:00	32.5	11.5	51.50	106.85		68.16	28.39
	11/29/2022 17:00	28.5	9.96	41.59	40.63		69.41	28.18
	11/29/2022 18:00	29.7	10.6	47.38	19.97		71.13	28.01
	11/29/2022 19:00	32.5	12.1	41.17	87.95		72.74	27.63
	11/29/2022 20:00	28.8	10.6	46.56	62.70		73.74	27.59
	11/29/2022 21:00	29.7	11.2	30.00	66.08		73.87	27.33
	11/29/2022 22:00	27.3	10.3	30.41	100.09		74.95	27.08
	11/29/2022 23:00	26.6	10.2	25.07	96.16		75.80	26.86
	11/30/2022 0:00	24.9	9.63	23.16	53.95		76.67	26.60
	11/30/2022 1:00	23.4	8.86	33.30	52.99		77.99	26.89
	11/30/2022 2:00	25.2	9.62	33.30	44.85		78.72	27.05
	11/30/2022 3:00	39.7	15.6	46.72	87.32		79.00	27.42
	11/30/2022 4:00	92.8	42.4	63.15	84.92		89.08	25.54
	11/30/2022 5:00	50.7	23.4	40.04	18.77		91.91	26.10
	11/30/2022 6:00	46.2	17	68.70	79.93		81.75	30.05
	11/30/2022 7:00	60.7	20.2	56.29	73.47		73.88	32.16
	11/30/2022 8:00	57.2	17.7	65.40	76.41		71.65	33.28
	11/30/2022 9:00	49	13.7	112.58	59.74		67.31	34.21
	11/30/2022 10:00	59.8	17.9	82.78	26.29		61.42	34.18
	11/30/2022 11:00	61.4	22.2	113.25	87.21		71.69	30.61
	11/29/2022 12:00	52.6	21.1	41.57	29.75		80.79	28.32
11/29/2022 13:00	19.2	4.85	47.46	110.08	83.39	30.58		
11/29/2022 14:00	36.6	12.6	52.98	87.87	82.46	30.36		
Hourly Limit Values	TA Luft	-	-	200	200	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>40.55</b>	<b>14.84</b>	<b>52.53</b>	<b>66.25</b>	<b>119.33</b>	<b>75.48</b>	<b>28.91</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 6** Measurement Graphs for Location ASR3

**Table 9 Measurement Results for Location 6**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR5	11/29/2022 15:00	24.5	8.21	0.00	0.00	84.21	72.53	28.31
	11/29/2022 16:00	21	7.26	0.00	0.00		76.44	27.64
	11/29/2022 17:00	20.3	7.09	0.00	0.00		77.32	27.50
	11/29/2022 18:00	19.4	6.95	0.00	0.00		80.05	27.34
	11/29/2022 19:00	20.1	7.45	0.00	0.00		80.87	27.07
	11/29/2022 20:00	17.9	6.7	0.00	0.00		82.22	26.83
	11/29/2022 21:00	18.5	7.06	0.00	0.00		82.75	26.73
	11/29/2022 22:00	18	6.89	0.00	0.00		83.19	26.75
	11/29/2022 23:00	16.3	6.36	0.00	0.00		84.07	26.45
	11/30/2022 0:00	16.7	6.73	0.00	0.00		85.27	26.28
	11/30/2022 1:00	15.4	6.05	0.00	0.00		86.00	26.52
	11/30/2022 2:00	16.4	6.39	0.00	0.00		85.83	26.73
	11/30/2022 3:00	23.3	9.26	0.00	0.00		85.39	27.16
	11/30/2022 4:00	52.1	25	0.00	0.00		94.24	25.51
	11/30/2022 5:00	31.3	15	0.00	0.00		93.45	26.27
	11/30/2022 6:00	31.8	11.6	0.00	0.00		85.30	29.49
	11/30/2022 7:00	37	10.8	0.00	0.00		74.41	32.07
	11/30/2022 8:00	40	11	0.00	0.00		69.88	33.11
	11/30/2022 9:00	41.8	10.5	0.00	0.00		66.03	34.54
	11/30/2022 10:00	43.6	11	0.00	0.00		64.16	34.76
	11/30/2022 11:00	57.4	22	0.00	0.00		78.45	29.21
	11/29/2022 12:00	43	15.6	0.00	0.00		80.64	29.99
11/29/2022 13:00	30.9	10.1	0.00	0.00	83.41	30.47		
11/29/2022 14:00	29.5	9.59	0.00	0.00	82.33	30.27		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
<b>Average</b>		<b>28.59</b>	<b>10.19</b>	<b>0.00</b>	<b>0.00</b>	<b>84.21</b>	<b>80.59</b>	<b>28.63</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

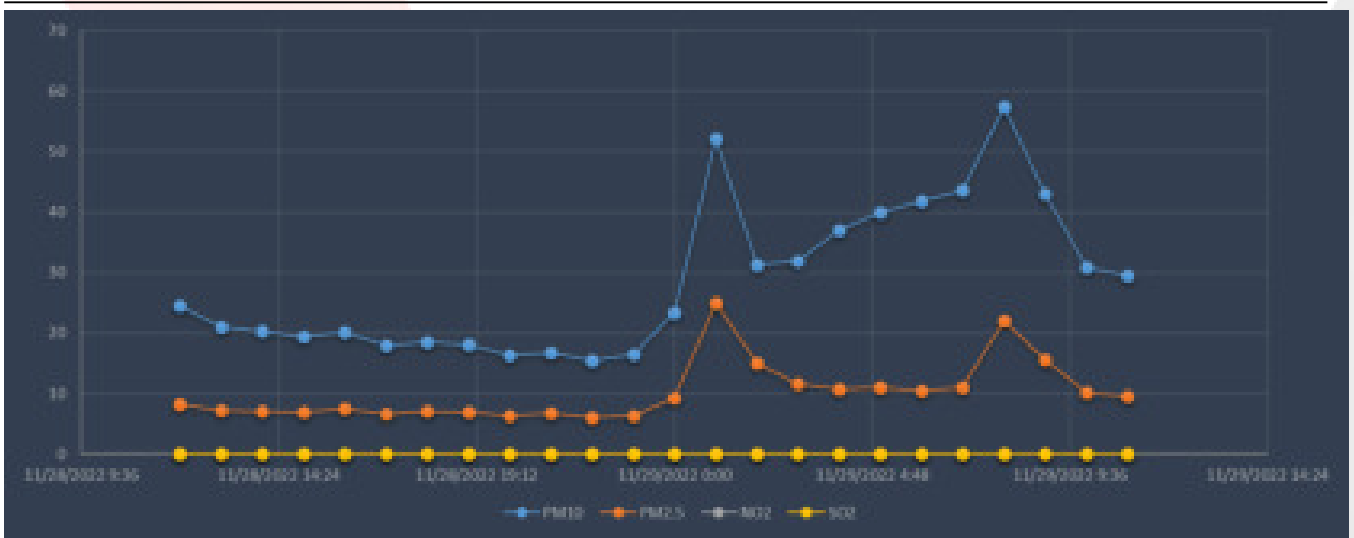
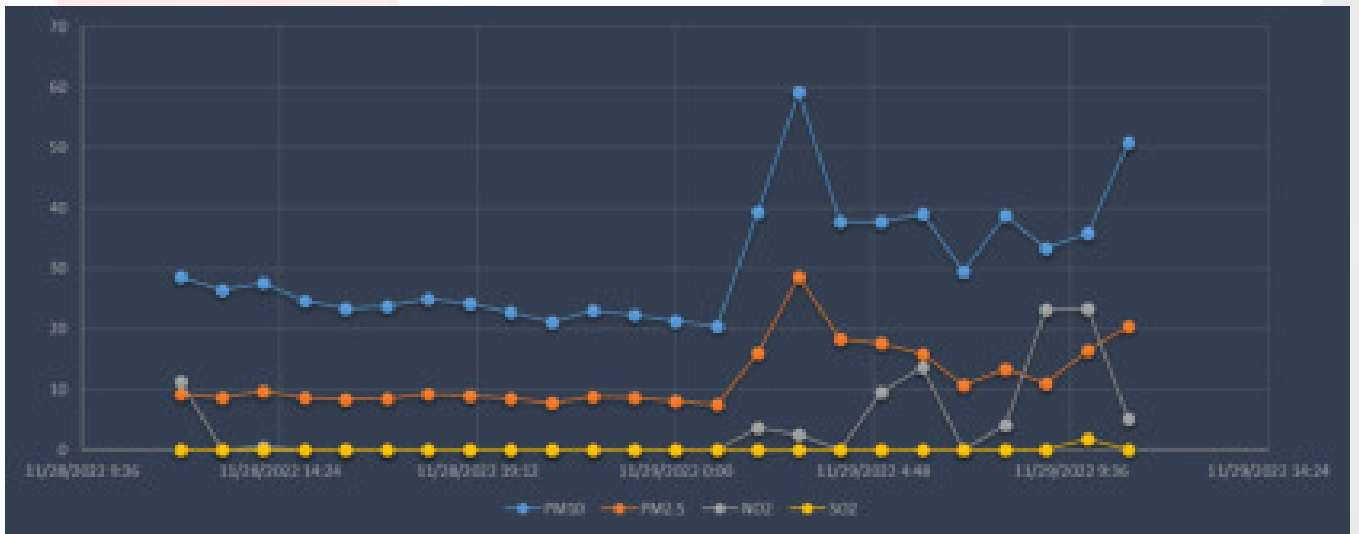


