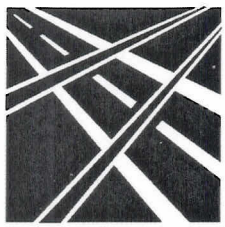
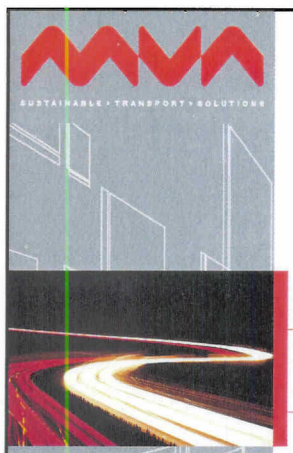


AWPR Scheme Testing

Summary: This report provides a synopsis of the scheme testing comparison carried out by MVA Consultants for the Scottish Executive prior to the announcement on 1 December 2005 that the AWPR would be taken forward on the Milltimber Brae Route with a spur south to Stonehaven. The report was provided to assist in the decision making process and contains technical information.



ASAM3 – AWPR Scheme Testing

Economic and Environmental

Murtle, Milltimber and Milltimber Brae Upgrade (N29)

Overview

- This presentation contains the following analysis of AWPR model runs using ASAM3:
  - Economic Analysis
  - Accident Analysis
  - Environmental Analysis
- The information has been prepared to a general specification and to provide indicative results for an additional scheme option – Milltimber Brae upgrade (N29).
- The scheme has been included in the absence of detailed engineering assessment and the costs have been prepared in the absence of detailed design, but approximate and in accordance with previous alignment test options.
- Further information can be tailored\refined to suit if required following a review of the contents.

AWPR – Economics Background

- Economic assessment has been undertaken using the TUBA ecônomic software package version 1.6c. This version used the following parameters:
  - Modelling is based on 2010 and 2025 forecast demand model runs;
  - Costs Benefits are discounted to 2002 prices;
  - Costs calculated in the absence of engineering design;
  - 30 and 60 year appraisal undertaken with and without Optimism Bias;
  - 3.5% discount rate;
  - No residual Value adjustments;
  - Annualisation factors of :
    - 616 AM Peak Hours;
    - 3978 Inter Peak Hours; and
    - 683 PM Peak Hours.

AWPR – Economics Results

30 Year Optimism Bias	Efficiency Benefits (PVB)	Present Value of Costs (PVC)	Benefit to Cost Ratio (BCR)
Murtle (P03) vs Ref Case (R04)	974207	281176	3.465
Milltimber Brae (N20) vs Ref Case (R04)	984367	341994	2.878
Milltimber Brae Upgrade (N29) vs Ref Case (R04)	1171921	412928	2.838

60 Year Optimism Bias	Efficiency Benefits (PVB)	Present Value of Costs (PVC)	Benefit to Cost Ratio (BCR)
Murtle (P03) vs Ref Case (R04)	1619236	277589	5.833
Milltimber Brae (N20) vs Ref Case (R04)	1638444	352130	4.653
Milltimber Brae Upgrade (N29) vs Ref Case (R04)	1950735	407547	4.787

30 Year (No Optimism Bias)	Efficiency Benefits (PVB)	Present Value of Costs (PVC)	Benefit to Cost Ratio (BCR)
Murtle (P03) vs Ref Case (R04)	974207	212168	4.592
Milltimber Brae (N20) vs Ref Case (R04)	984367	259682	3.791
Milltimber Brae Upgrade (N29) vs Ref Case (R04)	1171921	313298	3.741

60 Year (No Optimism Bias)	Efficiency Benefits (PVB)	Present Value of Costs (PVC)	Benefit to Cost Ratio (BCR)
Murtle (P03) vs Ref Case (R04)	1619236	214323	7.555
Milltimber Brae (N20) vs Ref Case (R04)	1638444	273140	5.999
Milltimber Brae Upgrade (N29) vs Ref Case (R04)	1950735	309558	6.302

- For all test options, Murtle Route (P03) demonstrates the highest BCR value.
- Milltimber Brae Upgrade (N29) costs have been estimated as Milltimber+B797 upgrade and therefore may over-estimate costs.
- Although N29 does not produce the highest BCR, it does produce the highest Efficiency Benefits by around 20%.
- It would be envisaged that a refinement of costs for N29 would result in a cost reduction and consequent BCR increase.
- Where appropriate, optimism bias has been applied to the costs at a rate of 32%, in line with the DFT guidance.

