

Report No. 4RS-AU-173298-R616827

**DIESEL EXHAUST MONITORING AT CRANSTON
CLOSE, BLOCK B CAR PARK.
CLIENT REFERENCE: ES10120A.**

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1. INTRODUCTION

- 1.1 4-RAIL Services Limited were requested by the client Mr. Chris Thompson, HMPS, to undertake monitoring at Cranston Close, Block B car park, near Ruislip Depot to monitor diesel fume possible exposure.
- 1.2 Concerns were raised by residents regarding the effect of idling diesel locomotives on air quality near Cranston Close.
- 1.3 Monitoring was undertaken on the 26th and 28th of February and 7th, 9th, 12th, 16th, and 29th of March 2018. Monitoring was undertaken by various operatives of 4-RAIL Services Limited.

Substance		Sampling Media / Technique	Sampling Period
1.	Respirable Dust	Active sampling pumps and cyclone sampling heads with quartz filters. Monitoring undertaken in accordance to MDHS 14/4.	Full shift, or minimum 4 hours whichever is longer
2.	Total Respirable Carbon	Further analysis of Respirable Dust filters for Elemental & Organic Carbon, allowing an assessment of Total Carbon associated with diesel fume	Full shift, or minimum 4 hours whichever is longer
3.	Carbon Monoxide (CO) Nitrogen Dioxide (NO ₂)	Data logging gas monitor to give real time measurements, an average of which will be taken at the end of the shift to allow an assessment of exposure as a 8hour TWA	Full shift, or minimum 4 hours whichever is longer

2. HAZARD INFORMATION, EXPOSURE LIMITS & GUIDELINE VALUES

- 2.1 Diesel fumes, also known as Diesel Engine Exhaust Emissions (DEEE), contain a complex mixture of gases, vapours, liquid aerosols and particulates. These products include the following:
- Carbon (soot)
 - Nitrogen, N₂
 - Water, H₂O
 - Carbon monoxide, CO
 - Oxides of nitrogen, NO_x (e.g. nitrogen monoxide, NO, and nitrogen dioxide, NO₂)
 - Oxides of sulphur, SO_x (e.g. sulphur dioxide, SO₂)
 - Aldehydes
 - Polycyclic aromatic hydrocarbons, PAH
- 2.2 Exhaust emissions from diesel engines are usually more visible than those emitted from petrol engines as they contain over ten times more soot particles. In general diesel engines produce less carbon monoxide than petrol engines but more oxides of nitrogen, oxides of sulphur (dependant on the sulphur content of the fuel), aldehydes and particulate matter.
- 2.3 From a practical perspective, the following substances were assessed during the monitoring:
- Respirable dust
 - Total carbon, indicator for Diesel Particulate Matter
 - Nitrogen dioxide
 - Carbon monoxide
- 2.4 These hazardous substances are the most practical to assess and will allow a good exposure assessment. Workplace Exposure Limits (WEL) in the UK are governed by Health & Safety Executive (HSE) document EH40/2005 Workplace Exposure Limits Second Edition. Where no WEL is given in EH40, other documentation is used to help assess the exposure.
- 2.5 WELs and other occupational exposure limits are values designed to help protect the health of workers for compliance to Control of Substances Hazardous to Health (COSHH) regulations.
- 2.6 WELs are given as a concentration in air averaged over a specified period of time. These time periods are:
- 8 hours, a Time Weighted Average (TWA) also known as the Long-Term Exposure Limit (LTEL)
 - 15 minutes, also known as the Short-Term Exposure Limit (STEL)
- 2.7 WELs are given in units of parts per million (ppm) and/or milligrams per meter cubed of air (mg/m³).

- 2.8 The WELs and the guidance documents applicable to the substances monitored are given below:

Substance	Long - term exposure limit of (8-hour time weighted average)	Short term exposure limit (STEL) – 15 minute average	Guidance Document
Nitrogen dioxide NO ₂	0.5 ppm	1.0 ppm	TFL - PR703 A1 HSE – CD283
Carbon Monoxide CO	30 ppm	50 ppm	HSE – EH40/2005 TFL - PR703 A1
Respirable Dust	4 mg/m ³	-	HSE – EH40/2005
Diesel Particulate Matter (Total Carbon)	0.1 mg/m ³	-	TFL – PR703 A1

2.9 Nitrogen Dioxide

- 2.9.1 Nitrogen dioxide reacts slowly with water to form nitric acid and nitrous acid, which causes nitrogen dioxide to be an irritant to the eyes, respiratory tract and the deep compartment of the respiratory tract. Research into the health effects and Occupation Exposure Limits (OEL) is ongoing.
- 2.9.2 There is currently no WEL for nitrogen dioxide in HSE EH40/2005 Workplace Exposure Limits Second Edition. Exposure to nitrogen dioxide is currently governed by COSHH regulations. Therefore, exposure to nitrogen dioxide should be kept as low as reasonably practicable.
- 2.10 'CD283 HSE Consultation Document: Consultation on implementing new and revised Workplace Exposure Limits' proposes that a 1ppm STEL and 0.5ppm TWA are to be adopted on 21st August 2018. TFL Procedure PR703 A1 has already adopted these limits.

2.11 Carbon Monoxide

- 2.11.1 Carbon Monoxide is a chemical asphyxiate. Haemoglobin in blood has a higher affinity for carbon monoxide than for oxygen, creating carboxyhaemoglobin, preventing the body from up taking further oxygen. Long term exposure, to high concentrations can lead to death but short duration exposure is quickly reversible.
- 2.11.2 Carbon monoxide has a WEL in HSE EH40/2005 Workplace Exposure Limits Second Edition of 30ppm for the 8-hour TWA LTEL and 200ppm for the 15 minute STEL.