Figure 7 Measurement Graphs for Location ASR2

**Table 10 Measurement Results for Location 7**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )				Ambient Conditions		
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ4	11-29-2022 12:00	28.7	9.24	11.26	0.00	63.20	69.99	29.39
	11-29-2022 13:00	26.4	8.64	0.00	0.00		71.47	28.87
	11-29-2022 14:00	27.6	9.65	0.45	0.00		73.42	28.27
	11-29-2022 15:00	24.7	8.73	0.00	0.00		73.92	27.69
	11-29-2022 16:00	23.4	8.32	0.00	0.00		76.85	27.70
	11-29-2022 17:00	23.8	8.54	0.00	0.00		76.39	27.59
	11-29-2022 18:00	25	9.26	0.00	0.00		77.58	27.41
	11-29-2022 19:00	24.2	8.99	0.00	0.00		78.54	27.34
	11-29-2022 20:00	22.8	8.53	0.00	0.00		78.43	27.03
	11-29-2022 21:00	21.1	7.86	0.00	0.00		78.92	26.97
	11-29-2022 22:00	23	8.86	0.00	0.00		79.91	26.86
	11-29-2022 23:00	22.4	8.72	0.00	0.00		80.31	26.63
	11-30-2022 0:00	21.3	8.09	0.00	0.00		81.18	27.00
	11-30-2022 1:00	20.4	7.51	0.00	0.00		81.19	27.25
	11-30-2022 2:00	39.4	16	3.63	0.00		82.45	27.31
	11-30-2022 3:00	59.2	28.6	2.47	0.00		91.56	24.96
	11-30-2022 4:00	37.7	18.4	0.00	0.00		91.78	25.34
	11-30-2022 5:00	37.7	17.7	9.51	0.00		92.15	26.45
	11-30-2022 6:00	39	15.8	13.65	0.00		87.35	28.61
	11-30-2022 7:00	29.5	10.7	0.00	0.00		85.91	29.20
	11-30-2022 8:00	38.8	13.4	4.10	0.00		81.44	30.47
	11-30-2022 9:00	33.3	11	23.22	0.00		79.79	30.30
11-30-2022 10:00	35.8	16.5	23.29	1.85	92.80	26.78		
11-30-2022 11:00	50.8	20.4	5.11	0.00	84.65	28.41		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	
	EU	-	-	200	350	-	-	
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	
Average		<b>30.67</b>	<b>12.06</b>	<b>4.03</b>	<b>0.08</b>	<b>63.20</b>	<b>81.17</b>	<b>27.66</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	
	EU	50	-	-	125	-	-	
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	





**Figure 8** Measurement Graphs for Location AQ4

## **6. ASSESSMENT**

The air quality measurement study was carried out with the aim of determining the air pollutants on ambient air quality. Results were assessed according to the TA LUFT, EU Council Directive 2008/50/EC and WHO limit values and this report was prepared. According to air quality measurement studies, background air quality values are comply with air quality standards.

# GOVERNMENT of MALDIVES

WtE Energy Facility Project

## BACKGROUND AIR QUALITY MEASUREMENT REPORT



Thilafushi Island/MALDIVES




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**Test Report**

<b>Customer Name/Address</b>	Alke Alkatas Joint Venture Pvt Ltd H.H.Moomiyaage 5A Asaree Hingun K.Male 20265 MALDIVES
<b>Order No.</b>	EN-M/2207/417_01
<b>Name and identity of test item</b>	Immission (Air Quality)
<b>Remarks</b>	-
<b>Date of Test</b>	21.12.2022-23.12.2022
<b>Number of Pages of the Report</b>	27 Pages
<b>Test Method</b>	Air Quality Sensors HSE-MDHS 14/3
<b>Test results</b>	The test results are given in the measurement result tables.
<b>Environmental conditions</b>	Environmental conditions during the measurement are given in the measurement result tables.
<b>Comments</b>	-

The test and/or measurement results, the uncertainties (if applicable) with confidence probability and test methods are given on the following pages which are part of this report.

Reporter and Approval
Ismail Ulusoy Environmental Engineer


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## 1. INTRODUCTION

This report has been prepared with the aim of determining the air quality in the sensitive receptors located in the impact area of the The Greater Malé Waste to Energy Project. Air quality results were determined for PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, TSP and O<sub>3</sub> parameters.

## 2. MEASUREMENT METHODS

PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> parameters were monitored by using air quality monitoring stations based on sensor technology. TSP's were measured by dust sampling devices conforming to the international HSE-MDHS 14/3. Ideally as recommended in the EIA report air quality should be measured 24 hours at each station, all measurements were made at each point within this framework 24 hours a day.

The US EPA refers to the term 'air sensor' as a class of non-regulatory technology that is low-cost, portable, capable of measuring several pollutants simultaneously, and often easier to operate than regulatory stations. For example, monitoring air pollution with reference measurement methods (regulatory stations) requires skilled operators to maintain and calibrate measuring instruments. On the other hand, air sensors describe the hardware and software set that can be operated without human intervention and enable unskilled users to monitor air pollution without additional technical knowledge.

Sensor specifications which are used for measurement study are shown below.

Sensor Name	Sensor Type	Accuracy r <sup>2</sup> -score*	Range
PM2.5	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
PM10	Laser scattering	>0.9	0 to 1000 µg/m <sup>3</sup>
NO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
SO <sub>2</sub>	Electro chemical	>0.82	0 to 5000 ppb
Temperature	CMOS IC	0.9	-20°C to 60°C
Humidity	CMOS IC	0.9	5% to 95%

The accuracy of these low-cost sensors is as critical as measuring the air quality. With the smart calibration process, low-cost sensors are corrected and accurate compared to reference stations. The Smart Calibration Algorithm consists of the below operational steps shown figure below.