AWPR – Accidents Background

- Accident assessment undertaken using the ACCDNT software package.
- ACCDNT model conforms to the NESA/COBA11 (Network Evaluation from Surveys and Assignments/Cost Benefit Analysis conditions set out in the 2002 NESA Manual in the Design Manual for Roads and Bridges.
- Three categories of personal injury accident are: fatal, serious and slight.
- Accident rates quoted are per year.

AWPR – Accidents Results

Number of Accident Casualties Forecast

Accident Type	Base Year (2002)	Ref. Case (2010)	Ref. Case (2025)	Murtle (2010)	Murtle (2025)	Milltimber Brae (2010)	Milltimber Brae (2025)	Milltimber Brae Upgrade (2010)	Milltimber Brae Upgrade (2025)
Fatal	17	13	13	13	12	12	12	12	11
Serious	165	120	118	116	113	116	113	115	112
Slight	1208	1245	1218	1210	1179	1213	1180	1202	1172
Total	1389	1378	1349	1338	1304	1340	1304	1330	1296

Change in Accident Casualties Forecast

Accident Type	Ref. Case (2010)	Ref. Case (2025)	Murtle (2010)	Murtle (2025)	Milltimber Brae (2010)	Milltimber Brae (2025)	Milltimber Brae Upgrade (2010)	Milltimber Brae Upgrade (2025)
Fatal	-4	-4	-1	-1	-1	-1	-1	-1
Serious	-45	-47	-5	-6	-5	-6	-5	-6
Slight	37	10	-34	-40	-32	-39	-42	-46
Total	-11	-40	-40	-45	-38	-45	-48	-53

Cost of Accidents Forecasts (£1,000s)

Year	Base Year (2002)	Ref. Case	Murtle	Milltimber Brae	Milltimber Brae Upgrade
2010	£74,241	£74,890	£72,013	£72,055	£71,698
2025	£74,241	£98,408	£94,120	£94,065	£93,719

Change in Costs of Accidents Forecasts (£1,000s)

Year	Ref. Case	Murtle	Milltimber Brae	Milltimber Brae Upgrade
2010	£649	-£2,878	-£2,836	-£3,192
2025	£24,167	-£4,287	-£4,343	-£4,689

AWPR – Accidents Casualty Results

- Accident rates per km of road link type are forecast to reduce over time (this is fixed within accident analysis and therefore, despite increases in traffic flows, it is still anticipated that numbers of accidents will decrease.)
- All three scheme (Murtle, Milltimber and Milltimber Brae upgrade) demonstrate a reduction in accident casualties over the Reference Case (R04). This is consistent for both the 2010 and 2025 forecast years and a consequence of moving traffic away from urban links\junctions to more rural un-interrupted flow.
- The Milltimber Brae scheme (N20) gives a similar number of casualty reductions to the Murtle scheme in both forecast years.
- The Milltimber Brae Upgrade scheme (N29) gives additional casualty reductions over and above those of the Murtle and Milltimber Brae schemes.
- Each test option reduces the categories of casualties (fatal, serious and slight) below Reference Case levels and the majority of reductions are in slight casualties in every case.

