4. Air Quality

4.1. Introduction

4.1.1. This section provides an assessment of the potential impacts of the proposed scheme on air quality within the study area. The assessment has been carried out in accordance with DMRB Volume 11, section 3, part 1 HA 207/07. Calculations have been undertaken utilising DMRB Screening Method version 1.03c, July 2007, and the NO_2/NOx conversion calculator.

4.1.2. The process of the combustion of petrol or diesel in road vehicles causes the emission of a number of pollutants, oxides of nitrogen, carbon monoxide, particulate matter and hydrocarbons (such as benzene and 1,3-butadiene). These pollutants become dispersed and diluted the further one moves from the road. Vehicle emissions contribute to a general degradation of air quality both locally and regionally.

4.1.3. Any alteration to the road network, by the construction of a new road, the improvement of an existing road or the redistribution of traffic without new road construction may cause changes in air quality in adjacent areas. These changes in air quality are a factor to be taken into consideration during the design and development of a road improvement scheme and therefore form part of any environmental assessment.

4.1.4. In addition during the construction phase there is potential for the generation of adverse but temporary effects on local ambient air quality and the creation of nuisance dust. Construction activities include the construction of the proposed road and associated structures and elements.

4.1.5. The proposed A77 Maybole bypass will provide a single carriageway with climbing lanes. By providing safe passing places the traffic is less likely to be held up by heavy Goods Vehicles (HGV's) and/or local agricultural traffic, thus reducing the potential for vehicles to travel in 'platoons'. The new road will change the proximity of the road to local receptors which in this case include domestic residences, commercial properties, and schools. There is therefore potential for the scheme to impact upon air quality during both the construction and operation of the scheme.

4.1.6. The changes being proposed at Maybole are not anticipated to result in a significant increase in traffic volumes using the A77 other than by normal growth however, it will result in a decreased volume of traffic travelling through Maybole High street as much of the traffic flow will choose the bypass option, there will also be a slight increase in average vehicle speed through Maybole town centre, and traffic travelling on the bypass will travel at significantly greater speeds than would otherwise through the town centre, a factor that can affect pollution concentration levels.

Pollutants

4.1.7. The process of the combustion of petrol or diesel in road vehicles causes the emission of a number of pollutants, oxides of nitrogen, carbon monoxide, particulate matter and hydrocarbons (such as benzene and 1,3-butadiene).

4.1.8. These pollutants become disperse and diluted the further one moves from the road. Vehicle emissions contribute to a general degradation of air quality both locally and regionally.

4.1.9. Nitrogen dioxide, Carbon monoxide and PM_{10} are considered to be the main concern with respect to local air quality impacts from road traffic emissions.

4.1.10. The EU is proposing a PM2.5 exposure reduction target and PM2.5 limit value. The Defra (Department for Environment, Food and Rural Affairs) Air Quality Strategy for 2010 aims for a target of 15% reductions in concentrations at urban background between 2010 and 2020 and an objective of 25μgm^{-3} to be achieved by 2020. At the time of writing no method for assessing the PM2.5 of road schemes has yet been developed, therefore this pollutant is not considered further in the assessment.

Carbon Monoxide (CO)

4.1.11. Approximately 50% of the UK's emissions of Carbon Monoxide were from road transport in 2004. The compound is rapidly absorbed by the blood reducing its oxygen carrying capacity. At extreme concentrations, far higher than the typical levels found adjacent to roads, it can be acutely toxic. Carbon Monoxide contributes indirectly to the greenhouse effect by depleting atmospheric levels of hydroxyl radicals which in turn slows the destruction of methane, a powerful greenhouse gas.

Benzene (C6H6)

4.1.12. Benzene is a volatile organic compound, known to be a human carcinogen associated with leukaemia. In the UK, the main atmospheric source of benzene is the combustion and distribution of petrol. Benzene is a hydrocarbon and as such is an important precursor to the formation of smog. It can have a negative impact on health giving rise to cancer, central nervous system disorders, liver and kidney damage, reproductive disorders and birth defects.

1,3 Butadiene (B_4H_6)

4.1.13. 1,3 butadiene is formed during the process of combustion and is thought to be carcinogenic to humans. Approximately 68% of the UK's 1,3-butadiene is produced by road transport, the majority of which is derived from petrol consumption. Effects on human health include cancer, central nervous system disorders, liver and kidney damage, reproductive disorders and birth defects.

Nitrogen Dioxide (NO_2)

4.1.14. Nitric Oxide (NO) is mainly derived from road transport emissions and other combustion processes. It is not considered to be harmful to health however once released into the atmosphere it is usually very rapidly oxidised mainly by ozone (O_3) to Nitrogen Dioxide ($NO_{2)}$ which can be harmful to health and affect the respiratory system.

Particles (PM_{10})

4.1.15. In 2004 road transport was responsible for 23% of the UK's PM_{10}. Particles in the atmosphere are composed of a wide variety of compounds. In relation to roads particles are emitted from vehicle exhausts, re-suspension of road surface dust, abrasion of tyres and brakes, and road surface wear. Exhaust emissions from diesel powered vehicles contain much higher particle concentrations than emissions from petrol powered vehicles. Exhaust particles are generally fine, (less than 1µm diameter). Secondary particles are also formed through atmospheric chemical processes, such particles are composed of nitrates and sulphates and are associated with the acidification of water courses.

4.2. Methodology

4.2.1. Any alteration to the road network, by the construction of a new road, the improvement of an existing road or the redistribution of traffic without new road construction may cause changes in air quality in adjacent areas. These changes in air quality are a factor to be taken into consideration during the design and development of a road improvement scheme and therefore form part of any environmental assessment.

4.2.2. This air quality assessment is in line with the Simple Assessment methodology as described in the DMRB Volume 11, section 3. The DMRB methodology sets out to compare current local air quality levels with those predicted for the future. DMRB guidance indicates that pollutant concentrations are likely to be highest in the opening year of the scheme. Estimates of the pollution concentrations, including PM_{10} and NO_2 are made for the base year taken to be 2013 and the opening year 2018. The DMRB requires that the worst future year in the first fifteen years following construction should also be assessed. The future year has been chosen as 2031 as traffic data is readily available for this year at the time of assessment.

4.2.3. The DMRB states that 'the introduction of tighter European vehicle emission and fuel quality standards since 1993 have been the most important way of reducing vehicle emissions and improving air quality. Vehicle emission standards are tightened every five years or so resulting in a steady decrease in emissions of oxides of nitrogen, carbon monoxide, hydrocarbons and particles.'

4.2.4. This assessment utilises revised technical guidance issued by Defra in February 2009 on long term air quality trends in NO_2 and NO_x concentrations. Research has shown that NO_2 and NO_x concentrations have reduced between 1996 and 2002, thereafter concentrations have stabilised with little or no reduction between 2004 and 2010. There is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in Defra's technical guidance and observed trends. This revised guidance includes a methodology for the calculation of NO_2 and NO_x concentrations and has been used in this assessment for determining concentration levels of both pollutants for the assessment years.