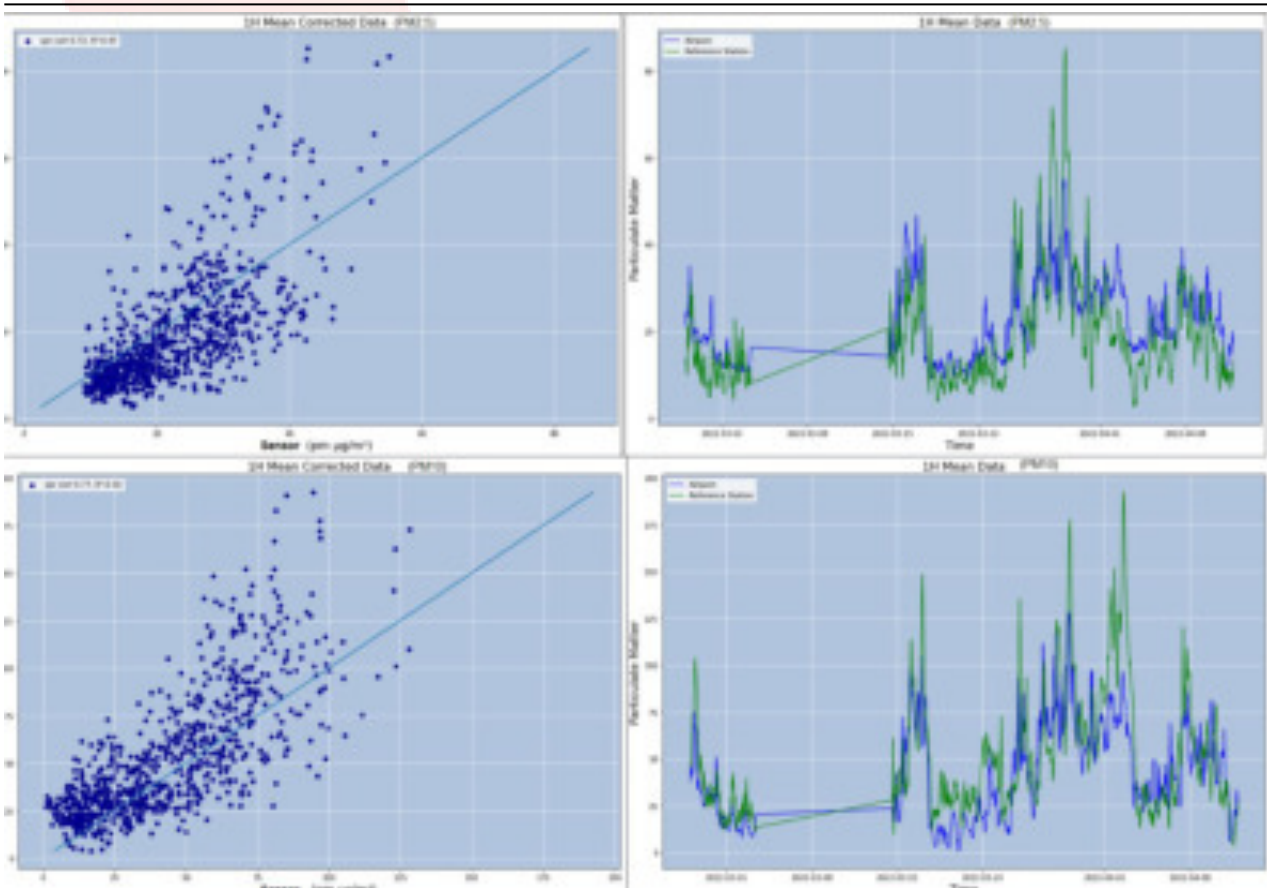
Sensor Units were calibrated using reference stations for a period before the deployment. The calibration process for particle matter and gas pollutants measurement is explained below.

**Table 1 Calibration Process for Pollutants**

Description	Methodology	
	NO <sub>2</sub> -SO <sub>2</sub> -O <sub>3</sub>	PM <sub>10</sub> -PM <sub>2.5</sub>
Installation	Near Reference Station (3/4 meters)	Near Reference Station (3/4 meters)
Pre-Test	Quality Check in zero air conditions	Quality Check in zero air conditions
Co-Located Period	4-5 weeks	8 weeks
Sampling Period	30 seconds. Hourly mean is used because the reference station measurements are hourly.	60 seconds. Hourly mean is used because the reference station measurements are hourly.
Validation	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.	Cross-validation is used. Also, some ranges of measurement are eliminated, where the reference station is not available.
Calibration Procedure	is obtained via R <sup>2</sup> and spearman correlation	is obtained via R <sup>2</sup> and spearman correlation

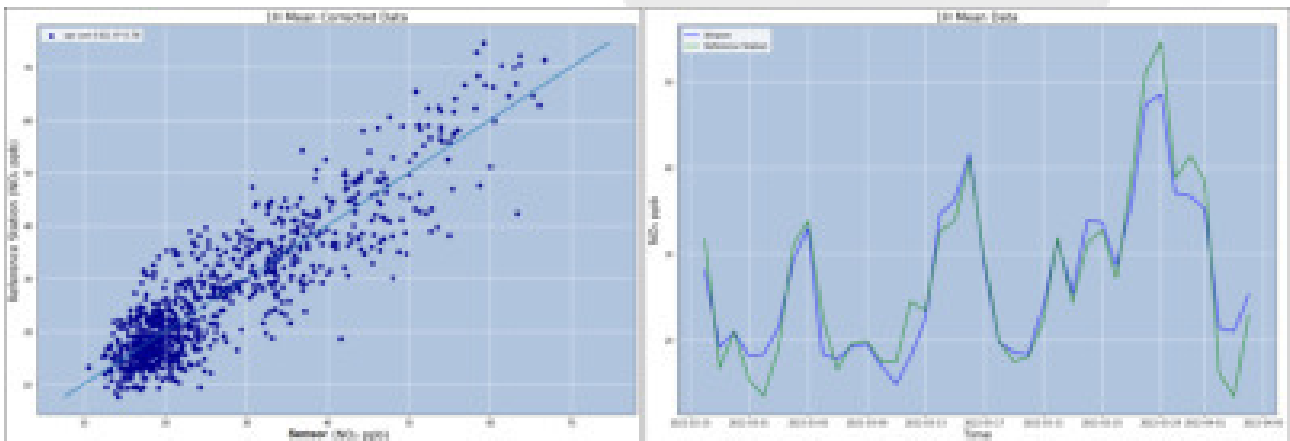
**Calibration Result for PM**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit’s PM<sub>2.5</sub> measurements between Reference Station’s PM<sub>2.5</sub> measurements for hourly and daily mean of data is 0.73, and the correlation between Sensor Unit’s PM<sub>10</sub> measurements between Reference Station’s PM<sub>10</sub> measurements for hourly and daily mean of data is 0.77.



**Calibration Result for Gases**

The corrected measurement results after the Smart Calibration Process are shown in the figures below. The correlation between Sensor Unit’s NO<sub>2</sub> measurements between Reference Station’s NO<sub>2</sub> measurements for hourly and daily mean of data is respectively 0.823, 0.898



## **2.1. FIELD APPLICATION**

This section describes how the measurements, the general methodology of which is given above, are applied in the field.

### **Preliminary Preparations**

Preliminary preparations for air quality measuring stations with sensors include factory calibrations and field calibrations. Factory calibrations are provided by the sensor manufacturer. Stations capable of making reference measurements were used for field calibrations, as described above. For this purpose, a 1-month comparison measurement was carried out at a reference station in the Turkish air quality monitoring network and the calibration factors were applied.

For TSP measurements, filter conditioning was carried out in the laboratory. For this purpose, cassettes and filters were conditioned for 24 hours in a room conditioned at 25 degrees Celsius and 50% humidity and were tared.

### **During Measurements**

Air quality measurements were made with four sets of devices. AQ1, AQ2, AQ3 and ASR2 measurements were made with these devices on the first day, and ASR 3, ASR5 and AQ4 points were measured on the second day.

The locations of the sampling points are determined in the macro scale ESIA report. A site visit was made and a location was determined at the micro scale where the devices would be placed.

Measurements were made at a height of 1.5 to 4 meters from the ground, depending on the suitability of the sampling point.

24-hour measurements were made at each point. Parameters measured with sensor devices consist of the averages of instantaneous measurements taken at 10-minute intervals. For TSP measurements, 24-hour uninterrupted sampling was carried out.

### **After Measurements**

The values after the measurements were taken by reading directly on the air quality measuring devices with sensors.

In TSP measurements, the filters were brought to the laboratory, conditioned for 24 hours at 25 degrees Celsius and 50% humidity for 24 hours and weighed. The 24-hour dust amount was found by subtracting the last weighing result from the first weighing result.

### 3. MEASUREMENT LOCATION

For the Preconstruction baseline environmental assessment of the ambient air quality was conducted at seven locations: 6 locations at Thilafushi (AQ1, AQ2, and AQ3 in the EIA and the ASR 2, ASR3 and ASR5 recommended for monitoring in the EIA Report) and one location at Villingili (AQ4).

**Table 2 Sampling Point Coordinates and Sampling dates**

No	Location	Description	Distance to Source (meters)
1	AQ1	Represents dense industrial area	650
2	AQ2	Represents dense industrial area	1000
3	AQ3	Represents dense industrial area	500
4	ASR2	Represents dense industrial area	700
5	ASR3	Represents dense industrial area	500
6	ASR5	Represents dense industrial area	1000
7	AQ4	Represents dense housing and population area	4500



Figure 1 Sampling Points on satellite Map

#### 4. LEGAL FRAMEWORK

Within the scope of the project, particle matter (PM<sub>10</sub>-PM<sub>2.5</sub>), NO<sub>2</sub>, SO<sub>2</sub> AND TSP emissions were measured. It is known that Maldives does not have a national air quality policy. Therefore, international standards were used for the evaluation. WHO defines limit values in “Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide” document. European Union directives also have limit values for air pollution prevention (EU Council Directive 2008/50/EC relating to health based standards and objectives for a number of pollutants in ambient air). Germany has an air pollution control regulation titled "Technical Instructions on Air Quality Control" (Technische Anleitung zur Reinhaltung der Luft) and commonly referred to as the TA Luft and determines the limit values to protect the general public and the neighborhood against harmful effects of air pollution on the environment. Comparison of these limit values and chosen parameters and values for the modeling study according to these standards are shown in Table 3.

