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R0018

**BERMUDA ELECTRIC LIGHT COMPANY, LTD.**

# **ANNUAL AMBIENT AIR QUALITY MONITORING REPORT**

FOR THE PERIOD

JANUARY 1<sup>ST</sup> TO DECEMBER 31<sup>ST</sup>, 2022

MARCH 1<sup>ST</sup>, 2023

PREPARED BY: OHSE COORDINATOR

## Table of Contents

Introduction .....	1
Exceedance Report .....	1
Annual Data.....	2
Data Availability .....	2
Year-on-Year Comparison of Average & Maximum Recorded Pollutant Concentrations .....	7
Semiannual Audits .....	18
Conclusion.....	18
Appendix A .....	1

## List of Tables

Table 1: BAAQS exceedance record for the reporting period.....	1
Table 2: BAAQS exceedance log for the reporting period.....	2
Table 3: Annual summary of data availability figures for BDA1, BDA2, BDA3 and BDA4 .....	3

## List of Figures

Fig. 1: Data Availability Rates for BDA1 monitoring station, pollutant parameters.....	4
Fig. 2: Data Availability Rates for BDA2 monitoring station, pollutant parameters.....	4
Fig. 3: Data Availability Rates for BDA4 monitoring station, pollutant parameters.....	5
Fig. 4: Data Availability Rates for BDA1 monitoring station, meteorological parameters.....	5
Fig. 5: Data Availability Rates for BDA3 monitoring station, meteorological parameters.....	6

Fig. 6: Data Availability Rates for BDA4 monitoring station, meteorological parameters.....	6
Fig. 7: Maximum 1-Hour Average Concentration of NO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	8
Fig. 8: Maximum 24-Hour Average Concentration of NO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	9
Fig. 9: Annual Average Concentration of NO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	10
Fig. 10: Maximum 1-Hour Average Concentration of SO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	11
Fig. 11: Maximum 24-Hour Average Concentration of SO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	12
Fig. 12: Annual Average Concentration of SO <sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	13
Fig. 13: Maximum 24-Hour Average Concentration of PM <sub>10</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	14
Fig. 14: Annual Average Concentration of PM <sub>10</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022.....	15
Fig. 15: Maximum 24-Hour Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2022.....	16
Fig. 16: Annual Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2022.....	17

## Introduction

This report summarizes the findings and operation of BELCO’s Ambient Air Quality Monitoring for the period January 1<sup>st</sup> to December 31<sup>st</sup>, 2022, as required by Condition 6.3.1 and 6.3.4 of BELCO’s Operating License, #OL-114.

BELCO operates and maintains four ambient air quality monitoring stations. ‘BDA1’ is located on Cemetery Lane, Pembroke, and measures both pollutant and meteorological parameters. ‘BDA2’ is located on Langton Crescent, Pembroke, and measures pollutant parameters. ‘BDA3’ is located in the northwest corner of BELCO’s Pembroke Power Station and measures meteorological parameters. ‘BDA4’ is located on Ocean Lane, Pembroke, and measures pollutant and meteorological parameters and operated until June 27<sup>th</sup>, 2022 when BELCO ceased data collection in preparation to remove the monitoring station as requested by the property owner.

## Exceedance Report

During the reporting period, zero (0) exceedances of the Bermuda Ambient Air Quality Standards (BAAQS) were recorded at BELCO’s three ambient air quality monitoring stations, ‘BDA1’, ‘BDA2’, and ‘BDA4’; please refer to Table 1 and Table 2 for details. Annual averages of all measured pollutant parameters were below the annual BAAQS at both ‘BDA1’, ‘BDA2’, and ‘BDA4’ stations in 2022.

**Table 1:** BAAQS exceedance record for the reporting period.

Station	Parameter	BAAQS - 1-Hr (µg/m <sup>3</sup> )	Max. 1-Hr Avg. (µg/m <sup>3</sup> )	# of Exceed. (1-hr)	BAAQS - 24-Hr (µg/m <sup>3</sup> )	Max. 24-hr Avg. (µg/m <sup>3</sup> )	# of Exceed. (24-Hr)	BAAQS – Annual (µg/m <sup>3</sup> )	Annual Avg. (µg/m <sup>3</sup> )	# of Exceed. (Annual)
<b>BDA1</b>	<b>NO<sub>2</sub></b>	<b>400</b>	74	0	<b>200</b>	23	0	<b>60</b>	2.7	0
	<b>SO<sub>2</sub></b>	<b>450</b>	15	0	<b>150</b>	7	0	<b>30</b>	2.3	0
	<b>PM<sub>10</sub></b>	-	-	-	<b>50</b>	37	0	<b>30</b>	9.9	0
	<b>TSP</b>	-	-	-	<b>100</b>	-	0	<b>60</b>	-	0
<b>BDA2</b>	<b>NO<sub>2</sub></b>	<b>400</b>	104	0	<b>200</b>	37	0	<b>60</b>	2.7	0
	<b>SO<sub>2</sub></b>	<b>450</b>	206	0	<b>150</b>	73	0	<b>30</b>	1.8	0
	<b>PM<sub>10</sub></b>	-	-	-	<b>50</b>	41	0	<b>30</b>	11.6	0

	TSP	-	-	-	100	-	0	60	-	0
BDA4	NO <sub>2</sub>	400	331	0	200	69	0	60	5.9	0
	SO <sub>2</sub>	450	293	0	150	97	0	30	6.9	0
	PM <sub>10</sub>	-	-	-	50	33	0	30	12.8	0
<b>Total Number of BAAQS Exceedances Recorded During Reporting Period</b>										<b>0</b>

**Table 2:** BAAQS exceedance log for the reporting period.

Station	Parameter	Averaging Period	Date/Time (AST)	Concentration (ug/m3)	BAAQS (ug/m3)
-	-	-	-	-	-

## Annual Data

All valid data collected during the reporting period is provided in tabular form in the excel spreadsheet titled “BELCO AQMS Dataset – 2022 Annual”, which has been provided electronically with this report.

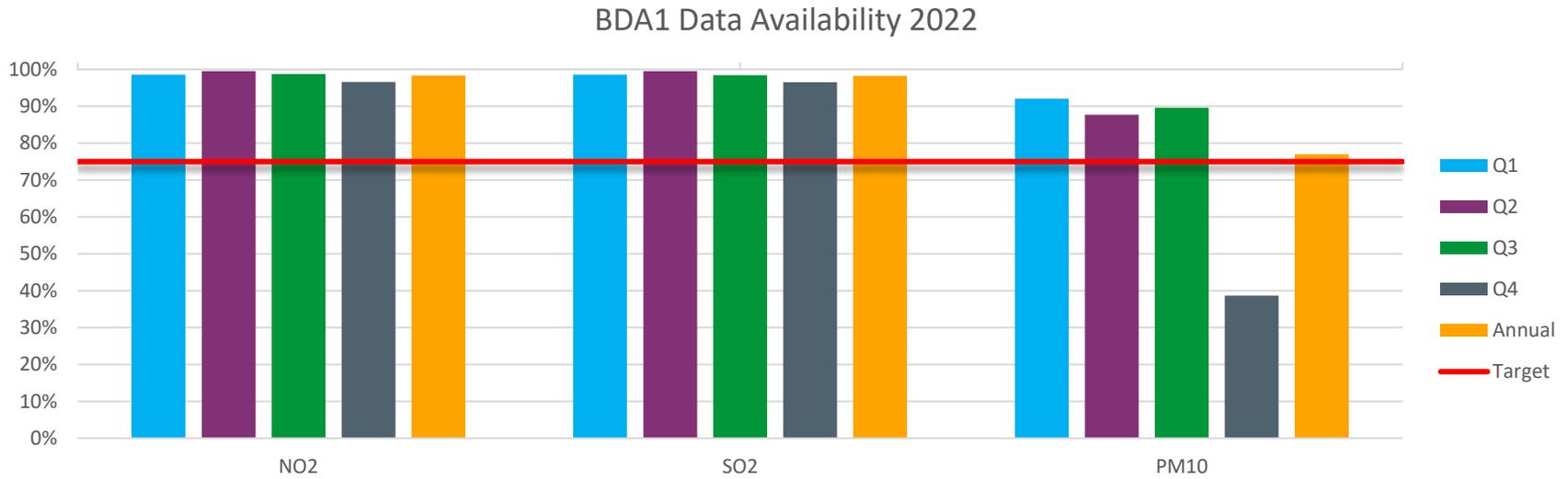
## Data Availability

An annual summary of data availability figures for 2022 is provided in Table 3 and illustrated in Figures 1-6.

