9 Noise and Vibration

9.1 Introduction

9.1.1 This chapter assesses the potential noise and vibration impacts from the junction improvements on the A90 at Laurencekirk. The assessment will consider the potential operational and construction impacts on existing noise sensitive receptors.

9.1.2 The proposed scheme alignment being assessed is described in Chapter 2 and shown in **Figure 1.2** and **Figure 1.3** in Volume 3 of this environmental report.

9.1.3 A Design Manual for Roads and Bridges (DMRB) Stage 2 Environmental Assessment Report (EAR) was undertaken in April 2018 (Ref. 9.1) to determine the optimal option, considering environmental issues, traffic, socio-economic matters and the engineering aspect of the position and buildability of the proposals.

9.1.4 The objective of the DMRB Stage 3 EIAR is to understand the noise and vibration effects of the proposed scheme, for both day and night time periods. The assessment was undertaken in accordance with guidance for Detailed Assessment provided in the DMRB, Volume 11, Section 3, Part 7 “Noise and Vibration”, HD 213/11 (Ref. 9.2). This will be referred to throughout the report as HD 213/11.

9.1.5 The assessment considers the impacts without changing the alignment (referred to as the Do-Minimum) and future years when the new alignment is fully opened to traffic (Do-Something). These scenarios were generated based on traffic data taken from the traffic model which was prepared by Amey’s Transport Planning team.

9.2 Policy and Legislative Background

Legislative Background

The Environmental Noise (Scotland) Regulations 2006

9.2.1 The Environmental Noise (Scotland) Regulations 2006 (Ref. 9.3) implement the European Union (EU) Assessment and Management of Environmental Noise Directive (END) 2002/49/EC. This Directive requires member states to generate strategic noise maps and noise action plans intended to enable the derivation of a common assessment method by which exposure to environmental noise may be determined and, subsequently, reduced.

9.2.2 The Transportation Noise Action Plan describes the key objectives under the END and how the Scottish Government will deliver the obligations. These obligations include commitments to combat unwanted or harmful noise created by human activities such as road transport to improve health conditions and to improve quality of life.

9.2.3 The latest Transportation Noise Action Plan identifies potential areas where transportation annoyance is an issue. In July 2014, the second round of noise maps and action plans was published by the Scottish Government and identified Candidate Noise Management Areas (CNMAs) or Noise Managements Areas, where possible mitigation measures may help manage the noise from road or rail.

The Noise Insulation (Scotland) Regulations 1975

9.2.4 The Noise Insulation (Scotland) Regulations 1975 (NISR) (Ref. 9.4) provide local authorities with a duty to provide a grant towards the installation of noise insulation measures or with powers to undertake such works, as appropriate; these apply to dwellings affected by noise from new or altered roads.

9.2.5 To establish receptor eligibility the methodology provided in "The memorandum on the NISR 1975" (Ref. 9.5) Regulations 3 and 6 should be followed.

9.2.6 Regulation 5 of the NISR allows a roads authority to offer a grant towards insulation works, or empowers it to provide such works, where noise from the construction of a new road affects the enjoyment of an eligible building.

National Policy/Guidance

Scottish Planning Policy (SPP)

9.2.7 The SPP (Ref. 9.6) sets out priorities from the Scottish Government for the operation of the planning system and the development of land to ensure the key principles of sustainability are being met. This policy allows all environmental aspects to be considered along with health, social and economic factors.

Scotland's Third National Planning Framework (NPF3)

9.2.8 The NPF3 (Ref. 9.7) is the spatial expression of the Scottish Government's Economic Strategy as a guide to sustainable economic growth. Section 2 discusses reducing the impact of the car on city and town centres to make a significant contribution, using design to achieve significant health benefits through the reduction of urban noise.

Transport Scotland National Transport Strategy (NTS)

9.2.9 The Transport Scotland NTS (Ref. 9.8) addresses issues of health improvements from improvements to the road network. This is achieved through one of NTS objectives which is to minimise the adverse impact of freight movements on the environment, in particular, through the reduction in emissions and noise.

Local Policy/Guidance

Aberdeen City and Aberdeenshire Strategic Development Plan (SDP)

9.2.10 The SDP (Ref. 9.9) recognises that road traffic noise can have a negative effect and that all transport developments should aim to minimise these impacts. Laurencekirk sits within a development area that includes Stonehaven, Newtonhill and Portleven; the improvements to the A90 are part of the Plan for the area.

Aberdeen City and Aberdeenshire Local Transport Plan (LTP)

9.2.11 The LTP (Ref. 9.10) states that any new development should not result in increasing numbers of people exposed to adverse noise impacts. Mitigation measures are required for new transport schemes that may impact on existing noise sensitive receptors.

Aberdeenshire Local Development Plan 2017

9.2.12 The plan is a set of documents to guide development within the Aberdeenshire Area. Policy P3 states that development proposals should not cause significant loss of amenity to neighbouring properties through noise, traffic movements or other nuisance.

9.3 Methodology

Defining the study area

9.3.1 HD 213/11 guidance defines the noise study area as 1km from the existing and new carriageway edges.

9.3.2 The noise calculation area, associated with both construction and use of the road by traffic, as defined by HD 213/11, is approximately 600m from the scheme extents. Beyond 600m, noise calculations become increasingly unreliable due to the influence of local atmospheric factors and 'ground effects'.

9.3.3 The construction-related vibration study area is approximately 100m from any significant vibration-emitting activities. The study area for the vibration assessment associated with traffic using the road, once fully open, is limited to dwellings within 40m of the scheme carriageway.

9.3.4 The assessment examines noise from all 'affected routes'; affected routes are roads where there is the possibility of a change in noise levels of 1dB $L_{A10,18h}$ or more in the short-term or 3dB $L_{A10,18h}$ or more in the long-term, due to the proposed scheme.

9.3.5 The assessment includes noise from all affected routes within the 1km study area as well as noise within 50m of affected routes beyond the 1km study area, where there is a possibility of a change in noise of 1 dB $L_{A10,18h}$ in the short-term, or 3 dB $L_{A10,18h}$ in the long-term. This is discussed further in operational impacts section (paragraphs 9.5.8 to 9.5.10).

