

5.6 AIR QUALITY STUDY

5.6.1 METEOROLOGY

In order to determine the likely impacts on the air environment secondary data on the meteorology was collected from the Barbados MET Service for the study area for years 1982 to 2018. Table 4.1 shows the mean annual wind speed, the rainfall, the maximum and minimum temperatures, the mean relative humidity and wind direction for the period 1982 to 2018.

Table 4.1 Meteorological data 1982-2018

Month	Rainfall(mm)	Max Temp (C)	Min Temp (C)	Wind speed Km/h	Mean RH	Wind Direction
Jan	48.9	28.6	23.5	21.9	77%	80E
Feb	14.4	28.7	23.7	22.6	77%	80E
Mar	59	29.2	23.7	21.7	75%	80E
Apr	16.8	29.7	24.5	21.7	77%	90E
May	48.4	30.3	25.3	22.7	78%	90E
Jun	54.8	30.3	25.6	24.6	80%	90E
Jul	68.6	30.2	25.5	22.4	81%	90E
Aug	44.8	30.4	25.5	18.9	81%	100E
Sep	91.2	30.5	25.3	16.8	81%	100E
Oct	105.7	30.2	25.1	17.7	82%	100E
Nov	50.1	29.7	24.9	18.6	83%	90E
Dec	43.4	29.1	24.2	20.6	79%	80E

Table 5.6.1 Climate Data (January 1982 to December 2018) Bridgetown, Barbados

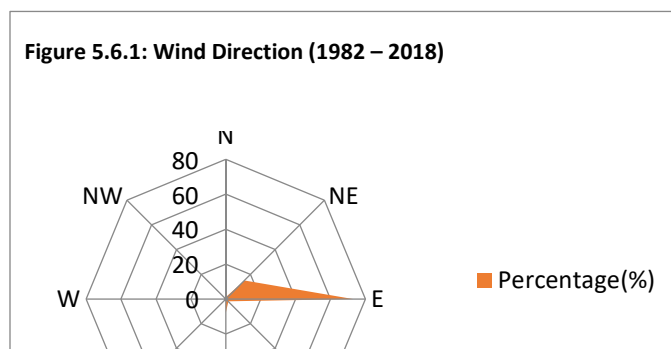


Table 5.6.2: Maximum and minimum conditions on climate recorded in Barbados

Maximum Temperature	33.1 C (September 2005)
Minimum Temperature	16.5 C (January 2nd 1984)
Highest Monthly Rainfall	513.9mm (November 1991)
Lowest Monthly Rainfall	3.6mm (February 2010)
Highest Daily Rainfall	235.4mm (October 30th, 2010)
Lowest Relative Humidity	39% (February 17th, 2008)

Source: Barbados MET office At Grantley International Airport

5.6.2 Temperature

The site has an average maximum mean temperature of 29.7°C and minimum mean temperature of 24.7°C yearly or an average mean temperature of 27.2°C. The highest temperature ever recorded in Barbados is 33.1°C and minimum of 16.5°C (table 4.2). The data on the ambient temperature is shown in table 4.1 above.

5.6.3 Rainfall

The average maximum rainfall for the period 1982 to 2018 is 105.7 recorded in the month of October. The minimum is 16.8 recorded in the month of April. Total average annual amount of rainfall is 646.1 mm for Bridgetown.

5.6.4 Humidity

The average relative humidity values varied from the lowest of 77 % in the months of January, February, and April to the highest of 83% during November.

5.6.5 Wind Speed and Direction

The average maximum wind speed is recorded to be 20.8 km/hr. Apart from this, as per the climatological data for the year 1982-2018; wind rose pattern for Bridgetown is recorded to be in an easterly direction generally between 80E and 100E. The maximum wind speed was recorded as 24.6 km/hr during the month of June and the minimum wind speed 16.8 Km/hr was recorded during the months of September.

5.6.6 Location of Air Quality Stations.

Based on the climatology data for the study area, primary baseline monitoring was carried out as per the standard methodologies and accepted protocols as detailed by the EPA National Ambient Air Quality Standards (N AAQS). Air quality was monitored with high volume samplers for 24 hours, twice a week for one month. Each sampler was maintained at volumetric flow rate ranging between 1-1.5 m³/min. Analysis of pollutants was done as per standard IS code methods.