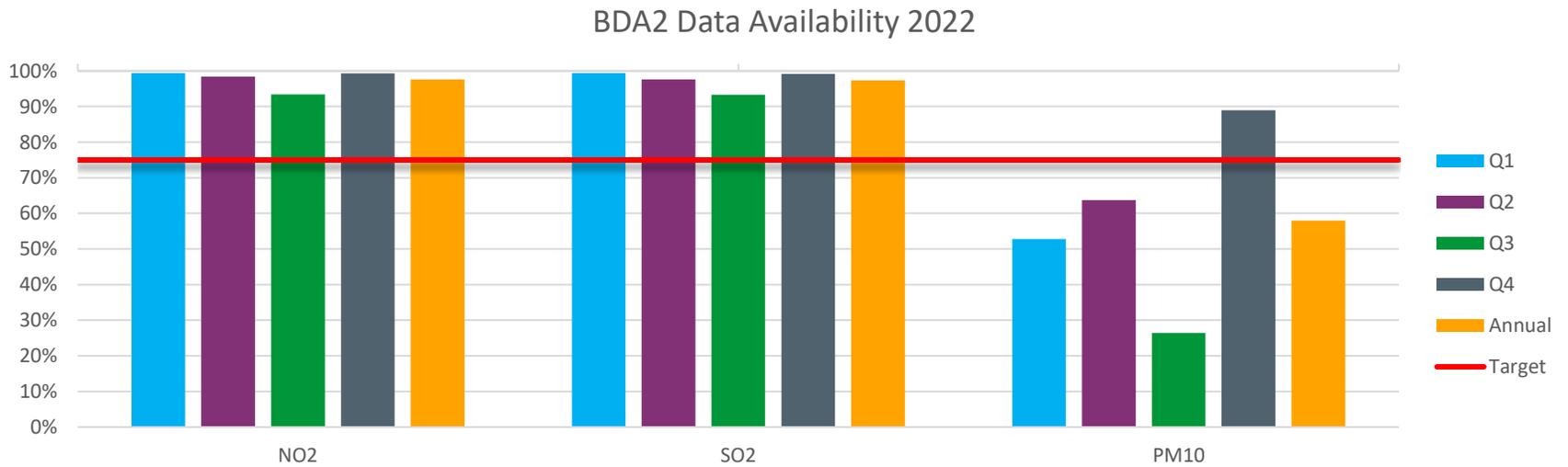
Data collection at all sites was interrupted for periods of time throughout 2022 in order to perform routine maintenance, recalibrate instrumentation, audit instrumentation, lower the meteorological tower in high winds, and to troubleshoot and resolve instrument failures. Detailed explanations of significant periods of downtime (>6 hours) can be found in the quarterly reports submitted throughout 2022.

**Table 3:** Annual summary of data availability figures for BDA1, BDA2, BDA3 and BDA4.

	Q1	Q2	Q3	Q4	2021 Annual	Target
<b>BDA1 - Pollutant Parameters</b>						
NO <sub>2</sub>	98.6%	99.5%	98.7%	96.6%	98.4%	75.0%
SO <sub>2</sub>	98.6%	99.5%	98.4%	96.5%	98.3%	75.0%
PM <sub>10</sub>	92.1%	87.7%	89.6%	38.7%	77.0%	75.0%
<b>BDA1 - Meteorological Parameters</b>						
Wind Direction	99.7%	100%	90.7%	98.6%	83.4%	90.0%
Horiz. Wind Speed	99.7%	100%	90.7%	98.6%	83.4%	90.0%
Vert. Wind Speed	99.7%	100%	90.7%	99.6%	83.4%	90.0%
Temperature	99.7%	100%	90.7%	99.9%	97.6%	90.0%
Rel. Humidity	99.7%	100%	90.6%	99.9%	83.7%	90.0%
<b>BDA2 - Pollutant Parameters</b>						
NO <sub>2</sub>	99.4%	98.4%	93.4%	99.3%	97.6%	75.0%
SO <sub>2</sub>	99.4%	97.6%	93.3%	99.2%	97.4%	75.0%
PM <sub>10</sub>	52.8%	63.7%	26.4%	89.0%	58.0%	75.0%
<b>BDA3 - Meteorological Parameters (SODAR, 65m)</b>						
Wind Direction	56.4%	57.2%	72.1%	86.4%	53.7%	90.0%
Horiz. Wind Speed	56.4%	57.2%	72.1%	86.4%	53.7%	90.0%
Vert. Wind Speed	59.4%	65.5%	86.5%	97.6%	57.4%	90.0%
<b>BDA4 - Pollutant Parameters</b>						
NO <sub>2</sub>	90.4%	94.5%	-	-	92.5%	75.0%
SO <sub>2</sub>	90.4%	94.6%	-	-	92.5%	75.0%
PM <sub>10</sub>	98.3%	80.8%	-	-	88.6%	75.0%
<b>BDA4 - Meteorological Parameters</b>						
Wind Direction	91.9%	86.1%	-	-	89.0%	90.0%
Horiz. Wind Speed	91.9%	86.1%	-	-	89.0%	90.0%
Vert. Wind Speed	91.9%	86.1%	-	-	89.0%	90.0%
Temperature	91.9%	86.1%	-	-	89.0%	90.0%



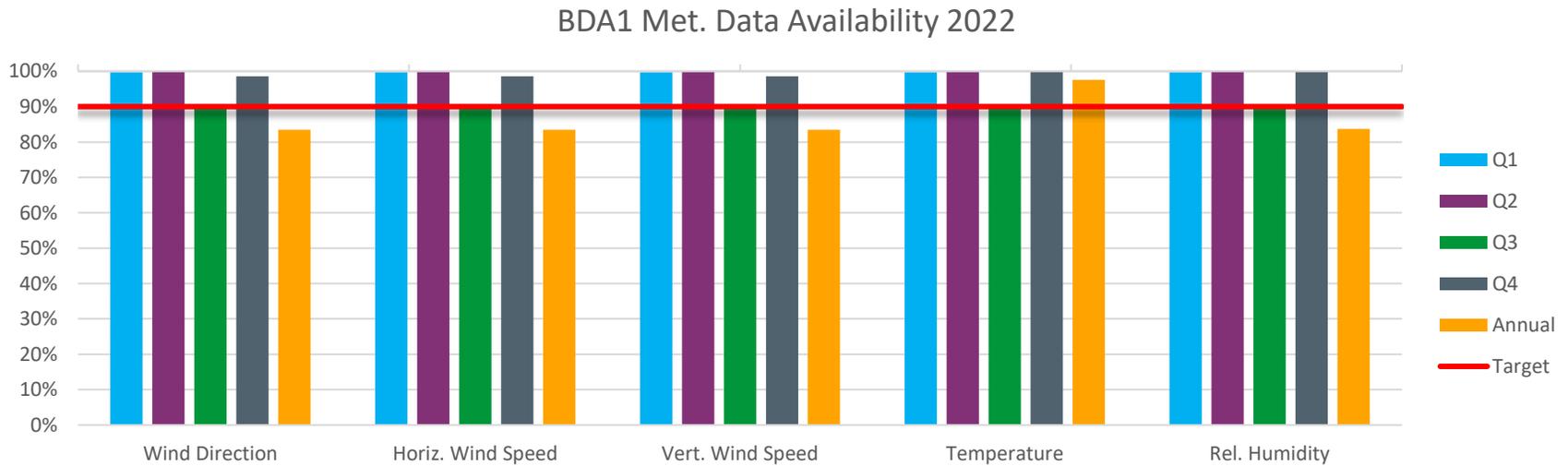
**Fig. 1:** Data Availability Rates for BDA1 monitoring station, pollutant parameters.