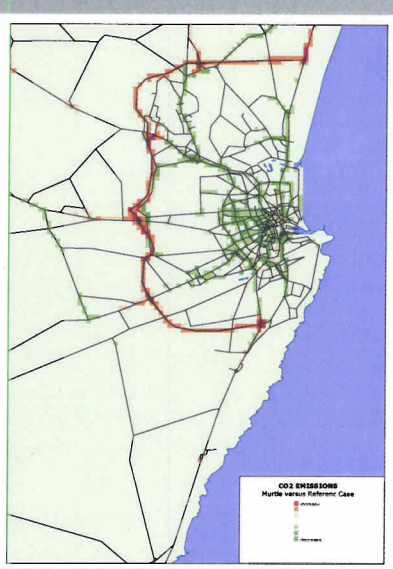
AWPR – Accidents Cost Results

- The Reference Case scenario illustrates that although accident casualties are forecast to decrease over time, the costs associated with each casualty will rise over time, leading to a total increase in accident costs.
- The Murtle (P03) and Milltimber Brae (N20) schemes reduce accident costs below Reference Case levels in each forecast year by a similar amount.
- The Milltimber Brae Upgrade scheme (N29) produces a further reduction in future accident costs with respect to the Reference Case over and above those of the Murtle and Milltimber Brae schemes.

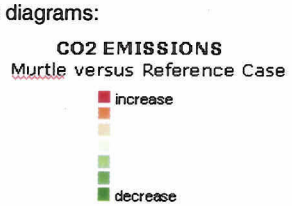
AWPR Environmental Analysis

- The environmental analysis in this report is based on the 2010 model year. Similar analysis can also be undertaken for other modelled years.
- Environmental analysis has been undertaken using the ENEVAL software package.
- ENEVAL conforms to the guidance and methodologies described in Design Manual for Roads and Bridges, Volume 11, Section 3.
- ENEVAL is capable of analysing link and user defined region based:
  - Carbon Monoxide (CO);
  - Hydrocarbons (THC);
  - Various oxides of Nitrogen (NOx);
  - Particulates (PM10); and
  - Carbon Dioxide (CO_2) emissions.
- Results for CO_2 and NOx are presented in both tabular and graphical format in this report.

Emission mapping - Example



Key to diagrams:

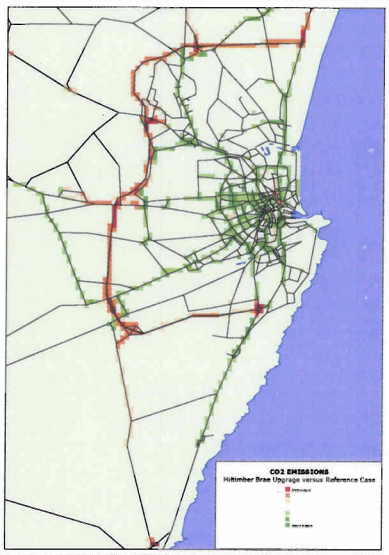


The following maps show increases and decreases of link based emissions for CO_2 and NOx relative to the Reference Case or to another Test Option.

As can be seen from the key above, green represents the magnitude of decrease, while red represents the increases in emissions.

Please note that these maps do not represent dispersion models.

CO_2 Analysis



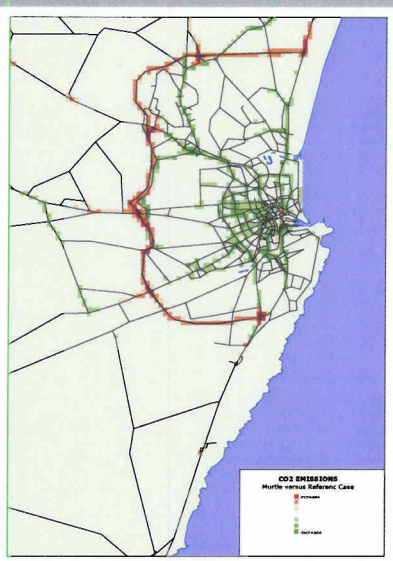
Milltimber Brae Upgrade (N29)

Link based CO_2 emissions (tonnes per km) increase along the AWPR alignment and decrease within Aberdeen City and Aberdeen South relative to the Reference Case (2010).

