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GARVOCK FILLING STATION REDEVELOPMENT

Noise Impact Assessment – Rev 00

Report no. 7674-00-00

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1 INTRODUCTION

This report is written on behalf of AMCA Architects and presents results of the noise impact assessment for the redevelopment of the Shell Garvock Filling Station, 86 Halbeath Rd, Dunfermline KY12 7RS.

The report is submitted in support of the planning application for the redevelopment of the site following the withdrawal of planning application reference 23/01266/FULL.

The assessment covers the impact of noise from the new automated rollover car wash, three bay jet wash, vacuum and tyre air pressure pump equipment to be located to the rear of the site along with noise impact of removing the existing car wash portal structure due to subsequent exposure of existing wall mounted air conditioning / refrigeration units serving the filling station shop. The assessment of the noise from these sources to nearest noise sensitive receptors to the site is undertaken in accordance with BS 4142:2014, "Methods for Rating and Assessing Industrial and Commercial Sound".

Fencing is shown on the site sectional drawings along the east and west site boundaries. This report will recommend the required height of these barriers in order to avoid "significant adverse impact" as defined by BS 4142:2014.

All measurements were taken by Callum Forsyth AMIOA, BSc Audio Engineering (2018), IoA Diploma (2021) and Kyle Wilson Student IOA, BSc Audio Engineering (2022). This report was written by Callum Forsyth who has worked in environmental noise for 4 years and reviewed by Anne Budd MIOA, BEng(Hons) Electroacoustics (2000) who has 18 years of undertaken environmental noise surveys including BS 4142 in Scotland.

2 THE DEVELOPMENT

The Garvock service station is located to the north of Halbeath Road, Dunfermline and is bounded to the east and west by residential neighbours and to the north by a band of woodland beyond which is a public cycle way.

The site has been a filling station with a carwash for many years, originally this will have been a rollover car wash but more recently the car washing provision was undertaken by staff using handheld jet sprays. To access the existing carwash cars would enter the site at the east and drive round the rear of the buildings to access the carwash (situated to the west of the main building) from the north. Images from Google Earth show cars queuing round this route to access this carwash facility. It is unknown when this car washing activity ceased and therefore the noise environment at site does not currently include car washing as a source of

noise. The site is currently used for fuel delivery, air pressure and vacuum plus the shop / post office.

The nearest noise sensitive receptors to the site are the residential dwellings on either side of the filling station on Halbeath Road as well as those to the northeast on Milldean Grove.

On the western boundary of site, there is an existing stone wall along the front/southern section with a closed boarded fence behind (the existing fence is not situated on the development site). Towards the back / north of the site the wall stops and there is a raised grassed bund on the boundary with the fence on top of this. There are currently sections of the western boundary fence missing.

On the eastern boundary of site there is an existing stone wall along the front/southern section with an open boarded / palisade fence situated on-top of the stone wall. Towards the back / north of the site the stone wall stops and there is a large hedge on the boundary which continues to the back of the site. There are currently sections of the eastern boundary fence missing.

Due to the open slatted nature of the eastern boundary fence and the missing sections of fencing to both boundaries, the existing acoustic screening is currently limited to the nearest neighbours.

The site location and existing site plan are shown in Appendix 1, along with photos from site showing existing boundary conditions as well as the existing wall mounted Air Conditioning and Refrigeration Units and the existing (to be removed) car wash structure which provides screening of these units to the neighbours.

The re-development of the site will include the installation of:

- an automated car wash situated to the rear / north of the site
- three jet washing bays adjacent to the car wash
- a car vacuum station
- an air pressure pump station

As part of the re-development of the site, the existing car wash structure, located to the west of the main building is to be demolished. As noted above, this structure currently provides screening to the nearest noise sensitive receptors from five wall mounted air conditioning and refrigeration units servicing the shop. With the car wash demolished , the existing screening will be removed and for this reason the impact of this change to noise from the AC units is therefore included as part of this assessment.

The proposal for the redevelopment is for to both the east and west boundaries to provide screening of noise to the neighbours.

The Filling Station operates 24 hours, however the new car washing facilities will only operate during daytime hours.

The proposed site layout plan and sections for the redevelopment can be seen in Appendix 2.

3 LOCAL AUTHORITY REQUIREMENTS

A Noise Impact Assessment was requested in correspondence from Fife Council Planning Department following consultation on the original planning application by Environmental Health. Text from the Planner as follows:

> "I refer to the above application for Garvock Service Station, Halbeath Road. Having reviewed the proposal, given that the proposed development would result in an intensification of the sites existing use, particularly through the additional 3 jet washes and the drive thru, colleagues in our environmental health team have requested the submission of a noise report to demonstrate the proposal wouldn't have any significant detrimental impact on the amenity of neighbouring properties".

4 STANDARDS & GUIDANCE

The assessment is undertaken in accordance with BS 4142 (2014) – "Methods for Rating and Assessing Industrial and Commercial Sound", this is a "relative" assessment method which provides a method of comparing the noise level from commercial and industrial sources with the existing background noise level.

BS 4142:2014 states, it is used to "assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident" in order to determine the degree of impact on the residents as a result of the change in overall noise level. This is done by comparing the average level of the noise source to be assessed (labelled the 'specific' noise, $L_{Aeq,T}$[1]), with the underlying background noise level which existed before the noise source was installed (represented by the $L_{A90,T}$[2]). Before the comparison is made the specific noise is adjusted to become the 'rating' noise level with penalties added if the specific noise has certain acoustic characteristics which make it more noticeable such as being particularly tonal, impulsive or intermittent in nature. All levels are external to the noise sensitive building being assessed.

BS 4142:2014 states that the significance of an industrial type noise depends upon both the exceedance over background and the context in which the sound occurs, starting with "indication of low impact" when the new noise does not exceed the existing background noise (i.e. the rating level is 0dB above background noise level), with an exceedance of around +5dB above the existing background noise level "likely to be an indication of an adverse impact, depending on context", and an exceedance of +10dB or more "likely to be an indication of significant adverse impact, depending on context". It goes on to say that, "When making assessment and arriving at decisions… it is essential to place the sound in context". Context can mean a number of things including; the time of day the sound occurs, the

[1] L_{Aeq} is the 'A' weighted, logarithmic average noise level over the defined time period

[2] L_{A90} is the 'A' weighted noise level which occurs for more than 90% of the time during the defined time period, often used to represent the 'background' noise level

frequency of occurrence and the noises already present in the surrounding environment.

The period of assessment used in BS4124 2014 is 1 hour during the day (0700-2300) and 15 minutes at night (2300-0700). For this report, only the 1 hour daytime period is assessed.

5 NOISE SENSITIVE RECEIVERS

The nearest noise sensitive receptors to the site are all residential. These are located to the east and west of the site on Halbeath Road and Milldean Grove.

The receptors and positions of receivers selected to represent them in modelling are detailed in Table 5.1.