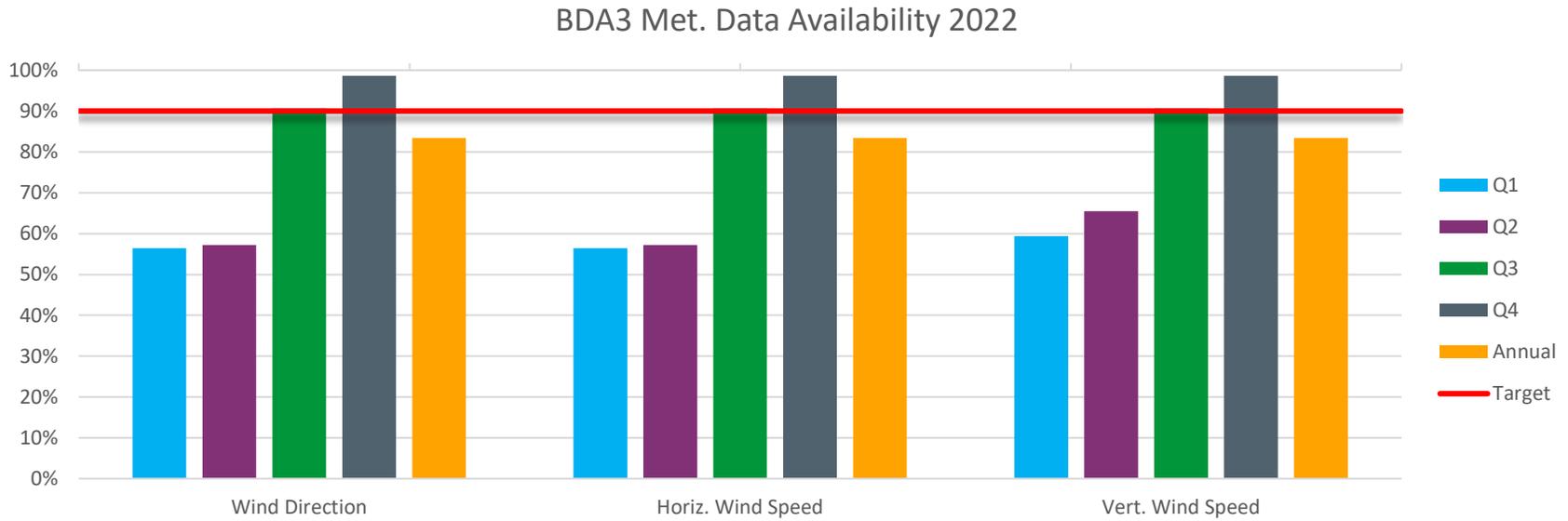
**Fig. 2:** Data Availability Rates for BDA2 monitoring station, pollutant parameters.



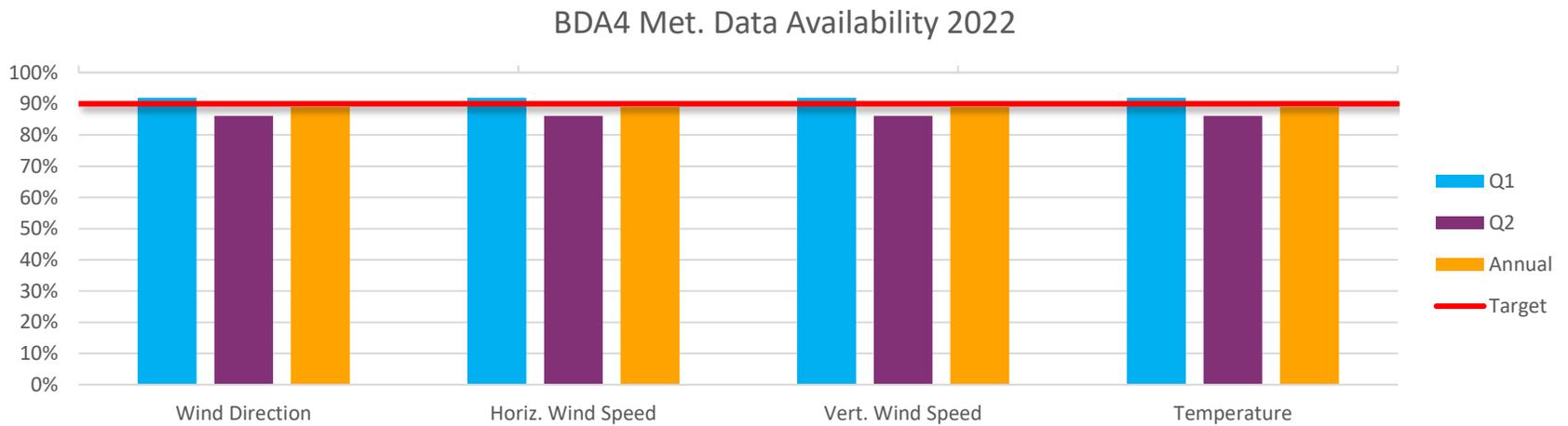
**Fig. 3:** Data Availability Rates for BDA4 monitoring station, pollutant parameters.



**Fig. 4:** Data Availability Rates for BDA1 monitoring station, meteorological parameters.



**Fig. 5:** Data Availability Rates for BDA3 monitoring station, meteorological parameters.



**Fig. 6:** Data Availability Rates for BDA4 monitoring station, meteorological parameters.

## Year-on-Year Comparison of Average & Maximum Recorded Pollutant Concentrations

Year-on-year comparisons of maximum 1-hr average concentrations of SO<sub>2</sub> and NO<sub>2</sub>, maximum 24-hr average concentrations of SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, and TSP, as well as annual averages of SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, and TSP recorded at BELCO's 'BDA1', 'BDA2', and 'BDA4' monitoring stations during the years 2006-2022 are illustrated in Figures 7-16. Year-on-year commentary on data collected from the 'BDA4' monitoring station may not be representative of the values recorded over a full calendar year as data collected in 2020 was limited to the months of October-December and in 2022 limited to the months January- June.

With regards to trends observed in Nitrogen Dioxide (NO<sub>2</sub>) concentrations recorded:

- Max. 1-hr avg. concentrations of NO<sub>2</sub> are trending as stable at 'BDA1'; trending upward at 'BDA2'.
- Max 24-hr avg. concentrations of NO<sub>2</sub> are trending as stable at 'BDA1'; trending downward at 'BDA2'.
- Annual avg. concentrations of NO<sub>2</sub> are trending downward at 'BDA1'; trending downward at 'BDA2'.

