

BERMUDA ELECTRIC LIGHT COMPANY, LTD.

ANNUAL AMBIENT AIR QUALITY MONITORING REPORT

FOR THE PERIOD

JANUARY 1ST TO DECEMBER 31ST, 2021

MARCH 1ST, 2022

PREPARED BY: OHSE COORDINATOR

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Introduction

This report summarizes the findings and operation of BELCO's Ambient Air Quality Monitoring for the period January 1st to December 31st, 2021, 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.

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 2021.

Table 1: BAAQS exceedance record for the reporting period.

Station	Parameter	BAAQS - 1-Hr ($\mu\text{g}/\text{m}^3$)	Max. 1-Hr Avg. ($\mu\text{g}/\text{m}^3$)	# of Exceed. (1-hr)	BAAQS - 24-Hr ($\mu\text{g}/\text{m}^3$)	Max. 24-hr Avg. ($\mu\text{g}/\text{m}^3$)	# of Exceed. (24-Hr)	BAAQS – Annual ($\mu\text{g}/\text{m}^3$)	Annual Avg. ($\mu\text{g}/\text{m}^3$)	# of Exceed. (Annual)
BDA1	NO ₂	400	72	0	200	22	0	60	4	0
	SO ₂	450	9	0	150	2	0	30	-1	0
	PM ₁₀	-	-	-	50	44	0	30	10	0
	TSP	-	-	-	100	27	0	60	16	0
BDA2	NO ₂	400	87	0	200	52	0	60	4	0
	SO ₂	450	159	0	150	74	0	30	3	0
	PM ₁₀	-	-	-	50	47	0	30	12	0
	TSP	-	-	-	100	24	0	60	21	0

BDA4	NO₂	400	105	0	200	69	0	60	6	0
	SO₂	450	300	0	150	123	0	30	10	0
	PM₁₀	-	-	-	50	46	0	30	15	0
Total Number of BAAQS Exceedances Recorded During Reporting Period										0

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 – 2021 Annual”, which has been provided electronically with this report.

Data Availability

An annual summary of data availability figures for 2021 is provided in Table 3 and illustrated in Figures 1-3.

Data collection at all sites was interrupted for periods of time throughout 2021 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 2021.

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

	Q1	Q2	Q3	Q4	2021 Annual	Target
BDA1 - Pollutant Parameters						
NO ₂	98.8%	81.5%	73.1%	97.9%	87.8%	75.0%
SO ₂	82.9%	44.6%	88.0%	86.9%	75.6%	75.0%
PM ₁₀	54.6%	43.4%	83.4%	89.3%	67.7%	75.0%
BDA1 - Meteorological Parameters						
Wind Direction	100.0%	99.6%	35.8%	98.8%	83.4%	90.0%
Horiz. Wind Speed	100.0%	99.6%	35.8%	98.8%	83.4%	90.0%
Vert. Wind Speed	100.0%	99.6%	35.8%	98.8%	83.4%	90.0%
Temperature	88.0%	71.5%	35.8%	98.8%	73.5%	90.0%
Rel. Humidity	100.0%	99.6%	35.8%	100.0%	83.7%	90.0%
BDA2 - Pollutant Parameters						
NO ₂	79.9%	38.8%	89.1%	99.6%	76.9%	75.0%
SO ₂	80.0%	17.6%	84.3%	99.6%	70.4%	75.0%
PM ₁₀	84.2%	99.0%	93.8%	65.4%	85.6%	75.0%
BDA3 - Meteorological Parameters (SODAR, 65m)						
Wind Direction	42.2%	13.7%	80.8%	77.3%	53.7%	90.0%
Horiz. Wind Speed	42.2%	13.7%	80.8%	77.3%	53.7%	90.0%
Vert. Wind Speed	43.6%	13.9%	87.9%	83.4%	57.4%	90.0%
BDA4 - Pollutant Parameters						
NO ₂	57.8%	97.2%	90.5%	99.1%	86.1%	75.0%
SO ₂	97.9%	97.3%	97.6%	99.1%	98.0%	75.0%
PM ₁₀	88.7%	99.5%	71.7%	94.3%	88.5%	75.0%
BDA4 - Meteorological Parameters						
Wind Direction	97.6%	99.2%	100.0%	99.5%	99.1%	90.0%
Horiz. Wind Speed	97.6%	99.2%	100.0%	99.5%	99.1%	90.0%
Vert. Wind Speed	97.6%	99.2%	100.0%	99.5%	99.1%	90.0%
Temperature	97.6%	99.2%	100.0%	99.7%	99.1%	90.0%

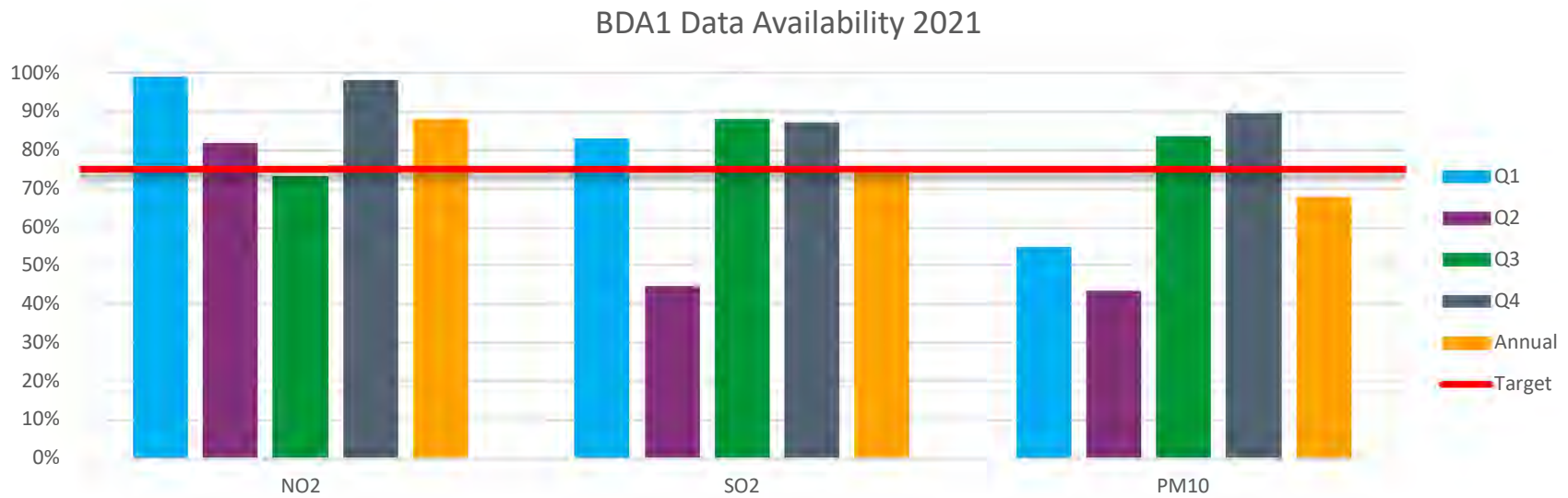


Fig. 1: Data Availability Rates for BDA1 monitoring station, pollutant parameters.

