BAFFINLAND IRON MINES CORPORATION

2020 Annual Air Quality, Dustfall and Meteorology Report

Final Report

April 29, 2021

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Executive Summary

This annual report presents a summary of the ambient air quality, dustfall and meteorology data collected during 2020 for the Mary River Project (the Project) by Baffinland Iron Mines Corporation. For context, the ambient air quality data are compared with standards and objectives for ambient air quality. The 2020 dustfall monitoring data are compared with the two meteorology parameters the have the strongest influence on the generation of fugitive dust and dustfall: wind speed and rain precipitation. The Project's 2020 meteorology data are compared with 2020 data from the nearest climate monitoring station operated by Environment and Climate Change Canada (Pond Inlet) and with the latest available 30-year climate normal (1981-2010) for Pond Inlet.

Ambient air quality data were collected at two Baffinland sites (Mine Site Complex and Port Site Complex). The data were collected for NO_2 and SO_2 using Teledyne NOx and SO_2 analyzers maintained and calibrated monthly and verified with onboard Permeation (perm) tube technology. Data acquisition was done using "Envidas" data acquisition software with on-site computer systems located in the respective environmental stations. Monthly data reports were sent for review to verify data and look for any trending equipment deficiencies evident in the data and calibration results.

Data were compared to previous years' data as provided by RWDI annual summary reports. The 2020 Data collected at Mine Site Complex and Port Site Complex were consistent to previous years' data trends, with the highest SO_2 and NO_2 levels occurring during the winter months and falling sharply during the summer periods.

Meteorological data were gathered at three sites (Mary River, Milne Port and Steensby meteorology stations). Gathered data includes air temperature, relative humidity, rainfall precipitation, wind speed and direction, and solar radiation. Data were compared to previous years through both previous reports from EDI and Knight Piesold, as well as the 30-year climate normal as provided by Environment Canada for the Pond Inlet Airport climate station.

Temperature trends compare well with the climate normals, with the coldest period during January and February, and the warmest period during July. Temperature values during summer tended to be higher than the climate normal, and information from Pond Inlet Airport was also warmer in 2020. Compared to previous years, the minimum temperatures were slightly warmer at Mary River. At Milne Port, the minimum temperature recorded was slightly warmer in 2020 than in 2019, but similar to values in previous years and the baseline. The maximum temperatures were warmer at Mary River as well. At Milne Port, the maximum temperature was much higher in 2020 than in 2019, but again consistent with the baseline. An issue has been identified with the temperature sensor at the Mary River monitoring station because the 2020 monthly averages are significantly higher (> 6°C) in every month. Troubleshooting to correct this faulty air temperature sensor is ongoing.

Relative humidity trends are indicative of a coastal area, with consistently high (greater than 65%) relative humidity through most of the year. This trend is slightly lower but similar to those observed in previous years.

The precipitation as rainfall was lower in 2020 for Mary River and Milne Port when compared to previous years. However, Pond Inlet Airport also observed low rainfall in 2020. Although the number of days with rain for Milne Port was similar to other low rainfall years for the same station, Mary River experienced an extremely low number of rainy days. Steensby recorded approximately twice as much 2020 rainfall as Mary River and Milne Port. Steensby is geographically much further south, and therefore is subject to somewhat different meteorological influences than Mary River, Milne Port, and Pond Inlet. All three sites (Mary River, Milne Port and Pond Inlet) experienced the same periods for rainfall, coinciding with spring and summer.

Average wind speeds measured at Mary River and Milne Port were consistent with the climate normals and previous years. The average wind directions for Mary River were consistent with prior data. At Milne Port, the average wind direction was north-north-easterly, despite being north-westerly and northerly in previous years. However, the northerly origin of the wind remained the same.

Solar radiation observations recorded at the three stations were consistent, with the largest observed radiative flux occurring in July (the warmest month). There are no historical data to compare to, nor is this information a part of the current climate normal.

A correlation was made between the 2020 monthly dustfall rates and the monthly precipitation; however, there was no correlation between the monthly dustfall rates and the monthly average and maximum wind speeds. All the dustfall stations recorded elevated rates during April and September 2020. The elevated dustfall rates for the monitoring stations at the Mine Site and Tote Road North Crossing during September 2020 coincided with dry conditions, and a relatively lower level of dustfall during June 2020 coincided with an appreciable amount of rain (46.8 mm at the Mary River meteorological station). The elevated dustfall rates for the monitoring stations at the Milne Port and Tote Road South Crossing locations during September 2020 coincided with dry conditions, and a relatively lower level of dustfall during June and July coincided with an appreciable amount of rain (31.0 and 20.9 mm, respectively) recorded at the Milne Port meteorology station.

Table of Contents

List of Tables

List of Figures

List of Photos

Appendices

Abbreviations

AQNAMP........................Air Quality and Noise Abatement Management Plan
Baffinland ....Baffinland Iron Mines Corporation
CAAQS..........................Canadian Ambient Air Quality Standards
CCME............................Canadian Council of Ministers of the Environment
CO.................................Carbon Monoxide
e.g. ....example
ECCC ....Environment and Climate Change Canada
EDI ....Environmental Dynamics Inc.
GIS ....Geographic Information System
GN.................................Government of Nunavut
GPS...............................Global Positioning System
MPO ....Manufactured, Processed or Otherwise used
MSC ....Mine Site Complex
NAAQS..........................Nunavut Ambient Air Quality Standards
NIRB..............................Nunavut Impact Review Board
NO_2................................Nitrogen dioxide
NOx ....Nitrogen oxides
NWTAAQS ....Northwest Territories Ambient Air Quality Standards
PDA...............................Project Development Area
PM.................................Particulate matter
$PM_{2.5}$..............................Particulate matter with an aerodynamic diameter of less than 2.5 micrometers
PMT ....photo multiplier tube
PPB ....parts per billion
Project...........................Mary River Project
PSC...............................Port Site Complex
SO_2................................Sulphur dioxide
SOP...............................Standard operating procedure
SWE ....snow-water-equivalent
TBRG ....Tipping bucket rain gauge
TEAMR..........................Terrestrial Environment Annual Monitoring Report
TEMMP ....Terrestrial Environment Mitigation and Monitoring Plan
TSP ....Total Suspended Particulates

1 INTRODUCTION

Nunami Stantec Limited was retained by Baffinland Iron Mines Corporation (Baffinland) to compile an annual report for the air quality, dustfall and meteorology monitoring programs at the Mary River Mine Project (the Project). These monitoring programs include:

- Continuous ambient air quality monitoring for SO_2, NOx and NO_2 at Port Site Complex (PSC) and the Mine Site Complex (MSC) accommodations buildings;
- Proposed 2021 continuous ambient air quality monitoring for TSP and $PM_{2.5}$ at the PSC and MSC (see Section 2 for more details);
- Passive dustfall monitoring at Milne Port, the Mine Site, and along the Northern Transportation Corridor; and
- Automated meteorology stations at the Milne Port, the Mine Site and Steensby Port locations.

The background and ambient air quality (including dustfall) objectives are summarized below. Chapter 2 contains a more detailed description of the ambient air quality monitoring program and results. Chapter 3 contains a detailed description of the dustfall monitoring and results. Chapter 4 contains a detailed description of the meteorology monitoring program and results. Chapter 5 presents an overall summary. Chapter 6 contains the references.

1.1 Background and Objectives

Continuous monitoring of gaseous SO_2 and NO_2 is undertaken at the MSC and PSC, in accordance with Project Certificate Conditions #7 and #8. No air quality monitoring is undertaken at Steensby Port as that component of the Project has not yet been constructed and no project-related activities occurred in that area in 2020. Continuous ambient air quality monitoring for SO_2 and NO_2 would normally be done at the Project Development Area (PDA) boundary; however, because there are no power sources available along the PDA boundary, the SO_2 and NO_2 monitors are located in an active area of the facility (e.g., at the accommodation and office facilities). The results from the monitoring of gaseous SO_2 and NO_2 are compared to ambient air quality standards and objectives for Nunavut as shown in Table 1-1.

Ambient air quality standards and objectives are non-statutory limits (i.e., not legally binding) used to assess ambient air quality and guide air management decisions. Ambient air is defined as the air outside (beyond) a PDA boundary. The PDA boundary is often referenced in industry as a property fenceline where public access is restricted. The PDA boundary is not a physical fenceline but industry terminology for the boundaries at the edge of the lease areas for the Mine Site and Port Site.

The air quality inside of the PDA boundary is considered from an occupational workplace perspective and is assessed using different standards. In Nunavut, workplace air quality is protected by the Schedule O Contamination Limits provided in the Nunavut Occupational Health and Safety Regulations (NU Reg 003-2016, http://canlii.ca/t/52qsb). The exception to this situation is the comparison of the SO_2 and NO_2 monitoring data at the PSC and MSC that are being compared to the Nunavut Ambient Air Quality Standards (NAAQS).

The Government of Nunavut (GN) has established the NAAQS for several criteria air contaminants (CACs): total suspended particulate matter (TSP), particulate matter with an aerodynamic diameter of <2.5µm ($PM_{2.5}$), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) (GN 2011). The NAAQS did not include and annual standard for PM_{10}, therefore the Northwest Territories Ambient Air Quality Standard (NWTAAQS) was adopted for comparison purposes. Table 1-1 presents the air quality guidelines and objectives adopted by the Project for the CACs.

Table 1-1 Standards and Objectives for Ambient Air Quality

Criteria Air Contaminant	Averaging Time	Units	NAAQS[1]	NWTAAQS[2]	2020 CAAQS[3]	Project Standard[5]
SO_2	1 hr	µg/m³	450 (172 ppb)	-	183[5]	450
	24 hr	µg/m³	150 (57 ppb)	-		150
	Annual	µg/m³	30 (11 ppb)	-	13.1[4]	30
NO_2	1 hr	µg/m³	400 (213 ppb)	-	113[4]	400
	24 hr	µg/m³	200 (106 ppb)	-		200
	Annual	µg/m³	60 (32 ppb)	-	32.0[4]	60
TSP	24 hr	µg/m³	120	-	-	120
	Annual	µg/m³	60	-	-	60
$PM_{2.5}$	24 hr	µg/m³	30	-	27	30
	Annual	µg/m³	-	10	8.8	10

Notes:
1. GN (2011).
2. Northwest Territories (2014).
3. 2020 Canadian Ambient Air Quality Standards (2020 CAAQS); CCME, 2014. Provided for context, not intended for use at facility PDA boundary for compliance.
4. CAAQS for these parameters are provided in parts per billion (ppb); these have been converted to µg/m³ by the equation: Concentration (µg/m³) = 0.0409 x Concentration (ppb) x molecular weight (Boguski, 2006).
5. Project Standards are from Nunavut Standards where available, or otherwise the most stringent available from a Territorial Government.

The Canadian Ambient Air Quality Standards (CAAQS) were established as objectives under sections 54 and 55 of the *Canadian Environmental Protection Act*, 1999 on May 25, 2013. The 2020 CAAQS are not facility-level regulatory standards that are to be enforced at a PDA boundary. The 2020 CAAQS are summarized in Table 1-1 for comparison purposes, although the adopted Project Standard for each CAC is based on the Nunavut standards or a provincial or Health Canada surrogate.

The CAAQS were developed by the Canadian Council for the Ministers of the Environment (CCME) to manage air emissions and ambient air quality concentrations in a regional airshed; CAAQS are not intended to determine compliance at the PDA boundary for an industrial facility. CAAQS are best suited as a tool to manage air emissions in regional airsheds that have multiple industrial sources. Regional airsheds typically have sensitive receptors (i.e., vulnerable populations such as infants, the elderly, and those with respiratory ailments), major industrial air emissions, and opportunities for achievable emission reductions. These airsheds often have multi-pollutant management needs. Regional airsheds differ based on the unique characteristics of local geography, meteorological conditions, and composition of human activity, including industrial activity.

Baffinland has committed to advancing an ambient air quality monitoring framework for the current operations (6 million tonnes per year of production) in consultation with the GN and Environment and Climate Change Canada (ECCC). Section 2 describes the additional continuous monitoring equipment for determining the TSP and $PM_{2.5}$ concentrations at the MSC and PSC. This new monitoring equipment will be commissioned in 2021. The potential applicability of the 2020 CAAQS to the Project was considered as part of the monitoring framework and Baffinland determined that the 2020 CAAQS would be used for comparison purposes only in agreement with the CCME objective to “keep clean areas clean” with respect to ambient air quality.

Passive sampling of dustfall is undertaken at a total of thirty-nine (39) sampling sites at Milne Port, the Mine Site, and along the Northern Transportation Corridor (North and South crossings). This program forms part of the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP) because of its linkage to monitoring of metals concentrations in soil and vegetation and monitoring of vegetation abundance and diversity programs also presented in the TEMMP. The location and methodology used for the thirty-nine (39) dustfall monitoring stations is summarized in the 2020 Terrestrial Environment Annual Monitoring Report (TEAMR, EDI 2021).

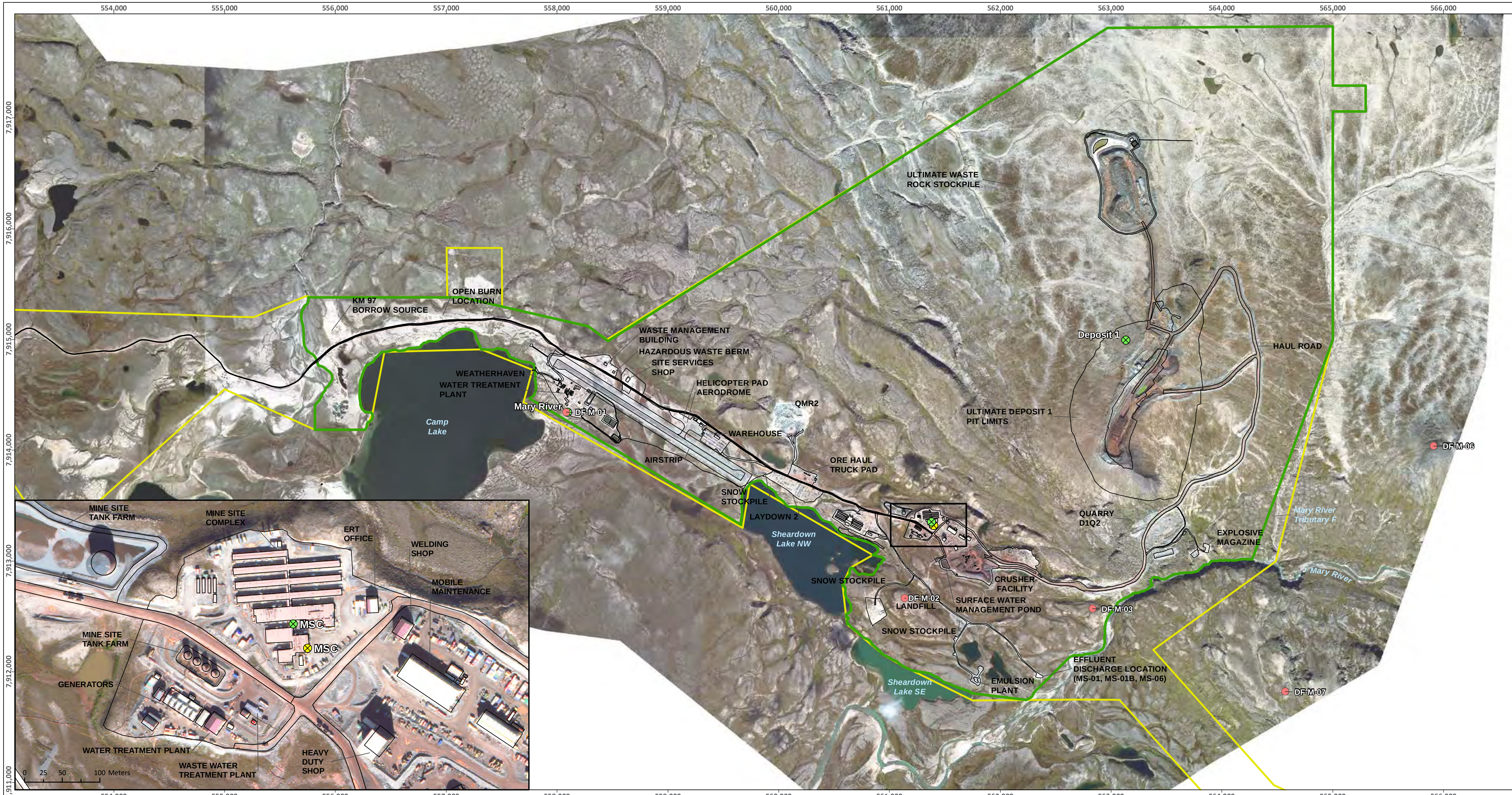
1.2 Monitoring Locations

Table 1-2 and Figures 1-1 to 1-3 summarize the locations for the two (2) ambient air quality monitoring stations and the four (4) automated meteorology monitoring stations.

Table 1-2 Summary of Baffinland Ambient Air Quality and Meteorology Stations and the Pond Inlet Airport Climate Station

Station	Location	Data Period	Distance to PDA (km)	Latitude (º)	Longitude (º)
Port Site Complex (PSC) Ambient Air Quality Monitoring Station	Port Site	year-round	Within PDA	71.8841	-80.8857
Mine Site Complex (MSC) Ambient Air Quality Monitoring Station	Mine Site	year-round	Within PDA	71.3154	-79.2832
Mary River Meteorology Station [a]	Mine Site	year-round	Within PDA	71.3243	-79.3743
Milne Port Meteorology Station [a]	Port Site	year-round	1.6	71.8775	-80.8321
Steensby Meteorology Station [a]	Mine Site	year-round	Within PDA	70.2768	-78.5271
Pond Inlet Airport Climate Station [b]	Pond Inlet Airport	year-round	130 from the Port Site Complex	72.6894	-77.9689

Note
[a] Based-on information from Baffinland
[b] Based on Environment and Climate Change Canada (ECCC 2021)



LEGEND

Monitoring Station

- Continuous Ambient Air Quality
- MET
- Dustfall Monitoring Site

- Current Infrastructure
- Project Development Area
- Commercial Lease Boundary

MARY RIVER PROJECT

Mine Site Air Quality and MET Stations

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © 2020 Digital Global, Inc.
Imagery and Infrastructure are representative as of August 2020.

0 195 390 780 Meters
Scale 1:34,000

N

Baffinland

FIGURE 1-1

SAVED: C:\Users\kate.mcguire\Documents\4 - Maps\External\Stantec\Air Quality Report_040321\BIM_Fig 1-1 Mine Site.mxd; 08-Mar-21

LEGEND

Monitoring Station

- Continuous Ambient Air Quality
- MET
- Dustfall Monitoring Site
- Foreshore Lease Boundary
- Current Infrastructure
- Borrow Area
- Quarry Area
- Project Development Area
- Commercial Lease Boundary

MARY RIVER PROJECT

Milne Port Air Quality and MET Stations

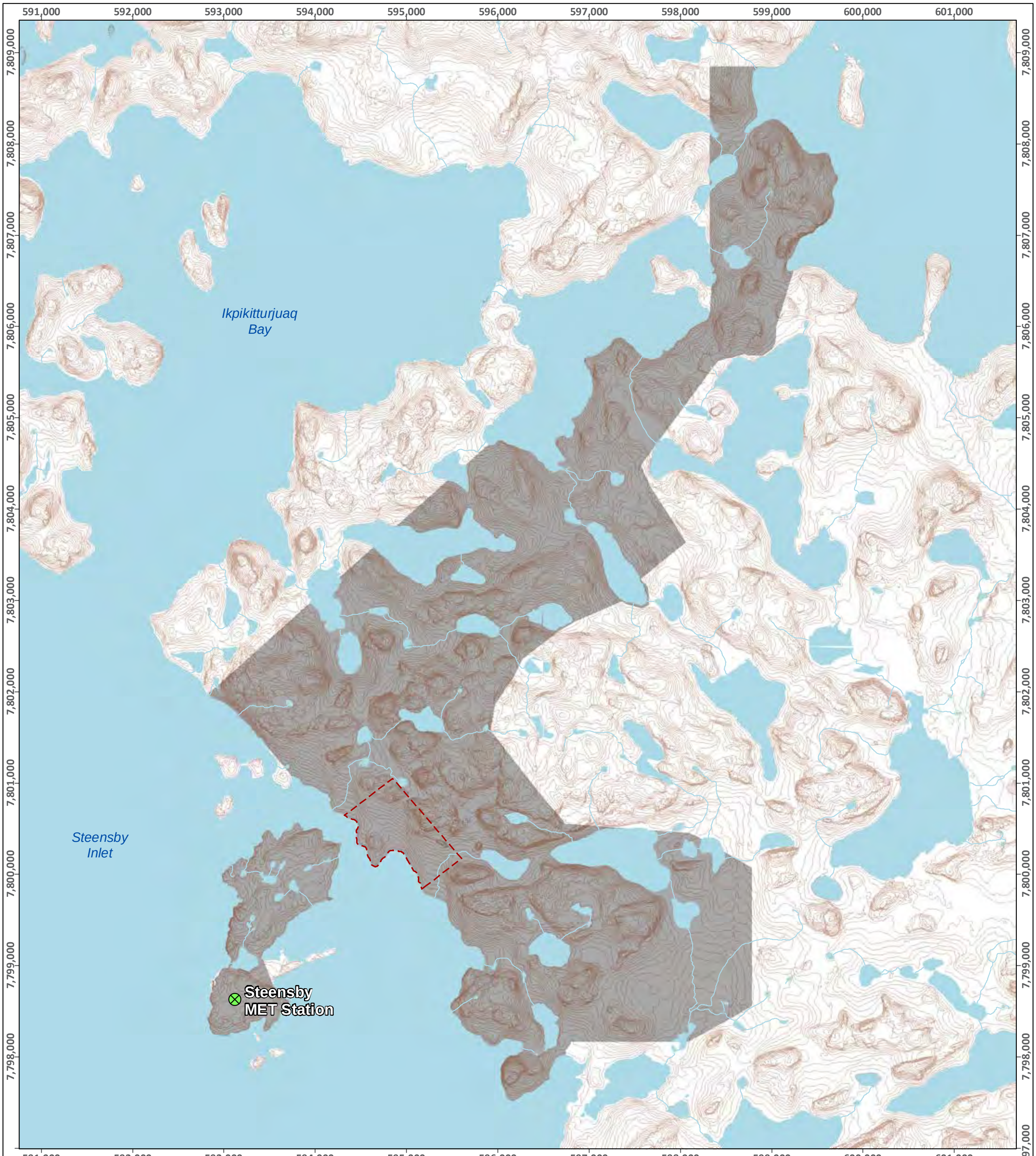
Projection: NAD 1983 UTM ZONE 17N.
Base Map: © 2020 Digital Globe, Inc.
Imagery and Infrastructure are representative as of August 2020.

0 50 100 200 300 400 Meters
Scale 1:14,000

N

Baffinland

FIGURE 1-2



LEGEND

- Lease Boundary
- Contour (20 m Interval)
- Crown Land
- Project Development Area

Monitoring Station

- MET

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Steensby Port MET Station

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © Queen's Printer for Ontario, 2020.

0 300 600 1,200 Meters
Scale 1:60,000

N

Baffinland

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FIGURE **1-3**

1.2.1 Mary River Mine Site

There is one (1) automated meteorology station at the Mine Site located near the Weatherhaven structure. Photo 1-1 shows the Mary River meteorology station. Photo 1-2 shows the continuous gas analyzers at the MSC. The ENVIDAS computer that controls the data collection is the grey device at the bottom of the rack. The device below the computer display is the Teledyne dilution calibrator. Photo 1-3 shows the location of the Mine Site ambient air quality monitoring station in relation to nearby buildings. Photo 1-4 shows a dustfall station near the Mine Site.

Photo 1-1 The Mary River Meteorology Station looking towards the north

Photo 1-2 The rack-mounted Teledyne T100 (SO_2) and T200 (NOx-NO_2) continuous gas analyzers at the MSC

Photo 1-3 Plan view showing the location of the ambient air quality (AQ) monitoring station for SO_2 and NO_2 at the MSC

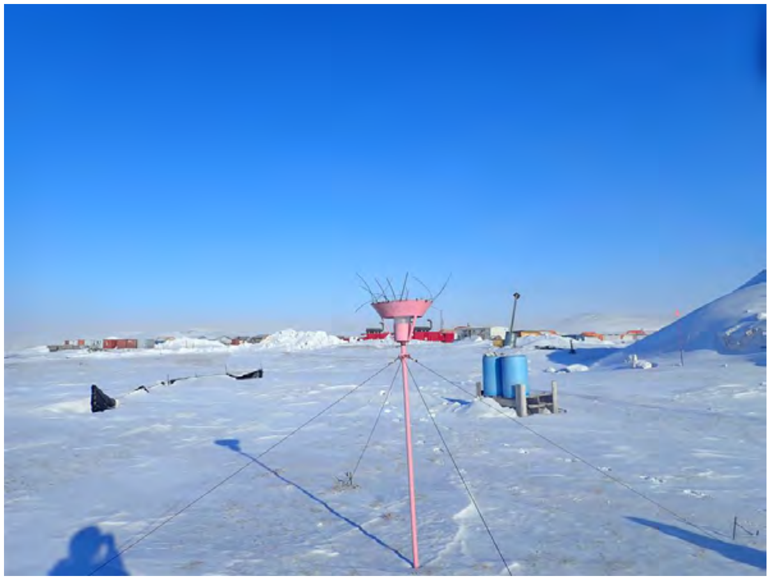

Photo 1-4 Dustfall station DF-M-01 (March 20, 2021) near the Mine Site is located approximately 250 m south of the airstrip and 250 m east of Camp Lake

1.2.2 Milne Port

Photo 1-5 shows the Milne Port Meteorology Station located approximately 2 km east of the Milne Port infrastructure. Photo 1-6 shows the continuous gas analyzers at the PSC. The ENVIDAS computer that controls the data collection is the grey device at the bottom of the rack. The device below the computer display is the Teledyne dilution calibrator. Photo 1-7 shows the location of the PSC ambient air quality monitoring station in relation to nearby buildings. Photo 1-8 shows dustfall monitoring station DF-P-01 near Milne Port.

Photo 1-5 Milne Port Meteorology Station (September 2, 2020)

Photo 1-6 The rack-mounted Teledyne T100 (SO_2) and T200 (NOx-NO_2) continuous gas analyzers at the PSC

Photo 1-7 **The plan view showing the location of the ambient air quality (AQ) monitoring station for SO_2 and NO_2 at the PSC.**

Photo 1-8 **Dustfall station DF-P-04 (February 17, 2021) near Milne Port is located approximately 300 m south of Quarry Q1 and 300 m east of the Tote Road**

1.2.3 Steensby

The Steensby automated meteorology station shown in Photo 1-9 is located approximately 120 km southeast from the Mary River Mine Site. As the Mary River mine site increases production a railway is to be constructed to the southeast to transport ore to a port at Steensby Inlet which would operate year-round to ship ore to market.

Photo 1-9 The Steensby Port Meteorology Station looking towards the west

2 AMBIENT AIR QUALITY MONITORING

2.1 Methods

2.1.1 Continuous Monitoring for Nitrogen Oxides, Nitrogen Dioxide and Sulphur Dioxide at Mary River and Milne Port

The T200 NOx analyzer uses a photo multiplier tube (PMT) to detect the amount of chemiluminescence created in the Reaction Cell. Photons from the reaction are filtered by an optical high-pass filter which enter the PMT and strike a negatively charged photo cathode causing it to emit electrons. A high voltage potential across these focusing electrodes directs the electrons toward the array of high voltage dynodes. The dynodes in the T200 are designed so that each stage multiplies the number of emitted electrons by emitting multiple, new electrons. This activity increases the number of electrons emitted which are collected by the anode to create a useable current signal. The Signal is then interpreted across the PMT board and translated to numerical data through the motherboard to be displayed on the unit's display panel and transmitted to collection software.

(Operation Manual Model T200 NO/NO_2/NO_X Analyzer, Teledyne API 2018)

The T100 UV Fluorescence SO_2 Analyzer determines the concentration of SO_2 in the ambient air by drawing in a continuous sample through the instrument. The sample gas is exposed to ultraviolet light which causes the SO_2 molecules to change to an excited state (SO_2*). As the molecules decay into SO_2 they emit a photon. The reaction enters a PMT which increases the number of electrons emitted (as in the T200). The Signal is then interpreted across the PMT board and translated to numerical data through the motherboard to be displayed on the units display panel and transmitted to collection software. (Operation Manual Model T100 UV Fluorescence Analyzer, Teledyne API 2018)

The NOx and SO_2 analyzers are calibrated and maintained in accordance with the manufacturer-recommended calibration methods and the USEPA calibration standards in compliance with 2020 Canadian Ambient Air Quality Standards and CCME, 2013.

2.1.2 Continuous Monitoring for Particulate Matter at Mary River and Milne Port

A commitment for the Production Increase Proposal Extension was made to ECCC to add continuous monitoring equipment for particulate matter at the Mine Site and Milne Port where a suitable and reliable power source is available.

The current commitment is to implement one (1) continuous and/or discrete particulate monitoring station for TSP and $PM_{2.5}$ at the Port site, and one (1) continuous and/or discrete particulate monitoring station for TSP and $PM_{2.5}$ at the Mine site. To achieve this, a desktop review and site visit were completed in 2020 to inform placement of these monitoring stations. The intention was to deploy these monitoring stations in 2020, subject to logistical constraints and external factors.

In September 2020, Nunami Stantec Limited completed the site visit which was delayed due to COVID-19. Currently, the equipment is being procured. Met One BAM 1020 instruments for continuous monitoring of TSP and $PM_{2.5}$ will be installed and commissioned at the Mine Site MSC and Milne Port PSC during early summer 2021. This new equipment will be installed next to the existing continuous analyzers for monitoring SO_2 and NO_2 concentrations. All the continuous ambient air quality monitoring systems will be connected to the existing ENVIDAS data collection platform. The Air Quality and Noise Abatement Management Plan (AQNAMP) will be updated with the two (2) new monitoring locations outlined above for the 2021 NIRB Report submission in April 2021.

2.2 Results and Discussion

2.2.1 MSC Ambient Air Quality Monitoring Station

SO_2 data at the MSC ambient air quality monitoring station had 89.3% valid data for 2020 with a low of 16% for the month of April after a pump failure causing a perm tube spike and subsequent shutdown of the analyzer in March due to operator error (Table 2-1). The pump was repaired, and the system taken out of "off-scan" mode; however, since the percent of data collected was below 75%, the data for those two (2) months are considered invalid. The SO_2 concentrations remained very low throughout 2020 and did not exceed the hourly (172 ppb), 24-hour (57 ppb) or annual (11 ppb) NAAQS (GN 2011). The maximum hourly recorded concentration was 5% of the NAAQS Hourly Standard, 5% of the Nunavut Air Quality 24-hour Standard and 1% of the NAAQS. Sulphur Dioxide concentrations were 4% of the 1-Hour CAAQS[1]

. The annual mean concentration was 0.12 ppb representing 2% of the annual CAAQS SO_2 standard.

The SO_2 concentrations were highest in the winter and lowest in the summer months (Figure 2-1); consistent with historical trends (RWDI 2015, 2017,2018).

[1] Mary River data based on 98th percentile of data values; derived from 7845 and 8665 valid data points for SO_2 and NO_2, respectively

Table 2-1 Hourly Summary of SO_2 data for MSC Ambient Air Quality Monitoring Station (measured in parts per billion (ppb))

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2
Mean	1.11	1.13	0.61	-1.07	-1.30	-1.06	-0.80	-0.67	0.61	0.47	0.88	0.68	0.12
Median	1	1	0.5	-1.2	-1.3	-1	-0.8	-0.7	0.3	0.3	0.7	0.7	0.2
Mode	1	0.7	0.3	-1.3	-1.3	-1	-0.8	-0.7	0	0.3	0.5	0.7	-0.8
Range	6.2	5.3	5.5	3	1.4	3	0.8	3.6	8	4.5	5.3	9.8	0
Minimum	-0.5	-1	-0.5	-2.7	-1.9	-1.5	-1.1	-1.2	-1.2	-0.3	0.1	-0.6	-2.7
Maximum	5.7	4.3	5	0.3	-0.5	1.5	-0.3	2.4	6.8	4.2	5.4	9.2	9.2
Count	713	683	524	115	740	717	741	743	689	735	713	732	7845
% Valid	95.83%	98.13%	70.43%*	15.97%*	99.46%	99.58%	99.60%	99.87%	95.69%	98.79%	99.03%	98.39%	89.31%

Note: *- March and April invalid – below the >75% Valid data criteria

- Negative values reflect normal noise in the analyzer and are considered valid "zero" data
- In the column for the annual values the lowest minimum and highest maximum monthly values are shown.

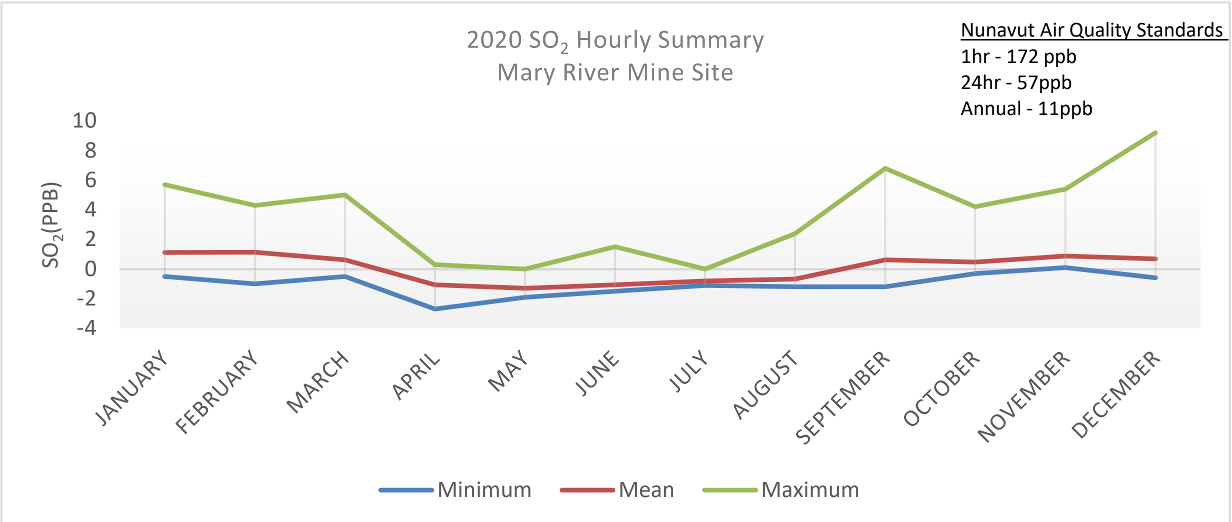

Figure 2-1 MSC Hourly SO_2 Level (ppb) Summaries by Month

NO_2 data at the Mary River MSC ambient air quality monitoring station had 98.5% valid data for 2020 with a low of 96.3% for the month of September due to an extended calibration cycle (Table 2-2). The NO_2 concentrations did not exceed the hourly (213 ppb), 24-hour (106 ppb) or annual (32 ppb) NAAQS (GN 2011) with concentrations of 151 ppb, 76 ppb and 18.3 ppb, respectively (Figure 2-2). The NO_2 concentrations exceeded the 1-hour federal CAAQS[A] in 2% of the hourly averaged data (175 points) with the highest average hourly maximum occurring on January 21, 2020 (151.4 ppb). The annual CAAQS mean was 18.3 ppb which is 108% of the annual CAAQS arithmetic mean.

Minimum values present in the data reflect the level of zero air noise in the analyzer and remained consistent between calibrations with a drop in March/April during the pump failure.

The NO_2 concentrations were highest in the winter and lowest in the summer months (Figure 2-2) consistent with historical trends (RWDI 2015, 2018). Data collected for the Mine Site in 2017 were not sufficient to use for annual trend comparisons.

Table 2-2 Hourly Summary NO_2 data for MSC Ambient Air Quality Monitoring Station (ppb)

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2
Mean	49.74	51.69	22.47	14.72	5.06	4.87	4.14	4.43	13.56	11.01	24.74	15.68	18.3
Median	52.35	50.1	19.05	9.9	3.3	3.8	3.1	3	11.7	5.1	22.2	12.4	9.2
Mode	61.1	42.9	11.7	2.1	1.7	2.2	2.1	0.2	1.5	0.9	24.5	5.3	1.2
Range	150.8	107.9	83.1	71.6	26.7	18	23.2	33.8	45.5	69.5	87.7	75.2	154.3
Minimum	0.6	3.1	0.5	0.2	0.1	0.1	-0.5	-0.1	-2.9	-1.7	-0.6	-2.9	-2.9
Maximum	151.4	111	83.6	71.8	26.8	18.1	22.7	33.7	42.6	67.8	87.1	72.3	151.4
Count	722	690	730	706	740	719	741	744	693	735	712	733	8665
% Valid	97.04%	99.14%	98.12%	98.06%	99.46%	99.86%	99.60%	100.00%	96.25%	98.79%	98.89%	98.52%	98.65%

Note: In the column for the annual values the lowest minimum and highest maximum monthly values are shown.

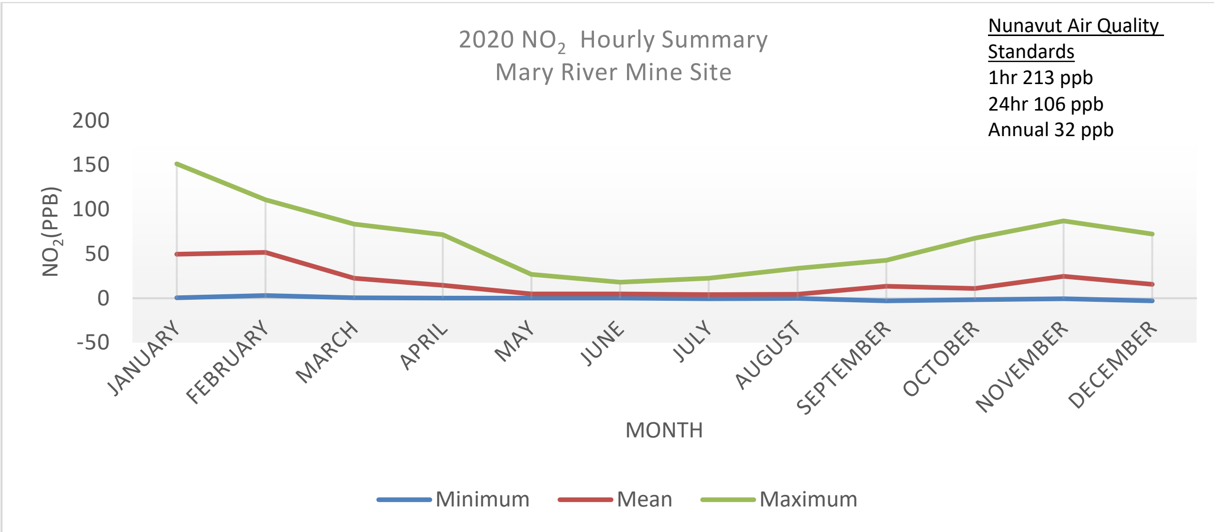

Figure 2-2 MSC Hourly NO_2 (ppb) Summaries by Month

2.2.2 PSC Ambient Air Quality Monitoring Station

SO_2 data at the PSC ambient air quality monitoring station had 98.5% valid data for 2020 with a low of 96.3% for the month of September due to an extended calibration cycle (Table 2-3). The SO_2 concentrations remained very low (0 - 7.7ppb) throughout 2020 and did not exceed the hourly (172 ppb), 24-hour (57 ppb) or annual (11 ppb) NAAQS (GN 2011). The maximum hourly recorded concentration was 4% of the NAAQS Hourly Standard, 6% of the Nunavut Air Quality 24-hour Standard and 4% of the NAAQS. Negative values reflect the level of zero air noise in the analyzer and remained consistent between calibrations. The SO_2 concentrations were highest in the winter and lowest in the summer months (Figure 2-3).

Table 2-3 Hourly Summary SO_2 data for PSC Ambient Air Quality Monitoring Station

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2	SO_2
Mean	0.90	0.88	0.67	0.28	0.70	1.40	0.15	0.11	-0.08	-0.21	-0.27	0.53	0.44
Median	0.8	0.8	0.7	0.2	0.7	1.4	0.1	0.2	-0.3	-0.3	-0.4	0.5	0.4
Mode	0.7	0.8	0.7	0.3	1	1.4	0.1	0.2	-0.2	-0.5	-0.3	0.2	0.3
Range	3.4	3.5	3.7	4.7	2.4	2	1.7	2.3	4.6	3.1	6	7.7	7.7
Minimum	-0.2	-0.4	-0.6	-0.7	0	0.5	-0.2	-0.8	-2	-1.2	-1.3	-1.5	-2
Maximum	3.2	3.1	3.1	4	2.4	2.5	1.5	1.5	2.6	1.9	4.7	6.2	6.2
Count	740	692	740	716	742	720	581	337	711	739	714	738	8170
% Valid	97.04%	99.14%	98.12%	98.06%	99.46%	99.86%	99.60%	100.00%	96.25%	98.79%	98.89%	98.52%	98.52%
Note: In the column for the annual values the lowest minimum and highest maximum monthly values are shown.													

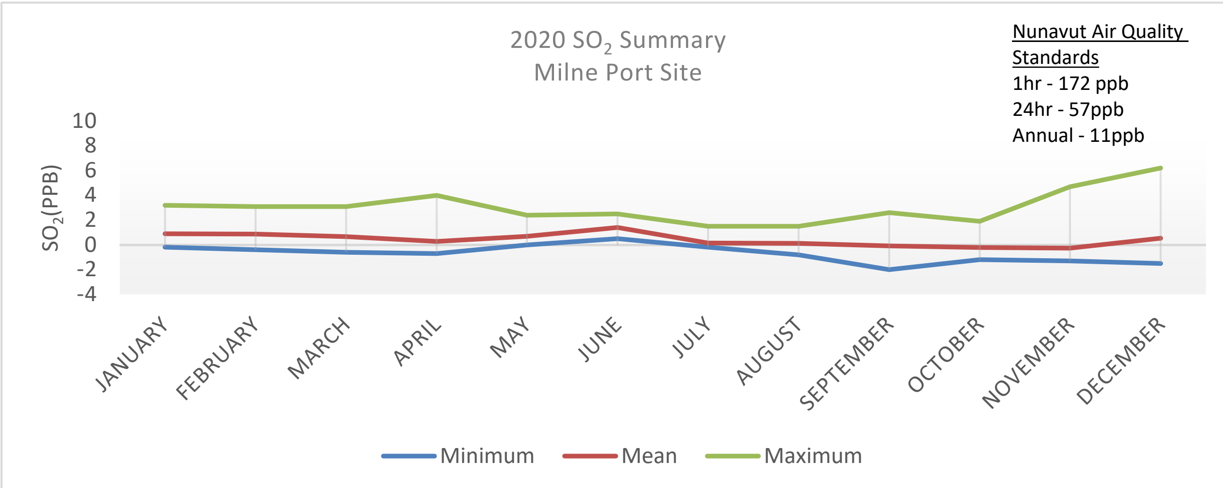

Figure 2-3 PSC Hourly SO_2 Summaries by Month

NO_2 data at the Milne Port PSC had 98.52% valid data for 2020 with a low of 96.25% for the month of September due to an extended calibration cycle (Table 2-4). The NO_2 concentrations did not exceed the hourly (213 ppb), 24-hour (106 ppb) or annual (32 ppb) NAAQS (GN 2011) with concentrations of 148.5 ppb, 72.4 ppb and 16.9 ppb, respectively (Figure 2-4). The NO_2 concentrations exceeded the 1-hour CAAQS[2] in 2% of the hourly averaged data (164 occurrences) with the highest average hourly maximum occurring on November 16, 2020 (148.5 ppb). The CAAQS are being used for comparison purposes only in agreement with the CCME objective to “keep clean areas clean” and the most relevant NO_2 standard for comparison is the NAAQS.The annual CAAQS mean was 16.9 ppb which is 99% of the annual CAAQS arithmetic mean.

Negative values present in the data reflect the level of zero air noise in the analyzer when the ambient gas concentrations are below analyzer detection limits.

The NO_2 concentrations were highest in the winter and lowest in the summer months (Figure 2-2), consistent with historical trends (RWDI 2015, 2017,2018).

[2] Milne Port data based on 98th percentile of data values derived from 8170 valid data points each for SO_2 and NO_2[2]

Table 2-4 Hourly Summary of NO_2 data for PSC Ambient Air Quality Monitoring Station

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2	NO_2
Mean	44.97	38.88	24.72	17.23	4.37	2.19	1.65	5.03	6.11	9.68	20.47	19.01	16.94
Median	44.4	35.45	18.05	10.85	2.5	1.4	0.6	2.9	4.4	5.3	11.45	11.05	6.7
Mode	45.3	36.2	1.6	1.2	0.8	0.2	0.1	0.7	0.5	0.4	2	0.5	0.5
Range	136.3	141.1	137.4	117.3	42.5	18.1	25	22.7	106.4	75.7	148.8	130.6	151.2
Minimum	0.1	-0.1	0.2	0.2	-0.1	-0.2	-0.2	0	-2.7	-1.3	-0.3	-0.3	-2.7
Maximum	136.4	141	137.6	117.5	42.4	17.9	24.8	22.7	103.7	74.4	148.5	130.3	148.5
Count	740	692	740	716	742	720	581	337	711	739	714	738	8170
% Valid	97.04%	99.14%	98.12%	98.06%	99.46%	99.86%	99.60%	100.00%	96.25%	98.79%	98.89%	98.52%	98.52%

Note: In the column for the annual values the lowest minimum and highest maximum monthly values are shown.

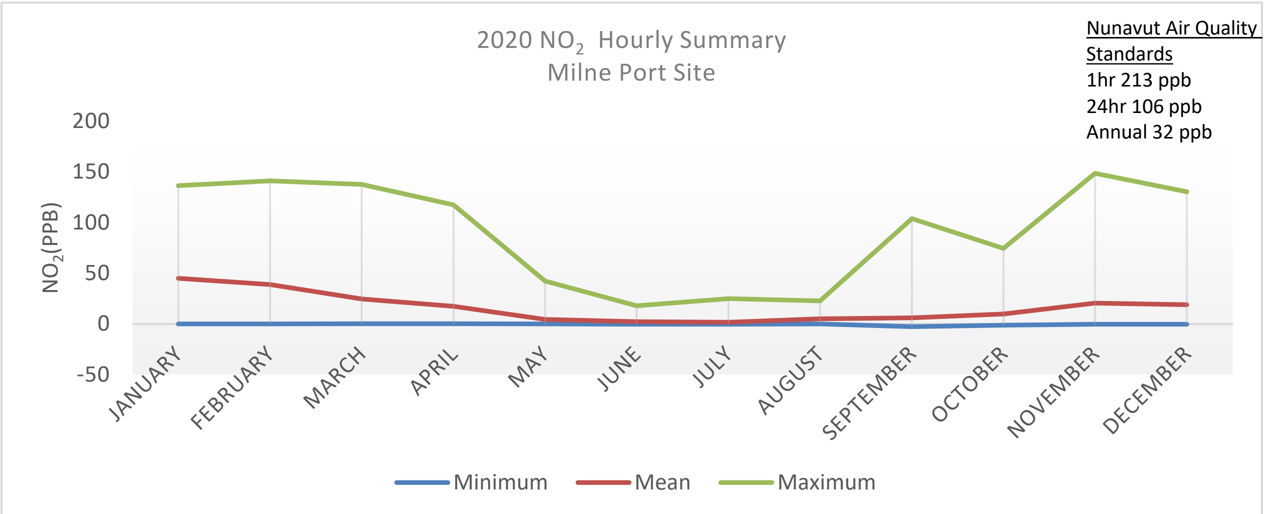

Figure 2-4 PSC Hourly NO_2 Level Summaries by Month

2.2.3 Quality Assurance and Quality Control

From September 3–16, 2020 a site visit by Valley Environmental Services (subcontractor for Nunami Stantec Limited) was conducted. The scope of work for the site visit included trouble shooting and calibrating the NOx/SO_2 analyzers, including meter annual maintenance, chamber extraction and cleaning, as well as filter and component replacements. Perm tubes were not available at the time of the site visit so were not replaced, but instructions were given to on-site personnel on the proper procedures for replacement. The expired NOx analyzer perm tube at MSC was replaced in December 2020. The SO_2 analyzer perm tube at PSC was replaced in October 2020; however, the MSC SO_2 replacement is still pending.

A training session was conducted with the on-site technicians, which included weekly and monthly equipment maintenance best practices and manufacturer-recommended component replacement intervals. Calibration and gas cylinders were also checked, and replacements requested based on calibration standard and gas expiry date. A list of components needed for on-site maintenance was compiled and discussed with the on-site technicians during the site visit and training. Parts Procurement is still being verified and is ongoing.

During the annual site visit, gas checks were conducted and calibration gas cylinders were identified that were out of date and/or may have contamination in the calibration mixture. Analyzer gas replacement was recommended at that time to ensure ongoing analyzer accuracy during calibrations and verification. New analyzer gases have been budgeted for in the 2021 replacement budget and are expected to be on site in early spring.

Table 2-5 summarizes the maintenance and calibration activities that were completed for the gas analyzers during September 2020.

Table 2-5 September 2020 Gas Analyzer Calibration and Maintenance Summary

Continuous Ambient Air Quality Monitoring Station	Calibration and Maintenance Completed	Maintenance not Completed and Requiring Additional Work
Mary River MSC Teledyne T100 analyzer for SO_2 Teledyne T200 analyzer for NO/NO_2/NOx	• Rebuilt pump for T100 • Installed new molybdenum converter assembly (chamber) for the T200 • Rebuilt reaction chamber for T100 and T200 • Replaced internal filters for T100 and T200 • Replaced sintered filters and flow orifices for T100 and T200 • Conducted preburn calibration on T100, T200 • Conducted follow-up calibration check after 5-7 day "burn in" • **Perm tube was replaced December 2020**	• If vacuum reaches 10" then rebuild pump for T200 • Install new perm tube for T200
Port Site Complex Teledyne T100 analyzer for SO_2 Teledyne T200 analyzer for NO/NO_2/NOx	• Rebuilt pump for T100. • Installed new molybdenum converter assembly (chamber) for the T200. • Rebuilt reaction chamber for T100 and T200 • Replaced internal filters for T100 and T200. • Replaced Sintered Filters and flow orifices for T100 and T200. • Conducted preburn calibration on T100, T200. • Conducted follow-up calibration check after 5-7 day "burn in" **Perm tube was replaced October 2020.**	• If vacuum reaches 10" then rebuild pump for T100. • Install new perm tube for T100.

2.2.3.1 Permeation (Span) and Zero Daily Quality Assurance

Perm tubes coupled with zero span daily checks are used to assess if a gas analyzer has a failure during the previous 23-hour cycle. If the daily level changes significantly over the observed daily trend (sudden spikes or dips), then technicians conduct an on-site calibration check of the analyzer in question to ensure that the unit is operating within the calibration validation limits (<15% of previous months calibration values, <6% analyzer operational limits). Once the checks are completed the analyzer data are validated and ongoing perm/zero checks are monitored for changes. Further details are available in the Ambient Air Quality Monitoring Standard Operating Procedure (SOP).

Monthly perm span/zero checks for MSC and PSC are presented in Appendix A. Data presented in Appendix A show typical trends during normal operation and erratic spikes that are expected when the perm tubes are approaching the end of their useful life (e.g., extinction).

2.2.4 Sulphur Dioxide (SO_2)

2.2.4.1 MSC

SO_2 data at the Mary River MSC had 89.3% valid data for 2020 with a low of 16% for the month of April after a pump failure causing a perm tube spike and subsequent shutdown of the analyzer in March (Figure 2-5). The pump was repaired in April and the system restarted (Table 2-1). The percent of data collected In March and April fell below 75% invalidating the data for those two months. The SO_2 concentrations remained very low (0-9.2 ppb) throughout 2020 and did not exceed the hourly (172 ppb), 24-hour (57 ppb) or annual (11 ppb) NAAQS (GN 2011). The SO_2 concentrations did not exceed the NAAQS and the 1-hour maximum concentration was 4% of the 1-hour CAAQS[3] and the annual concentration was 2.4% of the annual CAAQS (Figure 2-5). The annual SO_2 concentrations are very low, ranging from 0-9 ppb.