Percentage change in Regional CO_2 emissions shown below.

	Miltimber Brae Upgrade
Aberdeen City Centre	-5%
Aberdeen North	-9%
Aberdeen South	-8%
Aberdeenshire North	14%
Aberdeenshire South	-4%
TOTAL	**2%**

CO_2 Analysis



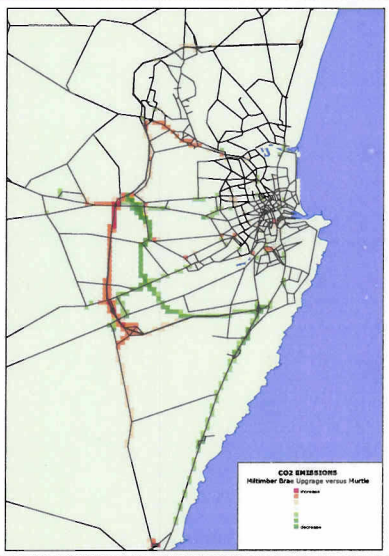
Murtle Alignment (PO3)

Link based CO_2 emissions (tonnes per km) increase along the AWPR alignment and decrease within Aberdeen City relative to the Reference Case (2010).

Percentage change in Regional CO_2 emissions shown below.

	Murtle Alignment
Aberdeen City Centre	-5%
Aberdeen North	-9%
Aberdeen South	-5%
Aberdeenshire North	13%
Aberdeenshire South	-2%
TOTAL	**3%**

CO_2 Analysis



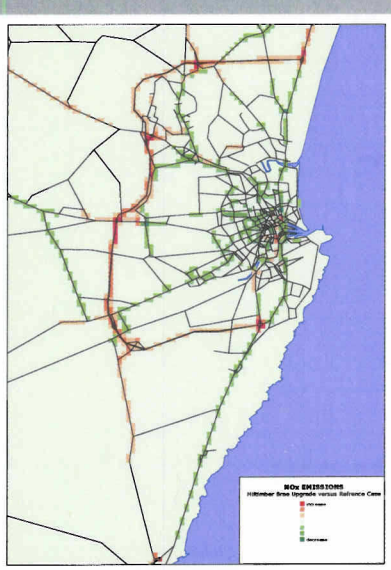
Milltimber Brae Upgrade (N29) compared to Murtle Alignment (PO3)

Compared to Murtle Alignment, link based CO_2 emissions (tonnes per km) increases on the A96 and (as one would expect) the B979 while the A90 South between Charleston and Stonehaven CO_2 emission decreases.

Percentage change and difference in Regional CO_2 emissions are shown below.

	Murtle Alignment	Miltimber Brae Upgrade	% Difference
Aberdeen City Centre	-5%	-5%	0%
Aberdeen North	-9%	-9%	0%
Aberdeen South	-5%	-8%	-4%
Aberdeenshire North	13%	14%	0%
Aberdeenshire South	-2%	-4%	-2%
TOTAL	**3%**	**2%**	-1%

NOx Analysis



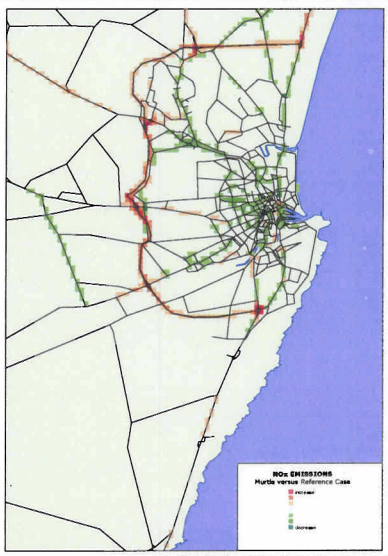
Milltimber Brae Upgrade (N29)

Link based NOx emissions (tonnes per km) increase along the AWPR alignment, decrease within Aberdeen City and along A90 South relative to the Reference Case (2010).