Site-specific background air quality monitoring program was conducted near the proposed project site during a two-week period (8th April to 22nd April, 2019). Background data was collected for PM_{2.5}, PM₁₀, SO₂, NO_x, & CO. Five sampling stations were located within the study area within a 1km radius from the site, so as to cover the overall air quality status of the study area. Also, project emissions are not likely to have significant impacts beyond such a distance.

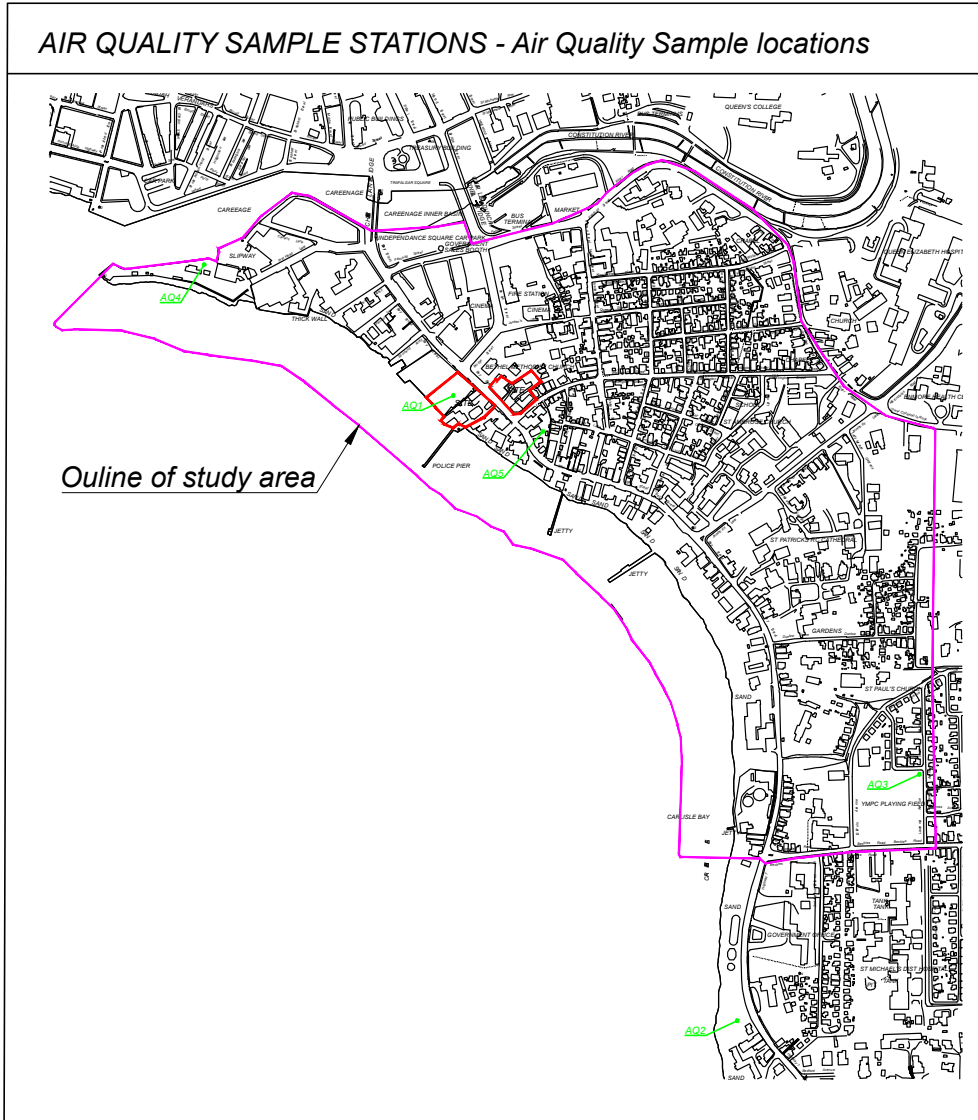
For selection of the monitoring locations, long-term meteorological trends (1982-2018) were taken into consideration to obtain the predominant wind direction during the sampling period. In this manner, there were air quality monitoring stations AQ1 at the centre of the seaward side of the project, AQ2 and AQ3 were placed downwind direction, AQ4 and AQ5 in the upwind direction from site. Monitors were placed at sensitive receptors (i.e. nearby residential area). The monitoring locations are specified in Figure 5.6.2 and the distance from the site is shown in Table 5.6.3.