4.2.5. The DMRB screening model output results were verified against PM_{10} and NO_2 monitoring data undertaken by the council. This verification enabled the screening model to be calibrated and output results validated against real-time monitoring data for the town.

4.2.6. Traffic data was obtained from surveys carried out on behalf of Amey. All traffic speeds for the base and future assessment years were modelled by Amey.

4.2.7. Background air quality values have been taken from the Air Quality in Scotland website, www.scottishairquality.co.uk

Planning Policy and Legislative Context

4.2.8. Clean Air is a necessary component for a good quality of life. The Scottish Government is committed to meeting the air quality criteria for human health and for the protection of vegetation and ecosystems. Emissions of air pollutants can travel large distances and affect air quality across international boundaries so it is vital that European Union (EU) member states are also committed to reducing their national emissions. The Government also has targets in place to reduce emissions of greenhouse gases which are associated with climate change.

4.2.9. No Air Quality Action Plans have been published by South Ayrshire Council as no potential exceedences of air pollutants have been identified leading to declaration of an Air Quality Management Area (AQMA).

4.2.10. Significant quantities of dust are considered a statutory nuisance under the Environmental Protection Act 1990 (as amended). The relevant local authority has a duty to uphold this legislation, and where deemed necessary, can serve an abatement notice on those responsible for the dust generation. The decision on whether a nuisance is present is a matter for the local authority's Environmental Health Officer.

4.2.11. The main purpose of Planning Advice Note (PAN) 51 is to support existing policies within the planning system in relation to environmental protection regimes. It summarises the statutory responsibilities of the environmental protection bodies such as Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH) and informs these bodies about the planning system. This PAN details numerous environmental protection regimes including local air quality management.

4.2.12. The local air quality regime is based on domestic and European legislation.

4.2.13. The National Planning Framework for Scotland 2 (NPF2) aims to guide Scotland's development to 2030, and sets out strategic development priorities to promote sustainable economic growth. The framework identifies key issues and drivers of change, and identifies priorities and opportunities for each part of the country including Ayrshire and the South-West of Scotland. Issues of national importance identified include improving air quality and implementing the Government's policy commitments on climate change.

4.2.14. In September 2001 the Scottish Executive published a consultation paper proposing tighter objectives for a number of pollutants. These new objectives were incorporated in the Air Quality (Scotland) (Amendment) Regulations 2002, which came into force on 12 June 2002, (subsequently amended July, 2007).

4.2.15. Objective concentrations for various air pollutants are set out in the government publication "The Air Quality Strategy for England, Scotland, Wales and Northern Ireland" (DETR, 2007). Within this publication, air quality objectives are defined (in paragraph 107) as follows:-

"*Objectives are policy targets generally expressed as a maximum ambient concentration to be achieved, either with or without exception or with a permitted number of exceedances, within a specified timescale*."

4.2.16. Government and Local Authorities air quality policies are directed at achieving these air quality objectives.

4.2.17. EU member states are required to incorporate the provisions of the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC adopted 21 May 2008 and entering into force 11 June 2008 into national legislation before 11 June 2010. This directive merges most of the existing legislation (Framework Directive 96/62/EC, 1-3 daughter Directives 1999/30/EC, 2000/69/EC, 2002/3/EC, and Decision on Exchange of Information 97/101/EC) into a single directive.

4.2.18. The objectives relevant to this assessment are set out in Table 4.1. For all pollutants the objectives are taken from Chapter 2 of The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

Table 4.1 Objective Concentrations of Air Pollutants

Pollutant	Objective		Date by which to be achieved
	Concentration	Measured as	
Nitrogen dioxide	40µg/m3	Annual mean	31 December 2005
	200µg/m3 (not to be exceeded > 18 times a year)	1 hour mean	31 December 2005
Particles (PM_{10})	18µg/m3	Annual mean	31 December 2010
	50µg/m3 (not to be exceeded > 7 times a year)	1 hour mean	31 December 2010

Determination of Baseline Conditions

4.2.19. The baseline air quality data obtained from the Air Quality of Scotland website has been derived from monitoring sites in the Scottish Air Quality Database project. Pollutant maps are available for 2010 using measurements exclusively from Scottish air quality monitoring sites and Scottish meteorology. On behalf of the Scottish Government, Ricardo AEA provided mapped concentrations of pollutants on a 1 x 1km grid square basis. These annual mean pollutant maps combine Scottish pollutant measurement data with the spatially disaggregated emissions information from the UK's National Atmospheric Emissions Inventory (NAEI) to provide estimated pollutant concentrations for the whole of Scotland.

4.2.20. This data is available for various years, but a list of correction factors are provided such that the estimates of background pollutant concentrations can be found for the years of interest.

4.2.21. In relation to the published data in rural areas, the DMRB assessment procedure suggests that the analysis of rural grid squares containing the road link under consideration may already be influenced by an existing road.

4.2.22. The DMRB advocates that to avoid this influence, which could result in an over prediction, the background data used in the assessment is that based on the average levels of background concentrations at locations up to four grid squares away on either side of the road. For this assessment the average background concentration of centre grid square NS 230 610 and the surrounding eight grid squares has been used.

Determination of Impact Significance

4.2.23. To assess the potential effects on air quality associated with the proposed scheme, the sensitivity of the receptor and the degree of change that any impact may have must be determined.

4.2.24. The DMRB states that particular attention should be given to properties where the young and elderly and other susceptible populations are located. For this reason schools, hospitals and nursing homes located within 200m of the route are considered to have a very high sensitivity. Also in accordance with Development Control: Planning for Air Quality 2010 Environmental Protection UK (EPUK), which states that pollutant concentrations fall off rapidly with distance from a road, the individual receptor sensitivity (Table 4.2) has been determined in relation to distance of the property from the road.

4.2.25. The sensitivity of all other properties has been considered using 50m distance banding.

Table 4.2 Determination of Receptor Sensitivity.	
Sensitivity	**Typical Criteria Descriptors**
Very High	Properties for the young, the elderly, schools and hospitals within 200m of the route alignment
High	Properties within 50m of the route alignment
Medium	Properties located within 50-100m of the route alignment
Low	Properties located within 100-150m of the route alignment
Negligible	Properties located within 150-200m of the route alignment

4.2.26. In accordance with Development control: Planning for Air Quality 2010 (EPUK), the impact magnitude or degree of change experienced as a result of the scheme is assessed as a percentage of the objective concentration as shown in Table 4.3.

Table 4.3 Determination of Impact Magnitude (EPUK)	
Impact Magnitude	**Typical Criteria Descriptors**
Large	An increase or decrease greater than 10%of the objective concentration
Medium	An increase or decrease of 5-10% of the objective concentration
Small	An increase or decrease of 1-5% of the objective concentration.
Imperceptible	An increase or decrease of less than 1% of the objective concentration.