9.3.6 The calculation area is shown in **Figure 9.1**.

Determination of the baseline

Desk study

9.3.7 An initial desktop study was undertaken to identify affected routes, appropriate locations for measurement of noise, constraints such as Candidate Noise Management Area (CNMA) and particularly sensitive receptors. The following sources were used:

- Strategic Noise Mapping in Scotland, (Ref 9.11)
- Multi Agency Geographic Information for the Countryside (MAGIC) interactive maps (Ref 9.12)
- Scottish Government - Second Round of strategic mapping (Ref 9.13)
- Scottish Government - Transportation Noise Action Plan (Ref 9.14)
- Candidate Noise Management Areas (Ref 9.15)

Field study

9.3.8 Baseline noise surveys were undertaken on 8th and 9th March 2017 and 10th June 2019, at representative sensitive locations, to establish the ambient noise levels in the area. The surveys were conducted in accordance with the guidance contained in BS 7445 (Ref 9.16) and Calculation of Road Traffic Noise (CRTN) (Ref 9.17). The measurement locations, as shown in **Figure 9.1**, are:

- ML1: located near Oatyhill Cottage – OS national grid reference NO 69831 69803
- ML2: located off the centre junction near the cemetery – OS national grid reference NO 72031 70936
- ML3: located off High Street, at the south junction, at start of Public Right of Way (PRoW) – Ordnance Survey (OS) national grid reference NO 70975 70644

9.3.9 The data from the noise measurement surveys enable the existing ambient noise situation to be characterised and quantified and assist in validating the results from the Basic Noise Level (BNL) calculations for the assessment and cross-checking of the computer noise model.

9.3.10 The findings of the baseline noise survey are presented later in this Chapter. The noise survey record sheets and instrument calibration certificates are provided in Appendix 9.1.

Assessment method

Assessment of construction impacts

Noise model

9.3.11 For the prediction of road traffic noise, HD 213/11 suggests the use of the methodology described in the BS5228-1. The proprietary software NoiseMap 5 (with the BS5228 calculation package) was used *t*o predict noise levels at sensitive receptors.

Noise Assessment

9.3.12 The assessment of temporary impacts follows the guidance presented in HD 213/11. DMRB HD 213/11 recommends the use of the methodology described in Annex E of BS 5228-1 (Ref. 9.18) for evaluating the significance of construction noise.

9.3.13 When assessing the temporary effects of construction noise, the sensitivity depends on the existing noise levels in the study area. Noise from construction works are expected to be more intrusive in a quiet area with low background noise levels compared to a noisy area with existing high background noise levels, where construction noise would not be easily heard. BS 5228-1 Table E.1 provides an example assessment method to determine the sensitivity of dwellings in relation to construction noise using the "ABC method"; Table E.1 is represented here as Table 9-1.

Table 9-1: Example threshold values for construction noise at dwellings in dB $L_{Aeq,T}$

Period	Category A	Category B	Category C
Daytime weekday (07:00-19:00); and Saturdays (07:00-13:00)	65	70	75
Evenings weekday (19:00-23:00); Saturdays (13:00-23:00); and Sundays (07:00-23:00)	55	60	65
Night-time (23:00-07:00).	45	50	55
Note 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. **Note 2**: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3dB due to site noise.			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values (i.e. below 65). **Category B**: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values (i.e. 65). **Category C**: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values (i.e. above 65).			

9.3.14 Although given in BS5228-1 as an example, the method and the levels given in the Table are conventionally applied to assessments as presented. These levels only indicate where there could be a potentially significant effect as a result of the level of noise. The duration of the impact,

the character of the construction noise and the existing noise climate also needs to be considered when determining significance.

9.3.15 In addition to the criteria set out in Table E.1 of BS 5228-1, the effects of construction may be significant if they last for at least 10 days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months. It should also be noted that where the existing ambient noise level is already above Category C noise levels, threshold levels may be permitted to be higher.

9.3.16 The assessment compares the difference in the noise climate between a baseline year prior to the start of the works and an assessment year during the works.

Vibration

9.3.17 BS 5228-2 (Ref. 9.19) provides the basic methods of vibration control relating to construction and open sites.

9.3.18 Table 9-2 and Table 9-3 presents the significance of construction vibration impacts used in the assessment of likely construction vibration impacts for human perception and buildings, respectively.

9.3.19 The threshold of perception is generally in the range of 0.14mm/s to 0.3mm/s peak particle velocity (PPV). Accordingly, a magnitude of impact has been applied based on Table 2.2 in DMRB HA205/08.

Table 9-2: PPV Guidance Criteria – human perception

Vibration Level	Effect	Magnitude of Impact
0.14mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible
<0.3mm/s	Unlikely to be perceptible in residential environments	Negligible
0.3mm/s	Onset of perceptibility in residential environments	Minor
1.0mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Moderate
≥10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	Major

Table 9-3: Guidance Criteria – buildings

Type of Building	Peak Component Peak Velocity in Frequency Range of Predominant Pulse	
	4Hz to 15Hz	15Hz and above
Reinforced or framed structures industrial and heavy commercial buildings	50mm/s at 4Hz and above	50mm/s at 4Hz and above
Unreinforced or light framed structures Residential poor light commercial buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
Note 1: Values referred to are at base of the building Note 2: At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.		

9.3.20 There are no residential properties located within 50m of the scheme and only one located within 50m to 100m and ground level plant is not considered to generate levels of vibration above the threshold limits within BS5228-2. Therefore, construction vibration has been scoped out of the assessment.

Assessment of operational impacts

Noise model

9.3.21 For the prediction of road traffic noise, HD 213/11 suggests the use of the methodology described in the technical memorandum CRTN 1988. HD 213/11 Annex 4 provides additional guidance on the use of CRTN.

9.3.22 The proprietary software *NoiseMap 5 (with the CRTN calculation package)* was used to predict noise levels at sensitive receptors within the study area for the opening year and future year, for both the existing layout (Do-Minimum) and proposed layout (Do-Something). The parameters used in the model are in Table 9-4.