- 2.12 'CD283 HSE Consultation Document: Consultation on implementing new and revised Workplace Exposure Limits' propose that 100ppm STEL and 20ppm TWA are to be adopted on 21st August 2018.

2.13 Respirable Dust

- 2.13.1 Respirable dust is the fraction of dust that can penetrate down to the deep lung, where gas exchange takes place. In general this dust will have an aerodynamic diameter of less than 10µm. Respirable dust, dependent upon the specific nature, can be linked to fibrosis, scarring of the lung as well as cancer and other health complaints.
- 2.13.2 The COSHH definition of substance hazardous to health includes dust of any kind when present at a concentration of air equal or greater than 4mg/m³ 8-hour TWA of respirable dust. Respirable dust concentrations above 4mg/m³ 8-hour TWA will be subject to COSHH if people are exposed to these levels.

2.14 Diesel Particulate Matter

- 2.14.1 Diesel Particulate Matter (DPM) is a mixture of particles, including carbon as soot, combustion by-products such as ash, wear particles and dust. Due to the complex mixture of particles in DPM, the total amount of carbon is used to indicate the amount of DPM. Total carbon is calculated from the elemental carbon and organic carbon.
- 2.14.2 As detailed within HSG187, Control of Diesel Engine Exhaust Emissions in the Workplace, no WEL has be set for DPM or DEEE as a whole. This is because there is insufficient data to establish a clear, reliable threshold for all potential health effects. All exposure to DPM is currently governed by COSHH regulations, and exposure should kept be as low as reasonably practicable.
- 2.14.3 In January 2017, London Underground Ltd in combination with Transport for London published an in-house procedure, PR0703 Control of Diesel Engine Exhaust Emissions. This procedure gives details on LU workplace air quality exposure limits for diesel particulate. The WEL for diesel particulate in PR0703 is 0.1mg/m³ for the 8-hour TWA.

3. SITE VISIT, SAMPLING AND METHODOLOGY

- 3.1 Static gas monitoring and aerosol monitoring was carried out in the car park of block B Cranston Close, see Figure 1. The site operative parked in the bay furthest to the right hand side of the car park, as this was near the train exhaust, where available.
- 3.2 Monitoring equipment was set up on top of the vans.
- 3.3 It was noted on several shifts that the train had not arrived the night before so no monitoring was necessary.
- 3.4 Aerosol monitoring was undertaken in accordance to UKAS accredited 4-RAIL Services Limited method 4R-E206 Aerosol Monitoring Manual based on MDHS 14/4. Sampling was carried out using AirLite personal pumps, cyclone respirable heads and quartz filters.
- 3.5 The respirable dust monitoring filters were then further analysed to determine the amount of total respirable carbon present, used as an indicator for diesel particulate matter.
- 3.6 Gas monitoring was undertaken with, one Industrial Scientific BM25 toxic gas monitor. The following gases were monitored using the gas monitor:
 - Carbon monoxide
 - Nitrogen dioxide
 - Nitrogen monoxide
- 3.7 Note that WELs are applicable to personal exposure. Monitoring undertaken at static locations is for information purposes and may not reflect the exposure of individuals carrying out tasks in these locations.

4. RESULTS

- 4.1 Figure 1 shows site diagram of the sampling locations.
- 4.2 Figures 2 to 4 show photographs taken during the diesel engine operation at Cranston Close Block B Car Park.
- 4.3 The average concentrations of diesel gases during the idling of the diesel engine are shown in Table 1.
- 4.4 The results of the respirable dust and total respirable carbon monitoring are shown in Table 2.
- 4.5 Figure 5 to 11 show the gas monitor readings at the locations. Measurements are averaged per minute.

5. DISCUSSION

- 5.1 Operatives undertaking the monitoring noted that when a diesel locomotive idled near Cranston Close Block B Car Park there was a large amount of noise and smoke generated, see Figures 2 to 4.
- 5.2 Elevated concentrations of carbon monoxide and nitrogen dioxide were detected at Cranston Close Block B Car Park on 26/02/2018 and 12/03/2018 during the idling of the diesel locomotive. See Figures 5 and 8.
- 5.3 Elevated concentrations of carbon monoxide were detected at Cranston Close Block B Car Park on 28/02/2018 and 26/02/2018 when a diesel locomotive was not present. This was most likely due to a petrol engine in the vicinity of the monitoring. See Figures 5 and 11.
- 5.4 The average concentrations of carbon monoxide and nitrogen dioxide were above the resolution of the gas monitor on the 26/02/2018. See Table 1.
- 5.5 The respirable dust concentrations, when compared to the data taken on 28/02/2018 where the diesel locomotive was not present, were elevated during the following monitoring periods (see Table 2):
 - 26/02/2018 08:40 to 10:15
 - 09/03/2018 08:00 to 10:10
 - 12/03/2018 07:57 to 13:08
 - 29/03/2018 23:45 to 30/03/2018 02:44
- 5.6 The total respirable carbon concentrations were elevated during the following monitoring periods (see Table 2):
 - 26/02/2018 08:40 to 10:15
 - 09/03/2018 08:00 to 10:10
 - 12/03/2018 07:57 to 13:08
- 5.7 During the monitoring period of 26/02/2018 the total respirable carbon would have exceeded the PR703 diesel particulate limit.
- 5.8 During the remaining monitoring periods, minimal concentrations of diesel exhaust emissions were detected.