**Table 3.** Limit Values Stipulated in the International Legislation

Pollutant	Averaging Period	TA Luft	EU	WHO Ambient Air Quality Guideline Value	Project Standards
Particular Matter <10 µm (PM <sub>10</sub> )	24 hours	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>	45 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>	15 µg/m <sup>3</sup>
Particular Matter <2.5 µm (PM <sub>2.5</sub> )	24 hours	-	-	15 (not to be exceeded more than 3-4 times a year)	15
	1-year	-	20	5	5
Nitrogen Dioxide (NO <sub>x</sub> )	1-hour	200 µg/m <sup>3</sup>	200 µg/m <sup>3</sup>	-	200 µg/m <sup>3</sup>
	24 hours	-	-	25 µg/m <sup>3</sup>	25 µg/m <sup>3</sup>
	1-year	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>	10 µg/m <sup>3</sup>
Sulphur Dioxide (SO <sub>2</sub> )	1-hour	350 µg/m <sup>3</sup>	350 µg/m <sup>3</sup>	-	350 µg/m <sup>3</sup>
	24 hours	125 µg/m <sup>3</sup>	125 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>
	1-year	50 µg/m <sup>3</sup>	-	-	50 µg/m <sup>3</sup>
TSP*	-	-	-	-	-

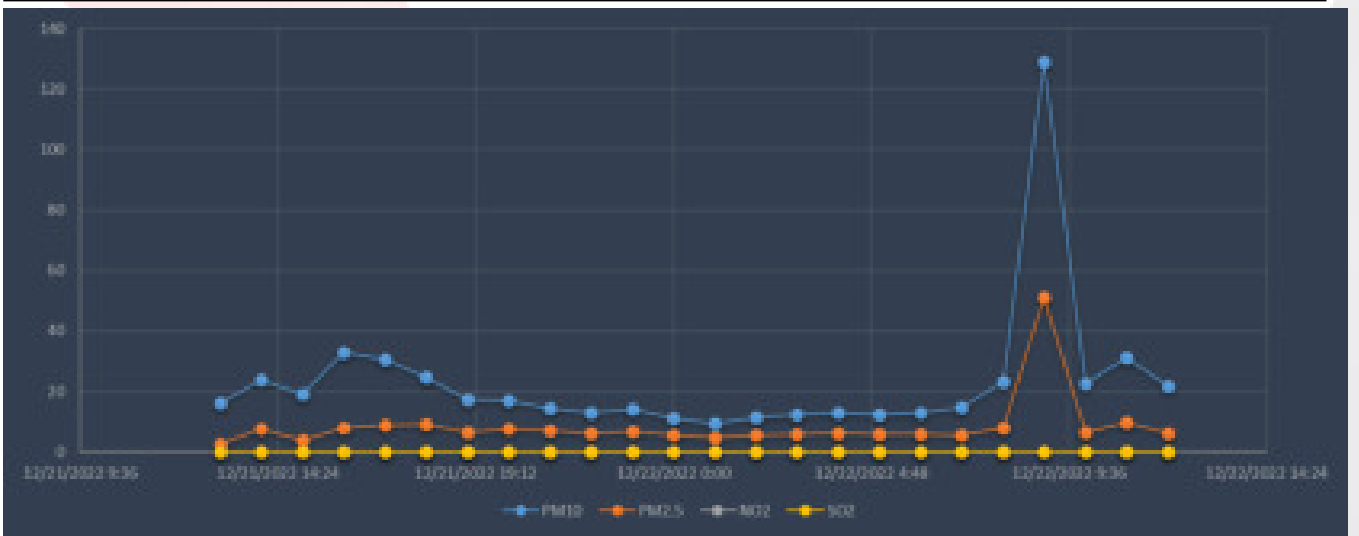
\*There is no limit value for TSP.

## 5. RESULTS

Table 4 Measurement Results for Location 1

Location	Sampling Date	Air Quality Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQI	2022-12-21 13:00:00	16.1	2.77	0.00	0.00	166.41	76.82	31.10
	2022-12-21 14:00:00	23.9	7.71	0.00	0.00		82.19	29.40
	2022-12-21 15:00:00	19.2	3.86	0.00	0.00		77.60	31.46
	2022-12-21 16:00:00	32.8	8.1	0.00	0.00		69.71	33.08
	2022-12-21 17:00:00	30.5	8.93	0.00	0.00		71.84	30.93
	2022-12-21 18:00:00	24.6	9.22	0.00	0.00		82.14	27.72
	2022-12-21 19:00:00	17.4	6.59	0.00	0.00		86.71	27.30
	2022-12-21 20:00:00	17.1	7.59	0.00	0.00		90.13	26.12
	2022-12-21 21:00:00	14.4	7.19	0.00	0.00		93.97	25.65
	2022-12-21 22:00:00	13	6.2	0.00	0.00		93.62	25.99
	2022-12-21 23:00:00	14.1	6.76	0.00	0.00		93.66	26.04
	2022-12-22 00:00:00	11.3	5.7	0.00	0.00		95.56	26.02
	2022-12-22 01:00:00	9.36	4.69	0.00	0.00		95.57	26.08
	2022-12-22 02:00:00	11.6	5.62	0.00	0.00		94.60	26.14
	2022-12-22 03:00:00	12.5	5.98	0.00	0.00		94.47	26.25
	2022-12-22 04:00:00	13.1	6.23	0.00	0.00		94.34	26.27
	2022-12-22 05:00:00	12.5	5.79	0.00	0.00		94.33	26.52
	2022-12-22 06:00:00	13	5.83	0.00	0.00		94.41	26.85
	2022-12-22 07:00:00	14.6	5.71	0.00	0.00		92.30	27.75
	2022-12-22 08:00:00	23.1	7.96	0.00	0.00		86.36	29.14
	2022-12-22 09:00:00	129	51	0.00	0.00		82.93	29.70
	2022-12-22 10:00:00	22.6	6.57	0.00	0.00		81.17	30.11
	2022-12-22 11:00:00	31.3	9.7	0.00	0.00		78.51	30.72
	2022-12-22 12:00:00	21.8	6.14	0.00	0.00		79.35	30.03
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
24 h Average		<b>22.87</b>	<b>8.41</b>	<b>0.00</b>	<b>0.00</b>	<b>166.41</b>	<b>66.32</b>	<b>29.68</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