With regards to trends observed in Sulphur Dioxide (SO<sub>2</sub>) concentrations recorded:

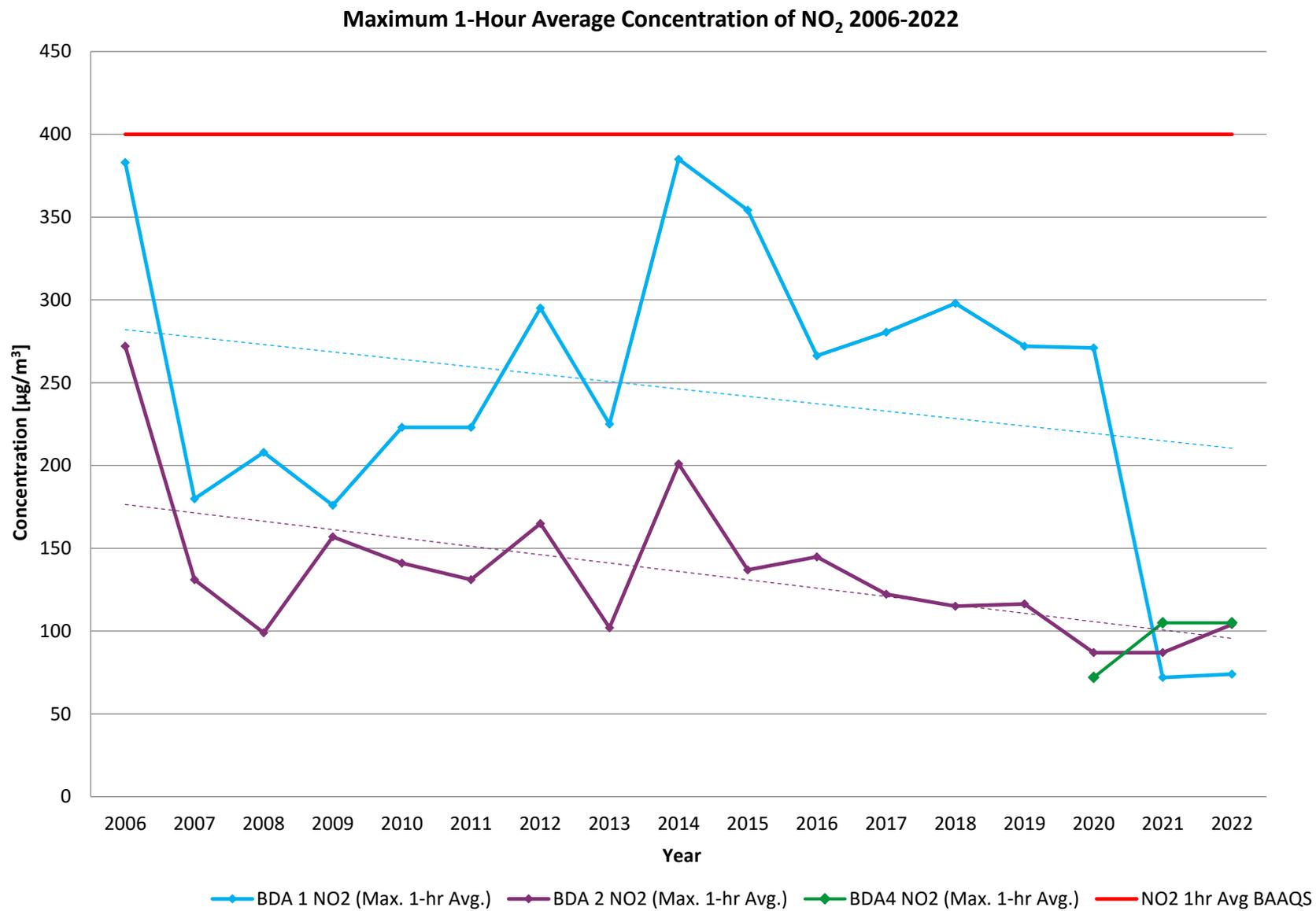
- Max. 1-hr avg. concentrations of SO<sub>2</sub> are trending as stable at 'BDA1'; trending upward at 'BDA2'.
- Max 24-hr avg. concentrations of SO<sub>2</sub> are trending upward at 'BDA1'; trending downward at 'BDA2'.
- Annual avg. concentrations of SO<sub>2</sub> are trending upward at 'BDA1'; trending downward at 'BDA2'.

With regards to trends observed in Particulate Matter <10 microns in diameter (PM<sub>10</sub>) concentrations recorded:

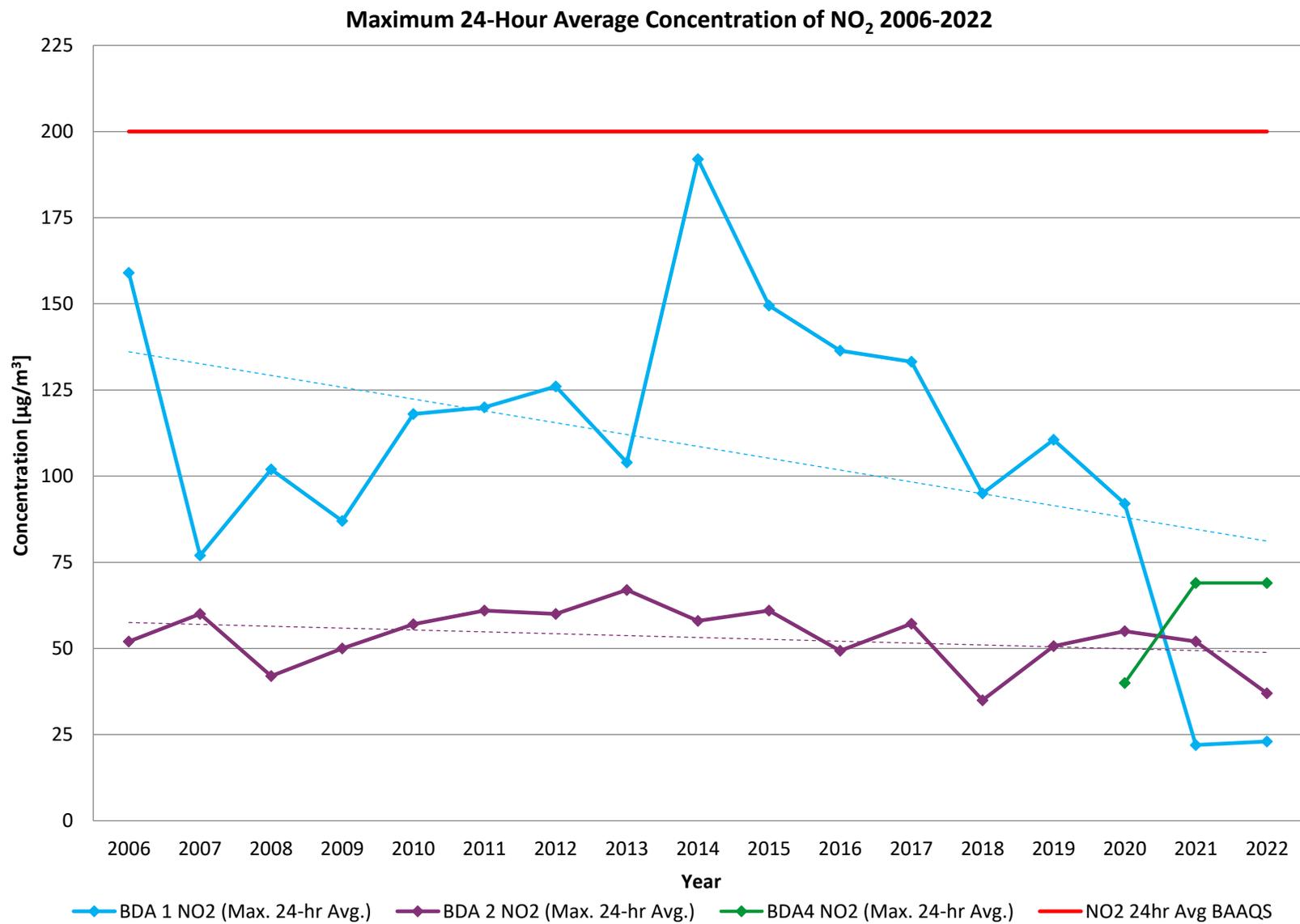
- Max 24-hr avg. concentrations of PM<sub>10</sub> are trending as stable at 'BDA1'; trending downward at 'BDA2'.
- Annual avg. concentrations of PM<sub>10</sub> are trending downward at 'BDA1'; trending downward at 'BDA2'.

