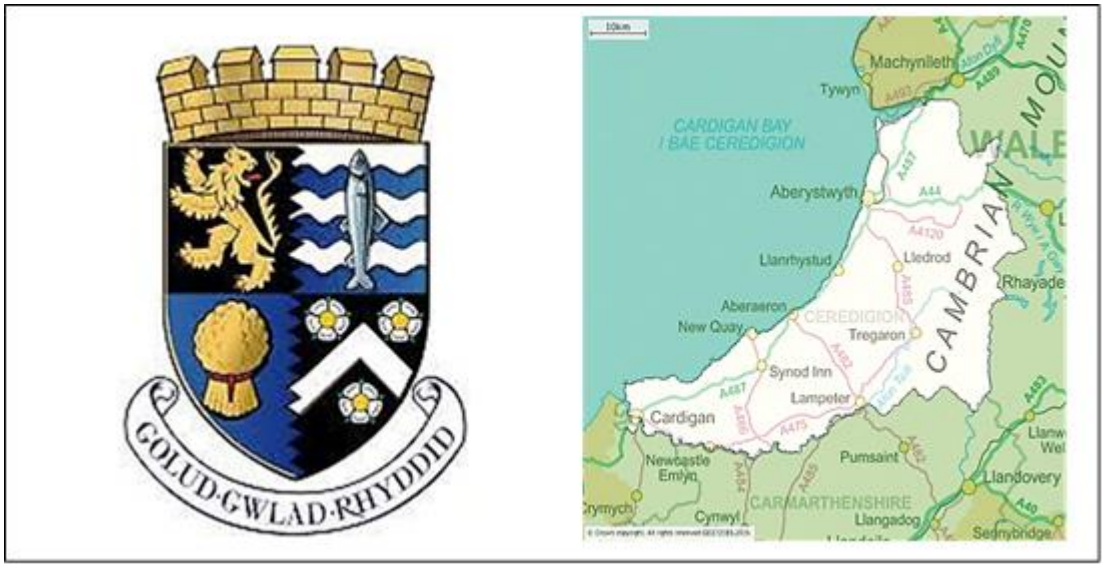

CYNGOR SIR CEREDIGION COUNTY COUNCIL

2018 Air Quality Progress Report

In fulfillment of Part IV of the Environment Act 1995 Local Air Quality Management

September, 2018

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Crynodeb Gweithredol: Ansawdd Aer yn ein Hardal

Ansawdd Aer yng Ngheredigion

1. Yn yr Adroddiad Cynnydd Ansawdd Aer 2018 hwn ar gyfer Ceredigion, caiff asesiadau eu hadolygu ar gyfer y llygryddion aer amrywiol sydd wedi'u cynnwys yn Strategaeth Ansawdd Aer Genedlaethol y DU (NAQS). Mae'r adroddiad yn ystyried y gofynion deddfwriaethol presennol ac yn adolygu'r casgliadau, amcangyfrifon, a'r rhagamcanion blaenorol yn sgil unrhyw dystiolaeth newydd, gan gynnwys gwaith monitro, modelu cyfrifiadurol a'r gofynion yn y Cyfarwyddyd Technegol (LAQM.TG[16]). Mesurau lleol yw un o'r dulliau pwysicaf y gall Llywodraeth y DU fodloni ei hamcanion cenedlaethol ar gyfer ansawdd aer. Mae dyletswydd ar awdurdodau lleol i gymryd camau i ddiogelu a gwella iechyd pobl yn eu hardaloedd lleol (gan gynnwys mewn perthynas ag ansawdd aer).
2. Mae Cyngor Sir Ceredigion yn aelod o Fforwm Ansawdd Aer Cymru. Mae'r Fforwm hwn yn dwyn ynghyd awdurdodau lleol ac Asiantaethau eraill yng Nghymru (megis Iechyd Cyhoeddus Cymru, Cyfoeth Naturiol Cymru ac ati) i asesu ac adrodd ar ansawdd aer a datblygu ffyrdd o wella ansawdd aer. Mae gwybodaeth am ansawdd aer ar gael ar wefan Fforwm Ansawdd Aer Cymru yn:

   https://airquality.gov.wales/

3. Mae Ceredigion yn sir wledig ac yn un o'r siroedd mwyaf yng Nghymru. Mae ganddi boblogaeth isel iawn ond y twf yn y boblogaeth gymharol uchaf yng Nghymru o ganlyniad i fewnfudo. Mae chwe thref farchnad yn y sir lle mae'r rhan fwyaf o'r boblogaeth yn byw ac yn gweithio - Aberaeron, Aberystwyth, Aberteifi, Llanbedr Pont Steffan, Llandysul a Thregaron. Aberystwyth yw'r dref fwyaf yng Ngheredigion a dyma lle mae'r rhan fwyaf o lygredd aer cysylltiedig â thraffig yn digwydd.
4. Prin iawn yw'r ffynonellau diwydiannol o lygredd aer yng Ngheredigion ac ni cheir unrhyw draffyrdd neu ffyrdd gyda thraffig trwm (yn ôl y disgrifwyr cenedlaethol). Mae rhwydwaith cefnffyrdd cyfan Ceredigion oddeutu 115km.
5. Ystyrir mai llygredd aer yw'r cyfrannwr amgylcheddol pwysicaf at faich clefyd dynol yn y DU ac mae'r **golygiadau o ran costau yn fwy na £20 biliwn y flwyddyn.** Mae gan ansawdd aer gwael ganlyniadau iechyd sylweddol a chredir bod crynodiadau presennol o lygredd aer yn achosi marwolaeth oddeutu **40,000** o bobl yn y DU bob blwyddyn ac yn nhrefn maint mae'n cael mwy o effaith ar forbidrwydd (salwch sy'n gysylltiedig ag ansawdd aer). Mae graddfa'r broblem yn golygu bod marwolaethau sy'n gysylltiedig ag ansawdd aer gwael **yn fwy erbyn hyn na'r cyfanswm cyfun a briodolir i ordewdra, alcohol, camddefnyddio cyffuriau a marwolaethau ychwanegol y gaeaf**, ac mae ystadegau'r Llywodraeth hefyd yn awgrymu bod llygredd aer yn y DU yn lleihau disgwyliad oes pob un gan 7-8 mis ar gyfartaledd. Mae achos iechyd cyhoeddus amlwg, felly, dros fwy o weithredu ar ansawdd aer. Gall pobl sy'n dioddef iechyd gwael a/neu sy'n byw mewn cymunedau trefol tlotach gael eu heffeithio'n anghymesur gan lygredd aer.

6. Mae astudiaethau ar gyfer yr Adran Iechyd yn dangos mai un llygrydd aer yn unig, sef PM2.5 (gronyn bach yn yr awyr), yw'r chweched lifer pwysicaf ar gyfer gwella iechyd cyhoeddus yn y DU. Mae epidemiolegwyr yn parhau i wella eu dealltwriaeth ac yn ceisio meintioli'r effeithiau llawn y mae llygryddion aer eraill megis nitrogen deuocsid yn eu cael ar iechyd.
7. Mae llygredd aer hefyd yn cael ei gydnabod fel y risg amgylcheddol mwyaf i iechyd cyhoeddus ar draws Ewrop gyda Llys Archwilwyr Ewrop yn cyhuddo Llywodraethau o fethu â delio â'r argyfwng. Amcangyfrifir bod llygredd aer yn lladd **400,000** o bobl yn Ewrop bob blwyddyn. Mae rhai o safonau llygredd aer Ewrop yn "wannach" na chanllawiau Sefydliad Iechyd y Byd (WHO guidelines) ac nid yw ansawdd aer mewn rhai rhannau o Ewrop yn cydymffurfio â'r safonau llai caeth. Yn ei archwiliad, mae Llys Ewrop yn gofyn i gyfreithiau ansawdd Ewrop gyfateb â safonau WHO, sydd o leiaf dwywaith yn llymach ar gyfer allyriadau gronynnol (PM2.5 a PM10) a chwe gwaith yn llymach ar gyfer y llygrydd aer sylffwr deuocsid (ar hyn o bryd does DIM safonau ar gyfer PM2.5 yng Nghymru a Lloegr).
8. Mae llywodraeth y DU wedi torri rhai o amcanion ansawdd aer yr Undeb Ewropeaidd ers 2010 a gallai wynebu dirwyon o filiynau o bunnoedd yn y llys Ewropeaidd. Mae'r DU yn un o 11 o wledydd a gafodd eu cyhuddo gan Fiwro Amgylcheddol Ewrop yn 2018 o ddefnyddio man gwan "addasiad llechres" sy'n cael yr effaith o godi'r terfyn ar allyriadau blaenorol nitrogen deuocsid (un o'r llygryddion ansawdd aer â blaenoriaeth).
9. Er bod Rheoli Ansawdd Aer Lleol wedi bod yn llwyddiannus o ran adnabod nifer fawr o fannau poeth ar gyfer llygredd aer yng Nghymru, cyfyngedig fu'r llwyddiant o ran eu dileu. Cydnabu'r Ysgrifennydd Cabinet ar gyfer yr Amgylchedd a Materion Gwledig yn Llywodraeth Cymru ym Mawrth 2017 fod rhaid cael hyd i ffyrdd o chwalu'r rhwystrau er mwyn gallu gweithredu'n fwy effeithiol ar wella llygredd aer.
10. Mae ansawdd aer gwael hefyd yn cael effaith ar yr amgylchedd naturiol, yn niweidio ecosystemau a bioamrywiaeth. Mae rhai o'r effeithiau mwyaf cyffredin ac arwyddocaol ar ecosystemau yn cynnwys y niwed i lystyfiant gan lygredd megis bod yn agored i osôn, ewtroffigedd ac asideiddio.
11. **Erbyn hyn ystyrir mai llygredd sŵn yw'r ail gyfrannwr amgylcheddol mwyaf at y baich o glefydau yn y DU** ac mae'r golygiadau o ran costau oddeutu £10 biliwn y flwyddyn**.** Mae mapiau sŵn, a ddatblygwyd yn 2012, yn dangos bod cartrefi mwy na 200,000 o bobl yng Nghymru yn agored i lefelau o **sŵn traffig ffyrdd** sy'n uwch na lefelau llygredd sŵn Sefydliad Iechyd y Byd. Yn aml bydd llygredd aer a sŵn yn dod o'r un ffynonellau (yn arbennig traffig ffyrdd). Gall mesurau sy'n mynd i'r afael ag ansawdd aer hefyd gael yr effaith o wella llygredd sŵn.
12. **Mae allyriadau i'r atmosffer hefyd yn creu twymo byd-eang a newid hinsawdd.** Mae rhybudd ynghylch y system hinsawdd yn glir ac, ers y 1950au, mae nifer o'r newidiadau a gafwyd heb eu gweld erioed o'r blaen yn hanes dyn. Mae rhai o ganlyniadau posibl newid hinsawdd yn lleol ac yn fyd-eang wedi cael dod i'r amlwg yn 2018 (tywydd cyfnewidiol ac eithafol, sychder a phroblemau cyflenwad dŵr, tanau gwyllt, yr effaith ar amaethyddiaeth, iâ yn dadmer, difrod gan stormydd a llifogydd ac ati).