Table 9-4: Noise Model Parameters and Sources

Parameter	Source	Details
Calculation method	CRTN 1988 and additional advice from DMRB HD 213/11 Annex 4.	
Calculation engine	NoiseMap 5 (CRTN package).	
Horizontal distances	Ordnance Survey (OS)	MasterMap
Ground levels	OS	Digital Terrain Model
Building heights	Amey Noise Model	Assumed building height: 8m
Addresses	AddressBase Premium	2018

Parameter	Source	Details
Receptor position	Amey Noise Model	1m from façade and 1.5m (ground floor and 4m (first floor) in height
Absorbent Ground	Amey Noise Model	Soft ground
Road surface type	Amey Noise Model	Bituminous impervious
Texture depth	Amey Noise Model	1.5mm
Traffic Data	Amey Transport Planners	2014, 2023, 2033
HGV category	DMRB HD 213/11	Vehicles with an unladen weight greater than 3.5t

9.3.23 The purpose of this assessment is to assess road traffic noise in relation to sensitive properties including dwellings and community facilities. The assessment does not typically consider commercial properties unless there is a specific reason to do so; there is no reason to do so for this scheme.

9.3.24 The main input to the noise model is the traffic data provided by Amey transport planners and is included in Appendix 9.2. Traffic data used in the Noise Model comprises the 18-hour Annual Average Weekday Traffic (AAWT, 18h) flows for 2014, 2023 and 2033, traffic speed and percentage HGVs.

Assessment scenarios

9.3.25 These scenarios are assessed for a baseline scheme opening year and a future year, i.e. design year. The baseline design years for the assessment of the permanent noise effects (i.e. from operation of the proposed scheme) are as follows:

- Pre-construction year was taken as 2014;
- Construction year was taken as 2022;
- The opening year was taken as 2023.

9.3.26 The design year is usually the year with highest traffic flows in the first fifteen years after the opening year of the road project (typically the 15th year); however, the traffic data indicates that 2033 will have the highest traffic flows in the fifteen-year period, and therefore this has been taken as the future assessment year.

9.3.27 During the assessment process, the following comparisons were made between scenarios in the scheme opening year and the future year to determine the impact of the proposed scheme in the short-term and the long-term:

- Do-Minimum scenario in the opening year against Do-Something scenario in the opening year (short-term Do-Something).
- Do-Minimum scenario in the opening year against Do-Minimum scenario in the future assessment year (long-term Do-Minimum).
- Do-Minimum scenario in the opening year against Do-Something scenario in the future assessment year (long-term Do-Something).

9.3.28 For night-time noise impacts, only comparisons in the long-term are considered. Night-time noise levels for these scenarios have been derived using the Transport and Road Research Laboratory (TRL) report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Ref. 9.21).

Noise Assessment

9.3.29 The assessment of permanent noise levels during operation (e.g. road traffic noise) follows the guidance provided in DMRB) HD 213/11 for the definition of the magnitude of impacts from the project that occur during the operational use of the project, i.e. permanent effects.

9.3.30 The assessment considers the noise and vibration climate:

- With the Scheme, referred to as the Do-Something scenario;
- Without the Scheme, referred to as the Do-Minimum scenario.

9.3.31 HD 213/11 classifies the magnitude of traffic noise impact in terms of the change in noise level as a result of the proposed scheme. HD 213/11 states that 'a change in road traffic noise of 1dB $L_{A10,18h}$ in the short term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long term, a 3dB $L_{A10,18h}$ change is considered perceptible'.

9.3.32 Table 9-5 gives the classification of impact used for traffic noise in the short term and in the long term.

Table 9-5: Classification of magnitude of noise impact in the short term and long term (Table 3.1 and 3.2 from HD 213/11)

Noise Change, dB $L_{A10,18h}$		Magnitude of impact in the short term	Magnitude of impact in the long term
Increase	10.0 +	Major adverse	Major adverse
	5.0 - 9.9		Moderate adverse
	3.0 - 4.9	Moderate adverse	Minor adverse
	1.0 - 2.9	Minor adverse	Negligible adverse
	0.1 - 0.9	Negligible adverse	Negligible adverse
No change	0.0	No change	No change

Noise Change, dB $L_{A10,18h}$		Magnitude of impact in the short term	Magnitude of impact in the long term
Decrease	0.9	Negligible beneficial	Negligible beneficial
	2.9	Minor beneficial	Negligible beneficial
	3.0 - 4.9	Moderate beneficial	Minor beneficial
	5.0 - 9.9	Major beneficial	Moderate beneficial
	10.0 +		Major beneficial

9.3.33 The sensitivity of noise sensitive receptors has been determined based on DMRB Volume 11 Section 2 Part 5. Residential and community receptors have a sensitivity of high.

9.3.34 Table 9-6 presents the typical significance categories from DMRB Volume 11 Section 2 (Ref. 9.20) which have been prepared specifically for decision making on road projects.

Table 9-6: Significance of Effect Categories

		Magnitude of impact				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Environmental Value (Sensitivity)	**Very High**	Neutral	Slight	Moderate /Large	Large /Very Large	Very Large
	High	Neutral	Slight	Slight /Moderate	Moderate /Large	Large /Very Large
	Medium	Neutral	Neutral /Slight	Slight	Moderate	Moderate /Large
	Low	Neutral	Neutral /Slight	Neutral /Slight	Slight	Slight /Moderate
	Negligible	Neutral	Neutral	Neutral /Slight	Neutral /Slight	Slight

Vibration

9.3.35 DMRB HD 213/11 outlines a method for the assessment of traffic-induced vibration and this includes the assessment of the numbers of people "bothered" by airborne vibration. It states that vibration associated with road traffic sources would not normally have any influence at distances more than 40m from an affected road. As such the assessment of vibration has been limited to buildings within 40m of the centre line of the proposed scheme. Additionally, as recommended by DMRB only those properties subject to predicted traffic noise levels of greater than 58dB $L_{A10,18h}$ have been considered.