Negative values present in the data and predominant during the summer (zero levels) indicate background noise in the system typical for ambient levels with zero detectable concentrations.

Zero and Span data indicate consistent trends with no significant spikes through the year (Figure 2-6). Span values dropped on the perm cycle throughout the year as the perm tube discharged the contents of its gas (Figure 2-6). Cycling was consistent with good daily responses (Figure 2-5). The downward trend (Figure 2-6) indicated consistent linear discharge although perm tubes should be replaced once they begin to trend down to avoid complete depletion of the perm tube and invalidation of the span check.

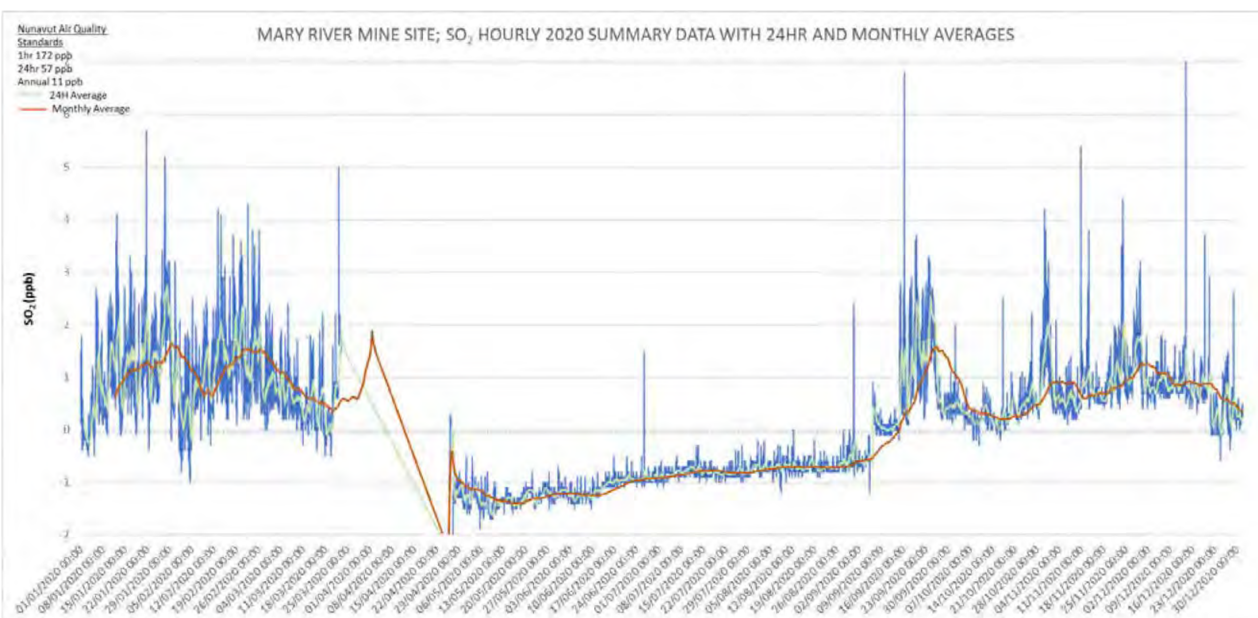

Figure 2-5 MSC Hourly SO_2 data with 24-hr and Monthly Average trends

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3 Mary River data based on 98th percentile of data values; derived from 7845 and 8665 valid data points for SO_2 and NO_2, respectively

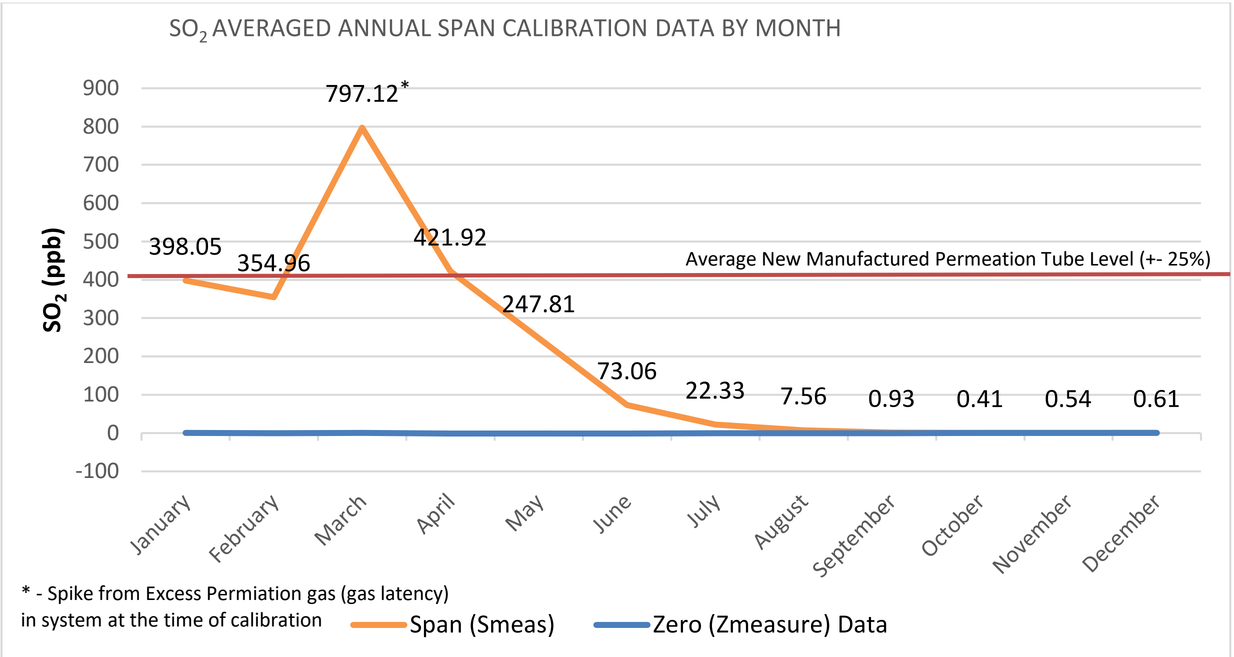


Figure 2-6 MSC SO_2 Annual Permeation Tube Data Span/Zero

2.2.4.2 PSC

SO_2 data at the Milne Port PSC station had 98.5% valid data for 2020 with a low of 96.3% for the month of September due to an extended calibration cycle (Table 2-3). The SO_2 concentrations remained very low throughout 2020 and did not exceed the hourly (172 ppb), 24hr (57 ppb) or annual (11 ppb) NAAQS (GN 2011). The maximum hourly recorded concentration was 4% of the NAAQS Hourly Standard, 6% of the NAAQS 24-hour Standard. Sulphur Dioxide concentrations were 0.3% of the 1-Hour CAAQS[4]. The annual mean concentration was 0.44 ppb representing 4% of the Annual CAAQS SO_2 standard. Consistent negative values present in the latter half of the year indicate excessive noise in the system for the zero range of the span which was corrected during the December calibration run. (Figure 2-7).

Span values began to decline on the perm cycle in April 2020 and returned to operation in September once the perm tube was replaced. Permeation values for the tubes are lower than anticipated but the data remain consistent through calibration cycles (Figure 2-8), indicating that the analyzer is operating within manufacturer specifications.

[4] Milne Port data based on 98th percentile of data values derived from 8170 valid data points each for SO_2 and NO_2[4]

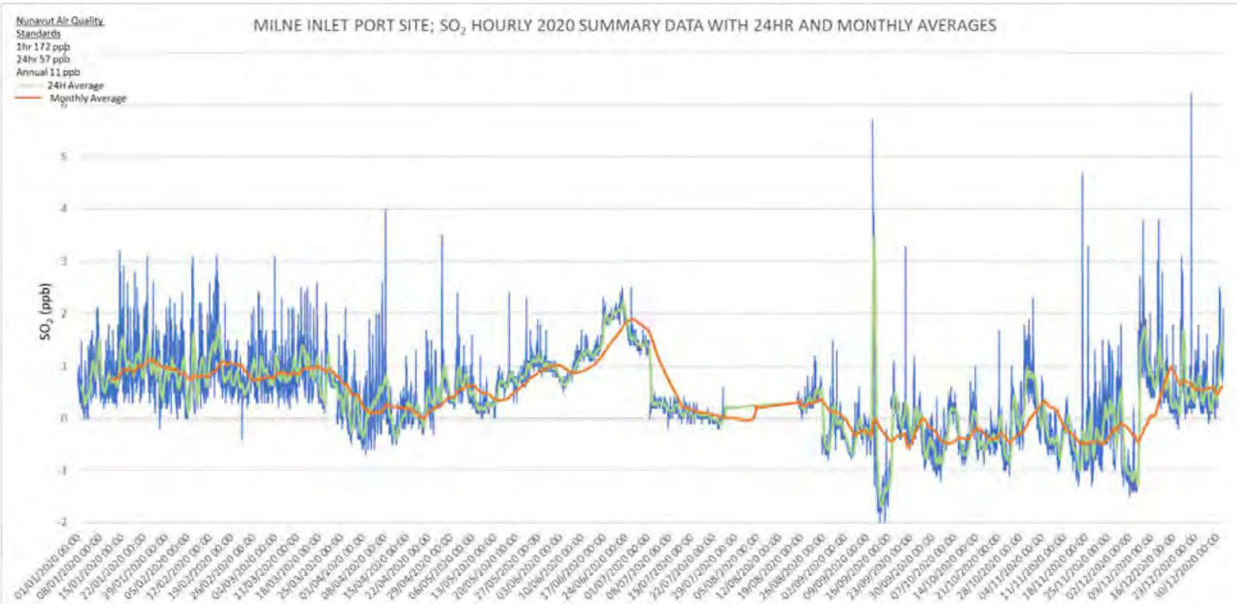


Figure 2-7 PSC Hourly SO_2 data with 24-hour and Monthly Average Trends

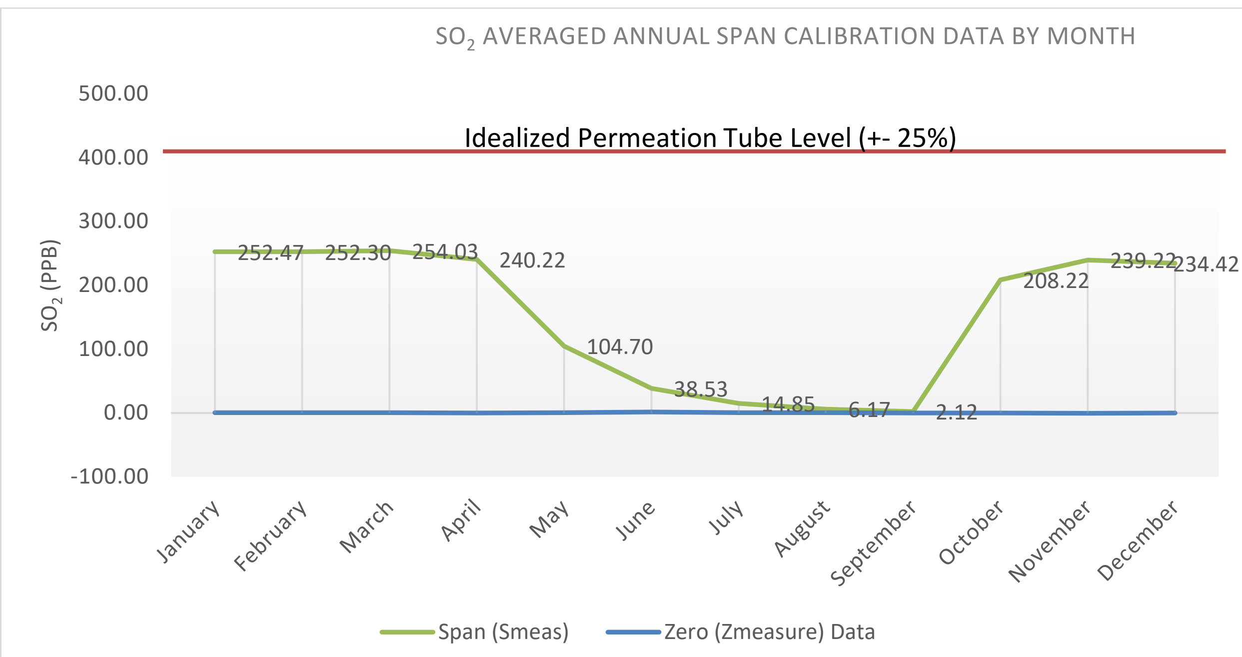


Figure 2-8 PSC SO_2 Permeation Tube Data Span/Zero

2.2.5 Nitrogen Dioxide (NO_2)

2.2.5.1 MSC

NO_2 data at the Mary River Mine Site Complex had 98.5% valid data for 2020 with a low of 96.3% for the month of September due to an extended calibration cycle (Table 2-2). The NO_2 concentrations did not exceed the hourly (213 ppb), 24hr (106 ppb) or annual (32 ppb) NAAQS (GN 2011) with concentrations of 151 ppb, 76 ppb and 18.3 ppb respectively (Figure 2-2, Figure 2.9). The maximum NO_2 concentration exceeded the 1-hour CAAQS[5] in 2% of the hourly averaged data, with the highest hourly maximum occurring on January 21, 2020 (151.4 ppb). The hourly concentrations exceeding the 1-Hour CAAQS[6] were during the winter months when higher NO_2 concentrations are historically observed (RWDI 2018). The annual CAAQS mean was 18.3 ppb which is 108% of the annual CAAQS arithmetic mean. The NO_2 concentrations trend higher during the winter months and fall during the summer months (Figure 2-9), which is consistent with historical trends (RWDI 2015, 2018).

Perm Span values remained consistent, dropping off throughout the year as the perm tube discharged the contents of its gas (Figure 2-10). Meter response was consistent during Span cycles and the downward trend indicated a consistent calibration cycle and linear discharge. The perm tube was replaced in December reflecting a Perm Span cycle returning to the full value of the manufactured perm tube concentration and discharge rate.

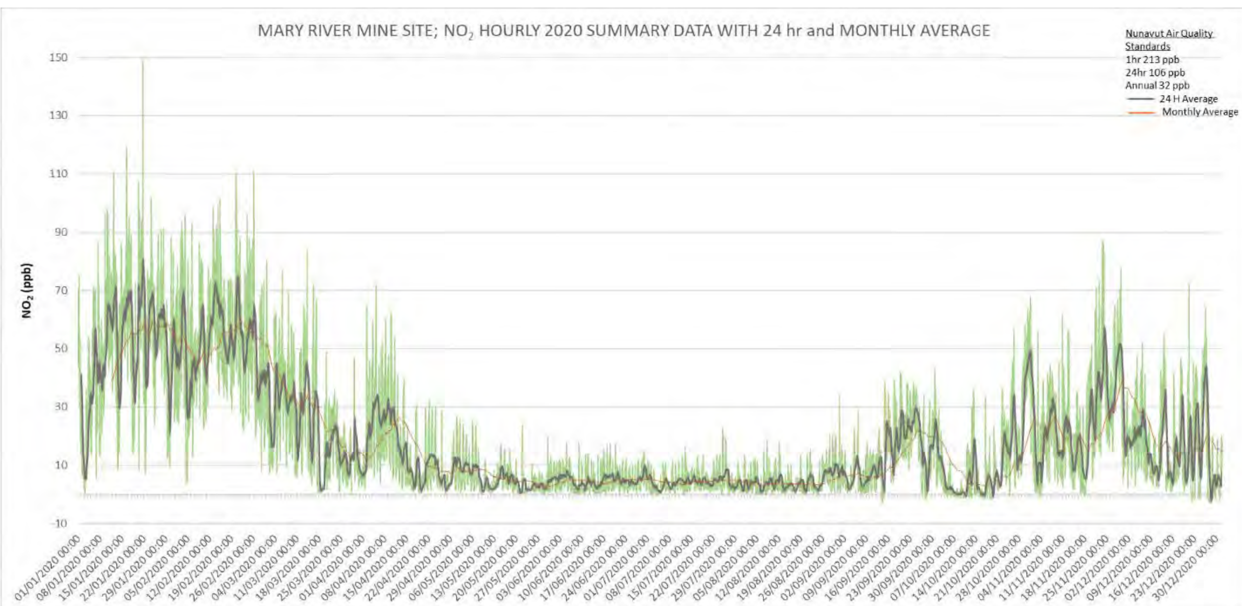


Figure 2-9 MSC Hourly NO_2 data with 24hr and Monthly Average trends

[5] Mary River data based on 98th percentile of data values; derived from 7845 and 8665 valid data points for SO_2 and NO_2, respectively
[6] Mary River data based on 98th percentile of data values; derived from 7845 and 8665 valid data points for SO_2 and NO_2, respectively

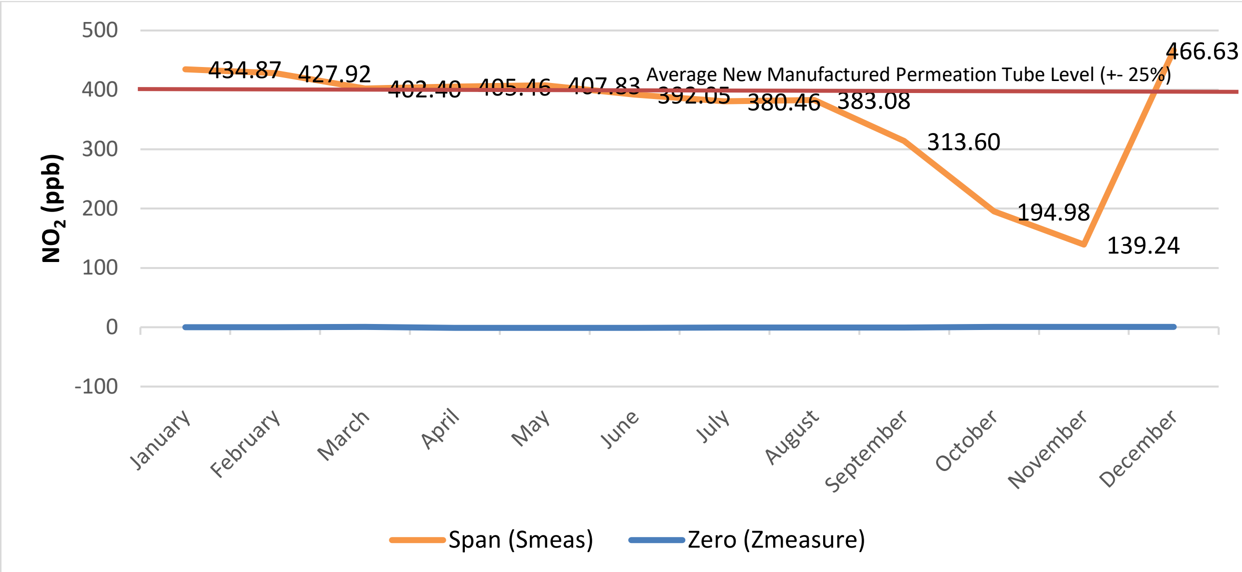


Figure 2-10 MSC Complex NO_2 Annual Permeation Tube Data Span/Zero

2.2.5.2 PSC

NO_2 data at the Milne Port Site Complex had 98.52% valid data for 2020 with a low of 96.25% for September due to an extended calibration cycle (Table 2-4). The NO_2 concentrations did not exceed the hourly (213 ppb), 24-hour (106 ppb) or annual (32 ppb) air quality objectives (GN 2011) with levels of 151.2 ppb, 72.4 ppb and 16.9 ppb respectively (Figure 2.11). The NO_2 concentrations exceeded the 1-hour CAAQS in 2% of the hourly averaged data (164[B] occurrences) with the highest average hourly maximum occurring on November 16, 2020 (148.5). The annual CAAQS mean was 16.9 ppb which is 99% of the annual CAAQS arithmetic mean.

Negative values present in the data reflect the level of zero air noise in the analyzer when the ambient gas concentrations are below analyzer detection limits.

The NO_2 concentrations were highest in the winter and lowest in the summer (Figure 2-2) consistent with historical trends (RWDI 2015, 2017, 2018).

NO_2 Span values remained consistent over the 2020 year with no noted spikes or data anomalies from permeation gas latency or extinction in the system. Permeation values for the tubes are lower than expected but the data remain consistent through calibration cycles (Figure 2-12), indicating that the analyzer is operating within manufacturer specifications.

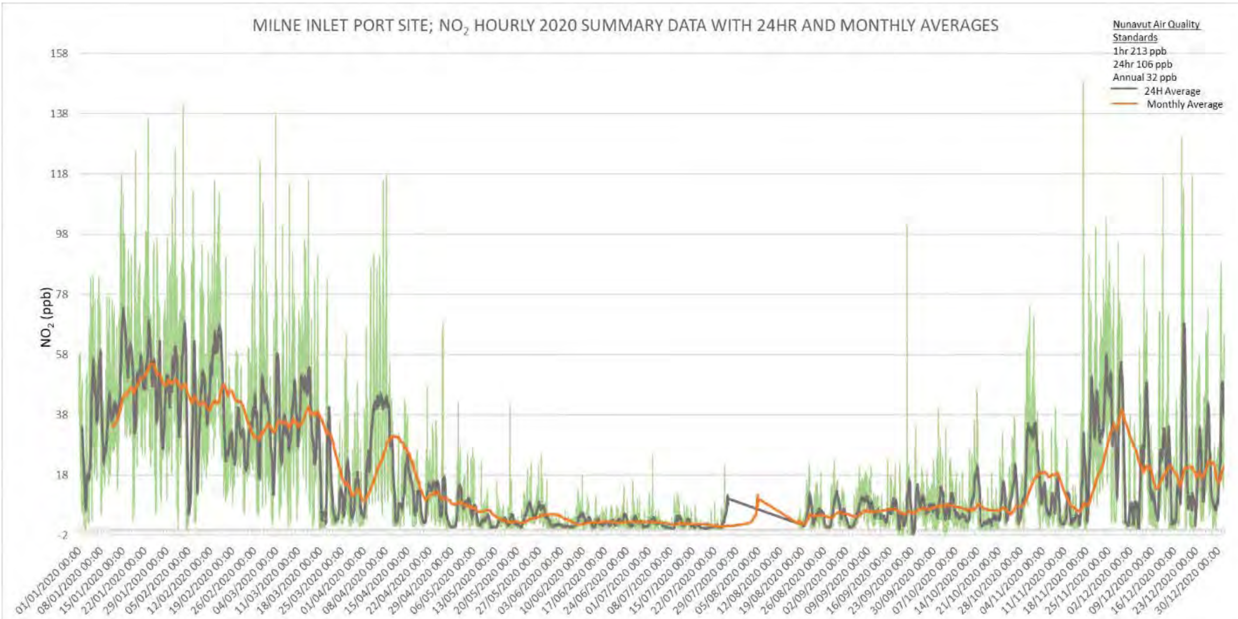


Figure 2-11 PSC Complex Hourly NO_2 data with 24 hour and Monthly Average Trends

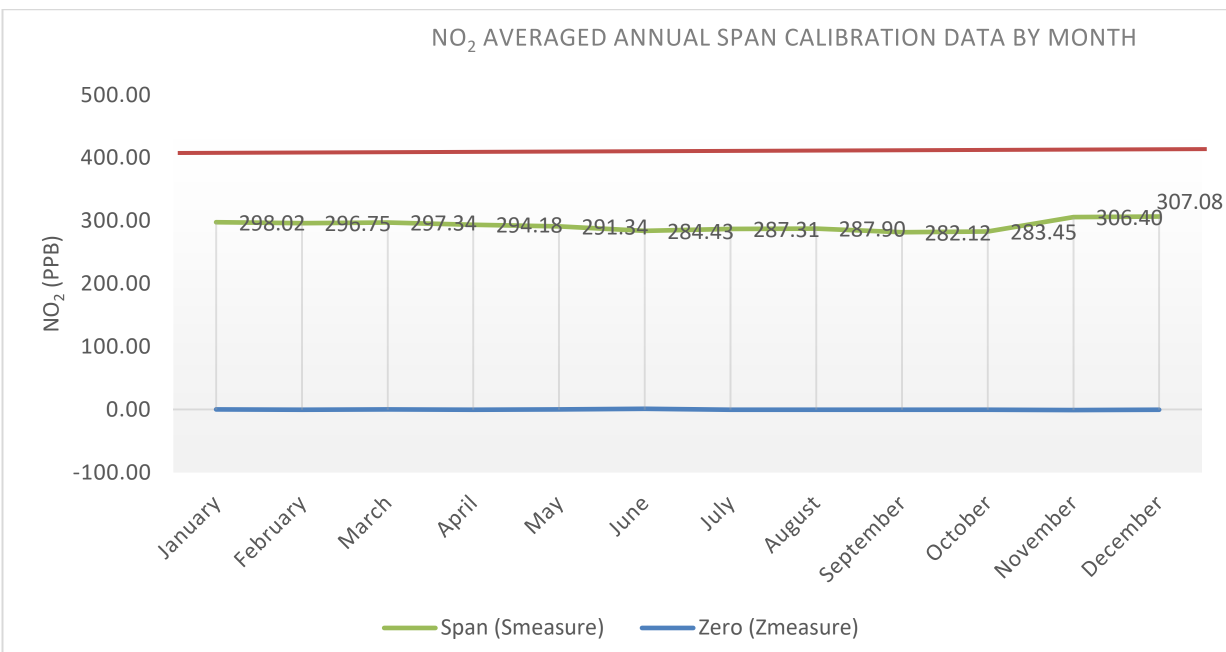


Figure 2-12 PSC Complex NO_2 Annual Permeation Tube Data Span/Zero (red horizontal line indicates the average new manufactured perm tube level ± 25%)

3 DUSTFALL

The dustfall monitoring program used a total of 39 passive dustfall collectors in 2020 to measure dust deposition related to Project activities, following the same methodology and analysis as in previous years (EDI 2021). Twenty-six (26) of these collectors are changed out monthly, while the rest are changed out during summer months due to their remote location. Figure 1-1 shows the location of the 2020 dustfall monitoring stations at the Mine Site. Figure 1-2 shows the location of the 2020 dustfall monitoring stations at Milne Port.

The methodology, including analytical methods for the passive dustfall monitors, is described in the 2020 TEAMR prepared by Environmental Dynamics Inc. (EDI 2021). EDI (2021) summarized the magnitude and extent of the 2020 dustfall, seasonal comparisons, and the inter-annual trends for seasonal and total annual dustfall. The purpose of this chapter is to review the 2020 dustfall results presented by EDI (2021) and determine what correlations can be made with the 2020 meteorology data. The two meteorology parameters that have the most influence on the generation of fugitive dust and dustfall are wind speed and rain precipitation.

Within the Early Revenue Program Final Environmental Impact Statement, annual TSP rates predictions were developed with input from the results of the dust dispersion models, existing literature related to air quality guidelines and dust deposition, and similar dust monitoring programs in place at other northern mines:

Low: 1 to 4.5 g/m²/year

Moderate: 4.6 to 50 g/m²/year

High: ≥50 g/m²/year

The results of the 2020 dustfall sampling program for monitoring site with year-round data collection were converted from units of mg/dm²·day to g/m²/year. They were compared with the modelled dust deposition isopleths for the Project to determine if deposition rates exceed the predicted range. Data for each month were converted to g/m²/day, and then summed to add up to one year (EDI 2021).

Dustfall magnitude was high near Milne Port, the Mine Site, and Tote Road infrastructure, and generally low in the surrounding area. The areas with the greatest dustfall deposition are restricted to mainly within 1,000 m of the PDA; an investigation of dustfall at 12 monitoring stations 1,000 m distant from the PDA indicates that dustfall was low throughout 2020. Future monitoring will continue to investigate dustfall at the 39 monitoring locations through the summer and a subset of 22 year-round monitoring stations (EDI 2021).

The general correlations between the 2020 dustfall data and the meteorological conditions (e.g., wind speed and rain precipitation) are discussed below.

3.1 Results and Discussion

The 2020 dustfall data trends and statistical analysis were summarized by EDI 2021 for four areas within the regional study area:

- Mine Site
- Milne Port
- Tote Road North crossing (km 28), and
- Tote Road South crossing (km 28)

The general relationship between the 2020 dustfall results for these four areas are discussed below in the context of 2020 wind speed and rain precipitation data collected at the Mary River and Milne Port automated meteorology stations. In general, dustfall deposition rates did not respond consistently to the changing seasonal wind speed and rain precipitation conditions.

3.1.1 Mine Site

Fugitive dust arises from mechanical disturbance of granular material exposed to the air. Dust generated from open sources is termed “fugitive” because it is not discharged to the atmosphere in a confined flow stream. Fugitive dust is generated by:

- pulverization and abrasion of surface materials by application of a mechanical force (e.g., wheels, blades), or
- entrainment of dust particles by the action of turbulent air currents (e.g., wind erosion of an exposed surface by wind speeds greater than 5.3 m/s) (US EPA 1995).

Common sources of fugitive dust include unpaved roads, blasting, and wind erosion of open storage piles. Fugitive dust results in suspended particulate matter in the atmosphere which, under the effects of gravity, settles to the earth’s surfaces as dustfall. Rain precipitation provides natural mitigation for the fugitive dust generated by Mine Site vehicle traffic and from open sources that are subject to wind erosion (e.g., storage piles). Snow on the surfaces of unpaved roads and open storage piles also provides natural mitigation for fugitive dust and dustfall.

The 2020 daily dustfall deposition rates at the Mine Site monitoring stations showed peaks during April and September and the rates were substantially lower for the other months (Figure 6-6 in EDI 2021). No rain was recorded at the Mary River meteorology station during April 2020; however, 0.8 mm of rain was recorded during September 2020. Hence, the two months for the peak dustfall rates were dry; however, it should be noted that the Mary River meteorology station does not have the ability to measure snow depth or snow-water-equivalent (SWE) precipitation, so the total precipitation is unknown for April 2020. The daily maximum air temperature for April 2020 was -0.4°C therefore it is highly unlikely that rain occurred. The daily dustfall deposition rates for the Mine Site monitoring stations were relatively low for June 2020 which recorded 46.8 mm of precipitation. The elevated dustfall during September 2020 could partially be attributed to dry conditions and the lower dustfall during June 2020 could partially be attributed to 46.8 mm of rain. However, due to the lack of total precipitation data, no correlation can be made with the elevated dustfall in April 2020.

The elevated dustfall levels during April and September 2020 did not correlate with elevated wind speeds. The average wind speeds at the Mary River meteorology station during April and September 2020 (2.8 and 2.6 m/s, respectively) were less than the annual average (3.2 m/s). The month with the greatest average wind speed (July 2020, 3.8 m/s) did not coincide with elevated dustfall rates. Similarly, the maximum monthly wind speeds recorded at the Mary River meteorology station did not coincide with the months with elevated dustfall rates (April and September). Hence, the Mine Site monthly dustfall rates did not correlate well with the 2020 average and maximum monthly wind speeds.

3.1.2 Milne Port

The 2020 monthly dustfall values recorded by the Milne Port monitoring stations displayed the same trend as the Mine Site dustfall stations with elevated values during April and September (Figure 6-6 in EDI 2021). Like the Mine Site, the elevated April and September dustfall rates for the Milne Port monitoring stations corresponded with low monthly rainfall at the Milne Port meteorology station. Lower rates of dustfall were recorded by the Milne Port dustfall stations during June and July when there was rainfall recorded at the Milne Port meteorology station (31.0 and 20.9 mm, respectively). The elevated dustfall during September 2020 could partially be attributed to dry conditions and the lower dustfall during June and July 2020 could partially be attributed rain and the corresponding natural mitigation for fugitive dust. The Milne Port meteorology station does not record SWE precipitation which is needed to calculate total precipitation. Due to the lack of total precipitation data, no correlation can be made with the elevated dustfall rates in April 2020 for the Milne Port monitoring stations.

The elevated dustfall levels during April and September 2020 did not correlate with elevated wind speeds. No wind speed data was available at the Milne Port meteorology station for January to August 2020. The average wind speed at the Milne Port meteorology station during September 2020 (3.5 m/s) was less than the four-month (September to December) average (5.0 m/s). The month with the greatest average wind speed (November 2020, 5.6 m/s) did not coincide with elevated dustfall rates. Similarly, the maximum wind speeds recorded at the Milne Port meteorology station for September to December 2020 did not coincide with the month with an elevated dustfall rate (September). Hence, there was no correlation between the 2020 average monthly and maximum wind speeds and the Milne Port monthly dustfall rates.

3.1.3 Tote Road North Crossing

The Tote Road North Crossing dustfall stations showed the same trend as the Mine Site and Milne Port dustfall stations, with elevated values during April and September 2020 (Figure 6-6 in EDI 2021). The closest meteorology station to the Tote Road North Crossing is at Milne Port. Hence, the discussion presented in section 3.1.2 for Milne Port is also applicable to the Tote Road North Crossing dustfall stations.

3.1.4 Tote Road South Crossing

The Tote Road South Crossing dustfall stations showed the same trend as the Mine Site and Milne Port dustfall stations, with elevated values during April and September 2020. The closest meteorology station to the Tote Road North Crossing is at the Mine Site. Hence, the discussion presented in section 3.1.1 for the Mine Site is also applicable to the Tote Road South Crossing dustfall stations.

4 METEOROLOGY

The Mary River, Milne Port, and Steensby meteorology stations are equipped to collect a suite of measurements, which are summarized in Table 4-1. Additionally, the measurements provided at the Pond Inlet Airport Climate Station are also summarized. In general, each station provides measurements of ambient temperature, relative humidity, rain precipitation, and wind speed/direction.

Additionally, the meteorology stations at Mary River, Milne Port, and Steensby record measurements of solar radiation. Although the climate station at the Pond Inlet Airport does not collect solar radiation data, the three (3) meteorology stations at the Project can be compared to each other. The data collected from the meteorological stations are used to establish an ongoing climatic record in key project areas.

Table 4-1 Summary of Data Collected at Each Baffinland Meteorology Station and the Pond Inlet Airport Climate Station

Station	Temperature	Relative Humidity	Rainfall Precipitation	Solar Radiation	Wind Speed/Wind Direction
Mary River Meteorology Station	x	x	x	x	x
Milne Port Meteorology Station	x	x	x	x	x
Steensby Meteorology Station	x	x	x	x	x
Pond Inlet Airport Climate Station	x	x	x		x

4.1 Methods

The three (3) meteorology stations at the Project are each equipped with a datalogger and a number of sensors, which are consistent across the three (3) sites as indicated in Table 4-1. Campbell Scientific Canada provided annual meteorology station maintenance services up until 2020. A summary of the probes currently installed at each site is provided in Table 4-2.

Each meteorology station is equipped with an enclosure that stores the datalogger, charger, and communications hardware. The enclosure is sealed after maintenance and contains a desiccant to prevent the buildup of moisture. The datalogger receives input from the sensors, which are stored and synched with offsite data storage via satellite communications (Campbell Scientific Canada 2015).

Table 4-2 Summary of Data Collection Equipment at Each Baffinland Meteorology Station

Station	Sensors	Datalogger	Communications
Mary River Meteorology Station	HC2-S3-XT Rotronics Temp and Relative Humidity Probe	CR 1000-55	9522B Iridium Satellite Modem
	05108 RM Young Wind Monitor		COM9522B Satellite Modem Interface
	SP Lite2 Kipp & Zonen Solar Radiation Sensor		SC932A CS I/O Interface
	TE525M Texas Electronics Tipping Bucket Rain Gauge up to September 2020 then the SBS 500 Tipping Bucket Rain Gauge		
Milne Port Meteorology Station	HC2-S3-XT Rotronics Temp and Relative Humidity Probe	CR 1000-55	9522B Iridium Satellite Modem
	05108 RM Young Wind Monitor		COM9522B Satellite Modem Interface
	SP Lite2 Kipp & Zonen Solar Radiation Sensor		SC932A CS I/O Interface
	TE525M Texas Electronics Tipping Bucket Rain Gauge up to September 2020 then the SBS 500 Tipping Bucket Rain Gauge		
Steensby Meteorology Station	HC2-S3-XT Rotronics Temp and Relative Humidity Probe	CR 1000-55	9522B Iridium Satellite Modem
	05108 RM Young Wind Monitor		COM9522B Satellite Modem Interface
	SP Lite2 Kipp & Zonen Solar Radiation Sensor		SC932A CS I/O Interface
	TE525M Texas Electronics Tipping Bucket Rain Gauge up to September 220 then the SBS 500 Tipping Bucket Rain Gauge		

The gathered data were post processed to provide monthly averages for the 2020 year. These datasets were then compared to the Canada Climate Normals, which are a set of monthly averages taken across a 30-year span beginning in 1981 and ending in 2010. This comparison provides context for year-over-year trends when compared to the 2020 dataset.

Additionally, ECCC provides guidance on data gathering and completeness for each type of data monitored. Data that do not adhere to the completeness standards can still be reported but will receive a code. In general, data with code A adhere to the listed completeness criteria, data with code B contain at least 25 years (83% of the 30-year climate normal data requirement), data with code C contain at least 20 years (67% of the 30-year climate normal data requirement), and data with code D contain at least 15 years (50% of the 30-year climate normal data requirement). For reference, the Climate Normals for Pond Inlet Airport are predominantly code C. Data that do not adhere to code A are noted in the tabulated results.

4.1.1 Quality Assurance and Quality Control

Table 4-3 summarizes the annual 2020 maintenance work completed for the three (3) Baffinland meteorological stations and the tasks that could not be completed and require additional work.

Table 4-3 Summary of the 2020 Annual Maintenance Completed for the Meteorological Stations

Meteorology Station	Maintenance Completed	Maintenance not completed and requiring additional work
Mary River	• Removed the TE525M tipping bucket rain gauge (TBRG) and replaced it with the model SBS 500 TBRG. • Removed the Kipp & Zonen SP Lite2 solar radiation sensor and replaced with a new Kipp & Zonen SP Lite2 sensor. • Replaced the flange bearings for the RM Young 05108 AP wind monitor. • Uploaded and tested the new CR1000-55 datalogger program (supplied by Campbell Scientific) and confirm the accuracy of the latest version of the datalogger wiring diagram. • General maintenance and replaced desiccant in the datalogger enclosure box.	• Campbell Scientific provided the wrong replacement head for the Rotronic HC2-S3 temperature and relative humidity sensor in September 2020. A new HC2-S3 sensor including cable arrived at site in early November 2020. • The Baffinland staff installed the new HC2-S3 sensor and cable on November 2, 2020. Given the uncertainty of the air temperature data a different HC2-S3 sensor and cable were installed on February 26, 2021.
Milne Port	• Removed the TE525M tipping bucket rain gauge (TBRG) and replaced it with the SBS 500 TBRG. • Removed the Kipp & Zonen SP Lite2 solar radiation sensor and replace with a new Kipp & Zonen SP Lite2 sensor. • Removed the RM Young 91000 ultrasonic anemometer (wind sensor) and installed a new RM Young 05108 AP wind monitor. • Uploaded and tested the new CR1000-55 datalogger program (supplied by Campbell Scientific) and confirmed the accuracy of the latest version of the datalogger wiring diagram. • General maintenance and replaced the desiccant in the datalogger enclosure box.	• Campbell Scientific provided the wrong replacement head for the Rotronic HC2-S3 temperature and relative humidity sensor in September 2020. • A new HC2-S3 sensor and cable arrived on site in early November 2020. Baffinland environmental staff will install it during the next site visit for maintenance. This station is remote and only accessible by helicopter. Hence, the new HC2-S3 sensor and cable will be installed when a helicopter returns to site in spring 2021. • The new RM Young 05108 AP wind speed and direction sensor was not oriented correctly to true north. During the next site visit for maintenance, the wind direction sensor will need to be rotated 180 degrees from its current position. The wind direction readings that are currently being recorded are being adjusted by 180 degrees. This station is remote and only accessible by helicopter. Hence, the wind direction sensor will be corrected when a helicopter returns to site in spring 2021.

Table 4-3 Summary of the 2020 Annual Maintenance Completed for the Meteorological Stations

Meteorology Station	Maintenance Completed	Maintenance not completed and requiring additional work
Steensby	• Removed the TE525M tipping bucket rain gauge (TBRG) and replaced it with the SBS 500 TBRG. • Removed the Kipp & Zonen SP Lite2 solar radiation sensor and replaced it with a new Kipp & Zonen SP Lite2 sensor. • Replaced the flange bearings for the RM Young 05108 AP wind monitor. • Uploaded and tested the new CR1000-55 datalogger program (supplied by Campbell Scientific) and confirmed the accuracy of the latest version of the datalogger wiring diagram. • General maintenance and replaced the desiccant in the datalogger enclosure box.	• Campbell Scientific provided the wrong replacement head for the Rotronic HC2-S3 temperature and relative humidity sensor. A new HC2-S3 sensor and cable was ordered and delivered to site in early November 2020. • This station is remote and only accessible by helicopter. Hence, the new HC2-S3 sensor and cable will be installed when a helicopter returns to site in spring 2021.

4.2 Results and Discussion

The meteorology stations are situated in the Northern Arctic Ecozone. The climate is semi-arid with relatively little precipitation. Monthly mean temperatures at long-term ECCC climate stations range from approximately -34ºC in February at Pond Port to about 7ºC in July at Igloolik. Mean monthly precipitation at long-term ECCC climate stations range from 4 mm in February at Pond Port, Hall Beach and Nanisivik, to about 64 mm in August at Dewar Lakes. Variability in precipitation at the long-term ECCC stations ranges from about 5 mm in January to about 30 mm in August (Baffinland 2018).

Generally, snow melt occurs in late June and frost–free conditions last until late August. The onset of snow melt usually begins around mid to late June where temperatures were consistently above 0ºC. Following the onset of snow melt, air temperatures rise, and the amount of daylight increases, triggering plant growth and green-up (Baffinland 2018).

The meteorology results compare the 2020 data received at each meteorology station with the Pond Inlet Airport Climate Station and the Canadian Climate Normal.

4.2.1 Air Temperature

Summaries of the monthly averages for the daily minimum, daily maximum and average temperatures are presented in Table 4-4, Table 4-5, and Table 4-6, respectively. The trends are presented graphically in Figure 4-1, Figure 4-2, and Figure 4-3, respectively. Each of the Project meteorology stations is compared to the 2020 data retrieved from the Pond Inlet Airport Climate Station, as well as the Canadian Climate Normal data (taken from Pond Inlet Airport).

ECCC recommends that a climatological day be taken from 6:00 UTC one day to 6:00 UTC the following day. For the site of interest (and for a large portion of Canada), one climatological day will start at approximately midnight one (1) day and end at midnight the following day (ECCC 2021).

For the daily minimum temperature, the lowest temperature recorded over the climatological day was taken as the value for that day, and the daily maximum temperature was the highest temperature recorded over the climatological day. For a given month, the average daily minimum and maximum temperatures were taken as the average of the daily values. Currently, all three (3) stations (Milne Port, Steensby, and Mary River) record an hourly minimum and maximum reading. Under these circumstances, the daily minimum and maximum values were taken from the hourly minimum and maximum values over the course of the climatological day. For the average temperature, the hourly temperature averages are averaged over the entire month of interest.

ECCC defines data completeness for the Canadian Climate Normal by the 3-and-5 rule (ECCC 2021). Months with more than three (3) consecutive days without data or more than five (5) total days without data are considered incomplete. In Table 4-4, Table 4-5, and Table 4-6, stations with incomplete data (or no data) are noted based on these criteria.

For the Steensby meteorology station, there were excessively low temperatures that resulted from an incorrect offset (-50°C compared to -40°C). This error has been corrected as of February 2021. The data reported has been adjusted up by 10°C to correct the offset.

For the Mary River meteorology station, the root cause of abnormally high 2020 air temperatures are being investigated. Currently, it appears that the datalogger programming for the air temperature sensor was correct, since it agrees with the user manual written by Campbell Scientific. A new air temperature sensor was installed at the Mary River meteorology station on February 26, 2021 and is being tested.

The results indicate that the temperatures at each station follow the same general trend, which is comparable with the Canadian Climate Normal for the Pond Inlet Airport. Peak low temperatures occur during the early part of the year (January and February), with peak high temperatures occurring during July. The recorded temperatures for Steensby and Milne Port meteorology stations, as well as the Pond Inlet Airport climate station, fall below the climate normal during peak cold months (January and February), while remaining at or above the climate normal during the rest of the year.

Knight Piesold provided a meteorological data summary for the years between 2006 and 2015 (Knight Piesold 2016) for Mary River and Milne Port. Their data had a similar trend to the climate normal, with the lowest temperature occurring in January or February, and the highest temperature occurring in July. At Milne Port, the lowest recorded temperature was -44.2°C in February, and the highest recorded temperature was 22.3°C in July (for the 2006-2015 summary). At Mary River, the lowest recorded temperature was -46.0°C in January and the highest recorded temperature was 22.8°C in July (for the 2006-2015 summary).

The 2018 and 2019 EDI TEAMR reported that Project temperatures tended to be coldest in February and warmest in July. While this is not exactly reflected in the 2020 Project air temperatures, the January – February region is usually the coldest while July is the warmest. At Milne Port, the lowest temperature recorded was -44.4°C in February 2018 and -50.2°C in February 2019, compared to -46.9°C in February 2008 (baseline conditions, 2005–2010) (EDI 2018). The warmest temperature recorded was 18.7°C in July 2018 and 10.7°C in July 2019, compared to 22.3°C in July 2009 (baseline conditions, 2005–2010). At Mary River, the lowest temperature recorded was -45.8°C in February 2018 and -40.3°C in January/February, compared to -70.0°C in April 2010 (baseline conditions, 2005–2010). The warmest temperature recorded was 19.4°C in July 2018 and 21.3°C in July 2019, compared to 22.8°C in July 2009 (baseline conditions, 2005–2010).

The inter-year trends noticed by EDI were colder air temperatures at Milne Port during the summer and winter during 2019. From the 2006–2015 summary by Knight Piesold, the lowest temperatures at Milne Port are within the same range through 2018 and 2019, with a general trend towards colder temperatures. However, in 2020 the lowest temperature rises to -45.5°C during January. The highest temperature recorded in 2020 was 22.6°C in July, which compares well with the baseline provided by EDI and the summary by Knight Piesold. However, when compared to the 2019 and 2018 values it is warmer.

At Mary River, the temperatures were warmer during the winter and similar during the summer when compared to the baseline during 2019. From the 2006–2015 summary by Knight Piesold, the lowest temperatures at Mary River are within the same range through 2018 and 2019, with a general trend towards warmers temperatures. For 2020, the lowest temperature increased to -40.1°C during January, which continues the trend. The highest temperature recorded in 2020 was 33.0°C in July. It marks a noticeable departure from the consistent trend over 2019 and both the baseline and the meteorology summary.

The trend values for the lowest and highest temperatures are summarized in Table 4-7, and Table 4-8.

Table 4-4 Summary of Daily Minimum Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

Station	Daily Minimum Temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a]	-31.8	-31.2	-24.1	-13.1	-0.7	12.1	20.0	14.6	4.8	-0.2	-17.4	-14.9	-6.8
Milne Port Meteorology Station [a]	-38.0	-37.3	-32.8	-21.3	-10.6	1.8	8.2	4.2	-3.2	-9.1	-25.4	-25.7	-15.8
Steensby Meteorology Station [a]	-38.0	-38.5	-33.5	-25.2	-12.2	-0.9	4.7	4.1	-4.5	-6.3	-22.5	-23.5	-16.4
Pond Inlet Airport Climate Station [b,c]	-36.8	-36.3	-32.1	-21.2	-9.9	1.2	5.1	3.5	-2.9	-7.4	-21.7	-25.1	-15.3
Pond Inlet Airport Climate Station [c]	-36.7	-37.1	-33.6	-26.1	-13.2	-0.6	2.7	1.7	-3.4	-12.9	-25.2	-31.8	-18.0

Note: [a] based on 2020 hourly data; [b] data incomplete in May; [c] based on 1981 to 2010 Climate normal data

Table 4-5 Summary of Daily Maximum Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

Station	Daily Maximum Temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a]	-23.0	-23.2	-13.5	-0.4	6.3	17.9	27.0	21.1	11.4	6.1	-7.4	-6.1	1.4
Milne Port Meteorology Station [a]	-32.4	-32.1	-25.3	-14.3	-5.4	7.1	15.2	9.2	0.3	-4.6	-19.1	-19.0	-10.0
Steensby Meteorology Station [a]	-32.4	-33.4	-25.3	-14.9	-5.4	4.1	12.3	9.3	2.2	-2.4	-15.4	-15.9	-9.8
Pond Inlet Airport Climate Station [b,c]	-32.2	-32.4	-26.2	-15.6	-5.4	5.8	12.1	8.6	0.7	-3.3	-16.5	-18.8	-10.3
Pond Inlet Airport Climate Station [c]	-30.0	-30.2	-26.2	-17.6	-5.3	5.2	10.5	7.8	1.8	-6.4	-17.8	-24.5	-11.1

Note: [a] based on 2020 hourly data; [b] data incomplete in May; [c] based on 1981 to 2010 Climate normal data

Table 4-6 Summary of Average Daily Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station.