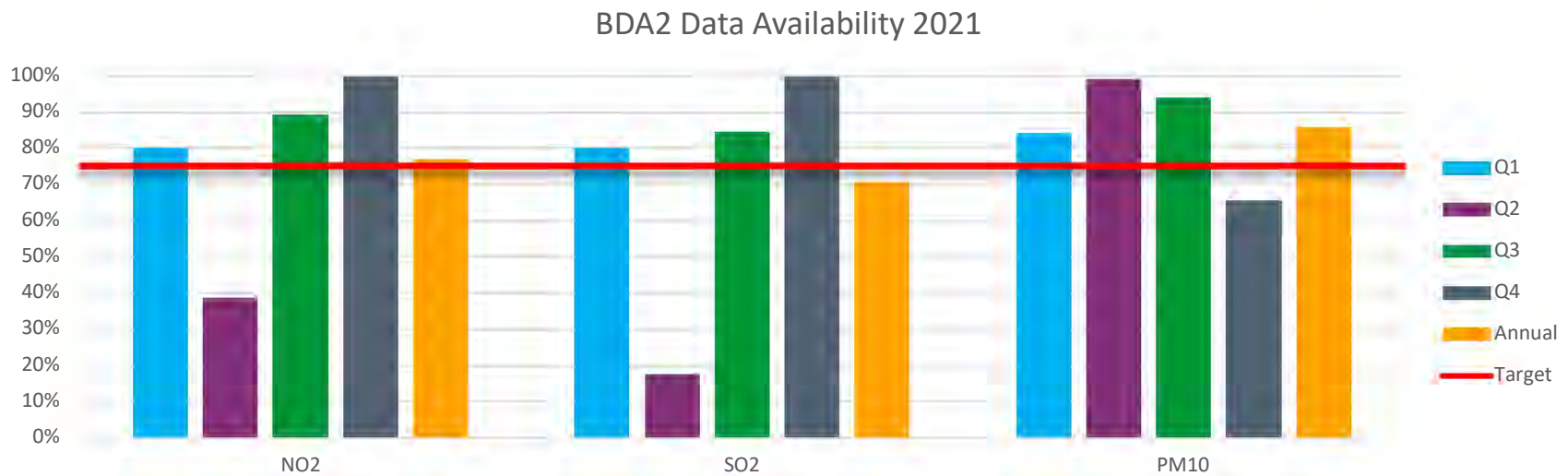


Fig. 2: Data Availability Rates for BDA2 monitoring station, pollutant parameters.

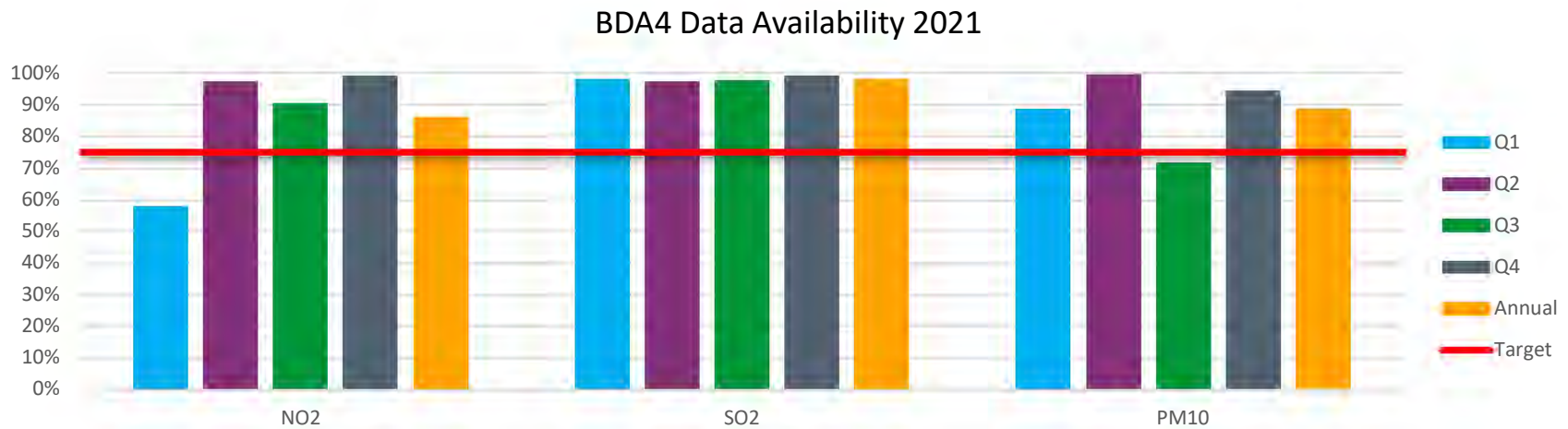


Fig. 3: Data Availability Rates for BDA4 monitoring station, pollutant parameters.

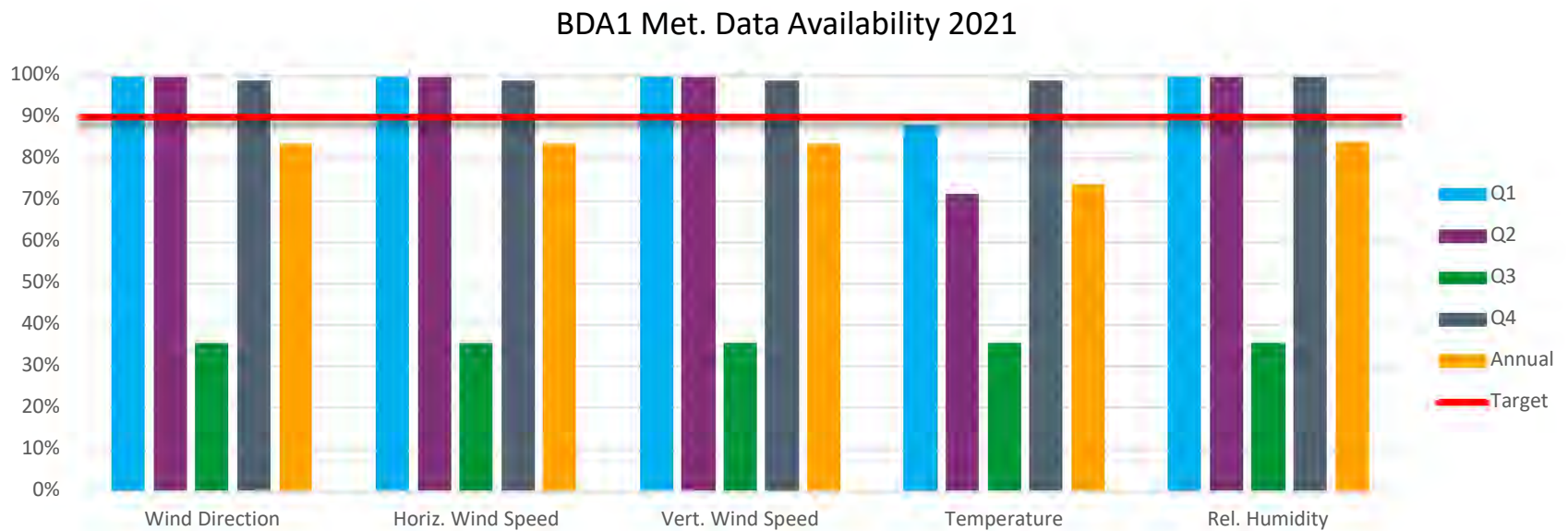


Fig. 4: Data Availability Rates for BDA1 monitoring station, meteorological parameters.

