



Three Mile Cross Service Station

Car Wash Noise Measurements

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REVISION HISTORY

Revision	Date	Revision Details	Author	Checked
R01	03/11/2023	Original Issue	 Susan Witterick BSc MIOA	 Ben Tomlin BSc MIOA

1 INTRODUCTION

- 1.1 dBx Acoustics Ltd was appointed by N&S Electrical Engineers Ltd to take in-situ measurements of noise emissions from an existing four bay self-service jet wash facility at Three Mile Cross Service Station, Basingstoke Road, Reading RG7 1BA.
- 1.2 The purpose of the measurements is to quantify typical operational noise emissions during a standard wash cycle, to support noise impact assessments for future installations.
- 1.3 A glossary of acoustic terminology has been supplied in Appendix A in order to assist the reader.

2.1 The installation measured comprises a 4-bay Adriatech Quadra Nova self-service jet wash with central plant enclosure, as shown in the manufacturer's brochure reproduced as Figure 1, below.

STANDARD

QUADRA NOVA Car Wash Structure

Self Service Car Wash

DIMENSIONS

Wash bay width	5100 mm
Technical room bay width	3000 mm
Depth	6800 mm
Height	max. vehicle height 2.6 m

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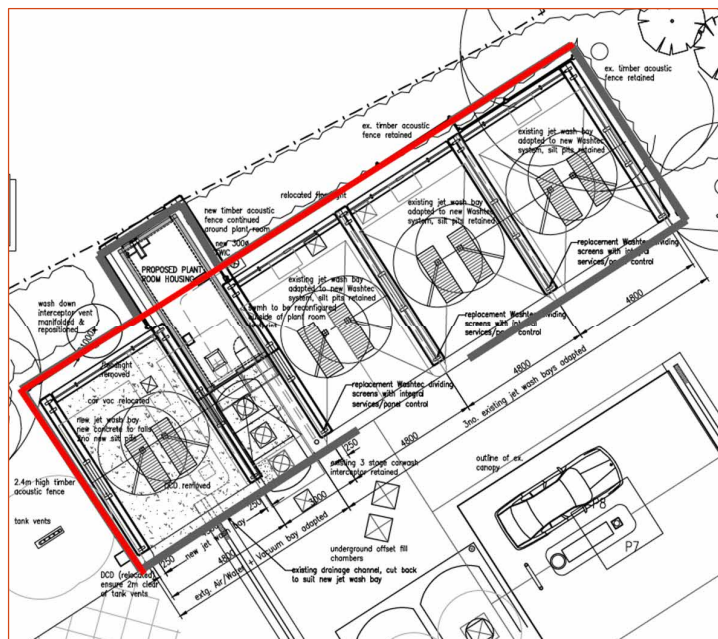
ADRIATECH

- 2.2 Customers purchase either 8, 12 or 16 minutes of wash time, within which period they are free to switch between washing programs as required.
- 2.3 The typical wash time is understood to be 8 minutes. This was verified by observations on site. Table 1, below, summarises the typical wash sequence and period.

Wash Program	Duration
Active Foam	45 seconds
HP Washing	1 minute 30 seconds
Brush Washing	1 minute 30 seconds
Rinsing	2 minutes
Wax	1 minute 30 seconds
Spot Free Finishing	1 minute 15 seconds

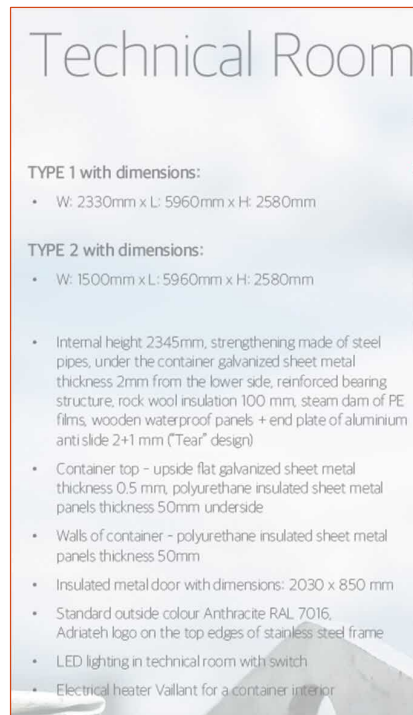
- 2.4 The installation at Three Mile Cross includes an after market close boarded timber noise barrier along the rear and west end of the jet wash as indicated in red in Figure 2, below. This barrier is 2.4m tall.