4.2.27. The DMRB uses a five point scale to determine receptor sensitivity, impact magnitude and impact significance. Details of this are found within Chapter 3 of this ES, Environmental Impact Assessment Methods. Table 4.4 'Determination of Impact Magnitude (DMRB)' shows how the EPUK criteria descriptors have been allocated under the five point scale of the DMRB. The impact magnitude on air quality receptors has been determined using Table 4.4 to ensure a consistent assessment throughout this chapter.

Table 4.4 Determination of Impact Magnitude (DMRB)	
Impact Magnitude	**Typical Criteria Descriptors**
Major	An increase or decrease greater than 10%of the objective concentration
Moderate	An increase or decrease of 5-10% of the objective concentration
Minor	An increase or decrease of 1-5% of the objective concentration.
Negligible	An increase or decrease of less than 1% of the objective concentration.
No Change	No changes in concentrations

4.3. Baseline Conditions

Study Area

4.3.1. The study area considered for the assessment of potential impacts on air quality extends 200m in each direction from the centre of the roads likely to be affected by the scheme. The DMRB states that for local air quality, the roads likely to be affected by the scheme should be identified. Affected roads are those that meet the following criteria:

- Road alignment will change by 5m or more;
- Daily traffic flows will change by 1000 AADT or more;
- Heavy Duty Vehicles (HDV) flows will change by 200 AADT or more;
- Daily average speed will change by 10km/hr or more; or
- Peak hour speed will change by 20km/hr or more.

4.3.2. In accordance with these criteria the only roads affected are the A77 and the B7023 Culzean Road. Kirklandhill Path, Alloway Road (B7024) and Gardenrose Path do not meet the DMRB assessment criteria.

4.3.3. The study area for the regional assessment includes a wider area which satisfies the DMRB criteria for regional effects, which are:

- 10% change in traffic flows;
- 10% change in HGV flows; and,
- 20km/hr change in average speeds.

Traffic Data

4.3.4. Traffic data was collected for the study area and used to model traffic predictions for the opening year and future design year. Traffic data was provided from the model in terms of the 24 hour Annual Average Daily Traffic (AADT) flows, the percentage Heavy Goods Vehicles (HGV) and average speed. Speeds below 20 km/h have been adjusted to 20 km/h.

4.3.5. Traffic data in the relevant format for this assessment has been used for the following locations along the existing A77 and B7023 Culzean Road:

- North of Maybole, north of the proposed bypass;
- North of Maybole, south of the proposed bypass northern tie in:
- Within Maybole at Cassillis Road, Maybole High Street and Whitehall;
- South of Maybole, north of the proposed bypass southern tie in:
- South of Maybole, south of the proposed bypass;
- Culzean Road, between Barns Terrace to Maybole Station;
- Culzean Road, between Cargill Road and Whitefaulds Avenue;
- Culzean Road, between Whitefaulds Avenue and Gallowhill Avenue;

- Culzean Road, between Gallowhill Avenue and the proposed Culzean roundabout;
- Culzean Road, outside Maybole.

Background Concentrations of Pollutants and Monitoring Data

4.3.6. South Ayrshire Local Council has carried out reviews and assessments of air quality over a number of years. Their most recent Updating and Screening Assessment was completed in April 2012. The results of the assessment indicated that a detailed Assessment was not required for any of the pollutants assessed. The 2012 Air Quality updating and Screening Assessment for South Ayrshire Council details NO_2 Annual mean concentrations of 10µg/m^3 in 2011 and no exceedences of the hourly mean of 200µg/m^3.

4.3.7. South Ayrshire Council has not declared the need for an Air Quality management Area (AQMA).

4.3.8. Between April 2010 and March 2012 South Ayrshire Council operated a monitoring station located close to the A77 in the grounds of Carrick Secondary School, Maybole. It was classed as an 'urban background' site set within an urban location distanced from sources and therefore broadly representative of city-wide background conditions e.g. urban residential areas. Data for NO_2, NO_x and PM_{10} are available from this site between April 2010 and March 2012. Mean NO_2 concentrations for 2011 was recorded as 8.6µg/m^3.

4.3.9. Results of the PM_{10} automatic monitoring obtained from Tapered Element Oscillating Microbalance Monitors (TEOM's) fitted with Filter Dynamics Measurements Systems (FDMS) at Carrick Academy shows a mean annual concentration of 13µg/m^3 in 2011 with no exceedences of the 24-hour mean (50µg/m^3). This site was used to validate the DMRB screening results for PM_{10}. The location of this monitoring site (M1) is shown on drawing 25000182/ENV/4.1.

4.3.10. Monitoring of nitrogen dioxide was undertaken using passive diffusion tubes at 22 separate locations in South Ayrshire during 2011. The diffusion tubes were located around the county, the closest to the scheme being a roadside site approximately 1m from the kerb at the local supermarket on Maybole High Street (M2), as shown on drawing 25000182/ENV/4.2. Results of the nitrogen dioxide tubes showed an annual mean concentration of 25.30µg/m3 in 2011.This monitoring site was used to validate the DMRB screening model results for NO_2.

4.3.11. The DMRB states that for local impact assessments it is necessary to specify background concentrations upon which the local traffic derived pollution is superimposed. Table 4.5 shows the background concentrations in 2013, 2018 and 2031 for the pollutants to be considered in the assessment. These concentrations were obtained from www.scottishairquality.co.uk using the background concentrations at the scheme grid coordinates. Projection of background concentrations is currently only available up to 2030 (from a base year of 2010). For this assessment the available 2030 data has been used to represent the assessment future year 2031.

Table 4.5 Background Concentrations in 2013, 2018, and 2031			
Pollutant	**Background Concentration µg/m^3**		
	2013	**2018**	**2031**
Nitrogen Dioxide (NO_2)	4.4	3.5	2.9
Oxides of nitrogen (NO_x)	6.5	5.1	4.3
Particles (PM_{10})	9.7	9.4	9.1

4.3.12. There are 315 private residential properties within 200m of the proposed bypass scheme extents. The private properties are predominantly concentrated to the southern end of the scheme. Drawing 25000182/ENV/4.1 illustrates the properties within the 50m distance bandings used to classify receptor sensitivity.

4.3.13. Table 4.6 – 'Properties within 200m of the existing A77 alignment', shows the number of properties within 200m of the existing A77 alignment through Maybole town centre in distance bands of 50m intervals. The locations of the identified properties are illustrated on drawing 25000182/ENV/4.2.