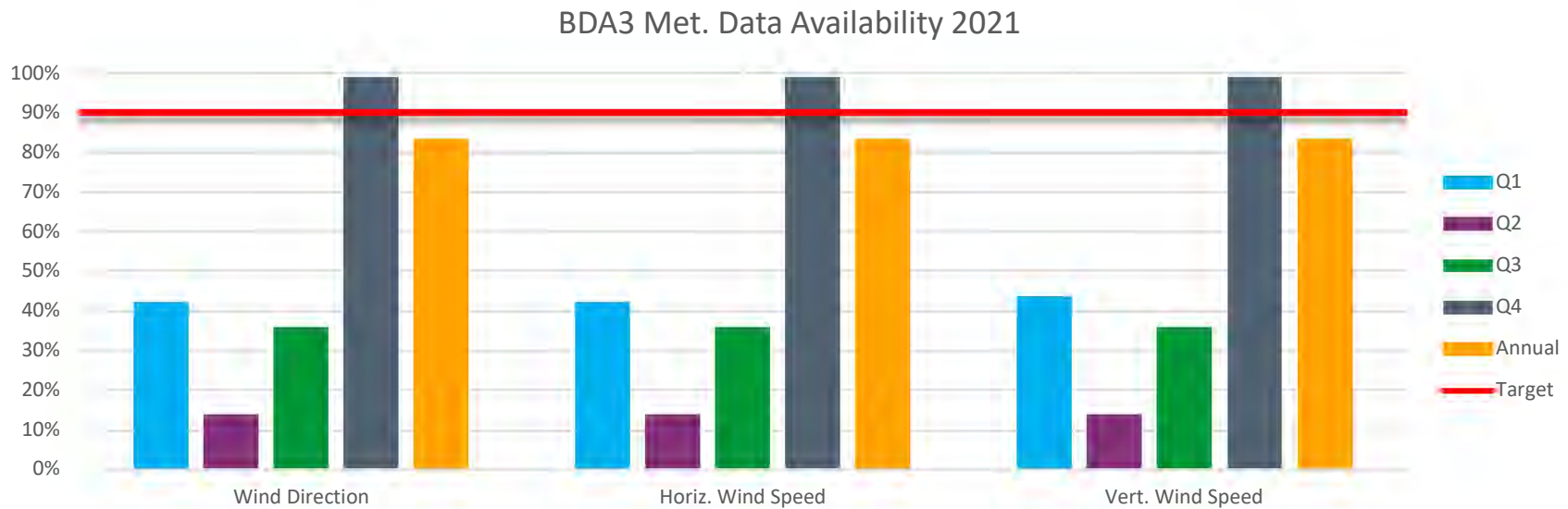


Fig. 5: Data Availability Rates for BDA3 monitoring station, meteorological parameters.

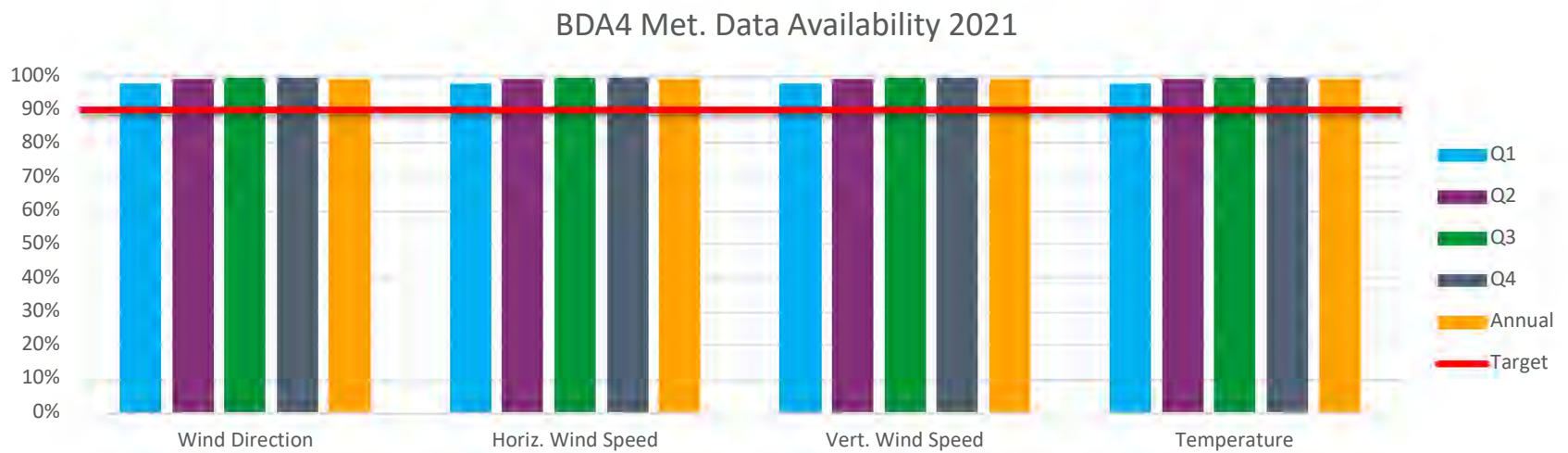


Fig. 6: Data Availability Rates for BDA4 monitoring station, meteorological parameters.

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

Year-on-year comparisons of maximum 1-hr average concentrations of SO₂ and NO₂, maximum 24-hr average concentrations of SO₂, NO₂, PM₁₀, and TSP, as well as annual averages of SO₂, NO₂, PM₁₀, and TSP recorded at BELCO's 'BDA1', 'BDA2', and 'BDA4' monitoring stations during the years 2006-2021 are illustrated in Figures 2-11. Year-on-year commentary on data collected from the 'BDA4' monitoring station as data collected in 2020 was limited to the months of October-December and may not be representative of the values recorded over a full calendar year.

With regards to trends observed in Nitrogen Dioxide (NO₂) concentrations recorded:

- Max. 1-hr avg. concentrations of NO₂ are trending as downward at 'BDA1'; trending downward at 'BDA2'.
- Max 24-hr avg. concentrations of NO₂ are trending as downward at 'BDA1'; trending as stable at 'BDA2'.
- Annual avg. concentrations of NO₂ are trending downward at 'BDA1'; trending downward at 'BDA2'.

With regards to trends observed in Sulphur Dioxide (SO₂) concentrations recorded:

- Max. 1-hr avg. concentrations of SO₂ are trending downward at 'BDA1'; trending downward at 'BDA2'.
- Max 24-hr avg. concentrations of SO₂ are trending downward at 'BDA1'; trending upward at 'BDA2'.
- Annual avg. concentrations of SO₂ are trending downward at 'BDA1'; trending downward at 'BDA2'.

With regards to trends observed in Particulate Matter <10 microns in diameter (PM₁₀) concentrations recorded:

- Max 24-hr avg. concentrations of PM₁₀ are trending upward at 'BDA1'; trending downward at 'BDA2'.
- Annual avg. concentrations of PM₁₀ are trending downward at 'BDA1'; trending downward at 'BDA2'.

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

- Max 24-hr avg. concentrations of TSP are trending downward at 'BDA1'; trending downward at 'BDA2'.
- Annual avg. concentrations of TSP are trending as downward at 'BDA1'; trending upward at 'BDA2'.