Figure 2: After-Market Noise Barrier



- 2.5 In addition to the jet wash, the site contains petrol filling pumps, a convenience store, and associated parking. The jet wash is located to the north of the site, with access from Basingstoke Road to the south.
- 2.6 A “Type 1” plant room is located between Bay 1 and Bay 2, the manufacturer’s information for which is presented in Figure 3, below.

Figure 3: Plant Room



- 2.7 There is no local plant within the wash bays. Individual bays are serviced via high level pipework from the main plantroom.

3 NOISE MEASUREMENTS

- 3.1 Operational noise measurements were taken at the Three Mile Cross site by dBx Acoustics Ltd on Tuesday 17th October and Tuesday 24th October 2023.
- 3.2 All measurements were made with the microphone 1.5m above ground level, in free field conditions.
- 3.3 Measurements were made in accordance with BS EN ISO 7445-1:2003.

Weather Conditions

- 3.4 The temperature during the noise surveys varied between 8°C and 10°C. There was no precipitation. Wind speeds during the surveys averaged 3m/s.

Noise Sources

- 3.5 At the measurement locations, use of the jet wash was considered the primary noise source. Other contributions to the noise climate arose due to road traffic on Bracknell Road, and vehicle movements and refuelling within the site.

Equipment Used

- 3.6 The equipment used during the noise survey is presented in Table 2, below.

Table 2: Equipment Used

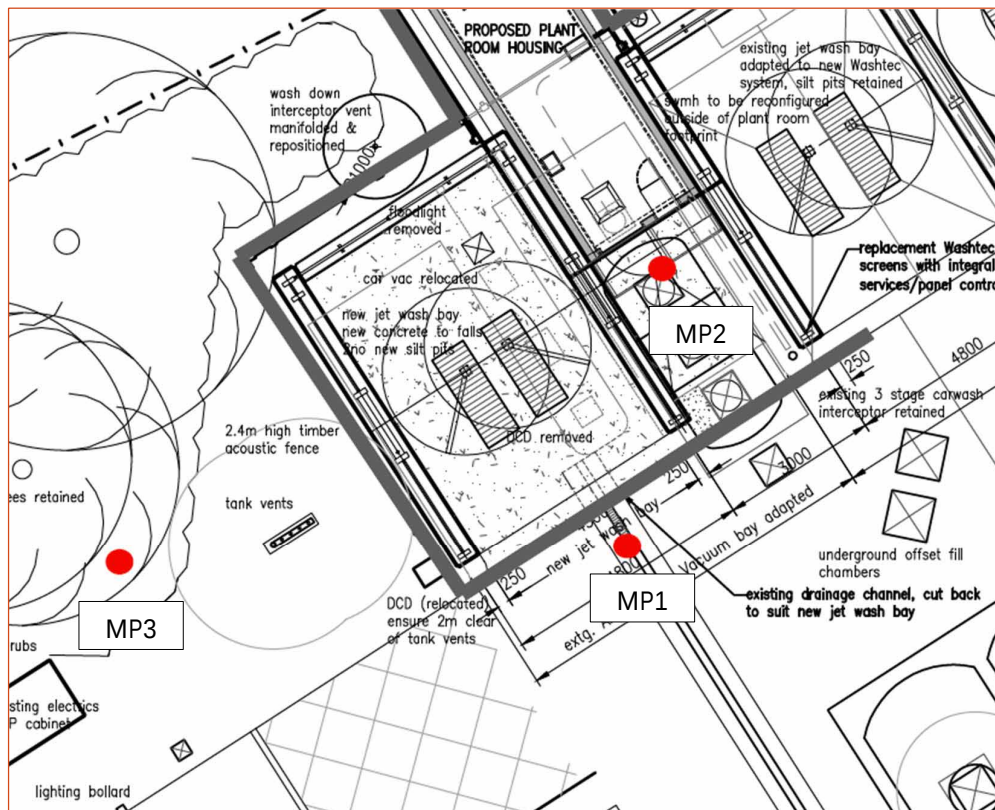
Measurements	Equipment	Manufacturer & Part No.	Serial Number
Bay Entrance – 17 th October and 24 th October	Meter	NOR 140	1405619
	Pre-Amp	NOR 1209	15526
	Microphone	NOR 1225	168247
	Calibrator	NOR 1251	33827
1m from Plantroom – 24 th October	Meter	NOR 140	1403443
	Pre-Amp	NOR 1209	12967
	Microphone	NOR 1225	18437
	Calibrator	B&K 4231	1821323
5m from end of Bay 1 – 24 th October	Meter	Casella C633C	1716934
	Pre-Amp	CEL 495	001773
	Microphone	CEL 251	000847
	Calibrator	CEL 120/1	204515