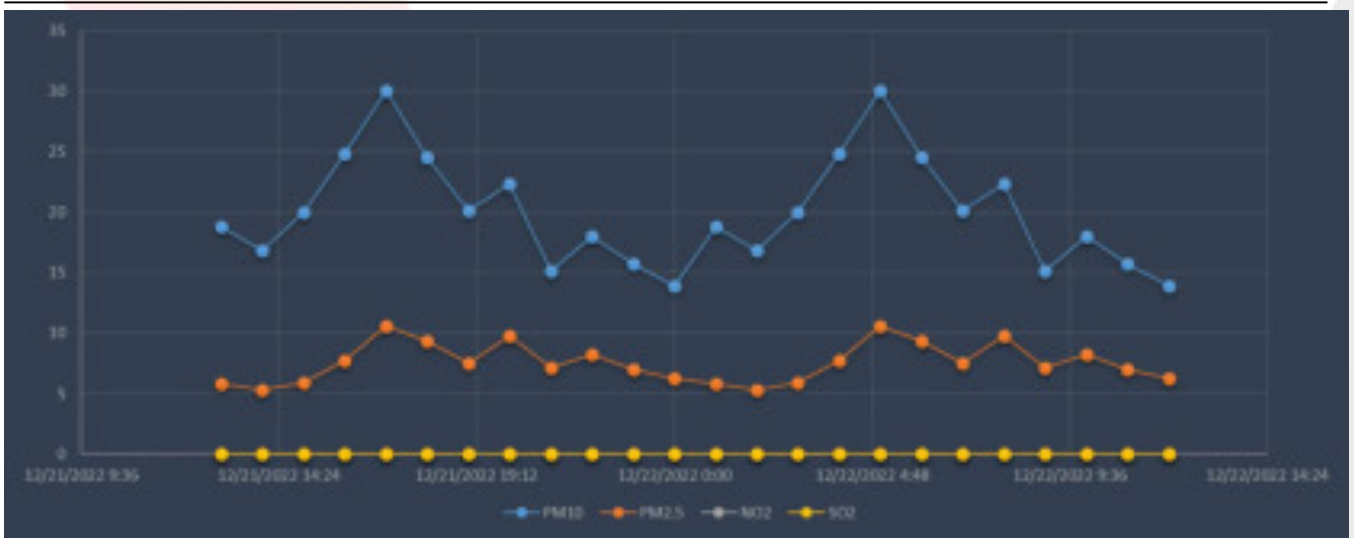


**Figure 2** Measurement Graphs for Location AQ1



**Table 5 Measurement Results for Location 2**

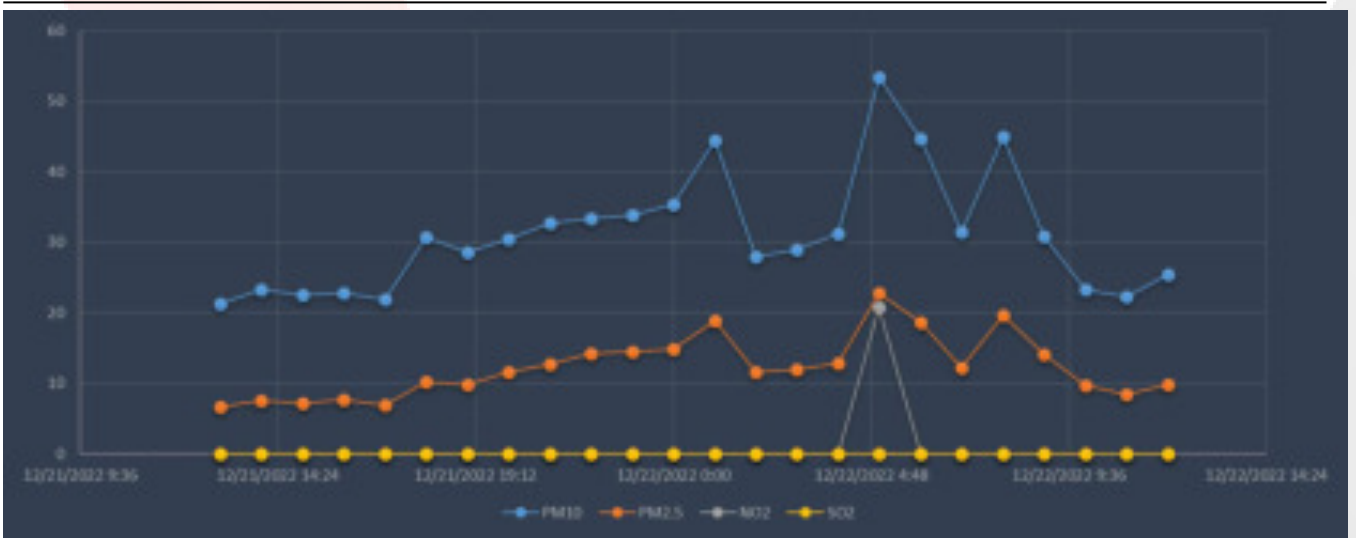
Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ2	2022-12-21 13:00:00	18.8	5.79	0.00	0.00	86.40	78.05	28.56
	2022-12-21 14:00:00	16.8	5.27	0.00	0.00		80.56	28.17
	2022-12-21 15:00:00	20	5.9	0.00	0.00		76.51	29.08
	2022-12-21 16:00:00	24.8	7.74	0.00	0.00		73.45	29.26
	2022-12-21 17:00:00	30	10.6	0.00	0.00		76.85	28.53
	2022-12-21 18:00:00	24.5	9.31	0.00	0.00		82.83	27.58
	2022-12-21 19:00:00	20.1	7.53	0.00	0.00		84.75	27.47
	2022-12-21 20:00:00	22.3	9.77	0.00	0.00		87.53	26.10
	2022-12-21 21:00:00	15.1	7.15	0.00	0.00		90.92	25.36
	2022-12-21 22:00:00	18	8.24	0.00	0.00		90.09	25.76
	2022-12-21 23:00:00	15.7	7	0.00	0.00		90.29	26.00
	2022-12-22 00:00:00	13.9	6.28	0.00	0.00		91.04	25.98
	2022-12-22 01:00:00	18.8	5.79	0.00	0.00		71.66	24.08
	2022-12-22 02:00:00	16.8	5.27	0.00	0.00		74.73	23.63
	2022-12-22 03:00:00	20	5.9	0.00	0.00		61.83	23.58
	2022-12-22 04:00:00	24.8	7.74	0.00	0.00		61.15	23.75
	2022-12-22 05:00:00	30	10.6	0.00	0.00		60.42	23.85
	2022-12-22 06:00:00	24.5	9.31	0.00	0.00		60.06	23.77
	2022-12-22 07:00:00	20.1	7.53	0.00	0.00		59.71	23.69
	2022-12-22 08:00:00	22.3	9.77	0.00	0.00		59.56	23.73
	2022-12-22 09:00:00	15.1	7.15	0.00	0.00		88.23	26.65
	2022-12-22 10:00:00	18	8.24	0.00	0.00		85.43	27.20
	2022-12-22 11:00:00	15.7	7	0.00	0.00		85.82	27.93
	2022-12-22 12:00:00	13.9	6.28	0.00	0.00		80.43	28.04
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
<b>Average</b>		<b>20.00</b>	<b>7.55</b>	<b>0.00</b>	<b>0.00</b>	<b>86.40</b>	<b>58.24</b>	<b>28.97</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 3** Measurement Graphs for Location AQ2

**Table 6 Measurement Results for Location 3**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ3	2022-12-21 13:00:00	21.25	6.64	0.00	0.00	114.36	69.40	28.50
	2022-12-21 14:00:00	23.23	7.59	0.00	0.00		65.53	28.30
	2022-12-21 15:00:00	22.54	7.23	0.00	0.00		63.50	28.42
	2022-12-21 16:00:00	22.82	7.72	0.00	0.00		67.74	27.82
	2022-12-21 17:00:00	21.93	6.94	0.00	0.00		64.78	28.46
	2022-12-21 18:00:00	30.68	10.17	0.00	0.00		60.23	29.14
	2022-12-21 19:00:00	28.59	9.79	0.00	0.00		63.15	28.38
	2022-12-21 20:00:00	30.40	11.59	0.00	0.00		70.90	26.94
	2022-12-21 21:00:00	32.77	12.67	0.00	0.00		71.63	26.91
	2022-12-21 22:00:00	33.38	14.21	0.00	0.00		75.57	25.19
	2022-12-21 23:00:00	33.86	14.54	0.00	0.00		77.61	25.24
	2022-12-22 00:00:00	35.31	14.91	0.00	0.00		75.99	25.49
	2022-12-22 01:00:00	44.36	18.91	0.00	0.00		76.68	25.59
	2022-12-22 02:00:00	27.93	11.60	0.00	0.00		77.04	25.63
	2022-12-22 03:00:00	28.91	11.99	0.00	0.00		77.14	25.73
	2022-12-22 04:00:00	31.15	12.80	0.00	0.00		75.76	25.89
	2022-12-22 05:00:00	53.35	22.83	20.71	0.00		55.60	23.48
	2022-12-22 06:00:00	44.72	18.67	0.00	0.00		69.04	25.32
	2022-12-22 07:00:00	31.41	12.20	0.00	0.00		73.60	26.86
	2022-12-22 08:00:00	44.96	19.64	0.00	0.00		79.93	25.57
	2022-12-22 09:00:00	30.89	14.08	0.00	0.00		83.97	24.85
	2022-12-22 10:00:00	23.25	9.76	0.00	0.00		80.55	25.61
2022-12-22 11:00:00	22.22	8.40	0.00	0.00	76.55	26.67		
2022-12-22 12:00:00	25.46	9.89	0.00	0.00	76.60	26.60		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>31.06</b>	<b>12.28</b>	<b>0.86</b>	<b>0.00</b>	<b>114.36</b>	<b>69.88</b>	<b>29.48</b>
Daily Limit Values	TA Luft	50	-	-	-	-	-	-
	EU	50	-	-	-	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	-	-	-	-