Station	Daily Average Temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a]	-27.5	-27.4	-18.7	-6.5	2.9	15.0	23.5	17.9	8.4	3.2	-12.7	-10.4	-2.7
Milne Port Meteorology Station [a]	-35.3	-34.7	-29.3	-17.9	-7.9	4.4	11.5	6.6	-1.4	-6.8	-22.1	-22.4	-13.0
Steensby Meteorology Station [a]	-35.6	-36.5	-29.4	-19.9	-8.5	1.6	8.3	6.2	0.4	-4.4	-19.0	-19.3	-13.0
Pond Inlet Airport Climate Station [b,c]	-34.7	-34.5	-29.0	-18.0	-7.4	3.5	8.7	6.3	-0.8	-5.0	-19.0	-22.1	-12.7
Pond Inlet Airport Climate Station [c]	-33.4	-33.7	-30.0	-21.9	-9.3	2.4	6.6	4.8	-0.8	-9.7	-21.7	-28.2	-14.6

Note: [a] based on 2020 hourly data; [b] data incomplete in May; [c] based on 1981 to 2010 Climate normal data

Table 4-7 Summary of Lowest Temperature Trends at the Baffinland Meteorology Stations

Station	Minimum Temperature (°C)				
	2005 – 2010 Baseline [a]	2006 -2015 Summary [b]	2018[c]	2019[d]	2020[e]
Mary River Meteorology Station	-70.0	-46.0	-45.8	-40.3	-40.1
Milne Port Meteorology Station	-46.9	-44.2	-44.4	-50.2	-45.5

Note: [a] EDI, 2019; [b] Knight Piesold, 2016; [c] EDI, 2018; [d] EDI 2019; [e] taken from absolute minimum temperature

Table 4-8 Summary of Highest Temperature Trends at the Baffinland Meteorology Stations

Station	Maximum Temperature (°C)				
	2005 - 2010 Baseline [a]	2006 -2015 Summary [b]	2018 [c]	2019 [d]	2020 [e]
Mary River Meteorology Station	22.8	22.8	19.4	21.3	33.0 [f]
Milne Port Meteorology Station	22.3	22.3	18.7	10.7	22.6

Note: [a] EDI, 2019; [b] Knight Piesold, 2016; [c] EDI, 2018; [d] EDI 2019; [e] taken from absolute maximum temperature, [f] Mary River data are being further analyzed

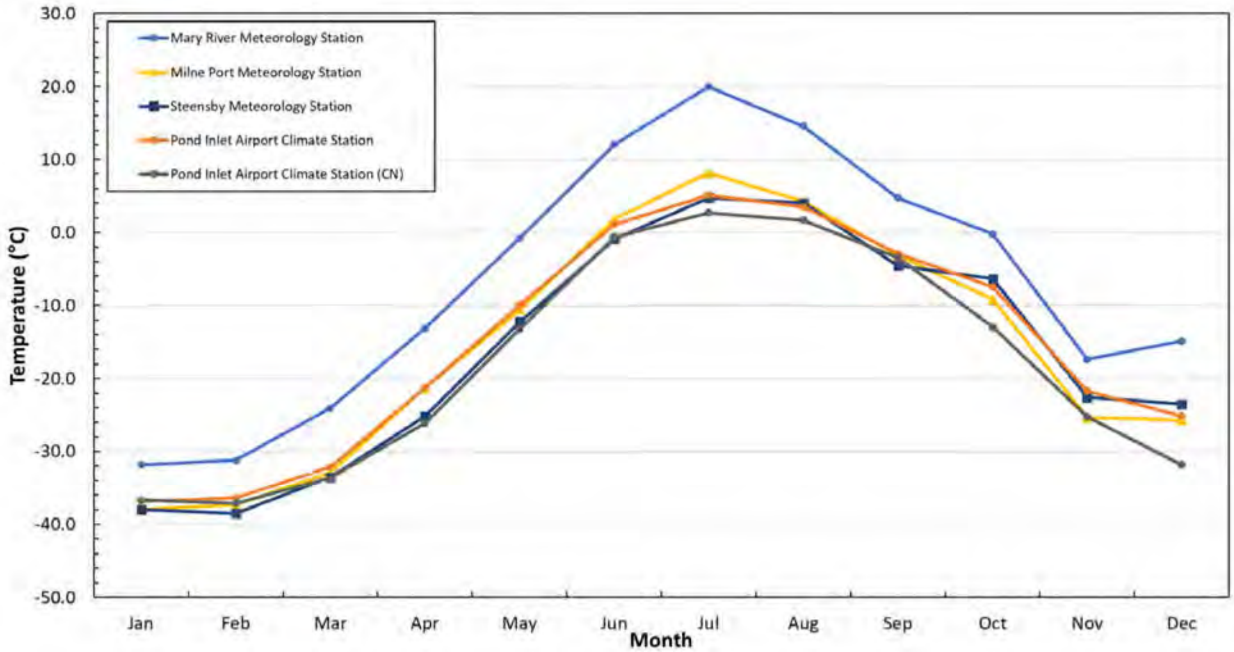


Figure 4-1 **Summary of Daily Minimum Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station**

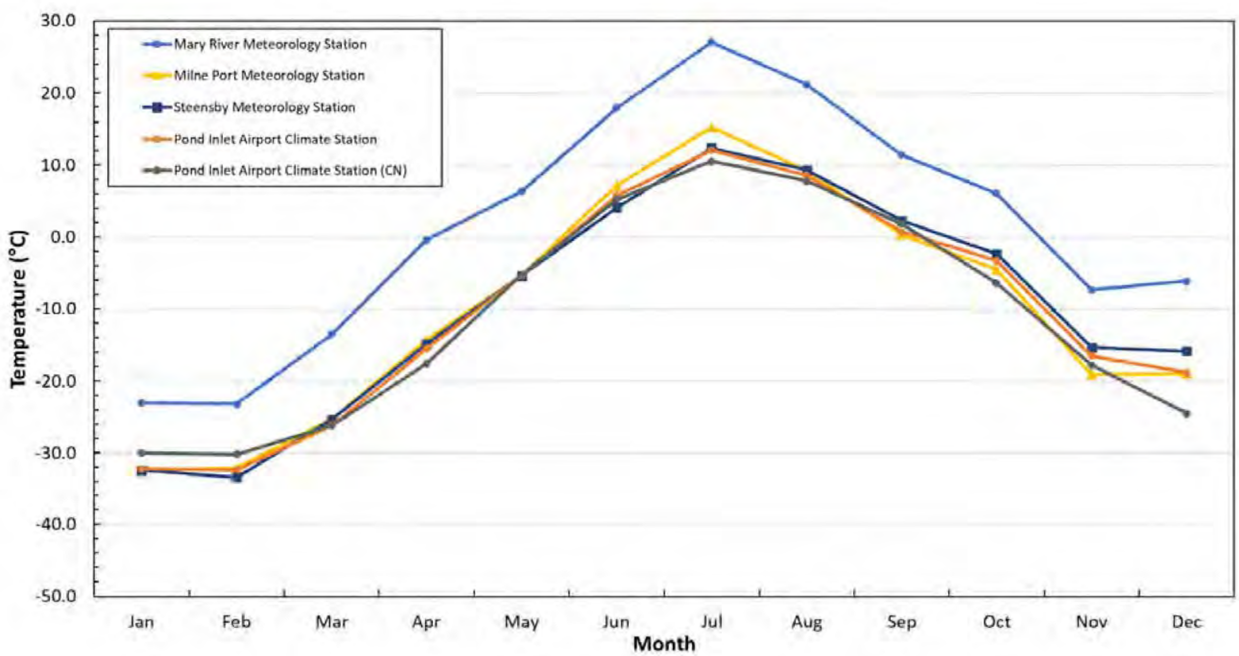


Figure 4-2 **Summary of Daily Maximum Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station**

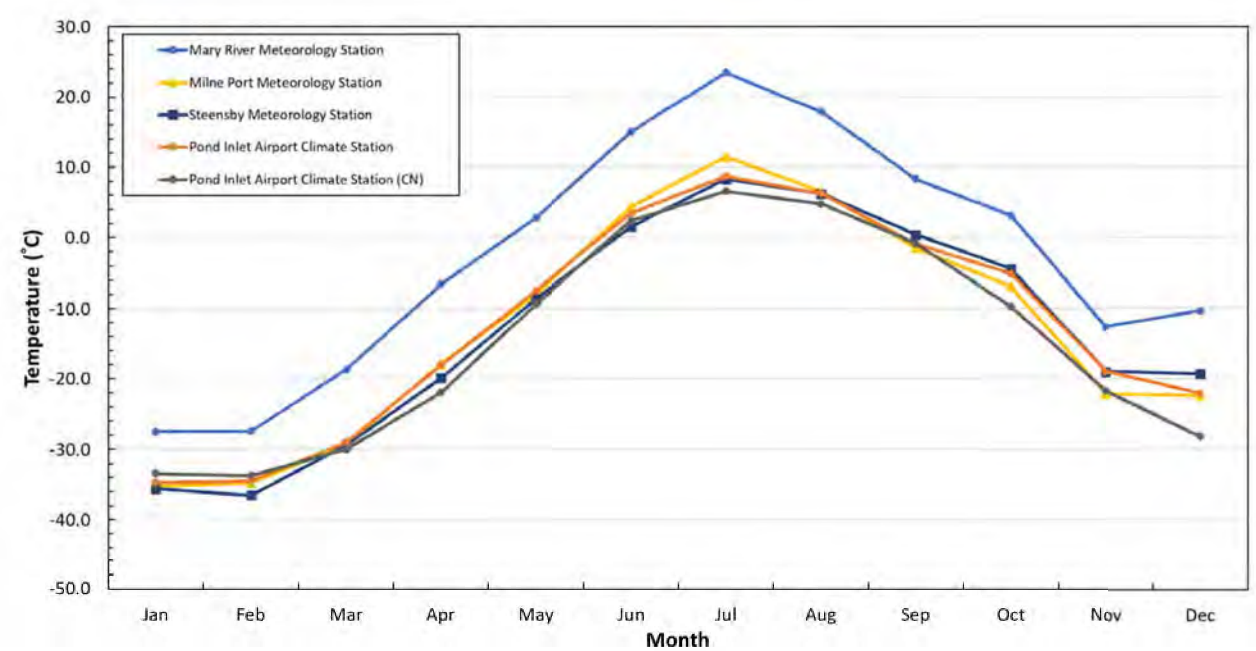


Figure 4-3 Summary of Average Daily Temperature at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

4.2.2 Relative Humidity

Summaries of the monthly averages for the relative humidity are presented in Table 4-9. The trends are presented graphically in Figure 4-4. Each meteorology station is compared to the 2020 data retrieved from the Pond Inlet Airport Climate Station, as well as the Canadian Climate Normals data (taken from Pond Inlet Airport).

The 2020 data from the three (3) meteorology stations and the data from the Pond Inlet Airport Climate Station were processed in the same way. The hourly relative humidity data was averaged by month. For the Climate Normals data, however, only the relative humidity at 6:00 LST and 15:00 LST are provided. In this case, the average was taken between the two (2) values and presented.

ECCC defines data completeness for the Canadian Climate Normals by a 90% completeness of hourly data per month (ECCC 2021). In Table 4-9, stations with incomplete data (or no data) are noted based on this criterion.

The results indicate that there was not much variation in the relative humidity over the course of the 2020, with the minimum average value approximately 65%, and the maximum at 89%. High relative humidity is common on islands and near the coastline. In general, the trends presented at the meteorological stations tend to match the Climate Normal, with higher values around spring and early summer (May and June), and then again in the fall (September and October). The values are clustered around the Climate Normal and are likely due to variations of terrain and elevation at individual sites.

The data provided for 2006–2015 by Knight Piesold (2016) indicated a more humid winter (January through March), with relative humidity at 71.3% and 74.4% in January for Mary River and Milne Port, respectively. This trend continued into spring, with relative humidity of 71.3% and 76.8% in April for Mary River and Milne Port, respectively. Summer humidity was fairly consistent, with the exception of August, in which the relative humidity was 77.8% and 78.7% for Mary River and Milne Port, respectively. Compared to the historical data, the trends presented in 2020 provide a good match.

Table 4-9 Summary of Average Relative Humidity at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

Station	Relative Humidity (%)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mary River Meteorology Station [a]	65.4	65.5	66.1	66.8	74.3	75.6	66.9	70.2	76.4	77.0	72.1	68.4	70.4
Milne Port Meteorology Station [a]	68.7	69.7	69.7	68.7	75.1	76.7	70.3	74.8	79.5	80.2	76.3	74.3	73.7
Steensby Meteorology Station [a]	70.9	69.8	71.3	75.8	80.4	88.9	80.9	81.8	79.0	82.1	80.4	76.9	78.2
Pond Inlet Airport Climate Station [a,b]	70.7	71.7	73.6	78.0	82.4	85.2	79.1	80.9	82.0	86.9	80.1	80.4	79.3
Pond Inlet Airport Climate Station [c]	65.1	65.4	65.3	70.7	79.6	78.8	76.6	79.4	79.9	80.5	72.4	67.3	73.4

Note:
[a] based on 2020 hourly data; [b] data incomplete for May; [c] based on 1981 to 2010 Climate normal data, with the average taken between the relative humidity at 0600 LST and 1500 LST

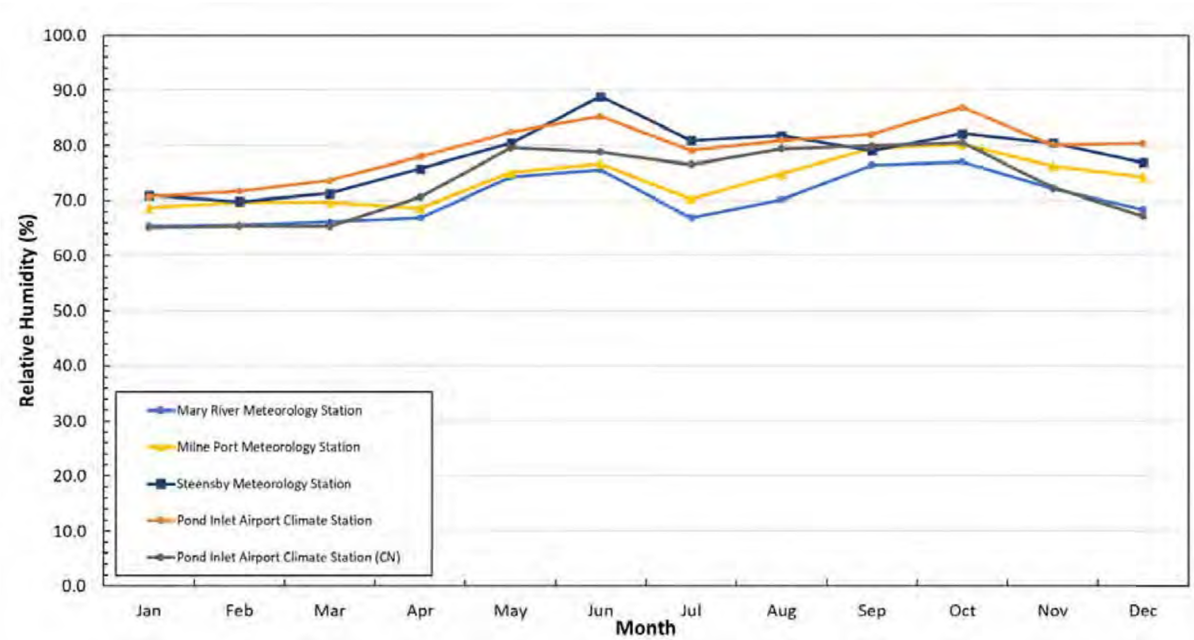


Figure 4-4 **Summary of Average Relative Humidity at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station**

4.2.3 Rain Precipitation

Summaries of the monthly totals for the rainfall are presented in Table 4-10. The trends are presented graphically in Figure 4-5. Each meteorology station is compared to the 2020 data retrieved from the Pond Inlet Airport Climate Station, as well as the Canadian Climate Normals data (taken from Pond Inlet Airport).

The data from the three (3) meteorology stations and the 2020 data from the Pond Inlet Airport Climate Station were processed in the same way. The hourly rainfall quantity was summed for each day, and then for each month. In the case where comments or flags in the data were provided, hours with snow were neglected since the sensors were not designed to measure SWE precipitation.

ECCC defines data completeness for the Canadian Climate Normals by a 100% completeness of hourly data per month (ECCC 2021). In Table 4-10, stations with incomplete data (or no data) are noted based on this criterion.

The results indicate that rain tends to fall between May and October, which was consistent with periods without snowfall. These results were similar to those presented by the Climate Normals for the region. For the Steensby meteorology station, the annual total is close to the Climate Normal. However, at the Pond Inlet Airport Climate Station the annual total rainfall was lower in 2020, which was consistent with the values presented at the Milne Port and Mary River meteorology stations.

Based on the results from the 2019 TEAMR, the baseline for Baffin Island is a wet July and August, which seems to be true for Steensby and the Pond Inlet Airport. Milne Port had rainfall beginning in June, and lasting through July, while Mary River only had rain in June. The low levels of rainfall seem to be consistent with trends noted by the ECCC (Baffinland 2018).

However, the 2019 TEAMR lists total days with rainfall at Milne Port as forty (40) days in 2006, 25 days in 2007, 26 days in 2008, and 51 days in 2019. The total rainfall in 2019 was 156.6 mm, with the highest baseline value was 221 mm in 2006. The maximum amount of rainfall occurred on August 30, 2019, with a total rainfall of 16.7 mm. The baseline value maximum is 40.2 mm on September 2, 2006. Despite the total amount of rain in 2020 being 52.4 mm, there were only eight (8) total days of rain, which indicates that very little rain was seen in 2020. The maximum rainfall occurred on July 15, with 20.9 mm of rain. This value accounts for almost half the rainfall quantity. It is noted that the rainfall gauges were changed out in 2020, so these readings may not be accurate since due to previously documented issues with the previous tipping bucket rain gauge model. The funnels on the older Texas Electronic tipping bucket rain gauges were known to have blown off in strong winds. The rainfall at the Pond Inlet Airport was also low in 2020, so the year might have been dry. However, the Pond Inlet Airport recorded 28 days of rain, which was in line with the lower levels of rain observed in the baseline data collected by EDI.

Additionally, the 2019 TEAMR lists the total days with rainfall at Mary River as 46 days in 2005, 53 days in 2006, 34 days in 2007, 27 days in 2008, 51 days in 2009, and 64 days in 2019. The total rainfall in 2019 was 152.5 mm, with the highest baseline value not given. The maximum amount of rainfall occurred on June 18, 2019, with a total rainfall of 10.6 mm. The baseline value maximum is 32.8 mm on August 13, 2006. The total amount of rainfall in 2020 was 47.8 mm, across 22 days. The maximum rainfall in 2020 occurred on June 6, with 15.9 mm of rain. Compared to historical trends, the total rainfall seems low, although the maximum rainfall on June 6, 2020 compares well to 2019. The lower amount of total rainfall seems consistent with the Pond Inlet Airport, which was also low in 2020 compared to the climate normal. The total number of rainy days is also consistent with the Pond Inlet Airport, which had 28 days with rain.

Table 4-10 Summary of Total Rainfall at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station.

Station	Total Rainfall (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a,d]	0.0	0.0	0.0	0.0	0.0	46.8	0.0	0.0	0.8	0.0	0.0	0.0	47.6
Milne Port Meteorology Station [b,d]	0.0	0.0	0.0	0.0	0.2	31.0	20.9	0.0	0.3	0.0	0.0	0.0	52.4
Steensby Meteorology Station [d]	0.0	0.0	0.0	0.0	3.3	24.5	43.8	33.2	0.7	0.0	0.0	0.0	105.5
Pond Inlet Airport Climate Station [c,d]	0.0	0.0	0.0	0.0	0.2	9.8	17.0	28.8	0.7	0.0	0.0	0.0	56.5
Pond Inlet Airport Climate Station [e]	0.0	0.0	0.0	0.0	0.0	12.1	31.5	35.9	9.8	1.3	0.4	0.0	91.0

Note:
[a] data incomplete in December; [b] data incomplete in September; [c] data incomplete for May, June, July, November, December
[d] based on 2020 hourly data; [e] based on 1981 to 2010 Climate normal data

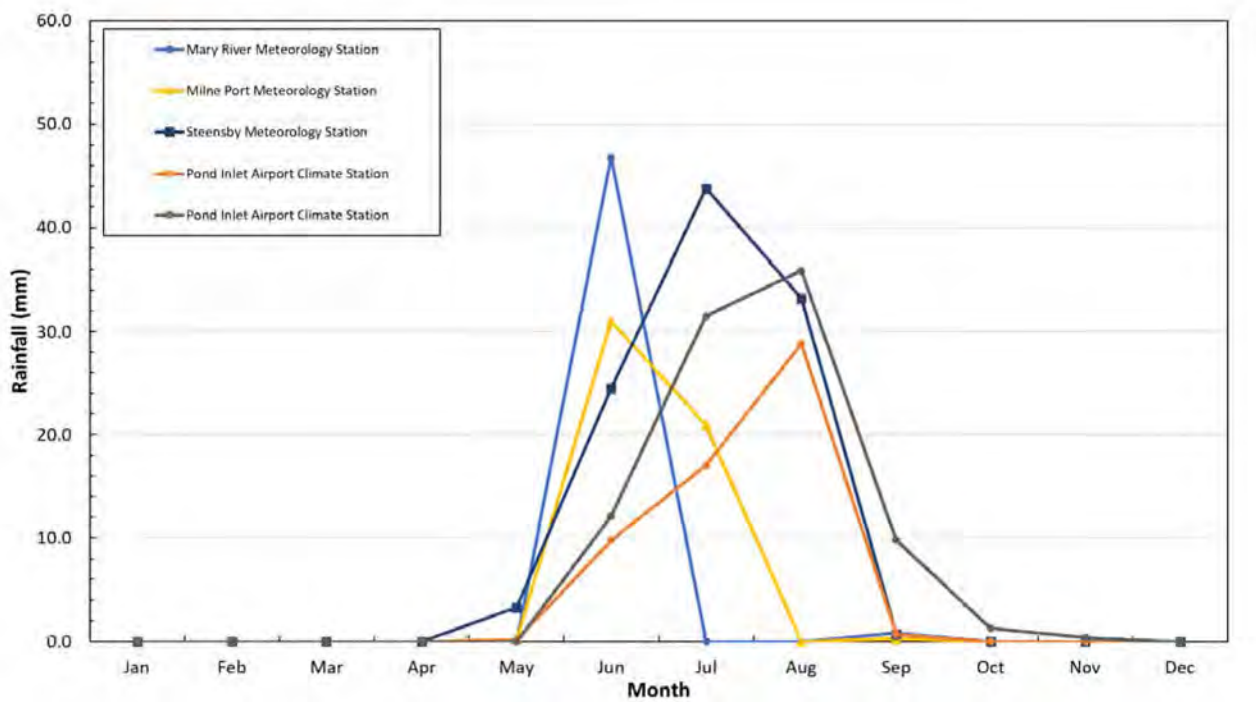


Figure 4-5 Summary of 2020 Total Rainfall at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

4.2.4 Wind Speed and Direction

Summaries of the monthly averages and monthly maximums for the wind speed are presented in Table 4-11 and Table 4-12, respectively. The trends of monthly average and monthly maximum are presented graphically in Figure 4-6 and Figure 4-7, respectively. Each meteorology station is compared to the 2020 data retrieved from the Pond Inlet Airport Climate Station, as well as the Canadian Climate Normals data (taken from Pond Inlet Airport).

The data from the three (3) meteorology stations and the 2020 data from the Pond Inlet Airport Climate Station were processed in the same way. The hourly wind speed was averaged, and the maximum of the hourly wind speed was selected for each month.

ECCC defines data completeness for the Canadian Climate Normals by a 90% completeness of hourly data per month (ECCC, 2021). In Table 4-11 and, stations with incomplete data (or no data) are noted based on this criterion.

The results indicate that monthly average wind speed at the Steensby meteorology station was the highest when compared with other stations. There is not much variation in the monthly average wind speed over the course of the year for the Pond Inlet Airport Climate Station (both for 2020 data and 1981 to 2010 climate normal data). Both the Steensby meteorology station and the Mary River meteorology station monthly averages of wind speed have similar monthly variation.

The results indicate that monthly maximum wind speed followed a similar monthly variation at the Steensby meteorology station, the Mary River meteorology station, and the Pond Inlet Airport climate station (for 2020 data). There was not much variation in the monthly maximum wind speed over the course of the year for the Pond Inlet Airport climate station (for the 1981 to 2010 Climate Normal data). The Steensby meteorology station monthly maximum wind speed is the highest compared with other stations for most of the course of the year.

In the 2018/2019 TEAMR reports, the wind speeds at Milne Port varied between 0–23.8 m/s (EDI 2018; EDI 2019). They also recorded hurricane level wind speeds (100 m/s) during eight (8) or nine (9) months out of the year. The range of wind speeds in 2020 at Milne Port was approximately 0–32.5 m/s, which is consistent with the 2018-2019 EDI data. The values of 100 m/s present in the EDI TEAMR reports were likely due to datalogging errors since there is no gradual increase in the maximum wind speeds leading up to the 100 m/s value. In addition, there are repeated 100 m/s maximum wind speed values for up to sixty-five (65) consecutive hours and it is highly unlikely that maximum wind speeds of that velocity would have persisted for such a long duration.

Table 4-11 Summary of Average Wind Speed at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station.

Station	Average Wind Speed (m/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a]	1.1	0.4	3.4	2.8	4.3	2.9	3.8	3.7	2.6	5.5	3.1	4.8	3.2
Milne Port Meteorology Station [a b]	-	-	-	-	-	-	-	-	3.5	4.6	5.6	5.5	5.0
Steensby Meteorology Station [a]	5.8	5.8	9.0	8.5	9.1	5.7	6.6	7.4	7.1	10.3	6.7	10.4	7.7
Pond Inlet Airport Climate Station [a c]	2.6	2.5	3.0	2.3	2.0	2.2	3.0	3.2	3.8	4.0	4.4	3.2	3.0
Pond Inlet Airport Climate Station [d]	1.9	1.8	2.0	2.2	2.4	2.5	2.6	2.8	3.1	3.8	2.8	2.1	2.5

Note:
"-" means data missing; [a] Based on 2020 hourly data; [b] Data missing for January to August of 2020, data incomplete in September; [c] Data incomplete in May
[d] Based on 1981 to 2010 Climate normal data (ECCC, 2021)

Table 4-12 Summary of Maximum Wind Speed at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station.

Station	Maximum Wind Speed (m/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station [a]	9.9	7.7	14.3	12.9	13.6	9.3	12.2	16.0	11.1	17.6	15.1	20.3	20.3
Milne Port Meteorology Station [a b]	-	-	-	-	-	-	-	-	10.9	16.4	18.3	23.2	23.2
Steensby Meteorology Station [a]	19.7	14.0	25.6	21.5	27.9	17.8	17.9	21.6	17.7	25.2	25.0	28.3	28.3
Pond Inlet Airport Climate Station [a c]	8.3	5.8	18.9	6.7	15.3	8.3	10.8	16.1	11.9	13.3	15.3	18.9	18.9
Pond Inlet Airport Climate Station [d]	21.1	19.4	18.1	20.6	19.4	17.5	19.4	19.4	20.6	20.6	25.3	25.8	25.8

Note:
"-" means data missing; [a] Based on 2020 hourly data; [b] Data missing for January to August of 2020, data incomplete in September; [c] Data incomplete in May
[d] Based on 1981 to 2010 Climate normal data (ECCC, 2021)

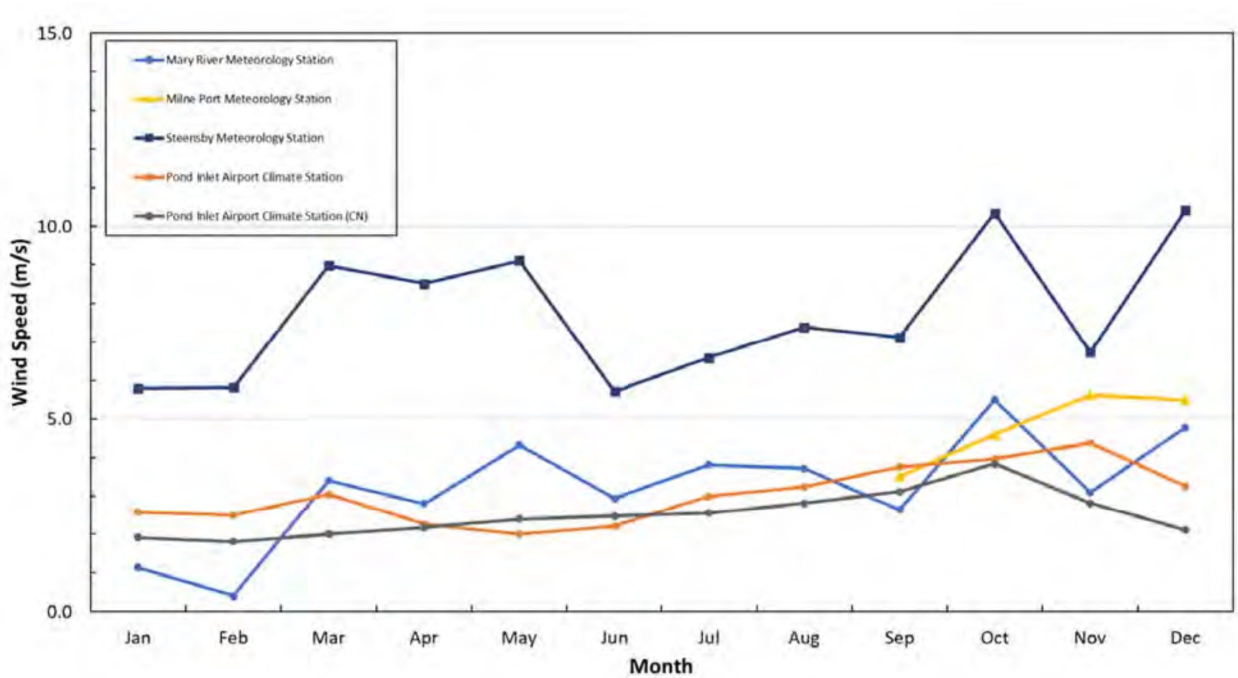


Figure 4-6 Summary of Average Wind Speed at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

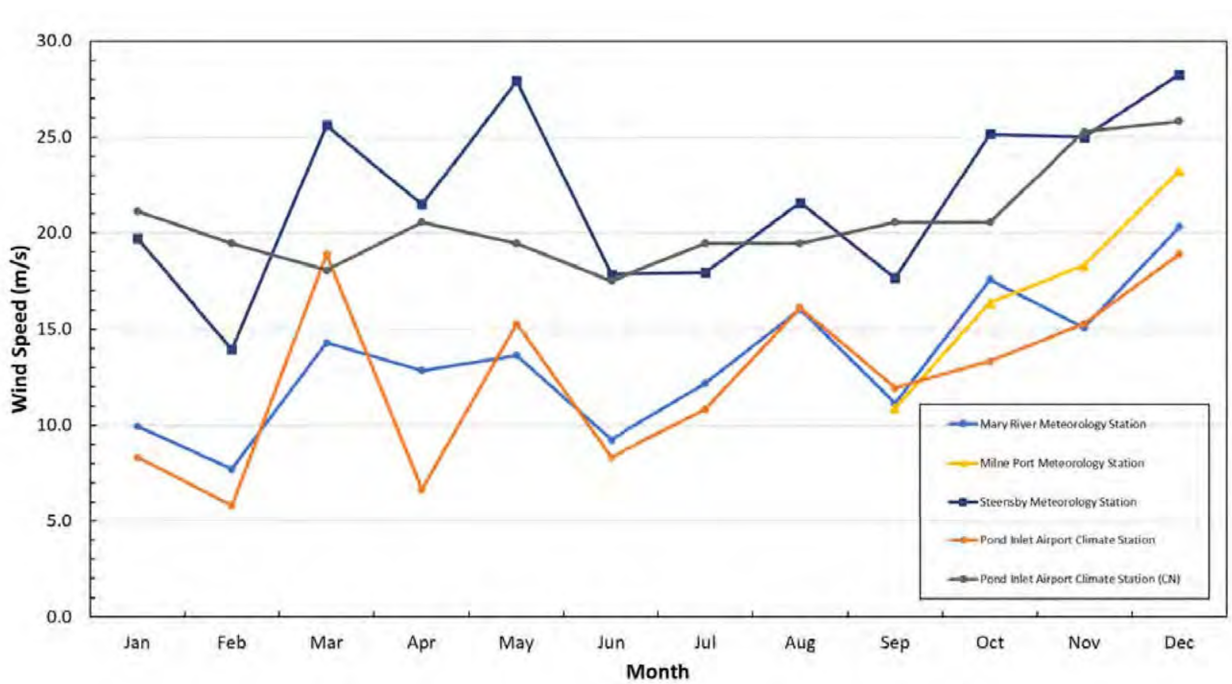


Figure 4-7 Summary of Maximum Wind Speed at the Baffinland Meteorology Stations and the Pond Inlet Airport Climate Station

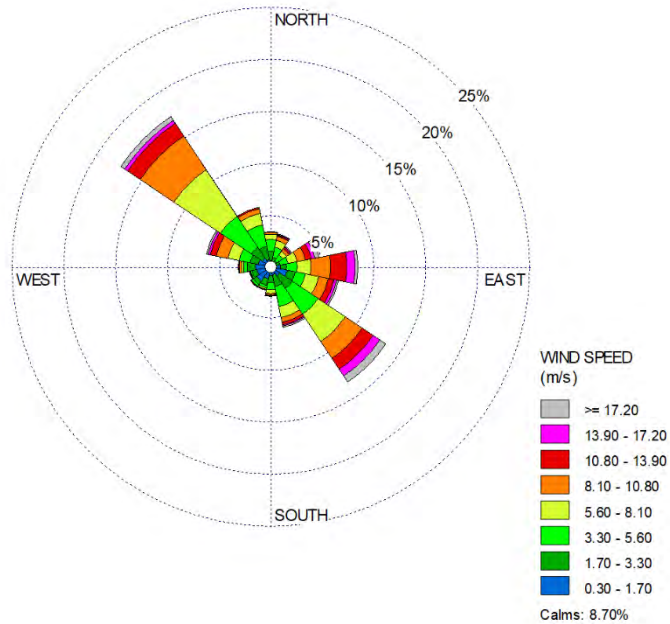
Summaries of the monthly averages and monthly maximums for the wind speed are presented in Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-12 for Mary River, Milne Port, Steensby, and the Pond Inlet Airport, respectively. The sites are not directly comparable to the climate normal because the wind direction will not be as consistent across the geographical distances as the other meteorological parameters.

At Mary River, south-easterly winds were prevalent during 2020, which is consistent with the observed trends during 2018 and 2019 (EDI 2018, 2019). The current trends also compare well with the Knight Piesold data for 2006–2015 (Knight Piesold 2016).

At Milne Port, north-north-easterly winds were prevalent during 2020. In 2018 and 2019, it was observed that north and northwest winds were most common, though the direction appears to be consistently from the north (EDI 2018, 2019). However, in the Knight Piesold data, prevalent wind directions were northerly and north-north-easterly (Knight Piesold 2016).

At Steensby, north-westerly winds were prevalent during 2020. The results for years between 2013 and 2019 are shown in Figure 4-11. Although the wind speed appears to be higher in 2020, the overall predominant wind direction remains north-westerly.

At the Pond Inlet Airport, southerly winds are prevalent. This is consistent with the Canadian Climate Normal for the climate station location, which demonstrates that southerly winds are the most common.



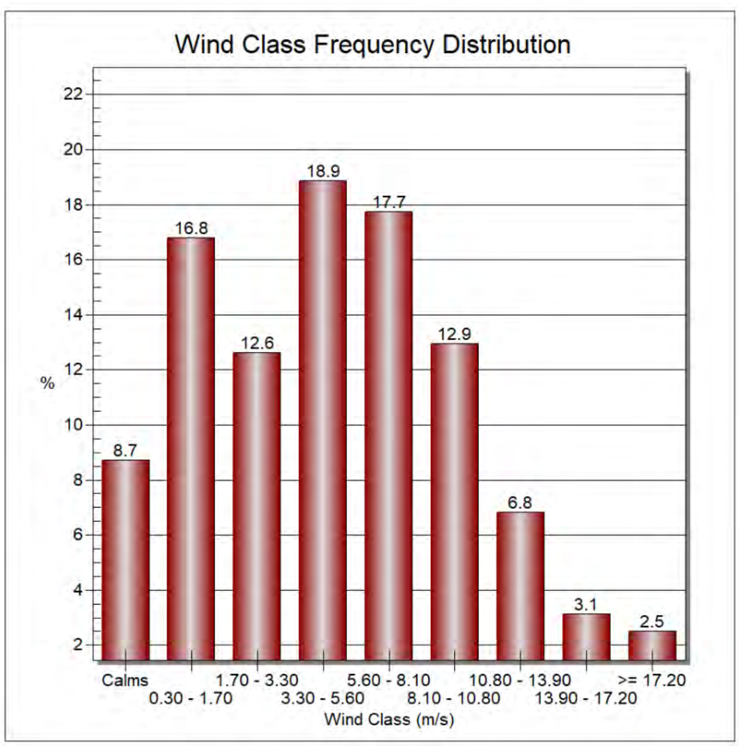
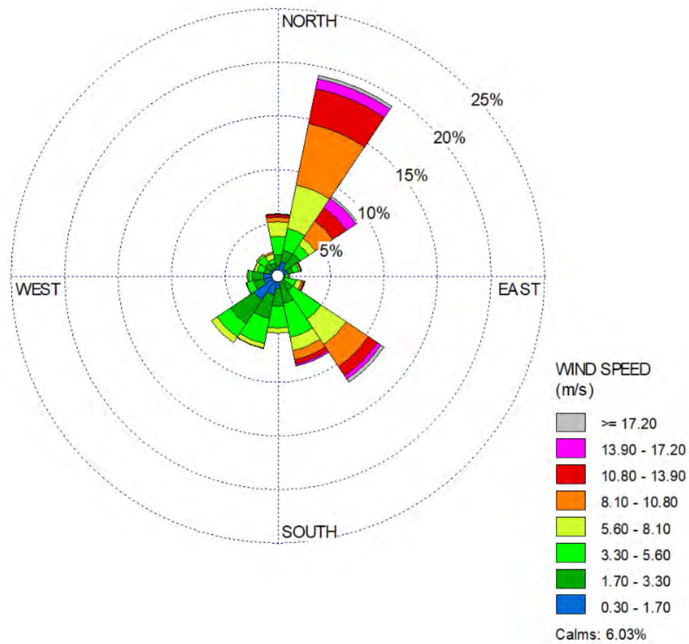


Figure 4-8 2020 Wind Rose and Wind Class Frequency Distribution at the Mary River Meteorology Station



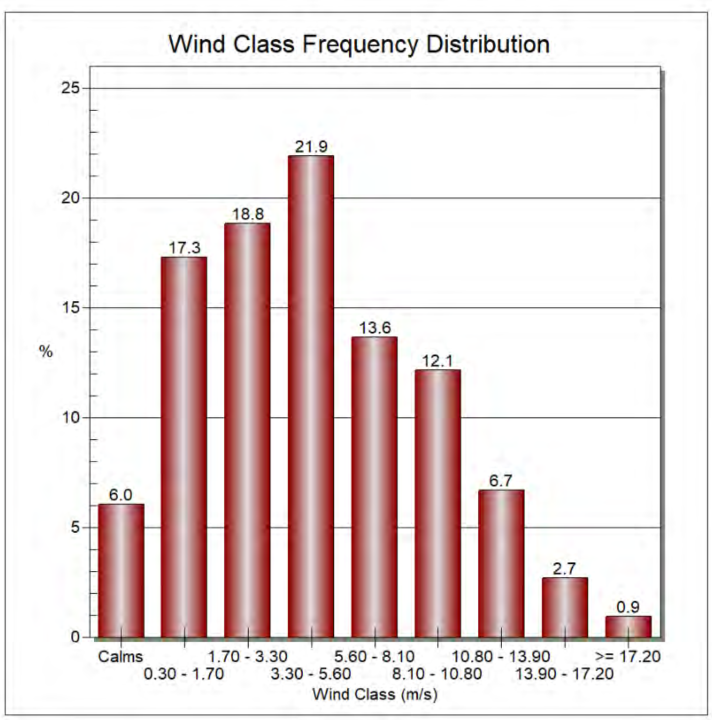
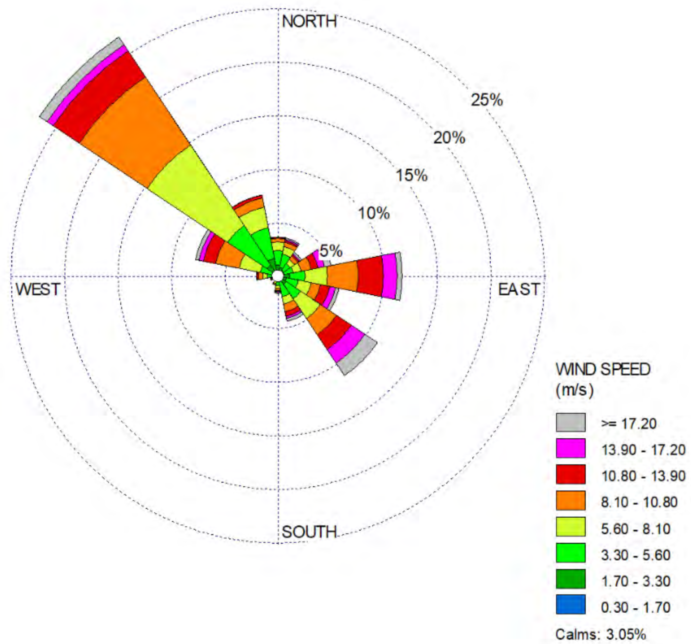


Figure 4-9 Wind Rose and Wind Class Frequency Distribution at the Milne Port Meteorology Station (Based on Data of Sep. 16 – Dec. 31, 2020)



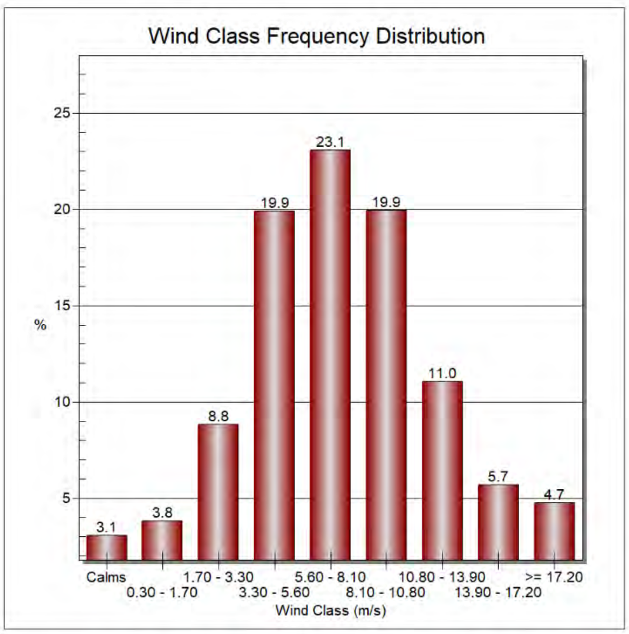
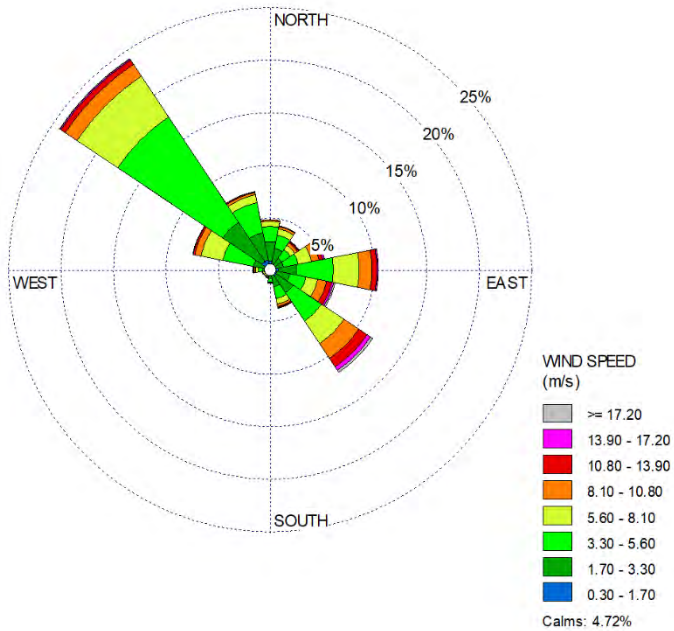


Figure 4-10 2020 Wind Rose and Wind Class Frequency Distribution at the Steensby Port Meteorology Station



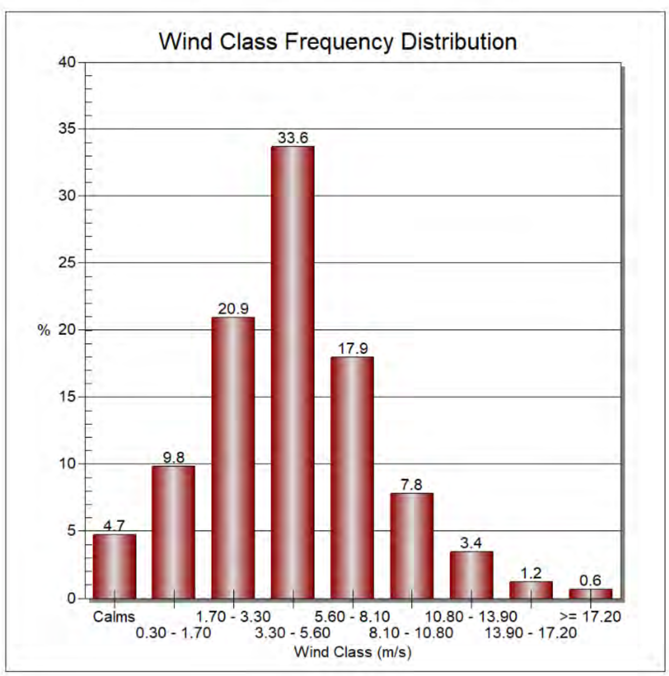
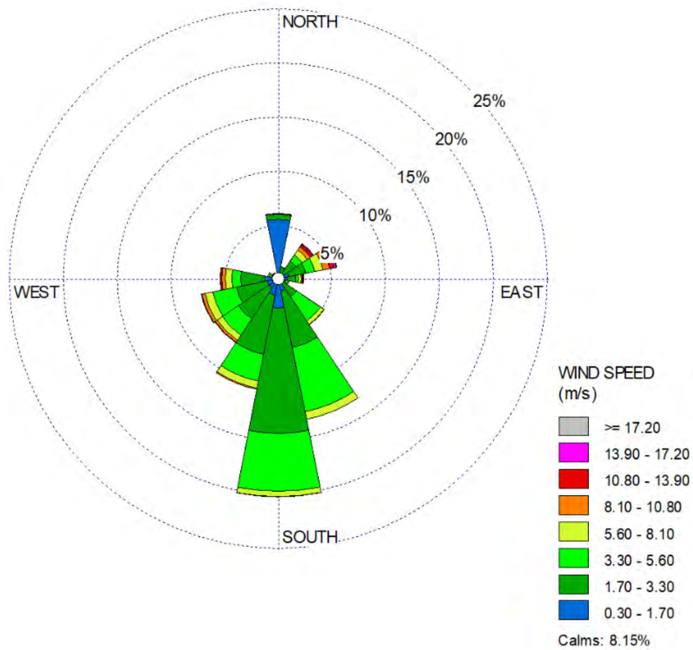


Figure 4-11 2013-2019 Wind Rose and Wind Class Frequency Distribution at the Steensby Meteorology Station



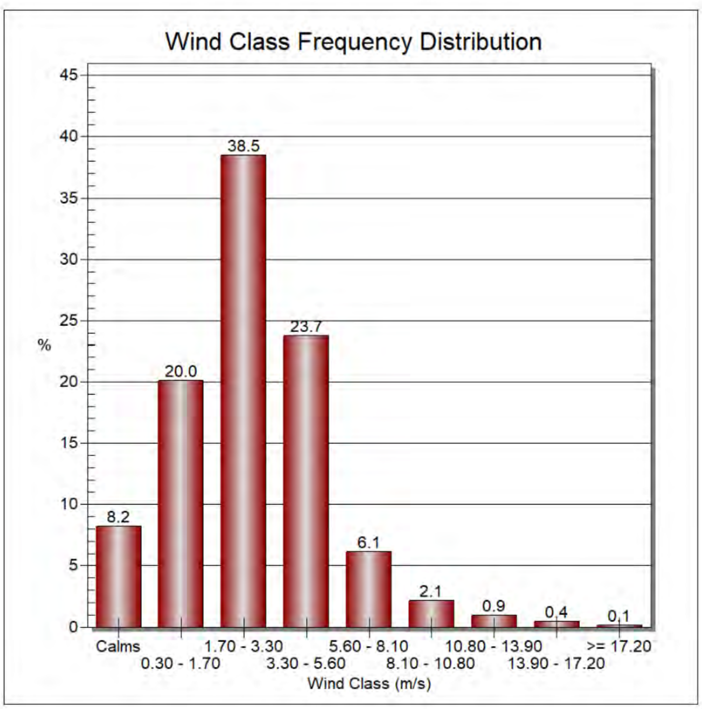


Figure 4-12 2020 Wind Rose and Wind Class Frequency Distribution at the Pond Inlet Airport Climate Station

4.2.5 Solar Radiation

Summaries of the monthly averages for solar radiation are presented in Table 4-13. The trends are presented graphically in Figure 4-13. Currently, the Pond Inlet Airport Climate Station does not record average solar radiation, so values are not compared to the Climate Normal.

The data from the three (3) meteorology stations were processed in the same way. The hourly average solar radiation was averaged each month.

ECCC defines data completeness for the Canadian Climate Normal by a 90% completeness of hourly data per month (ECCC 2021). In Table 4-13, stations with incomplete data (or no data) are noted based on this criterion.

The results indicate that solar radiation was low during the winter (November through February), and then increased until the early summer (June and July), where it peaked. All three (3) sites offer consistent data which indicates peak solar radiation in the summer was approximately 250 W/m^2 on average in 2020.

Table 4-13 Summary of 2020 Monthly Average Solar Radiation at the Baffinland Meteorology Stations

Station	Solar Radiation (W/m^2)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mary River Meteorology Station	0.3	7.6	74.2	175.3	219.8	239.3	197.4	142.4	76.4	20.8	1.4	0.0	96.2
Milne Port Meteorology Station	0.2	13.4	71.2	178.5	239.6	238.8	218.6	136.1	61.6	19.4	1.1	0.0	98.2
Steensby Meteorology Station	1.0	17.9	85.8	189.8	266.2	271.4	220.9	151.7	74.1	19.7	2.1	0.1	108.4

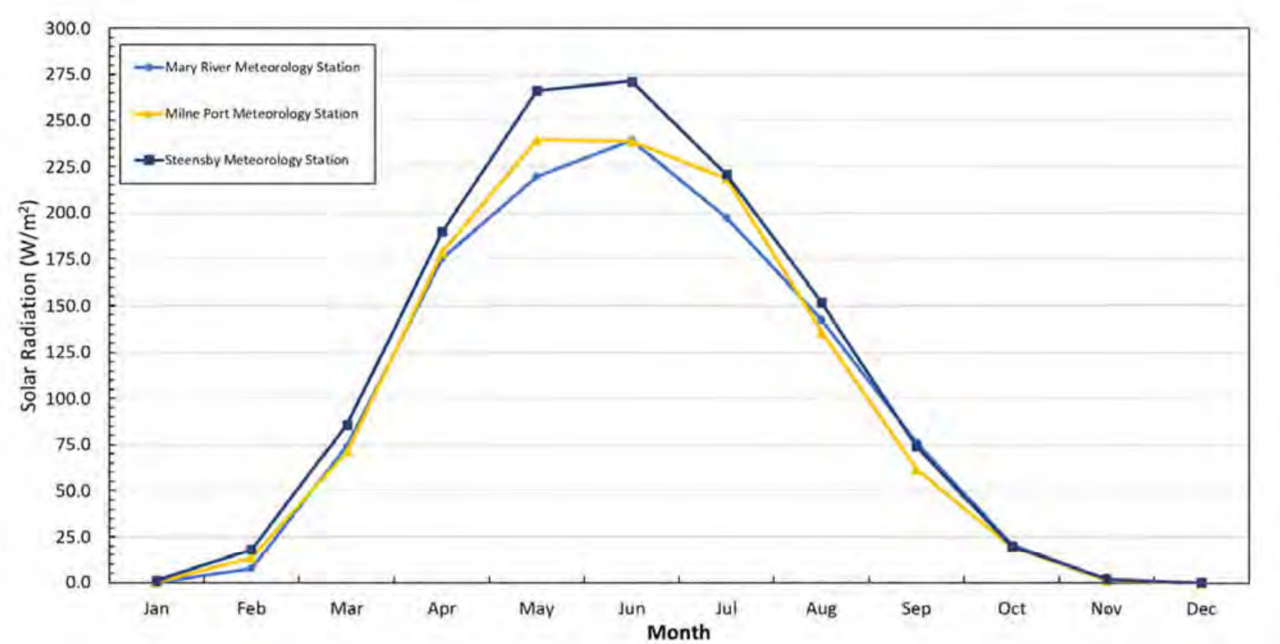


Figure 4-13 Summary of 2020 Monthly Average Solar Radiation at the Baffinland Meteorology Stations.

5 SUMMARY

5.1 Ambient Air Quality Monitoring Program

Ambient air quality data were collected at the Mary River MSC and the Milne Port PSC in 2020. Ambient Air was analyzed for SO_2, NO_2, NO, and NOx using Teledyne API SO_2/NOx analyzers. The data were tabulated and compared to 2015, 2017, and 2018 reports to analyze historical trends. The following summary observations are provided in relation to 2020 ambient air quality data:

- The measured concentrations of NO_2 and SO_2 at the Mary River MSC and Milne Port PSC were below the NAAQS for 2020.
- The measured concentrations of NO_2 and SO_2 at the Mary River MSC and Milne Port PSC exceeded the 2020 CAAQS for NO_2 and were less than the standard for SO_2. The comparison of the measured NO_2 and SO_2 concentrations to the CAAQS is for information only because the purpose of the CAAQS is for developing airshed management decisions for the CCME's objective of "keeping clean areas clean" - they are not to be used to determine ambient air quality compliance at the PDA boundary.
- The 2020 measured concentrations of NO_2 and SO_2 were highest in the winter and lowest in the summer, consistent with the previously reported historical trends.
- During 2020 the SO_2 and NOx analyzers at the Mary River MSC monitoring station had 89.39% and 98.65% valid data with 7,845 and 8,665 valid data points, respectively. Analyzers reporting greater than 75% of their data are considered valid for the month.
- The Mary River MSC ambient air quality monitoring station did not record SO_2 data from March 23-April 25 resulting in two (2) months of invalid data due to a pump failure caused by a perm tube spike and subsequent shutdown of the analyzer due to operator error.
- During 2020 the SO_2 and NOx analyzers at the Milne Port PSC monitoring station each had 98.52% valid data for the year, with 8,170 valid data points each.
- Permeation data results indicate consistent calibration cycles, but data indicate the MSC SO_2 analyzer perm tube should be replaced to allow calibration checks between calibration cycles.