Table 5.6.2: Distance of air quality stations from site

Location	Location Name	Distance from Site	Wind direction
AQ1	At site	-----	-----
AQ2	Police Sports Club	970m	Downwind

AQ3	Bayville Housing Area	834m	Downwind
AQ4	Pier Head	327m	Upwind
AQ5	London Bourne H.A	112m	downwind

Figure 5.6.3: Location of Air Quality Stations



Clean Air Act requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Act identifies two types of national ambient air quality standards. Primary standards provide public health protection,

including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria air pollutant". Periodically, the standards are reviewed and may be revised. The current standards are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$). (Table 5.6.4)

Table 5.6.4: NAAQS

Pollutant		Primary/Secondary	Average Time	Level	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Nitrogen Dioxide (NO ₂)		Primary	1 hour	100 ppb	98 percentile of 1 hour daily maximum concentrations, average over 3 years
		Primary & secondary	1 year	53 ppb	Annual mean
Particle pollution (PM)	PM _{2.5}	Primary	1 year	12.0 $\mu\text{g}/\text{m}^3$	Annual mean average over 3 years
		Secondary	1 year	15.0 $\mu\text{g}/\text{m}^3$	Annual mean average over 3 years
	PM ₁₀	Primary & secondary	24 hours	35 $\mu\text{g}/\text{m}^3$	98 percentile average over 3 years

		Primary & secondary	24 hours	150µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulphur Dioxide (SO ₂)		Primary	1 hour	75 ppb	99 percentile of 1 hour daily maximum concentrations, average over 3 years
		Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

The results of the air quality test are shown in tables 5.6.5 to 5.6.9 for pollutants PM₁₀, PM_{2.5}, SO₂, NO_x, and CO.

Table 5.6.5: Ambient Air Quality Results for Station AQ1- Site

AQ1	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
Maximum	32.1	10.3	8.2	12.3	896
Minimum	24.2	7.1	7.3	8.2	782
Arithmetic Mean	28.1	8.7	7.8	10.2	839
NAAQS	150	35	196	65	2000

Table 5.6.6: Ambient Air Quality Results for Station AQ2-Police Sports Club

AQ2	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
Maximum	36.1	11.3	9.5	10.3	746
Minimum	25.2	7.8	6.3	8.5	712
Arithmetic Mean	30.6	9.5	7.9	9.4	729
NAAQS	150	35	196	65	2000

Table 5.6.7: Ambient Air Quality Results for Station AQ3-Bayville H.A

AQ3	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
Maximum	37.1	12.3	10.2	12.8	1020
Minimum	25.2	8.1	9.3	10.2	998
Arithmetic Mean	31.1	10.2	9.7	11.5	1009

NAAQS	150	35	196	65	2000
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Table 5.6.8: Ambient Air Quality Results for Station AQ4-Pier Head

AQ4	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
Maximum	35.1	11.3	13.2	11.8	1096
Minimum	26.2	9.1	10.3	10.5	992
Arithmetic Mean	30.6	10.2	11.7	11.1	1044
NAAQS	150	35	196	65	2000

Table 5.6.9: Ambient Air Quality Results for Station AQ5-London Bourne H.A

AQ5	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO ₂ (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
Maximum	33.1	10.3	12.2	13.8	996
Minimum	25.2	8.1	10.1	11.5	942
Arithmetic Mean	29.1	9.2	11.1	12.6	969
NAAQS	150	35	196	65	2000

The results of the various pollutants were found to be within NAAQS requirements at all of the sampling stations. For PM₁₀ the maximum level was recorded at AQ3 and the minimum at AQ1. The details for the individual stations are provided in table 5.6.10.