4.3.14. In accordance with Table 4.2 – Determination of Receptor Sensitivity:

- 4 properties namely Carrick Academy, St Cuthbert's Primary School, Cairn Primary School and Maybole Health Centre and Day Hospital fall into the category of very high sensitivity;
- 329 properties, including residential, commercial, agricultural and community and recreational facilities (including bowling green pavilion, church, Maybole castle, public house, Town Hall, library, post office) have been categorised as being of high sensitivity due to their location being within 50m of the existing alignment;
- 28 properties classed as high sensitivity due to their location being within 50m of the proposed bypass;
- 302 properties including residential, commercial, agricultural, and community facilities (church, and fire station) are categorised as being of medium sensitivity due to their location of being between 50m and 100m of the existing alignment, with 55 medium sensitivity properties within 50m and 100m of the proposed bypass;
- 186 properties including residential, commercial and a church are categorised as being of low sensitivity due to their location of being between 100m and 150m of the existing alignment, and 112 properties within 100m to 150m of the proposed bypass;

- 161 properties including residential and commercial are categorised as being of negligible sensitivity due to their location of being between 150m and 200m of the existing alignment.
- There are 120 properties classed as having negligible sensitivity as they are located 150m to 200m from the proposed route.

4.3.15. These property figures are shown in Table 4.6.

Table 4.6 Number of Properties within 200m of the Existing and Proposed Alignments

Distance Band	Existing A77	Proposed Bypass
0-50m	329	28
50-100m	303	55
100-150m	186	112
150m-200m	161	120

4.3.16. There are no designated sites of ecological importance that have features sensitive to air quality within 200m of the scheme that require being considered for this assessment.

4.3.17. As the surrounding area is rural in nature, vehicle exhaust emissions are considered to be the main source of NO_2 and PM_{10} in the area.

4.4. Impact Assessment

During construction

4.4.1. Construction activities will potentially give rise to a negative impact on the local air quality in the area through generation of dust on site, and additional air pollution from traffic management and plant activity. A qualitative assessment of the impact has been undertaken in accordance with Chapter 2: Methodology, and in line with the Institute of Air Quality Management (IAQM) 'Guidance on the Assessment of the Impacts of Construction on Air Quality and the determination of their Significance'.

Dust

4.4.2. Locations sensitive to dust emissions during construction will include residential properties and commercial premises close to the proposed scheme. Sensitive ecosystems and vegetation close to the dust sources will also potentially experience negative effects. There are three watercourses running through the site, Parish March Burn is adjacent to the western tie-in, Brockloch Burn and Black Glen Burn.

4.4.3. Construction sites have the potential to generate significant volumes of dust through soil stripping and the associated movements of these materials to stockpiles or off site. Additional dust can be generated through the delivery of materials and handling of dusty materials and cutting of stone or concrete. It is not possible at this stage to state exactly what activities will take place during the construction of the bypass. This assessment therefore gives an indication, applying a worst case approach.

4.4.4. Most of the construction works, road laying etc. will take place off line. For this assessment it has been assumed that major dust raising activities might occur anywhere within the scheme boundaries and assuming that standard mitigation measures are in place there might thus be significant dust soiling up to 100m from the roadways and significant PM_{10} and vegetation effects up to 25m from the roadways.

4.4.5. Activities on construction sites can be divided into four categories for assessing the potential impacts of dust. Demolition, earthworks, construction and trackout. The potential for dust emissions is assessed for each activity. If any activities are not carried out then assessment for that category is not performed.

4.4.6. Demolition activities can be assigned a dust emission class and receptors can be assigned demolition risk categories (see Table 4.7). Within the scheme only one building is to be demolished, the derelict stone farmstead Kirklandhill Cottage. Dust soiling and PM_{10} levels as a result of demolition will pose a low to negligible risk to receptors due to the nature of the building and its location.

Table 4.7 Risk Categories from Demolition Activities

Distance to Nearest Receptor (m)		Dust Emission Class		
Dust Soiling and PM_{10}	Ecological	Large	Medium	Small
<20	-	High Risk Site	High Risk Site	Medium Risk Site
20-100	-	High Risk Site	Medium Risk Site	Low Risk Site
100-200	<20	Medium Risk Site	Low Risk Site	Low Risk Site
200-350	20-40	Medium Risk Site	Low Risk Site	Negligible

4.4.7. Earthworks will form a significant part of the dust generation for this scheme and will primarily involve excavating material, haulage, tipping and stockpiling, it will also involve levelling the site and landscaping,. Dust emissions due to earthworks can be signed a 'class' using the following criteria however, not all criteria need to be met for a particular class.

- Large: Total site area >10,000m^2, potentially dusty soil type (eg. Clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved > 100 000 tonnes.
- Medium: Total site area 2,500m^2 – 10,000m^2, moderately dusty soil type (eg. Silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m – 8m in height, total material moved 20,000tonnes – 100,000 tonnes; and

- Small: Total site area <2,500m^2, soil type with large grain size (eg. Sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.

4.4.8. These potential dust emission classes can be used to determine the earthworks risk category with no mitigation applied, see Table 4.8.

4.4.9. Potential dust emission class during the construction phase of the scheme will be determined by the size of infrastructure, method of construction, construction materials and duration of build. Construction dust risk classes can be determined in a similar way to earthworks based on the matrix in Table 4.8.

Table 4.8 Risk Categories from Earthworks and Construction Activities

Distance to Nearest Receptor (m)		Dust Emission Class		
Dust Soiling and PM_{10}	Ecological	Large	Medium	Small
<20	-	High Risk Site	High Risk Site	Medium Risk Site
20-50	-	High Risk Site	Medium Risk Site	Low Risk Site
50-100	<20	Medium Risk Site	Medium Risk Site	Low Risk Site
100-200	20-40	Medium Risk Site	Low Risk Site	Negligible
200-350	40-100	Low Risk Site	Low Risk Site	Negligible

4.4.10. Factors determining the magnitude class of dust due to trackout would include vehicle size, vehicle speed, vehicle numbers, the geology and the duration of the works. Receptors within 100m of the routes used by vehicles on the public road and up to 500m from the site entrances are those considered to be a risk.

4.4.11. Potential dust emission classes for trackout are again split into three classes, large, medium and small. As factors such as vehicle numbers, size and speed, geology and site entrance locations have not yet been identified trackout risks cannot be assigned at present for this scheme. General guidance suggests that trackout may occur up to 500m from large sites, 200m from medium sites and 50m from small sites (measured from the site exits). Table 4.9 displays the classes used to determine trackout risk category with no mitigation applied.

Table 4.9 Risk Categories from Trackout				
Distance to Nearest Receptor (m)		Dust Emission Class		
Dust Soiling and PM_{10}	Ecological	Large	Medium	Small
<20	-	High Risk Site	Medium Risk Site	Medium Risk Site
20-50	<20	Medium Risk Site	Medium Risk Site	Low Risk Site
50-100	20-100	Low Risk Site	Low Risk Site	Negligible

4.4.12. At the time of this assessment it is not known where construction vehicles would exit the site onto the main roads and so the worst case assumption has been made that they might exit the site onto any existing linking roads. This is followed by a second worst-case assumption that dirt could potentially be tracked up to 500m along any of these roads. Vehicles passing along these roads are then judged to be a minor source of dust as there might thus be some dust soiling within 25m of the centreline of any of these roads and some PM_{10} and vegetation impacts within 10m of the centreline.