Percentage change in Regional NOx emissions shown below.

	Miltimber Brae Upgrade
Aberdeen City Centre	-4%
Aberdeen North	-8%
Aberdeen South	-7%
Aberdeenshire North	12%
Aberdeenshire South	-3%
TOTAL	**2%**

NOx Analysis



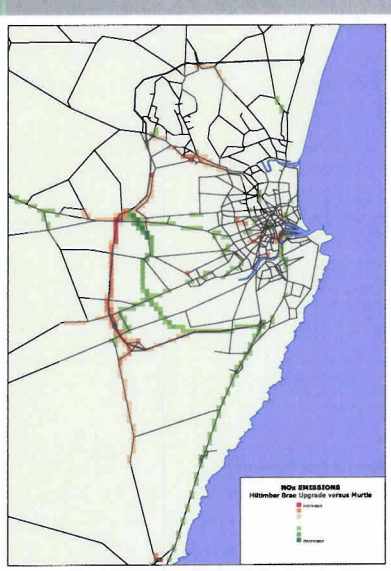
Murtle Alignment (PO3)

Link based NOx emissions (tonnes per km) increase along the AWPR alignment and decrease within Aberdeen City relative to the Reference Case (2010).

Percentage change in Regional NOx emissions shown below.

	Murtle Alignment
Aberdeen City Centre	-4%
Aberdeen North	-8%
Aberdeen South	-4%
Aberdeenshire North	11%
Aberdeenshire South	-1%
TOTAL	**3%**

NOx Analysis



Milltimber Brae Upgrade (N29) compared to Murtle Alignment (PO3)

Compared to Murtle Alignment, link based NOx emissions (tonnes per km) increase on the A96 and (as one would expect) the B979 while the A90 South NOx emissions decrease.

Percentage change and difference in Regional NOx emissions are shown below.

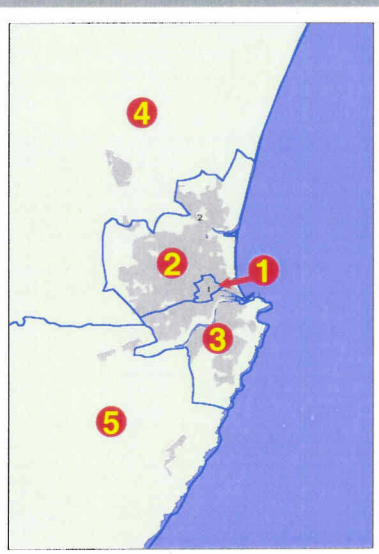
	Murtle Alignment	Milltimber Brae Upgrade	% Difference
Aberdeen City Centre	-4%	-4%	0%
Aberdeen North	-8%	-8%	0%
Aberdeen South	-4%	-7%	-3%
Aberdeenshire North	11%	12%	1%
Aberdeenshire South	-1%	-3%	-2%
TOTAL	**3%**	**2%**	-1%

AWPR Environmental Analyses

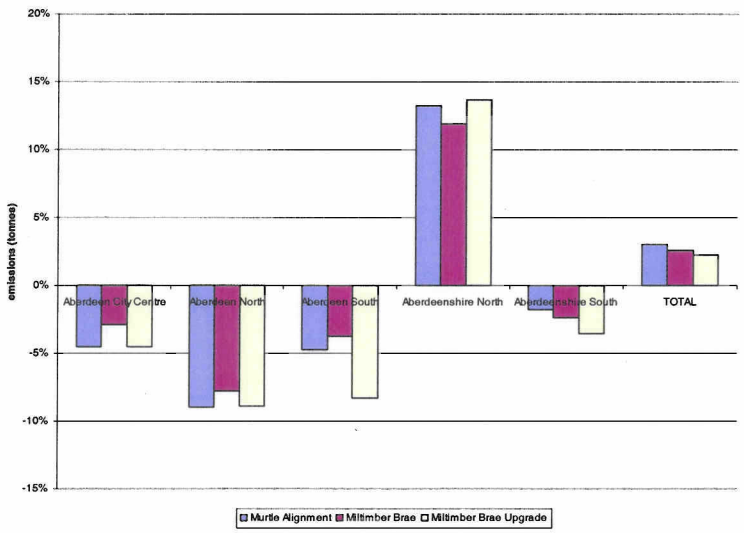
- The following graphs illustrate the percentage change in CO, THC, NOx, PM10 and CO_2 emissions of the three different AWPR alignments relative to the Reference Case for 2010.
- These alignments are:
  - Murtle Alignment (P03);
  - Milltimber Brae Alignment (N20); and
  - Milltimber Brae Upgrade (N29).