6. CONCLUSIONS

- 6.1 The PR703 A1 Control of Diesel Emissions Exhaust Emissions exposure limits for Diesel Particulate Matter were exceeded during monitoring on 26/02/2018.
- 6.2 The EH40 Workplace Exposure Limits were not exceeded for carbon monoxide and respirable dust during the monitoring.
- 6.3 The CD283 Workplace Exposure Limits were not exceeded for nitrogen monoxide and nitrogen dioxide during the monitoring.
- 6.4 However as the monitoring was not undertaken in a workplace, Workplace Exposure Limits and Occupation Exposure Limits are not applicable. Therefore the above is for information purposes only.
- 6.5 The location of the monitoring would indicate the worst case for the amount of exposure to diesel exhaust emissions at Cranston Close Block B Car Park. However the amount of the diesel exhaust emissions measured is also heavily dictated by the weather conditions during the monitoring.
- 6.6 It was noted by several operatives that the diesel locomotives are very loud while idling. This was also reflected in a complaint from the estate's maintenance manager and residents.
- 6.7 The diesel locomotive generated large amounts of smoke, see Figures 2 and 3. Residents noted that a residue was present on vehicles, possibly due to the close proximity to the diesel locomotive, see Figure 4.

7. RECOMMENDATIONS

- 7.1 The location of the diesel locomotive idling should be reviewed to ensure noise and diesel exhaust emissions are minimised for operatives and the public.
- 7.2 The duration of idling and the time of day at which this is carried out should also be reviewed.
- 7.3 The diesel locomotive should be serviced and maintained to prevent excessive diesel emissions.
- 7.4 If possible, the exhaust system can be modified to include a Diesel Particulate Filter (DPF) to minimise the particulate matter from the exhaust.

8. REFERENCES

Control of Substances Hazardous to Health Regulations 2002 (As amended).

HSE Document, EH40/2005 Workplace Exposure Limits (Second edition).

HSE Document HSG187, Control of Diesel Engine Exhaust Emissions in the Workplace.

TFL Management System Procedure, PR0703 A1 Control of Diesel Engine Exhaust Emissions.

CD283 HSE Consultation Document: Consultation on implementing new and revised Workplace Exposure Limits.

Figure 1. Site diagram – Cranston Close, Block B Car Park.