Table 5.6.10 Baseline Air Quality Results for PM₁₀ (µg/m³)

Monitoring Stations Results For PM ₁₀					
Location	Maximum	Minimum	Arithmetic Mean	NAAQS	Land Use
AQ1	32.1	24.2	28.1	150	Vacant/commercial
AQ2	36.1	25.2	30.6	150	Recreational
AQ3	37.1	25.2	31.1	150	Residential
AQ4	35.1	26.2	30.6	150	Commercial
AQ5	33.1	25.2	29.1	150	Residential

Figure 5.6.4 is a graphical representation of the comparison of PM₁₀ at the 5 locations.

Figure 5.6.4: Graph showing comparison of PM₁₀

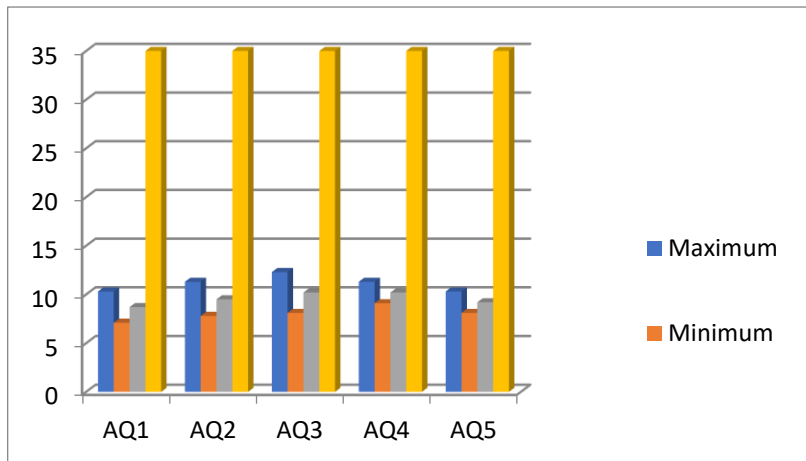


The results of PM_{2.5} were also recorded at the 5 locations and are provided in the table 5.6..11 below. The maximum level for PM_{2.5} was recorded at station AQ3 and the minimum at AQ1.

Table 5.6.11: Baseline Air Quality Results for PM_{2.5} (µg/m³)

Monitoring Stations Results For PM _{2.5}					
Location	Maximum	Minimum	Arithmetic Mean	NAAQS	Land Use
AQ1	10.3	7.1	8.7	35	Vacant/commercial
AQ2	11.3	7.8	9.5	35	Recreational
AQ3	12.3	8.1	10.2	35	Residential
AQ4	11.3	9.1	10.2	35	Commercial
AQ5	10.3	8.1	9.2	35	Residential

Figure 5.6.5: comparison of PM_{2.5} at the 5 locations.

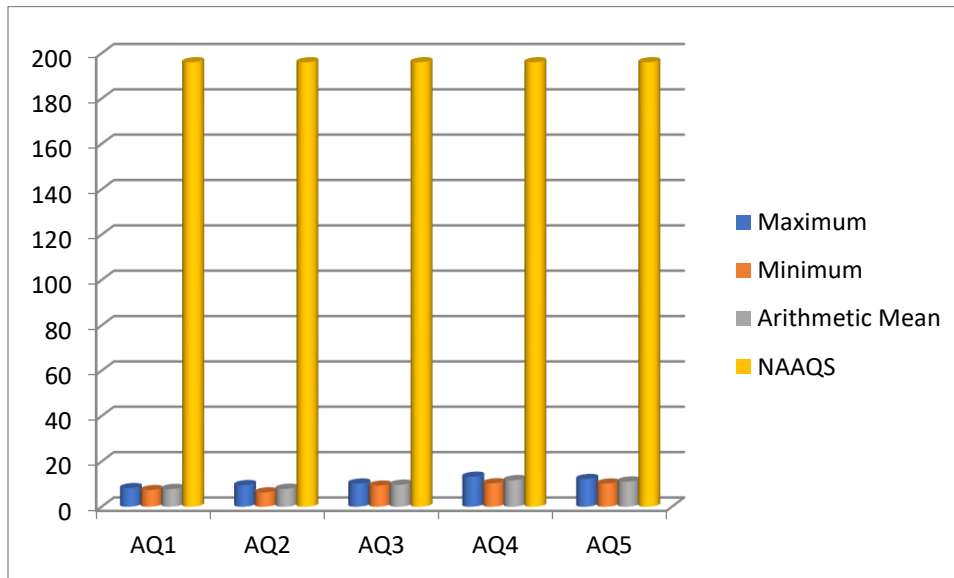


The results of SO₂ were also recorded at the 5 locations and are shown in the table 5.6.12 below.