4.4.13. Table 4.10 shows the number of properties within various distance bands. It should be stressed that these numbers do not represent the number of properties likely to be affected but those properties which, based on the information currently available, are thought to have a risk of possible impacts. It is highly unlikely that construction vehicles would leave the site by every possible route and there will inevitably be just a small number of site exits. The true number of properties at risk of experiencing dust impacts due to tracking out is thus likely to be a small fraction of the number presented in Table 4.10. Even at these properties, the assessment does not imply that significant impacts would be likely, or that if incidents did occur, they would be frequent. Any dust incidents would be highly dependent on the weather, requiring dry conditions and winds blowing towards a receptor. These conditions would also need to be combined with an activity creating dust close to a receptor. This should only be the case if there had been an inadequate application of the mitigation measures. Dust creating activities would not occur at all of the identified locations for the duration of the works. In many locations the duration will be limited or periodic.

Table 4.10 Properties within 200m of the proposed scheme	
Distance Band	Number of properties
0-50m	28
50-100m	55
100-150m	112
150m-200m	120 plus Carrick Academy and Gardenrose Primary School

4.4.14. Risk categories have been assigned for the four activities and are summarised In Table 4.11.

Table 4.11 Summary of Risk Effects with no mitigation		
Source	**Dust Soiling and PM_{10} effects**	**Ecological Effects**
Demolition	Low Risk Site	Low Risk Site
Earthworks	Medium Risk Site	Medium Risk Site
Construction	Medium Risk Site	Medium Risk Site
Trackout	Low Risk Site	Low Risk Site

4.4.15. The significance of the potential dust effects can be determined taking account of the sensitivity of the surrounding area. Sensitivity of the surrounding area has been assessed based on criteria detailed in the IAQM 'Guidance on the Assessment of the Impacts of Construction on Air Quality and the determination of their Significance' and assigned a low/medium sensitivity.

Table 4.12 Significance of Effects of each activity with mitigation			
Sensitivity of surrounding area	**Risk of site giving rise to dust effects**		
	High	**Medium**	**Low**
Very High	Minor adverse	Minor adverse	Negligible
High	Minor adverse	Negligible	Negligible
Medium	Negligible	Negligible	Negligible
Low	Negligible	Negligible	Negligible

4.4.16. Sensitivity of the surrounding area has been determined as medium to low, and the scheme has been assigned a medium risk of giving rise to dust effects. According to Table 4.12 the overall significance of the combined activity effects is negligible.

4.4.17. Without mitigation in place the worst case significance would be minor adverse. As shown in Table 4.13.

Table 4.13 Significance of Effects of each activity with no mitigation			
Sensitivity of surrounding area	**Risk of site giving rise to dust effects**		
	High	**Medium**	**Low**
Very High	Major adverse	Moderate adverse	Moderate adverse
High	Moderate adverse	Moderate adverse	Minor adverse
Medium	Moderate adverse	Minor adverse	Negligible
Low	Minor adverse	Negligible	Negligible

4.4.18. The overall significance of the effects arising from the construction of the bypass can be determined taking account of the significance of the effects of each of the four activities as displayed in Tables 4.14 and 4.15. With mitigation in place the significance of dust effects will be negligible as shown in Table 4.14.

Table 4.14 Summary of significance with mitigation		
Source	**Dust Soiling and PM_{10} effects**	**Ecological Effects**
Demolition	Negligible	Negligible
Earthworks	Negligible	Negligible
Construction	Negligible	Negligible
Trackout	Negligible	Negligible
Overall Significance		Negligible

4.4.19. Table 4.15 highlights that without mitigation measures in place the worst case significance of dust effects during construction would be minor adverse.

Table 4.15 Summary of significance with no mitigation		
Source	**Dust Soiling and PM_{10} effects**	**Ecological Effects**
Demolition	Negligible	Negligible
Earthworks	Minor Adverse	Minor Adverse
Construction	Minor Adverse	Minor Adverse
Trackout	Negligible	Negligible
Overall Significance		Minor Adverse

4.4.20. There are three watercourses running through the site, Parish March Burn adjacent to the western tie-in, Brockloch Burn and Black Glen Burn however with mitigation measures in place the effects should be negligible.

Air pollutants

4.4.21. Construction of the proposed bypass has the potential to cause a slight increase in the level of air pollutants associated with transport within the local area. This will be caused by the presence of HGV's delivering new material and removing the surplus, also onsite construction machinery and traffic management when required.

4.4.22. The results of the DMRB local air quality assessment (detailed later within this air quality chapter) indicate that air pollutant levels are comfortably within the guideline values presented in the National Air Quality Strategy 2007. It is therefore not expected that the presence of plant, and traffic management will significantly impact on this.

4.4.23. During construction the impact magnitude is assessed as minor in accordance with Table 2.2 as there may be some changes in air quality. The sensitivity of receptors is assessed as low in accordance with Table 4.2. The resulting impact significance during construction is therefore assessed as neutral or slight in accordance with Table 2.4, as a reduction in air quality may increase the overall adverse impact on a particular receptor.

Post construction

4.4.24. The number of properties within 200m of the centreline of all affected routes has been identified. Outwith 200m air pollutant concentrations should have decreased sufficiently that the background concentrations will be representative. A total of fourteen representative properties have been selected for the assessment as detailed in Table 4.16. A selection of properties within 200m of the proposed bypass along with properties within 200m of the existing A77 have been considered as it is envisaged that the proposed bypass will give rise to a significant improvement in air quality for these receptors close to the existing route through Maybole.

Table 4.16 Properties within 200m of the Proposed or Existing Alignment

Representative Receptors	Distance from road centreline of existing alignment	Distance from road centreline of proposed alignment
R1 - Carrick Academy	35	90
R2 - 42 Whitehall	6	>200
R3 - Maybole Health Centre and day hospital	6	>200
R4 - 19 Cassillis Terrace	10	>200
R5 - 2 High Smithson Cottages	15	>200
R6 – Burns Drive	>200	120
R7 – 21 Enoch Road	>200	140
R8 – Garden Rose Primary School	>200	160
R9 – Kirklandhill Farm	>200	150
R10 – The Ranch Caravan Park	>200	20m (from Culzean Road realignment)
R11 – new build	>200	20 (from Culzean Road realignment)
R12 – Broomknowes housing	49	75
R13 – St Cuthberts Primary School	33	>200
R14 – Cairn Primary School	95	>200