With regards to trends observed in Total Suspended Particulate Matter (TSP) concentrations recorded:

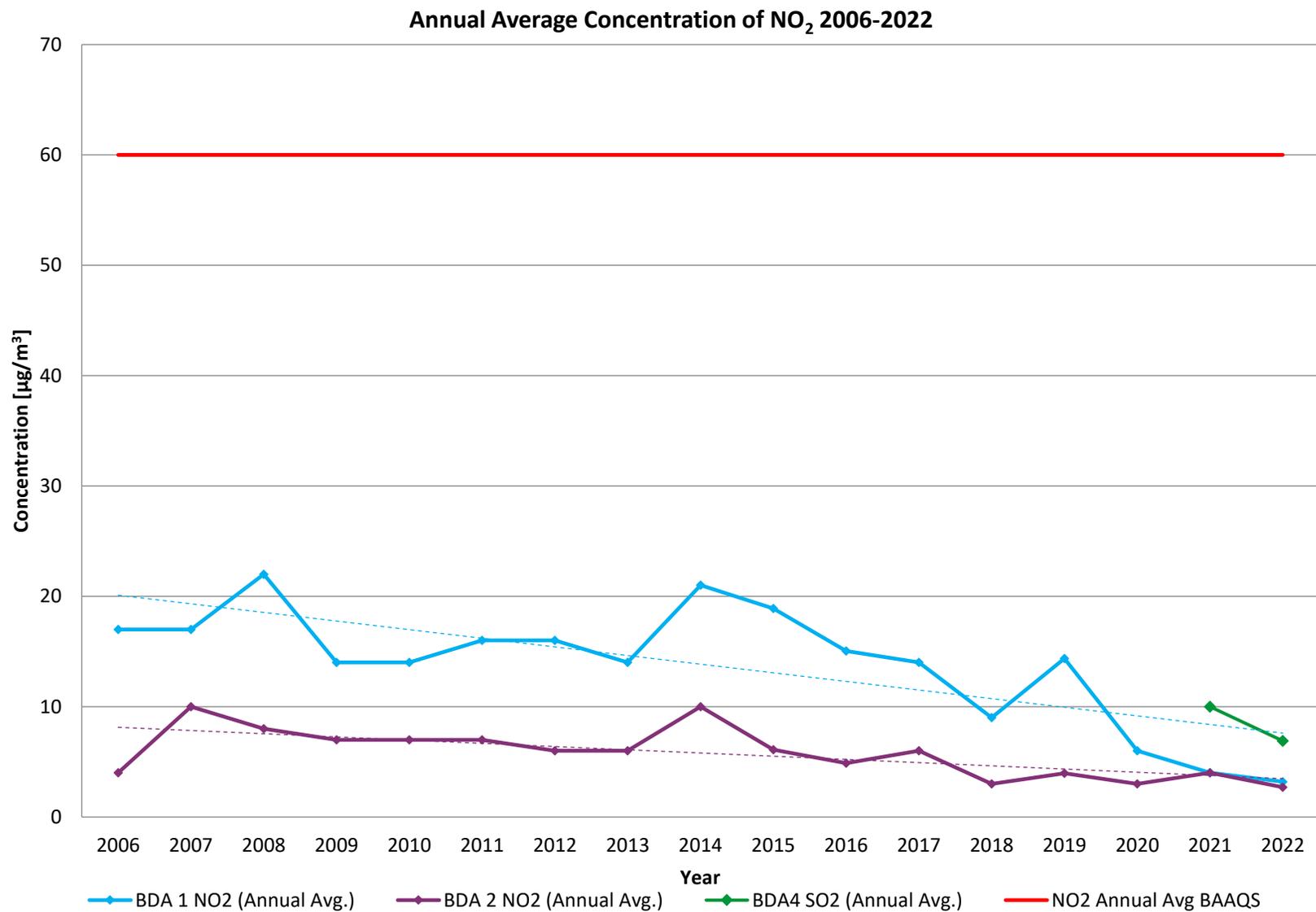
- TSP data was not collected at BDA1 nor BDA2 in 2022 as a result of instrument failures.



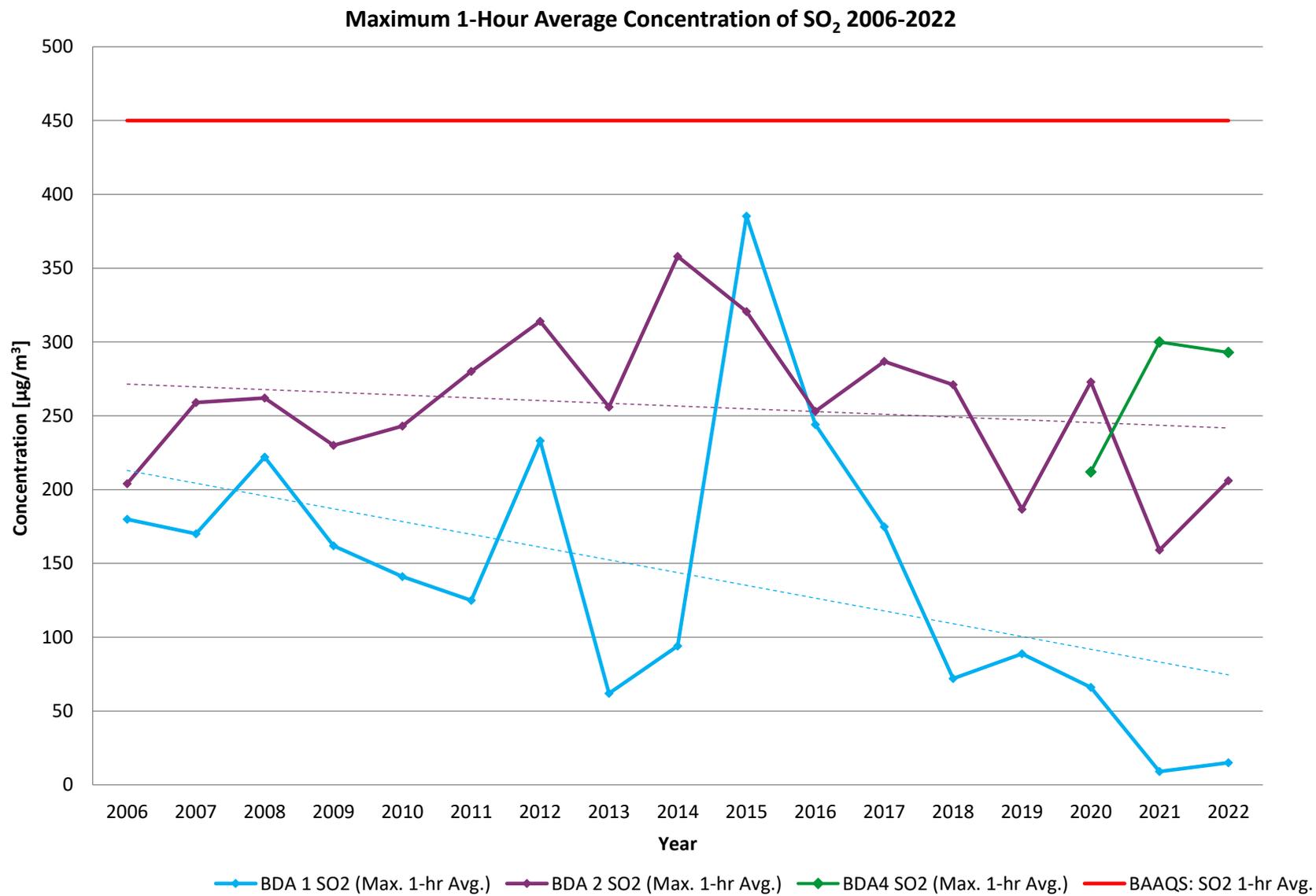
**Fig. 7:** Maximum 1-Hour Average Concentration of NO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