AWPR Environmental Analyses

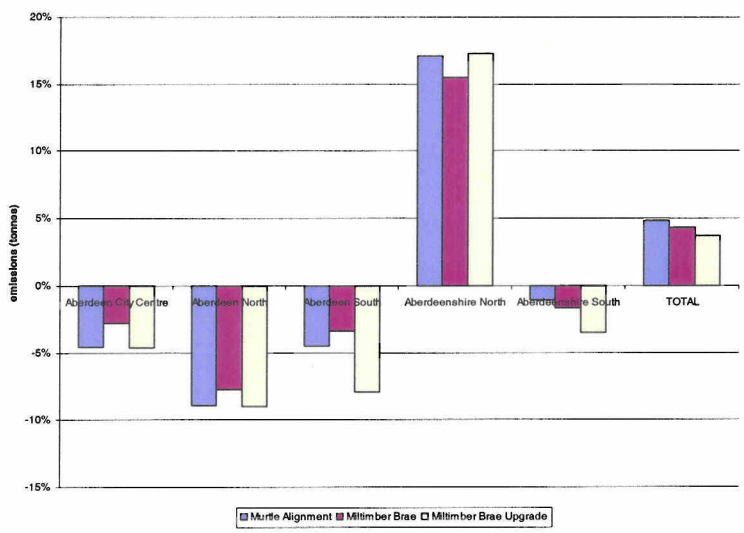
- The results are classified by model regions. The illustration on this page provides a key to the regions.
- This region system is inherited from the ASAM model development and could be altered to suit if required and further analysis can be undertaken to demonstrate emissions figures at a more aggregate\disaggregated level.
- Key:
  1. Aberdeen City
  2. Aberdeen North
  3. Aberdeen South
  4. Aberdeenshire North
  5. Aberdeenshire South