9.3.36 Ground-borne vibration is not anticipated to be an issue for the scheme because it is generally only perceptible where the road surface is uneven (Ref. 9.22) and this is not the case with this

scheme, as it can be assumed that on opening the surface will be of a high standard without defects.

Traffic Noise Nuisance

9.3.37 The DMRB notes that the nuisance caused by noise mainly affects people in their homes. Nuisance is measured in terms of the percentage of the population as a whole that is bothered "very much" or "quite a lot" by virtue of a specific traffic related noise level.

9.3.38 In line with DMRB HD 213/11, noise nuisance takes into account both the long-term and short-term impacts. The results are presented for the Do-Minimum and Do-Something comparisons. The noise nuisance levels are directly calculated from the predicted noise level change.

Noise Insulation (Scotland) Regulations (NI(S)R)

9.3.39 The 1975 Noise Insulation Regulations and subsequent amendment regulations provide criteria for assessing the eligibility for noise mitigation for properties based on variations in traffic noise due to a new or improved road scheme. Noise level criteria are given within the Regulations which, if satisfied, indicate whether properties in the vicinity may be entitled to the installation of additional noise insulation or to a grant to cover the cost of the noise insulation.

9.3.40 For eligibility, the following conditions must be triggered:

- Properties are situated within 300m of the new road or altered carriageway;
- the use of the road causes, or is expected to cause, noise at a level not less than 68dB $L_{A10, 18h}$;
- the property will experience a 'relevant noise level' exceeding the 'prevailing noise level' by at least 1.0dBA;
- The noise from the new road alone must make an effective contribution to the 'relevant' noise level of at least 1.0dB; and
- Properties must have a clear line of sight i.e. from the most exposed windows or façade, a straight line can be drawn to the new or altered road without passing through another building.

Assessment of operational effects

9.3.41 The level of significance and its relevance to the decision-making process is detailed in HA205/08 as follows:

- Very large: Effects at this level are material in the decision-making process;
- Large: Effects at this level are likely to be material in the decision-making process;

- Moderate: Effects at this level can be considered to be material decision-making factors;
- Slight: Effects at this level are not material in the decision-making process; and
- Neutral: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

9.4 Baseline Conditions

Desk study

9.4.1 Laurencekirk is a small town located off the A90 dual carriageway approximately 40km from Dundee. At present, there are 2 junctions within the study area that provide access to Laurencekirk. These are:

- The central B9160 link road connecting St Cyrus and residential properties located just off the carriageway;
- The A937 south junction which also connects to High Street and the primary school, care home, churches and community halls.

9.4.2 The principal urban area of Laurencekirk is situated to the west of the A90 whereas, to the east of the road, the setting is principally rural, elevated relative to the road, with scattered farms and housing.

9.4.3 The A90 was included in the Second Round of strategic noise mapping carried out by the Scottish Government. The Transportation Noise Action Plan produced by Transport Scotland identified no Candidate Noise Management Area (CNMA) in Laurencekirk.

9.4.4 No statutory designated sites (Area of Outstanding Natural Beauty, National Park, Special Areas of Conservation, Special Protection Areas, or Sites of Special Scientific Interest) are located within the study area.

Field Study

9.4.5 During the baseline noise survey (Appendix 9.1), it was noted that the dominant noise in the area was associated with road traffic on the A90. Additional noise sources in the area include: passing trains at the south junction; bird calls, in particular around the south junction; agricultural activity near the central junction near the cemetery.

9.4.6 The measured day time noise data are summarised in Table 9-7. The locations of the monitoring points are presented in **Figure 9.1**.

Table 9-7: Summary of short term measured noise levels (free-field)

Survey locations		Descriptors		Noise sources
		dB $L_{A10,18hr}$	dB $L_{Aeq,\ T}$	
ML1	Near Oatyhill Cottage NGR NO 69831,69803	61.1	59.1	Traffic from A90 dominant.
ML2	Along Cairn Gardens just outside the cemetery – central junction A90 NGR 372036,770973	72.3	69.2	A90 road traffic dominant with high percentage of HGVs. Sheep in the fields adjacent to the cemetery. Cars entering and leaving the central junction accessing Garvock Road.
ML3	High Street 355m from A90 – south junction NGR 370956,770632	64.1	61.4	A90 audible in the distance with intermittent local traffic from the A987. Passing trains, calling birds.

9.5 Impact Assessment

Sensitivity of receptors

9.5.1 Noise sensitive receptors (NSRs) are receptors potentially sensitive to noise or vibration. They typically include dwellings, hospitals, community facilities and designated areas. **Figure 9.1** illustrates the noise sensitive receptors within the calculation area, defined by a 600m buffer around the proposed scheme. In total, 724 residential and 8 community receptors have been included in the calculation area as part of this assessment. Table 9-8 shows details of the noise-sensitive receptors within 600m of the scheme. Residential and community receptors have been assigned a sensitivity of *High*.

Table 9-8: Noise sensitive receptors within 600m of the scheme

Distance (m)	Number of Receptors	
	Residential	Community
0-50	0	0
50-100	1	0
100-150	12	0
150-200	33	0
200-300	125	3
300-600	553	5
Total	724	8

Construction

Noise

9.5.2 Representative receptors for construction works were chosen based on their proximity to the scheme. The location of the representative receptors is shown in **Figure 9.1**.

- Representative Receptor (RR) 1: Oatyhill Farmhouse (SE)
- RR2: The West Lodge (SW)
- RR3: 112 Kirkburn (S)
- RR4: Laurencekirk Primary School (S)
- RR5: Newton Farmhouse (W)

9.5.3 Table 9-9 shows the pre-construction noise levels for the representative receptors and the category as defined in BS5228-1 Table E.1 where daytime ambient noise levels L_{Aeq} have been predicted for each receptor from the 2014 pre-construction year model.

9.5.4 In terms of sensitivity to construction noise, three of the representative receptors are Category A, one is Category B and one is Category C. The corresponding adverse effect threshold for each category is detailed in Table 9-9.