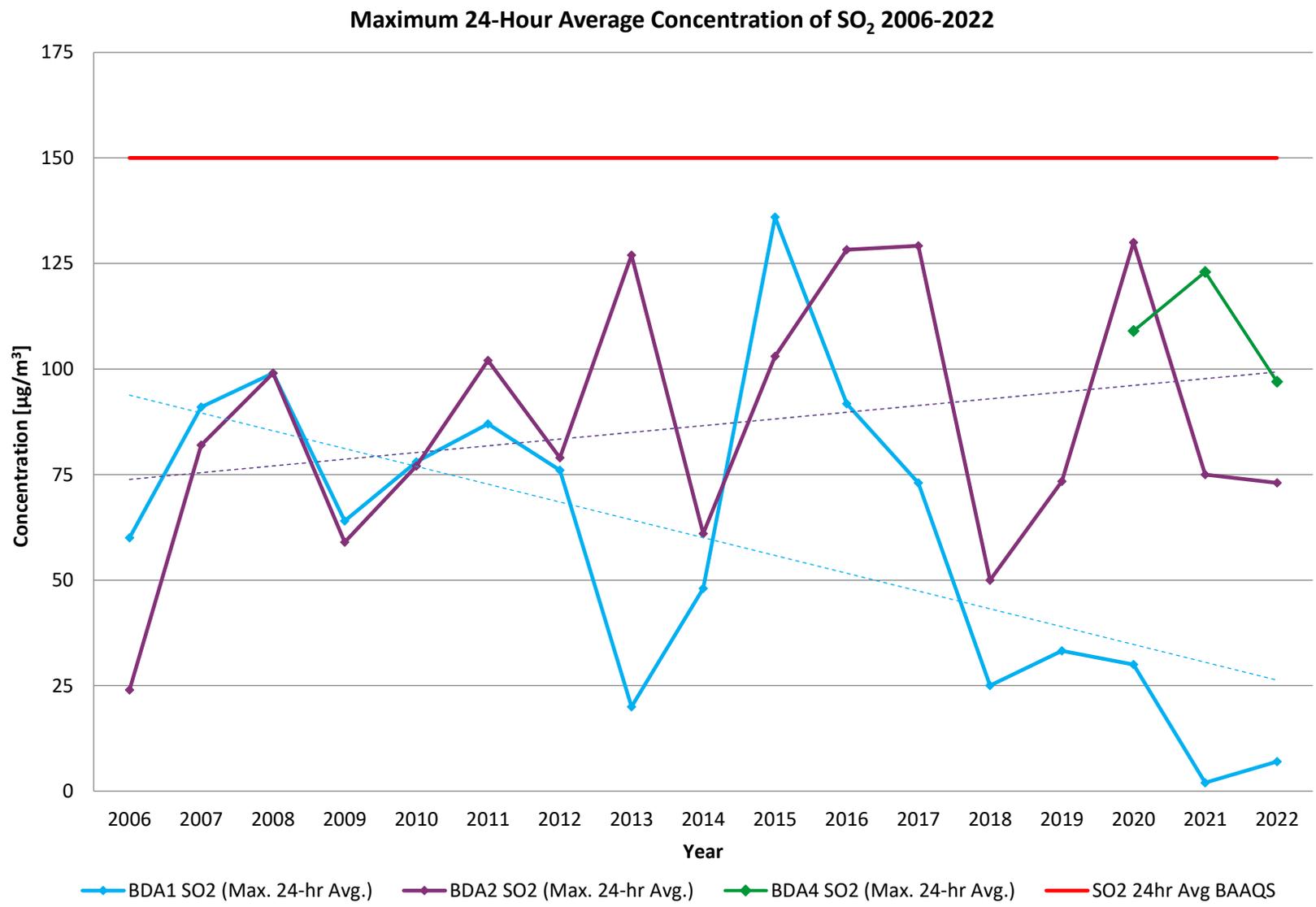
**Fig. 8:** Maximum 24-Hour Average Concentration of NO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



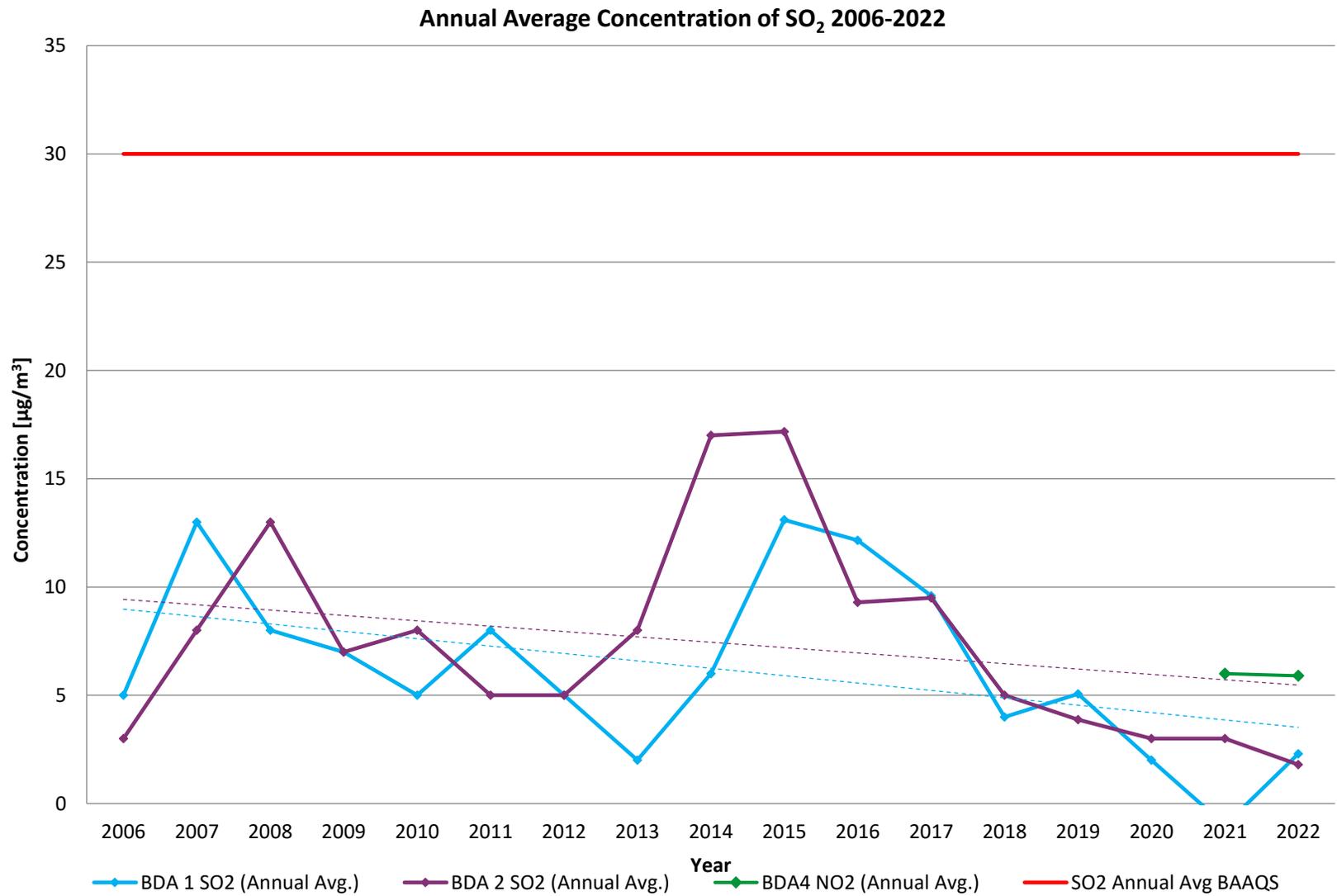
**Fig 9:** Annual Average Concentration of NO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