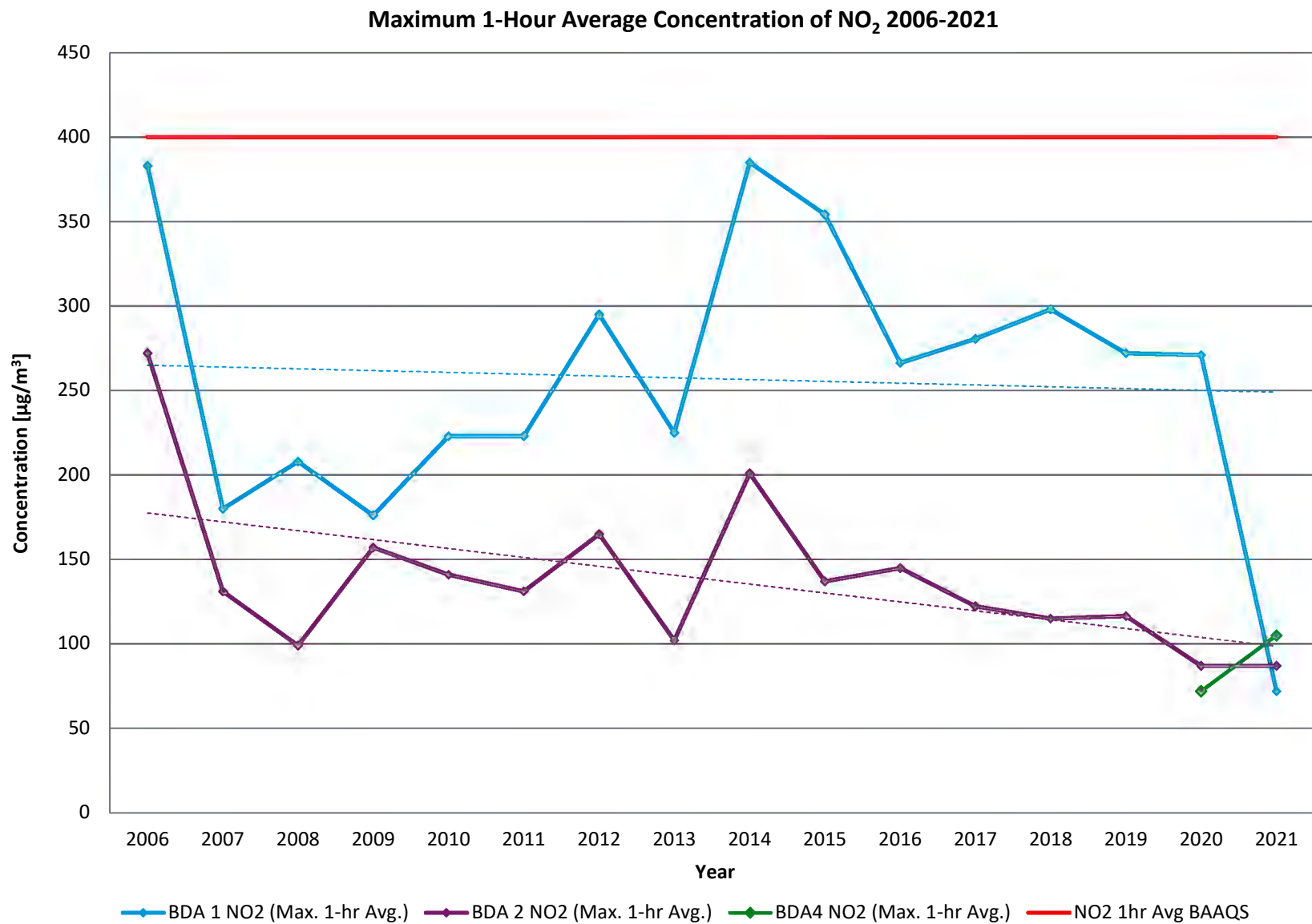


Fig. 7: Maximum 1-Hour Average Concentration of NO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

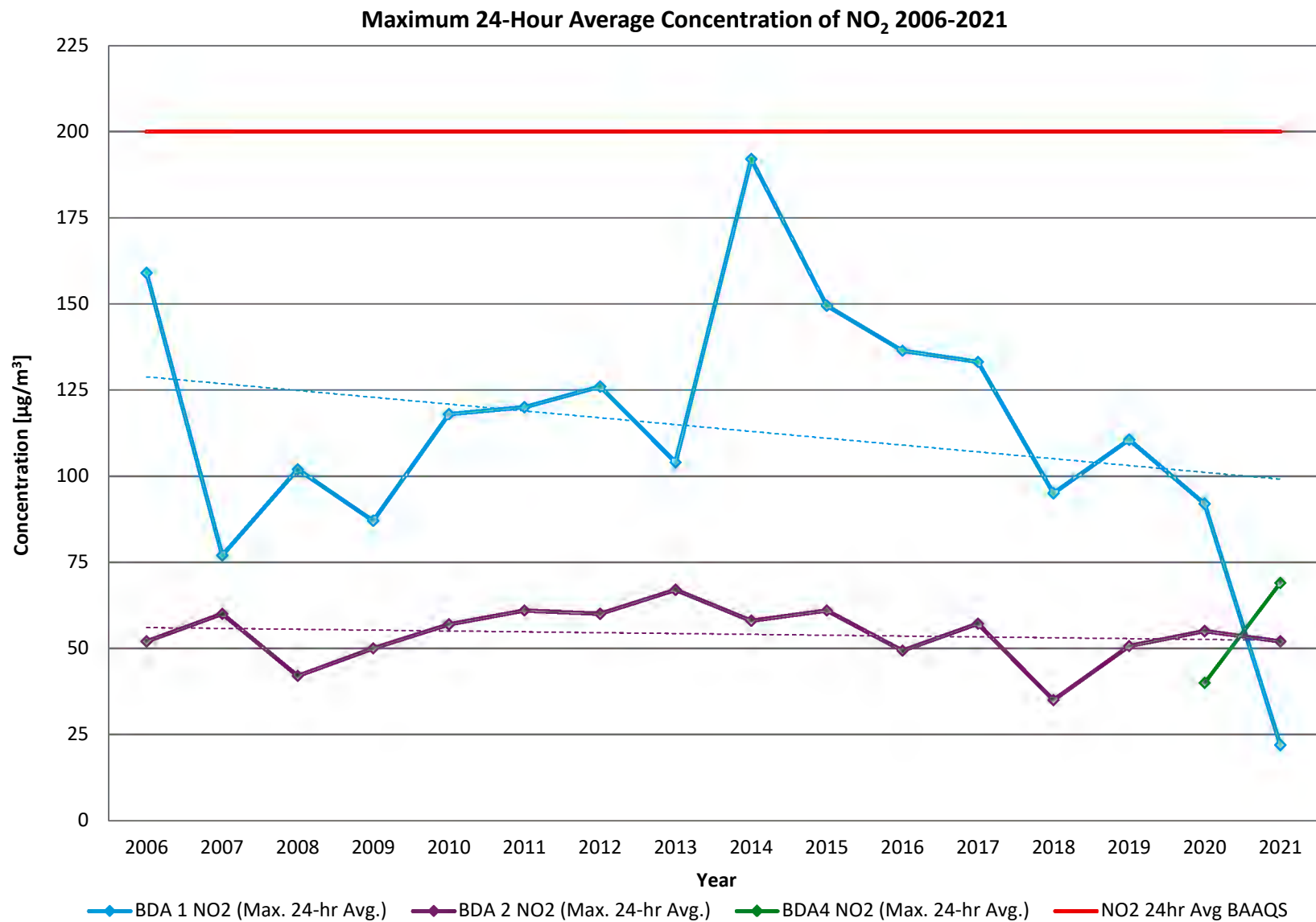


Fig. 8: Maximum 24-Hour Average Concentration of NO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