5.2 Dustfall

A correlation can be made between the 2020 monthly dustfall rates and the monthly precipitation; however, there was no correlation between the monthly dustfall rates and the monthly average and maximum wind speeds. All the dustfall stations recorded elevated rates during April and September 2020 (Figure 6-6 in EDI 2021). The elevated dustfall rates for the monitoring stations at the Mine Site and Tote Road North Crossing during September 2020 coincided with dry conditions and a relatively lower level of dustfall during June 2020 coincided with an appreciable amount of rain (46.8 mm at the Mary River meteorological station). The elevated dustfall rates for the monitoring stations at the Milne Port and Tote Road South Crossing locations during September 2020 coincided with dry conditions and a relatively lower level of dustfall during June and July coincided with an appreciable amount of rain (31.0 and 20.9 mm, respectively) recorded at the Milne Port meteorology station.

5.3 Meteorology

Meteorological data were collected at three (3) meteorology stations in 2020 (Mary River, Milne Port and Steensby). Data collected included ambient air temperature, relative humidity, rainfall precipitation, wind speed and wind direction, and solar radiation.

The data collected were compared to 2020 data recorded at the Pond Inlet Airport Climate Station, as well as the 30-year climate normals (1981-2010) produced by the station. The following summary observations are provided in relation to 2020 meteorological data.

- In general, the trends observed for temperature, relative humidity, and rainfall precipitation matched well with the Climate Normals recorded at Pond Inlet.
- Average temperatures tended to be slightly higher than the Climate Normal for most of the year (particularly in the summer). This increase in temperature was also observed in previous reports made.
- Mary River recorded higher temperatures when compared with all other stations and is currently being investigated to see if there is any quality concern with the data.
- Relative humidity remains in a consistent band (65% to 89%), with similar trends across each year and compared to the climate normal.
- Rainfall precipitation is low during most of the year, which is consistent with historical data records.
- Windspeeds for the sites are consistent with the Climate Normal, except for Steensby. Steensby is approximately 120 km southeast from the Mine Site and 260 km southeast from Pond Inlet, and therefore has a slightly different meteorological regime compared to the other stations.
- Wind directions for Mary River and Milne Port are within reason compared to historical data records. Trends for the Pond Inlet Airport climate station are in line with the data recorded in the Climate Normal. Steensby does not have any historic data for comparison.
- Although there is no solar radiation Climate Normal for comparison, solar radiation appears to be consistent across the three stations.

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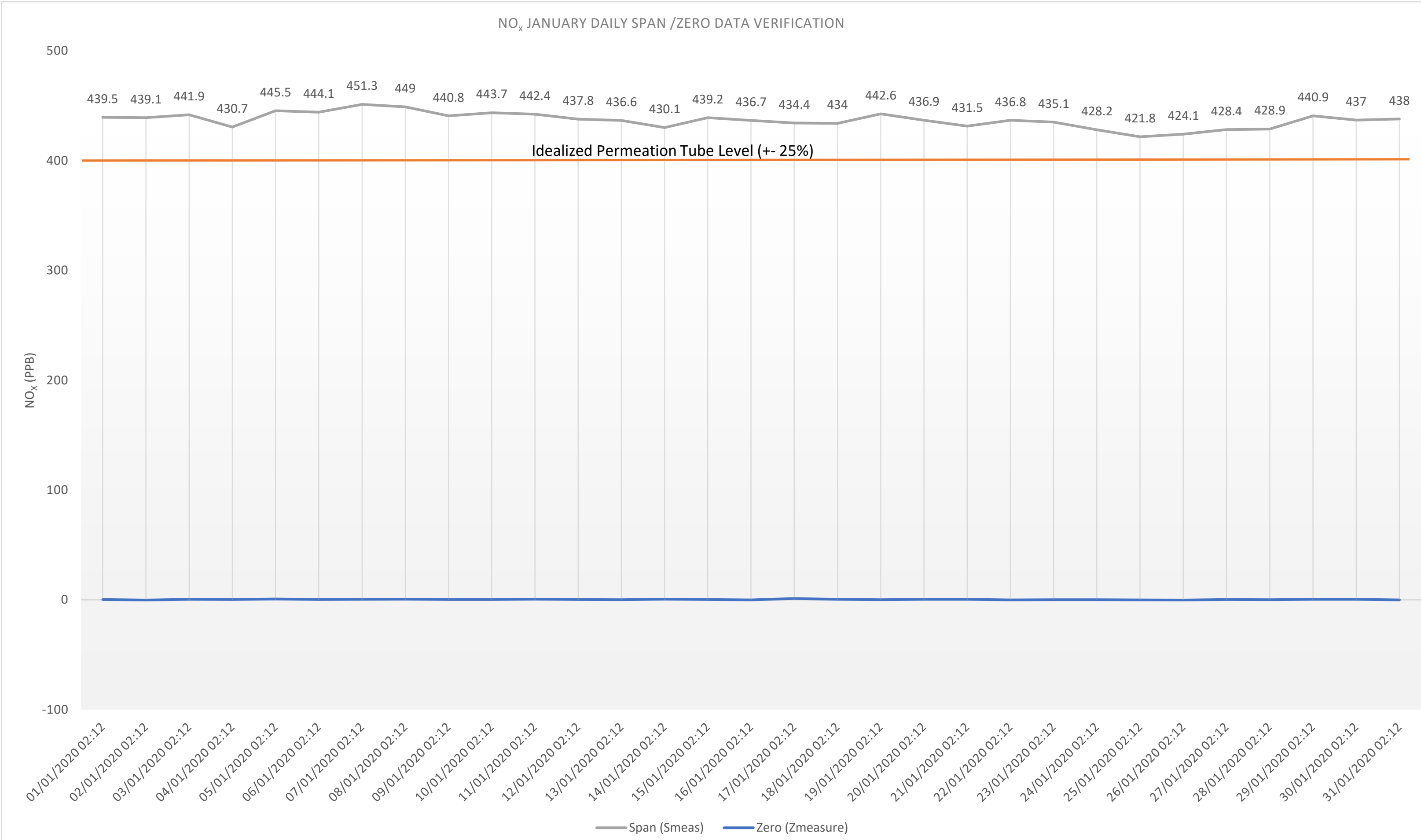
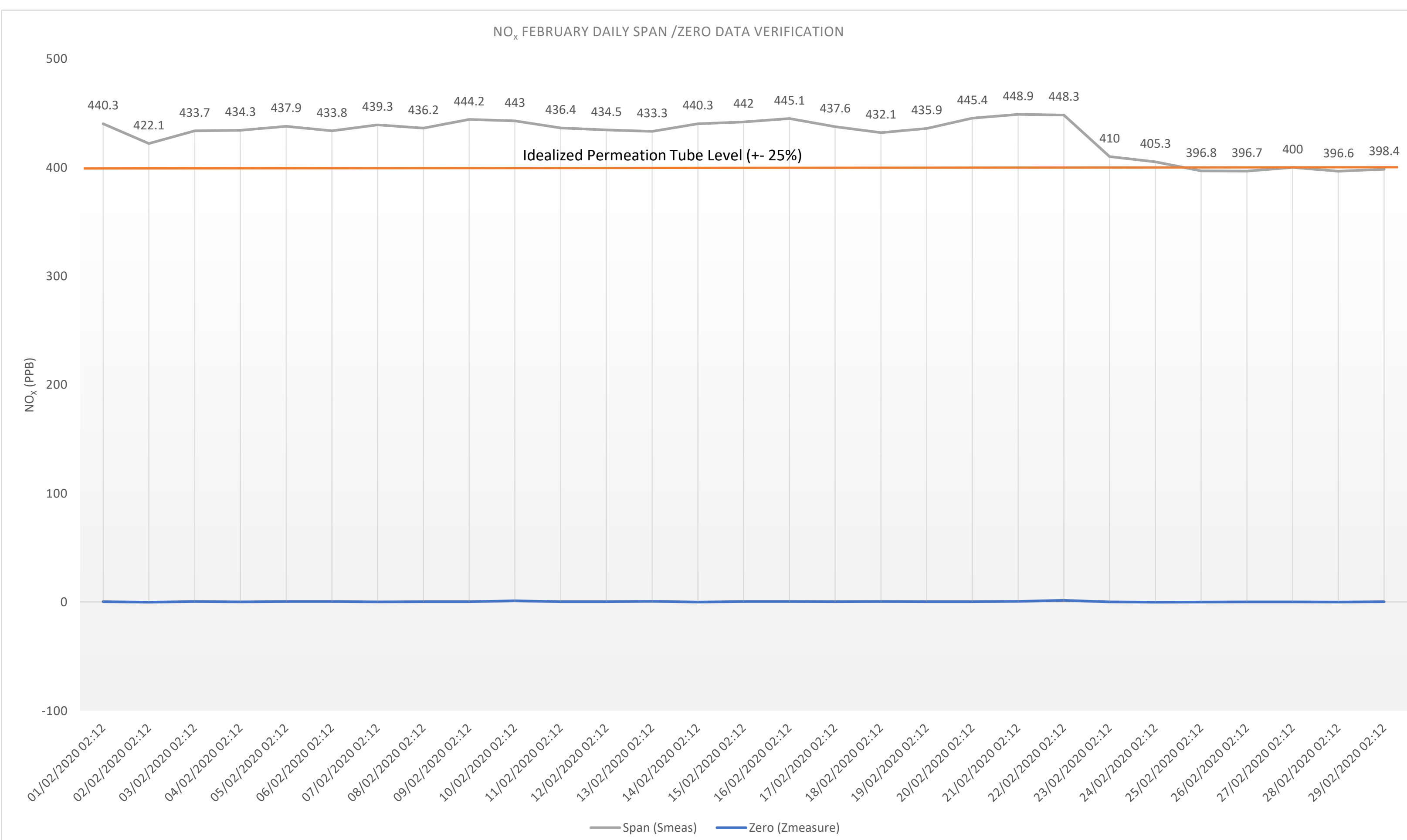
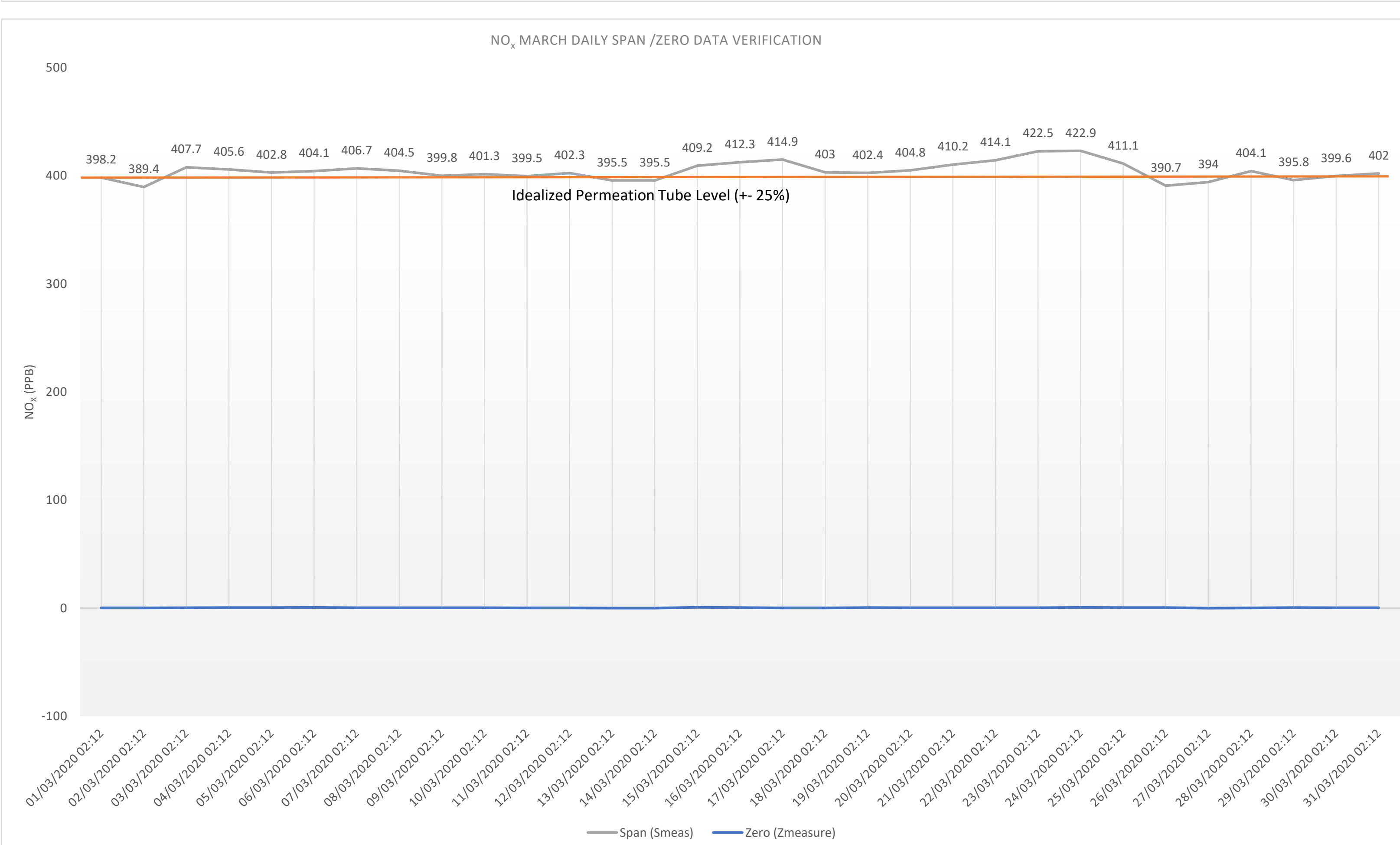
APPENDIX A Continuous Gas Analyzer Quality Control Summary

MARY RIVER - NO_X DAILY SPAN / ZERO DATA VERIFICATION







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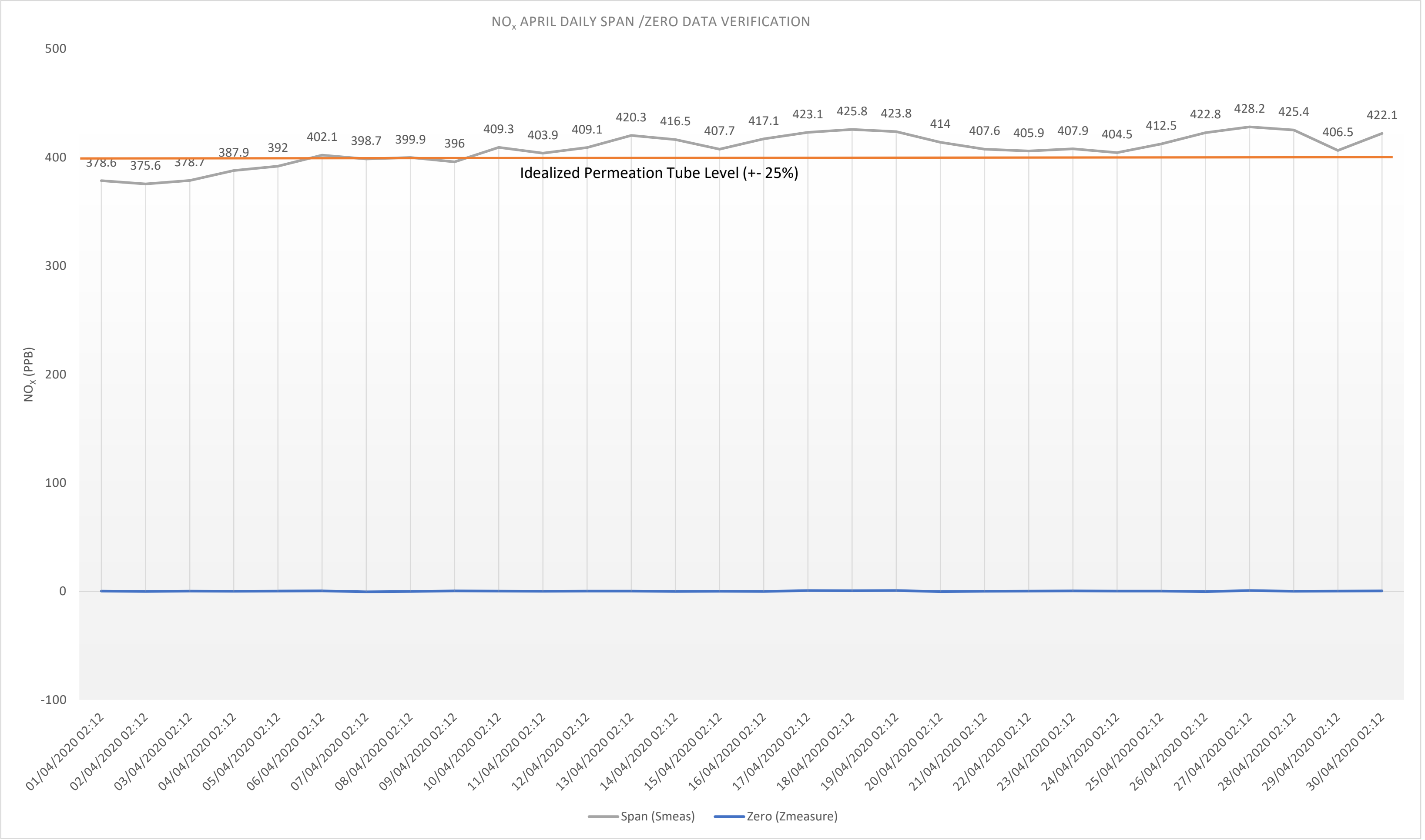

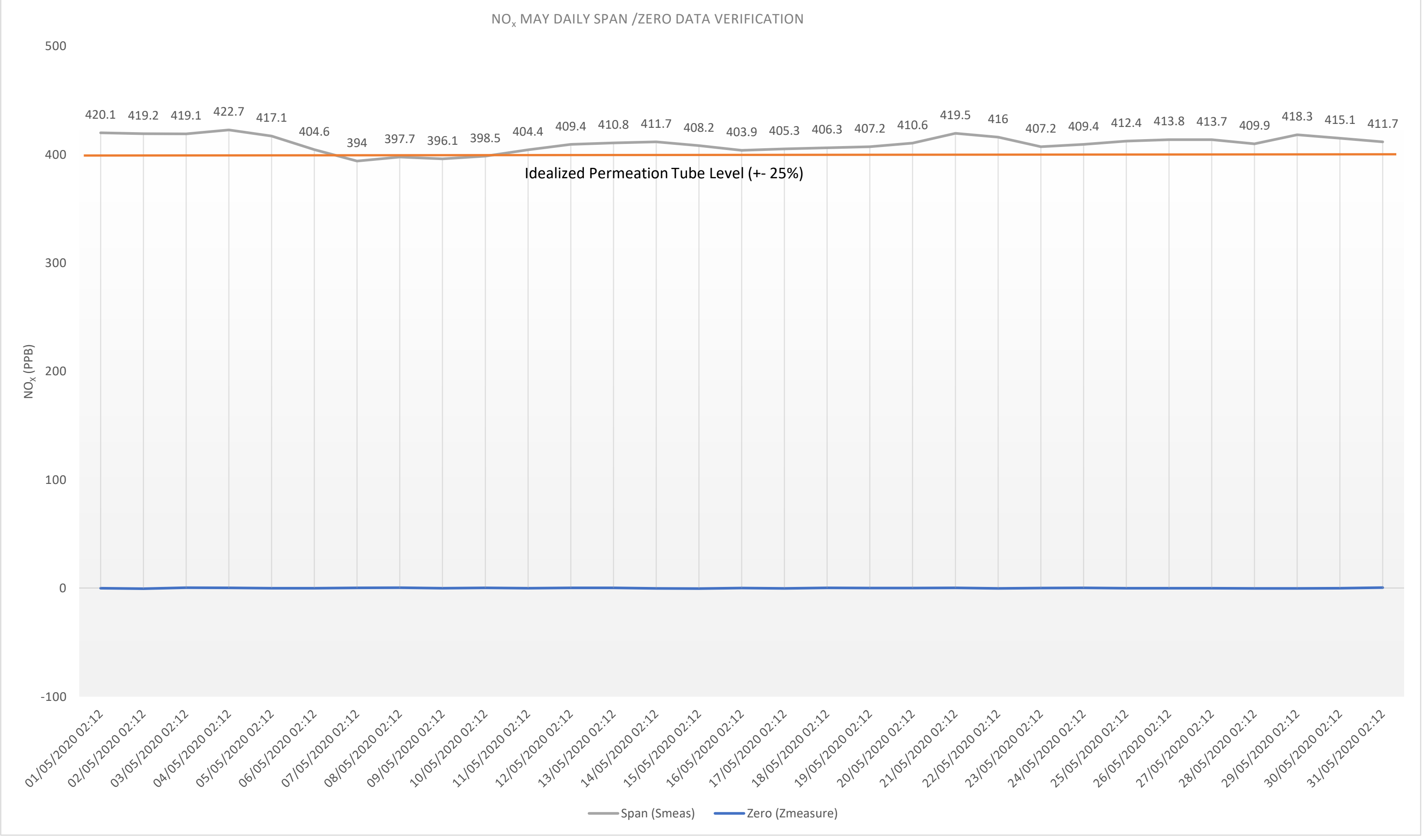

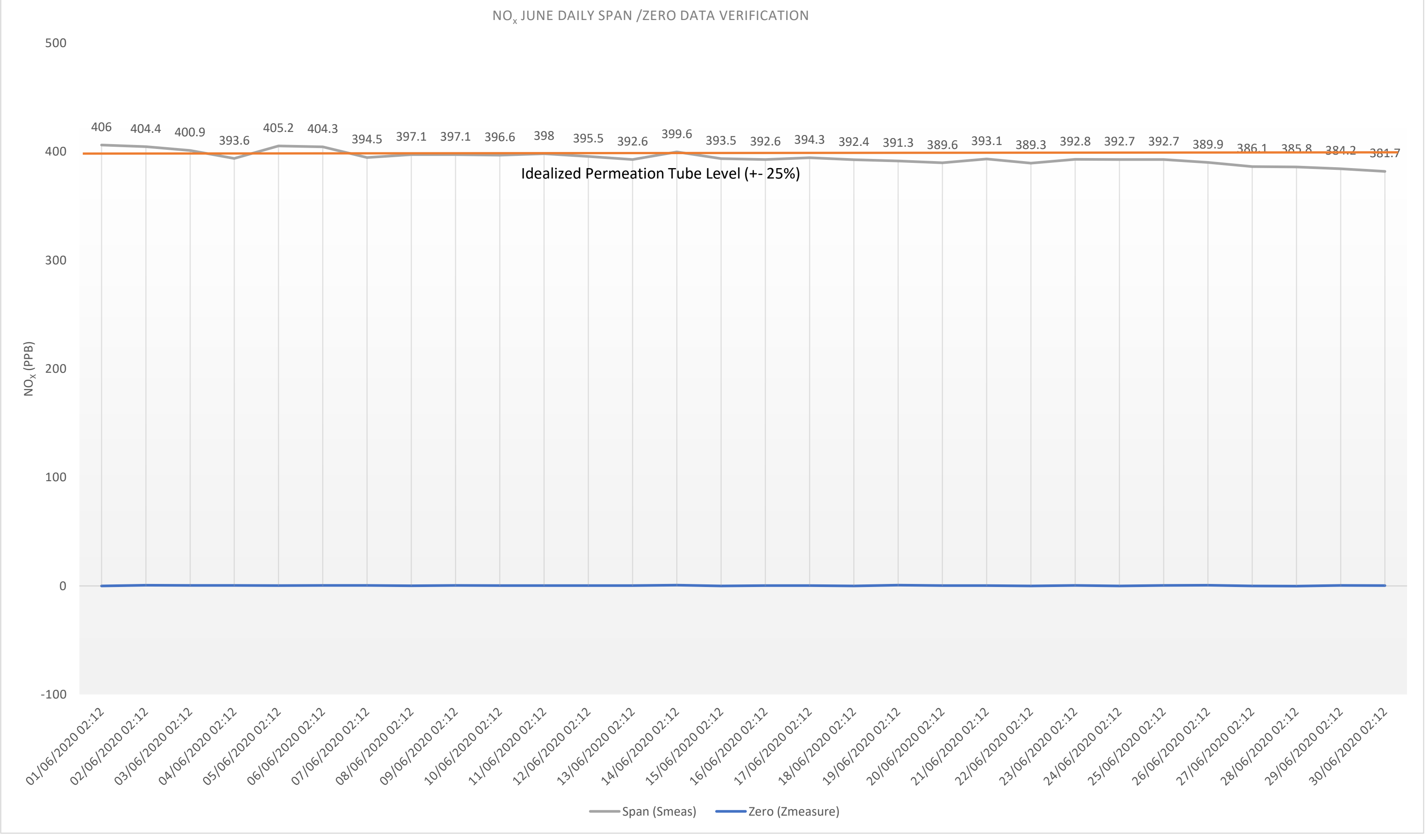

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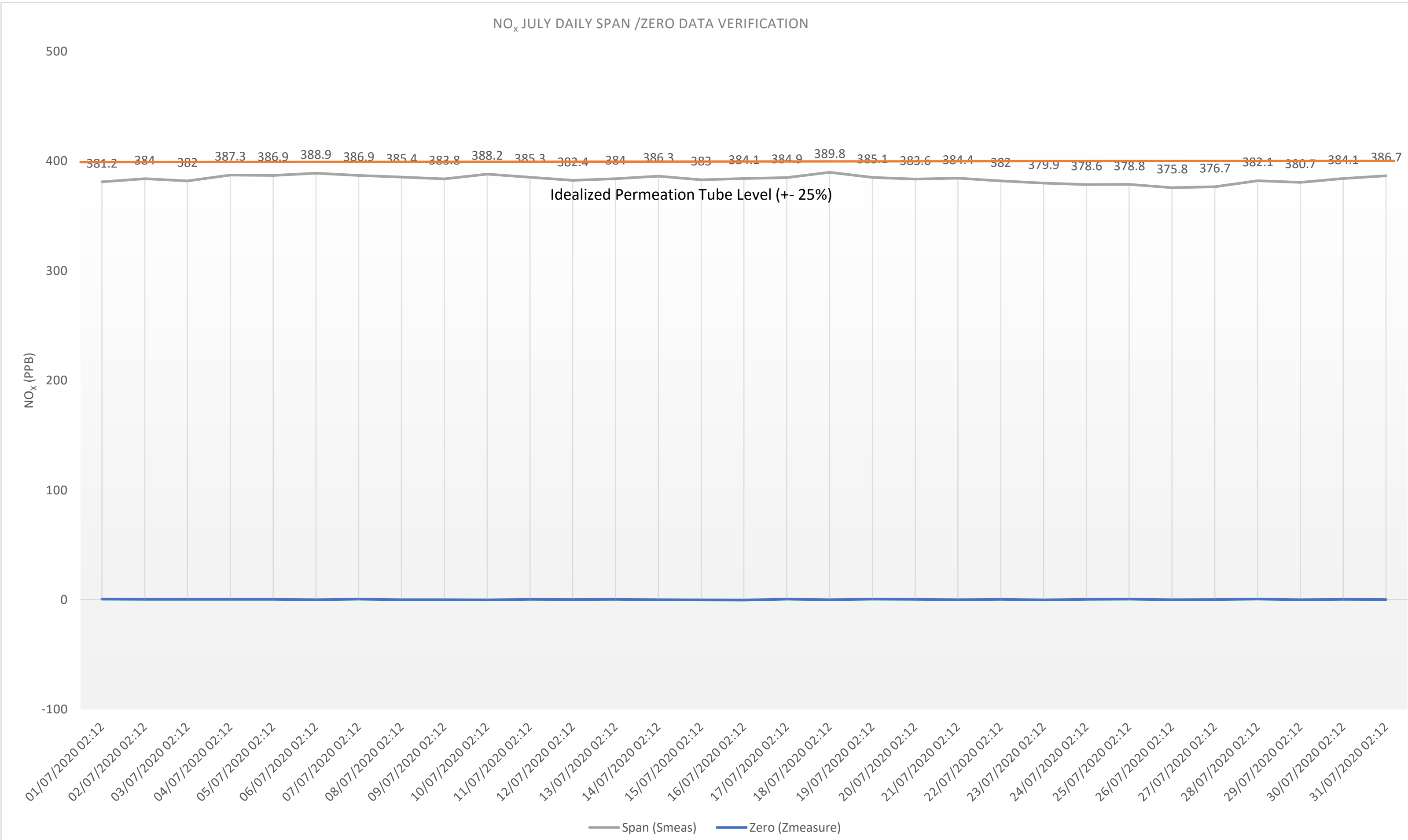

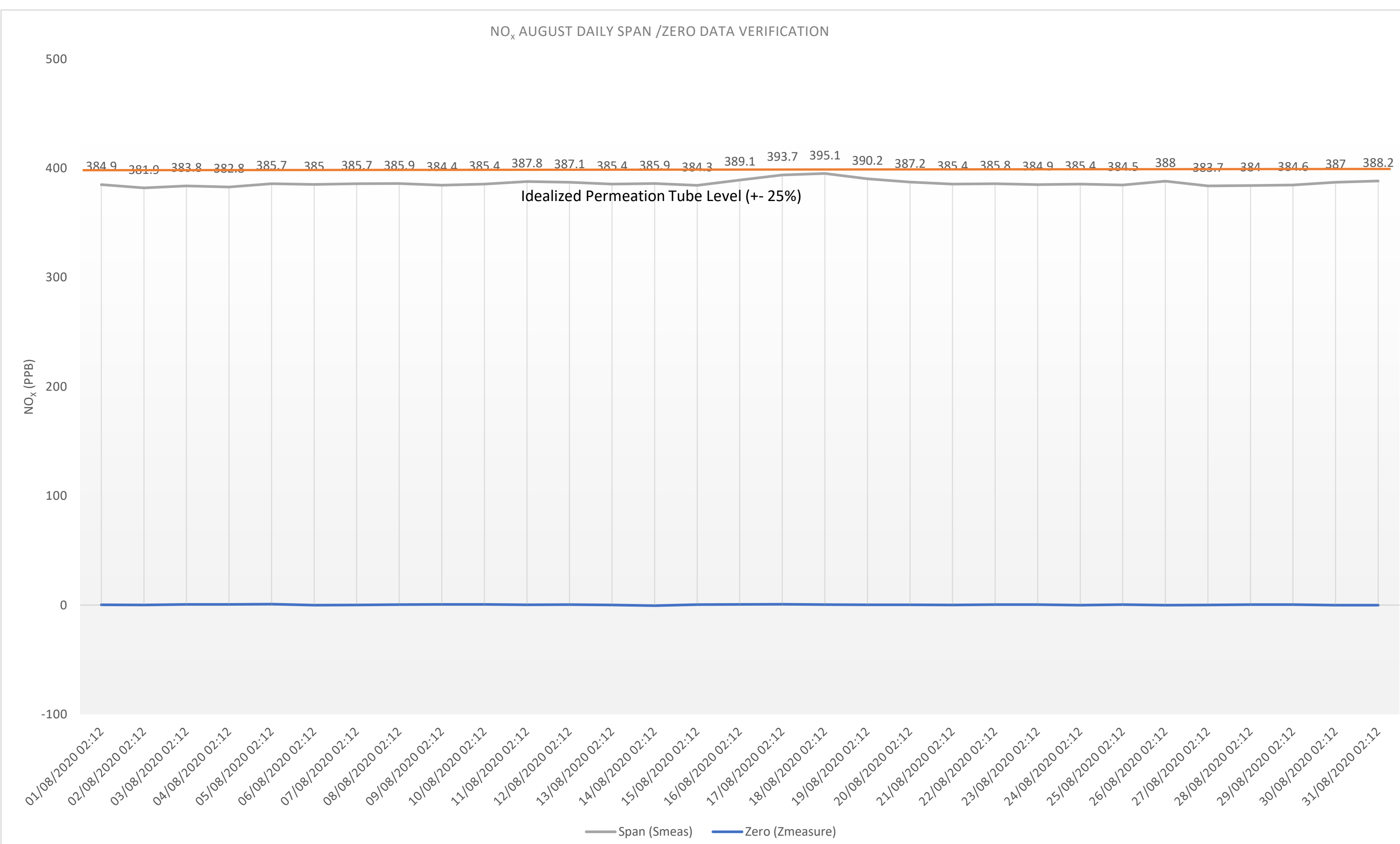

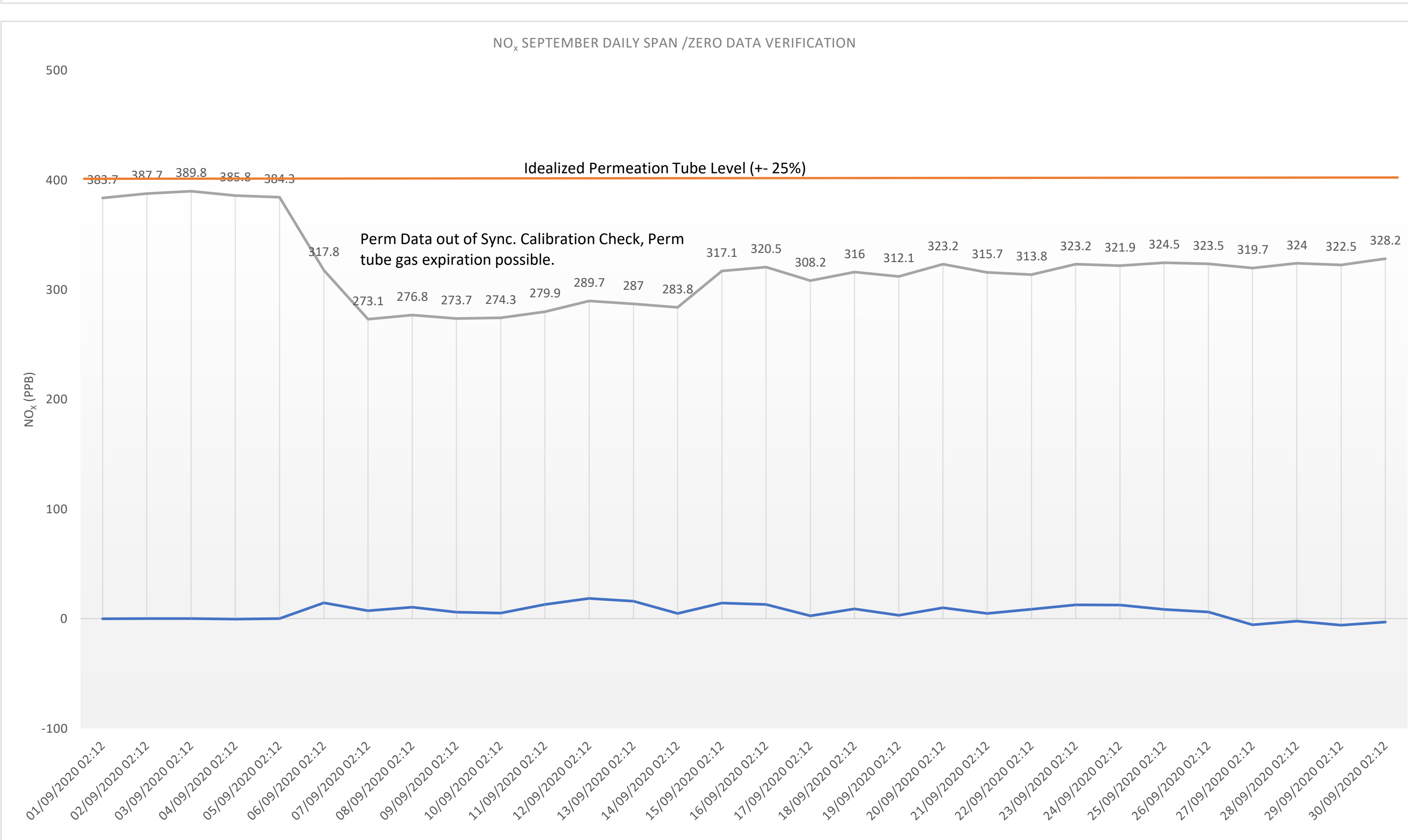

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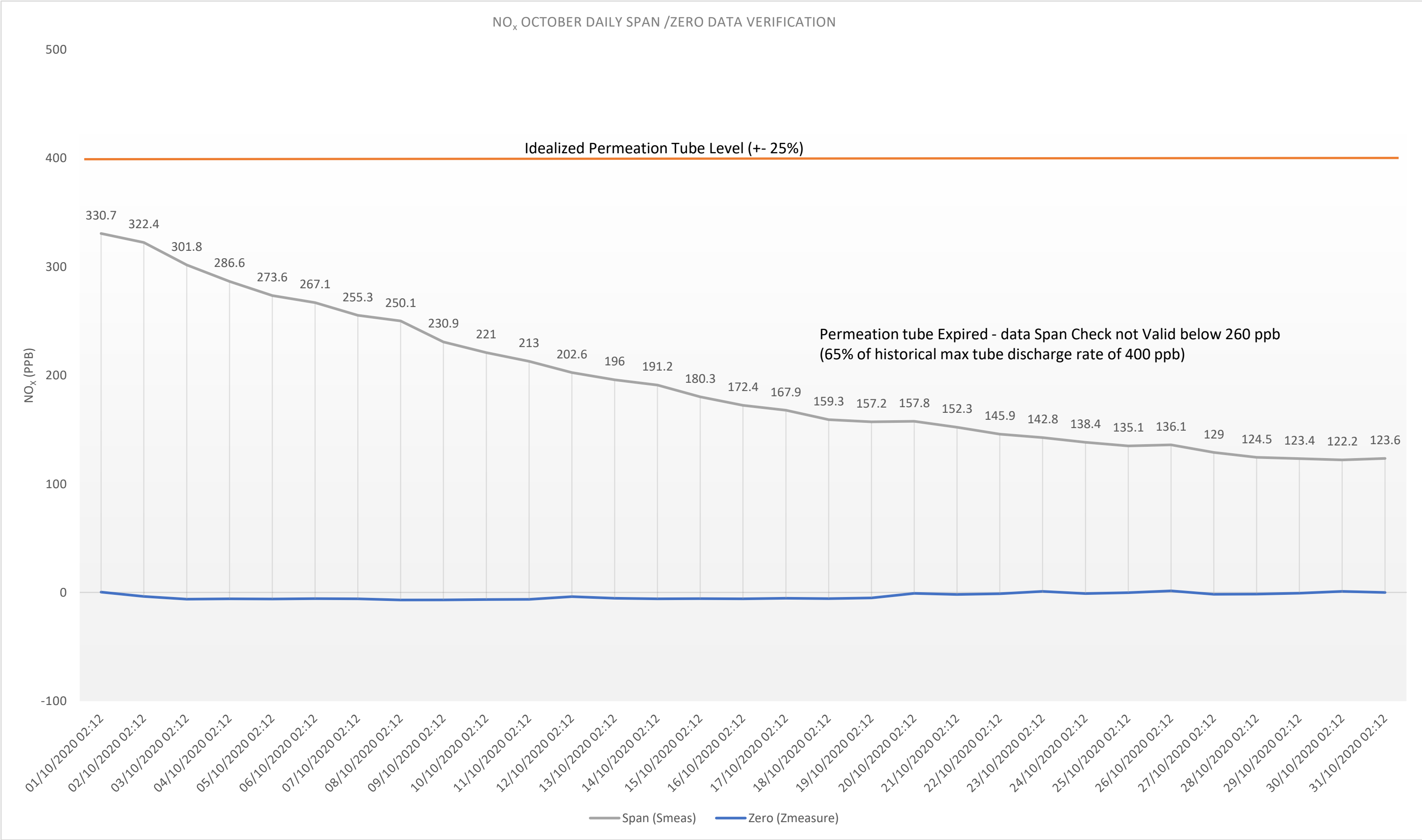

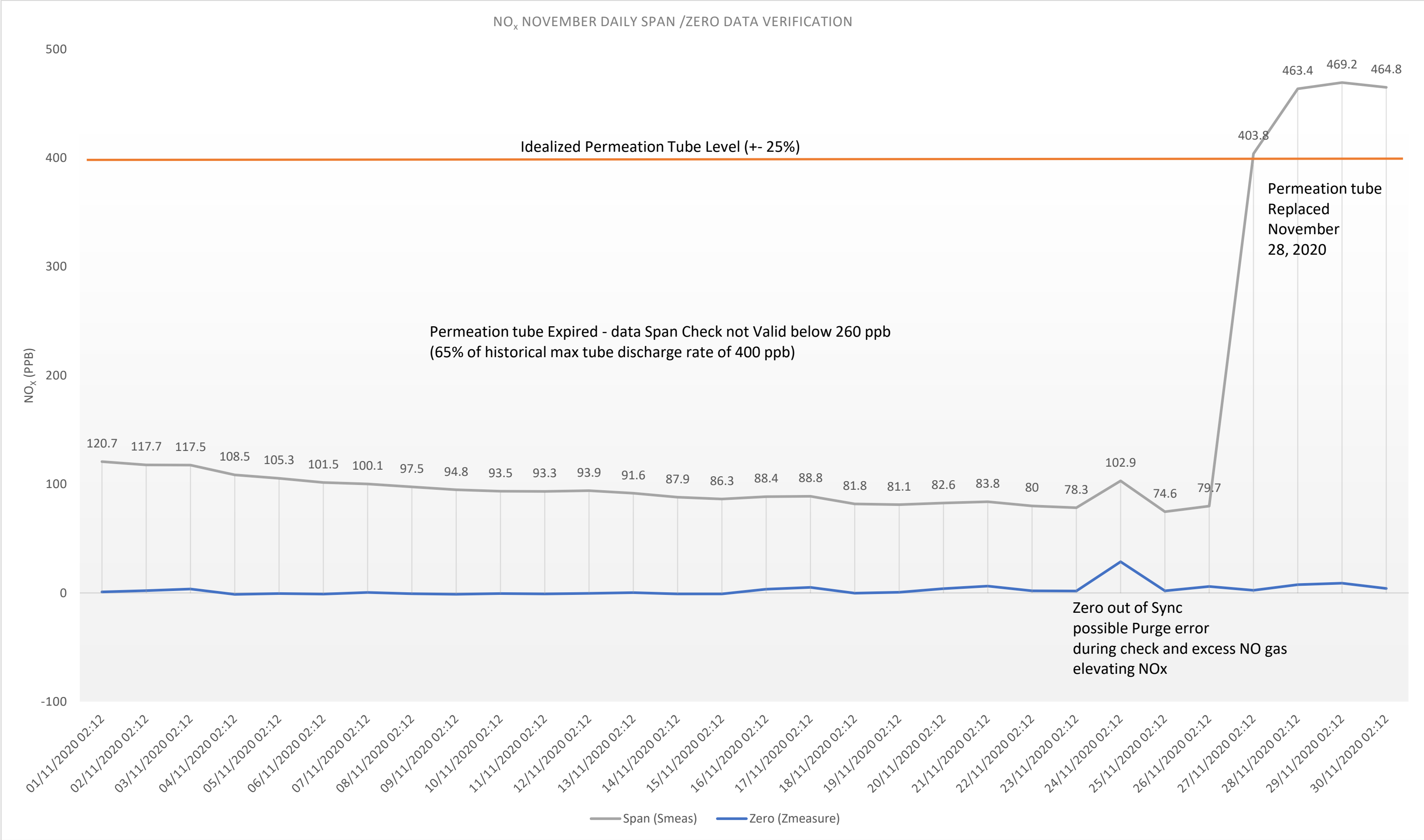

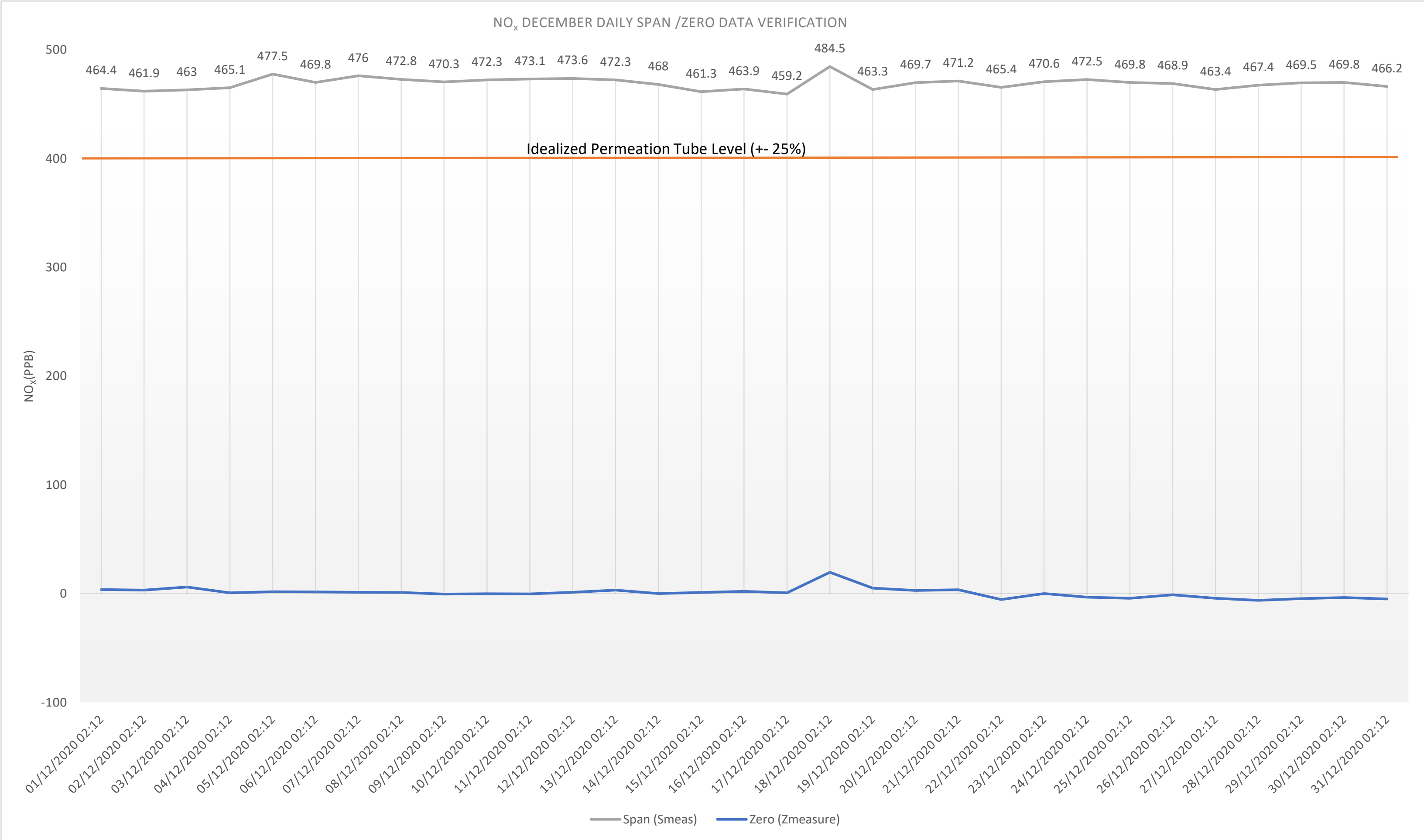

2020 ANNUAL AIR QUALITY, DUSTFALL AND METEOROLOGY REPORT

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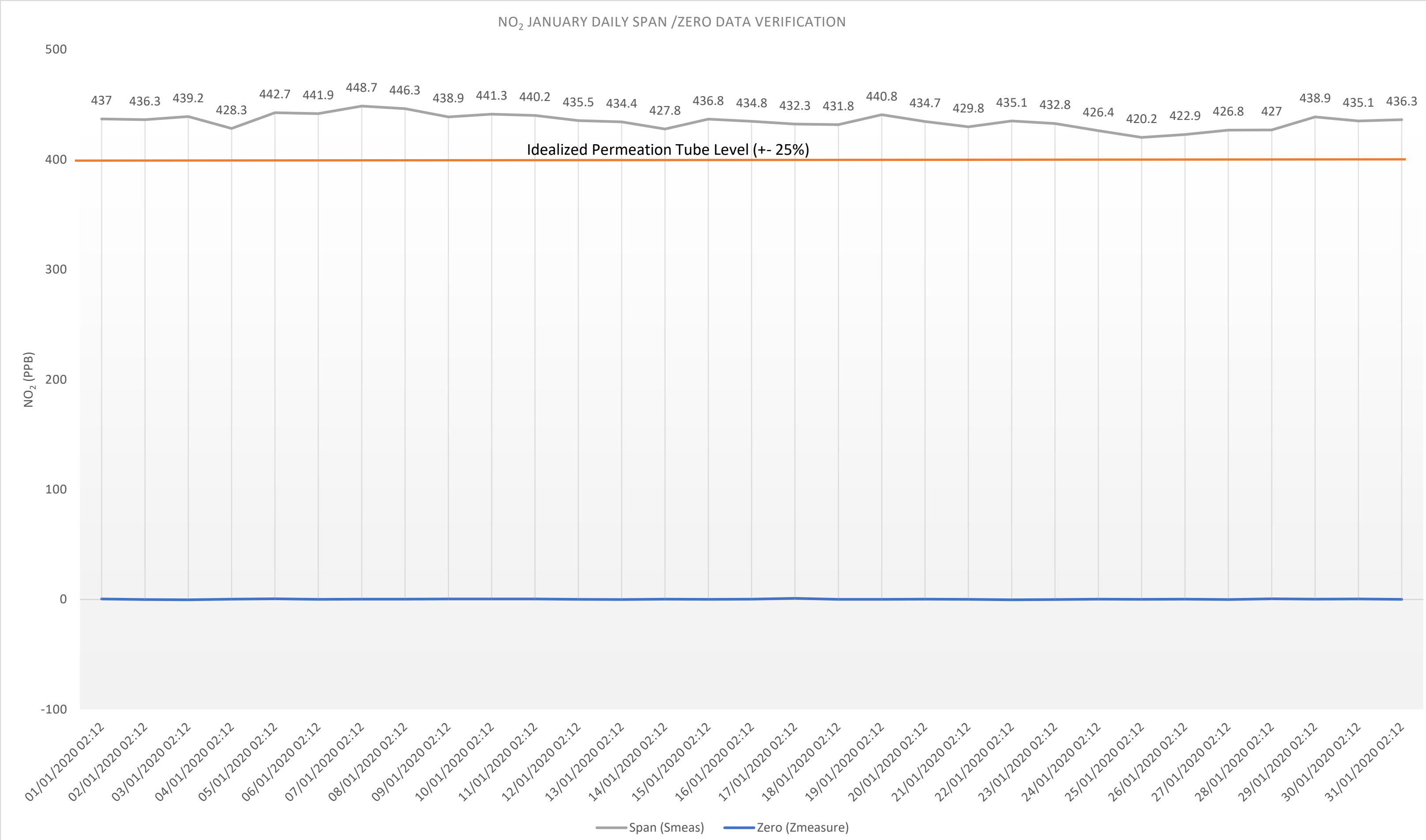