**Figure 4** Measurement Graphs for Location AQ3

**Table 7 Measurement Results for Location 4**

Location	Sampling Date	Results (µg/m <sup>3</sup> )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR2	2022-12-21 16:00:00	10.57	2.51	0.00	5.63	74.10	81.66	28.18
	2022-12-21 17:00:00	35.16	14.78	0.00	8.77		66.36	28.73
	2022-12-21 18:00:00	20.07	5.30	27.25	2.46		73.38	29.84
	2022-12-21 19:00:00	19.22	5.69	17.41	7.59		76.76	28.86
	2022-12-21 20:00:00	15.20	5.15	19.66	9.00		82.66	27.41
	2022-12-21 21:00:00	20.75	8.10	7.48	9.41		86.01	27.26
	2022-12-21 22:00:00	21.41	9.29	0.00	9.48		86.24	27.10
	2022-12-21 23:00:00	20.61	9.13	7.98	7.63		87.71	26.84
	2022-12-22 00:00:00	18.51	8.36	5.29	8.85		87.45	26.62
	2022-12-22 01:00:00	19.02	8.67	17.32	8.75		88.12	26.74
	2022-12-22 02:00:00	18.23	8.40	16.31	8.89		89.51	26.40
	2022-12-22 03:00:00	18.79	8.69	13.23	8.97		89.88	26.21
	2022-12-22 04:00:00	18.27	8.38	14.54	9.40		88.06	25.74
	2022-12-22 05:00:00	19.22	8.60	19.08	11.53		86.34	25.18
	2022-12-22 06:00:00	20.26	8.85	13.10	7.62		81.19	25.10
	2022-12-22 07:00:00	21.83	9.42	16.66	3.41		78.45	24.66
	2022-12-22 08:00:00	21.98	9.46	14.12	13.36		78.12	25.37
	2022-12-22 09:00:00	29.99	12.87	14.96	21.23		77.49	26.16
	2022-12-22 10:00:00	27.45	11.78	18.42	17.55		80.12	26.69
	2022-12-22 11:00:00	25.86	11.06	14.79	16.40		79.25	27.00
	2022-12-22 12:00:00	25.76	11.02	19.45	29.14		74.12	27.69
	2022-12-22 13:00:00	23.28	9.96	8.83	22.13		76.75	28.15
	2022-12-22 14:00:00	23.09	9.84	20.82	35.74		71.18	28.39
2022-12-22 15:00:00	22.61	9.52	13.61	24.88	69.54	28.06		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>21.55</b>	<b>8.95</b>	<b>13.35</b>	<b>12.83</b>	<b>74.10</b>	<b>71.93</b>	<b>29.37</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



Figure 5 Measurement Graphs for Location ASR2

**Table 8 Measurement Results for Location 5**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR3	2022-12-22 17:00:00	31.10	14.86	0.00	0.00	53.16	82.29	23.92
	2022-12-22 18:00:00	14.91	5.50	0.00	0.00		89.61	27.72
	2022-12-22 19:00:00	13.19	5.85	0.00	0.00		93.50	26.76
	2022-12-22 20:00:00	9.00	5.03	0.00	0.00		97.96	25.98
	2022-12-22 21:00:00	6.58	3.33	0.00	0.00		96.78	26.40
	2022-12-22 22:00:00	6.75	2.38	0.00	0.00		93.89	27.35
	2022-12-22 23:00:00	5.78	1.99	0.00	0.00		94.53	27.40
	2022-12-23 00:00:00	4.27	1.42	0.00	0.00		95.37	27.31
	2022-12-23 01:00:00	7.03	2.37	0.00	0.00		93.30	27.47
	2022-12-23 02:00:00	5.48	1.49	0.00	0.00		92.14	27.41
	2022-12-23 03:00:00	9.53	3.52	0.00	0.00		92.44	27.37
	2022-12-23 04:00:00	9.14	3.41	0.00	0.00		92.80	27.31
	2022-12-23 05:00:00	11.10	4.49	0.00	0.00		93.62	27.32
	2022-12-23 06:00:00	12.54	6.05	0.00	0.00		94.99	26.29
	2022-12-23 07:00:00	10.66	6.38	0.00	0.00		99.20	25.64
	2022-12-23 08:00:00	2.89	2.25	0.00	0.00		98.94	25.69
	2022-12-23 09:00:00	4.26	2.46	20.71	0.00		98.73	26.54
	2022-12-23 10:00:00	8.52	2.56	0.00	0.00		92.46	28.11
	2022-12-23 11:00:00	13.63	3.99	0.00	0.00		89.12	29.01
	2022-12-23 12:00:00	13.27	3.29	0.00	0.00		87.89	29.58
	2022-12-23 13:00:00	20.68	5.51	0.00	0.00		83.49	30.54
	2022-12-23 14:00:00	15.68	6.21	0.00	0.00		90.19	27.33
	2022-12-23 15:00:00	16.77	5.44	0.00	0.00		88.52	28.92
2022-12-23 16:00:00	21.12	6.89	0.00	0.00	86.31	29.36		
Hourly Limit Values	TA Luft	-	-	200	200	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>11.41</b>	<b>4.44</b>	<b>0.86</b>	<b>0.00</b>	<b>53.16</b>	<b>71.93</b>	<b>29.37</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-

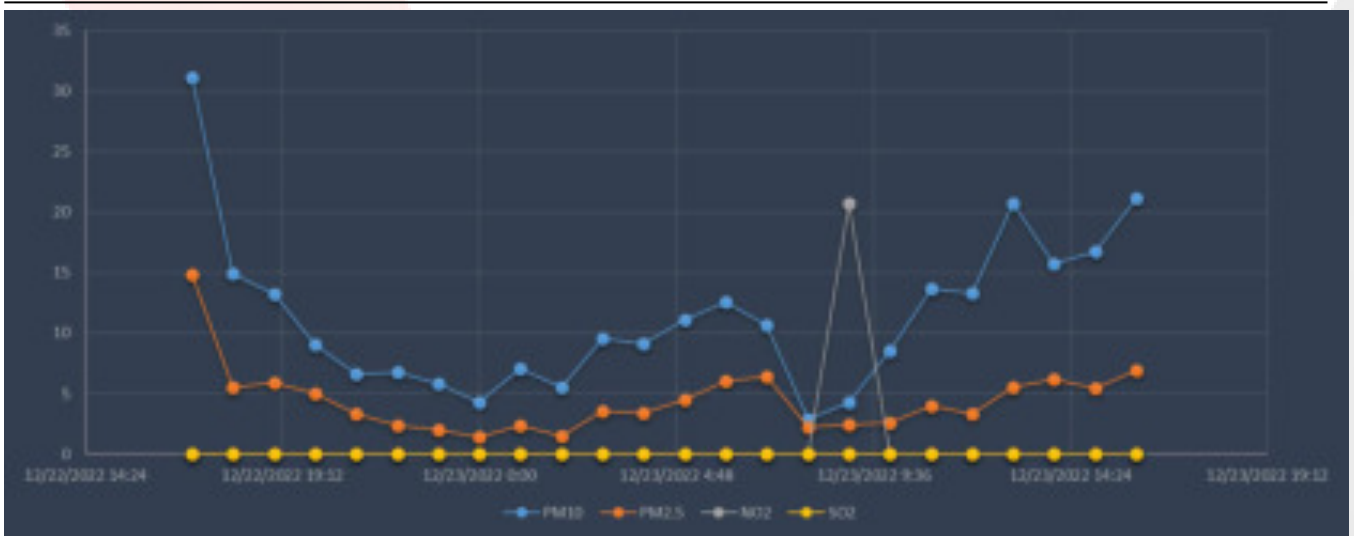
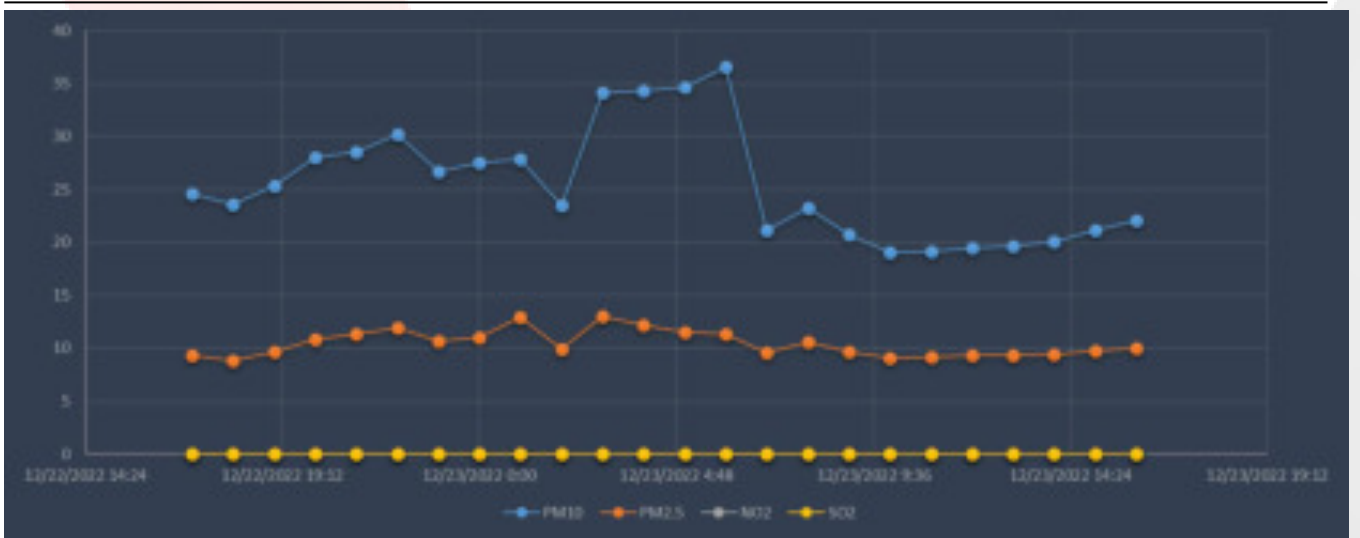