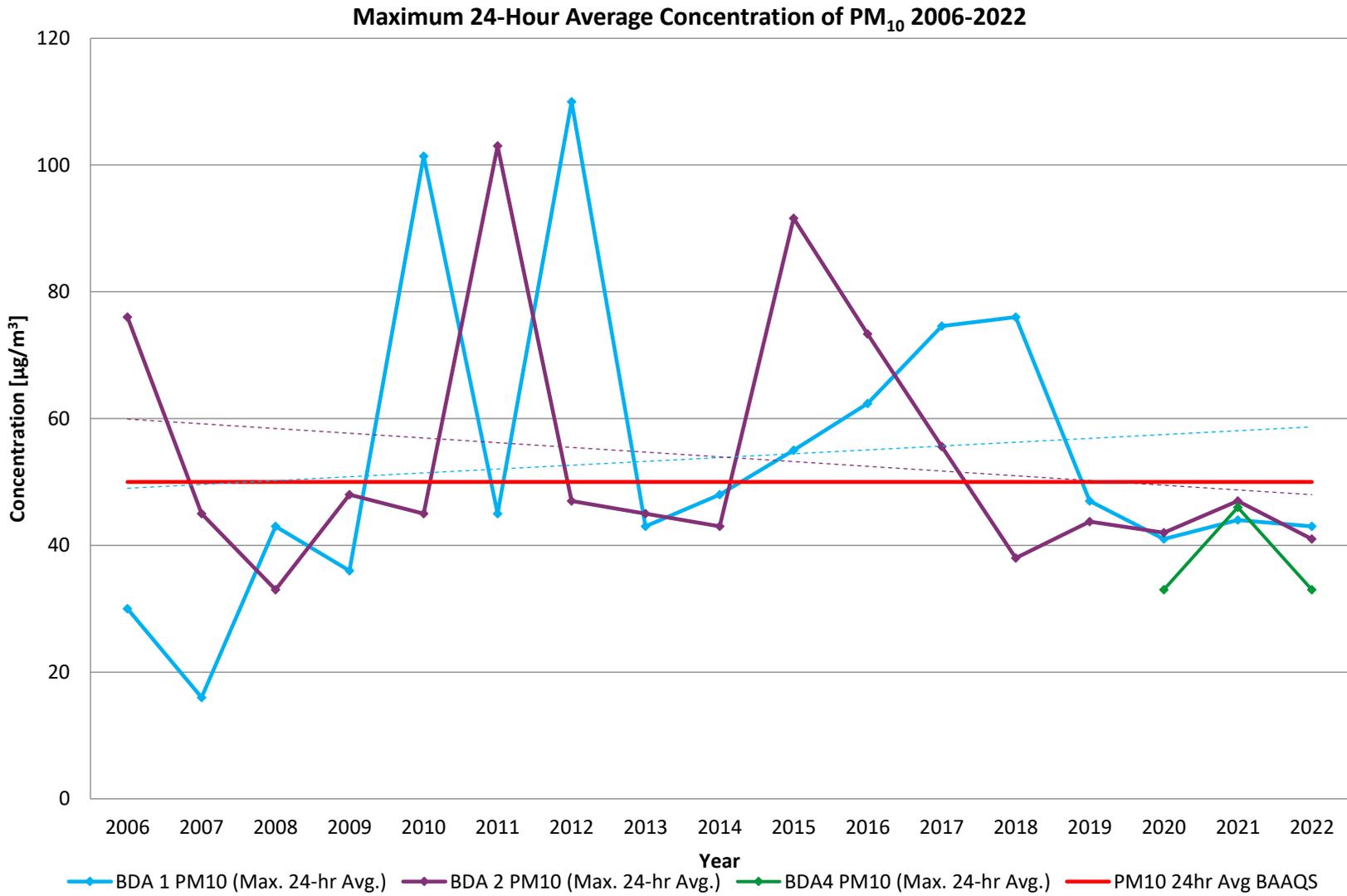
**Fig 10:** Maximum 1-Hour Average Concentration of SO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



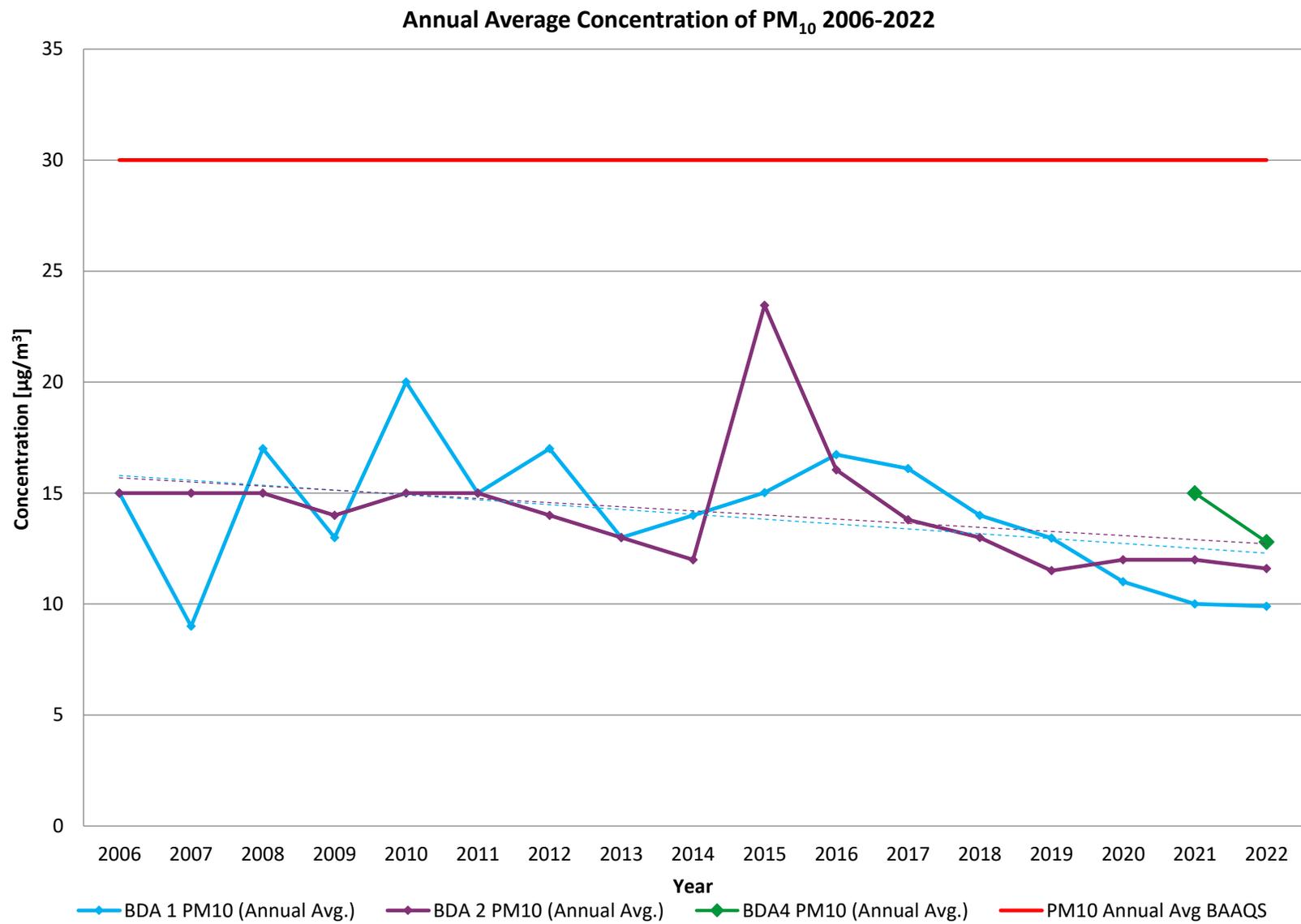
**Fig. 11:** Maximum 24-Hour Average Concentration of SO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