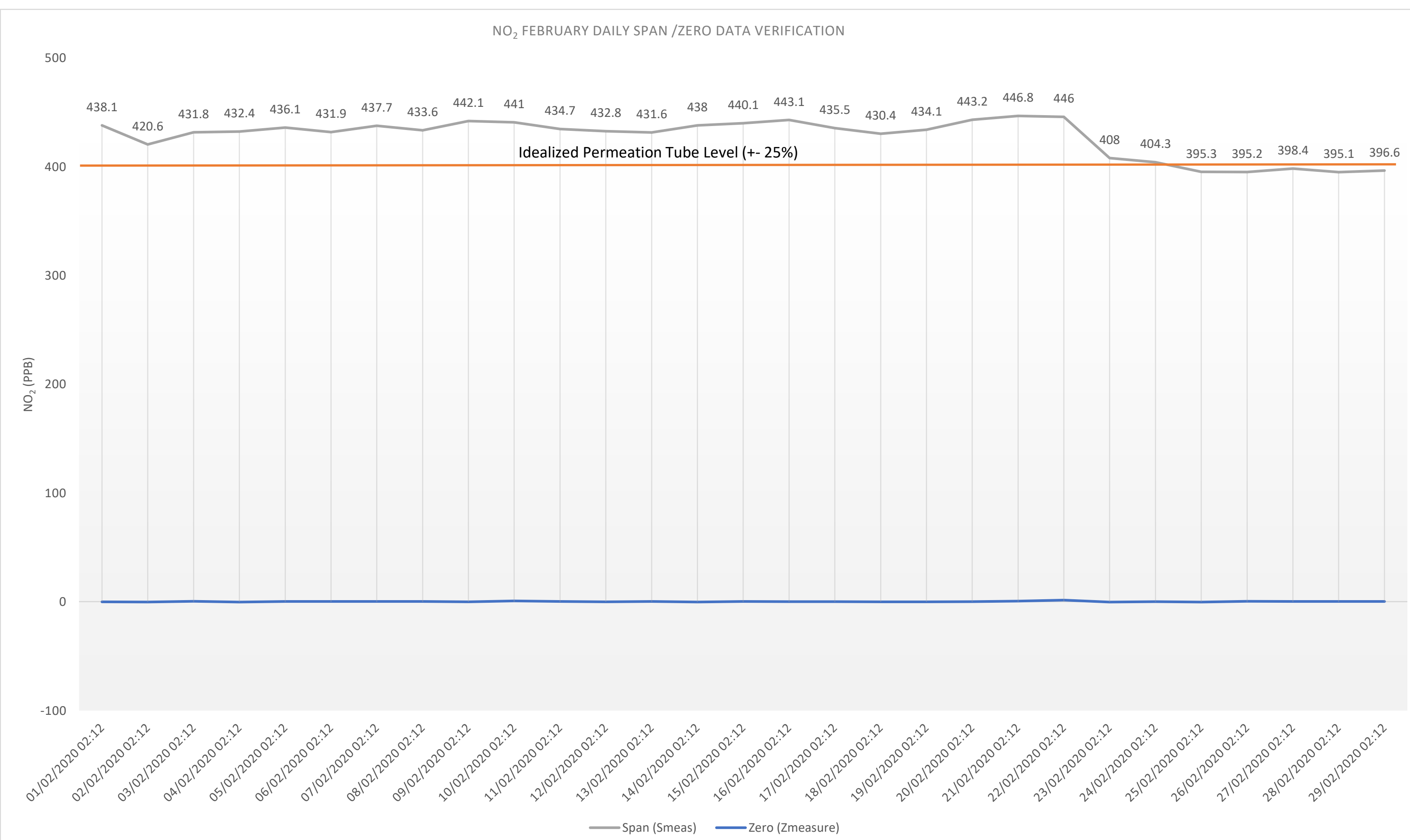

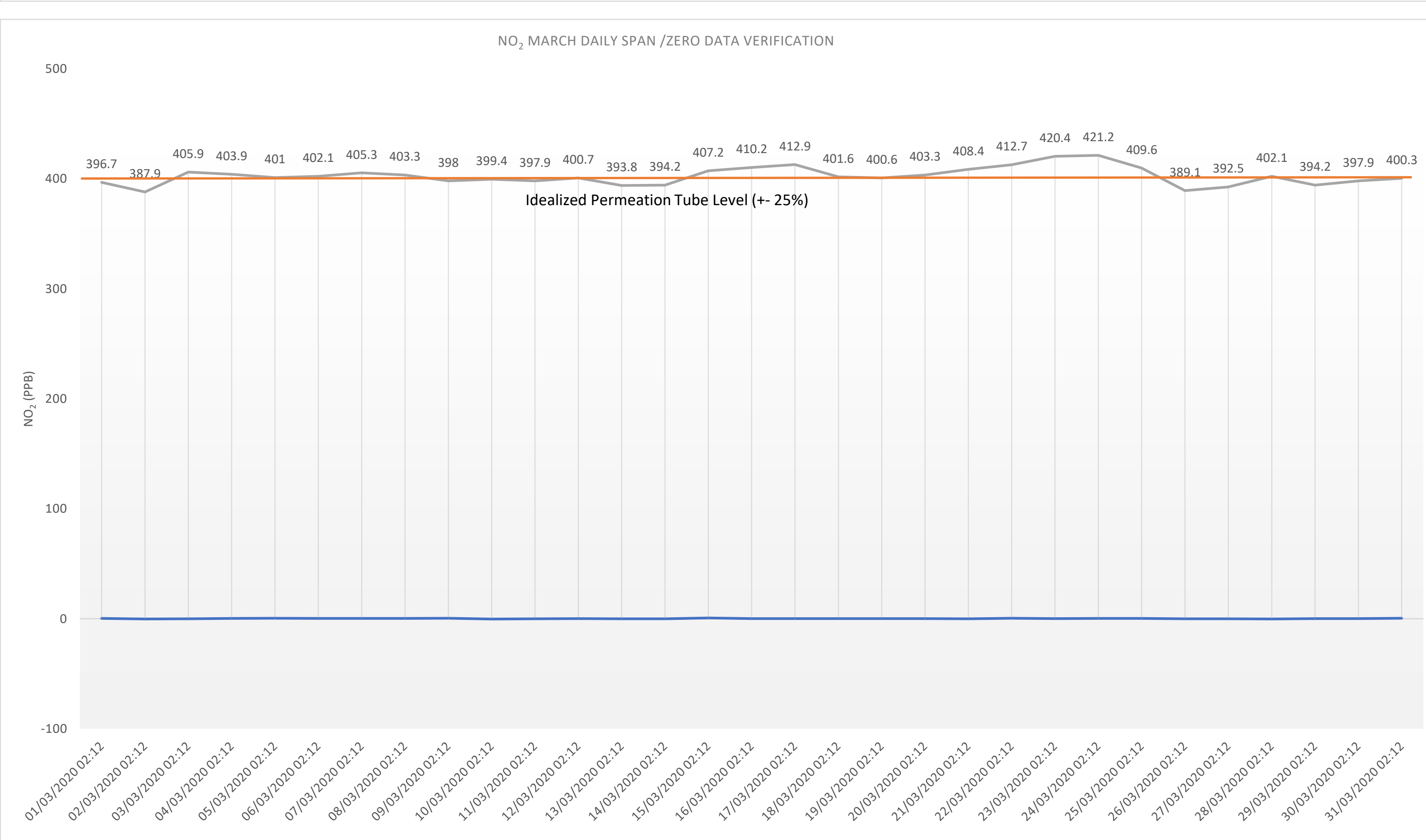

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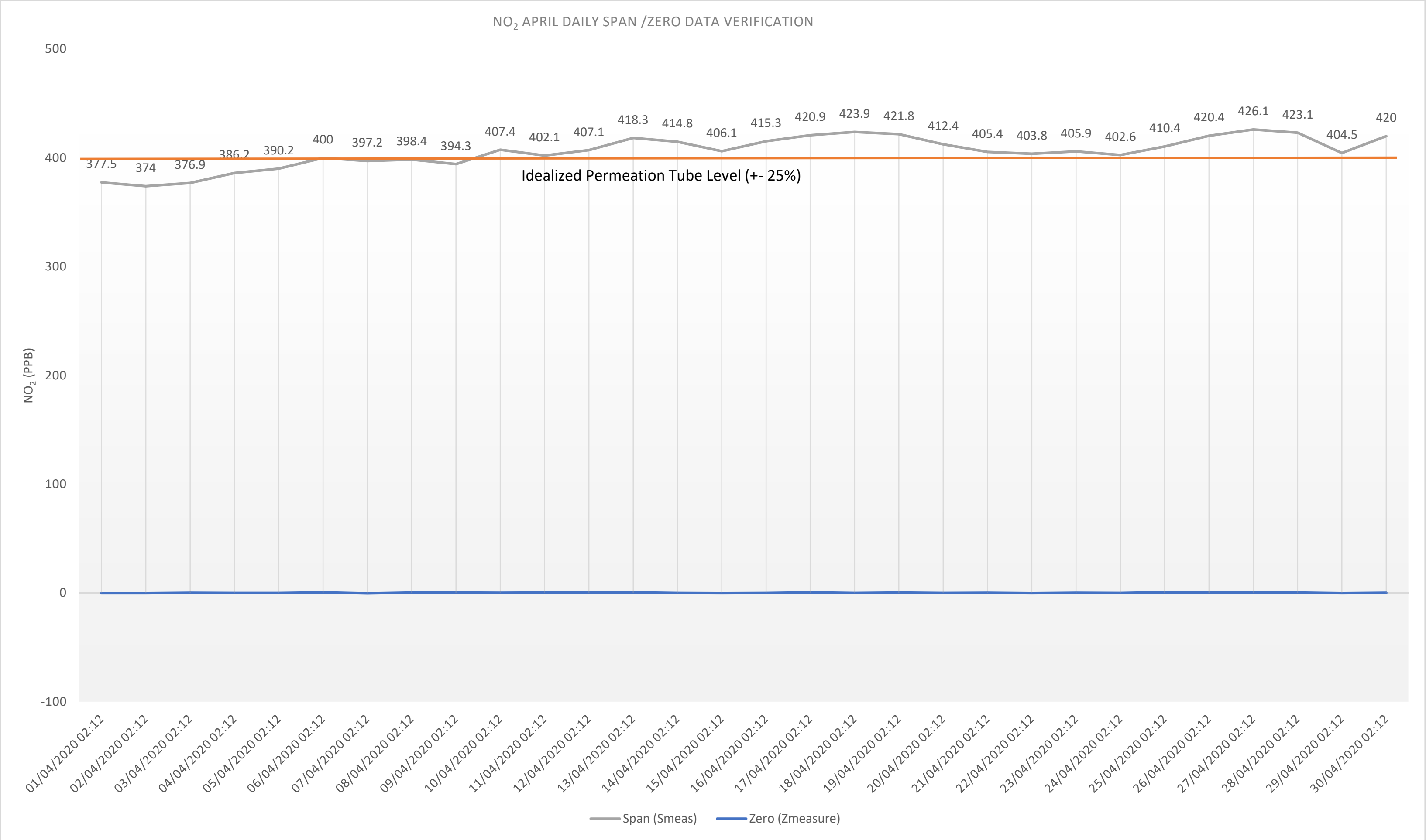

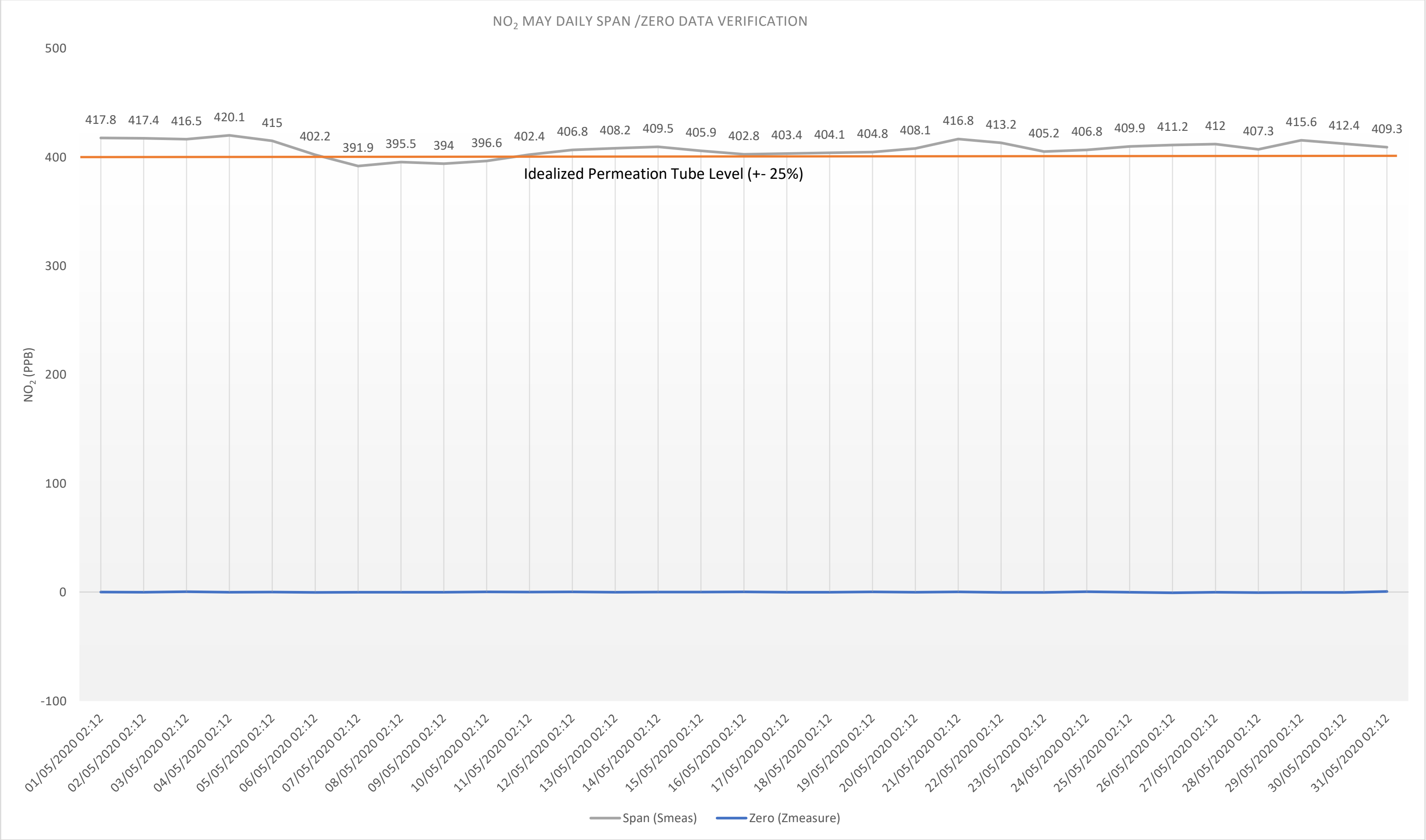

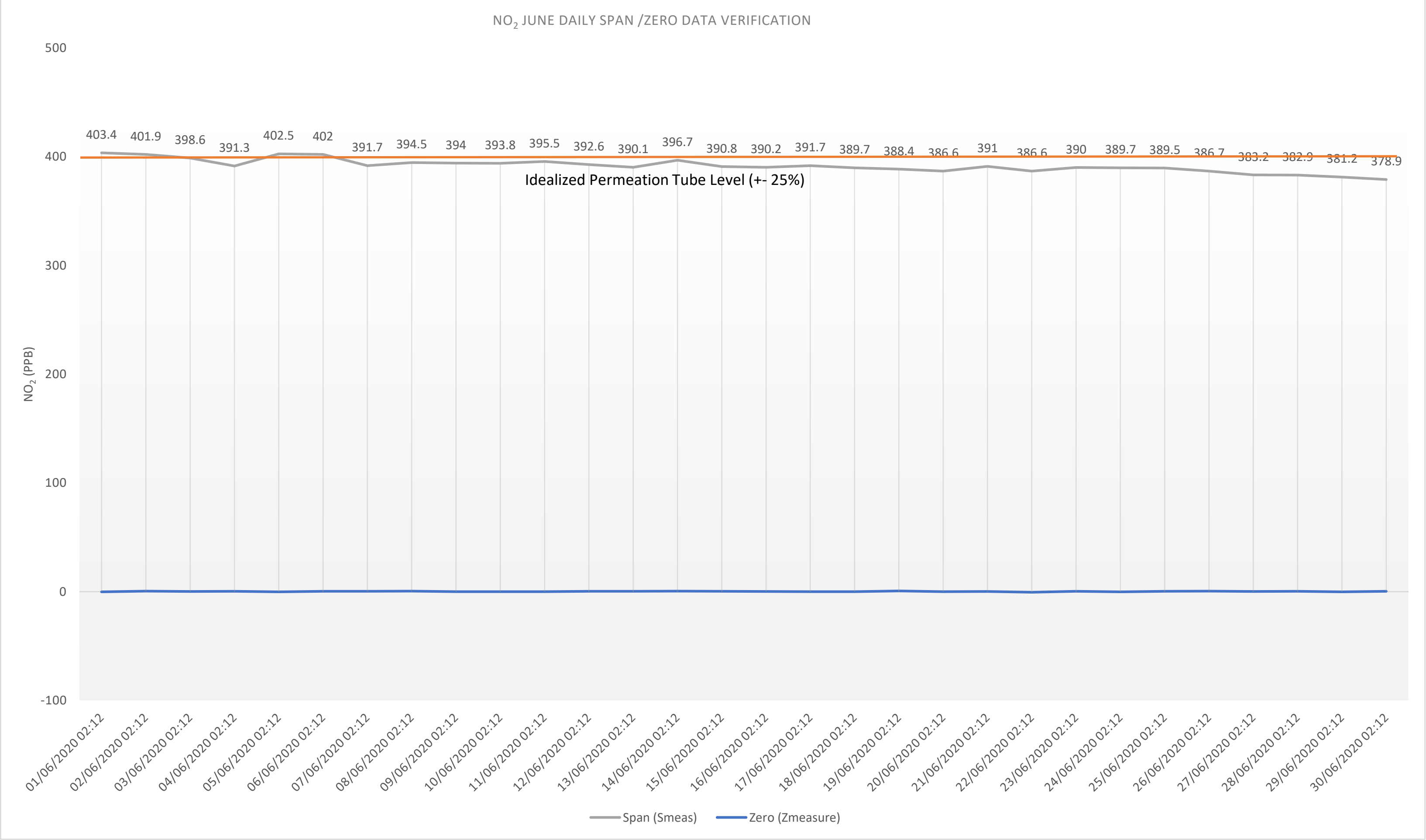

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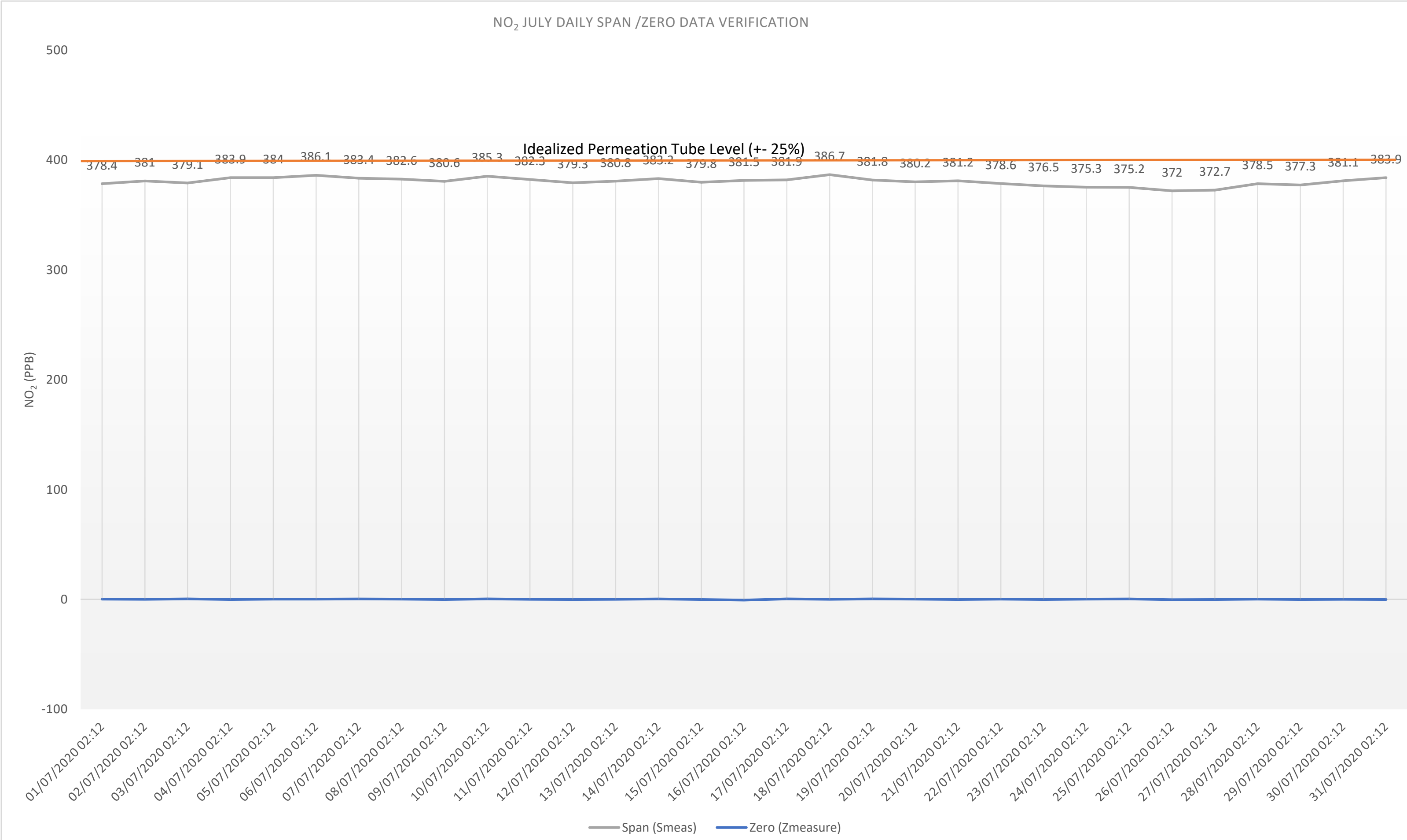
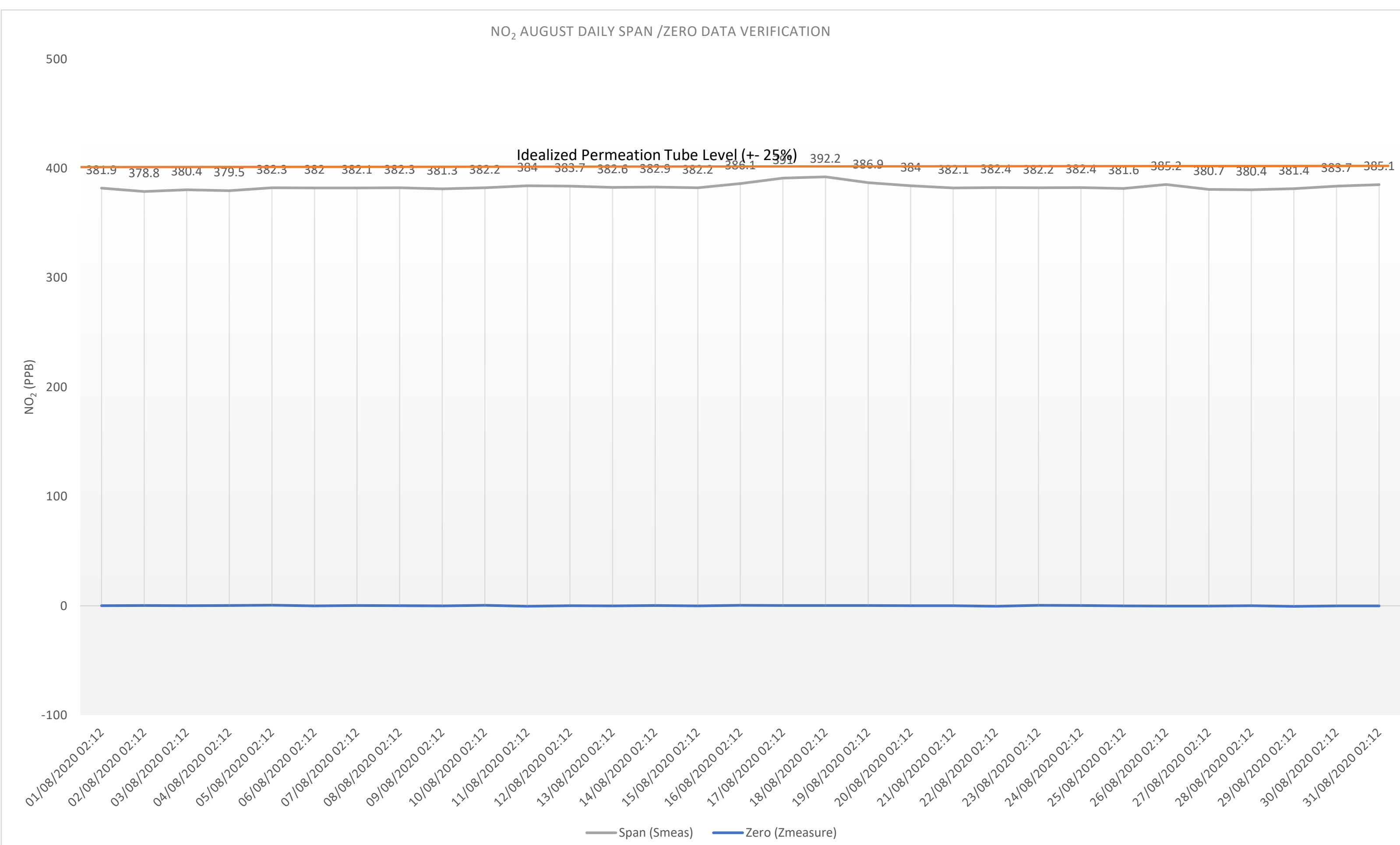
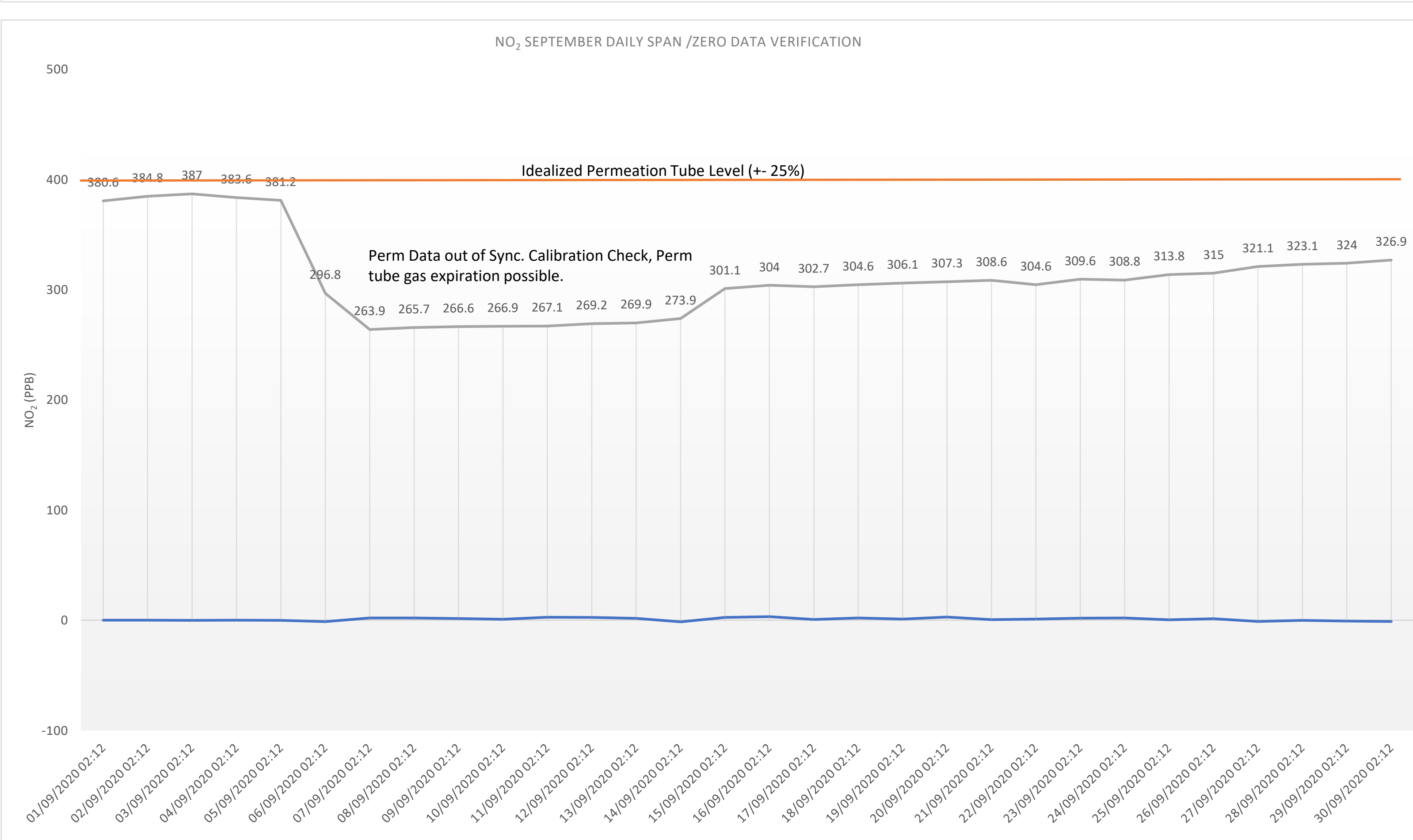
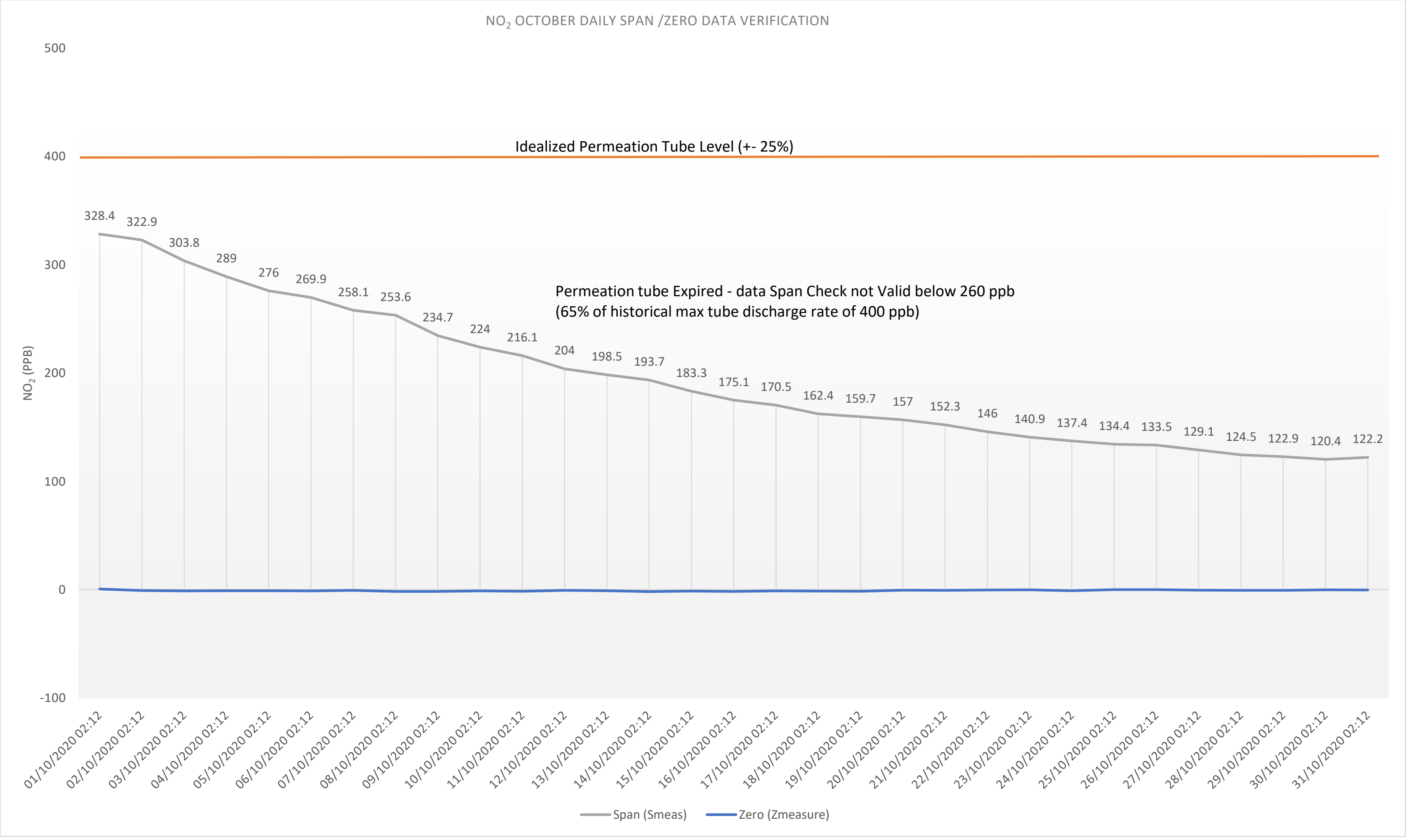
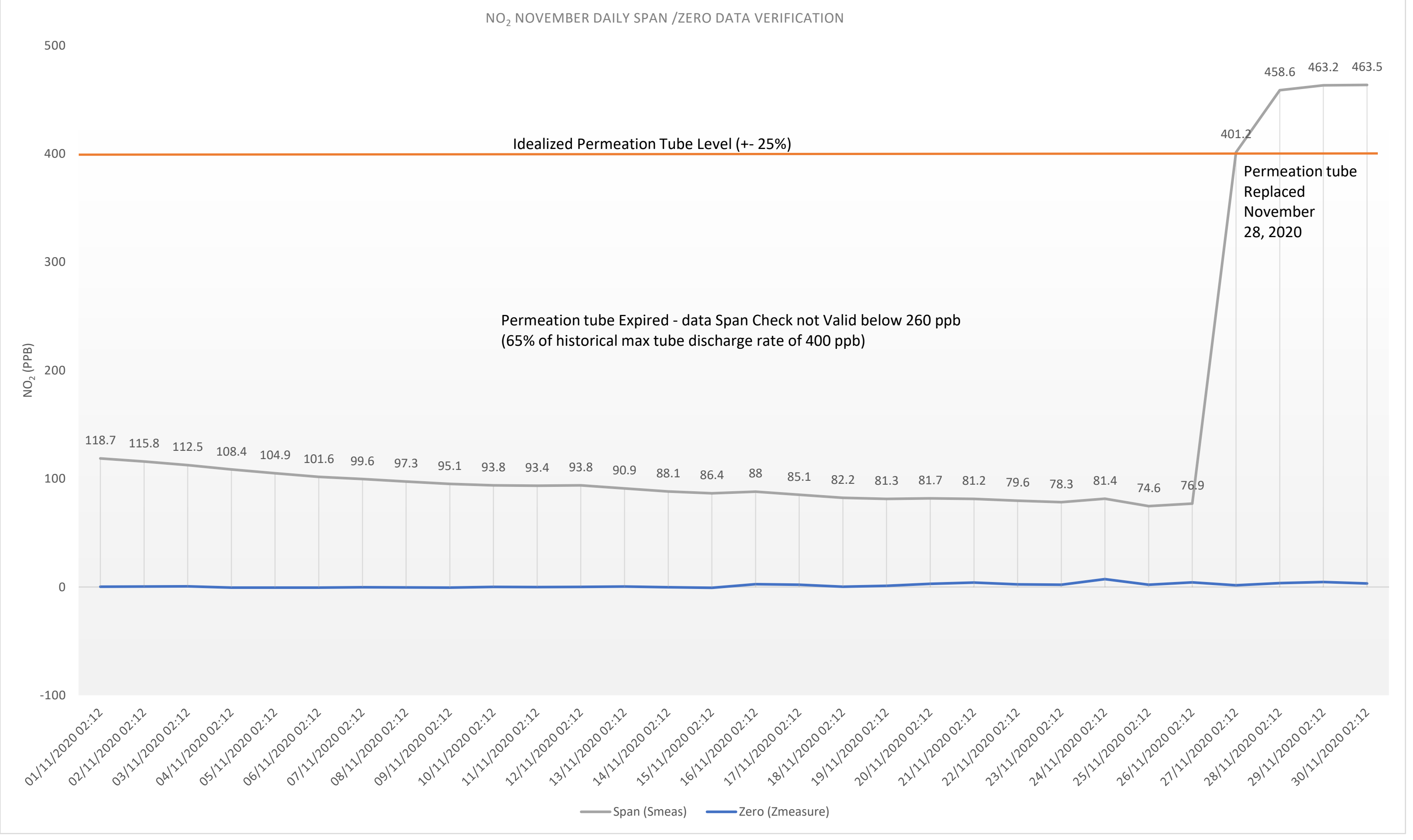


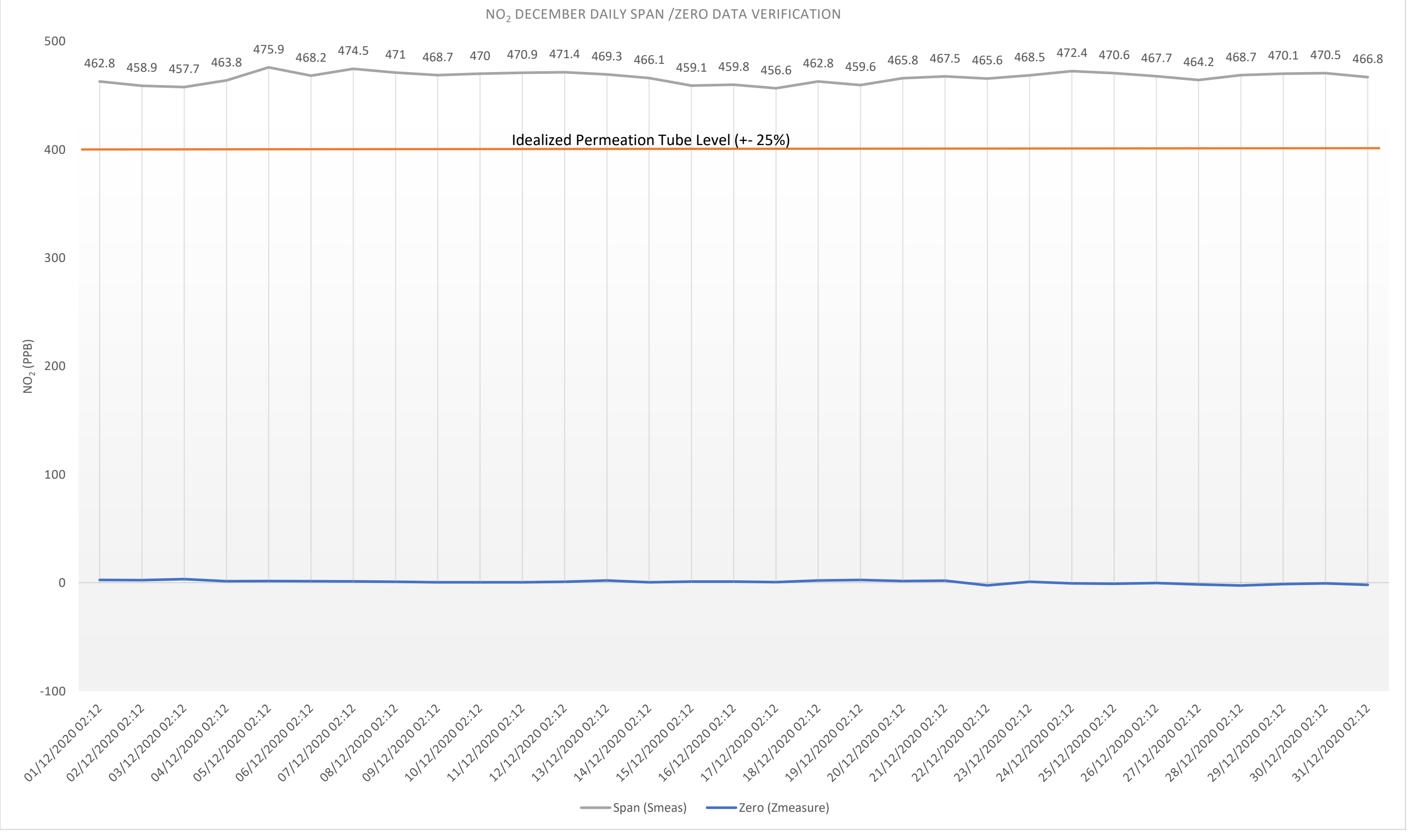




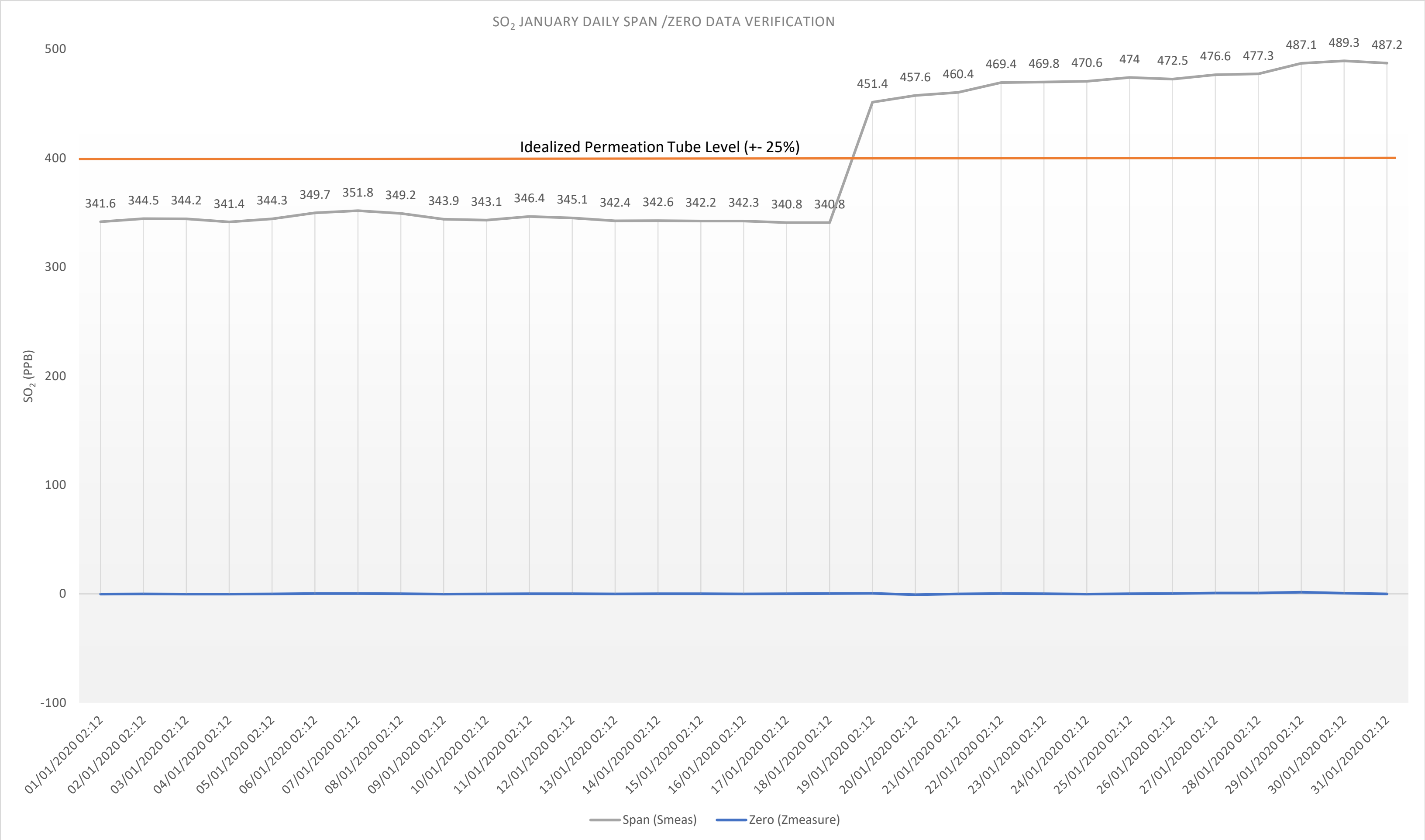
MARY RIVER - NO_2 DAILY SPAN / ZERO DATA VERIFICATION

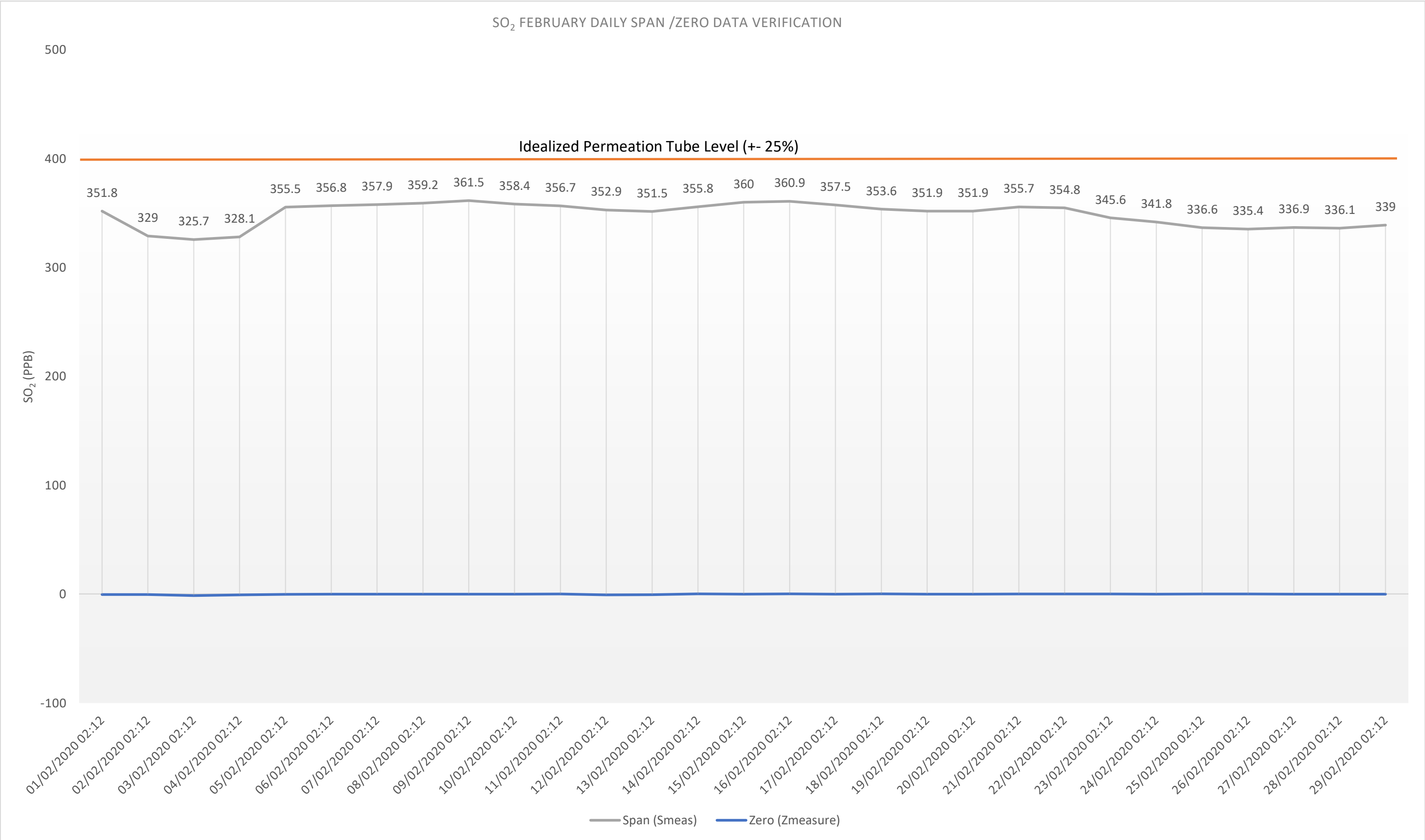


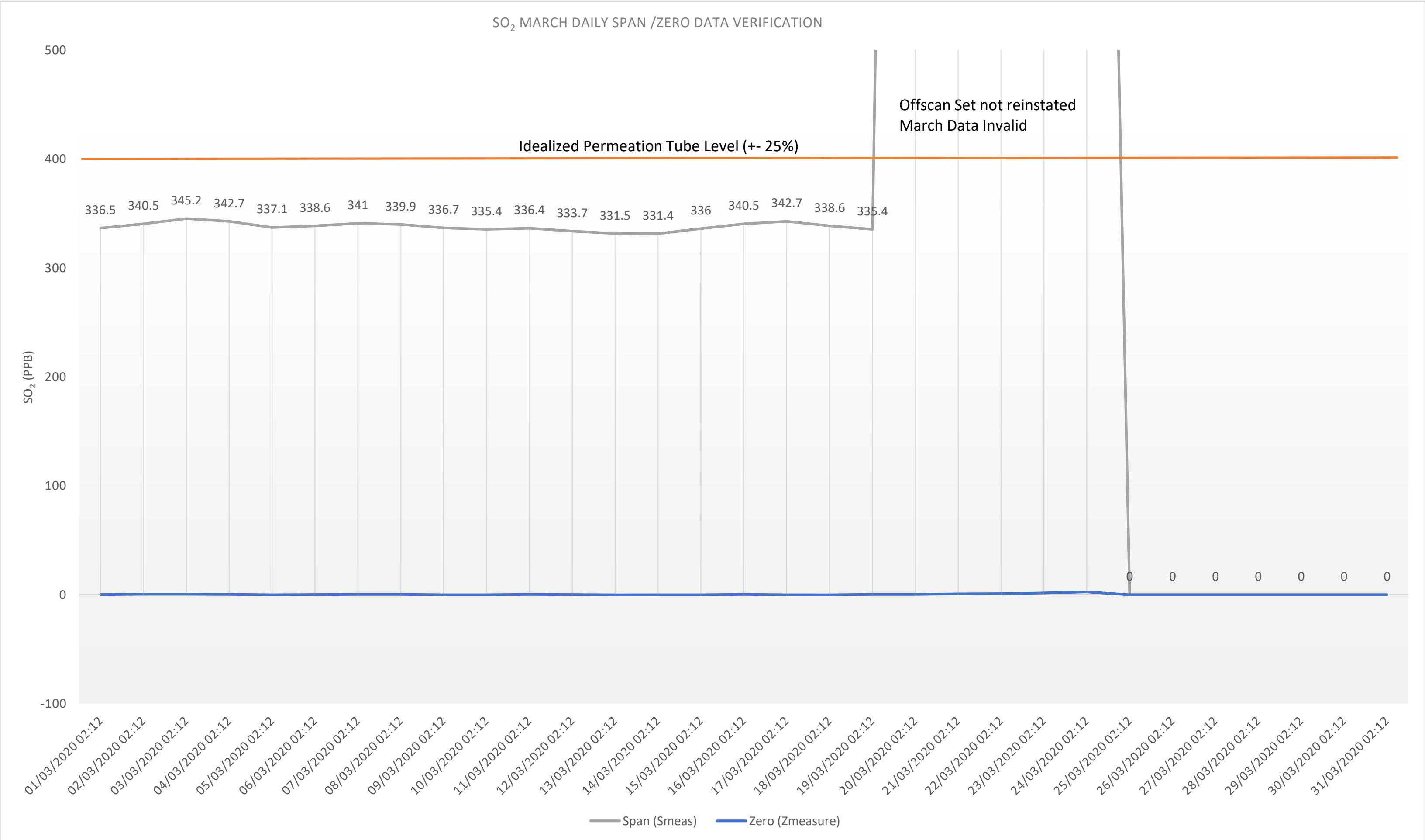




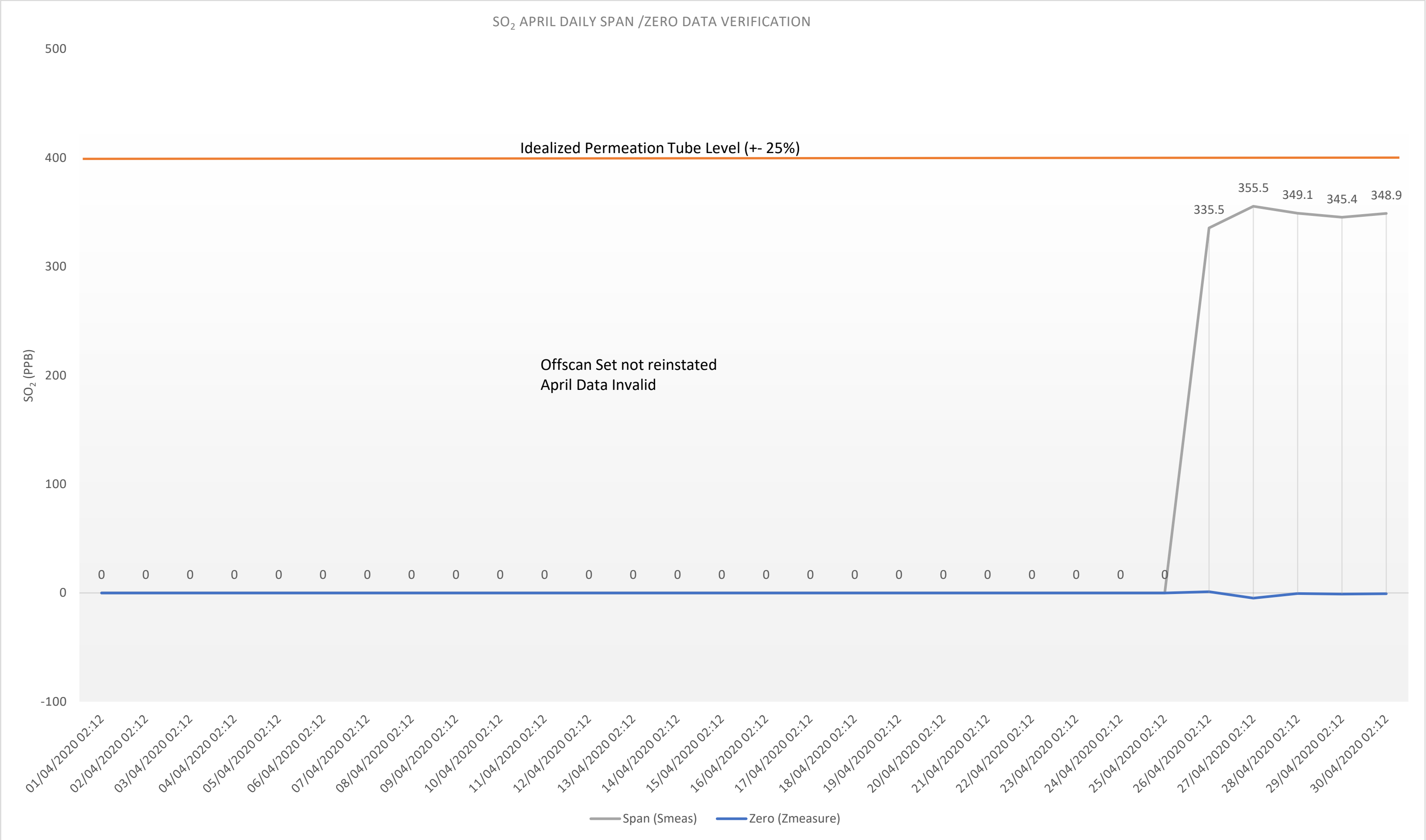
MARY RIVER - SO_2 DAILY SPAN / ZERO DATA VERIFICATION