Table 5.1 – Noise Sensitive Receptors

Receiver ID	Receptor Name	Receptor Type
1	82a Halbeath Rd	Single storey property to rear of 82 Halbeath Rd - receiver at ground floor in east façade
2	82 Halbeath Rd	Bungalow with upper floor - receiver in east façade at 1st floor level
3	82a Halbeath Rd	Pitched roofed single storey block to rear - receiver at ground floor in south façade
4 a/b	88 Halbeath Rd	Bungalow with dorma windows - receivers in west façade at ground floow level
5	1 Milldean Grove	2 storey house - ground floor extension window
6	1 Milldean Grove	2 storey house - first floor window

6 BACKGROUND NOISE MEASUREMENTS

Background noise measurements were taken on Wednesday 30th August 2023 at a position west of the existing car wash. This position was selected as providing representative background noise for the adjacent properties as it is currently entirely screened from the existing air conditioning / refrigeration units. The measurement position can be seen on the site plan in Appendix 3, this is within 3.5m of reflecting surfaces and is therefore not freefield (<3.5m to the nearest reflecting surfaces e.g. the fence and carwash wall to either side). This position is considered representative conditions experienced at the nearby residential properties which have fences close to the receiver windows at ground level. The measurement position is marked on the existing site plan in Appendix 3.

The measurement was made for 1 hour during operational hours at the filling station, logged every 5 minutes. In accordance with BS 4142 the most commonly occurring background noise level has been derived as 48dB L_{A90}.

The logged measurement data and statistical analysis can be seen in Appendix 4.

Measurements were made using a Type 1, Bruel & Kjaer Type 2250 sound level meter (Serial No. 2479699) fitted with the standard foam windshield Type UA 1650. The meter was mounted on a tripod at a height of 1.5m from the ground. The meter was calibrated before and after the measurements using a Bruel & Kjaer Type 4231 sound level meter calibrator and calibration signals recorded. Laboratory certificates are available for all equipment on request.

Weather conditions were monitored on site as being dry with 50% cloud coverage, a temperature of 17°C and wind speeds below 5ms^{-1} from the NW.

A wide variety of acoustic parameters were recorded but only the background noise L_{A90} and L_{Aeq} are presented here.

The noise environment consisted of noise from road traffic on the Halbeath Road with traffic noise including cars pulling in and out of the filling station forecourt.

Uncertainty in the background noise level recorded is considered to be low as there was little variation in the logged 5 minute, L_{A90} data during the measurement, Type 1 equipment was used, the weather conditions were good and measurement equipment was monitored throughout.

7 SOURCE NOISE MEASUREMENTS

Source noise measurements were made using a Type 1, Bruel & Kjaer Type 2250 sound level meters (Serial No. 2479699) fitted with the standard foam windshields Type UA 1650. At Armadale, the meter was mounted on a tripod at a height of 1.2m from the ground during the measurements. At Garvock the meter was handheld as required depending on the height of the unit being measured.

Source noise measurements of the wall mounted air conditioning / refrigeration units attached to the Garvock filling station shop were undertaken on Wednesday 30th August 2023. Each of the five units was measured at a distance of 1m (varying heights above ground). Measurement of each unit lasted 30 seconds and was recorded during noise generating phase of the cycle. The overall measured noise level for each unit (100% on-time) are shown in Table 7.1. Corresponding frequency data in third octave band noise data can be seen in Appendix 5. A photograph of the units can be seen in Appendix 1 and measurement positions are marked on the existing site plan in Appendix 3. Weather conditions were as per background noise measurements at Garvock set out in Section 6.

Source noise measurements of an existing automated rollover car wash, manual jet wash, vacuum and tyre pressure station of the same type (model and manufacturer) as will be installed at Garvock were undertaken on Wednesday 30th August 2023 at the Bathgate Road filling station in Armadale. Weather conditions during the measurement were dry and partly cloudy, with temperature between 13-15°C and wind speeds below 5ms^{-1} from the SW.

Measurements of the automated car wash were taken at a distance of 5m in front of the carwash exit for the duration of the automated washing and drying process. The car wash has both wash and drying cycles and given the difference in noise levels between these two functions, it has been determined that these cycles should be modelled independently. Measurements were logged every 30 seconds for the period of operation, which lasted a total of 9 minutes; 6.5 minutes for the wash cycle and 2.5 minutes for the drying cycle. This is the noise generating on-time of the unit and does not including the car entering and leaving. The overall measured noise level for each operation (100% on-time) are shown in Table 7.2. Corresponding frequency data in third octave band noise data can be seen in Appendix 5. A photograph of the carwash and measurement equipment during measurement can be seen in Appendix 3.

Measurements of the manual jetwash were taken at a distance of 5m from the edge of the central bay with no other bays in operation. Measurements were logged every 30 seconds for the period of operation, which lasts 10 minutes. This is the noise generating on-time of the unit and does not including the car entering and leaving. The overall measured noise level (100% on-time) is shown in Table 7.2. Corresponding frequency data in third octave band noise data can be seen in Appendix 5. A photograph of the jetwash and measurement equipment during measurement can be seen in Appendix 3.

Measurements of the vacuum and air pump were taken at a distance of 1m from the source at each of the accessible front and sides during periods of operation of the unit. The average measured noise level (100% on-time) for the vacuum and air pump shown in Table 7.2. Corresponding frequency data in third octave band noise data can be seen in Appendix 5.

Table 7.1 – Noise Source Measurements at Garvock

Noise Source	Measurement Position	Time (mins)	$L_{Aeq,T}$ (dB)
Danfoss (top right)	1m	0.5	59.8
Danfoss (top middle)	1m	0.5	67.6
Inverter (bottom left)	1m	0.5	57.9
Danfoss (bottom middle)	1m	0.5	62.8
Mitsuibishi (bottom right)	1m	0.5	62.1

Table 7.2 – Noise Source Measurements at Armadale			
Noise Source	Measurement Position	Time (mins)	$L_{Aeq,T}$ (dB)
Car Wash - Washing	5m to opening of bay	6.5	68.1
Car Wash - Drying	5m to opening of bay	2.5	79.6
Jet Wash	5m to opening of bay	10	59.8
Vacuum	1m (from each side)	3*	66.5**
Air Pressure	1m (from each side)	3*	65.0**

*1 each side / **average of 3 sides

Uncertainty in the source noise measurements is low as the equipment was operating normally and measurements were taken at relatively close proximity to the noise source without interference from spurious sources. Measurement equipment was attended throughout the measurement and the resultant noise levels are of the same magnitude as previous measurements by New Acoustics and others of similar equipment.

The sound power levels for the Air Conditioning / Refrigeration units, vacuum and type air pressure pump have been calculated using a conformal area based on the dimensions of the source and distance from the source at which the measurement was made.

The sound power level of the automated car wash (wash and dry cycling) and the jet wash were derived by creating a calibration model of Armadale (where the measurements were made) in Cadna-A environmental noise modelling software. Vertical area sources (sized as per the open areas at the ends of the Armadale automated car wash) are used to represent radiating sources at the ends of the car wash and a point source used to represent the jetwash between the reflecting Perspex barriers forming the wash bay. The measured source noise spectrums were then applied to the sources in the calibration model and shifted until the required SPL was reached at the calibration position (5m from the bay opening) replicating the conditions under which the measurement was taken.

The resultant 100% on-time sound power levels for each noise source are shown in Table 7.3. These are the sound power levels used in the noise modelling for the re-developed Garvock site, although with on-times applied for typical operation as described in Section 8.