- 3.7 The sound level meters were calibrated before and after measurements, with no significant drift recorded. An accredited laboratory calibrated the equipment not more than two years prior to the measurements being made, with the exception of the calibrators, which had been calibrated not more than one year prior to the survey.

Measurement Procedure

- 3.8 Measurements on 17th October were made at the front of the wash bay (2m from the average lance position). During this period, all wash bays were in use.
- 3.9 Measurements on 24th October were made at multiple locations as follows:
- 1m from front of wash bay (3m from average lance position)
 - 1m from front of plant room
 - 5m from side of Bay 1 (screened by after-market timber fence)
- 3.10 Measurements on 24th October were made with only one wash bay in operation.
- 3.11 The measurement locations for 24th October are shown in Figure 4, below.

Figure 4: Measurement Locations

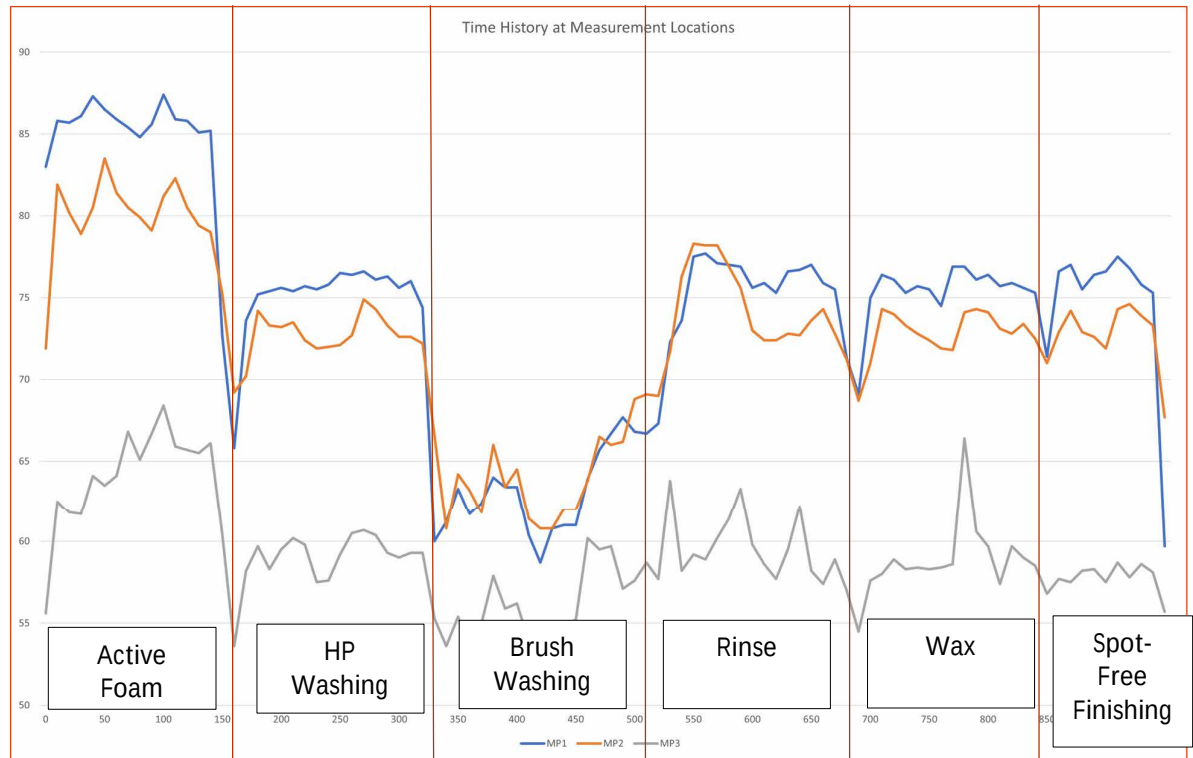


- 3.12 It was not possible to measure at the rear of the wash bays due to the acoustic fencing. Measurements at a greater distance from the front of the wash bay were not considered practical, due to the risks associated with vehicle movements, and the contribution of noise from both road traffic, and vehicle refuelling activities.
- 3.13 Measurements were made in 1/3 octave bands with a 10 second integrating period for the duration of the wash cycle.
- 3.14 The petrol station and shop were in operation during measurements and as such there are potential noise contributions from these sources within the measurements made, particularly for location MP3. Background noise levels were measured at all locations, and detailed notes were made during measurements, to allow these noise sources to be accounted for in the following assessment.