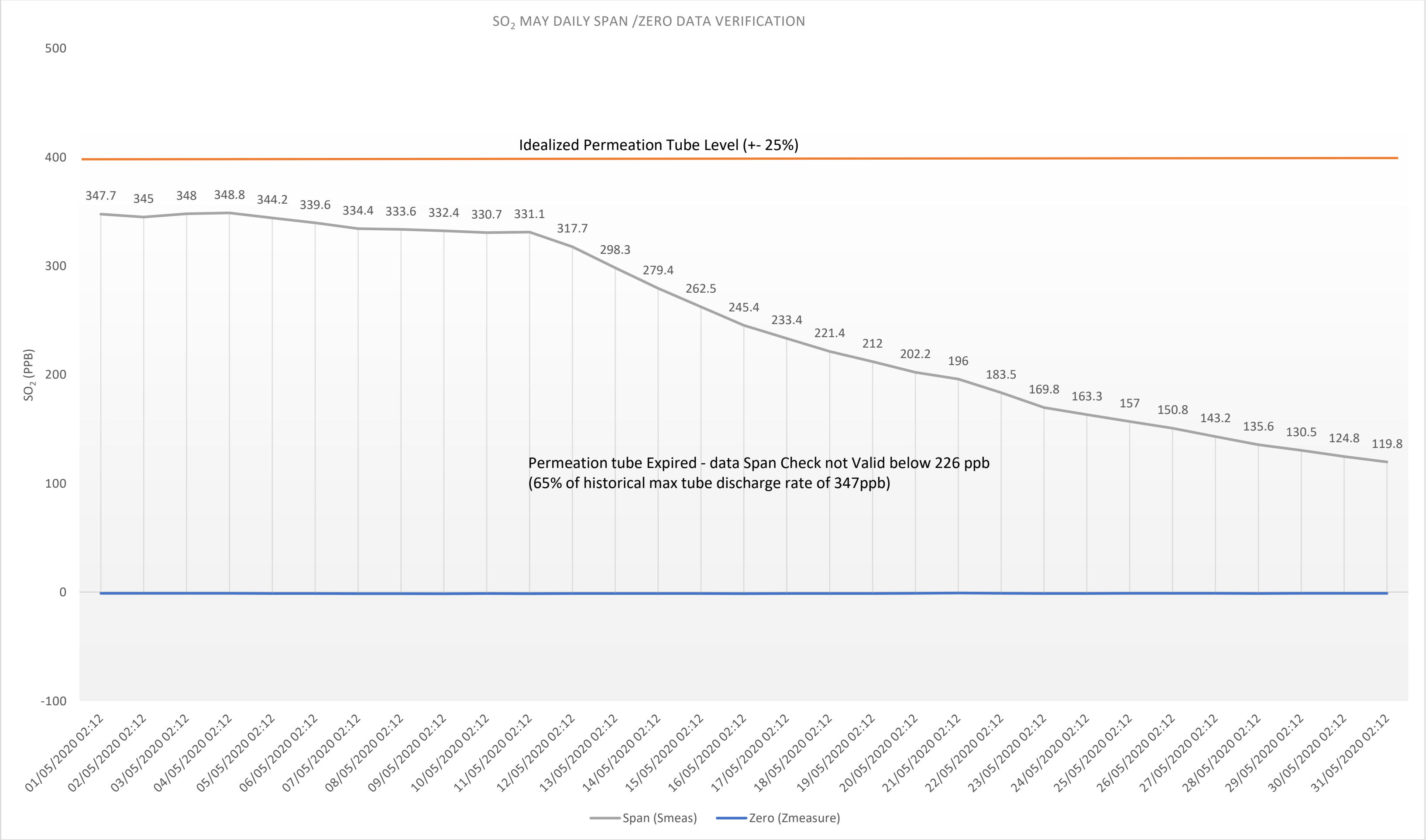


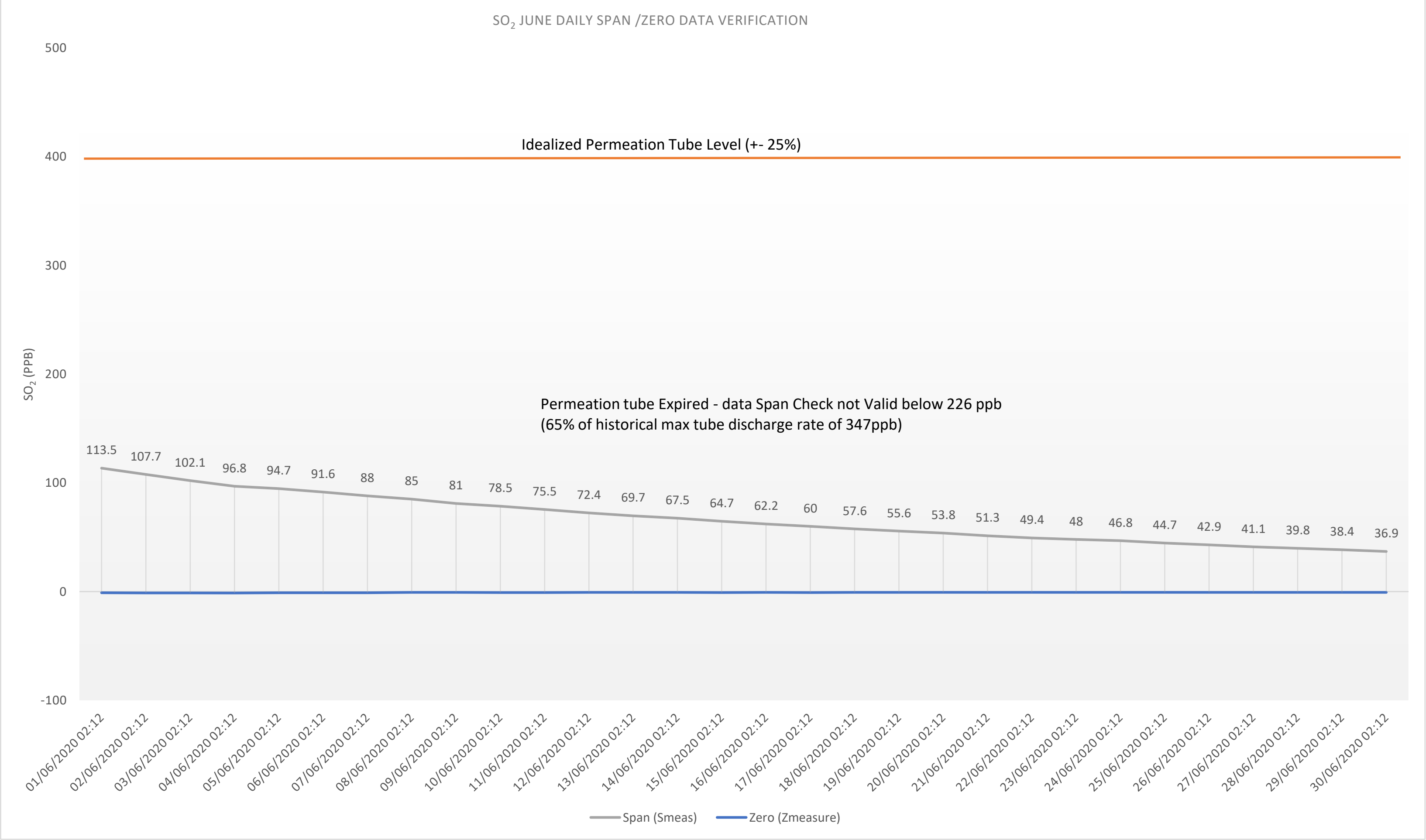




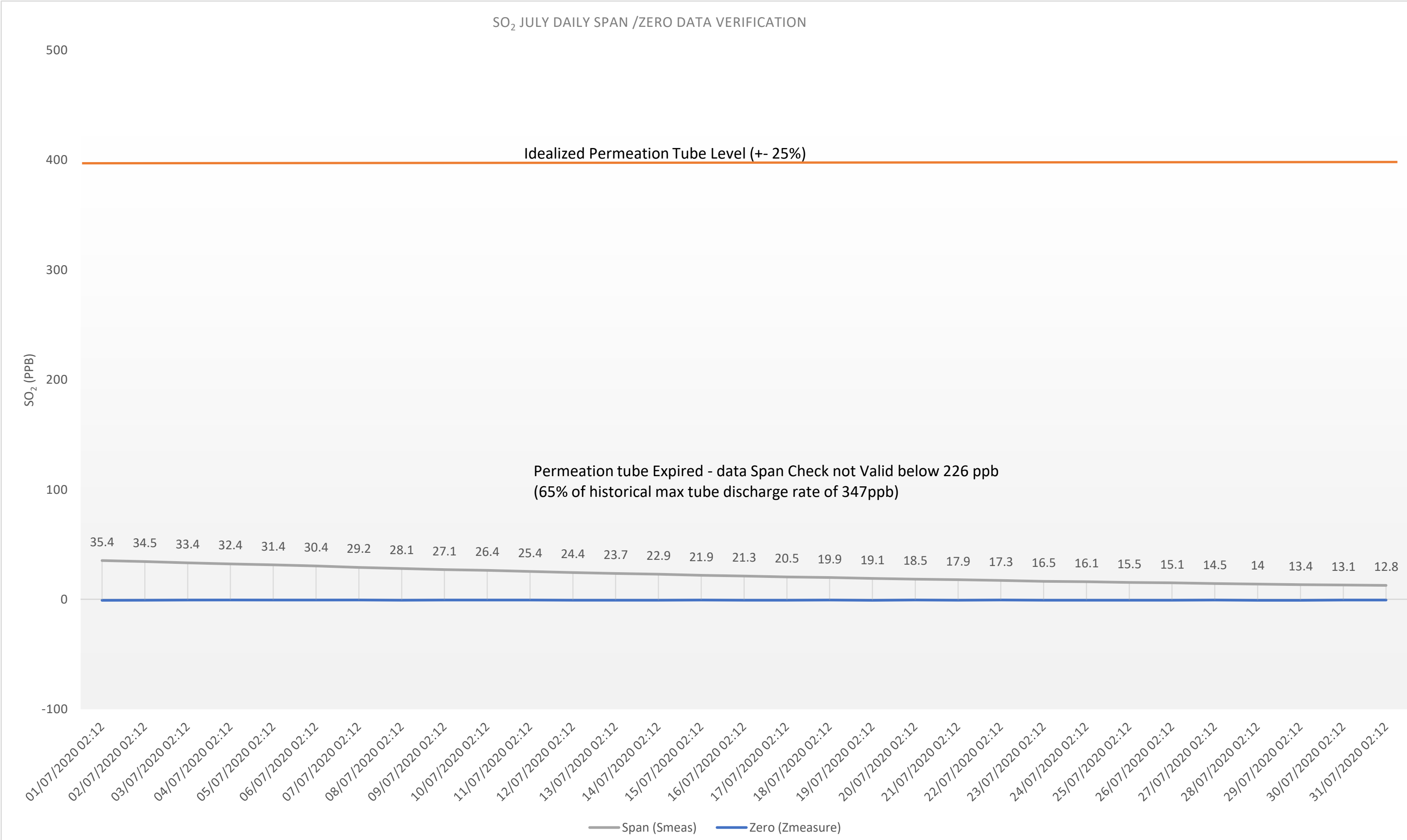
MARY RIVER - SO_2 DAILY SPAN / ZERO DATA VERIFICATION

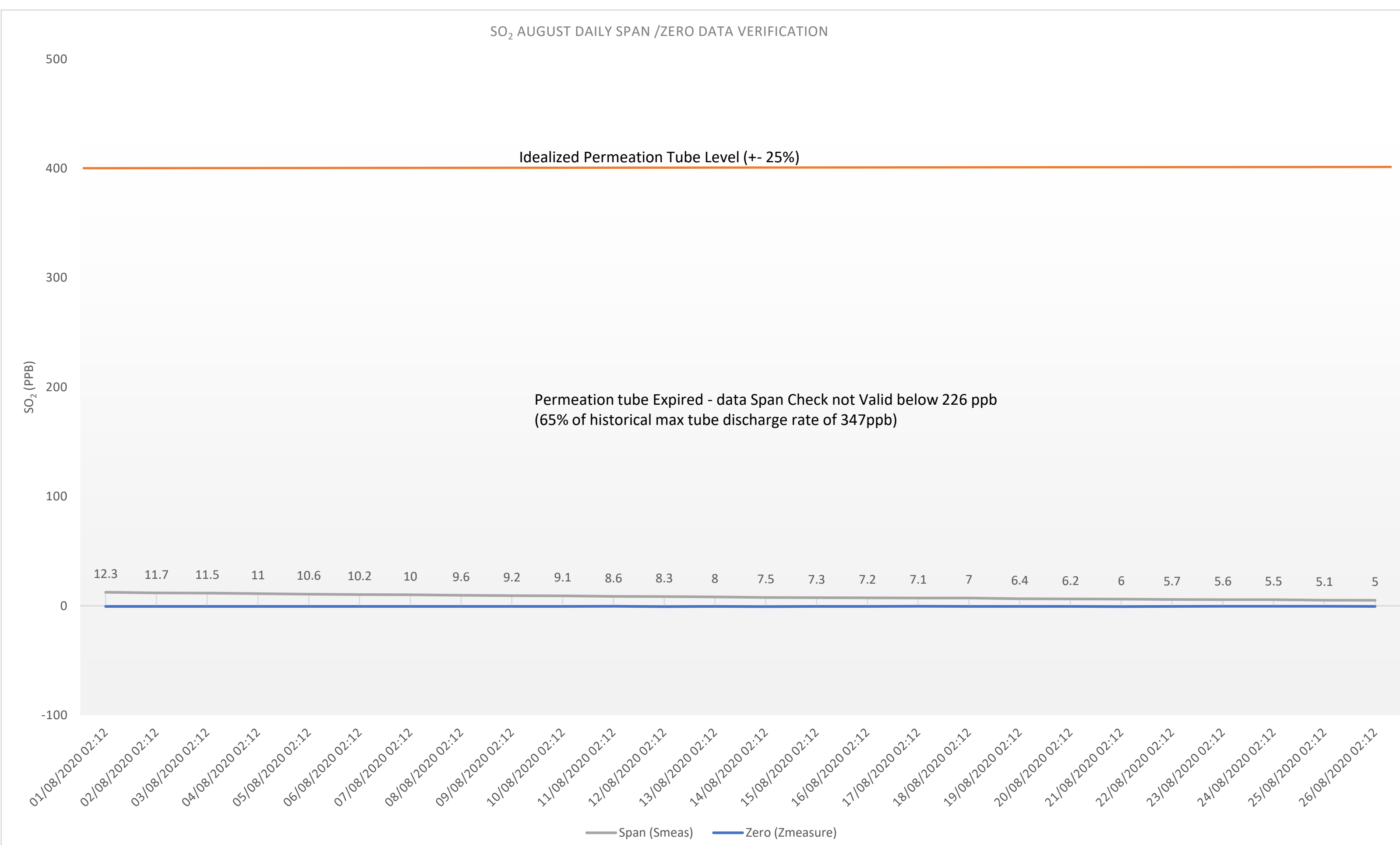


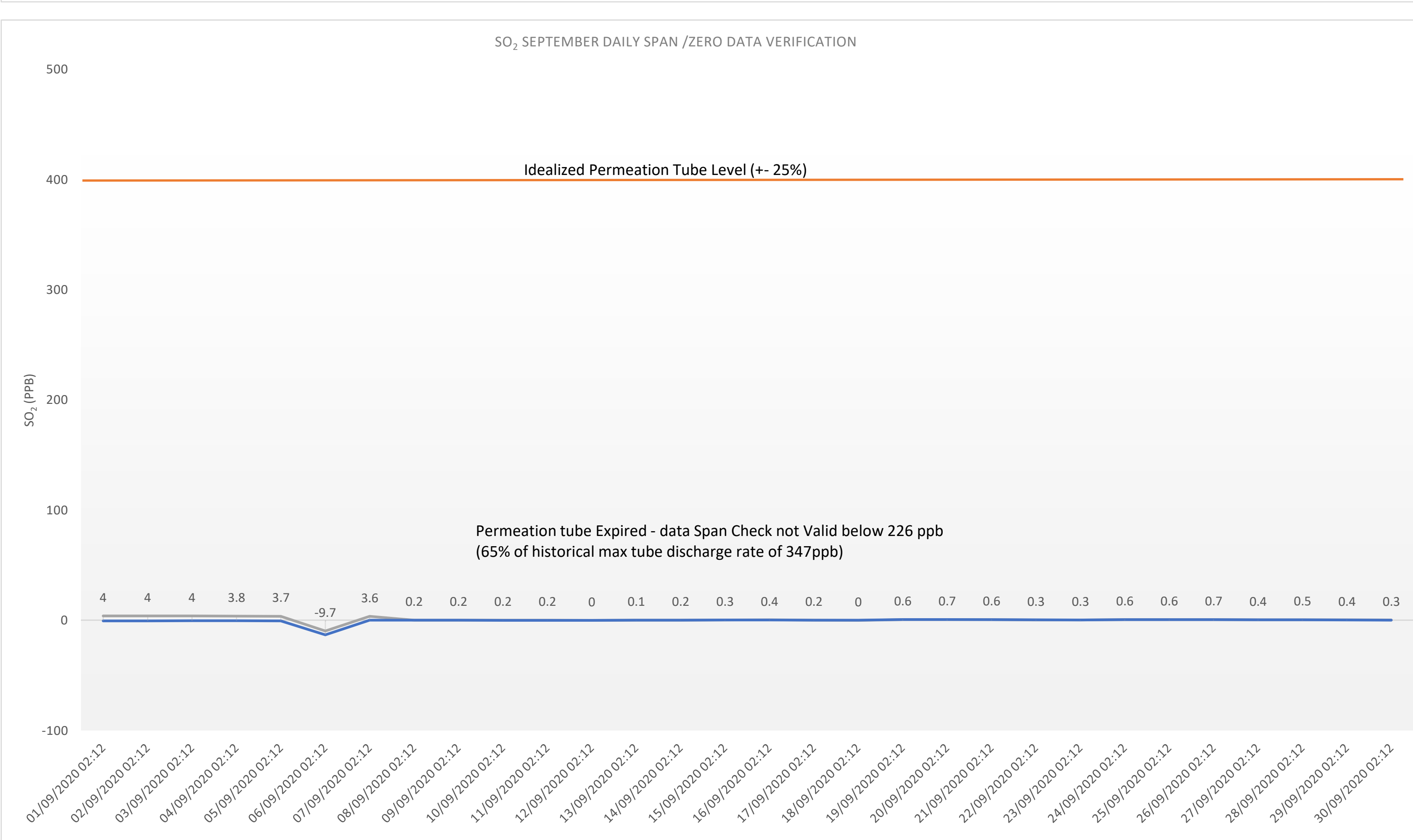


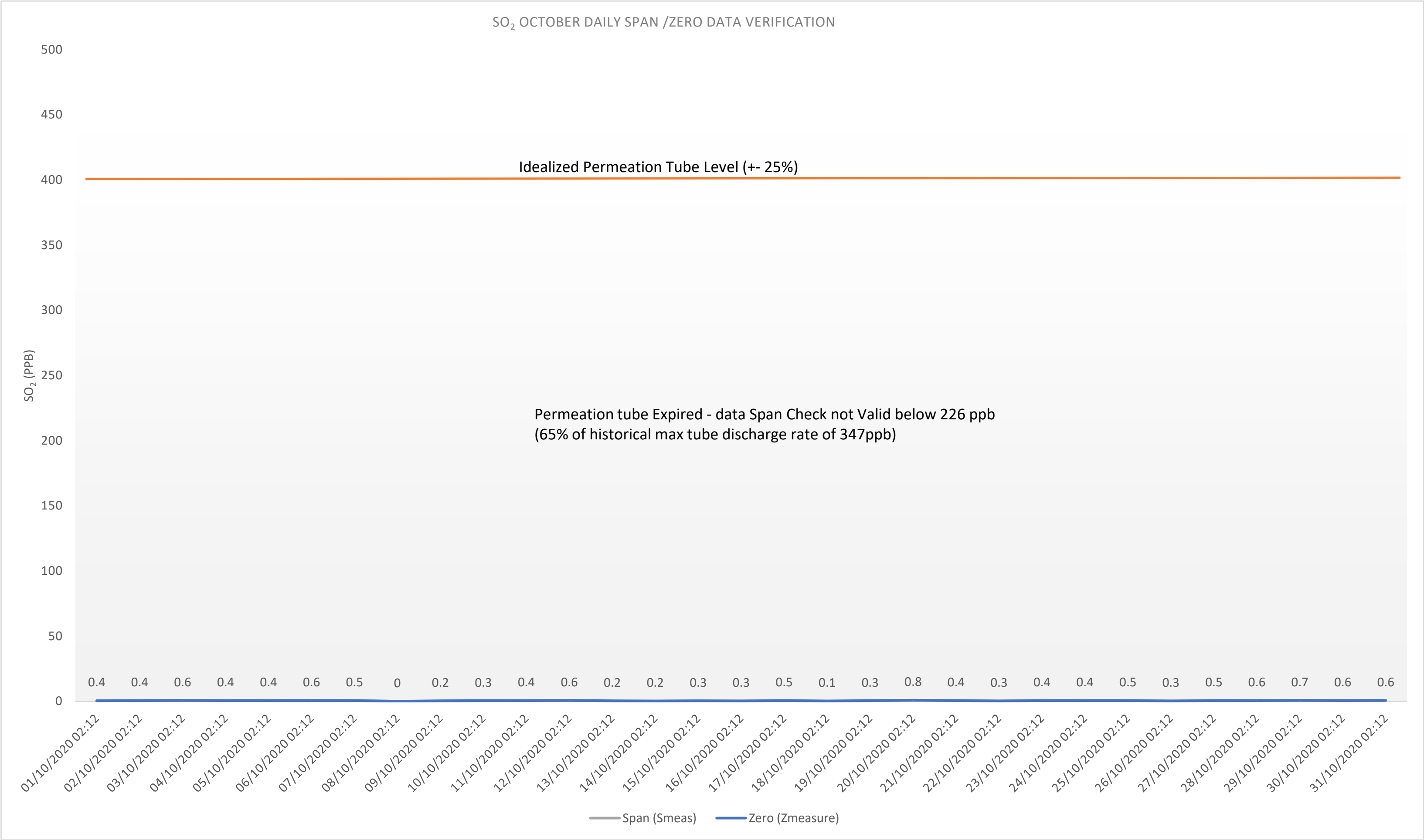


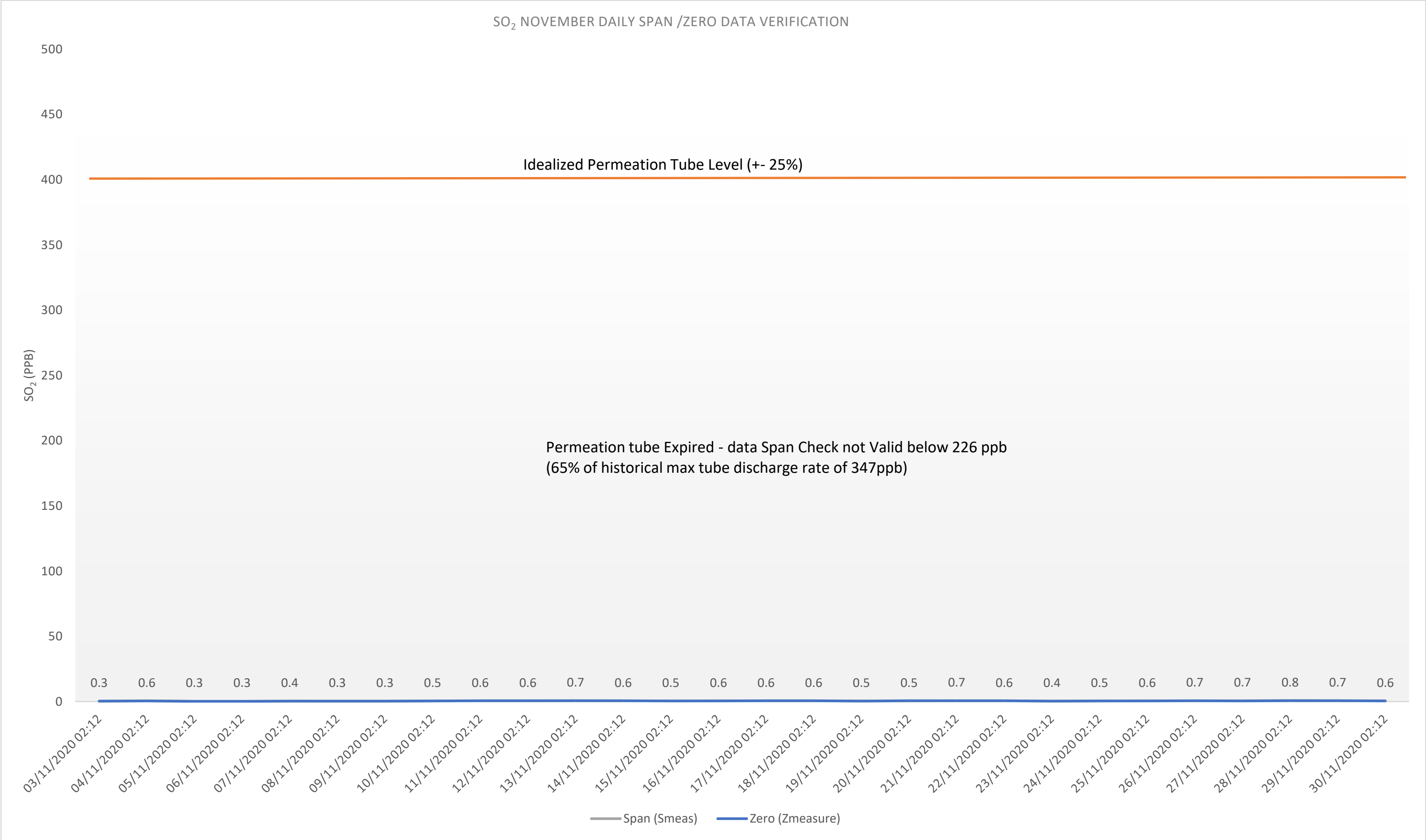
MARY RIVER - SO_2 DAILY SPAN / ZERO DATA VERIFICATION

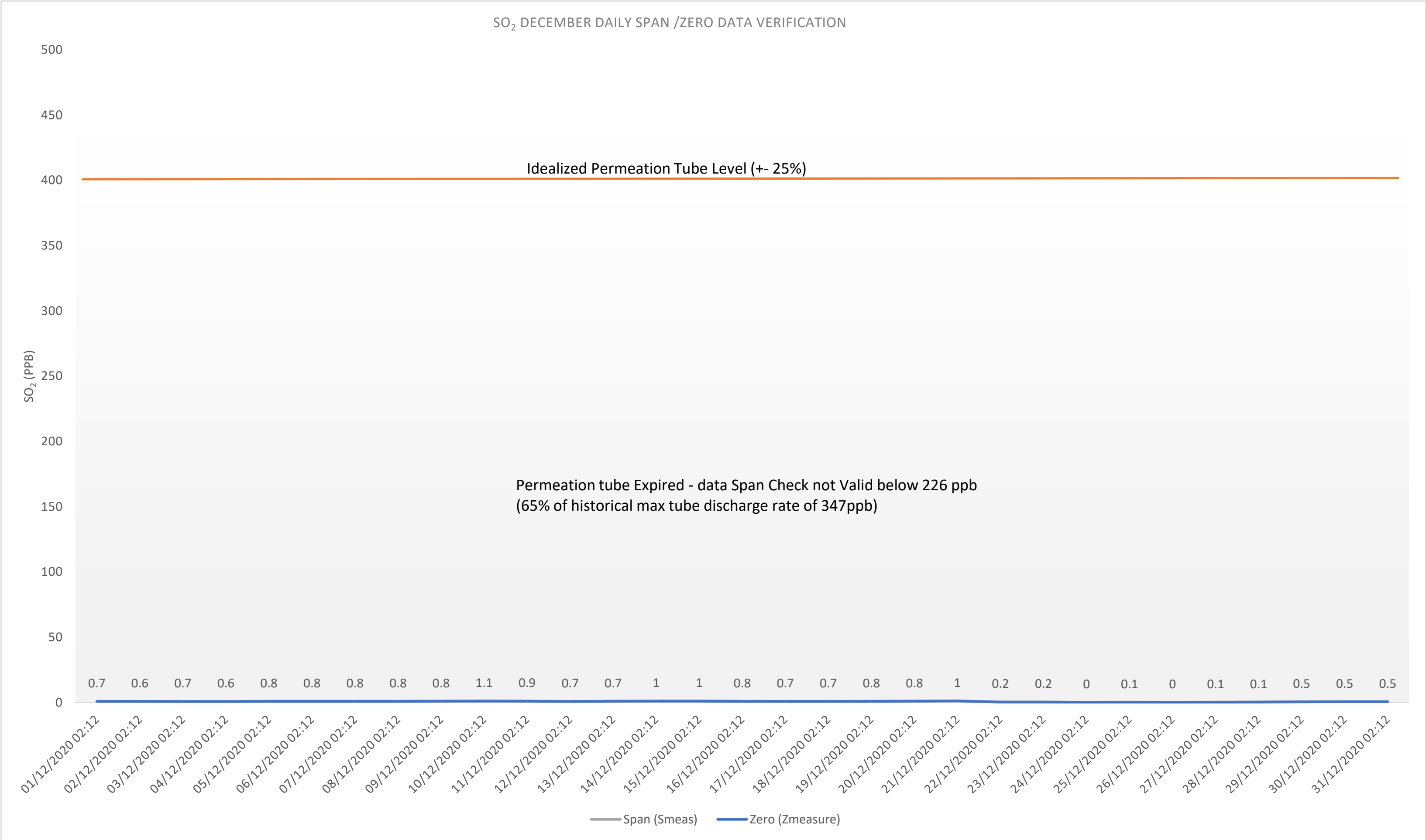






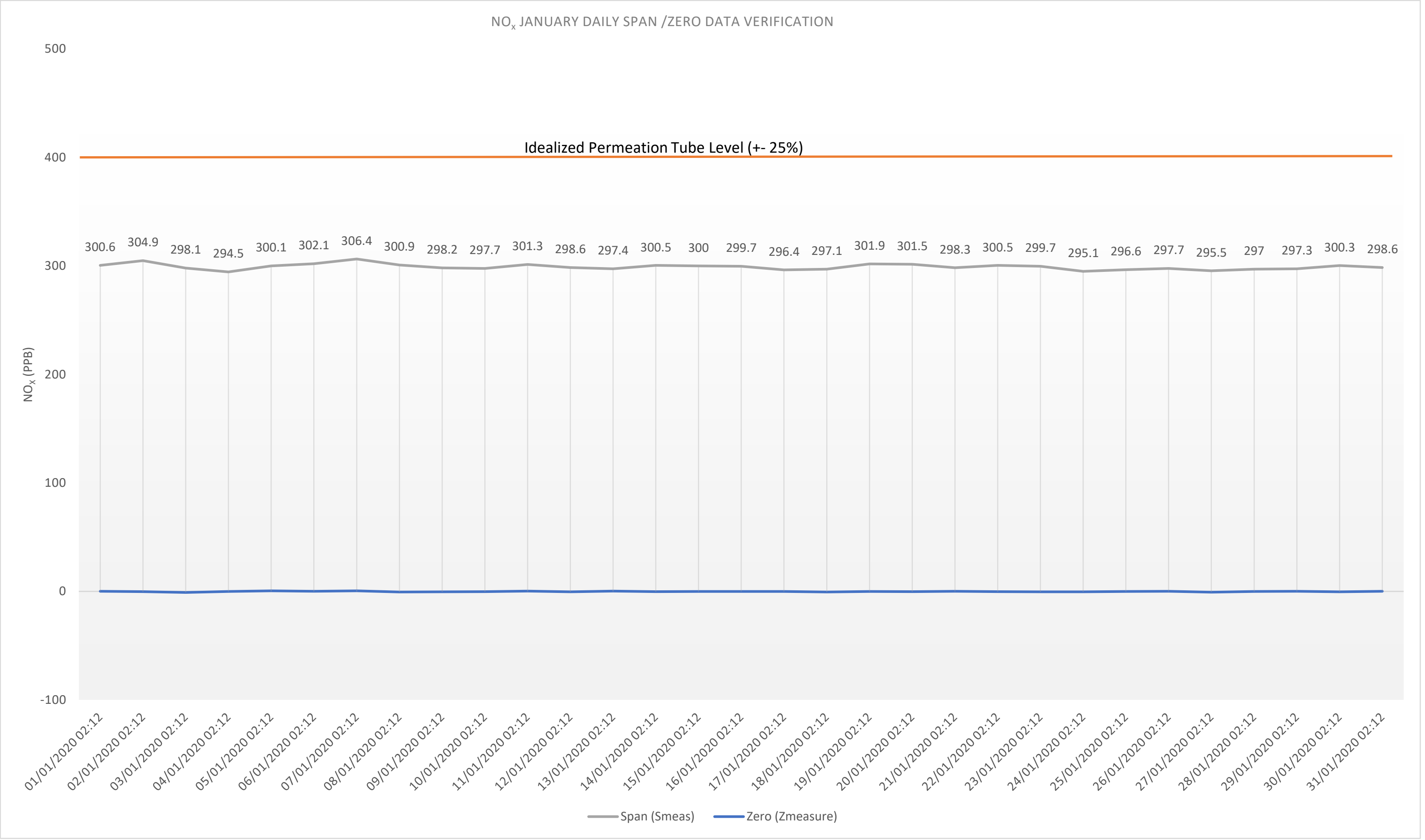

SO2 OCTOBER DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
Permeation tube Expired - data Span Check not Valid below 226 ppb
(65% of historical max tube discharge rate of 347ppb)
SO2 (PPB)
Span (Smeas)
Zero (Zmeasure)

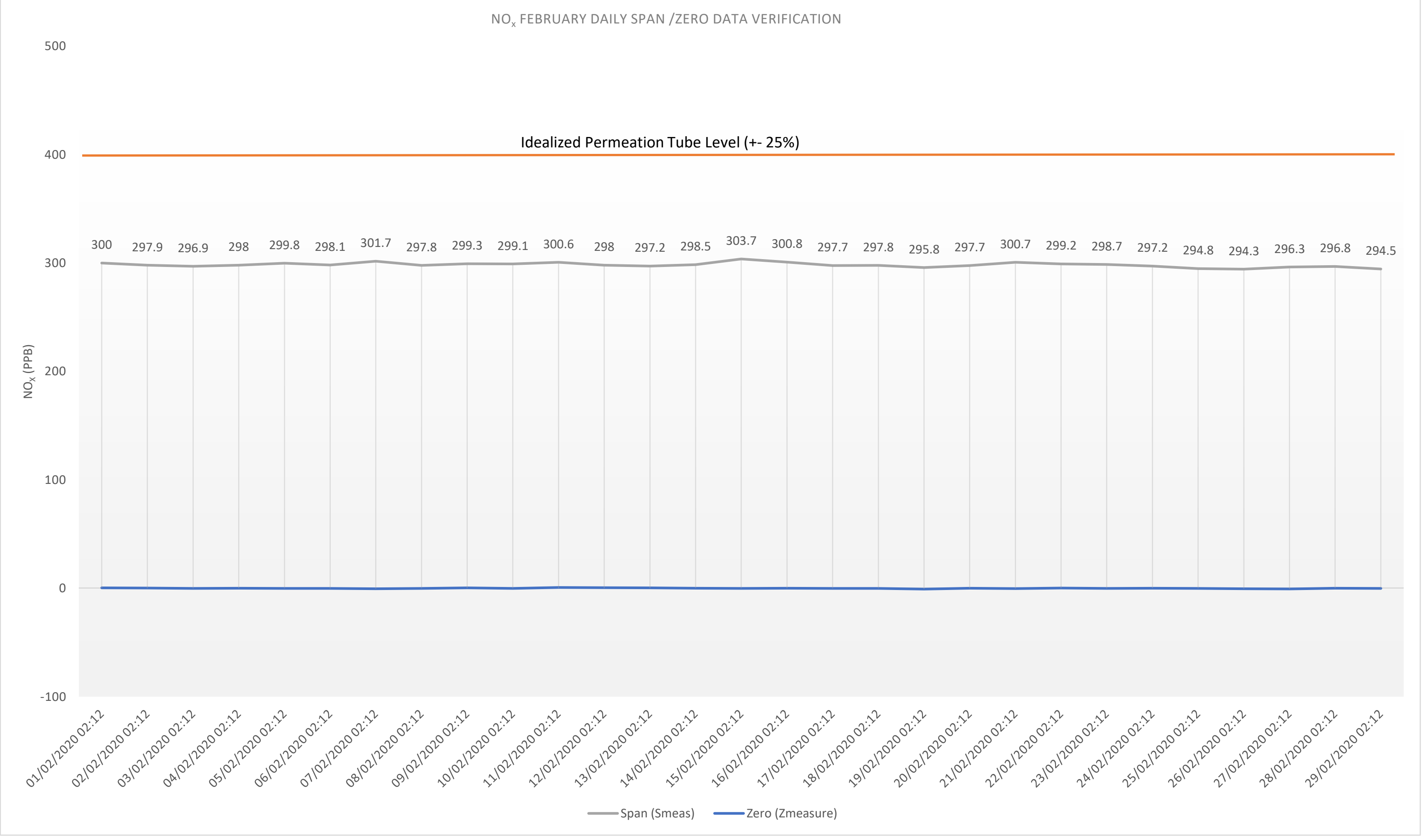

SO2 NOVEMBER DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
Permeation tube Expired - data Span Check not Valid below 226 ppb
(65% of historical max tube discharge rate of 347ppb)
SO2 (PPB)
Span (Smeas)
Zero (Zmeasure)

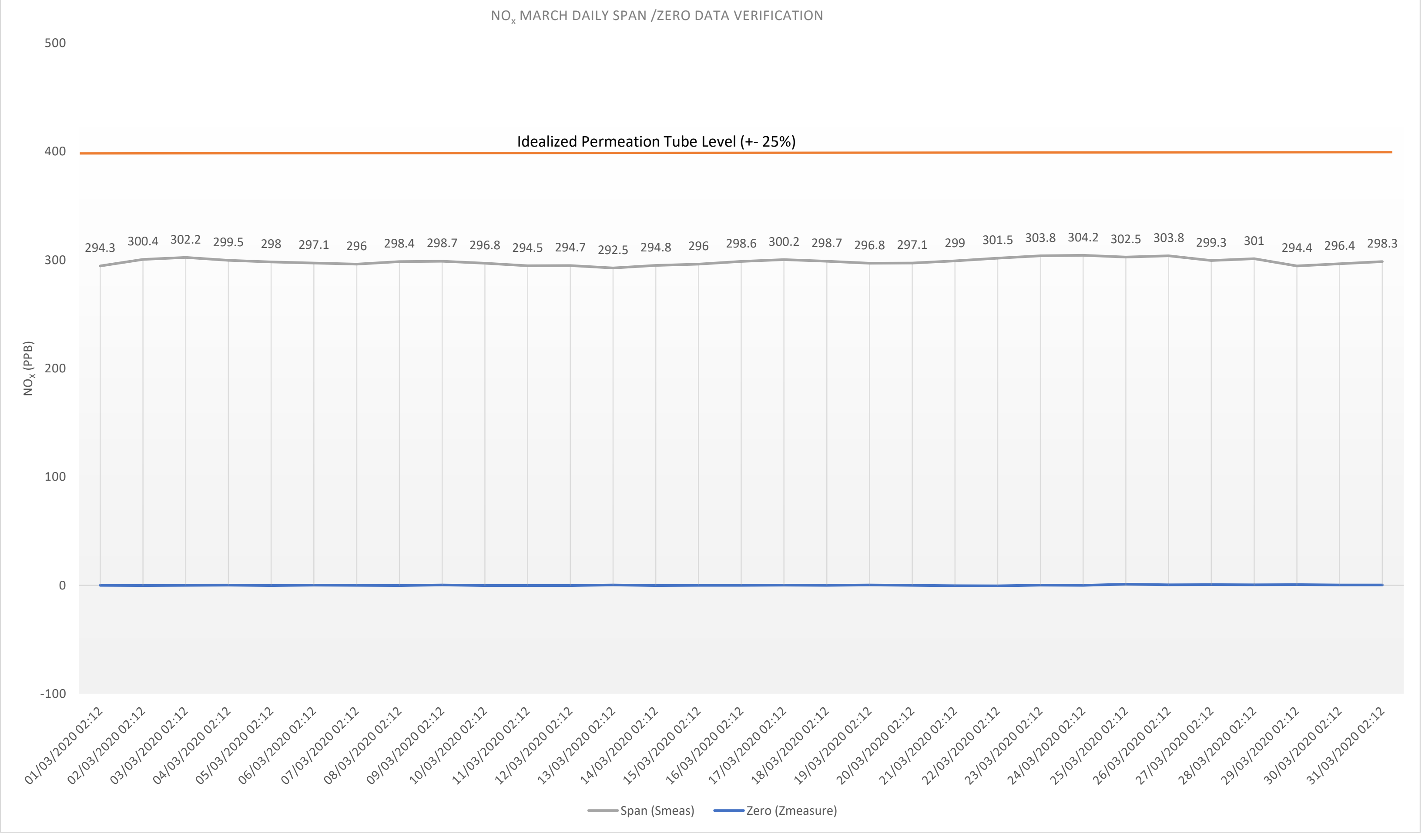

SO2 DECEMBER DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
Permeation tube Expired - data Span Check not Valid below 226 ppb
(65% of historical max tube discharge rate of 347ppb)
SO2 (PPB)
Span (Smeas)
Zero (Zmeasure)