4.4.25. Table 4.17 shows the predicted traffic flows and speeds for the opening year (2018) and future year (2031).

Table 4.17 Traffic Information								
	2018				2031			
	Do Minimum		Do Something		Do Minimum		Do Something	
	Two way traffic Flow (AADT	Average Traffic Speed (kph)	Two way traffic Flow (AADT	Average Traffic Speed (kph)	Two way traffic Flow (AADT	Average Traffic Speed (kph)	Two way traffic Flow (AADT	Average Traffic Speed (kph)
A77 North of Maybole and Bypass	11743	79	11744	79	12895	77	12890	77
A77 North of Maybole	11746	64	4716	69	12895	63	5108	69
A77 Maybole Cassillis Road	12120	47	5042	48	13313	45	5477	48
A77 Maybole High Street	10216	24	5074	27	11258	23	5471	27
A77 Maybole Whitehall	8920	45	3766	45	9872	45	4076	45
A77 South of Maybole	8877	48	3413	48	9812	47	3681	48
A77 South of Maybole and Bypass	8875	87	8877	85	9818	85	9814	84
Culzean Road (Barns Terrace to Maybole Station)	5048	29	3125	29	5405	29	3360	29
Culzean Road (Cargill Road to Whitefaulds Avenue)	3534	43	2881	45	3774	43	3074	45
Culzean Road (Whitefaulds Avenue to Gallowhill Avenue)	2959	47	2877	45	3162	47	3073	45
Culzean Road (Gallowhill Avenue to Culzean Roundabout)	2300	37	2867	48	2459	37	3063	48
Culzean Road outside Maybole	2301	68	2300	68	2456	68	2456	68
Ladyland Road	784	32	274	32	860	32	303	32
Maybole Bypass North	-	-	7082	90	-	-	7834	89
Maybole Bypass South	-	-	5664	72	-	-	6346	71

4.4.26. DMRB requires that air pollutant concentrations are predicted for the opening year of the scheme and a future year for both do minimum and do something scenarios. Predicted air pollution concentrations have been calculated at the 14 selected receptors identified using the DMRB 'local' screening method V1.03c. and in line with Defra/HA guidance for the conversion of NO_x to NO_2. The results of this air quality assessment for NO_2 and PM_{10} for the years 2013 (base year), 2018 (opening year) and 2031 (future year) with do minimum and do something scenarios are summarised in Table 4.18 and detailed in Appendix C1 'Local Air Quality Assessments – DMRB Screening Model output'.

4.4.27. As outlined previously, real-time monitoring data was used to validate the output from the DMRB screening model. PM_{10} monitoring at Carrick Academy (M1 on drawing 25000182/ENV/4.2) was used to validate the PM_{10} output from the DMRB screening model for location R1, Carrick Academy. A calibration factor of 1.27 was determined based on this monitoring data and applied to all the DMRB PM_{10} output results.

4.4.28. Diffusion tube monitoring data undertaken at the kerbside of the local supermarket (M2 on drawing 25000182/ENV/4.2) was used to validate the NO_2 output from the DMRB screening model for location R3, Maybole Health Centre. A calibration factor of 1.79 was determined based on this available monitoring data and applied to all the DMRB NO_2 output results.

4.4.29. As Kirklandhill Path and Gardenrose Path are being maintained like for like and there is not predicted to be any change in traffic flow with the 'do minimum' and 'do something' scenarios on these roads, background pollution concentrations for both NO_2 and PM_{10} at receptors R7, R8 and R9 have been used for the do minimum scenario. 2030 background concentrations have been used to represent future year 2031 due to the limitation of background concentration predictions only being available to 2030.

4.4.30. The predicted validated DMRB results as displayed in Table 4.18 show that pollution concentrations at all selected receptor locations are well below the National Air Quality Strategy objectives for all years with the do minimum and do something scenarios.

Table 4.18 Air Quality Assessment												
Representative Receptors	Pollutant Concentration											
	NO_2 (µg/m^3)						PM_{10} (µg/m^3)					
	Do-Minimum			Do-Something			Do-Minimum			Do-Something		
	2013	2018	2031	2013	2018	2031	2013	2018	2031	2013	2018	2031
R1	14.2	11.6	10.5	8.9	7.2	6.1	13.0	12.5	12.2	12.4	12.0	11.6
R2	21.5	17.8	16.6	10.8	8.9	7.8	13.9	13.3	13.0	12.7	12.3	12.0
R3	25.4	21.1	20.0	12.0	9.9	8.8	14.7	14.0	13.8	13.1	12.6	12.3
R4	22.5	18.7	17.7	11.8	9.6	8.6	14.1	13.4	13.3	12.9	12.4	12.1
R5	19.7	16.4	15.2	10.8	8.8	7.8	13.6	13.1	12.8	12.7	12.3	12.0
R6	7.9	6.3	5.2	8.5	6.8	5.8	12.3	11.9	11.6	12.4	12.0	11.6
R7	7.9	6.3	5.2	8.4	6.7	5.6	12.3	11.9	11.6	12.4	12.0	11.6
R8	7.9	6.3	5.2	8.2	6.6	5.5	12.3	11.9	11.6	12.4	12.0	11.6
R9	7.9	6.3	5.2	8.3	6.6	5.5	12.3	11.9	11.6	12.6	12.0	11.6
R10	9.0	7.3	6.2	9.0	7.3	6.2	11.2	12.1	11.7	12.5	12.1	11.7
R11	9.1	7.3	6.2	10.1	8.3	7.2	12.5	12.1	11.7	12.6	12.2	11.8
R12	12.4	10.1	9.0	11.5	9.4	8.3	12.8	12.4	12.0	12.7	12.3	11.9
R13	15.9	13.0	12.0	10.0	8.1	7.0	13.3	12.8	12.5	12.6	12.2	11.9
R14	9.7	7.8	6.7	8.3	6.7	5.6	12.5	12.1	11.8	12.4	12.0	11.6

4.4.31. Table 4.19 shows the change in air pollutant concentrations from the do minimum and do something scenario for 2018 and 2031, and change between the do minimum in 2013 to do something in 2018. Table 4.20 shows these changes as a percentage of the objective limit in line with EPUK guidance.

Table 4.19 Air Quality Assessment Summary						
Representative Receptors	Change in Pollutant Concentration					
	2018 do something against 2018 do minimum		2031 do something against 2031 do minimum		2018 do something against 2013 do minimum	
	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R1	-4.4	-0.5	-4.4	-0.6	-7.0	-1.0
R2	-8.9	-1.0	-8.8	-1.0	-12.6	-1.6
R3	-11.2	-1.4	-11.2	-1.5	-15.5	-2.1
R4	-9.1	-1.0	-9.1	-1.2	-12.9	-1.7
R5	-7.6	-0.8	-7.4	-0.8	-10.9	-1.3
R6	0.5	0.1	0.6	0.0	-1.1	-0.3
R7	0.4	0.1	0.6	0.0	-1.2	-0.3
R8	0.3	0.1	0.3	0.0	-1.3	-0.3
R9	0.3	0.1	0.3	0.0	-1.3	-0.3
R10	0.0	0.0	0.0	0.0	-1.7	-0.9
R11	1.0	0.1	1.0	0.1	-0.8	-0.3
R12	-0.7	-0.1	-0.7	-0.1	-3.0	-0.5
R13	-4.9	-0.6	-5.0	-0.6	-7.8	-1.1
R14	-1.1	-0.1	-1.1	-0.2	-3.0	-0.5