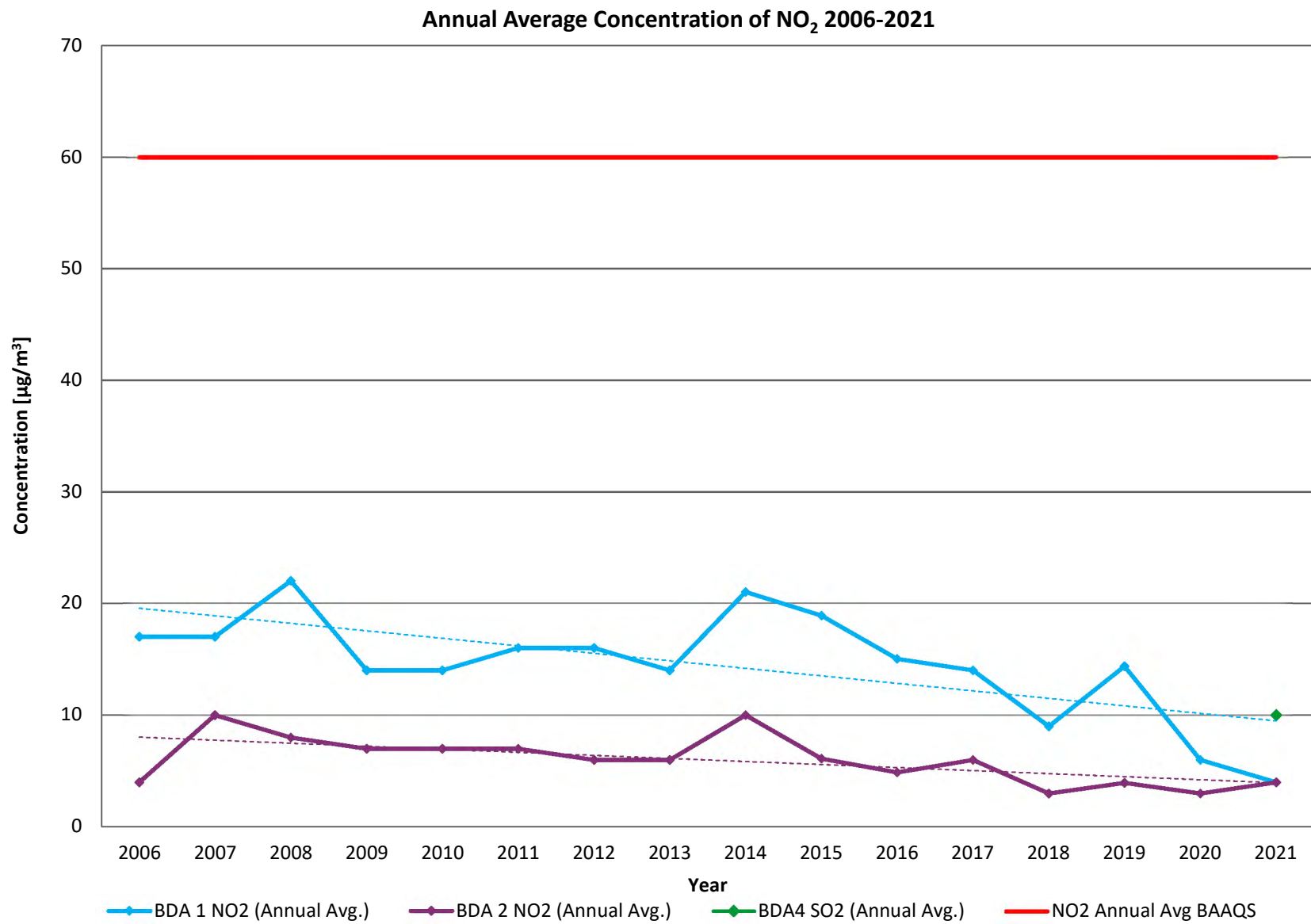


Fig 9: Annual Average Concentration of NO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

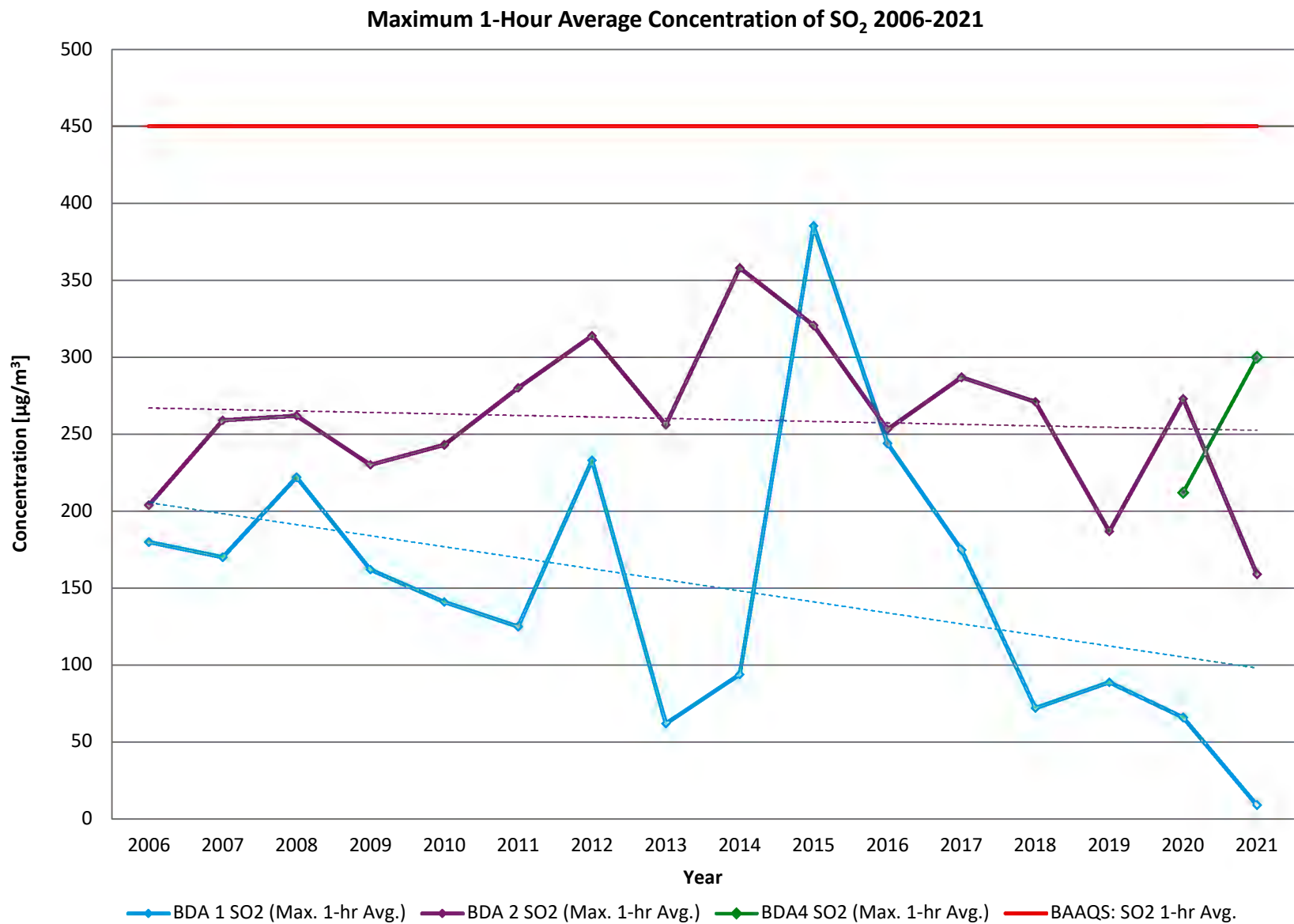


Fig 10: Maximum 1-Hour Average Concentration of SO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