Table 7.3 – Source Sound Power Levels (100% on-time level representative of measurement condition)	
Sources	SWL (dBA)
Car Wash - washing	87.9
Car Wash - drying	99.4
Jet Wash	87.7
Vacuum	80.1
Tyre Pump	78.6
Fan1 - Danfoss (top right)	71.7
Fan2 - Danfoss (top middle)	79.4

Fan3 - Inverter (bottom left)	69.8
Fan4 - Danfoss (bottom middle)	74.8
Fan5 - Mitsuibishi (bottom right)	73.9

8 PREDICTED NOISE LEVELS

In order to predict the noise levels from the carwash, jet wash, vacuum, air pressure unit and AC/refrigeration units at the closest receptors a Cadna-A environmental noise model (Datakustic CadnaA Version 2023) has been created for the Garvock site. The model calculates noise levels using the methodology set out in ISO 9613-2, "Acoustics − Attenuation of Sound During Propagation Outdoors".

Where total attenuation between source and receiver is defined as:

$$A = A_{div} + A_{atm} + A_{bar} + A_{gr}$$

A_{div} being geometrical divergence, A_{atm} atmospheric absorption, A_{bar} barrier attenuation and A_{gr} ground effect. Attenuation due to foliage has not been included in the model.

Air absorption is calculated using the measured third octave band levels and absorption coefficients from ISO9613-1 for 15°C and 70% relative humidity. Ground absorption is set to G=0 (hard ground) for the filling station site, with the remainder of the model having a ground absorption of G=0.5 (mixed soft and hard ground). Buildings and barriers set to be reflective with 3 reflections set in the configuration. All buildings and boundary fences are set to be reflecting with "structured façade" (diffuse reflection), however, the Perspex screens surrounding the car wash and jet wash are set to 'smooth' (specular reflection). Car wash screens are 3m high and Jet wash screen are 2.4m high relative to local proposed ground levels.

The model is based on the site layout as shown on AMCA drawing 3891_PL_007_H_PROPOSED SITE PLAN, location of relevant noise sensitive receptors taken from AMCA drawing 3891_PL_001_A_LOCATION PLAN and topography relative to noise sources incorporated from AMCA drawing 3891_PL_012_D_PROPOSED SITE LEVELS. The heights for the receivers representing the noise sensitive receptors in the model were taken from Malcolm Hughes Charted Land surveyors drawing 54658_01 2D Topographical Survey (04-11-2019), with receivers located at 1m below the noted eaves levels. All drawings were provided by AMCA Architects.

The sectional drawing 3891_PL_010_B_PROPOSED SITE ELEVATIONS_SHEET 1 reproduced in Appendix 2 shows fences along both east and west boundaries. Heights of fencing on boundaries are not shown on the drawing.

Top of fence heights in the model are shown on the illustration in Appendix 6 as absolute heights above datum and summarised here:

- West boundary rear section top of fence height 92.95m
- West boundary front section 92.2m

- East boundary rear section top of fence height 93.1m
- East boundary front section 91.5m

To provide effective acoustic screening, fences should be of solid construction with no gaps between slats (overlapping or abutting fences can be used) or at the foot of the fence between the fence and ground /wall. The fence should have a density of at least 10kg/m^2 over the lifetime of the installation. This typically requires a fence with no less than ~18-25 kg/m^2 or as advised by the manufacturer if a proprietary product is used.

The model layout including the location of the receivers, buildings and fences are shown in is shown in Appendix 6, along with 3D views of the model.

The sound power level associated with each noise source have been calculated for the normal operational conditions over a 1 hour period. These are based on the noise levels as set out in Section 7 with "on-time" corrections for a 1 hour assessment period.

The on-times and time corrected sound power levels for the sources in the model are shown in Table 8.1.

Table 8.1 – Time Corrected Source Sound Power Levels

Sources	Event Time (mins)	No. of vehicles per hour	On-time per hour (mins)	On time corrected SWL (dBA)
Car Wash - washing	6.5	4	26	84.3
Car Wash - drying	2.5	4	10	91.6
Jet Wash (3no.)	10	3*	30*	84.7
Vacuum	10	5	50	79.3
Tyre Pump	5	10	50	77.8
Fan1 - Danfoss (top right)	--	--	30	68.7
Fan2 - Danfoss (top middle)	--	--	30	76.4
Fan3 - Inverter (bottom left)	--	--	30	66.8
Fan4 - Danfoss (bottom middle)	--	--	30	71.8
Fan5 - Mitsuibishi (bottom right)	--	--	30	70.9

*each of the 3no. jetwashes

To replicate the automated rollover car wash, the washing and drying sources were modelled as four area sources with two each (one wash, one dry) covering entrance and exit of the bay. Each end of the carwash e.g. 2-sources (wash and dry cycles) are run on the model alternatively to ascertain the noise levels for the east and west side receptors (dimensions 3m high by 5m wide).

All other sources were modelled as point sources (jetwash/vacuum/air at 1.2m and AC/Refrigeration units at relevant height on wall).

The resulting predicted specific noise levels at receivers representing each of the noise sensitive receptors during operational hours are shown in Table 8.2.

Table 8.2 – Predicted Specific Noise Levels	
Receiver	Predicted Noise Level, $L_{Aeq,1hour}$ (dBA)
1	40.9
2	47.4
3	47.7
4a	40.6
4b	39.2
5	43.3
6	47.8

ISO 9613-2 quotes an uncertainty of +/-3dB for distances up to 1km, however, noise source data used in the Garvock modelling is all measured on site (low uncertainty) and sources are calibrated in the model to match measured levels. In addition, the prediction method assumes moderate downwind conditions to all receivers and the distances to receivers from the sources are relatively small. Uncertainty in the predicted noise levels is therefore considered low.

9 ASSESSMENT

Specific noise levels as derived in Section 8 are rated in accordance with BS 4142:2014 for acoustic characteristics (+3dB for intermittency and +2dB for "tonality" as identified subjectively during measurement of existing equipment and third octave band data, totalling a 5dB penalty) and the "rating" noise level compared with the statistically derived background noise level to calculate the exceedance over background at the noise sensitive receptors.

The BS 4142 numerical assessment for operating hours are shown in Table 9.1.

Table 9.1 – BS 4142 Numerical Assessment					
Receiver	Specific Noise Level, $L_{Aeq,1hr}$ (dB)	Rating	Rating Noise Level $L_{Aeq,1hr}$ (dB)	Background Noise Level L_{A90} (dB)	Exceedance over background (dB)
R1	40.9	5	45.9	48	-2.1
R2	47.4	5	52.4	48	4.4
R3	47.7	5	52.7	48	4.7

R4a	40.6	5	45.6	48	-2.4
R4b	39.2	5	44.2	48	-3.8
R5	43.3	5	48.3	48	0.3
R6	47.8	5	52.8	48	4.8

BS 4142:2014 states that when the rating noise level does not exceed the existing background this is an "indication of low impact" and where there is exceedance of around 5dB above the existing background noise level this is "likely to be an indication of an adverse impact, depending on context".

The highest predicted exceedance over background is at model receiver 6; the first floor of 1 Milldean Grove, where the predicted exceedance is +4.8dB.

The context of the new noise is that it occurs during daytime hours only. The site is a well established filling station and has operated a carwash for many years prior to the current proposals. The characteristics of the new noise sources are the same in nature to existing noise sources already on site and that intensity of use of the facility will be similar to that at the site for many years prior to the current no carwash situation. Taking this context into consideration the predicted numerical 4.8dB exceedance of rating level over the existing background is considered unlikely to cause adverse impact at the surrounding noise sensitive neighbours.

