Prosiect Maen Hir

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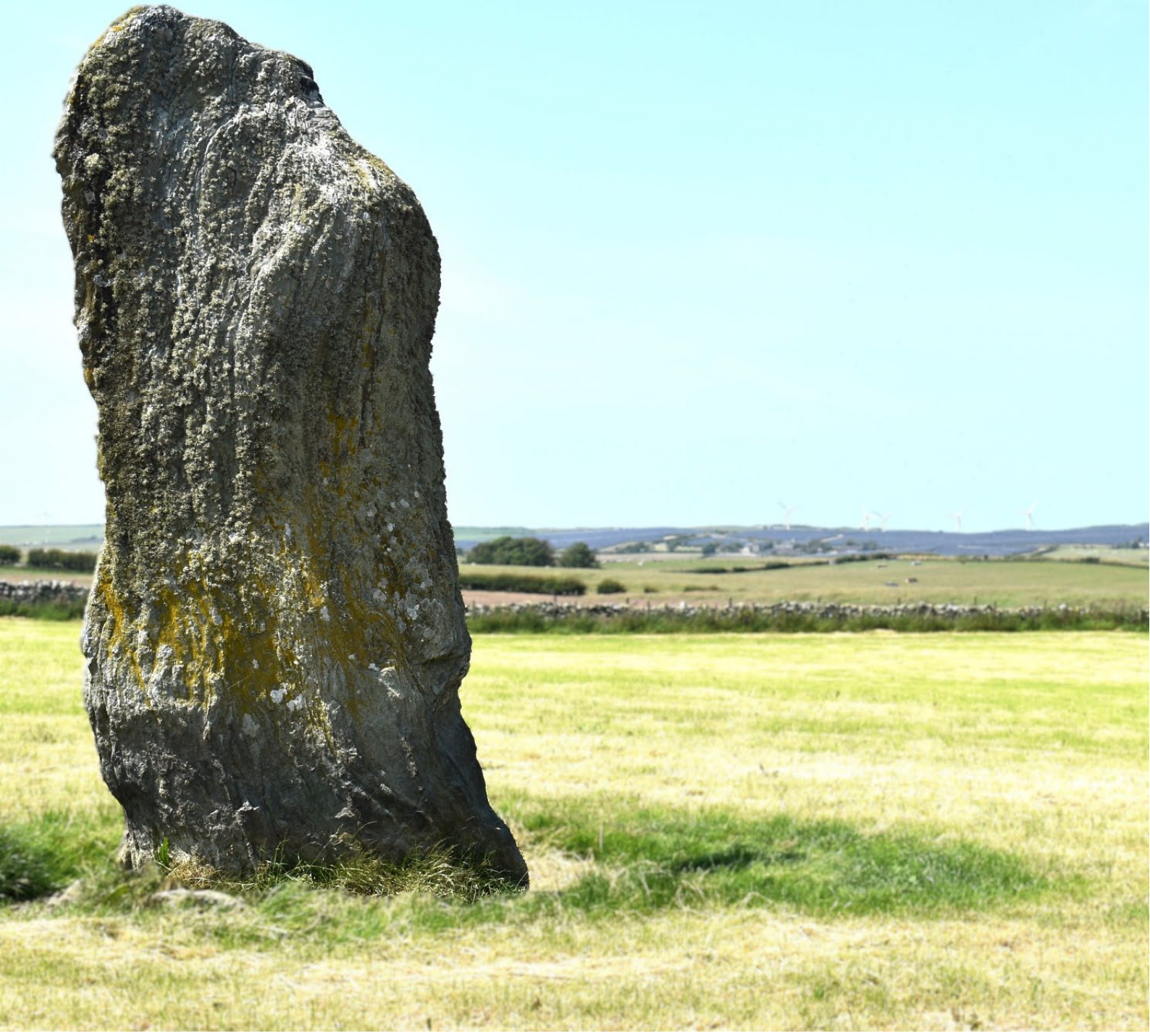

Preliminary Environmental Information Report

Volume III

Appendix 15-5: Model Verification

Prosiect Maen Hir - September

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Appendix 15-5 Model Verification

Whilst ADMS-Roads is widely validated for use in this type of assessment, model verification for the area around the Site will not have been included. To determine model performance at a local level, a comparison of modelled results with monitored results in the study area was done in accordance with the methodology provided by Defra. This process of verification aims to minimise modelling uncertainty by correcting modelled results by an adjustment factor to give greater confidence to the results.

Diffusion tubes IACC-049, IACC-050, IACC-053, IACC-054, IACC-081 and IACC-084 are located to then west of the Proposed Development and IACC-083 is located to the east of the Proposed Development. However, on further review of the location of IACC-083, this diffusion tube is located adjacent to a petrol station and as such, NO_2 concentrations at this location are likely to be influenced by queuing traffic and idling vehicles and therefore was not considered to be representative of traffic conditions in the study area. As such, verification was not undertaken utilising this monitoring location.