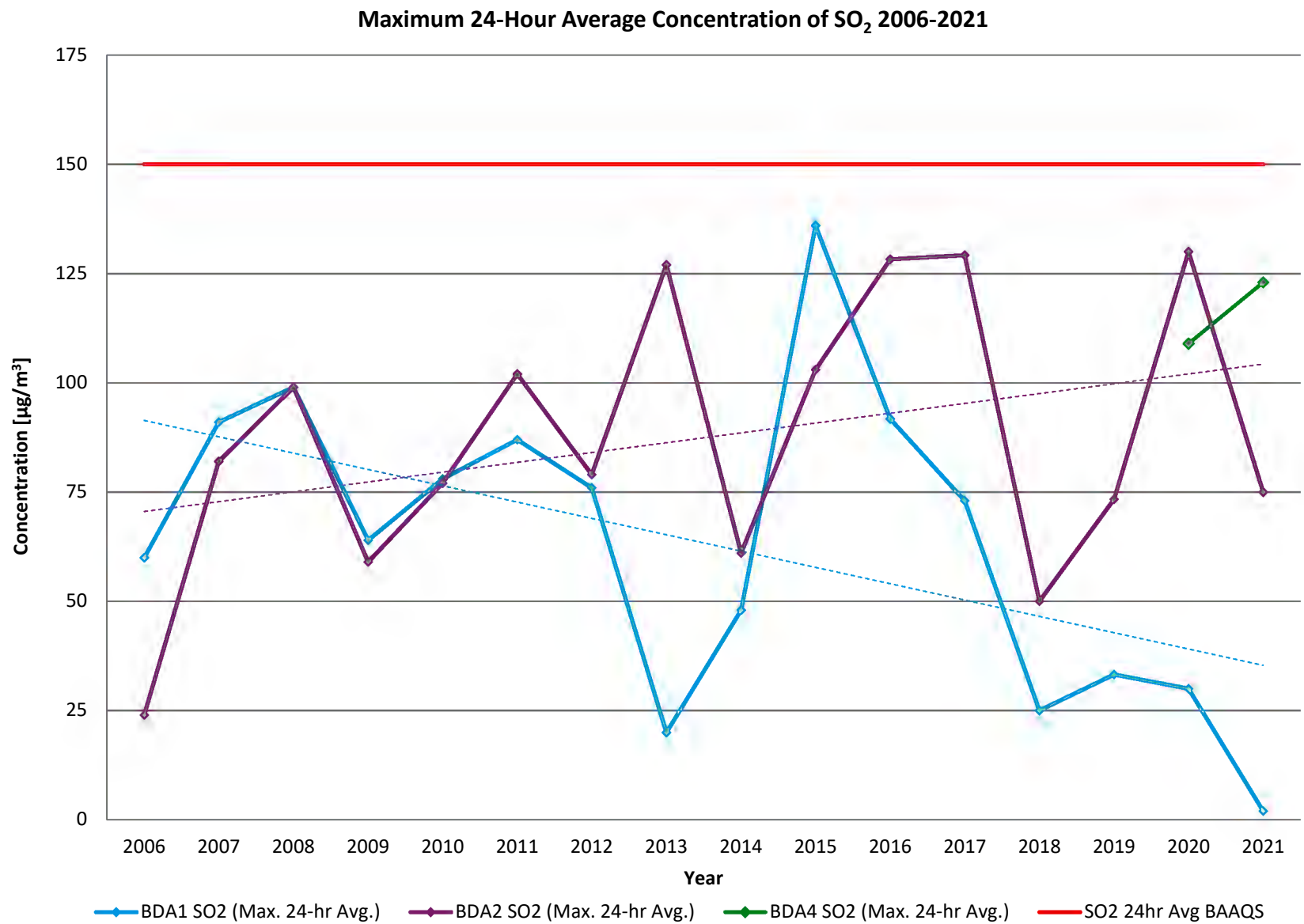


Fig. 11: Maximum 24-Hour Average Concentration of SO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

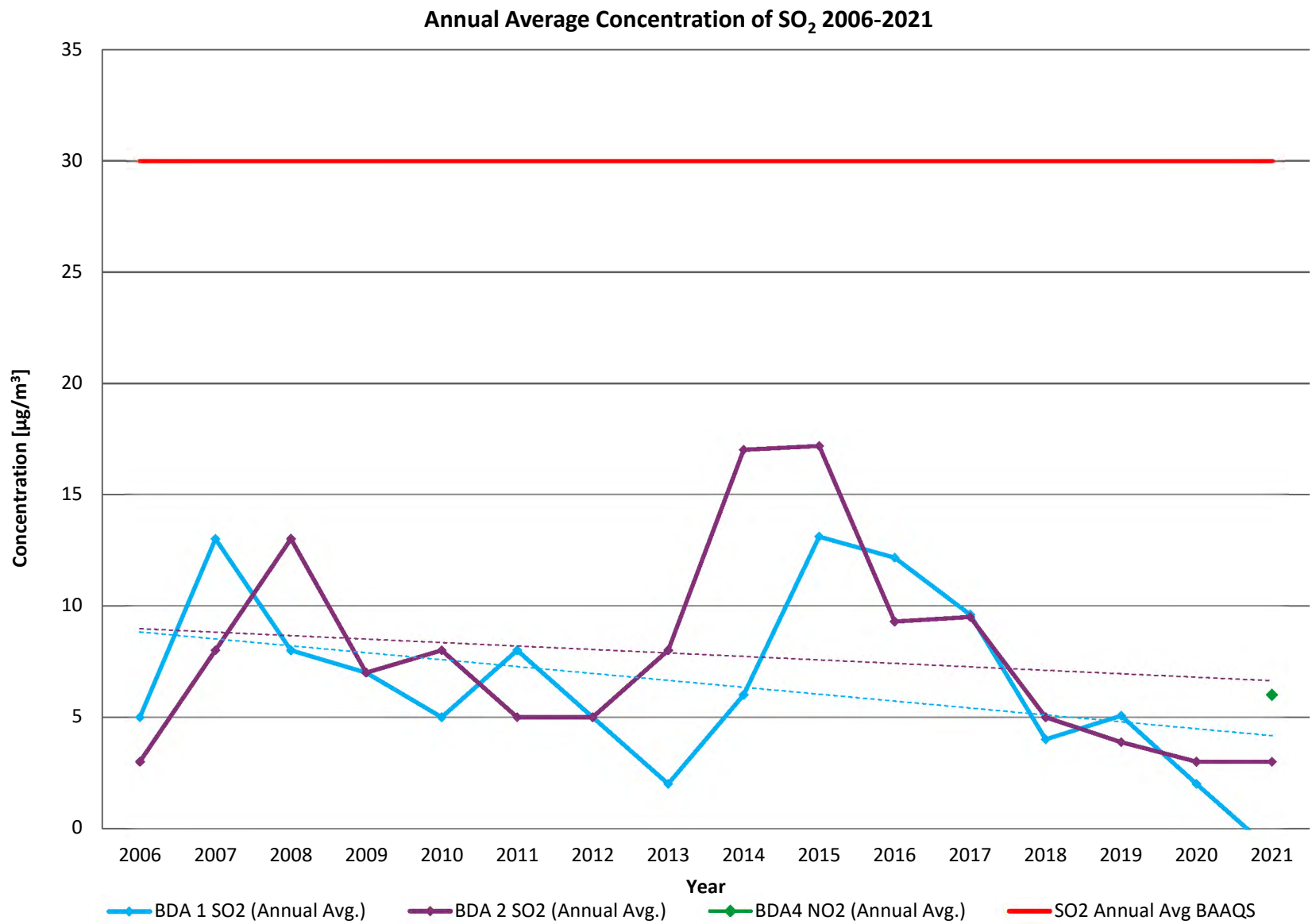


Fig. 12: Annual Average Concentration of SO₂ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