10 CONCLUSION

A noise impact assessment has been undertaken for the proposed redevelopment of the Garvock Filling Station in accordance with BS 4142:2014 "Methods for Rating and Assessing Industrial and Commercial Sound".

Background noise levels have been measured and statistically analysed to provide representative background noise levels at the nearest noise sensitive receptors to the site. Source noise levels have been measured on site at Garvock and at a similar filling station site at Armadale.

Noise levels from the proposed operations are predicted in a Cadna-A environmental noise model for the nearest noise sensitive receptors using the ISO 9613-2 method.

Top of boundary fence heights are provided and modelled to achieve an exceedance of no more than 5dB rating noise level over existing background noise level.

BS 4142:2014 states that when the rating noise level does not exceed the existing background this is an "indication of low impact" and where there is exceedance of around 5dB above the existing background noise level this is "likely to be an indication of an adverse impact, depending on context". Given that that the context of the new noise is daytime only and that the new noise will in effect be similar in nature to existing noise sources already on site and those on site prevously, the assessment indicates that the predicted 4.8dB exceedance is unlikely to cause adverse impact on the surrounding noise sensitive receptors.

APPENDIX 1 – SITE LOCATION & EXISTING SITE LAYOUT & PHOTOS

Figure A1.1: Site Location

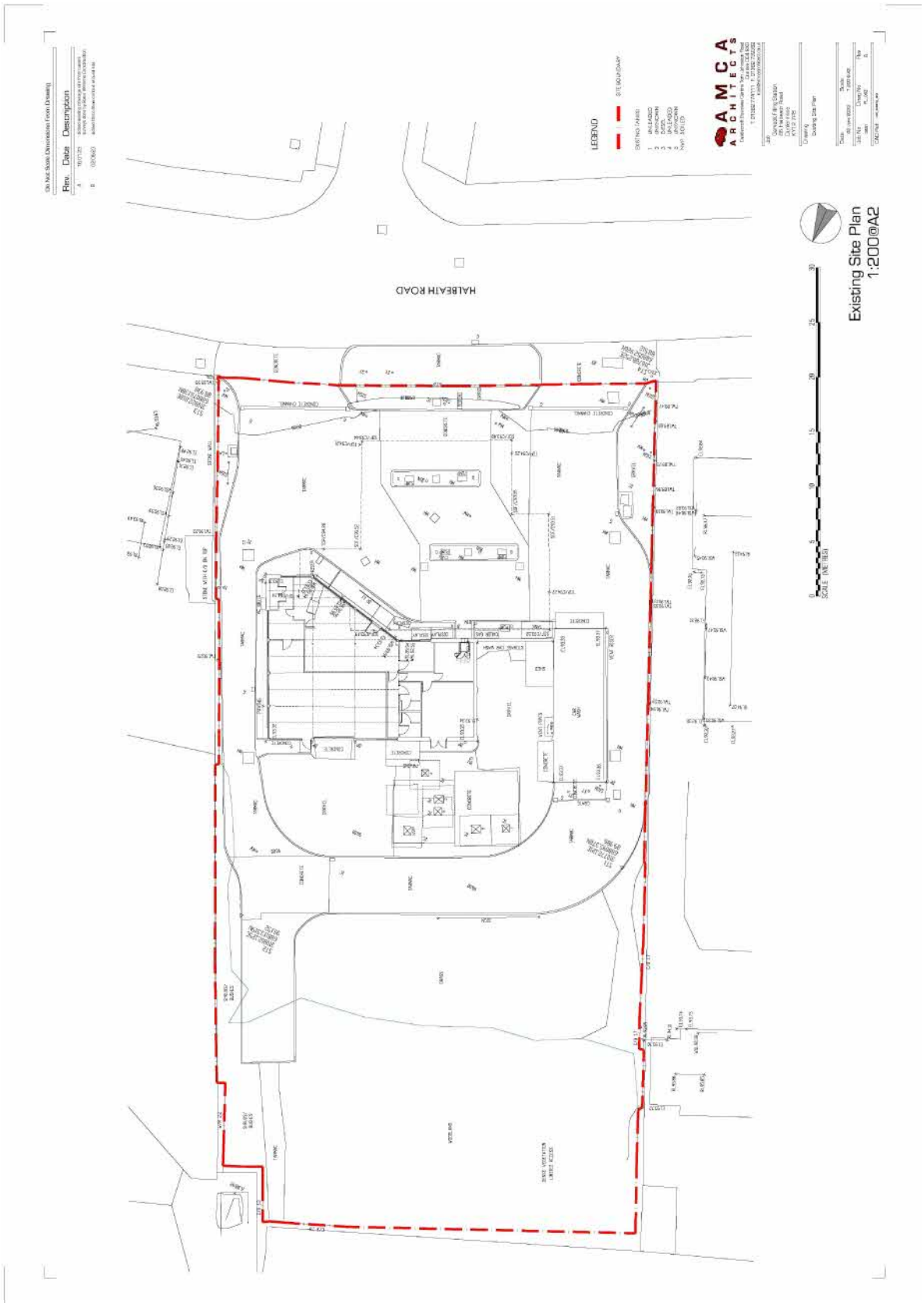

Figure A1.2: Existing Site Plan

Figure A1.3: View (looking south) of existing carwash portal at Garvock and the wall mounted AC / Refrigeration Units to the left. 82 Halbeath Road and the existing boundary stone wall and fence behind can be seen to the right.

Figure A1.4: As Figure 1.3 but with view of missing fencing section and ground floor window to rear of 82 Halbeath Road

Figure A1.5: View to rear of the Garvock petrol station shop building with view of the eastern boundary open slatted fence on the stone wall (boundary with 88 Halbeath Road) and the large hedge (boundary with 1 Milldean Grove)

APPENDIX 2 – PROPOSED SITE PLAN & SECTION

Figure 2.1 below shows the proposed site layout detailing the location of the proposed location of the new bays for the car and jet washes as well as the vacuum and air pressure.