Figure 2. Photograph at Car Park Block B during Engine Start



Figure 3. Photograph at Car Park Block B during Engine Idling

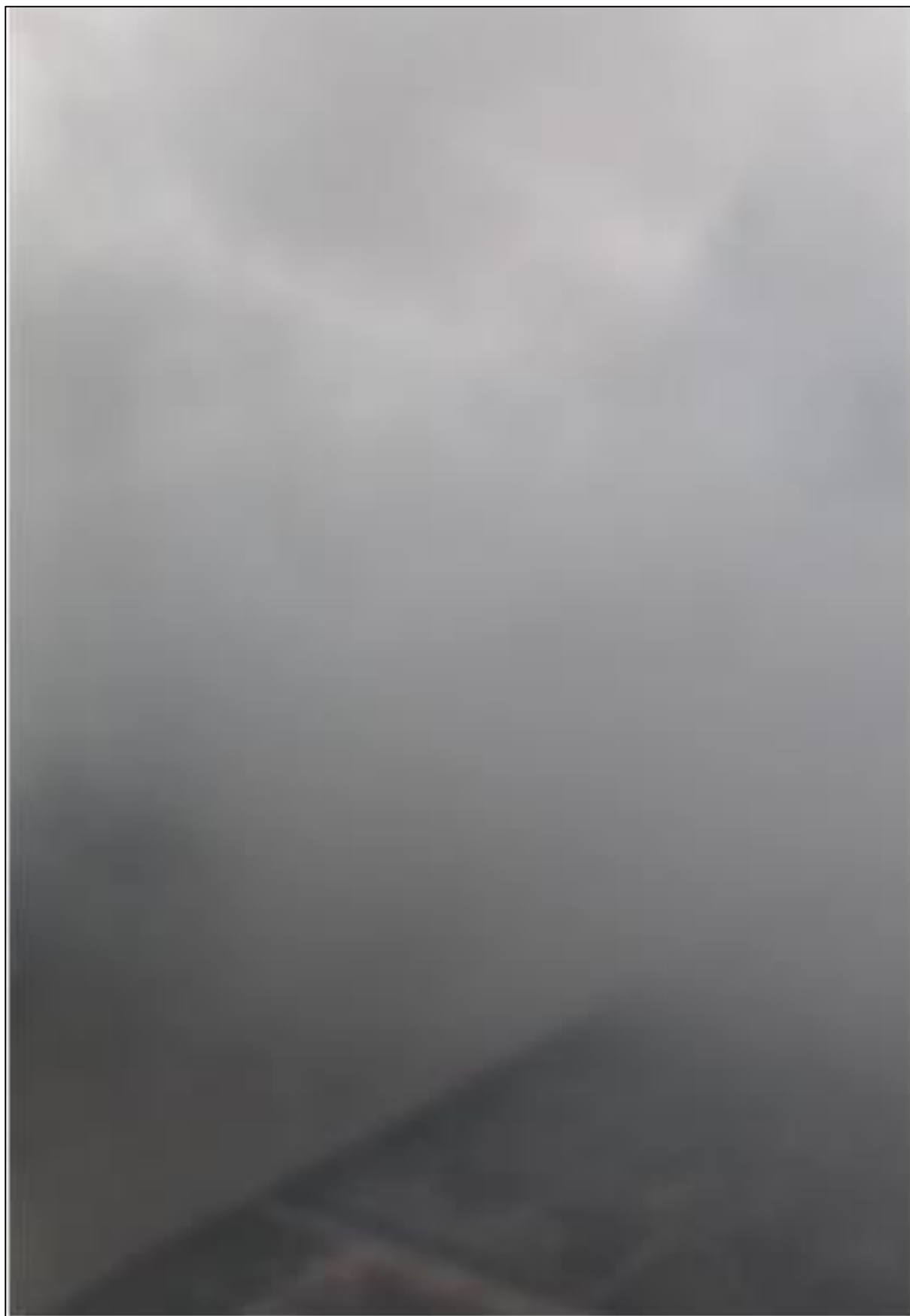


Figure 4. Photograph at Car Park Block B Showing Car Proximity



Table 1. Diesel Exhaust Gas Average Concentrations during Train Idling

SAMPLE LOCATION	MONITORING TIME	AVERAGE CARBON MONOXIDE / PPM	AVERAGE NITROGEN MONOXIDE / PPM	AVERAGE NITROGEN DIOXIDE / PPM
Cranston Close Block B Car Park	26/02/2018 08:40 to 10:15	1	< 1	0.1
Cranston Close Block B Car Park	07/03/2018 10:00 to 10:10	< 1	< 1	< 0.1
Cranston Close Block B Car Park	09/03/2018 08:35 to 09:30	< 1	< 1	< 0.1
Cranston Close Block B Car Park	12/03/2018 10:29 to 12:59	< 1	< 1	< 0.1
Cranston Close Block B Car Park	16/03/2018 09:00 to 09:35	< 1	< 1	< 0.1
Cranston Close Block B Car Park	30/03/2018 01:10 to 01:44	< 1	< 1	< 0.1
Cranston Close Block B Car Park (no train idling, background data)	28/02/2018 08:07 to 09:40	< 1	< 1	< 0.1

Key:

TWA Limit Exceeded
STEL Limit Exceeded
Minimal Measurements

Table 2. Aerosol Monitoring Results

FILTER NUMBER	SAMPLE LOCATION	SAMPLE TIME	RESPIRABLE DUST CONCENTRATION / MG.M ⁻³	TOTAL RESPIRABLE CARBON / MG.M ⁻³	TOTAL RESPIRABLE CARBON 8HR TWA / MG.M ⁻³
173298/01	Cranston Close Block B Car Park	26/02/2018 07:51 to 12:18	0.29	0.256	0.142
173298/03	Cranston Close Block B Car Park	07/03/2018 08:33 to 11:26	Sample unusable		
173298/04	Cranston Close Block B Car Park	09/03/2018 08:00 to 11:00	0.06	0.036	0.014
173298/05	Cranston Close Block B Car Park	12/03/2018 07:57 to 13:08	0.11	0.089	0.058
173298/06	Cranston Close Block B Car Park	16/03/2018 08:02 to 12:03	0.02	< 0.011	
173298/07	Cranston Close Block B Car Park	29/03/2018 23:45 to 30/03/2018 02:44	0.12	< 0.023	
173298/02	Cranston Close Block B Car Park (no train idling, background data)	28/02/2018 07:51 to 09:43	0.02	< 0.026	

Key:

TWA Limit Exceeded
Minimal Measurements

Figure 5. Gas Monitor Data – Cranston Close, Block B Car Park – 26/02/2018

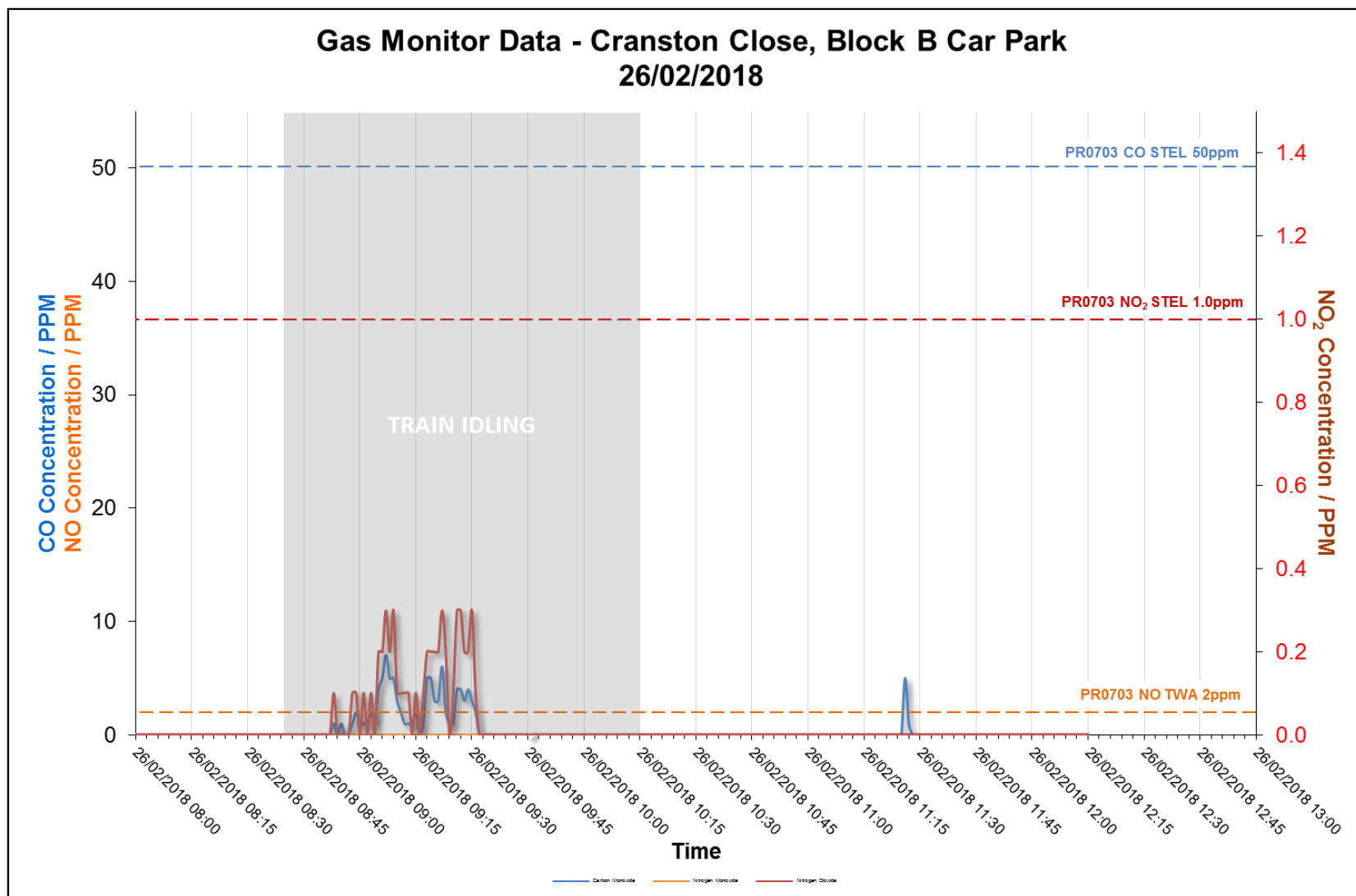


Figure 6. Gas Monitor Data – Cranston Close, Block B Car Park – 07/03/2018