Table 9-9: Threshold of the adverse effects at representative receptors for different time periods in L_{Aeq}, dB

Representative Receptors and Facade	Pre-Construction	BS 5228-1 Table E.1	
	Daytime $L_{Aeq, outside}$	Category ABC	Significance levels dB L_{Aeq}
Oatyhill Farmhouse (SE)	73.7	C	75 day; 65 evening and 55 night
The West Lodge (SW)	57.5	A	65 day; 55 evening and 45 night
112 Kirkburn (S)	64.9	B	70 day; 60 evening and 50 night
Laurencekirk Primary School (S)	61.1	A	65 day; 55 evening and 45 night
Newton Farmhouse (W)	57.2	A	65 day; 55 evening and 45 night

9.5.5 At the time of writing there is limited information relating to the methodology to be used during construction of the scheme. However, it is understood that normal construction techniques will be used such as excavation and fill. The construction plant expected to be used includes excavators, dump trucks and heavy rolling equipment. As a result, assumptions were made using typical road construction equipment, which have been used for calculations in accordance with the guidance in BS 5228-1.

9.5.6 It is expected that the construction works will last approximately 12 to 15 months. For the purposes of the assessment the construction works are separated into four stages (i. excavation, filling and compaction, ii. carriageway surfacing iii. footway paving and iv. overbridge construction) and noise levels were calculated for each stage. Details are presented in Table 9-10. As the nearest receptor is located over 580m from the location of the overbridge it has been scoped out of further assessment and is not considered within the construction assessment.

Table 9-10: Expected plant to be used during Phase 1 to 3 of construction

Construction Stage	Equipment	Table and Ref.*	Noise Level (L_{Aeq} at 10m unless stated otherwise)	Percentage on time (%)
Excavation, filling and compaction	1 Tracked excavator 22t	C.4 64	75dB	15
	1 Vibratory roller 12t	C.5 21	80dB L_{Amax}	15
	3 Lorries per hour	C.2 21	80dB L_{Amax} each	40
Carriageway surfacing	Road planer	C.5 7	82dB	10
	1 Asphalt paver plus tipper lorry 18t	C.5 32	84dB	25
	3 Lorries per hour	C.2 21	80dB L_{Amax} each	25
Footway Paving	Hand-held circular saw	C.5 36	87dB	5
	Vibratory roller 8.9t	C.5 20	75dB	25

9.5.7 Noise levels were calculated from several point sources within the scheme boundary with a plant height of 1m and haul routes were assumed to following the existing road layout.

9.5.8 Table 9-11 shows the calculated noise levels at the representative receptors for each construction stage. The noisiest construction activity at all the representative receptors is predicted to be excavation, filling and compaction. This phase has the potential to be significant at the closest NSRs.

Table 9-11: Predicted noise levels at each construction stage

Representative receptors and façade	dB L_{Aeq}		
	Construction stage		
	Excavation, filling and compaction	Carriageway surfacing	Footway paving
Oatyhill Farmhouse (SE)	53.1	43.4	45.4
The West Lodge (SW)	64.4	55.0	57.0
112 Kirkburn (S)	58.2	48.3	50.3
Laurencekirk Primary School (S)	62.1	50.8	52.8
Newton Farmhouse (W)	55.9	46.7	48.7

Operational

9.5.9 Paragraphs 9.5.10 to 9.5.19 details the impact the proposed scheme will have on receptors within the calculation area (600m). Further receptors within the study area (1km) are unlikely to be impacted by the scheme, based on guidance provided by DMRB.

Short-term impacts

9.5.10 Table 9-12 and **Figure 9.2** show the changes in noise levels in the short term as a result of the scheme. The scheme is predicted to have a negligible impact (<1.0dB change) for the majority (472) of dwellings and 6 community receptors within the study area, a minor adverse impact at 194 dwellings and a moderate adverse impact, of greater than 2.9dB at 58 residential receptors and 2 community receptors.

9.5.11 In **Figure 9.2**, the receptors within red areas are expected to experience increases in noise levels greater than 2.9dB (i.e. moderate adverse impact). Receptors within the orange area are expected to experience noise increases of between 1.0 and 2.9dB (i.e. a minor adverse impact).

Table 9-12: Short-term comparison for road traffic noise

Do-Something 2023- Do-Minimum 2023			
Change in noise level		**Daytime**	
		Number of dwellings	**Number of other sensitive receptors**
Increase in noise level, dB $L_{A10,18h}$	0.1-0.9	472	6
	1.0-2.9	194	0
	3.0-4.9	58	2
	5.0+	0	0
No change	0	0	0
Decrease in noise level, dB $L_{A10,18h}$	0.1-0.9	0	0
	1.0-2.9	0	0
	3.0-4.9	0	0
	5.0+	0	0

9.5.12 Table 9-13 shows noise changes at the representative receptors in the short-term. All representative receptors are expected to experience a minor adverse impact, except for Laurencekirk Primary School, which is expected to experience an increase of 3.1dB (moderate adverse impact).

Table 9-13: Short-term comparison for road noise at representative receptors in dB $L_{A10,18h}$

Representative Receptors and Façade	DS 2023	DM 2023	DS-DM	Magnitude of Impact
Oatyhill Farmhouse (SE)	75.9	74.6	+1.3	Minor Adverse
The West Lodge (SW)	59.6	58.2	+1.4	Minor Adverse
112 Kirkburn (S)	68.5	65.8	+2.7	Minor Adverse
Laurencekirk Primary School (S)	65.1	62.0	+3.1	Moderate Adverse
Newton Farmhouse (W)	60.4	58.0	+2.4	Minor Adverse

Long-term Do-Minimum comparison

9.5.13 Table 9-14 shows the predicted changes in the long-term without the scheme. All the receptors are expected to experience a negligible increase in noise levels of between 0.1 and 2.9dB $L_{A10,18h}$. However, these changes are due to predicted natural traffic growth, not due to the scheme. Thus, **Figure 9.3** shows that all receptors are within the green area (0.1 and 2.9dB).