Table 5.6.12: Baseline Air Quality Results for SO₂ (µg/m³)

Monitoring Stations Results For SO ₂					
Location	Maximum	Minimum	Arithmetic Mean	NAAQS	Land Use
AQ1	8.2	7.3	7.8	196	Vacant/commercial
AQ2	9.5	6.3	7.9	196	Recreational
AQ3	10.2	9.3	9.7	196	Residential
AQ4	13.2	10.3	11.7	196	Commercial
AQ5	12.2	10.2	11.1	196	Residential

Figure 7.6.6: the comparison of SO₂ at the 5 locations



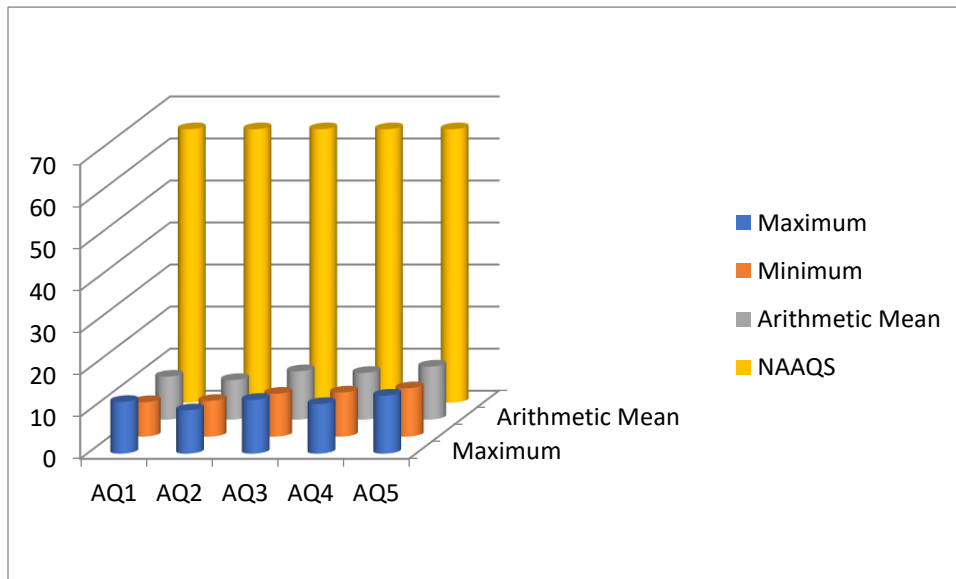
Samples were also taken for NO_x at the 5 locations and are listed below in Table 4.13

The maximum NO_x was recorded at sample stations Q5 and the minimum at station AQ1.

Table 5.6.13: Baseline Air Quality Results for NO_x(µg/m³)

Monitoring Stations Results For NO _x					
Location	Maximum	Minimum	Arithmetic Mean	NAAQS	Land Use
AQ1	12.3	8.2	10.2	65	Vacant/commercial
AQ2	10.3	8.5	9.4	65	Recreational
AQ3	12.8	10.2	11.5	65	Residential
AQ4	11.8	10.5	11.1	65	Commercial
AQ5	13.8	11.5	12.6	65	Residential

Figure 5.6.7: Comparison of NO_x at the 5 locations



Samples were also recorded for CO at the five locations and the data is shown in table 4.14. Note that the maximum CO reading was obtained at station AQ4 and the minimum reading was taken at AQ2.

Table 5.6..14 Baseline Air Quality Results for CO (µg/m³)

Monitoring Stations Results For CO					
Location	Maximum	Minimum	Arithmetic Mean	NAAQS	Land Use
AQ1	896	792	839	2000	Vacant/commercial
AQ2	746	712	729	2000	Recreational
AQ3	1020	998	1009	2000	Residential
AQ4	1096	992	1044	2000	commercial
AQ5	996	942	969	2000	Residential

Figure 5.6.8: Comparison of CO at the 5 locations