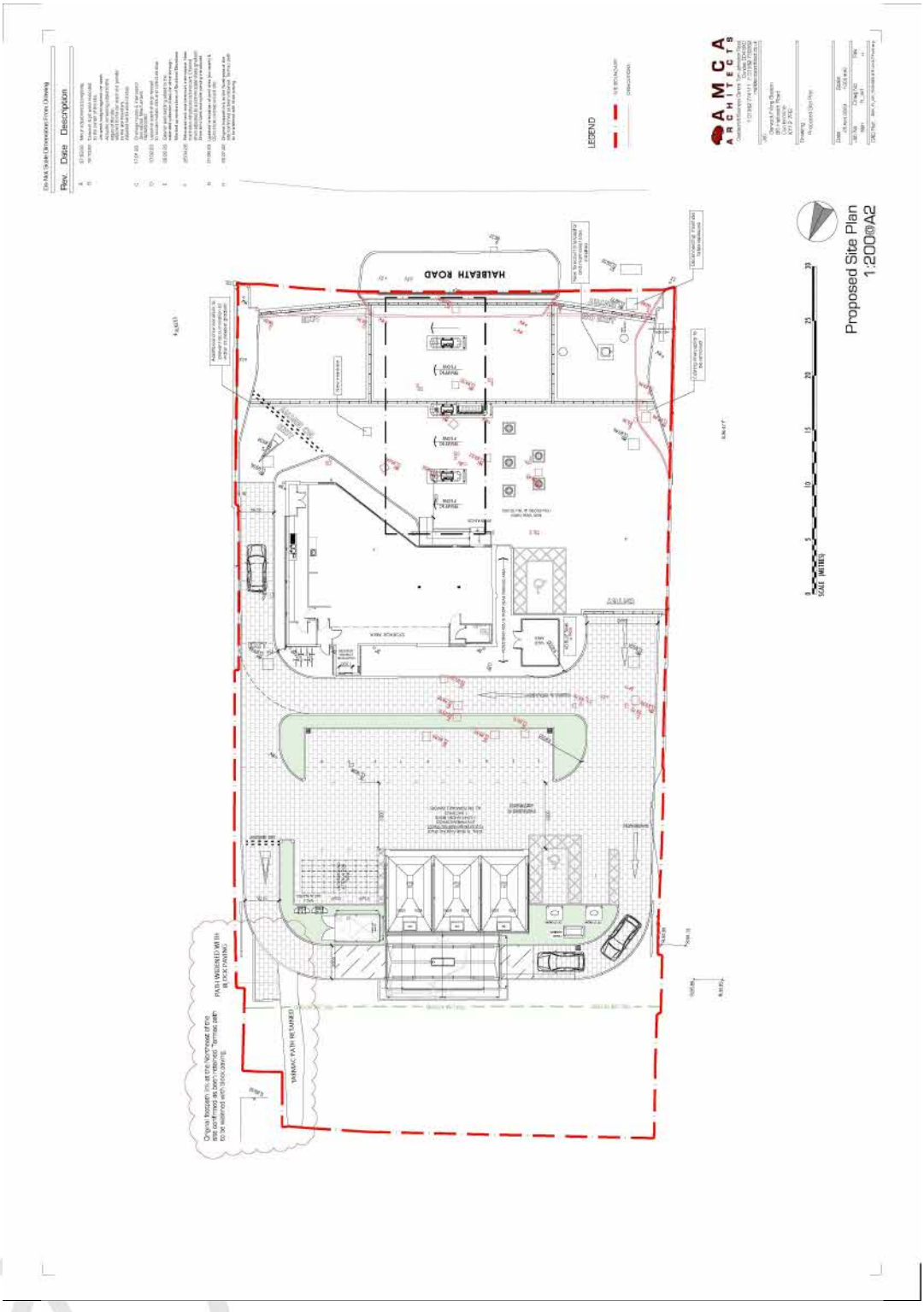

Figure 2.1: Proposed Site layout provided by ACMA Architects

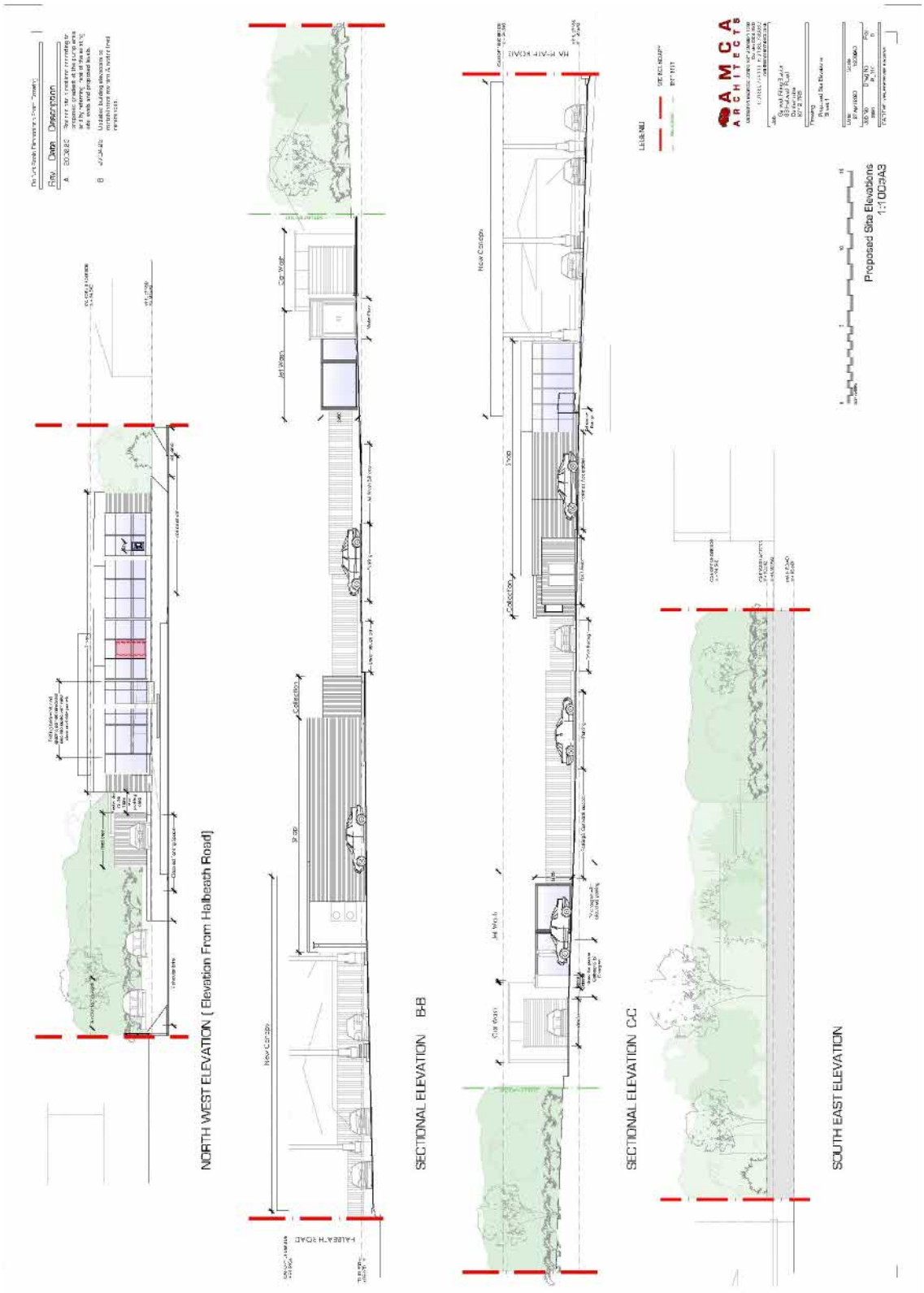

Figure 2.2: Proposed Site Sections provided by ACMA Architects

APPENDIX 3 – MEASUREMENT POSITIONS

Figure A3.1 below shows the background noise and source noise measurement positions at Garvock Filling Station.