4 MEASUREMENT RESULTS

- 4.1 Measurements were made during an artificially extended wash cycle to allow accurate analysis of the data.
- 4.2 Figure 5, below, shows a time history at each measurement location, annotated to indicate the wash programme.

Figure 5: Time History



- 4.3 It can be seen from Figure 5, above, that the initial 'active foam' program is the loudest part of the wash cycle, with a typical noise level at 1m from the bay entrance (MP1) of 86dB_{L_{Aeq,T}}.
- 4.4 HP Washing, Rinse, Wax and Finishing programs are similar in nature with a typical noise level at 1m from the bay entrance of 76dB_{L_{Aeq,T}}.
- 4.5 The brush washing programme is relatively quiet, with a typical noise level at 1m from the bay entrance of 65dB_{L_{Aeq,T}}.
- 4.6 A comparison of the data from MP1 (1m from the front of the wash bay) and MP2 (1m from the plant room and approximately 3.5m from the centre of Bay 1) indicates that noise levels are dominated by noise from the wash bay itself, with no significant contribution from the enclosed plant. This is supported by subjective observations made on site.
- 4.7 The data for MP3, 5m to the west of the wash bays and shielded by the after-market noise barrier, clearly shows the influence of other noise sources on the site during all aspects of the wash cycle other than the initial Active Foam program. This data has therefore not been used further within this assessment.
- 4.8 Supplementary measurements were made at 1m from the entrance to Bay 2 during a typical wash cycle and support the data presented in Figure 5, above.

Data Summary

- 4.9 The measured noise levels at 1m from the front of the wash bay (3m from average lance position) are summarised in Table 3, below, along with the overall sound pressure level for a typical 8-minute wash cycle.