Table 9-14: Do-Minimum comparison for road traffic noise

Do-Minimum 2033- Do-Minimum 2023				
Change in noise level		Daytime		Night-time
		Number of dwellings	Number of other sensitive receptors	Number of dwellings
Increase in noise level, dB $L_{A10,18h}$	0.1-2.9	724	8	26
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	10.0+	0	0	0
No change	0.0	0	0	0
Decrease in noise level, dB $L_{A10,18h}$	0.1-2.9	0	0	0
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	10.0+	0	0	0

9.5.14 Table 9-15 shows the noise change at the representative receptors in the long-term Do-Minimum comparison. All the representative receptors are predicted to experience negligible noise changes of between -1.0 and 1.0dB in the long-term without the scheme.

Table 9-15: Long-term Do-Minimum comparison for road traffic noise at representative receptors in dB $L_{A10,18h}$

Representative Receptors and Façade	DM 2033	DM 2023	DM-DM	Magnitude of Impact
Oatyhill Farmhouse (SE)	75.1	74.6	+0.5	Negligible Adverse
The West Lodge (SW)	58.7	58.2	+0.5	Negligible Adverse
112 Kirkburn (S)	66.5	65.8	+0.7	Negligible Adverse
Laurencekirk Primary School (S)	62.5	62.0	+0.5	Negligible Adverse
Newton Farmhouse (W)	58.6	58.0	+0.6	Negligible Adverse

Long term Do-Something comparison

9.5.15 Table 9-16 shows the changes in noise levels in the long-term with the scheme in place. The majority (643 of dwellings and 6 community receptors in the study area are expected to experience “no perceptible change” in noise levels (i.e. a change of less than 3.0dB). There are no receptors within the study area predicted to experience “no change” or a decrease in noise levels. It is predicted that 90 residential receptors and 2 community receptors will experience a minor adverse increase in noise levels of between 3.0 and 4.9dB.

9.5.16 In **Figure 9.5**, the areas in red are expected to experience an increase in noise of greater than 3dB. Receptors in the orange areas are expected to experience noise increases of between 1 and 3dB.

Table 9-16: Long-term Do-Something comparison road traffic noise

Do-Something 2033- Do-Minimum 2023				
Change in noise level		**Daytime**		**Night-time**
		Number of dwellings	**Number of other sensitive receptors**	**Number of dwellings**
Increase in noise level, dB $L_{A10,18h}$	0.1-2.9	643	6	32
	3.0-4.9	81	2	9
	5.0-9.9	0	0	0
	10.0+	0	0	0
No change	0.0	0	0	0
Decrease in noise level, dB $L_{A10,18h}$	0.1-2.9	0	0	0
	3.0-4.9	0	0	0
	5.0-9.9	0	0	0
	10.0+	0	0	0

9.5.17 Table 9-17 shows the noise changes at the representative receptors in the long-term. Magnitude of impact at three of the representative receptors is predicted to be negligible. Laurencekirk Primary School and 112 Kirkburn are predicted to experience an increase in noise levels of 3.1 and 3.4dB respectively, corresponding to a minor adverse impact.

Table 9-17: Long-term Do-Something comparison for road traffic at representative receptors in dB $L_{A10,18h}$

Representative receptors and façade	DS 2033	DM 2023	DS-DM	Magnitude of Impact
Oatyhill Farmhouse (SE)	76.2	74.6	+1.6	Negligible Adverse
The West Lodge (SW)	59.9	58.2	+1.7	Negligible Adverse
112 Kirkburn (S)	68.9	65.8	+3.1	Minor Adverse
Laurencekirk Primary School (S)	65.4	62.0	+3.4	Minor Adverse
Newton Farmhouse (W)	60.9	58.0	+2.9	Negligible Adverse

Vibration

9.5.18 In accordance with DMRB HD 213/11, an assessment of traffic-induced vibration nuisance should be undertaken for all dwellings within 40m of the scheme. As there are no potentially vibration-sensitive receptors within 40m of the proposed scheme, an assessment of vibration nuisance has not been carried out.

Traffic Noise Nuisance

9.5.19 Table 9-18 shows the change in traffic noise nuisance for the long-term Do-Minimum (Do-Minimum 2033 – Do-Minimum 2023) and long-term Do-Something (Do-Something 2033 – Do-Something 2023) comparison. In both scenarios all the dwellings are predicted to experience an increase in nuisance levels of less than 10% and the effects are similar, therefore, the impact is assessed to be negligible.

Table 9-18: Traffic noise nuisance

Change in nuisance level		Do-Minimum	Do-Something
		Number of dwellings	Number of dwellings
Increase in nuisance level	< 10%	722	724
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

Change in nuisance level		Do-Minimum	Do-Something
		Number of dwellings	Number of dwellings
No Change	0%	2	0
Decrease in nuisance level	< 10%	0	0
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

9.6 Recommended Mitigation

Construction

9.6.1 The following paragraphs describe potential mitigation measures in relation to reducing the significant adverse impact of noise during construction. These measures are described in detail in BS 5228-1.

Community Relations

9.6.2 Good relations with people living and working in the vicinity of the site operations are of paramount importance. Early establishment and maintaining good community relations throughout the duration of the contract should help to alleviate people's concerns.

9.6.3 It is suggested that the person, company or organisation carrying out work on site should appoint a responsible person to liaise with the public.

Limitations of Time of Works

9.6.4 Noise during construction works has the potential to be significant at the closest receptors particularly during the excavation, filling and compaction phase of the works. It is advisable to limit construction works to the daytime period during weekdays, avoiding night time and weekend working where practicable. Any change of working methods, durations and timings will be discussed with the Environmental Health Department.

Potential Mitigation Measures

9.6.5 Guidance and recommendation for basic methods of noise and vibration control relating to construction are taken from BS 5228-1. BS 5228-1 Table B.1 provides an estimate of the expected sound reduction in dB as a result of the mitigation proposals reproduced below.

9.6.6 Wherever possible, noise should be controlled at source as this limits the spread of noise. Mitigation measures for the proposed scheme should include, in the following order of preference:

- Control of noise at source.
- Control of the spread of noise.
- Provision of additional mitigation at noise-sensitive premises (NSPs).