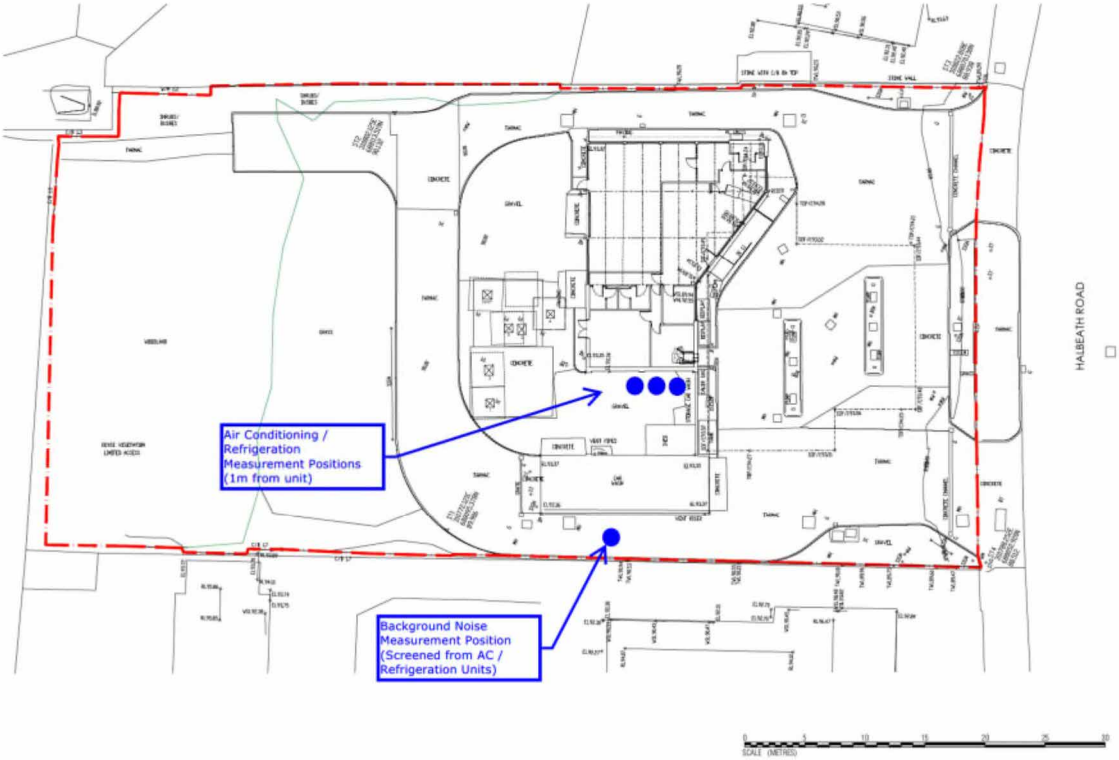

Figure A3.1: Measurement locations taken at Garvock Filling Station

There is no site plan available for the Armadale site at which existing noise levels of the jetwash, carwash, vacuum and air pressure machine were made.

Figure A3.2 and A3.3 below show the measurement equipment in situ at measurement positions for the proposed Car Wash and Jet Wash (5m from bay opening) at Armadale.

Figure A3.2 – Measurement of Car Wash

Figure A3.3 – Measurement of Jet Wash

APPENDIX 4 – BACKGROUND NOISE MEASUREMENT DATA

Table A4.1 – Calibration Signal Recordings				
Project Name	Date	Start Time	Elapsed Time	L_{Aeq} (dB)
Project 001	30/08/2023	15:01:31	00:00:09	93.9
Project 013	30/08/2023	16:31:54	00:00:08	93.9
Project 001	30/08/2023	17:30:17	00:00:09	94.0
Project 015	30/08/2023	19:03:13	00:00:06	94.0

Table A4.1 – Background Noise Data measured at Garvock Filling Station			
Start Time	Elapsed Time (T)	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)
15:15:59	00:05:00	58.0	51.9
15:20:59	00:05:00	60.5	47.8
15:25:59	00:05:00	58.5	47.2
15:30:59	00:05:00	57.9	47.9
15:35:59	00:05:00	59.0	49.3
15:40:59	00:05:00	58.4	45.4
15:45:59	00:05:00	60.1	46.1
15:50:59	00:05:00	57.8	47.7
15:55:59	00:05:00	57.6	49.3
16:00:59	00:05:00	58.5	50.4
16:05:59	00:05:00	59.1	48.3
16:10:59	00:05:00	58.8	51.3
15:15:59	01:00:00	58.8	48.5

Table A4.2 shows the statistical derivation of the background noise levels (L_{A90}) used in the assessment:

Table A4.2 – Most commonly occurring background noise level	
L_{A90} (dB)	Frequency of Occurrence
52	1
51	1
50	1
49	2
48	4
47	1
46	1
45	1

APPENDIX 5 – SOURCE NOISE MEASUREMENT

100% on time source noise measurements taken at Armadale are shown in the following Tables.

Table A5.1 – Logged Jet Wash Measurement at 5m from bay						
Date	Start Time	Elapsed Time	L_{Amax} (dB)	L_{Aeq} (dB)	L_{A90} (dB)	Notes
30/08/2023	17:33:55	00:00:30	73.3	58.5	51.8	Hand Jet Wash
30/08/2023	17:34:25	00:00:30	66.2	60.7	52.8	
30/08/2023	17:34:55	00:00:30	68.3	58.4	52.1	
30/08/2023	17:35:25	00:00:30	61.5	56.3	54.1	
30/08/2023	17:35:55	00:00:30	60.0	56.8	55.1	
30/08/2023	17:36:25	00:00:30	68.2	58.2	56.1	
30/08/2023	17:36:55	00:00:30	58.6	54.1	51.8	
30/08/2023	17:37:25	00:00:30	57.5	54.6	51.3	
30/08/2023	17:37:55	00:00:30	65.4	60.9	54.4	
30/08/2023	17:38:25	00:00:30	73.2	64.1	52.7	
30/08/2023	17:38:55	00:00:30	62.1	57.4	53.6	
30/08/2023	17:39:25	00:00:30	63.3	59.5	54.9	
30/08/2023	17:39:55	00:00:30	62.9	57.8	47.9	
30/08/2023	17:40:25	00:00:30	64.4	59.5	50.8	
30/08/2023	17:40:55	00:00:30	66.0	62.1	54.1	
30/08/2023	17:41:25	00:00:30	69.5	63.9	50.0	
30/08/2023	17:41:55	00:00:30	65.4	60.7	52.7	
30/08/2023	17:42:25	00:00:30	66.9	59.6	52.9	
30/08/2023	17:42:55	00:00:30	67.2	56.9	52.1	
30/08/2023	17:43:25	00:00:30	66.5	61.3	54.7	Beeping noise indicating time almost up

Table A5.2 – Logged Carwash "washing" cycle at 5m from entrance						
Date	Start Time	Elapsed Time	L_{Amax} (dB)	L_{Aeq} (dB)	L_{A90} (dB)	Notes
30/08/2023	18:42:28	00:00:30	69.9	64.6	55.7	washing
30/08/2023	18:42:58	00:00:30	74.6	69.6	62.1	washing
30/08/2023	18:43:28	00:00:30	76.4	72.6	61.7	washing
30/08/2023	18:43:58	00:00:30	75.2	69.0	65.0	washing
30/08/2023	18:44:28	00:00:30	71.3	67.7	64.9	washing
30/08/2023	18:44:58	00:00:30	71.1	68.4	66.0	washing
30/08/2023	18:45:28	00:00:30	71.8	65.4	60.0	washing
30/08/2023	18:45:58	00:00:30	72.2	65.4	61.1	washing
30/08/2023	18:46:28	00:00:30	72.8	69.2	67.1	washing