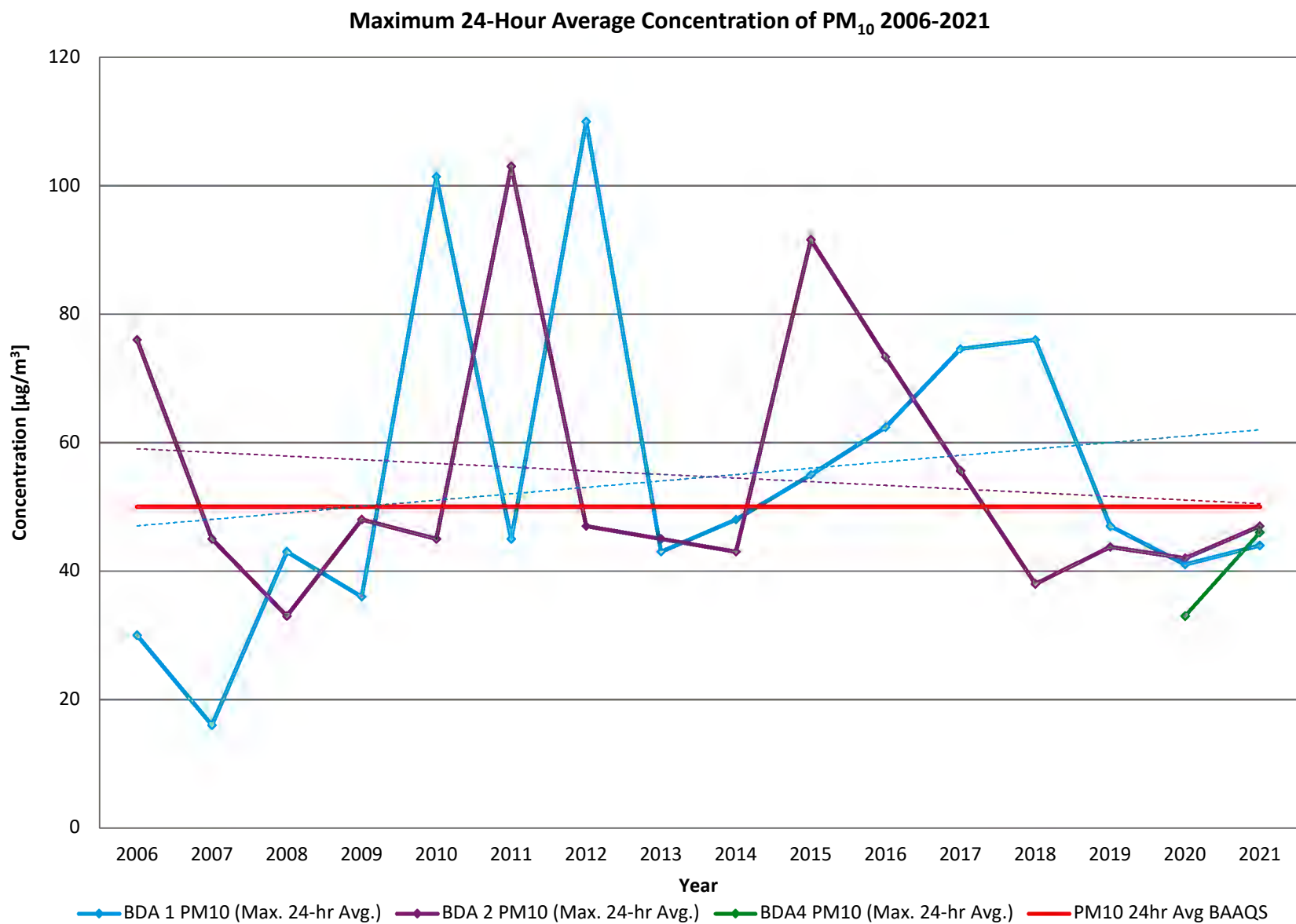


Fig. 13: Maximum 24-Hour Average Concentration of PM₁₀ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

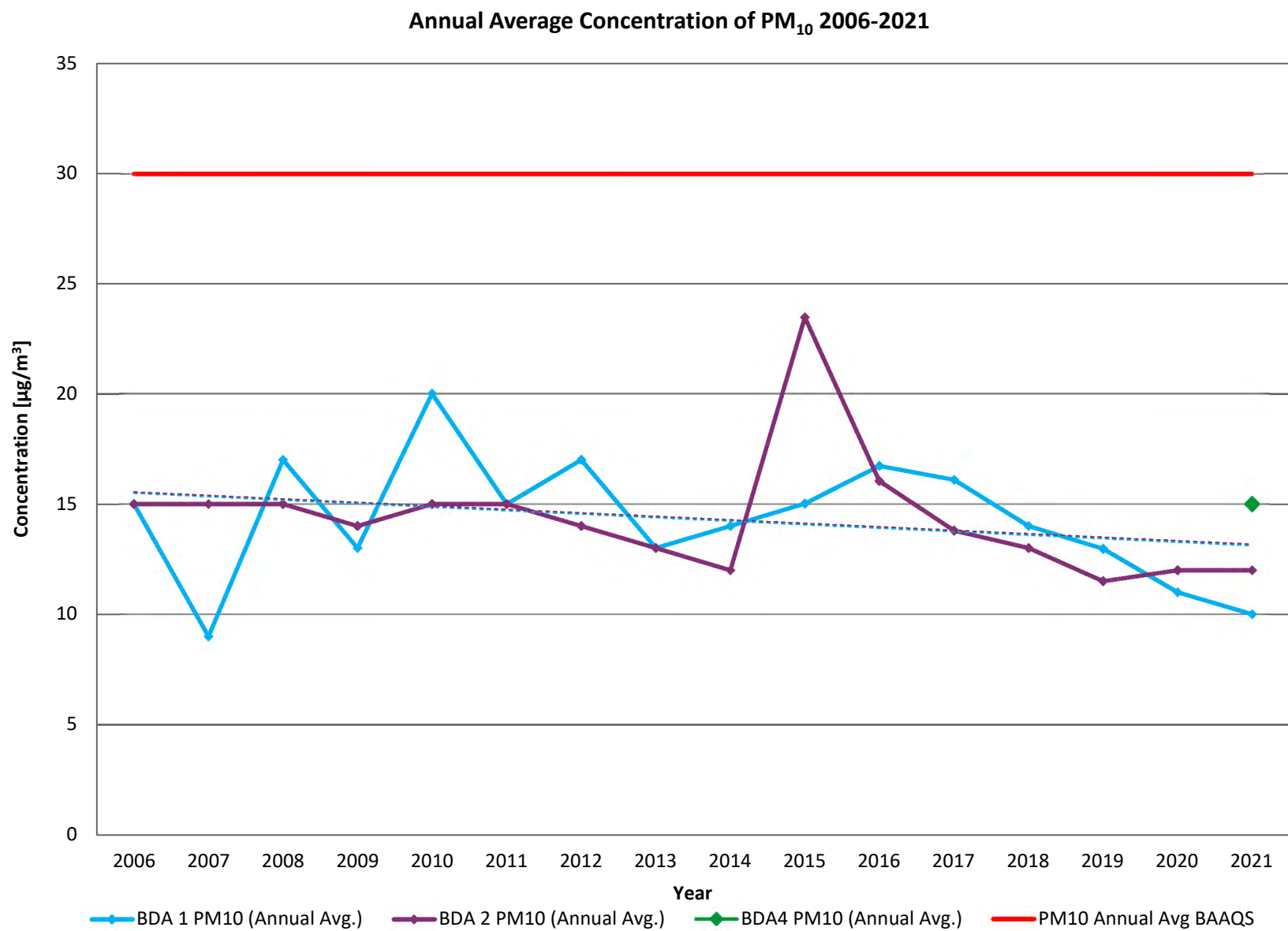


Fig. 14: Annual Average Concentration of PM₁₀ Recorded at BDA1, BDA2, and BDA4 Monitoring Stations 2006-2021