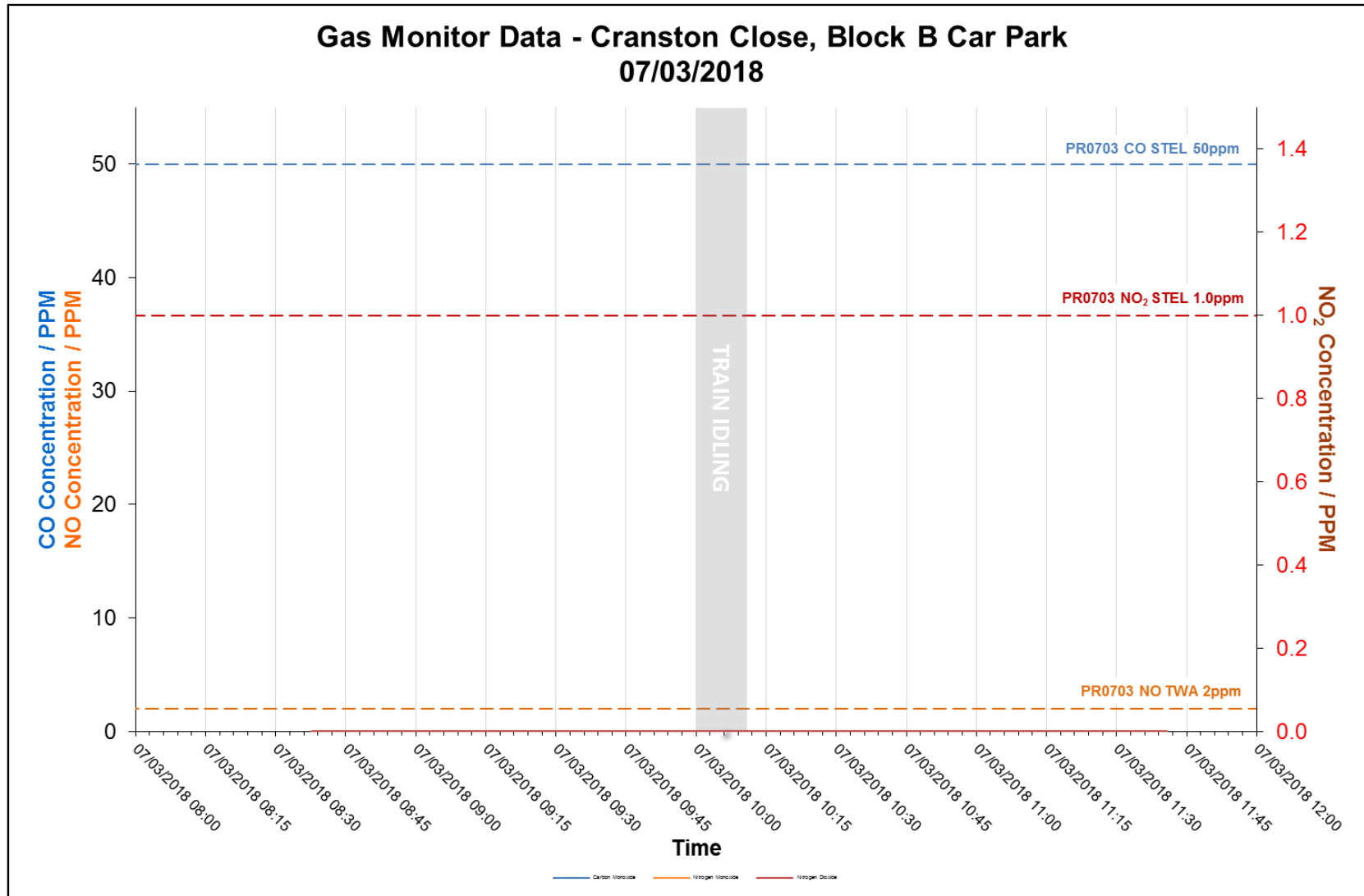


Figure 7. Gas Monitor Data – Cranston Close, Block B Car Park – 09/03/2018

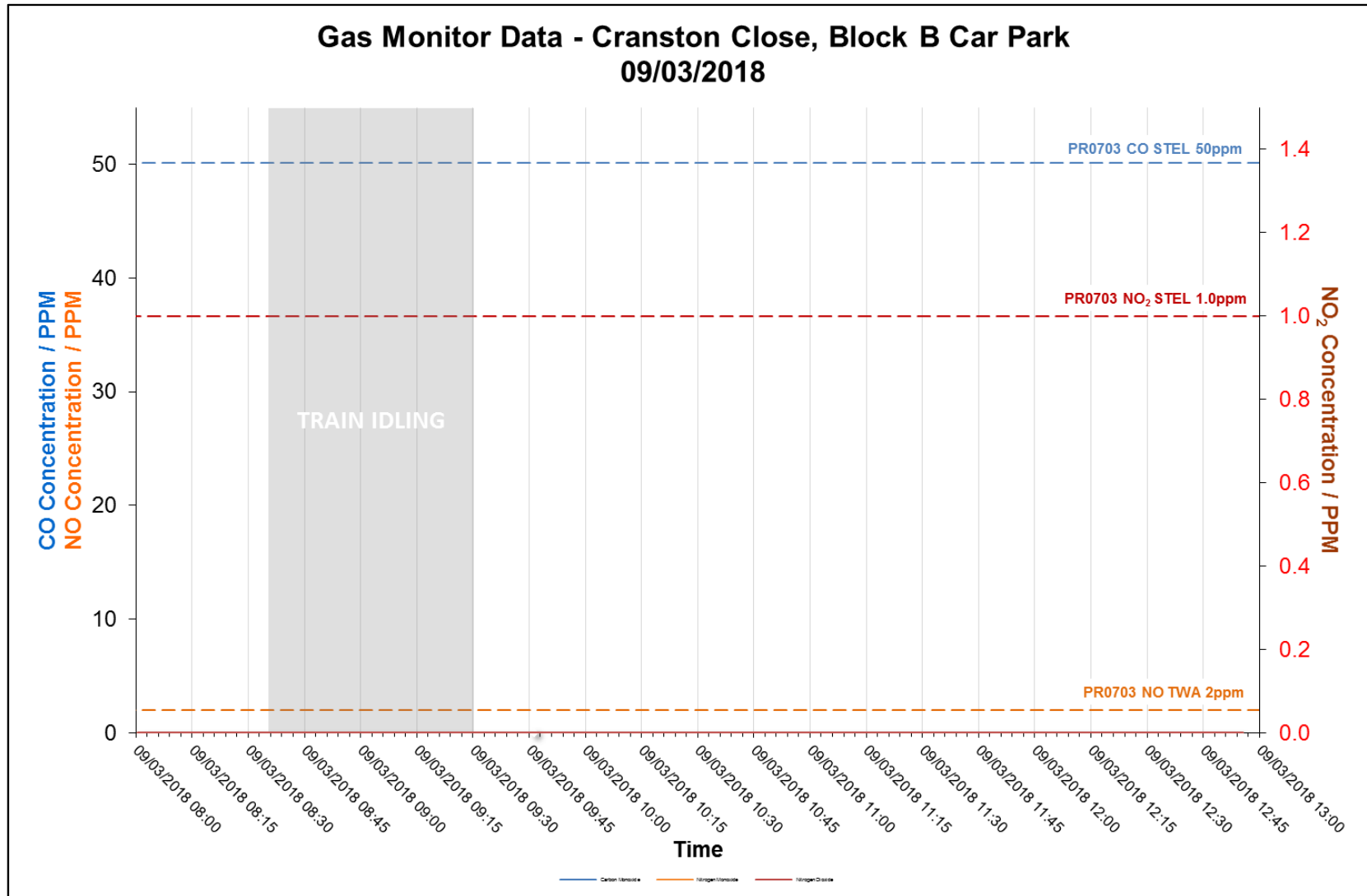