2020 ANNUAL AIR QUALITY, DUSTFALL AND METEOROLOGY REPORT

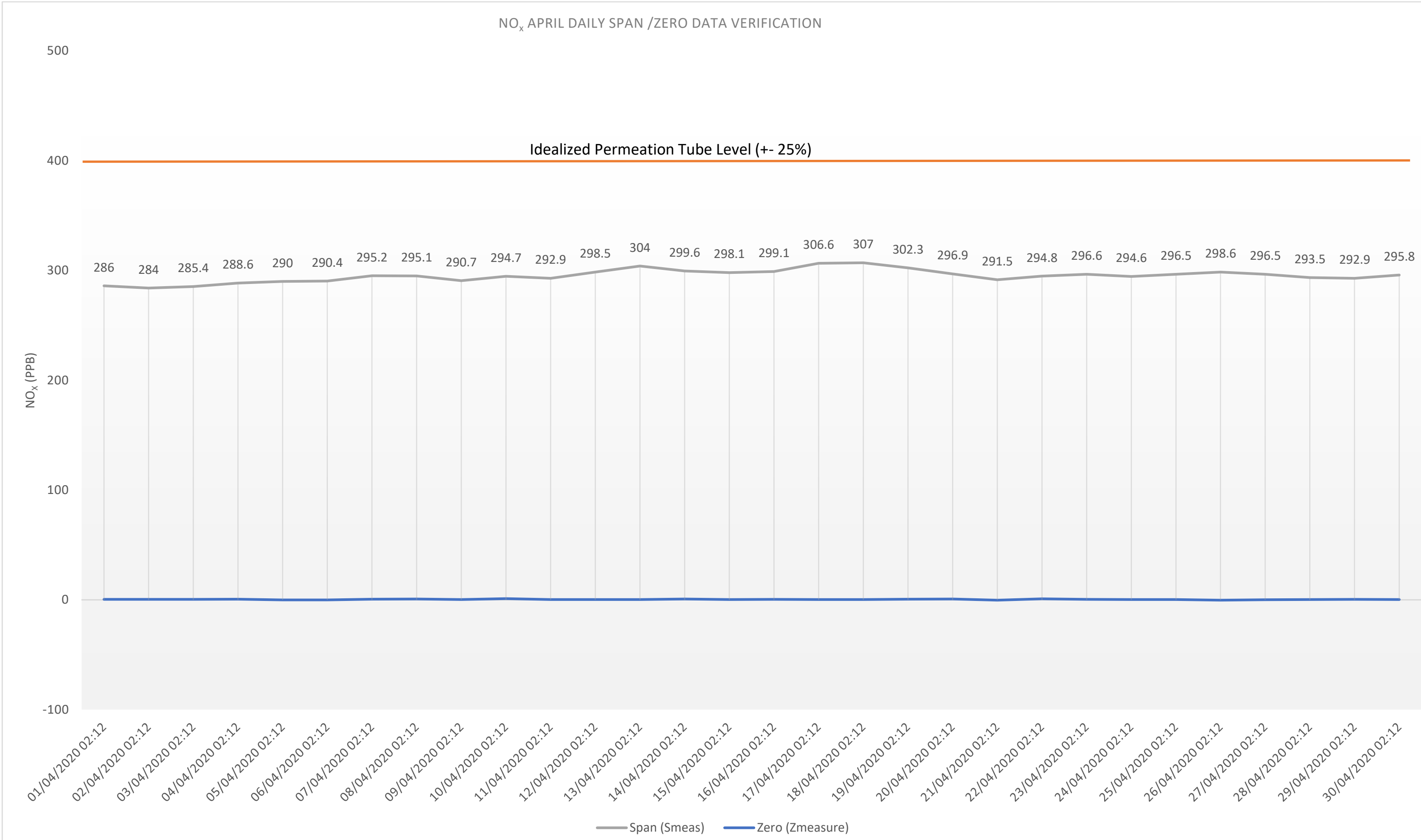
MILNE PORT - NO_X DAILY SPAN / ZERO DATA VERIFICATION

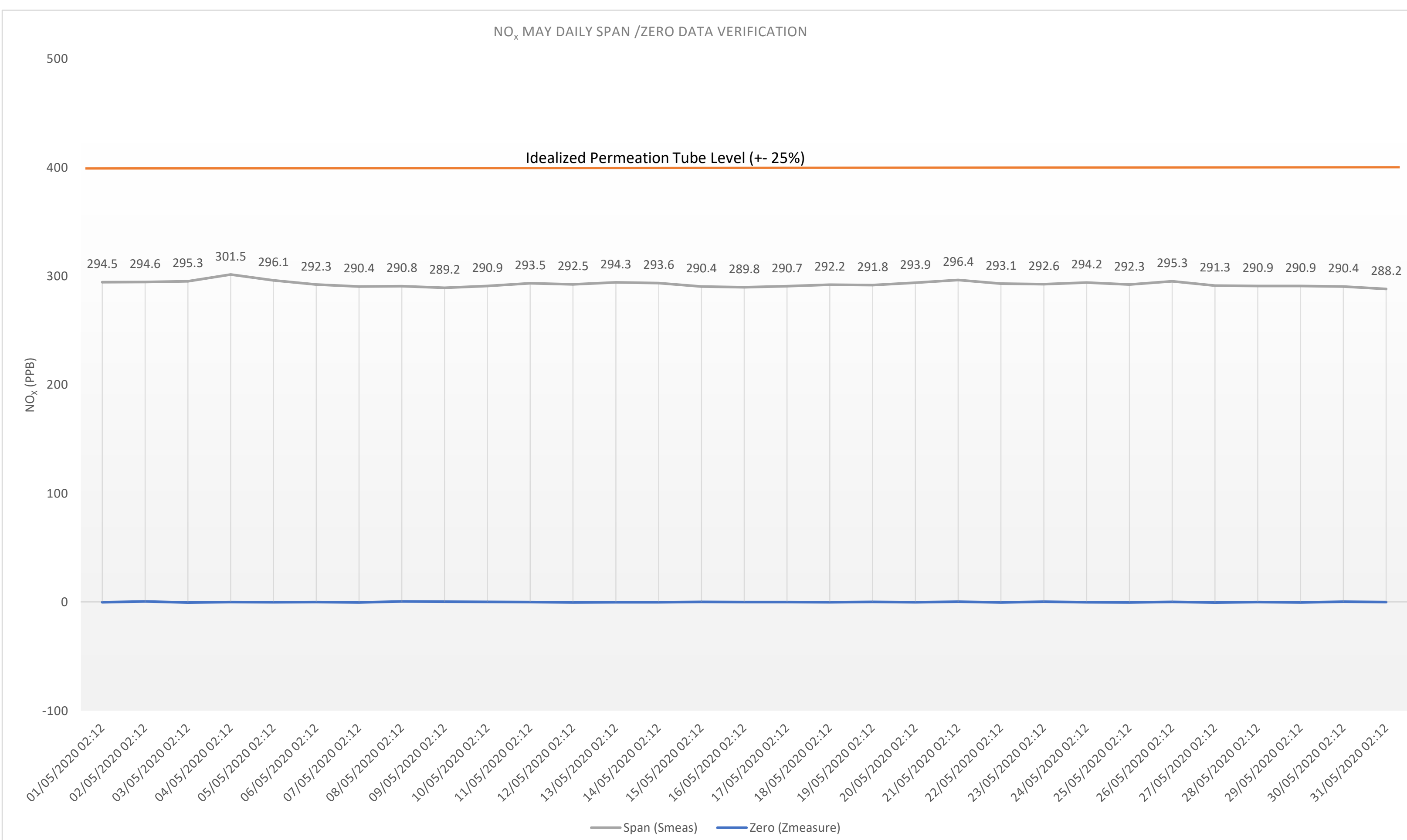


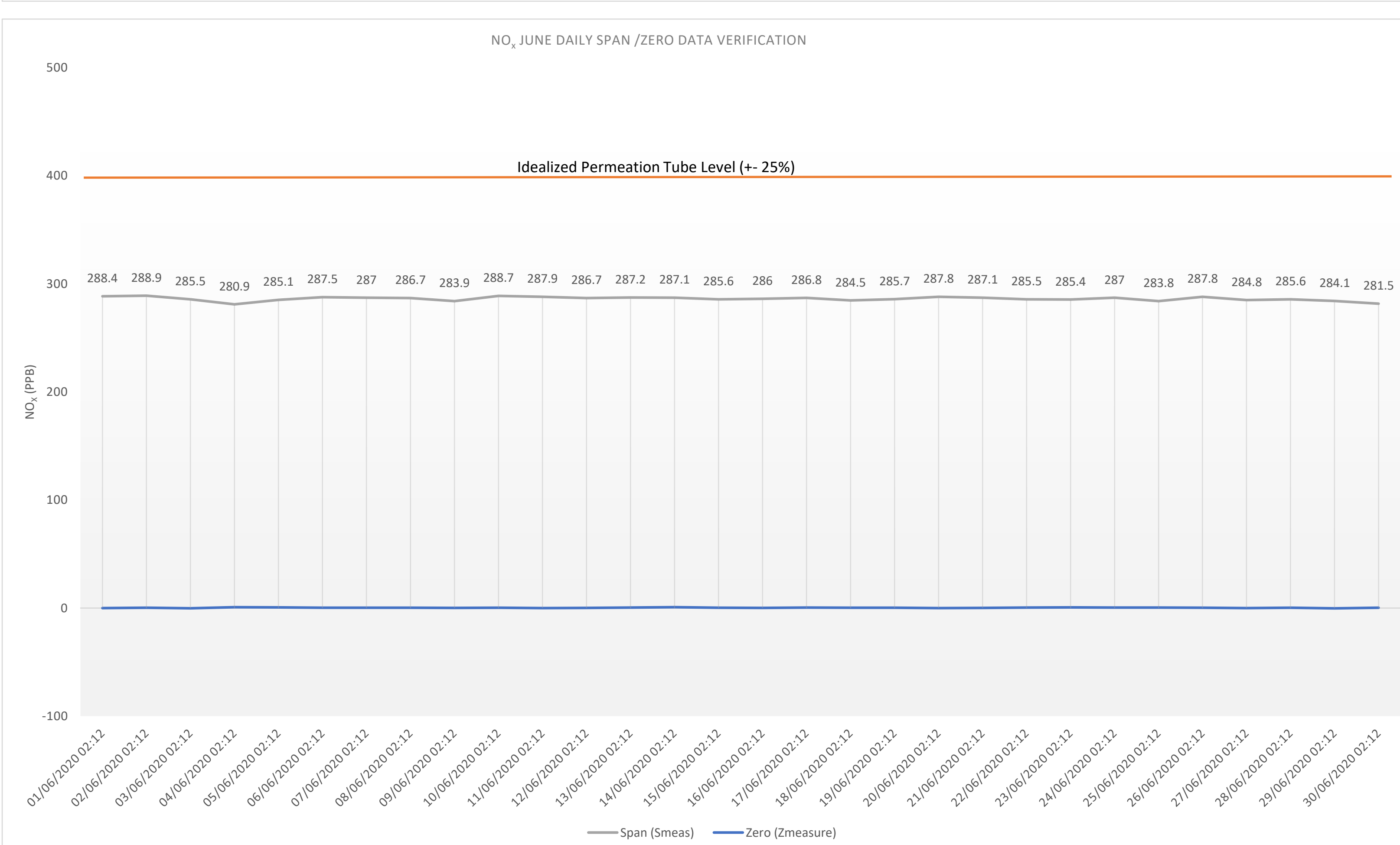


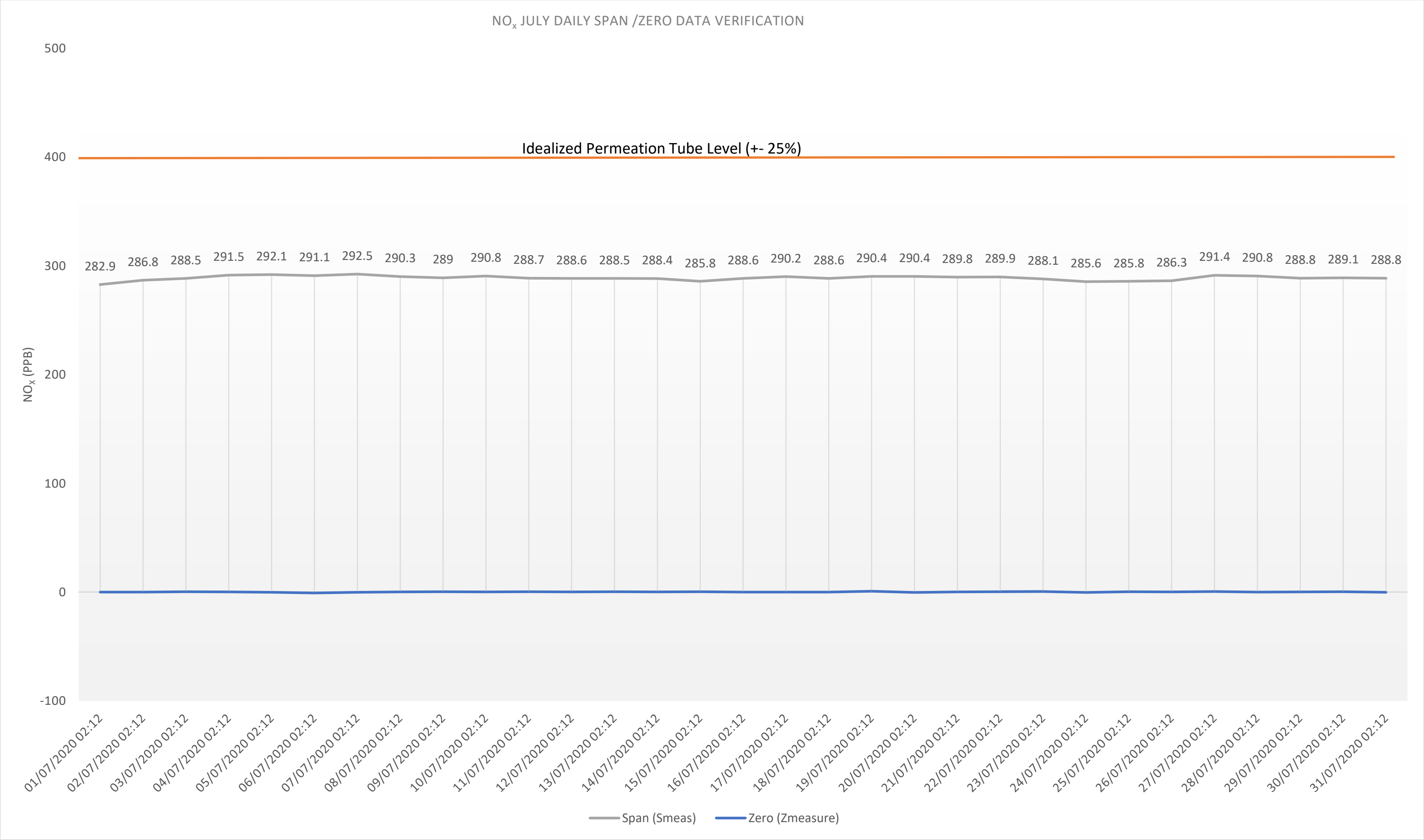


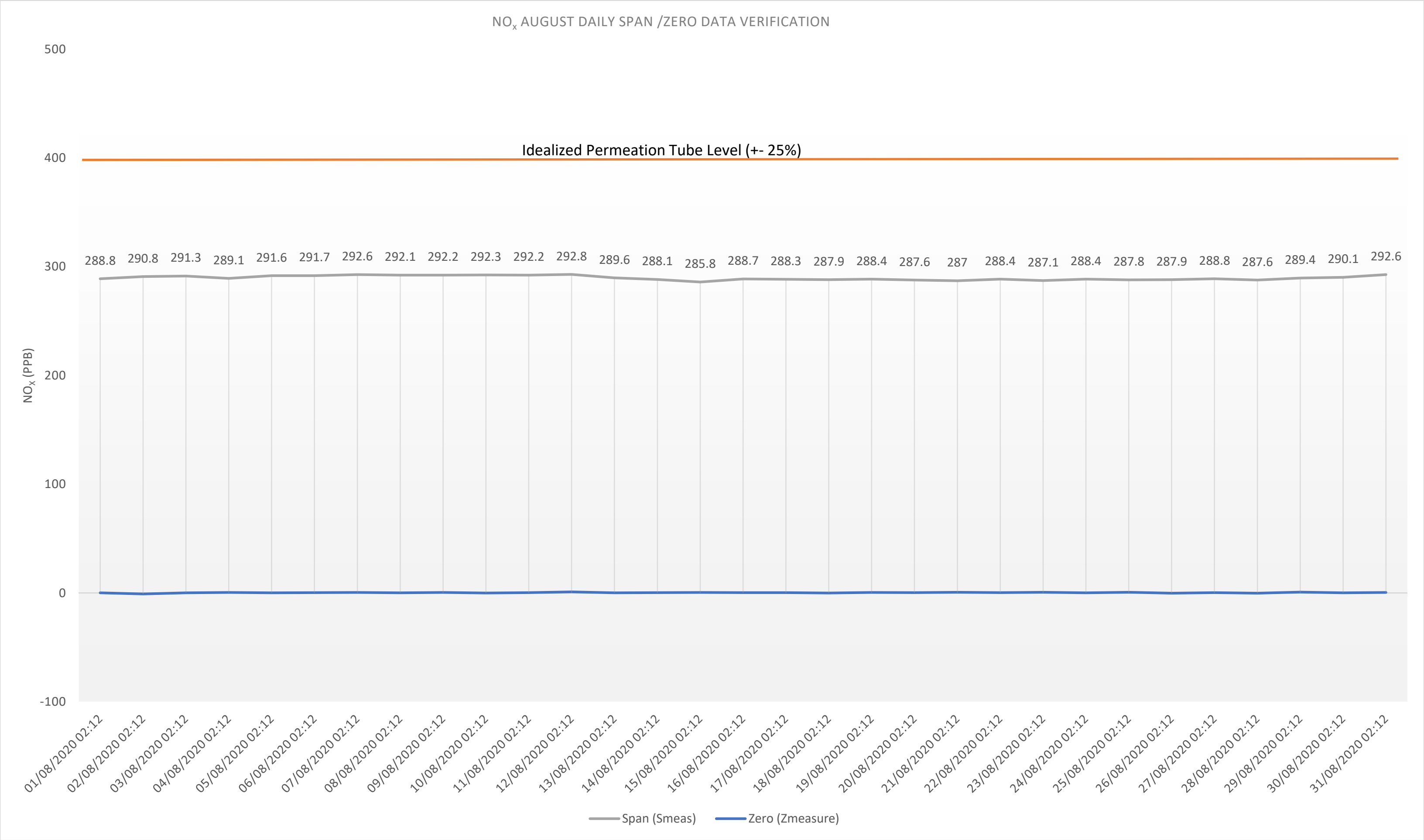
MILNE PORT - NO_X DAILY SPAN / ZERO DATA VERIFICATION

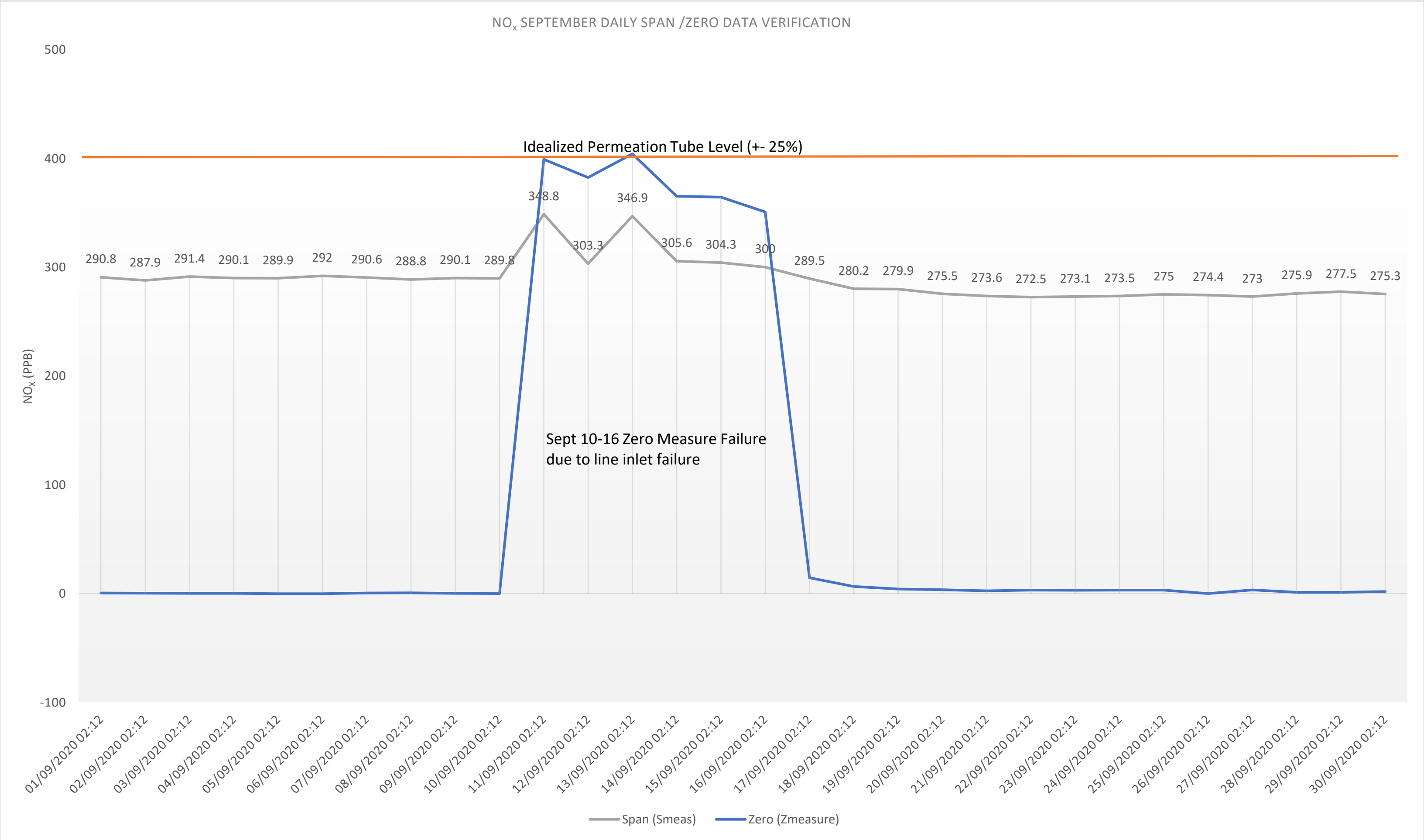




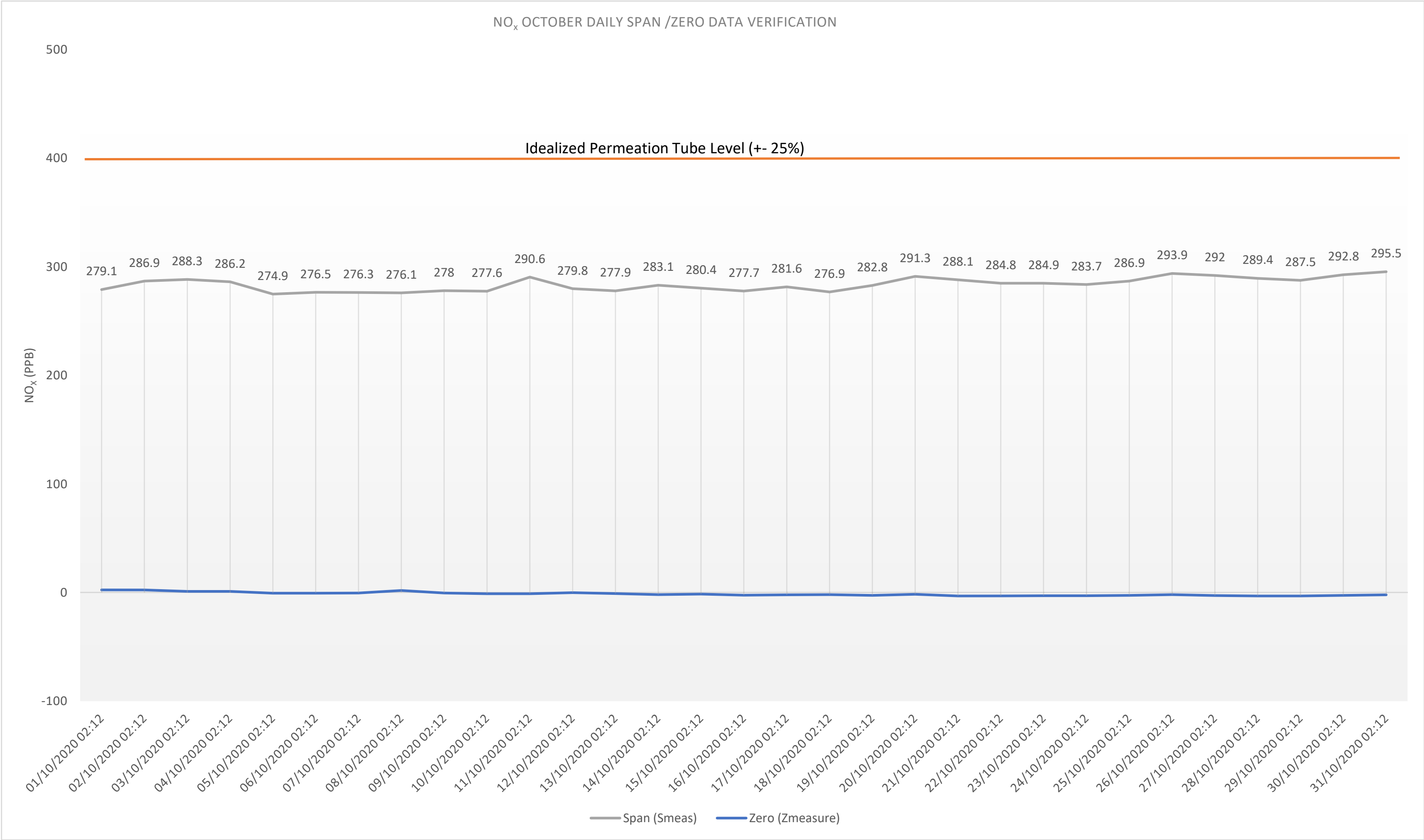


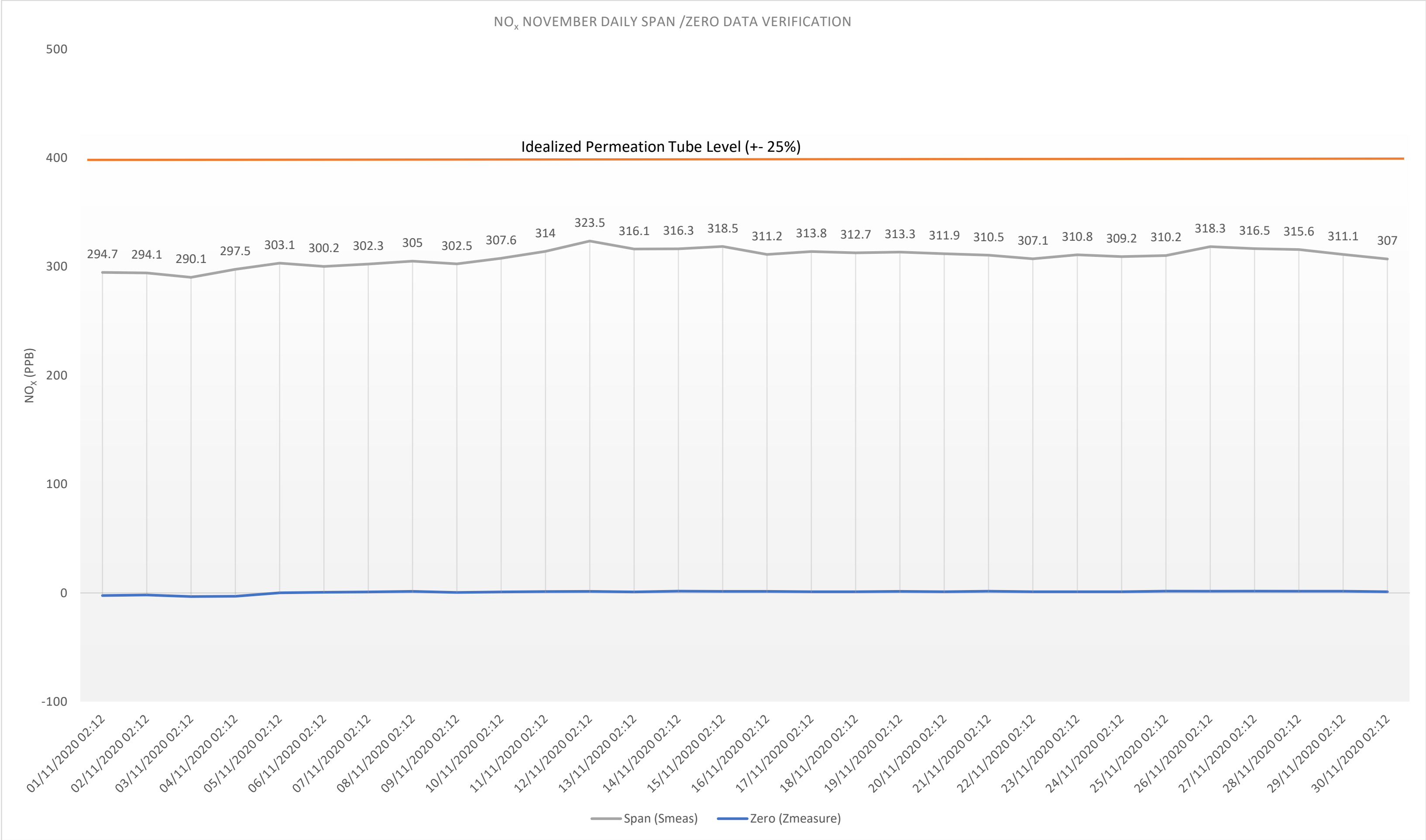

NOx JULY DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
NOx (PPB)
Span (Smeas)
Zero (Zmeasure)

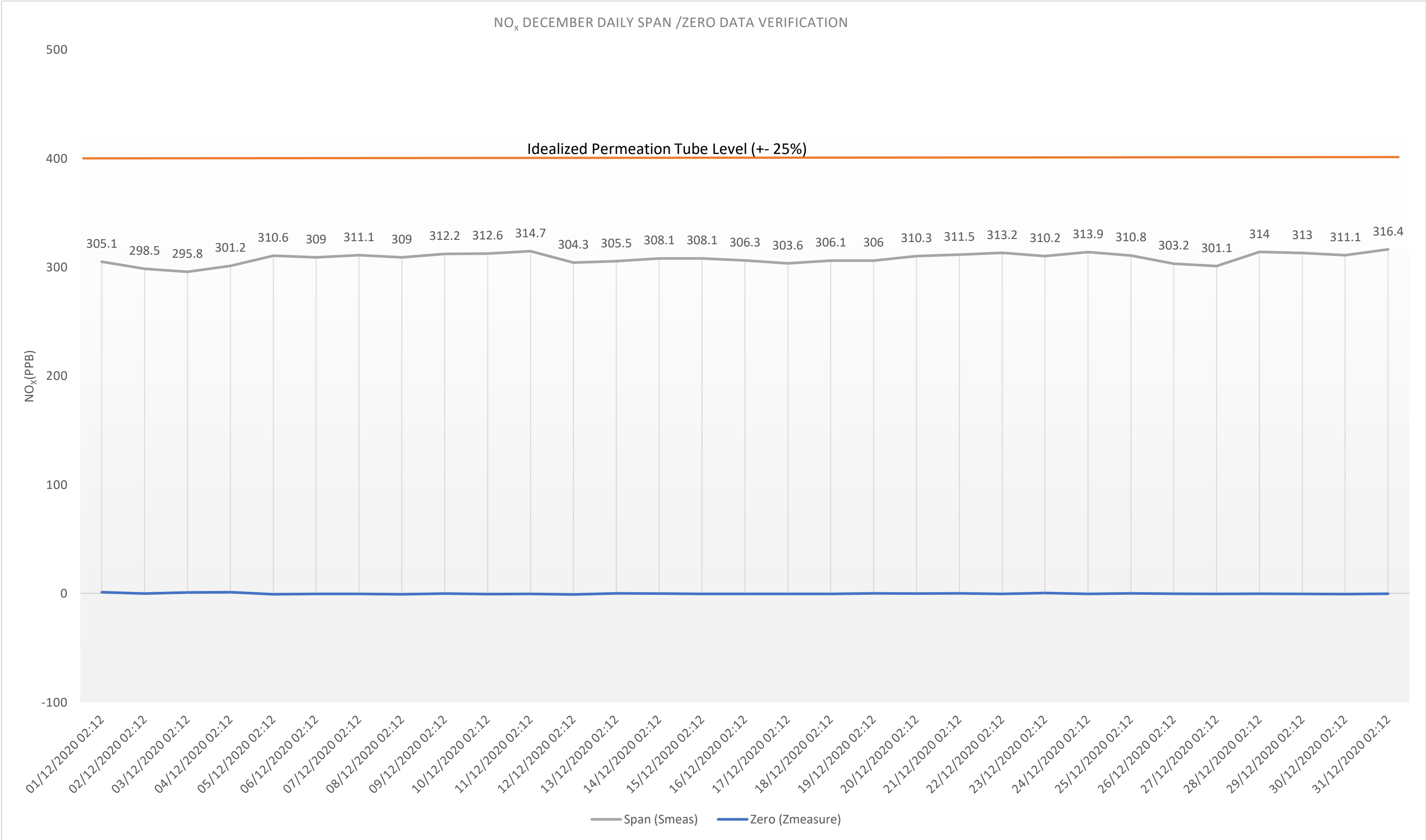

NOx AUGUST DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
NOx (PPB)
Span (Smeas)
Zero (Zmeasure)


NOx SEPTEMBER DAILY SPAN /ZERO DATA VERIFICATION
Idealized Permeation Tube Level (+- 25%)
Sept 10-16 Zero Measure Failure
due to line inlet failure
NOx (PPB)
Span (Smeas)
Zero (Zmeasure)