Figure 6 Measurement Graphs for Location ASR3



**Table 9 Measurement Results for Location 6**

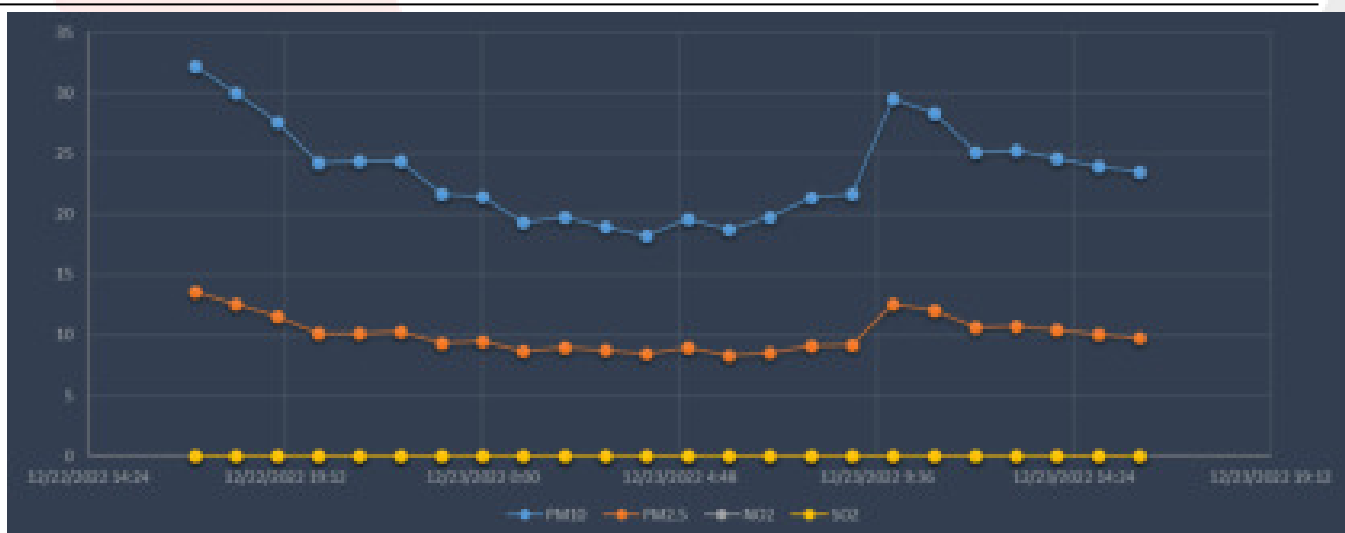
Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )					Ambient Conditions	
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
ASR5	2022-12-22 17:00:00	24.59	9.32	0.00	0.00	181.96	75.59	26.81
	2022-12-22 18:00:00	23.59	8.82	0.00	0.00		73.95	26.79
	2022-12-22 19:00:00	25.33	9.64	0.00	0.00		73.65	26.68
	2022-12-22 20:00:00	28.01	10.81	0.00	0.00		74.82	26.79
	2022-12-22 21:00:00	28.51	11.36	0.00	0.00		76.74	26.44
	2022-12-22 22:00:00	30.19	11.91	0.00	0.00		76.09	26.69
	2022-12-22 23:00:00	26.70	10.63	0.00	0.00		75.79	26.22
	2022-12-23 00:00:00	27.48	10.96	0.00	0.00		75.53	26.20
	2022-12-23 01:00:00	27.81	12.93	0.00	0.00		84.07	24.31
	2022-12-23 02:00:00	23.51	9.89	0.00	0.00		81.92	25.79
	2022-12-23 03:00:00	34.15	12.99	0.00	0.00		72.94	27.45
	2022-12-23 04:00:00	34.33	12.17	0.00	0.00		70.52	28.61
	2022-12-23 05:00:00	34.67	11.52	0.00	0.00		66.15	29.61
	2022-12-23 06:00:00	36.58	11.30	0.00	0.00		84.98	27.14
	2022-12-23 07:00:00	21.18	9.59	0.00	0.00		84.62	27.85
	2022-12-23 08:00:00	23.25	10.59	0.00	0.00		83.57	28.29
	2022-12-23 09:00:00	20.75	9.68	0.00	0.00		78.81	29.12
	2022-12-23 10:00:00	19.05	9.07	0.00	0.00		83.47	27.74
	2022-12-23 11:00:00	19.12	9.16	0.00	0.00		79.85	28.66
	2022-12-23 12:00:00	19.48	9.35	0.00	0.00		77.93	28.71
	2022-12-23 13:00:00	19.64	9.36	0.00	0.00		81.98	26.05
	2022-12-23 14:00:00	20.03	9.38	0.00	0.00		77.99	28.23
2022-12-23 15:00:00	21.16	9.70	0.00	0.00	83.44	28.30		
2022-12-23 16:00:00	22.06	10.01	0.00	0.00	87.36	27.42		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	-
	EU	-	-	200	350	-	-	-
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	-
Average		<b>25.47</b>	<b>10.42</b>	<b>0.00</b>	<b>0.00</b>	<b>181.96</b>	<b>80.59</b>	<b>28.63</b>
Daily Limit Values	TA Luft	50	-	-	125	-	-	-
	EU	50	-	-	125	-	-	-
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	-



**Figure 7** Measurement Graphs for Location ASR2

**Table 10 Measurement Results for Location 7**

Location	Sampling Date	Results ( $\mu\text{g}/\text{m}^3$ )				Ambient Conditions		
		PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	TSP (24 Hours Average)	Humidity (%)	Temperature (°C)
AQ4	2022-12-22 17:00:00	32.21	13.60	0.00	0.00	91.96	71.70	28.26
	2022-12-22 18:00:00	29.98	12.57	0.00	0.00		72.83	28.23
	2022-12-22 19:00:00	27.57	11.55	0.00	0.00		73.15	28.10
	2022-12-22 20:00:00	24.23	10.12	0.00	0.00		75.16	27.75
	2022-12-22 21:00:00	24.33	10.15	0.00	0.00		78.99	26.79
	2022-12-22 22:00:00	24.40	10.30	0.00	0.00		80.33	26.43
	2022-12-22 23:00:00	21.65	9.34	0.00	0.00		81.53	25.97
	2022-12-23 00:00:00	21.45	9.45	0.00	0.00		82.60	26.03
	2022-12-23 01:00:00	19.28	8.68	0.00	0.00		82.45	26.03
	2022-12-23 02:00:00	19.74	8.99	0.00	0.00		76.51	25.56
	2022-12-23 03:00:00	18.93	8.73	0.00	0.00		77.65	25.50
	2022-12-23 04:00:00	18.19	8.46	0.00	0.00		73.81	25.54
	2022-12-23 05:00:00	19.63	8.96	0.00	0.00		76.16	24.87
	2022-12-23 06:00:00	18.69	8.33	0.00	0.00		69.27	24.22
	2022-12-23 07:00:00	19.78	8.55	0.00	0.00		73.75	25.18
	2022-12-23 08:00:00	21.33	9.12	0.00	0.00		73.55	26.39
	2022-12-23 09:00:00	21.63	9.20	0.00	0.00		75.13	26.17
	2022-12-23 10:00:00	29.53	12.58	0.00	0.00		84.55	27.32
	2022-12-23 11:00:00	28.31	12.04	0.00	0.00		81.92	27.70
	2022-12-23 12:00:00	25.13	10.66	0.00	0.00		85.06	27.13
	2022-12-23 13:00:00	25.24	10.69	0.00	0.00		80.56	27.68
	2022-12-23 14:00:00	24.55	10.41	0.00	0.00		72.48	28.82
2022-12-23 15:00:00	23.94	10.09	0.00	0.00	72.52	28.45		
2022-12-23 16:00:00	23.48	9.77	0.00	0.00	71.14	28.59		
Hourly Limit Values	TA Luft	-	-	200	350	-	-	
	EU	-	-	200	350	-	-	
	WHO Ambient Air Quality Guideline Value	-	-	-	-	-	-	
Average		23.47	10.10	0.00	0.00	91.96	81.17	27.66
Daily Limit Values	TA Luft	50	-	-	125	-	-	
	EU	50	-	-	125	-	-	
	WHO Ambient Air Quality Guideline Value	45	15	25	40	-	-	



**Figure 8** Measurement Graphs for Location AQ4

## **6. ASSESSMENT**

The air quality measurement study was carried out with the aim of determining the air pollutants on ambient air quality. Results were assessed according to the TA LUFT, EU Council Directive 2008/50/EC and WHO limit values and this report was prepared. According to air quality measurement studies, background air quality values are comply with air quality standards.