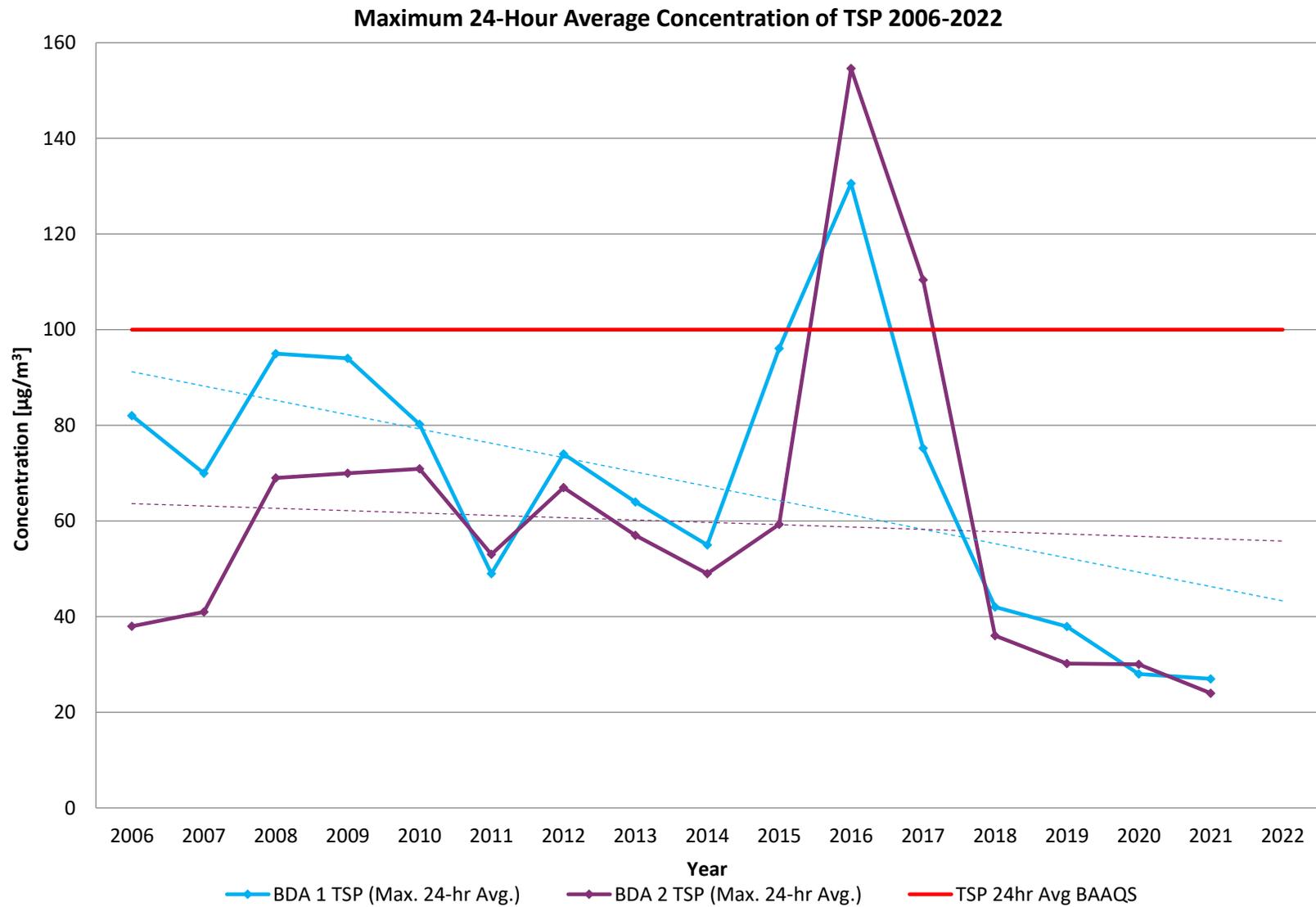
**Fig. 12:** Annual Average Concentration of SO<sub>2</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



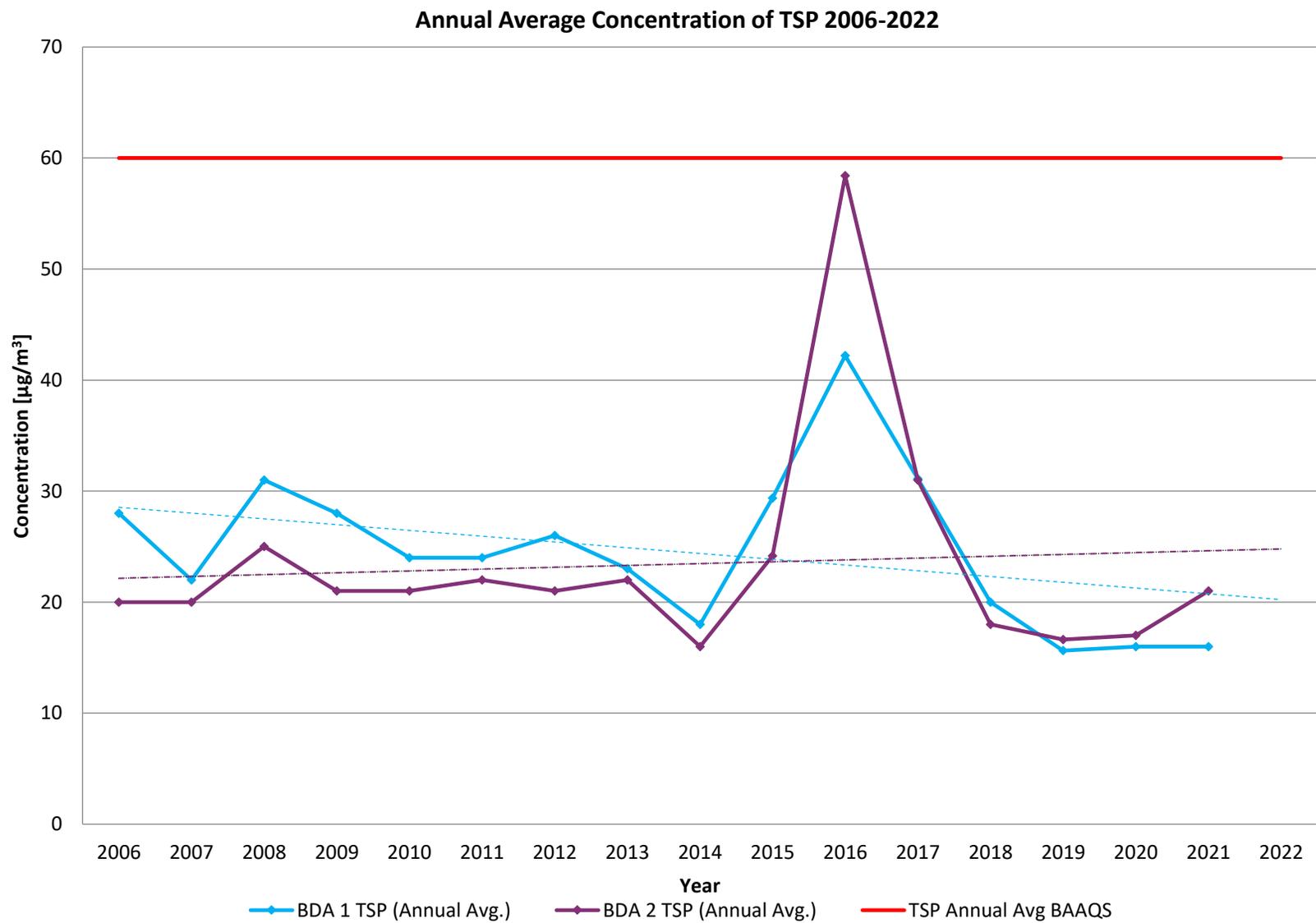
**Fig. 13:** Maximum 24-Hour Average Concentration of PM<sub>10</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



**Fig. 14:** Annual Average Concentration of PM<sub>10</sub> Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2022



**Fig. 15:** Maximum 24-Hour Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2022



**Fig. 16:** Annual Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2022

## Semiannual Audits

BELCO's Air Quality Monitoring System (AQMS) was audited in July and December of 2022 by an independent auditor, Environmental Engineering & Measurement Services, Inc., as per condition 5.4.7 of BELCO's Operating License Conditions. Full copies of the audit reports are provided in **Appendix A**.

## Conclusion

Zero (0) exceedances of the Bermuda Ambient Air Quality Standards (BAAQS) were recorded during this reporting period. Annual average concentrations of all gaseous and particulate parameters were measured to be below BAAQS. All monitoring equipment was routinely maintained and calibrated throughout the year. Independent audits of BELCO's air quality monitoring program were completed in July and December of 2022.