Control of noise at source

9.6.7 Control of noise at source measures include:

- Use of best practicable means and best practice methods.
- Reprogramming of concurrent activities.
- Enclosures.

9.6.8 The best practice methods for each activity are outlined below and should be adhered to wherever possible during the construction phase.

9.6.9 All compressors should be sound reduced models fitted with properly lined and sealed covers, which should be kept closed whenever the machines are in use. All ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers.

9.6.10 Plant and machinery in intermittent use shall be shut down in intervening periods of non-use or, where this is impracticable, they shall be throttled down to a minimum.

9.6.11 Unattended plant outside normal working hours should, if possible, be electrically-powered otherwise acoustic enclosures will be necessary to minimise noise levels.

9.6.12 Where possible, plant with directional noise characteristics should be positioned in such a way as to minimise noise at adjacent properties.

9.6.13 Static machines shall be sited as far away as practicable from inhabited buildings (or other noise sensitive premises) and/or behind temporary screens or enclosures.

9.6.14 Plant should be well maintained and effectively silenced.

Control of spread of noise

9.6.15 If noise cannot be controlled at source, then alternative methods of reducing the noise impact should be introduced. These can include noise reducing screens, noise barriers and earth bunds.

9.6.16 For maximum benefit, screens should be positioned close to the source of noise or close to the receiver. In order for a barrier to be effective, care is needed in its design, siting and construction.

For example, by reflecting sound a barrier can simply transfer a problem from one receiving position to another.

9.6.17 It is best practice that, at dwellings, noise levels should not exceed 75dB L_{Aeq} between 08.00 and 18.00 Monday to Friday and 08.00 to 13.00 on Saturday and at educational establishments noise levels should not exceed 65dB $L_{Aeq,1h}$ during term time. No audible construction activities should be undertaken outside normal construction working hours of 08.00 to 18.00 Monday to Friday and 08.00 to 13.00 on Saturday unless exceptional working hours are justified through the Construction Environmental Management Plan (CEMP) and agreed by the Local Planning Authority. A detailed noise and vibration monitoring assessment is also recommended, which includes the identification of suitable premises for noise monitoring and which would form part of the Schedule of Commitments.

Operational

9.6.18 It is recommended that low-noise surface is considered along the A90 which reduces the traffic noise produced by the interaction between road surface and vehicle tyres. This mitigation measure is most effective on roads with average speeds greater than 75kmh.

9.7 Residual Impacts

9.7.1 During the works programme, it is anticipated that an increase in the noise levels will be likely for the closest receptors, especially if works take place during the night. However, considering the mitigation measures stated above and that the works will be temporary, these impacts are considered to be minor.

9.7.2 A -3.5 dB(A) correction can be assumed when low noise surfacing is used on roads with speeds greater than 75 kpm. This would reduce the magnitude of impacts at receptors closest to the A90.

9.8 Significance of Effect

Construction

9.8.1 A detailed construction programme is not currently available; however, for the purposes of assessment construction is assumed to commence in 2022.

9.8.2 Representative receptors within the study area are deemed to be (BS 5228 -1) Category A (with potential adverse effect levels of 65dB L_{Aeq} during the day, 55dB L_{Aeq} in the evening and 45dB L_{Aeq} at night), Category B (with potential adverse effect levels of 70dB L_{Aeq} during the day, 60dB L_{Aeq} in the evening and 50dB L_{Aeq} at night) and Category C (with potential adverse effect levels of 75dB L_{Aeq} during the day, 65dB L_{Aeq} in the evening and 55dB L_{Aeq} at night). Where the

threshold value in the applicable category during the relevant period is exceeded, this is considered significant.

Excavation, filling and compaction

9.8.3 In relation to the excavation, filling and compaction, Table 9-19 gives details of the potential effects expected. None of the representative receptors are predicted to experience significant adverse effects if works take place during the day. Three are predicted to experience significant adverse effects if works take place during the evening and four if works take place at night.

Table 9-19: Potential effect of construction under BS 5228-1 Table E.1 at representative receptors – excavation, filling and compaction

Representative receptors and façade	Potential effect		
	Day	Evening	Night
Oatyhill Farmhouse (SE)	Not Significant	Not Significant	Not Significant
The West Lodge (SW)	Not Significant	Significant Adverse	Significant Adverse
112 Kirkburn (S)	Not Significant	Not Significant	Significant Adverse
Laurencekirk Primary School (S)	Not Significant	Significant Adverse	Significant Adverse
Newton Farmhouse (W)	Not Significant	Significant Adverse	Significant Adverse

Carriageway surfacing

9.8.4 Table 9-20 gives details of the potential effects expected due to the carriageway surfacing element of works. None of the representative receptors are predicted to experience significant adverse effects if works take place during the day or in the evening. Three of the representative receptors are predicted to experience significant adverse effects if works take place during the night.

Table 9-20: Potential effect of construction noise under BS 5228-1 Table E.1 and at representative receptors – carriageway surfacing

Representative receptors and façade	Potential effect		
	Day	Evening	Night
Oatyhill Farmhouse (SE)	Not Significant	Not Significant	Not Significant
The West Lodge (SW)	Not Significant	Not Significant	Significant Adverse
112 Kirkburn (S)	Not Significant	Not Significant	Not Significant
Laurencekirk Primary School (S)	Not Significant	Not Significant	Significant Adverse
Newton Farmhouse (W)	Not Significant	Not Significant	Significant Adverse

Footway paving

9.8.5 Table 9-21 gives details of the potential effects expected due to the footway paving element of works. None of the representative receptors are predicted to experience significant adverse effects if works take place during the day. One of the representative receptors are predicted to experience significant adverse effects if works take place during the evening and four if works take place during the night.