Table 3: MP1 Measured Noise Levels, $\text{dBL}_{\text{Aeq,T}}$

Wash Program	Sound Pressure Level, $\text{dBL}_{\text{Aeq,T}}$	Typical Duration
Active Foam	86	45 seconds
HP Washing	76	1 minute 30 seconds
Brush Washing	65	1 minute 30 seconds
Rinsing	76	2 minutes
Wax	76	1 minute 30 seconds
Spot Free Finishing	76	1 minute 15 seconds
Typical Full Cycle	$80\text{dBL}_{\text{Aeq,8min}}$	8 minutes

- 4.10 The third octave band data for each wash program have been interrogated to identify any potential tonality, in accordance with the methodology presented in Annex C to BS4142:2014. No tonality in the character of the noise generated by the jet wash is identified.

5 DERIVATION OF SOUND POWER LEVELS

- 5.1 From the above data, the overall sound power level of an individual wash bay can be estimated.
- 5.2 Due to the constraints of the on-site installation, it should be noted that the indicative sound power levels presented below were not measured strictly in accordance with any formal International or British Standard, and cannot be considered equivalent to a laboratory test. The data presented herein is, however, considered sufficient to inform impact assessment for similar installations.
- 5.3 The typical noise emission from a single wash bay, at 1m from the front of the bay (3m from the centre of the bay) over the full wash cycle was measured as 81dBL_{Aeq,T}.
- 5.4 The measurement location had a direct line of sight to the wash bay and as such this data can be used to estimate the sound power level (dBL_w) for the wash bay where:

$$L_p = L_w + 20 \log r - 11 - 10 \log Q$$

- 5.5 Where;

- L_p is the measured sound pressure level
- r is the distance from the average lance position, in this case 3m
- Q is directivity, to allow for reflections from the ground and enclosure, in this case 4.

- 5.6 The calculation procedure is outlined below;

- $L_p = 80\text{dBL}_{Aeq,T}$ at 3m from average lance position
- Distance correction over 3m, $20 \log (3) = +10\text{dB}$
- Correction +11dB
- Allowance for hemispherical directivity -6dB
- Sound power level of bay 95dBL_{w,A}

- 5.7 From the measured spectral data, the indicative octave band sound power spectrum for a single bay has been derived and is presented in Table 4, below.

Table 4: Octave Band Sound Power Level, dBL_w, Full Wash Cycle

	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8Hz	dBA
Sound Power Level, dBL _w	92	92	89	88	89	88	87	88	88	95

6 CONCLUSION

- 6.1 A series of in-situ noise measurements has been made of operational noise emissions from the Adriatech Quadra Nova jet wash installation at Three Mile Cross Service Station, Basingstoke Road, Reading RG7 1BA.
- 6.2 Measurements have been taken for each wash program and corrected for a typical 8-minute wash cycle. From these measurements, an indicative sound power level of 95dBL_{WA} for a single wash bay has been estimated, for use in noise impact assessment of similar installations.
- 6.3 Noise from the containerised plant room is not considered to contribute to the overall noise levels when the wash bays are in operation.
- 6.4 No tonal noise characteristics are identified within the measured noise data.