MILNE PORT - NO_X DAILY SPAN / ZERO DATA VERIFICATION

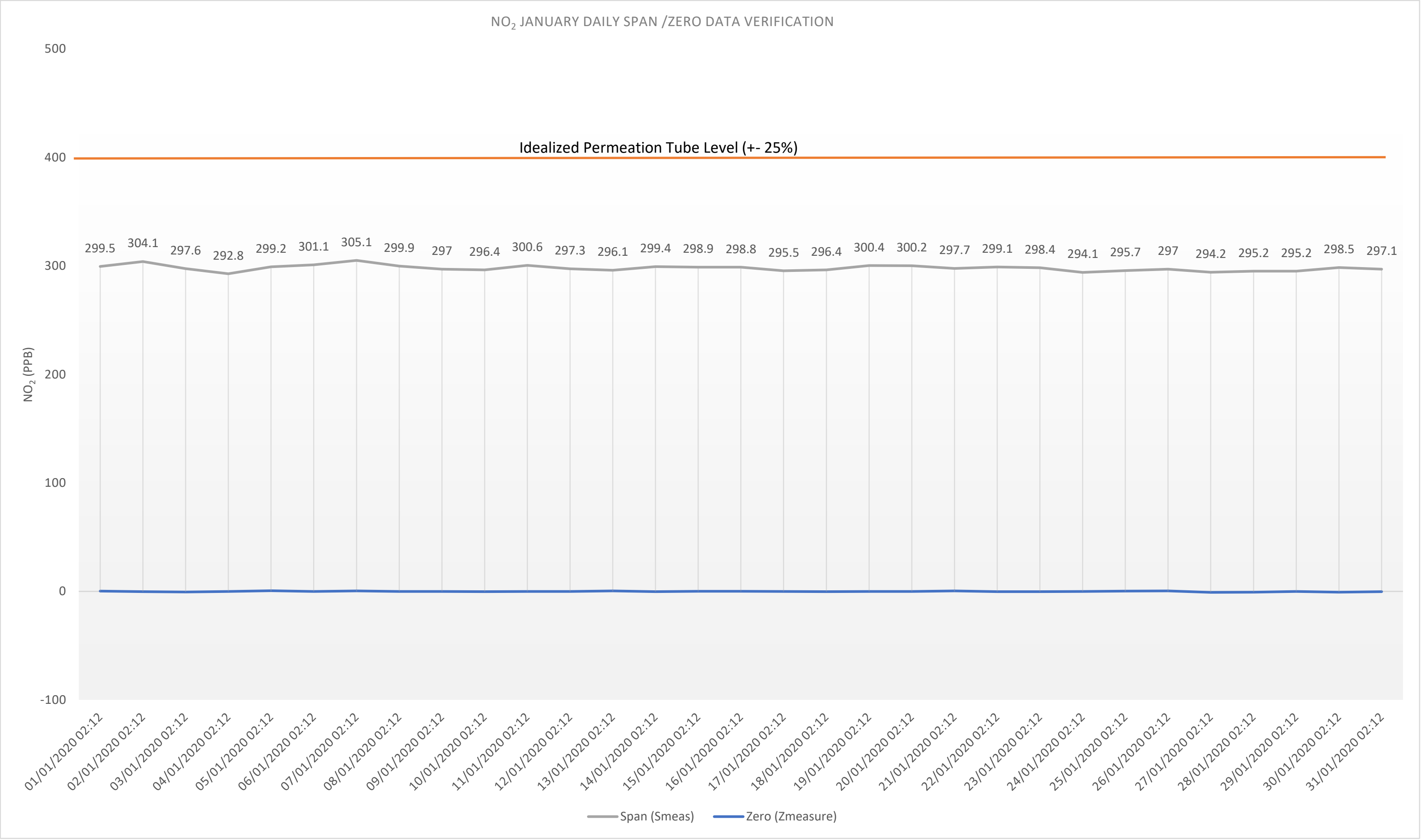


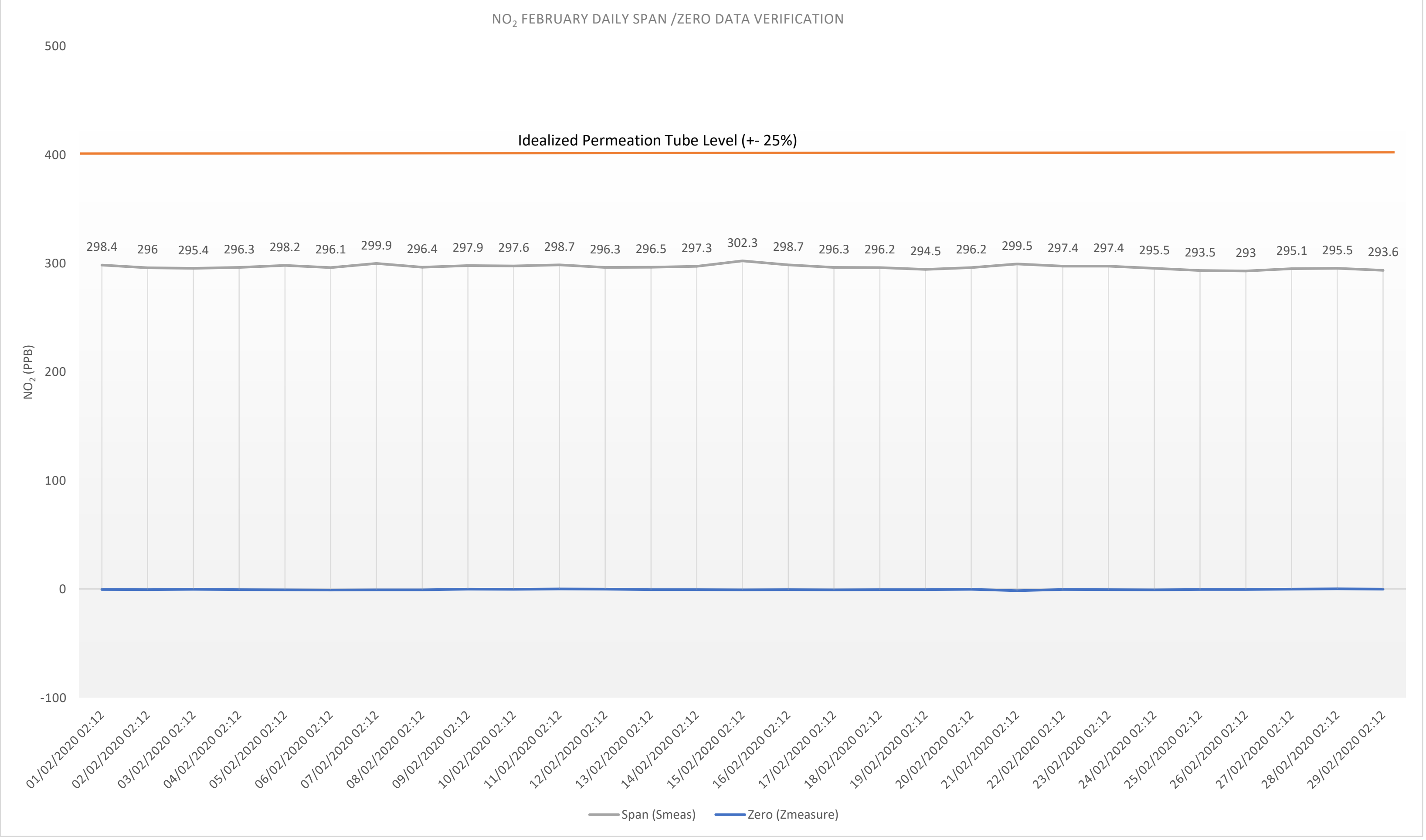


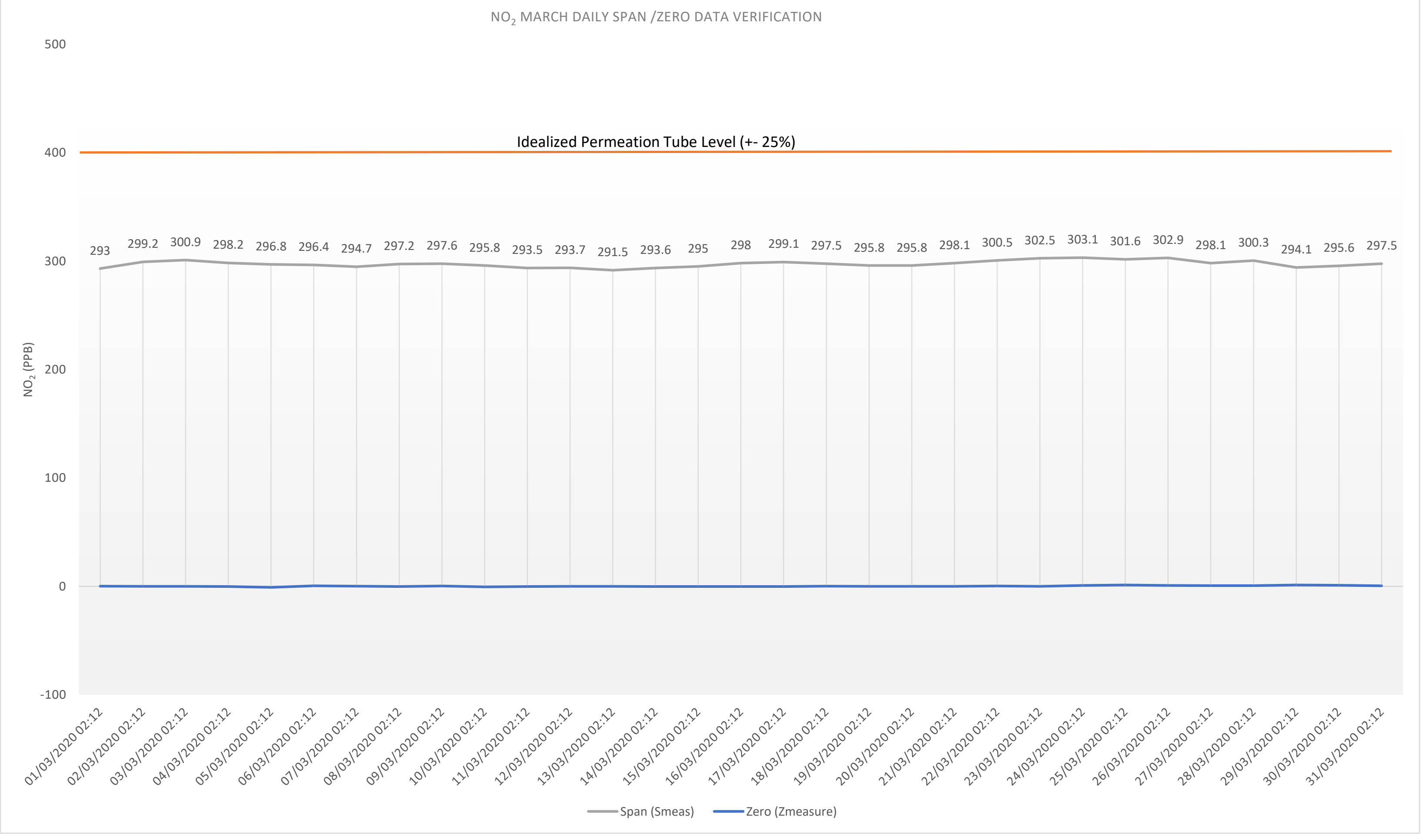


2020 ANNUAL AIR QUALITY, DUSTFALL AND METEOROLOGY REPORT

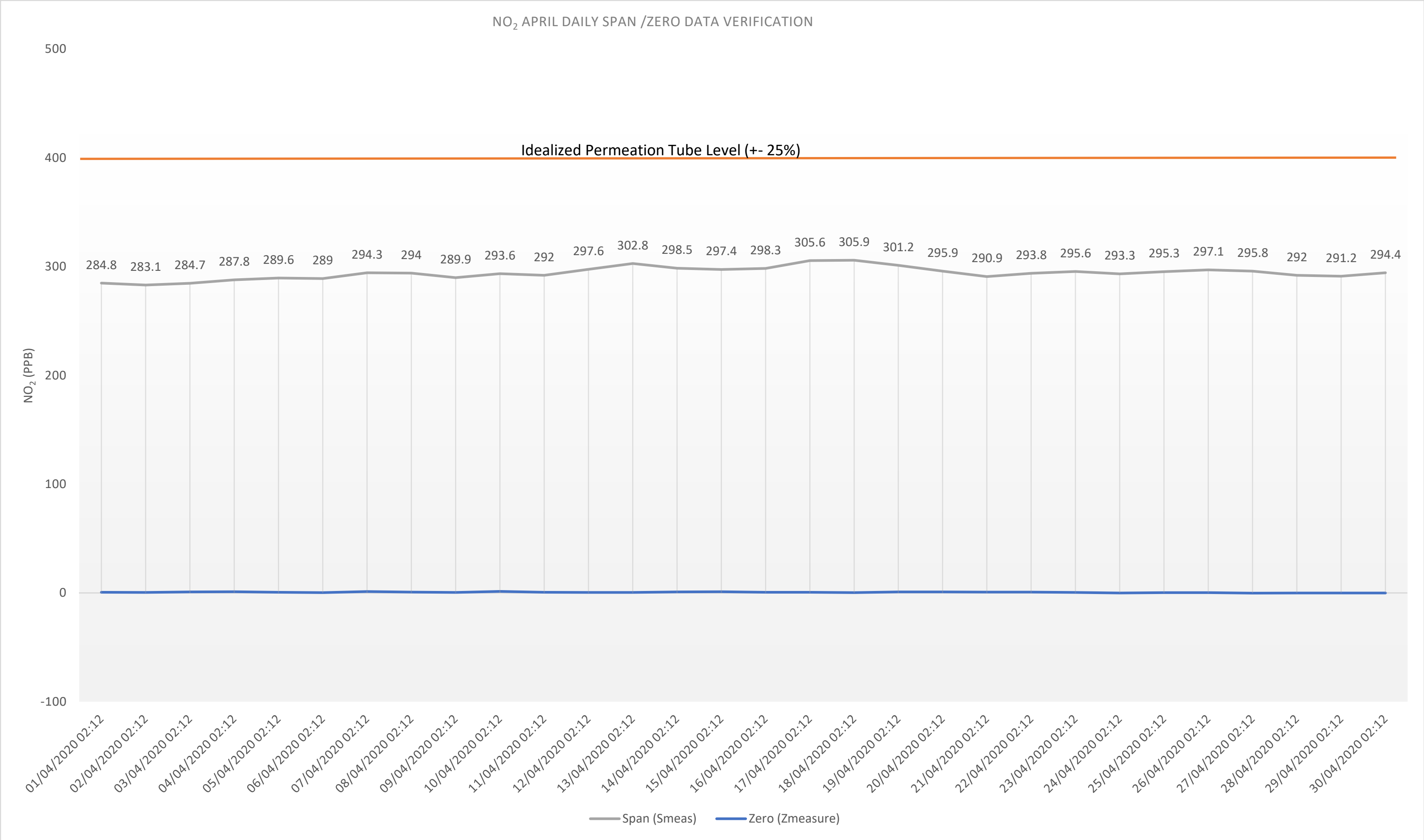
MILNE PORT - NO_2 DAILY SPAN / ZERO DATA VERIFICATION

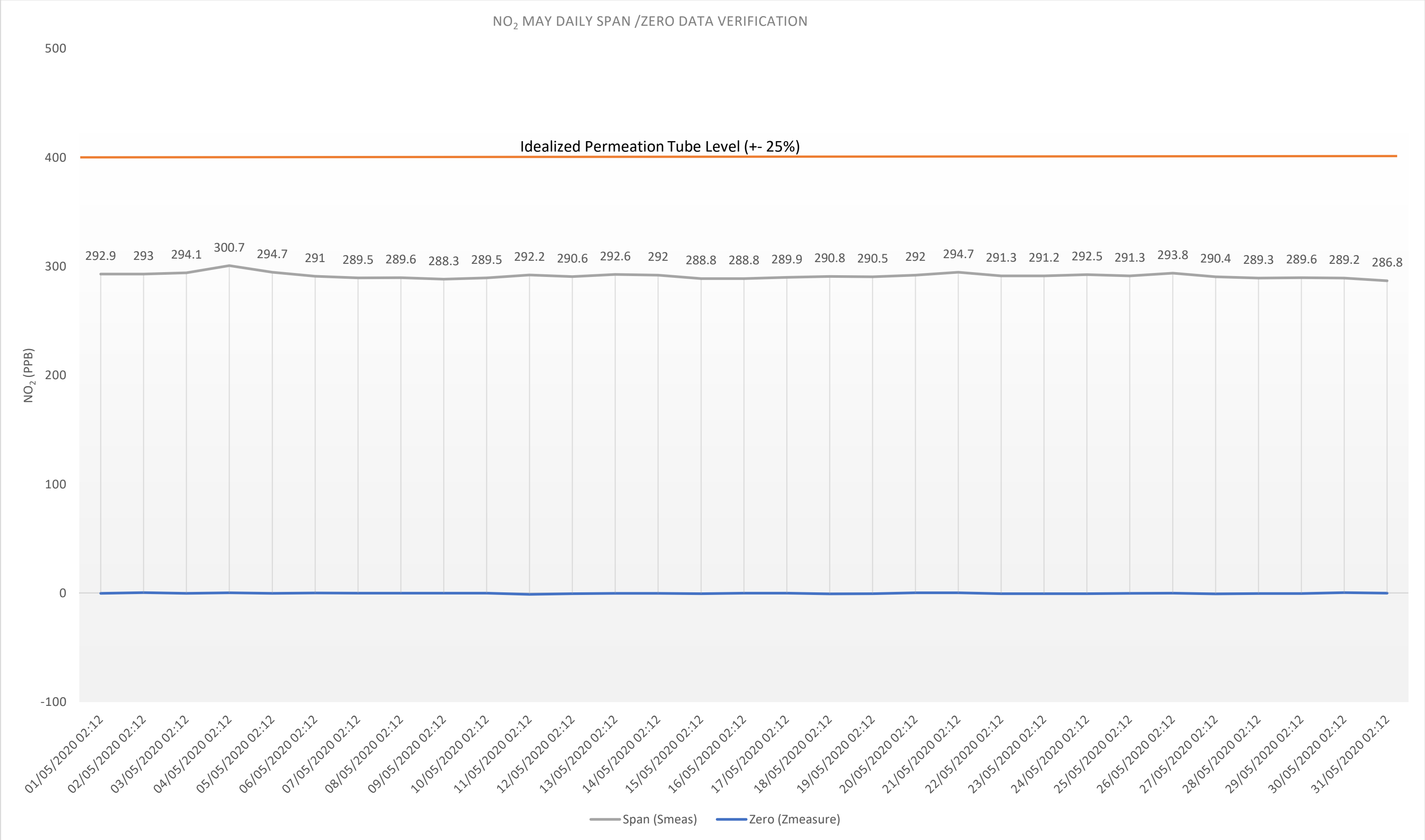


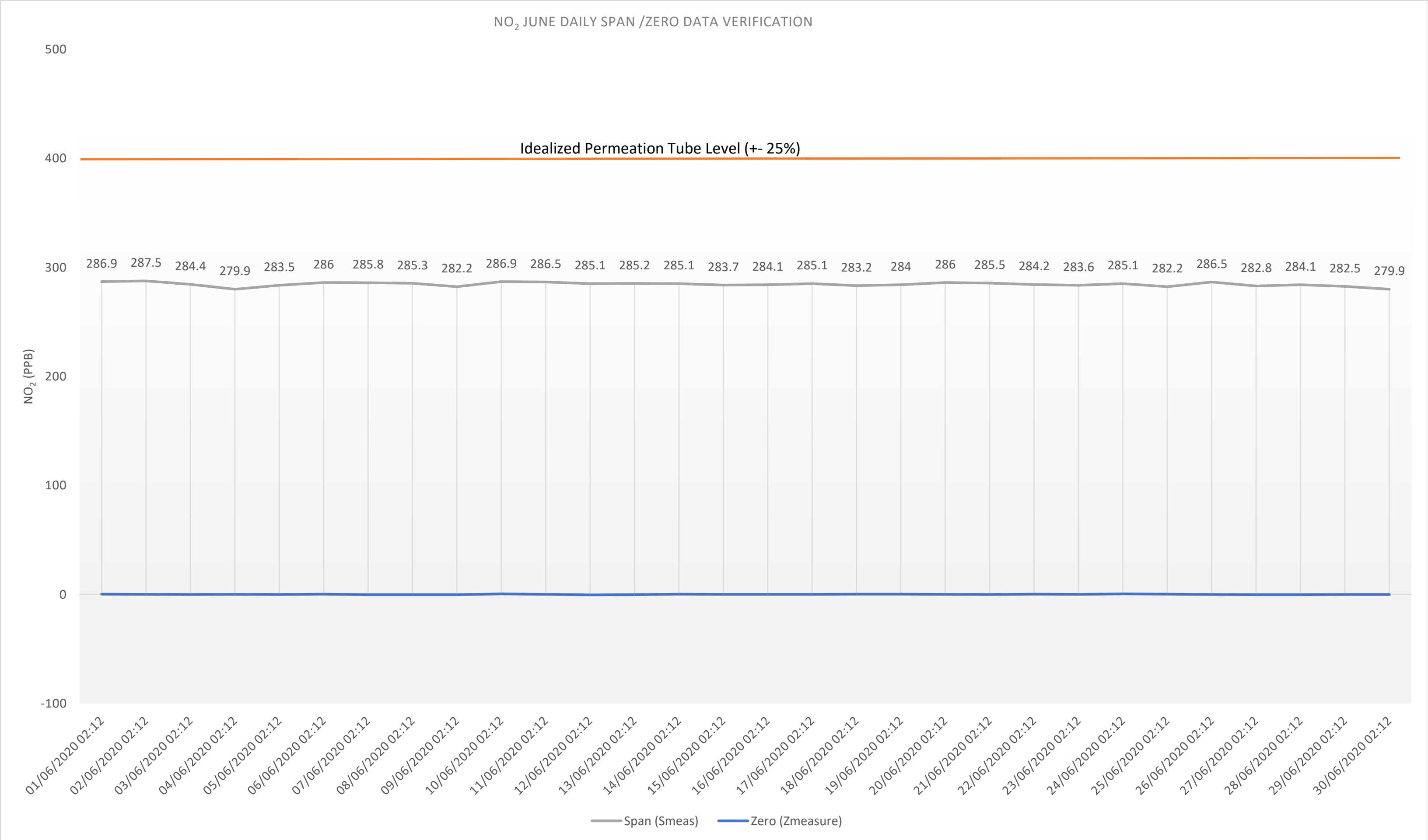




MILNE PORT - NO_2 DAILY SPAN / ZERO DATA VERIFICATION







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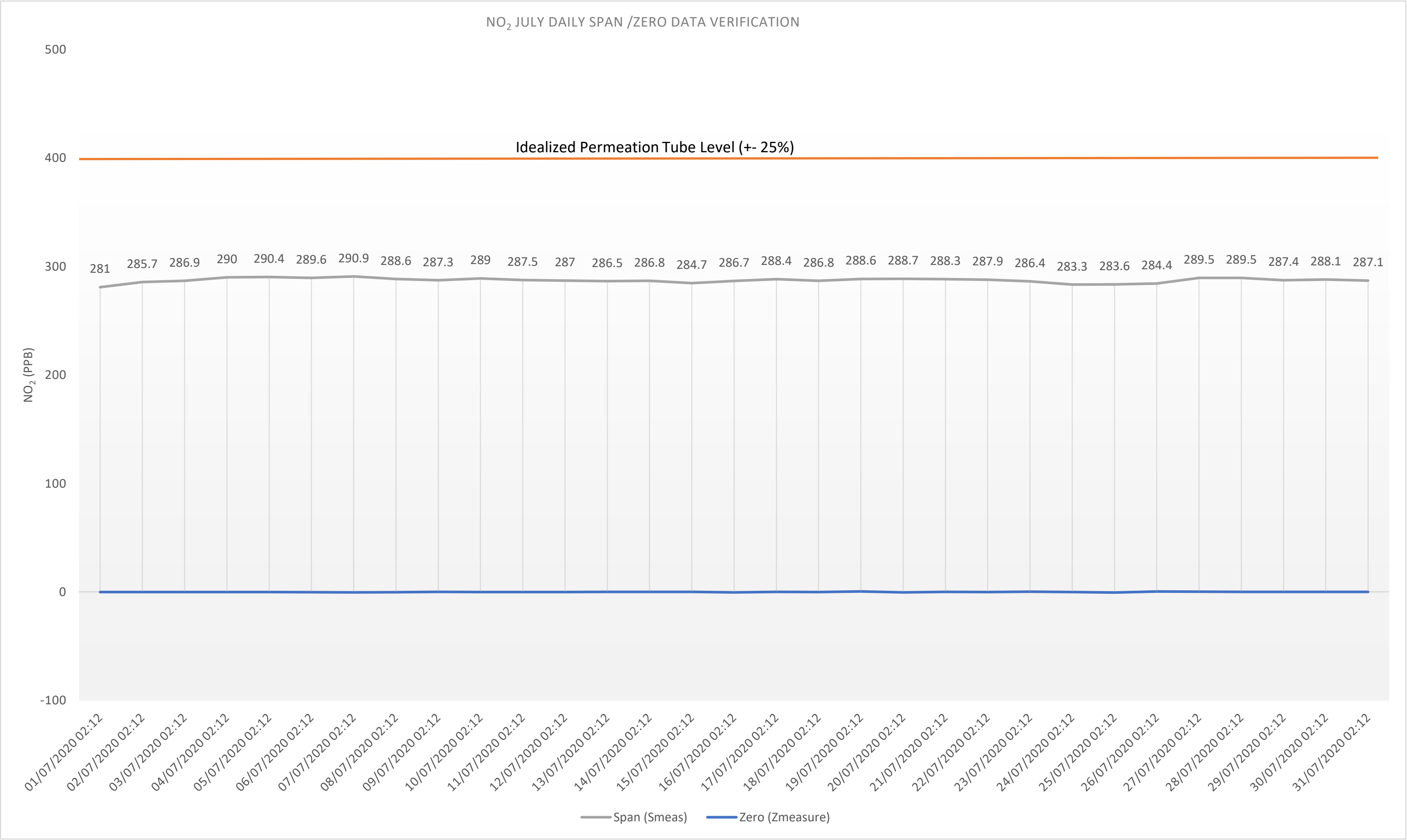
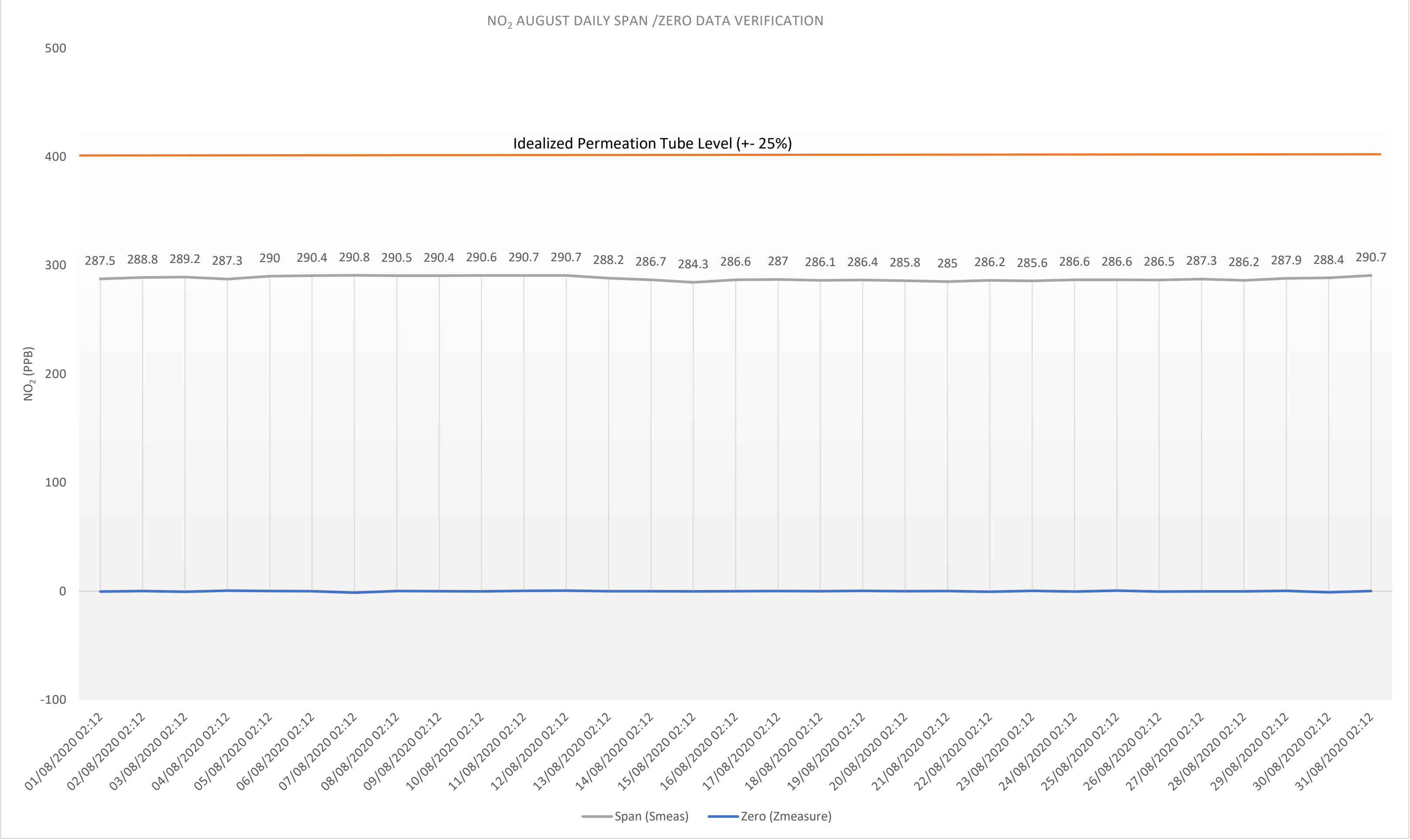
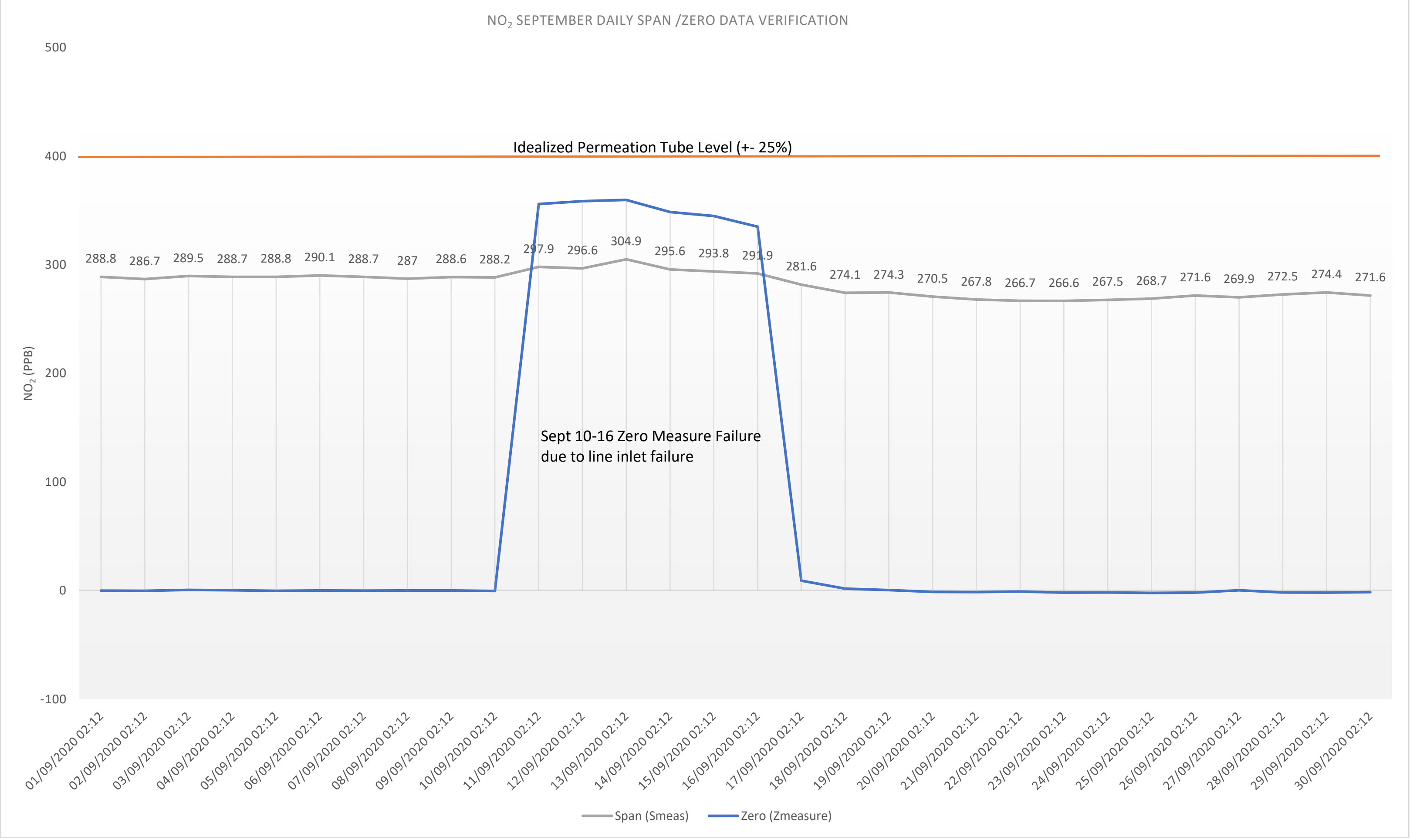
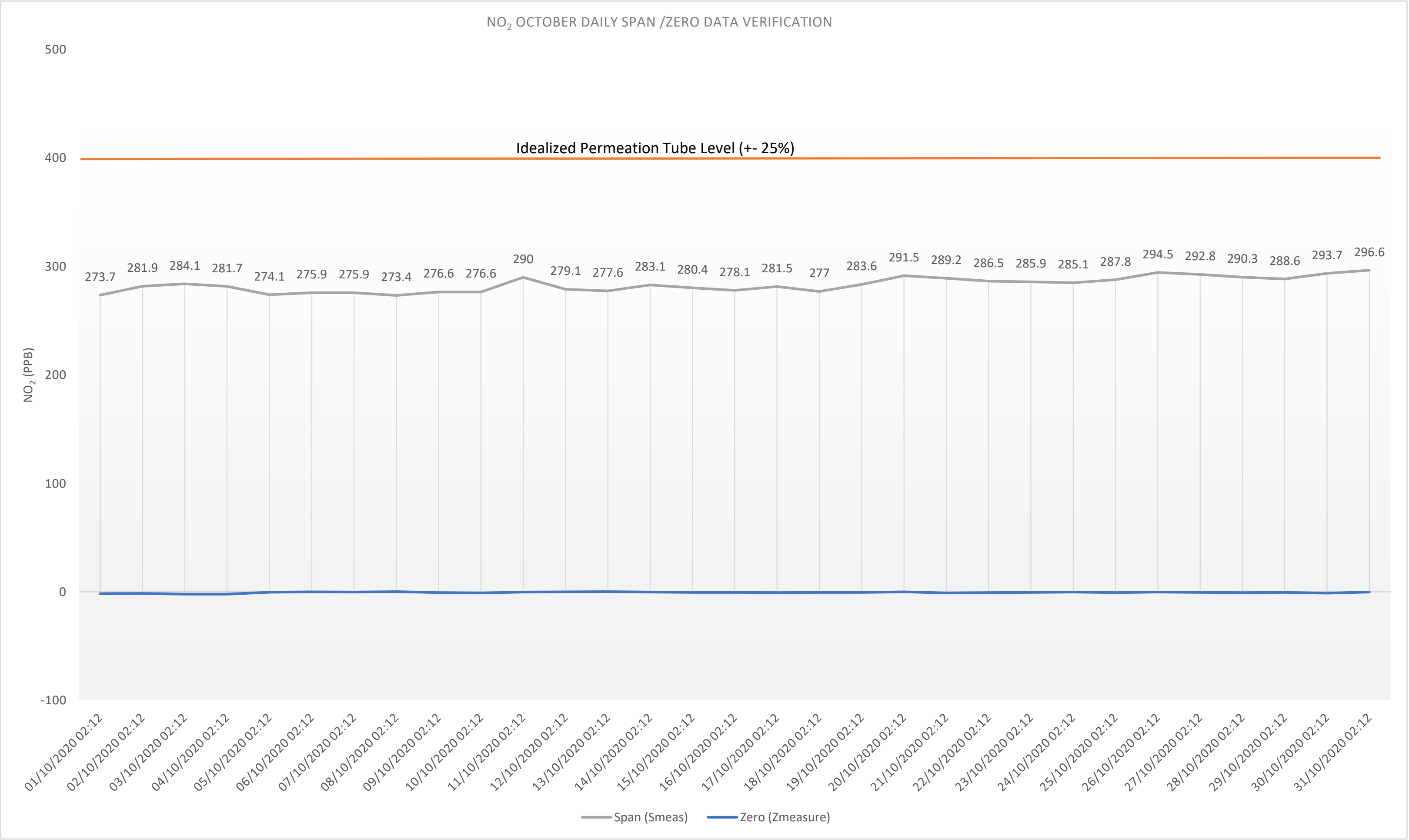
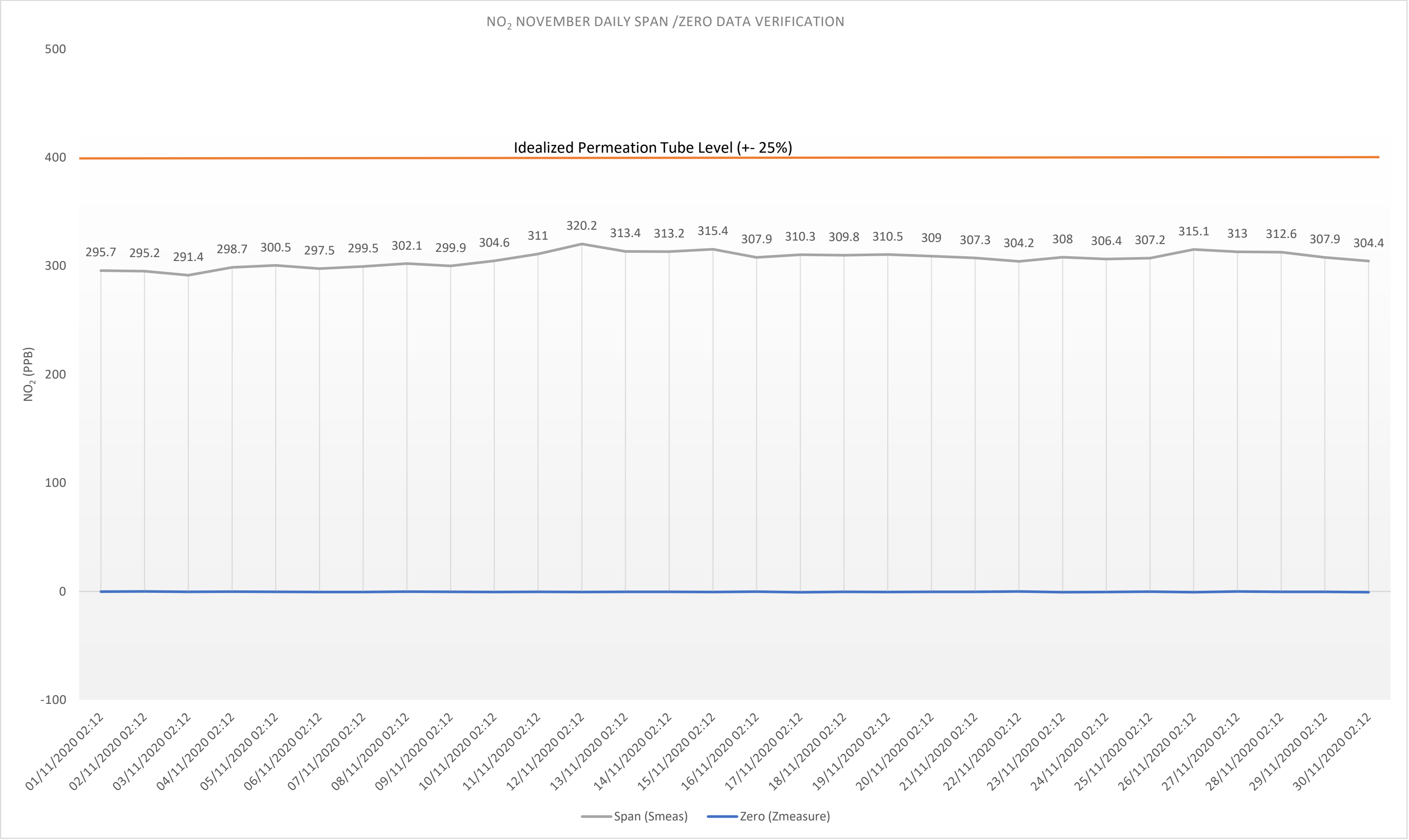


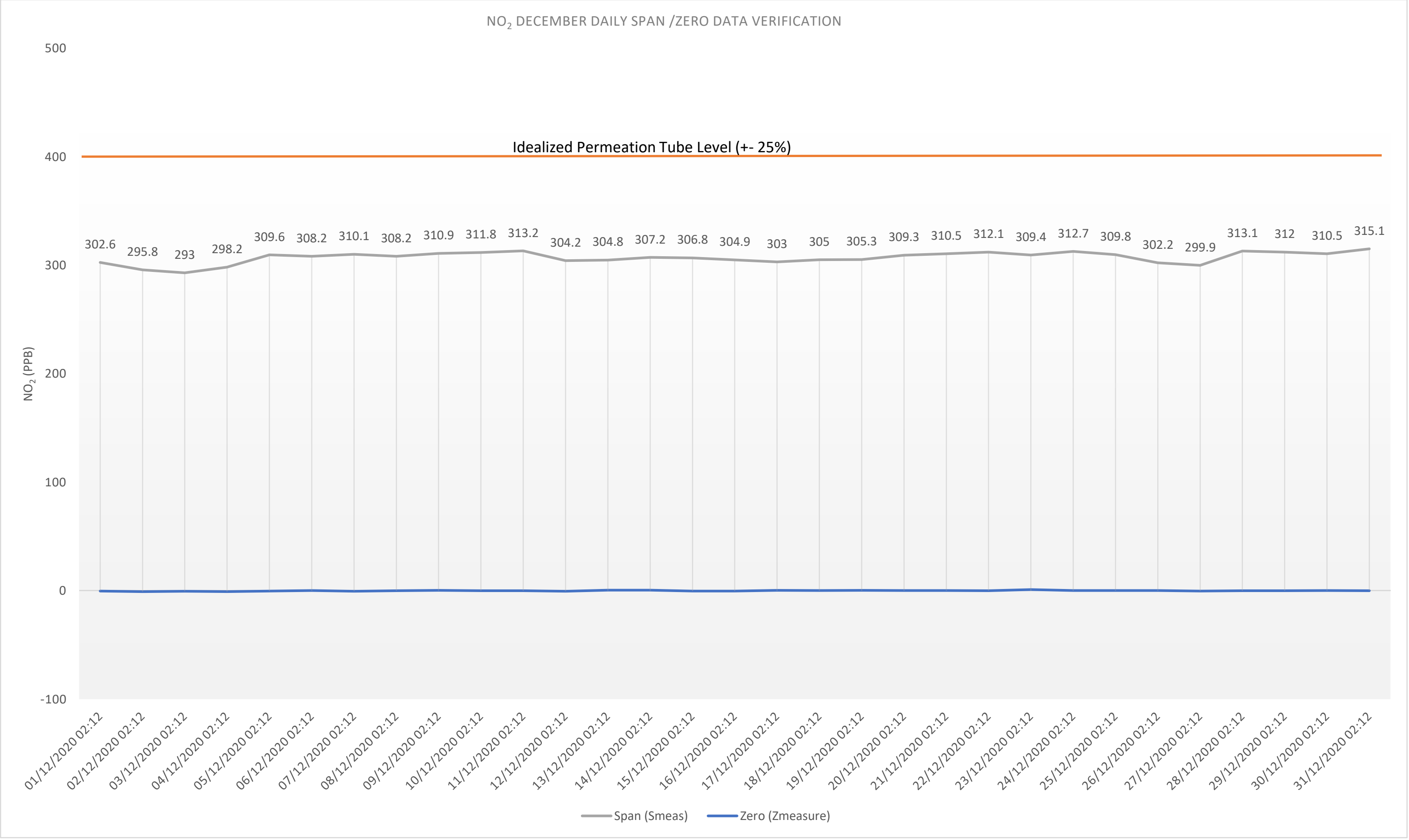




MILNE PORT - NO_2 DAILY SPAN / ZERO DATA VERIFICATION







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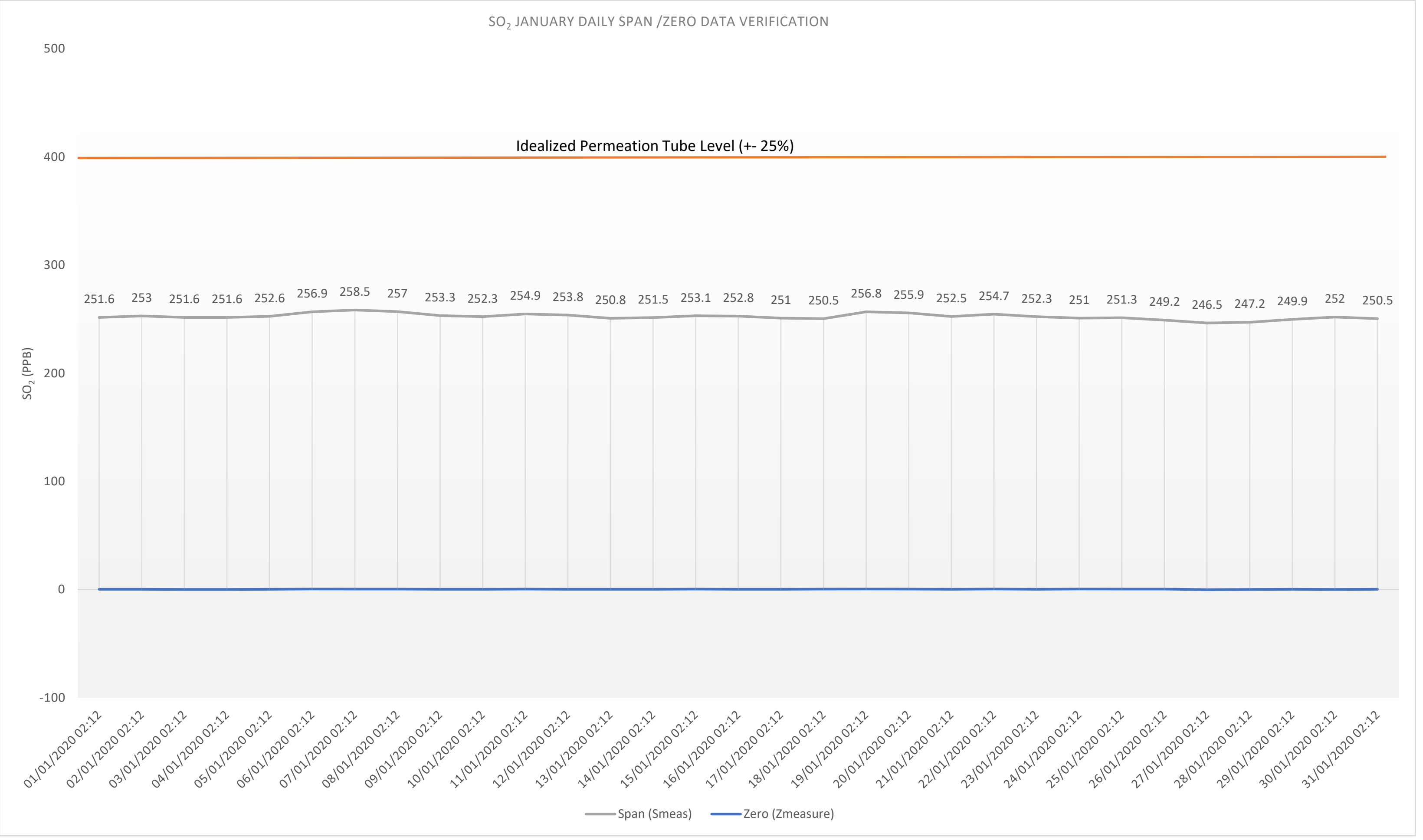
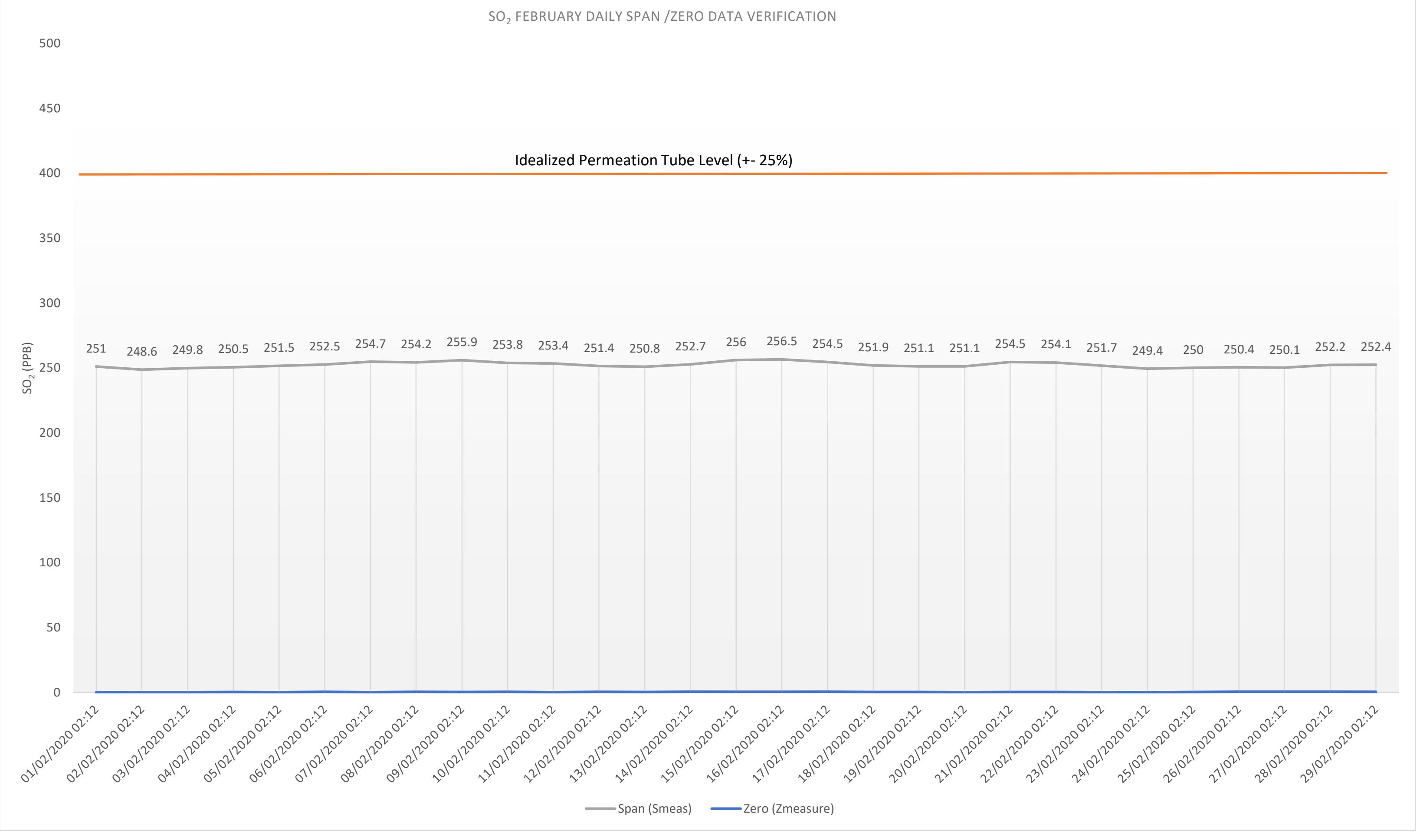
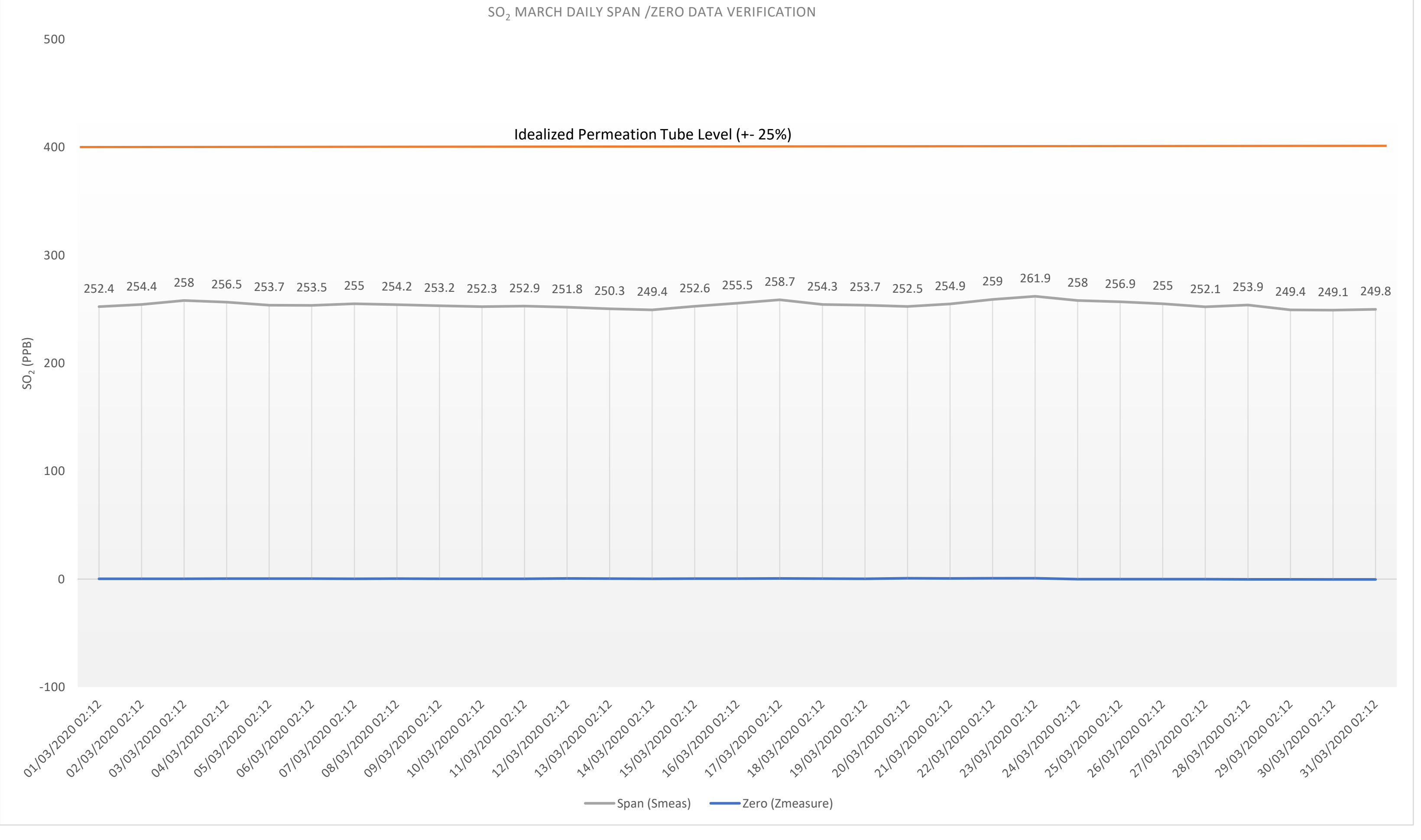
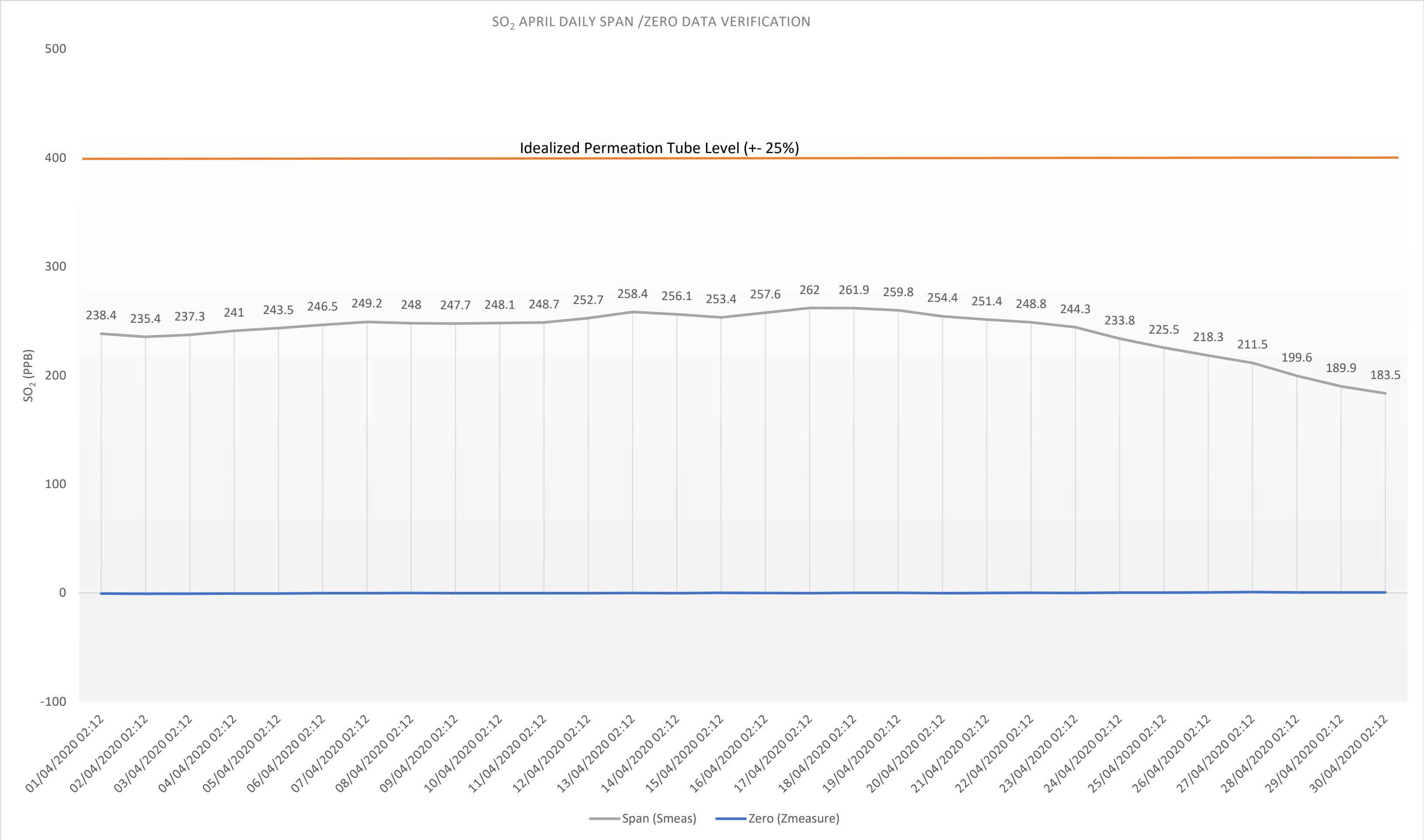
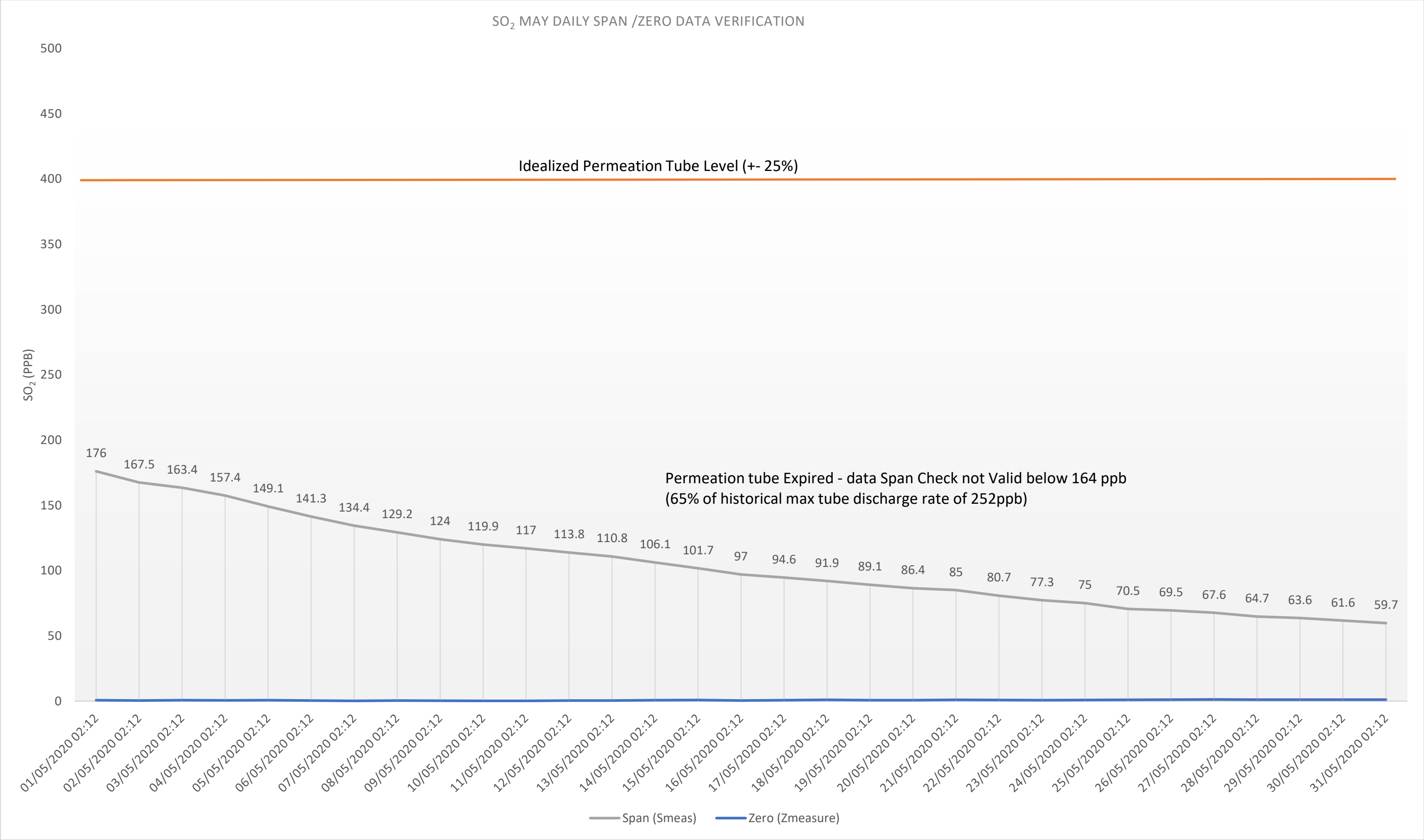


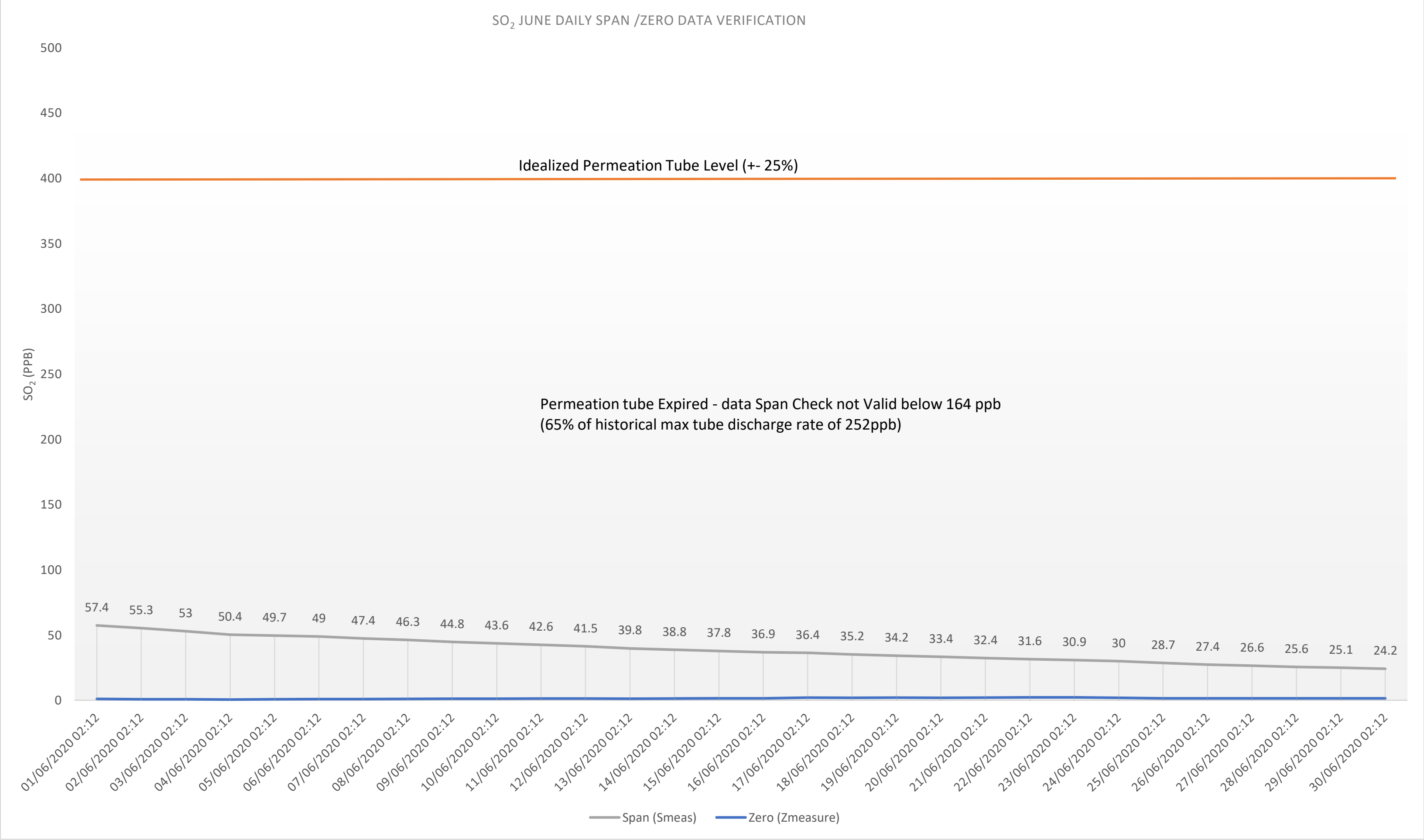




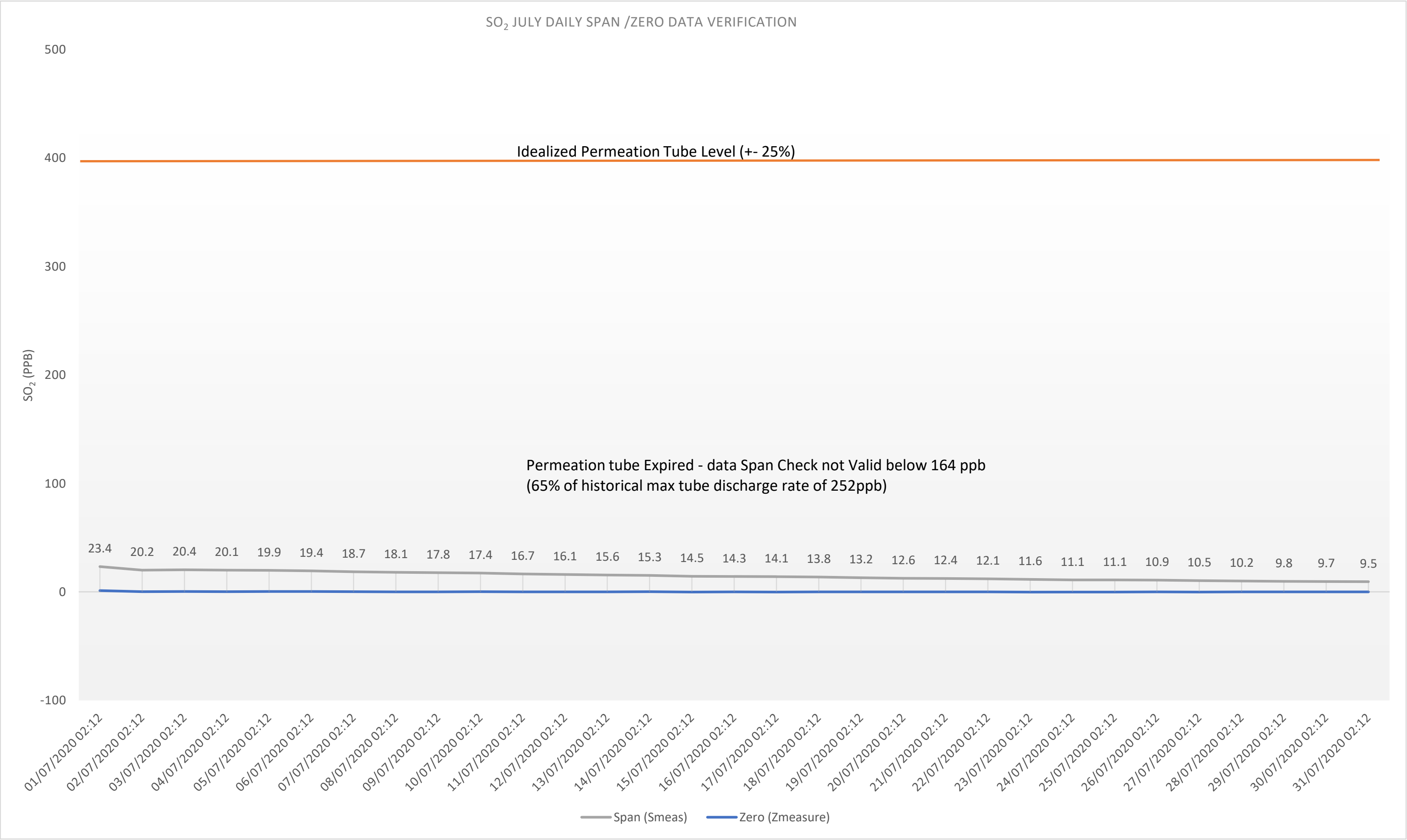
MILNE PORT - SO_2 DAILY SPAN / ZERO DATA VERIFICATION

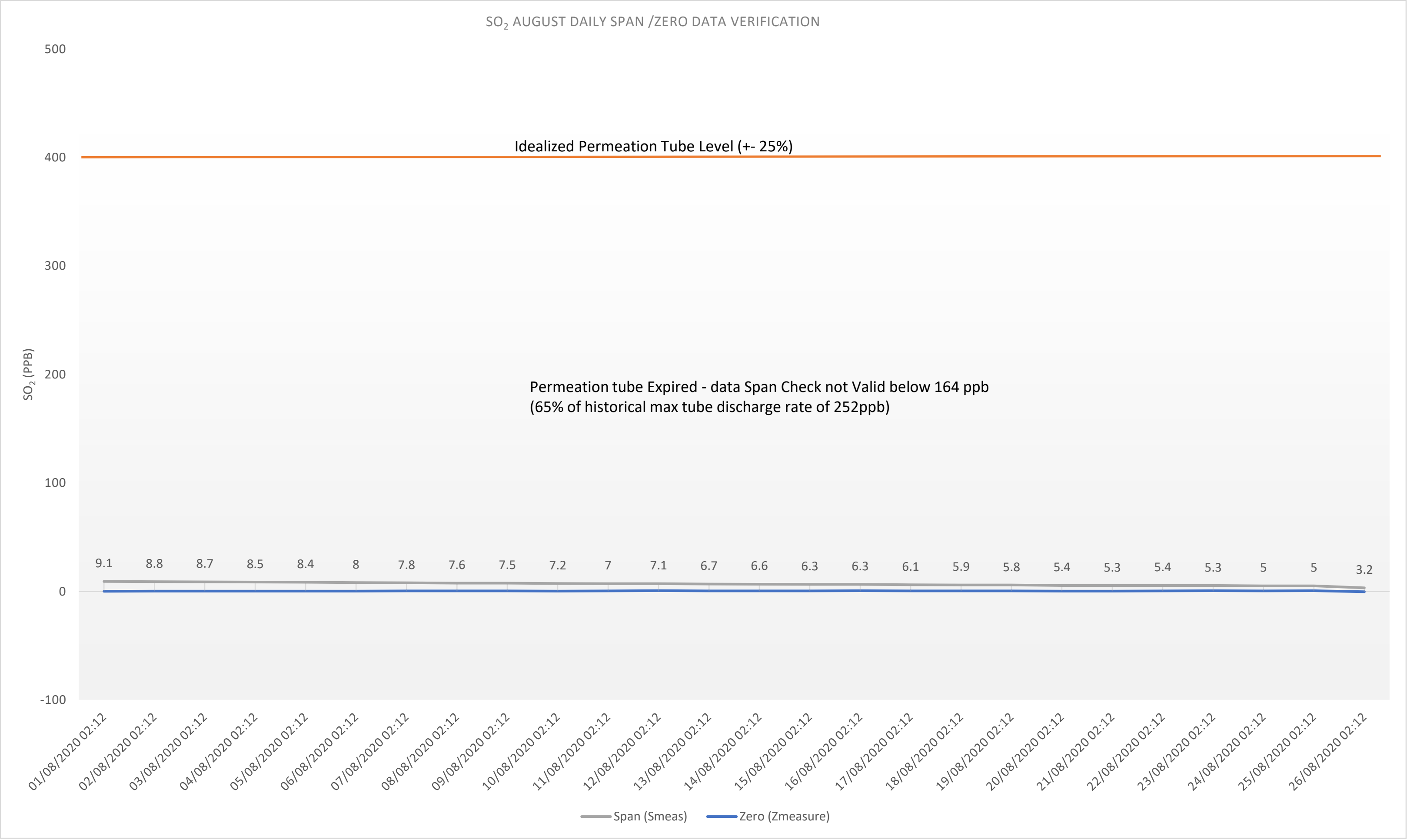


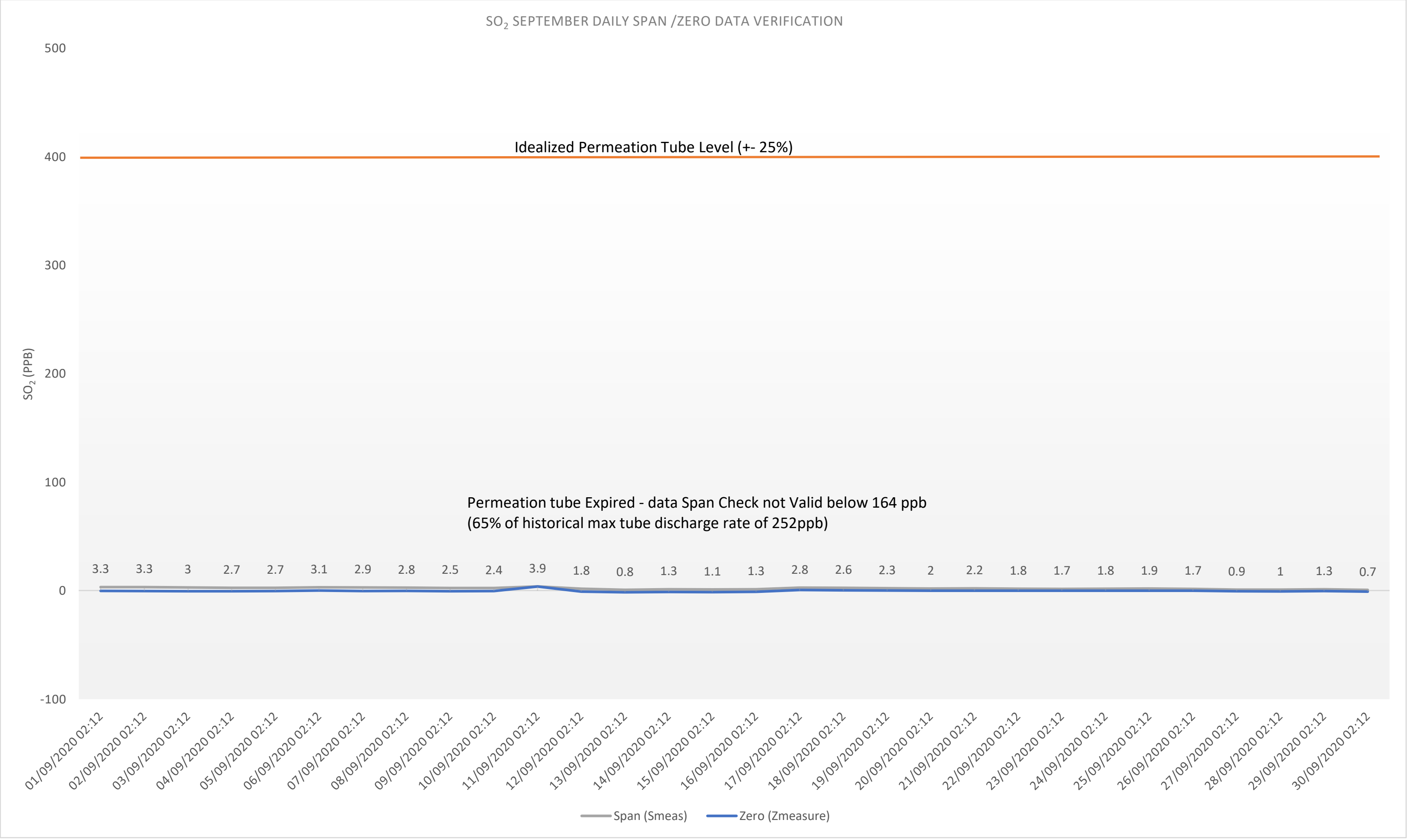




MILNE PORT - SO_2 DAILY SPAN / ZERO DATA VERIFICATION







MILNE PORT - SO_2 DAILY SPAN / ZERO DATA VERIFICATION