Figure 8. Gas Monitor Data – Cranston Close, Block B Car Park – 12/03/2018

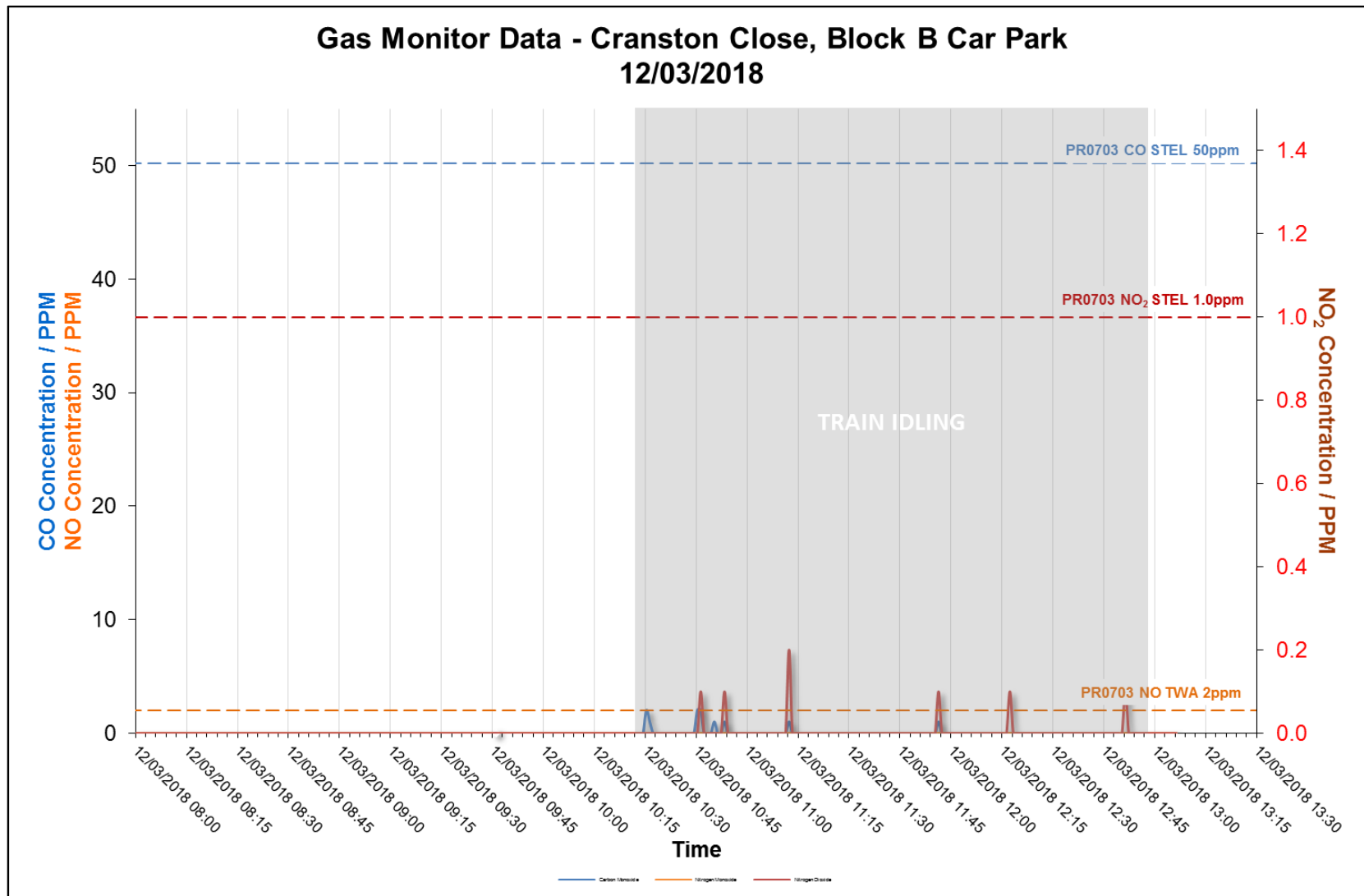


Figure 9. Gas Monitor Data – Cranston Close, Block B Car Park – 16/03/2018

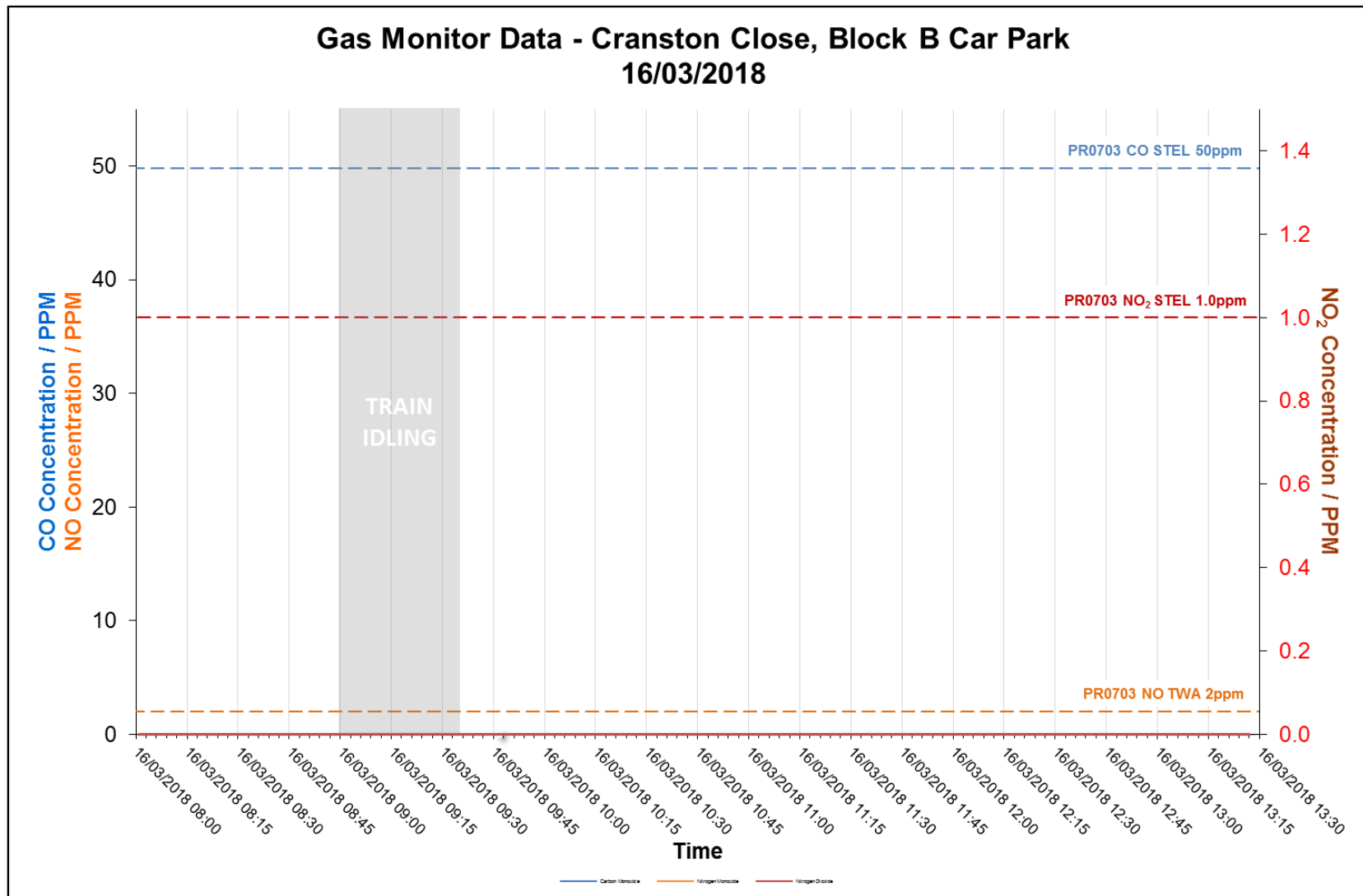