APPENDIX A – GLOSSARY OF ACOUSTIC TERMINOLOGY

Decibel, dB	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level (L_p) the reference quantity is 2×10^{-5} N/m ² . The sound pressure level existing when microphone measured pressure is 2×10^{-5} N/m ² is 0 dB, the threshold of hearing.
L	Instantaneous value of Sound Pressure Level (L_p) or Sound Power Level (L_w).
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
A-weighting	Arithmetic corrections applied to values of L_p according to frequency. When logarithmically summed for all frequencies, the resulting single "A weighted value" becomes comparable with other such values from which a comparative loudness judgement can be made, then, without knowledge of frequency content of the source.
$L_{eq,T}$	Equivalent continuous level of sound pressure which, if it actually existed for the integration time period T of the measurement, would possess the same energy as the constantly varying values of L_p actually measured.
$L_{Aeq,T}$	Equivalent continuous level of A weighted sound pressure which, if it actually existed for the integration time period, T, of the measurement would possess the same energy as the constantly varying values of L_p actually measured.
$L_{n,T}$	L_p which was exceeded for n% of time, T.
$L_{An,T}$	Level in dBA which was exceeded for n% of time, T.
L_{Fmax}	The instantaneous maximum sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
L_{AFmax}	The instantaneous maximum A weighted sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
$L_{Ar,Tr}$	The rating level: the equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.
Reverberation Time, T	The time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The descriptor T, often includes other nomenclature to describe the type of reverberation time measurement or if the reverberation time is an average taken for specific frequencies. For example, a T_{mf} is the mid-frequency reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Class, A - E	Classification of sound absorbers into Sound Absorption Classes A-E, according to BS EN ISO 11654, including frequencies 200-5000 Hz
NRC	A single-number rating system used to compare the sound-absorbing characteristics of building materials. A measurement of the acoustical absorption performance of a material, calculated by averaging its Sound Absorption Coefficients at 250, 500, 1000 and 2000 Hz
STI	Speech Transmission Index, Metric ranging between 0 and 1 representing the transmission quality of speech with respect to intelligibility by a speech transmission channel
R	Sound Reduction Index, the laboratory measured sound insulation properties of a material or building element in octave or third octave bands.
R_w	Weighted Sound Reduction Index, a single number which represents the sound reduction of a material. It is derived by plotting the sound reduction index against a set of reference curves. The curves are shifted until a best-fit is established and the curve which best fits the sound reduction spectrum is used to represent the single figure value.
D_w	Weighted Level Difference, the weighted level difference between a pair of rooms, stated as a single figure.

D_{nT}	Standardised Level Difference, a frequency-dependent measurement of airborne sound insulation, calculated using the following formula:
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	$D_{nT} = L_1 - L_2 + 10\log(T/T_0)$ dB Where: L_1 is the energy-averaged sound pressure level due to the pink noise source measured in the source room using a sweep technique. L_2 is the energy-averaged sound pressure level measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (= 0.5s for dwellings).
$D_{nT,w}$	Weighted Standardised Level Difference, a single-figure value of airborne sound insulation performance, derived according to procedures in BS EN ISO 717-1, based on the D_{nT} values at different frequencies (100-3150 Hz third octave bands).
$D_{nF,w}$	Weighted, Normalised Flanking Level Difference, the normalised, weighted difference in sound level between a pair of rooms via a flanking element, such as mullion or ceiling detail. The level difference in octave bands is first normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
D_{ne}	Normalised Element Level Difference. The normalised difference in sound level between a pair of rooms via a small element such as a trickle ventilator. The level difference in octave bands is normalized to a reference amount of absorption.
$D_{n,e,w}$	Weighted, Normalised Element Level Difference. The normalised, weighted difference in sound level between a pair of rooms via a small element such as a trickle ventilator, stated as a single figure. The level difference in octave bands is normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
C_{tr}	Spectrum Adaptation Term, a correction term applied to the sound insulation single-number values (R_w , $D_{w,i}$ and $D_{nT,w}$) in accordance with BS EN ISO 717-1. Applying the C_{tr} penalises a construction's performance if its low frequency performance is poor in relation its performance at higher frequencies.
Impact Sound	The noise generated by an impact on a structure. This is normally used to describe the noise created by people walking or moving furniture on a floor structure.
L_{nT}	Standardised Impact Sound Pressure Level, a frequency dependent measurement of impact sound insulation, calculated using the following formula: $L_{nT} = L_1 + 10\log(T/T_0)$ dB Where: L_1 is the mean sound pressure level due to the tapping machine measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (0.5s for dwellings)
$L'_{nT,w}$	Weighted Standardised Impact Sound Pressure Level, a single-figure value (@ 500 Hz) of impact sound insulation, performance, derived according to BS EN ISO 717-2, based on the L_{nT} values at different frequencies (100Hz- 3150 Hz third octave bands).
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence.
NR	The Noise Rating level. This is a single figure value derived by plotting a noise spectrum against a set of curves. The curve under which the spectrum fits is the resulting NR level.

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