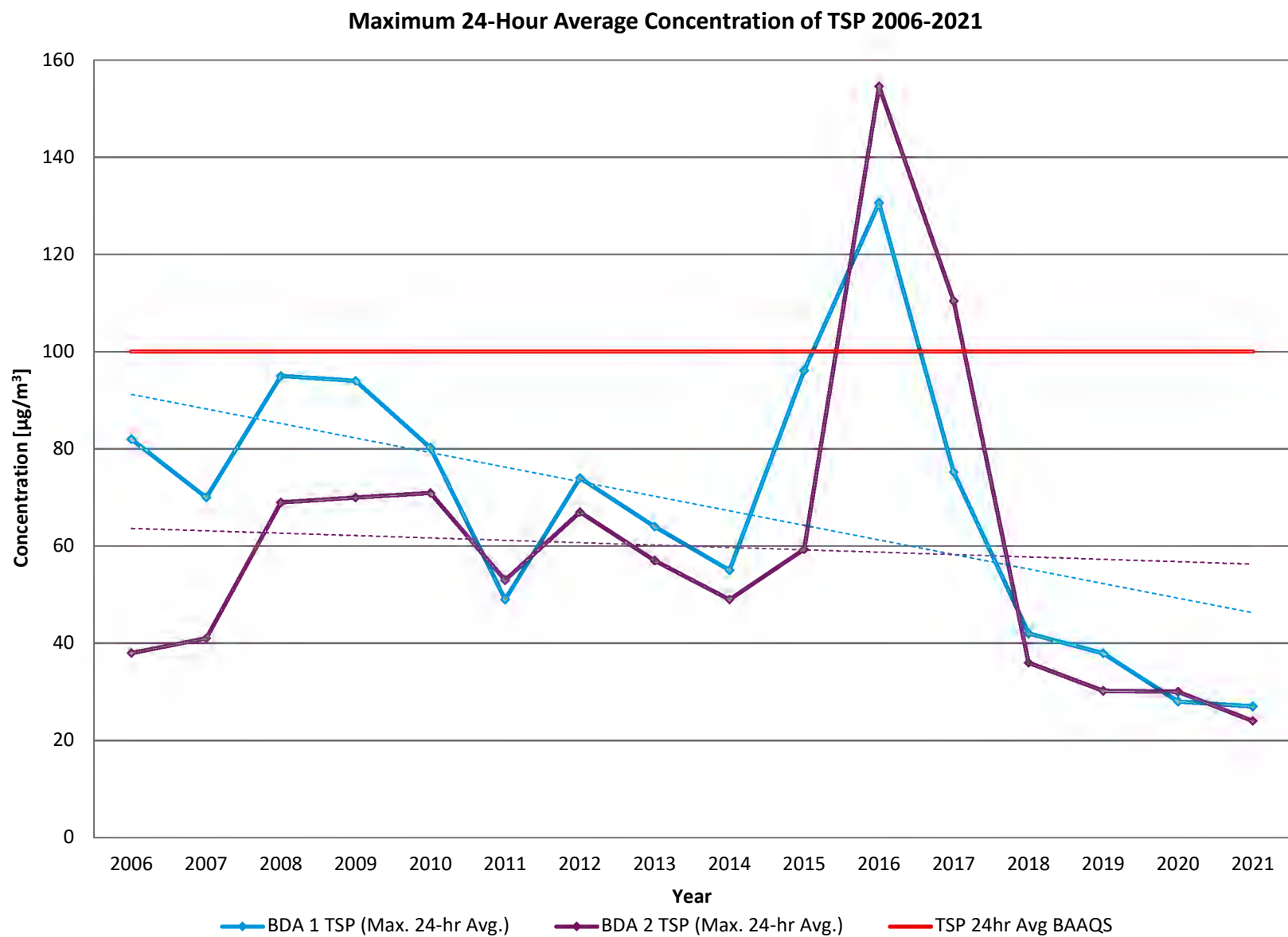


Fig. 15: Maximum 24-Hour Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2021

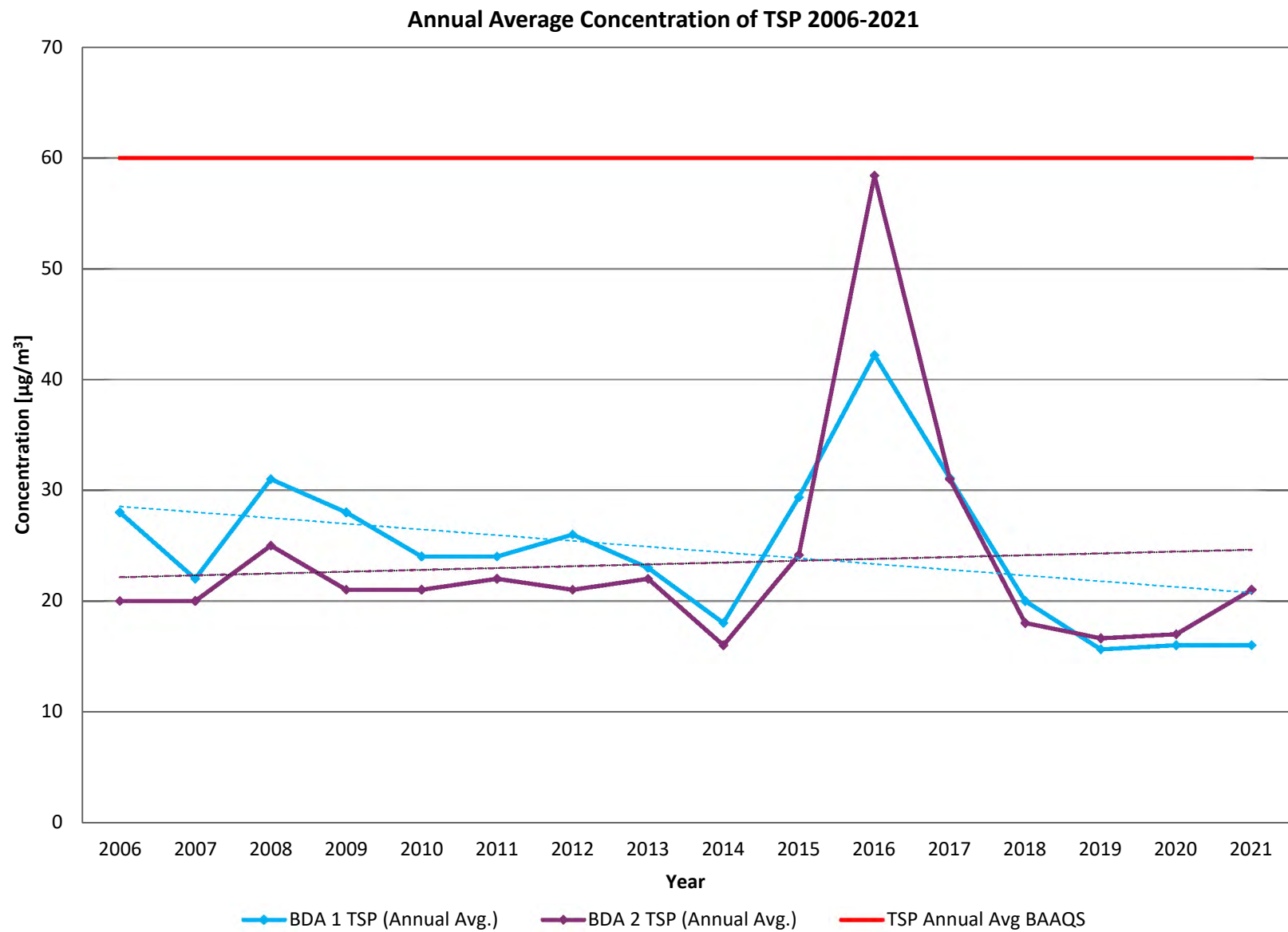


Fig. 16: Annual Average Concentration of TSP Recorded at BDA1 and BDA2 Monitoring Stations 2006-2021

Semiannual Audits

BELCO's Air Quality Monitoring System (AQMS) was audited in July and November of 2021 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 BAAQS were recorded during this reporting period. Annual average concentrations of all gaseous and particulate parameters were measured to be below Bermuda Ambient Air Quality Standards. 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 November of 2021.