30/08/2023	18:46:58	00:00:30	71.8	64.3	52.2	washing
30/08/2023	18:47:28	00:00:30	68.9	61.9	50.2	washing
30/08/2023	18:47:58	00:00:30	72.7	67.7	61.5	washing
30/08/2023	18:48:28	00:00:30	73.3	69.9	67.9	washing

Table A5.2 – Logged Carwash "drying" cycle at 5m from entrance						
Date	Start Time	Elapsed Time	L_{Amax} (dB)	L_{Aeq} (dB)	L_{A90} (dB)	Notes
30/08/2023	18:48:58	00:00:30	83.4	79.2	55.0	Dryer
30/08/2023	18:49:28	00:00:30	81.9	80.5	79.3	Dryer
30/08/2023	18:49:58	00:00:30	80.8	79.2	78.3	Dryer
30/08/2023	18:50:28	00:00:30	82.2	81.0	80.4	Dryer
30/08/2023	18:50:58	00:00:30	82.5	77.2	62.1	Dryer

Table 5.4 - Third Octave Frequency Spectrum (linear L_{eq}, dB) of Measurement Data for sources measured at Armadale and Garvock:

		Measured SPL (50Hz - 630Hz third ocatve bands)											
Source	Position	50	63	80	100	125	160	200	250	315	400	500	630
Carwash - washing	5m to opening of bay	65.2	67.0	64.7	61.6	60.8	63.8	59.7	59.2	58.5	57.8	57.9	58.4
Carwash - drying	5m to opening of bay	66.0	67.8	66.7	67.5	69.4	67.7	65.0	65.4	70.3	69.3	67.0	67.8
Jetwash	5m to opening of bay	61.8	58.3	60.6	63.2	57.3	57.3	52.7	51.5	49.4	47.3	47.7	48.0
Vacuum - left side	1m	64.7	52.7	63.8	75.6	60.1	63.7	57.6	59.9	55.6	57.7	54.9	62.0
Vacuum - right side side	1m	57.5	57.5	59.0	60.2	59.2	58.7	58.7	56.3	60.0	63.4	59.8	53.8
Vacuum - front	1m	58.3	60.7	61.1	58.5	56.6	54.0	57.0	62.5	56.1	59.7	56.2	52.7
Air - side	1m	68.7	54.1	67.3	78.9	60.5	59.4	59.8	54.9	53.9	54.5	53.1	50.1
Air - front	1m	70.6	54.0	66.8	78.5	64.1	64.3	59.3	54.9	53.7	54.9	56.8	58.4
Air - side	1m	67.4	57.3	64.3	75.5	57.4	56.4	56.8	54.3	53.2	53.9	52.9	49.9
FAN 1 - Danfoss (Top Right)	1m	65.0	55.8	56.2	61.6	58.1	58.3	54.3	53.3	51.7	50.2	50.3	51.5
FAN 2 - Danfoss (top middle)	1m	68.1	65.5	65.0	65.6	63.5	63.2	63.5	61.2	61.3	58.7	58.1	57.3
FAN 3 - Inverter (bottom left)	1m	66.2	49.5	46.3	46.2	44.6	52.7	56.5	44.6	43.4	47.3	44.9	44.7
FAN 4 - Danfoss (bottom middle)	1m	72.6	52.4	48.7	59.2	53.7	58.5	54.6	52.9	53.5	54.2	53.3	53.2
FAN 5 - Mitsubishi (bottom right)	1m	75.0	56.4	55.5	64.7	60.2	62.9	60.8	59.3	55.4	54.1	53.6	52.4

		Measured SPL (800Hz - 10kHz third octave bands)												
Source	Position	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	dBA
Carwash - washing	5m to opening of bay	58.2	58.7	57.9	56.6	54.8	54.7	53.7	54.1	54.5	54.5	54.7	54.9	68.1
Carwash - drying	5m to opening of bay	68.3	67.2	69.5	69.0	68.7	69.6	68.4	67.1	66.0	64.6	62.6	61.2	79.6
Jetwash	5m to opening of bay	47.8	48.0	46.9	45.8	45.6	47.4	49.5	48.5	47.0	47.3	47.7	48.0	59.8
Vacuum - left side	1m	58.6	54.5	50.2	50.2	51.3	48.8	46.3	48.0	48.5	48.4	49.5	49.6	66.1
Vacuum - right side side	1m	50.5	47.2	46.6	48.1	51.6	51.0	51.4	52.9	52.4	51.6	55.4	54.3	65.5
Vacuum - front	1m	51.8	47.0	47.1	49.3	52.7	52.0	53.2	54.7	54.0	54.0	64.9	59.5	67.7
Air - side	1m	49.6	50.4	50.4	47.4	48.7	49.6	52.1	56.3	54.5	53.2	52.2	50.9	65.5
Air - front	1m	57.8	54.7	52.5	53.0	52.9	49.2	49.3	48.8	49.9	50.6	51.6	51.5	66.3
Air - side	1m	48.9	49.7	48.0	45.7	44.9	45.3	45.7	47.4	48.9	50.0	51.5	48.6	62.2
FAN 1 - Danfoss (Top Right)	1m	53.8	53.2	46.4	47.4	45.1	41.3	41.9	42.3	39.1	38.6	34.2	31.5	59.9
FAN 2 - Danfoss (top middle)	1m	59.7	58.7	54.6	55.0	53.7	53.3	53.0	53.4	52.8	52.4	52.2	52.1	67.6
FAN 3 - Inverter (bottom left)	1m	52.0	54.7	43.6	45.4	40.6	34.2	31.9	34.7	30.2	31.0	28.0	25.0	58.0
FAN 4 - Danfoss (bottom middle)	1m	55.8	59.2	46.5	49.7	45.9	44.8	44.3	43.3	41.9	42.2	39.0	35.2	63.0
FAN 5 - Mitsubishi (bottom right)	1m	52.3	52.3	48.7	50.5	49.9	45.3	46.3	44.3	41.3	42.7	40.8	40.0	62.1

Figure A6.1 below shows the locations of the receivers representing the nearest NSRs to the site.