Figure 10. Gas Monitor Data – Cranston Close, Block B Car Park – 29/03/2018

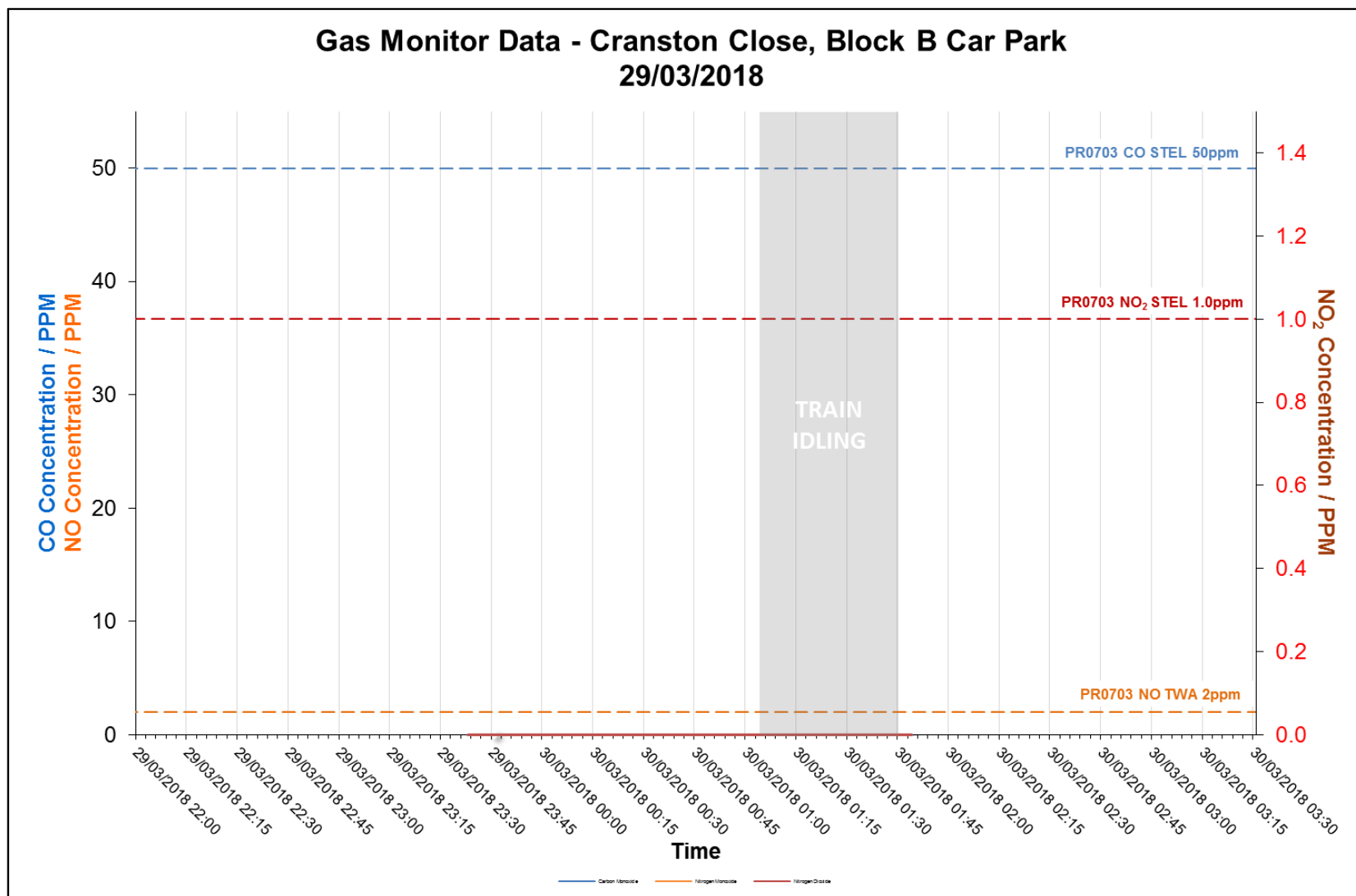


Figure 11. Gas Monitor Data – Cranston Close, Block B Car Park (Background Data) – 28/02/2018