Table 9-21: Potential effect of construction noise under BS 5228-1 Table E.1 at representative receptor – footway paving

Representative receptors and façade	Potential effect		
	Day	Evening	Night
Oatyhill Farmhouse (SE)	Not Significant	Not Significant	Not Significant
The West Lodge (SW)	Not Significant	Significant Adverse	Significant Adverse
112 Kirkburn (S)	Not Significant	Not Significant	Significant Adverse
Laurencekirk Primary School (S)	Not Significant	Not Significant	Significant Adverse
Newton Farmhouse (W)	Not Significant	Not Significant	Significant Adverse

Operational

9.8.6 Table 9-22 shows the comparison of the significance of effect between the short-term and the long-term, without mitigation, at representative receptors. All receptors were classified as having a high sensitivity to change. Without mitigation significance levels are slight/moderate (with the exception of Laurencekirk Primary School) in the short-term and slight or slight/moderate in the long-term. Receptors expected to experience Moderate/Large impacts in the short term and slight/moderate in the long term are within the lowest end of this classification.

9.8.7 Low noise surfacing has been recommended along the A90 which has the potential to reduce the significance of effects at receptors nearest the A90, which includes Laurencekirk Primary School and 112 Kirkburn.

Table 9-22: Summary of impact assessment long-term (LT) and short-term (ST)

Receptor	Sensitivity	Magnitude of Impact		Significance of Effect	
		ST	LT	ST	LT
Oatyhill Farmhouse (SE)	High	Minor Adverse	Negligible Adverse	Slight/moderate	Slight
The West Lodge (SW)	High	Minor Adverse	Negligible Adverse	Slight/moderate	Slight
112 Kirkburn (S)	High	Minor Adverse	Minor Adverse	Slight/moderate	Slight/moderate

Receptor	Sensitivity	Magnitude of Impact		Significance of Effect	
		ST	LT	ST	LT
Laurencekirk Primary School (S)	High	Moderate Adverse	Minor Adverse	Moderate/Large	Slight/moderate
Newton Farmhouse (W)	High	Minor Adverse	Negligible Adverse	Slight/moderate	Slight

Noise Insulation (Scotland) Regulations 1975

9.8.8 There are no properties that would qualify for insulation under the Noise Insulation (Scotland) Regulations.

9.9 Assumptions and Limitations

Construction

9.9.1 At the time of writing there is limited information relating to the methodology to be used during construction of the scheme. Therefore, assumptions were made using typical road construction methods as reported in BS 5228-1:2009+A1:2014.

Operational

9.9.2 The propriety software NoiseMap 5 was used to calculate results for all residential properties within 600m of the scheme. All buildings in the noise model were assumed as being two storeys with a height of 8m with reflecting façades.

9.10 Impacts on Policy and Legislation

9.10.1 Table 9-23 shows the impact that the proposed scheme is predicted to have on legislation and policies.

Table 9-23: Impact on Legislation and Policy

Legislation	Impact
The Environmental Noise (Scotland) Regulations 2006	No Candidate Noise Management Areas or Noise Management Areas are to be impacted by the scheme.
The Noise Insulation (Scotland) Regulations 1975	No properties qualify for insulation under the Noise Insulation (Scotland) Regulations.
Policy	**Impact**
Scotland's Third National Planning Framework	Slight/moderate significant is predicted at some receptors, however, mitigation has been recommended to reduce the significance of effects.
Transport Scotland National Transport Strategy	Slight/moderate significant is predicted at some receptors, however, mitigation has been recommended to reduce the significance of effects.

Legislation	Impact
Aberdeen City and Aberdeenshire Strategic Development Plan	Slight/moderate significant is predicted at some receptors, however, mitigation has been recommended to reduce the significance of effects.
Aberdeen City and Aberdeenshire Local Transport Plan	Adverse impacts are predicted at noise sensitive receptors; however, mitigation has been recommended to reduce the significance of effects.
Aberdeenshire Local Development Plan 2017	Slight/moderate significant is predicted at some receptors, however, mitigation has been recommended to reduce the significance of effects.

9.11 Conclusion

Construction

9.11.1 It is concluded that the representative receptors will not experience significant adverse impacts if works take place during the day. However, some receptors are predicted to experience adverse impacts if works take place during the evening and night.

9.11.2 Predicted construction noise levels represent a worst-case scenario in terms of plant locations and vehicle movements being taken as the closest approach to NSRs. In practice, these noise levels will not be sustained due to the mobility of working, and so actual noise levels are likely to be lower. However, best practice methods should be employed during the works to ensure noise will be kept to a minimum where possible.

9.11.3 As a result of the employment of best practice methods, significant loss of amenity to neighbouring properties through noise are not anticipated, as required by Aberdeenshire Local Development Plan 2017.

Operational

Short-term

9.11.4 The assessment concluded that, in the short-term, within 600m of the scheme, 472 residential receptors will experience a negligible increase in noise levels of between 0.1 and 0.9dB, 194 residential receptors will experience a minor adverse impact of between 1.0 and 2.9dB, and 58 residential receptors will experience a moderate adverse impact of between 3.0 and 4.9dB.

9.11.5 For the representative receptors, the predicted increase is between 1.3 and 2.7dB, with the exception of Laurencekirk Primary School. This is a minor adverse change, thus a slight/moderate significance. Laurencekirk Primary School is predicted to experience an increase of 3.1dB which is of moderate significance.

Long-term

9.11.6 The assessment concluded that, within 600m of the scheme, in the long-term, 643 residential receptors will experience a negligible increase in noise levels of between 0.1 and 2.9dB whilst 81 residential receptors will experience a minor adverse increase in noise levels of between 3.0 and 4.9dB.

9.11.7 For the representative receptors, this results in a change of between 1.6 and 2.9dB of slight significance, with the exception of 112 Kirkburn and Laurencekirk Primary School, which are predicted to experience a change of moderate significance.

9.11.8 Overall, the significance of effects range between slight to slight/moderate significance. Therefore, low noise surfacing has been recommended along the A90.

Noise Insulation Regulations 1975

9.11.9 The assessment concluded that no properties qualified for insulation under the Noise Insulation Regulations.

Legislation and policy

9.11.10 Adverse impacts are predicted at noise sensitive receptors; however, as mitigation is recommended to reduce these impacts the proposed scheme is compliant with legislation and local policy.