Table 4.20 Air Quality Assessment Summary						
Representative Receptors	Change in Pollutant Concentration as % of Objective Limit					
	2018 do something against 2018 do minimum		2031 do something against 2031 do minimum		2018 do something against 2013 do minimum	
	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R1	-11.0	-2.8	-11.0	-3.3	-17.5	-5.6
R2	-22.3	-5.6	-22.0	-5.6	-31.5	-8.9
R3	-28.0	-7.8	-28.0	-8.3	-38.8	-11.7
R4	-22.8	-5.6	-22.8	-6.7	-32.3	-9.4
R5	-19.0	-4.4	-18.5	-4.4	-27.3	-7.2
R6	1.3	0.6	1.5	0.0	-2.8	-1.7
R7	1.0	0.6	1.5	0.0	-3.0	-1.7
R8	0.8	0.6	0.8	0.0	-3.3	-1.7
R9	0.8	0.6	0.8	0.0	-3.3	-1.7
R10	0.0	0.0	0.0	0.0	-4.3	-5.0
R11	2.5	0.6	2.5	0.6	-2.0	-1.7
R12	-1.8	-0.6	-1.8	-0.6	-7.5	-2.8
R13	-12.3	-3.3	-12.5	-3.3	-19.5	-6.1
R14	-2.8	-0.6	-2.8	-1.1	-7.5	-2.8

4.4.32. The impact magnitude based on the percentage change in pollutant concentrations is assessed in accordance with Table 4.21.

Table 4.21 Assessment of Impact Magnitude						
Representative Receptors	Pollutants					
	2018 do something against 2018 do minimum		2031 do something against 2031 do minimum		2018 do something against 2013 do minimum	
	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R1	Major Beneficial	Minor Beneficial	Major Beneficial	Minor Beneficial	Major Beneficial	Moderate Beneficial
R2	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial
R3	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial
R4	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial	Major Beneficial	Moderate Beneficial
R5	Major Beneficial	Minor Beneficial	Major Beneficial	Minor Beneficial	Major Beneficial	Moderate Beneficial
R6	Minor Adverse	Negligible	Minor Adverse	No Change	Minor Beneficial	Minor Beneficial
R7	Minor Adverse	Negligible	Minor Adverse	No Change	Minor Beneficial	Minor Beneficial
R8	Negligible	Negligible	Negligible	No Change	Minor Beneficial	Minor Beneficial
R9	Negligible	Negligible	Negligible	No Change	Minor Beneficial	Minor Beneficial
R10	No Change	No Change	No Change	No Change	Minor Beneficial	Moderate Beneficial
R11	Minor Adverse	Negligible	Minor Adverse	Negligible	Minor Beneficial	Minor Beneficial
R12	Minor Beneficial	Negligible	Minor Beneficial	Negligible	Moderate Beneficial	Minor Beneficial
R13	Major Beneficial	Minor Beneficial	Major Beneficial	Minor Beneficial	Major Beneficial	Moderate Beneficial
R14	Minor Beneficial	Negligible	Minor Beneficial	Minor Beneficial	Moderate Beneficial	Minor Beneficial

4.4.33. The operational impacts on air quality at the principal receptor locations are detailed in Tables 4.22 and 4.23. The impact significance is assessed using a combination of receptor sensitivity and magnitude of impact. These values are combined using Table 2.4, Chapter 2 to give an overall significance of impact. The 'significance' has been assigned to each receptor.

4.4.34. Table 4.22 shows the significance of effect between the do-something and do-minimum scenario for the opening year of the scheme for NO_2 pollutant levels. As outlined, properties within Maybole will experience an improvement in air quality with some properties experiencing a beneficial impact of large significance. The most significant adverse impact will be at the new build properties off Culzean Road which will have impacts of moderate significance as a result of their proximity to the scheme.

Table 4.22 Air Quality – Impact Significance for NO_2 in the Opening Year Comparison

Representative Receptors	Sensitivity	Magnitude	Significance
R1	Very High	Major Beneficial	Large Beneficial
R2	High	Major Beneficial	Large Beneficial
R3	Very High	Major Beneficial	Large Beneficial
R4	High	Major Beneficial	Large Beneficial
R5	High	Major Beneficial	Large Beneficial
R6	Negligible	Minor Adverse	Slight Adverse
R7	Low	Minor Adverse	Slight Adverse
R8	Very High	Negligible	Slight Adverse
R9	Low	Negligible	Slight Adverse
R10	High	No Change	Neutral
R11	High	Minor Adverse	Moderate Adverse
R12	Low	Minor Beneficial	Slight Beneficial
R13	Very High	Major Beneficial	Very Large Beneficial
R14	Very High	Minor Beneficial	Moderate Beneficial

4.4.35. Similar significance of impact is predicted for PM_{10} pollutant levels in the opening year, as shown in Table 4.23.

Table 4.23 Air Quality – Impact Significance for PM_{10} in the Opening Year Comparison			
Representative Receptors	**Sensitivity**	**Magnitude**	**Significance**
R1	Very High	Minor Beneficial	Moderate Beneficial
R2	High	Moderate Beneficial	Moderate Beneficial
R3	Very High	Moderate Beneficial	Large Beneficial
R4	High	Moderate Beneficial	Moderate Beneficial
R5	High	Minor Beneficial	Slight Beneficial
R6	Negligible	Negligible	Neutral
R7	Low	Negligible	Slight Adverse
R8	Very High	Negligible	Slight Adverse
R9	Low	Negligible	Slight Adverse
R10	High	No Change	Neutral
R11	High	Negligible	Slight Adverse
R12	Low	Negligible	Slight Beneficial
R13	Very High	Minor Beneficial	Moderate Beneficial
R14	Very High	Negligible	Slight Beneficial

Nitrogen Dioxide

4.4.36. Predicted annual mean concentrations of NO_2 are anticipated as being well below the annual mean air quality objectives of 40µg/m^3 at all receptor locations for both the existing A77 through Maybole town centre and the proposed bypass.

4.4.37. Properties close to Maybole High Street will experience a reduction in NO_2 concentrations with a major beneficial impact. Properties closest to the proposed bypass will experience a very slight increase on NO_2 concentrations, the new build properties close to Culzean Road experiencing the greatest negative effect of a minor adverse impact.

Particulate Matter

4.4.38. Predicted annual mean concentrations of PM_{10} are below the annual mean air quality objective of 18µg/m_3 at all receptor locations for both the existing A77 through Maybole town centre and the proposed bypass route.

4.4.39. Properties close to Maybole High Street will experience a reduction in PM_{10} concentrations with a major beneficial impact.

4.4.40. Overall there will be no change to the air quality of the general area as pollutant concentrations will remain well below the objective levels of The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007).