## **Appendix 3 :Test Results of Marine Water and Groundwater**

### **Marine Water Quality**

Report No: (7422)332-0111

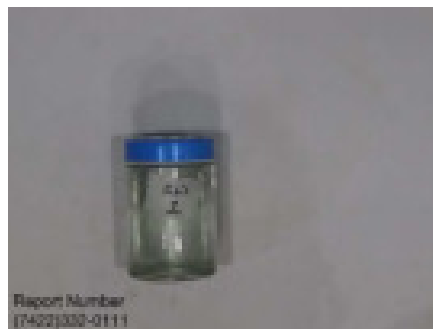
Dec 13, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 13, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-01  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

### Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka  
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411)  
112622198 & 199  
Email: [bvcps.lanka@lk.bureauveritas.com](mailto:bvcps.lanka@lk.bureauveritas.com)

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# TEST REPORT



Report No: (7422)332-0111

Dec 13, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	2	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	4	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	35	-	‰	By salinity refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.3	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - B
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, ‰ : Parts per thousand,

mg/l: milligrams per liter, ICP-MS: Inductively Coupled Plasma Mass Spectrometry.

### Contact information for this report (Technical and General Inquiries and Feedback)

<b>GENERAL INQUIRIES:</b>		
JAYAMEE DISSANAYAKE	TEL: +94 768 229 495	E-MAIL: envlab.lanka@bureauveritas.com
<b>TECHNICAL INQUIRIES:</b>		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
<b>FEED BACK:</b>		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY: \_\_\_\_\_  
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**



Report No: (7422)334-0390

Dec 13, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 13, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-02  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

## Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka  
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411)  
112622198 & 199  
Email: [bvcps.lanka@lk.bureauveritas.com](mailto:bvcps.lanka@lk.bureauveritas.com)

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# TEST REPORT



Report No: (7422)334-0390

Dec 13, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	2	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	3	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	35	-	‰	By salinity refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.5	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - B
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, ‰ : Parts per thousand,

mg/l: milligrams per liter, ICP-MS: Inductively Coupled Plasma Mass Spectrometry.

### Contact information for this report (Technical and General Inquiries and Feedback)

<b>GENERAL INQUIRIES:</b>		
JAYAMEE DISSANAYAKE	TEL: +94 768 229 495	E-MAIL: envlab.lanka@bureauveritas.com
<b>TECHNICAL INQUIRIES:</b>		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
<b>FEED BACK:</b>		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY: \_\_\_\_\_  
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**

Report No: (7422)334-0387

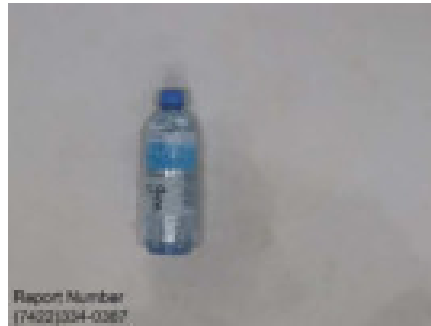
Dec 14, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 14, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-03  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

### Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka  
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411)  
112622198 & 199  
Email: [bvcps.lanka@lk.bureauveritas.com](mailto:bvcps.lanka@lk.bureauveritas.com)

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# TEST REPORT



Report No: (7422)334-0387

Dec 14, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	2	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	6	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	36	-	‰	Salinity-Refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.3	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - E
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, µm: micrometer,

mg/l: milligrams per liter, ‰: Parts per thousand.

### Contact information for this report (Technical and General Inquiries and Feedback)

<b>GENERAL INQUIRIES:</b>		
JAYAMEE DISSANAYAKE	TEL: +94 768 229 495	E-MAIL: envlab.lanka@bureauveritas.com
<b>TECHNICAL INQUIRIES:</b>		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
<b>FEED BACK:</b>		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY: \_\_\_\_\_  
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**

Report No: (7422)334-0394

Dec 13, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 13, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-04  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

## Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka  
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# TEST REPORT



Report No: (7422)334-0394

Dec 13, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	1	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	6	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	36	-	‰	By salinity refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.3	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - B
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, ‰ : Parts per thousand,


mg/l: milligrams per liter, ICP-MS- Inductively Coupled Plasma Mass Spectrometry.

### Contact information for this report (Technical and General Inquiries and Feedback)

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JAYAMEE DISSANAYAKE	TEL: +94 768 229 495	E-MAIL: envlab.lanka@bureauveritas.com
<b>TECHNICAL INQUIRIES:</b>		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
<b>FEED BACK:</b>		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY:   
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**

Report No: (7422)334-0383

Dec 13, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 13, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-05  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

### Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka  
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# TEST REPORT



Report No: (7422)334-0383

Dec 13, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	2	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	3	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	35	-	‰	By salinity refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.3	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - B
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, ‰ : Parts per thousand,


mg/l: milligrams per liter, ICP-MS: Inductively Coupled Plasma Mass Spectrometry.

### Contact information for this report (Technical and General Inquiries and Feedback)

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REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY:   
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**



Report No: (7422)334-0398

Dec 14, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 14, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-06  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

## Photo of the Submitted Samples



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Products Services Lanka (Pvt)  
Ltd.**

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# TEST REPORT



Report No: (7422)334-0398

Dec 14, 2022

Page 2 of 2

## TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Free Ammonia (as NH <sub>3</sub> )*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
2	Biological Oxygen Demand (BOD <sub>5</sub> ) @ 20°C	3	-	mg/L	APHA 23rd ed: 2017 : 5210D
3	Total Suspended Solids (TSS)	3	-	mg/L	APHA 23rd ed: 2017 : 2540D
4	Salinity*	33	-	‰	Salinity-Refractometer
5	Nitrate (as NO <sub>3</sub> <sup>-</sup> )*	0.4	-	mg/L	APHA 23rd ed: 2017: 4500 -NO <sub>3</sub> - E
6	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
7	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
8	Copper (as Cu)	ND	0.001	mg/L	
9	Nickel (as Ni)	ND	0.001	mg/L	
10	Cadmium (as Cd)	ND	0.0001	mg/L	
11	Total Chromium (as Cr)	ND	0.001	mg/L	
12	Lead (as Pb)	ND	0.001	mg/L	
13	Mercury (as Hg)	ND	0.00005	mg/L	
14	Zinc (as Zn)	ND	0.001	mg/L	

\*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

### NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, µm: micrometer,


mg/l: milligrams per liter, ‰: Parts per thousand.

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REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.  
AUTHORIZED SIGNATORY

APPROVED BY:   
RUWANI AMARASINGHE  
ASSISTANT MANAGER –  
FOOD & MICROBIOLOGY LABORATORY

**END OF THE REPORT**

Report No: (7422)334-0401

Dec 14, 2022

Page 1 of 2

Attn: Servet Burak Ozdemir

**Customer:** Alke – Alkataş Joint Venture (Pvt) Ltd  
**Address :** H.H. Moomiyaage, 5A, Asaree Hingun 20265, K. Male', Maldives  
**Date of Sample Received:** Nov 30, 2022  
**Date of Testing Started:** Nov 30, 2022  
**Date of Testing Completed:** Dec 14, 2022  
**Sample Description:** **Sample Received as:**  
A water samples contained in sealed glass & plastic bottles  
**Sample Identified by the Client as:**  
SW-07  
1.5L Plastic Bottle, 1L Glass Bottle & 0.5L Plastic Bottle  
**Sample Drawn By BVCPS** NO

## Photo of the Submitted Samples



**Bureau Veritas Consumer  
Products Services Lanka (Pvt)  
Ltd.**

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