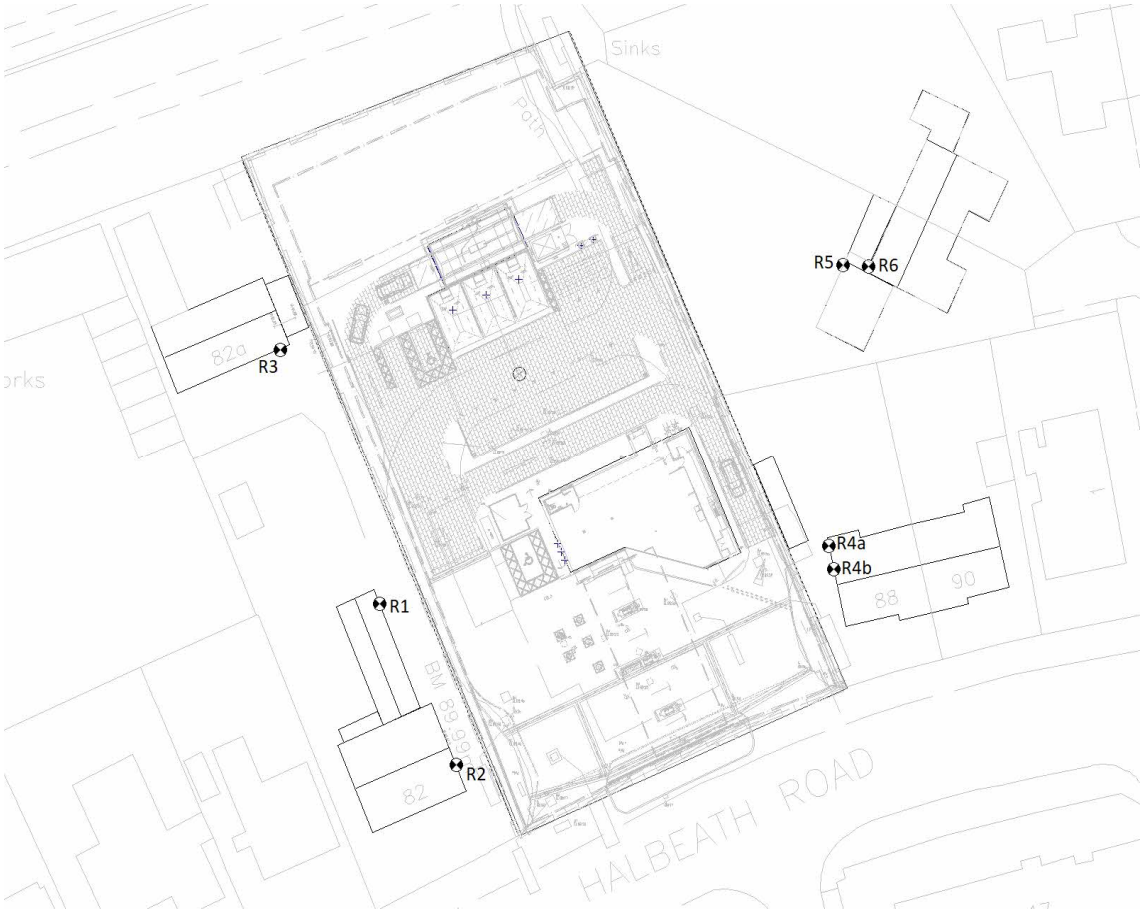

Figure A6.1 – Modelled receiver locations

Table A6.2 below shows the absolute heights of the receivers in the model along with the and reference point from which this has been derived.

Table A6.2 – Receiver heights as modelled		
Receiver	Absolute height (m)	Reference
R1	91.3	1m below eaves
R2	94.5	2m below ridge line
R3	92.74	1m below eaves
R4	91.4	1m below eaves
R5	91.5	1.5m above ground
R6	94.5	4.5m above ground

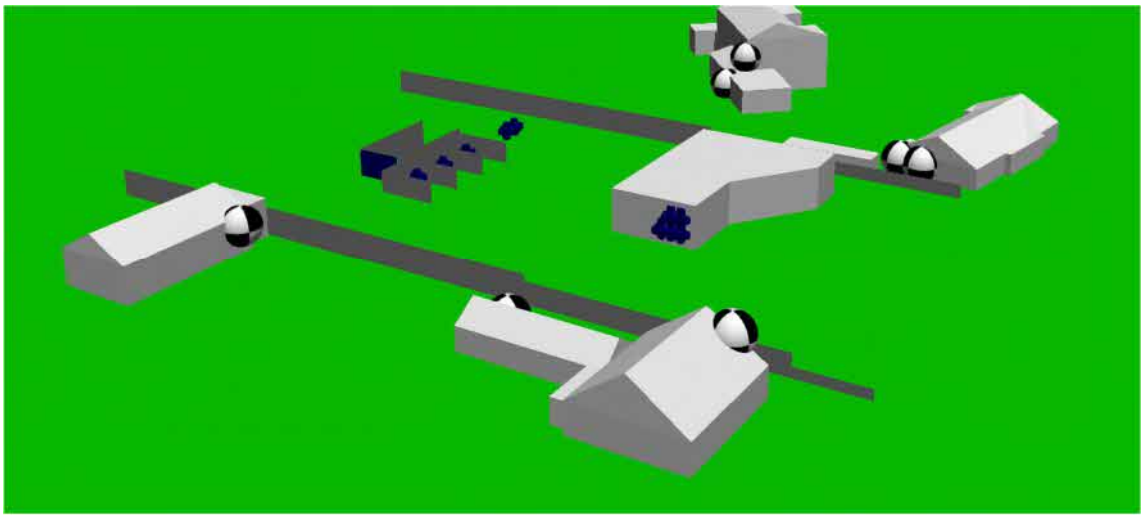

Figure 6.3 - View from the west looking towards the east (with carwash sources for west receivers on)

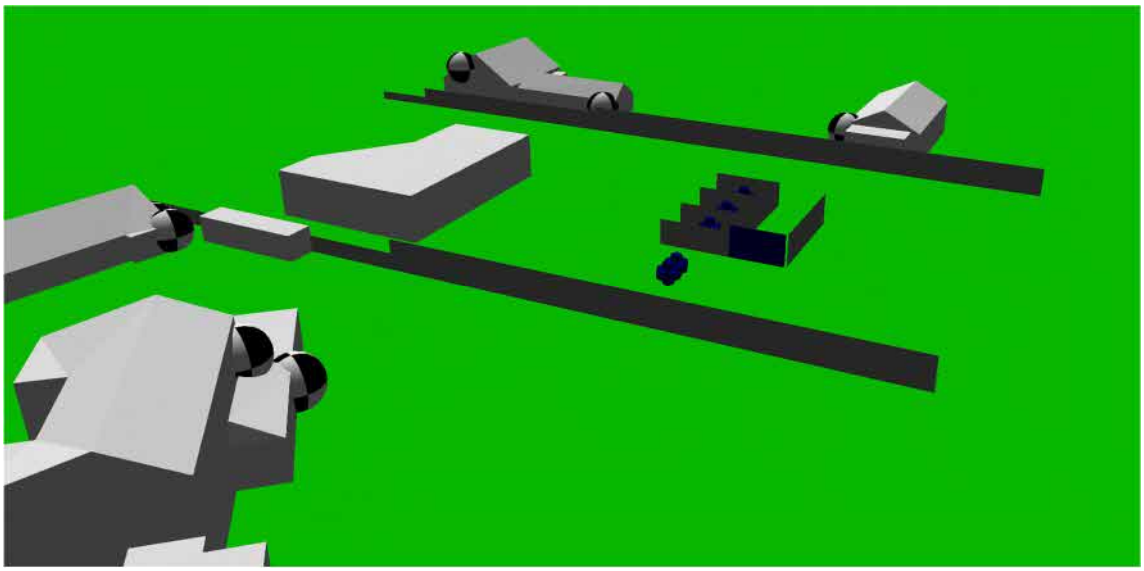

Figure 6.4 - View from the east looking towards the west (with carwash source for east receivers on)

Figure A6.5 below shows the modelled fence heights on the boundaries to east and west of the filling station site. Fence heights are shown as absolute "top of fence" heights, as the relative height of the fence will depend on if the fence is mounted on the wall or not.

Figure A6.5 – Barrier heights used in the Cadna-A environmental noise model