4.4.41. Local Authority monitoring data has shown no exceedences of the PM_{10} short term objective of 50µg/m3 (not to be exceeded more than 7 times a year). DMRB screening for the proposed scheme predicts a significant reduction in PM_{10} levels close to Maybole High Street with the introduction of the bypass and a slight increase close to the bypass but any increases will still be significantly below the 50µg/m3 objective set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

Regional Air Quality

4.4.42. A regional air quality assessment was undertaken using the DMRB screening method for the baseline year 2013, opening year 2018 and future year 2031. The modelled concentrations of carbon monoxide (CO), total hydrocarbons (THC), nitrogen oxides (NO_x), particulate matter and carbon dioxide (CO2), as Carbon, are presented in Table 4.24.

Table 4.24 Regional Air Quality Assessment

	CO (tonnes/yr)	THC (tonnes/yr)	NO_x (tonnes/yr)	PM_{10} (tonnes/yr)	CO_2 (as C) (tonnes/yr)
2013 Baseline.	17.5	2.9	15.9	0.4	1,463
2018 'do minimum'	17.9	3.0	13.7	0.4	1,504
2018 'do something'	15.5	2.5	13.4	0.4	1,539
2018 'do something – 2018 'do minimum'.	-2.4	-0.5	-0.3	0.0	+35
2018% change with the proposed bypass scheme.	-13.41%	-16.7%	-2.2%	0%	+2.3%
2031 'do something'.	16.9	2.8	15.0	0.4	1,735
2031 'do something' – 2018 'do minimum'.	-1.0	-0.2	2.2	0.0	+231
2031% change from 2018 'do minimum'	-5.6%	-6.7%	+16.1%	0%	+15.4%

4.4.43. The introduction of the scheme in the opening year 2018 results in an increase in carbon dioxide but a decrease in carbon monoxide, total hydrocarbons, and nitrogen oxide. Particulate matter remains the same.

4.4.44. The future year 2031 predicted emissions were compared with the opening year 2018, and showed an increase in nitrogen oxide and carbon dioxide and a decrease in carbon monoxide and total hydrocarbons. Particulate matter remains the same.

4.4.45. The regional assessment in DMRB requires an assessment to be made for schemes which contribute towards the National Emission Ceilings Directive (NECD) 2001/81/EC, which sets ceilings for the emissions of four key pollutants:

- Sulphur Dioxide (SO2);

- Oxides of Nitrogen (NOx);
- Volatile Organic Compounds (VOCs);
- Ammonia (NH3);

4.4.46. The NECD upper limit for total emissions for the UK by 2010 are:

- SO2 – 585 Kilotonnes;
- NOx – 1167 Kilotonnes;
- VOC – 1200 Kilotonnes;
- NH3 – 297 Kilotonnes;

4.4.47. The assessment for the opening year shows that the scheme will result in a reduction of total NO_2 emissions. The future year comparison against the opening year shows an increase in total NO_2 emissions, likely due to the natural growth in traffic.

4.5. Mitigation

During Construction

4.5.1. Measures to mitigate dust emissions will be required during the construction phase. This mitigation should be relatively straightforward as the necessary measures are routinely employed as 'good practice' on construction sites. Mitigation measures during construction should include:

- Early construction of a paved haul route across the site;
- Unpaved haul routes should be located as far as possible from occupied residential properties;
- Vehicles carrying dusty materials should be sheeted to prevent materials being blown whilst in transit;
- Speed limits should be enforced for vehicles on unmade ground to minimise dust;
- Early sealing of open ground with vegetation;
- Frequent dampening and sweeping down of routes designated for site vehicles should be undertaken;
- Exposed stockpiles likely to generate dust should be located as far from sensitive locations as possible and should be 'dampened down' on a regular basis, frequency will depend upon weather conditions;
- Wheel wash facilities should be provided for vehicles leaving site to minimise deposition of mud and debris on roads;
- Water sprays should be used to ensure that any unpaved routes across the site are maintained in a damp condition when in use;
- Paved areas on site should be regularly cleaned;

- Use of water suppression during any cutting of stone or concrete;
- Construction activities with the potential to generate large volumes of dust should be avoided in weather conditions likely to give rise to dust; and,
- A water assisted dust sweeper should be used regularly on local roads if necessary, to remove any material tracked out of the site.

4.5.2. Where mitigation measures are reliant on water, only sufficient water to damp down the material should be applied. There should not be any excess to potentially contaminate local water courses.

Post Construction

4.5.3. The findings of the assessment indicate pollutant concentrations will remain well below the objective levels of The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007) at all properties. The predicted air quality results indicate that there is no requirement for mitigation in relation to air quality.

4.5.4. Due to the low background concentrations (Table 4.5) which are well below the current Air Quality Strategy objectives, any potential increase in air pollutants generated by the operation of the proposed scheme is, based upon initial assessment, unlikely to create the need for the designation of an AQMA.

4.6. Residual Impacts

4.6.1. All of the air pollutant concentrations for all receptors modelled are well below the Air Quality Strategy objectives for England, Scotland, Wales and Northern Ireland (as detailed in Table 4.1) with the majority of receptors experiencing a benefit in pollutant concentration levels. Therefore, no residual impacts are predicted as a result of the scheme.

4.7. Assumptions and indication of Any Difficulties Encountered

4.7.1. Projection of background pollutant concentrations obtained from www.scottishairquality.co.uk is currently only available up to 2030 (from a base year of 2010). For this assessment the available 2030 data has been used to represent the assessment future year 2031.

4.7.2. Modelling has used the latest vehicle emissions factors available. The future year in the DMRB modelling extends to only 2025 therefore it has been assumed that no change is predicted between 2025 and the future year of 2031.

4.7.3. Traffic data supplied did not include the minor roads therefore background pollutant concentrations were used for receptors R7, R8 and R9 during DMRB screening for local Air quality for each of the three ‘do minimum’ scenarios.

4.7.4. Traffic data also makes assumptions on the percentage of Heavy Goods Vehicles and traffic speeds.

4.7.5. It has been assumed that the mitigation measures set out will be adopted in full as part of the construction process for the scheme.

4.8. Conclusions

4.8.1. An assessment has been conducted in accordance with the DMRB HA 207/07 of the potential impacts on air quality associated with the construction and operation of the proposed A77 Maybole Bypass.

4.8.2. Based on the construction known at the time of writing, the construction impacts are not predicted to be significantly adverse.

4.8.3. In terms of local air quality impacts, the proposed Maybole bypass is expected to improve the air quality in some locations and to cause a minor deterioration in air quality in other areas. At most receptor locations any adverse changes in air quality will be negligible or of slight significance, but adjacent to the existing route through Maybole town centre the impacts would be significantly beneficial.

4.8.4. Overall the net effect of the proposed scheme on local air quality is expected to be beneficial and no exceedences of Air Quality Strategy objectives are predicted in the opening year 2018 using worst case prediction of impacts.

4.8.5. The regional assessment concludes this scheme will not adversely contribute towards the National Emissions Ceiling Directive.