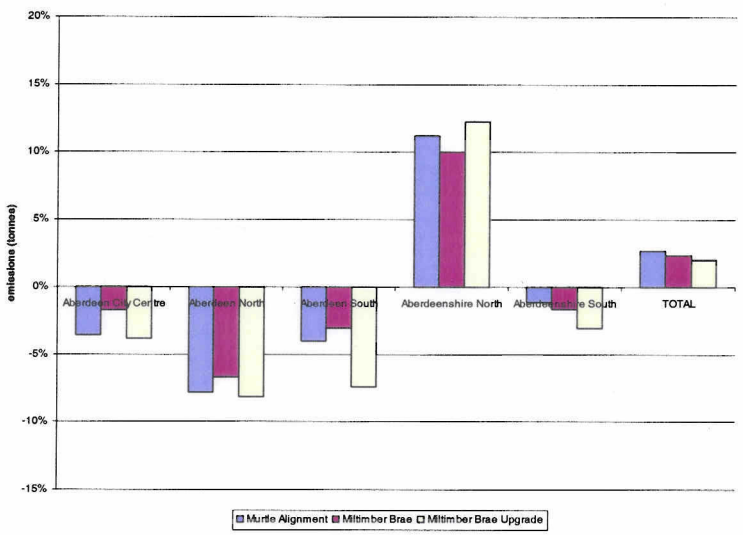
Percentage change in CO2



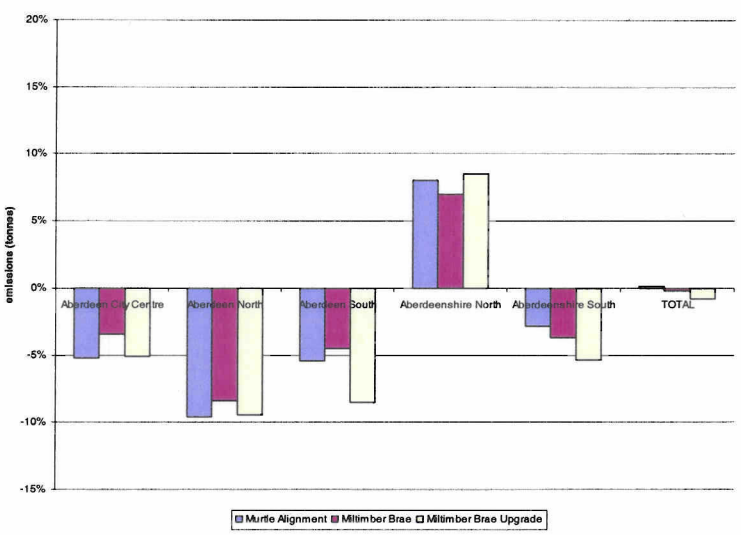
Percentage change in PM10



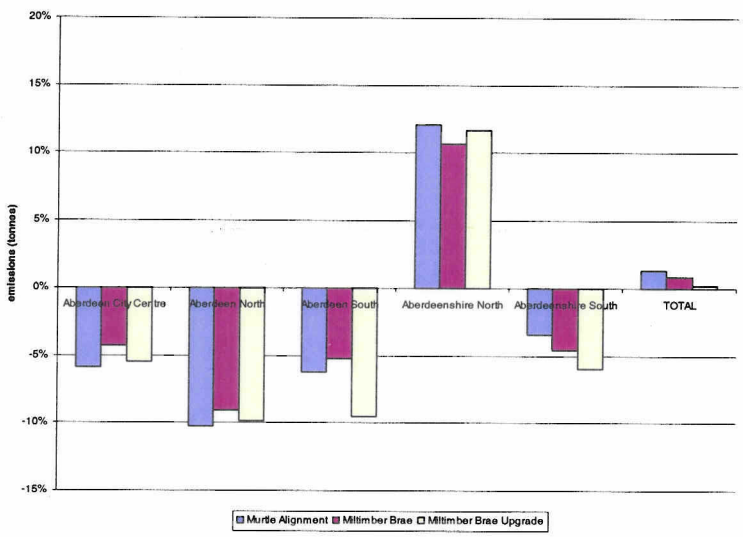
Percentage change in NOx



Percentage change in THC



Percentage change in CO



% Change in total emissions

- The table below presents the percentage change in all emissions relative to the Reference Case.
- In terms of the total emissions, Milltimber Brae Upgrade produces the lowest value while the Murtle alignment produces the highest of the three test options analysed.

	Murtle Alignment	Milltimber Brae	Milltimber Brae Upgrade
CO	1.3%	0.9%	0.2%
THC	0.1%	-0.2%	-0.8%
NOX	2.7%	2.3%	2.1%
PM10	4.8%	4.3%	3.7%
CO2	3.0%	2.6%	2.3%

N.B. Negative number represents reduction while positive numbers represent increase in emissions compared to the Reference Case.

Recommendations

- If it is agreed that further investigation should be made into the Milltimber Brae upgrade (N29) option:
  - A refined definition of the scheme, including junction layouts at Charleston and Milltimber and link specification between these locations should be undertaken;
  - Consequent revisions to the Capital and Land Purchase costs associated with the scheme should be prepared;
  - A refined economic, operational and (if required) environmental summary could then be prepared.