Using the monitoring locations to the west of the Proposed Development, two verification models were produced to consider the difference in availability of monitoring data in 2019 and 2022, the most recent representative monitoring years due to the influence of the COVID-19 pandemic, and how this may affect model verification. Scenario 1: 2019 Verification Year includes monitoring locations within the study area where 2019 monitoring data were available (IACC-049, IACC-050, IACC-053, IACC-054, IACC-081 and IACC-084). Scenario 2: 2022 Verification Year includes monitoring locations within the study area where 2022 monitoring data were available (IACC-081 and IACC-084).

The model was run for Scenario 1: 2019 Verification Year to predict the 2019 annual mean road contributions of NOx at the monitoring locations in the study area. The model outputs at these locations were compared to the 2019 monitored concentrations to provide adjustment factors. The model was also run for Scenario 2: 2022 Verification Year to predict the 2022 annual mean road contributions of NOx at the monitoring locations in the study area. The model outputs at these locations were compared to the 2022 monitored concentrations to provide adjustment factors.

Tables 15.5-1 and 15.5-2 present the verification process for NOx, PM_{10} and $PM_{2.5}$ for 2019 and 2022, respectively. Figure 15.5-1 details the monitoring locations utilised in both the model verification scenarios.

Table 15.5-1: NOx 2019 Verification Process

Model Verification Steps	IACC-081	IACC-084	IACC-049	IACC-050	IACC-053	IACC-054
2019 monitored total NO_2 ($\mu g.m^{-3}$)	18.7	7.8	14.5	8.9	8.2	9.5
2019 background NO_2 concentration ($\mu g.m^{-3}$)	6.7	4.6	4.6	3.9	3.9	4.0
Monitored road contribution NOx ($\mu g.m^{-3}$)	22.2	5.7	18.1	89	7.6	9.8
Modelled road contribution NOx ($\mu g.m^{-3}$)	9.5	2.6	9.4	4.3	4.8	4.4
Ratio of monitored road NOx to modelled road NOx	2.3	2.2	1.9	2.1	1.6	2.2
Adjustment factor for modelled road contribution NOx	**2.0847**					
Adjusted modelled road contribution NOx ($\mu g.m^{-3}$)	19.8	5.4	19.5	9.0	10.1	9.3
Modelled total NO_2 concentration ($\mu g.m^{-3}$)	17.4	7.7	15.3	8.9	9.6	9.2
Monitored total NO_2 concentration ($\mu g.m^{-3}$)	18.7	7.8	14.5	8.9	8.2	9.5
% difference between modelled and monitored total NO_2	-6.7	-1.7	5.2	0.2	16.8	-2.8
RMSE % (should be less than 25% and ideally less than 10%)	2.1%					

Road-NOx component, determined from NOx to NO_2 calculator

Table 15.5-2: NOx 2022 Verification Process

Model Verification Steps	IACC-081	IACC-084
2022 monitored total NO_2 ($\mu g.m^{-3}$)	14.1	6.5
2022 background NO_2 concentration ($\mu g.m^{-3}$)	6.0	4.1
Monitored road contribution NOx ($\mu g.m^{-3}$)	14.8	4.3
Modelled road contribution NOx ($\mu g.m^{-3}$)	6.9	1.8
Ratio of monitored road NOx to modelled road NOx	2.1	2.4
Adjustment factor for modelled road contribution NOx	**2.1668**	
Adjusted modelled road contribution NOx ($\mu g.m^{-3}$)	15.0	3.8

Model Verification Steps	IACC-081	IACC-084
Modelled total NO_2 concentration ($\mu g.m^{-3}$)	14.2	6.2
Monitored total NO_2 concentration ($\mu g.m^{-3}$)	14.1	6.5
% difference between modelled and monitored total NO_2 concentration	0.5	-4.3
RMSE % (should be less than 25% and ideally less than 10%)	0.5%	

Road-NOx component, determined from NOx to NO_2 calculator

For the 2019 verification model, a road-NOx factor of 2.0847 was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero. For the 2022 verification model, a road-NOx factor of 2.1668 was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero.

As the 2022 verification factor was higher than the 2019 verification factor, it was considered to be a robust approach to apply this factor to the modelled road-NOx concentration at each receptor, before conversion to NO_2 concentrations using the NOx to NO_2 calculator provided by Defra.

Furthermore, in the 2022 verification process, the RMSE value is lower than in the 2019 verification process, indicating that that the 2022 verification model is performing better than the 2019 verification model and shows greater agreement with 'real world' conditions.

No monitoring of PM_{10} or $PM_{2.5}$ is undertaken within the study area. Therefore the adjustment factor calculated during the NOx verification process was utilised to adjust predicted concentrations of PM_{10} and $PM_{2.5}$ at each receptor location.

Figure 15.5-1: Monitoring Locations Utilised in the ADMS-Roads Model Verification Process