O GYFNOD OER EITHAFOL I GYFNOD SYCH EITHAFOL YNG NGHEREDIGION YN 2018

13. Mae ansawdd aer a newid hinsawdd wedi'u rhyng-gysylltu a dylai strategaethau gael eu datblygu sy'n cydnabod hynny. Bydd sefyllfaoedd lle y bydd polisïau i leihau allyriadau nwyon tŷ gwydr yn cael effeithiau buddiol ar gyfer ansawdd aer, ac i'r gwrthwyneb. Mae Llywodraeth Cymru wedi datgan lle y bo'n ymarferol y dylai polisïau synergistaidd sy'n cwmpasu ansawdd aer a newid hinsawdd gael eu datblygu law yn llaw gan awdurdodau lleol.
14. Mae Llywodraeth Cymru, trwy Ddeddf Llesiant Cenedlaethau'r Dyfodol (Cymru) 2015, yn ei gwneud hi'n ofynnol i awdurdodau lleol osod amcanion llesiant a chyhoeddi adroddiad blynyddol yn dangos y cynnydd a wnaethant o ran cyflawni'r amcanion. Dylai adolygiad ac asesiad ansawdd aer, a rhaglenni lleihau carbon, lywio a bwydo i mewn i'r Cynllun Llesiant lleol.
15. Mae safonau ansawdd aer wedi cael eu gosod dim ond ar sail tystiolaeth feddygol a gwyddonol sydd ar gael ynghylch yr effeithiau y gwyddys fod llygryddion amrywiol yn eu cael ar iechyd. Os yw'r Safonau yn cael eu dilyn dylai fod dim risg arwyddocaol neu'r risg lleiaf yn unig i iechyd. Nid yw'r Safonau wedi cael eu seilio ar asesiad o gostau a buddion neu faterion o ymarferoldeb technegol. Fodd bynnag, mae amcanion ansawdd aer yn adlewyrchu'r hyn y gellir ei gyflawni ym marn y Llywodraeth o ran ansawdd aer erbyn dyddiadau targed ar sail y dystiolaeth ar gyfer costau, buddion ac ymarferoldeb technegol.
16. Mae'r crynoadau o'r llygryddion aer â blaenoriaeth yn ardal wledig Ceredigion yn isel o'u cymharu â'r lefelau y gellir eu canfod mewn rhannau mwy diwydiannol a threfol o'r wlad. Mae'r Adroddiad Cynnydd hwn yn cadarnhau, fel yn y blynyddoedd blaenorol, bod **yr holl Safonau ac Amcanion ansawdd aer statudol sy'n bod** wedi cael eu bodloni erbyn dyddiadau penodedig, ym mhob lleoliad (gan gynnwys ar ochr y ffordd) yng Ngheredigion. Mae safonau mwy hirdymor a dangosol hefyd yn cael eu bodloni **ar gyfer y llygryddion aer sydd wedi'u cynnwys yn y Rheoliadau.** Fel yn y blynyddoedd blaenorol, felly, ni ystyrir ei bod hi'n ofynnol symud ymlaen i gael asesiadau mwy manwl o ansawdd aer yng Ngheredigion neu ddatgan unrhyw Ardaloedd Rheoli Ansawdd Aer.
17. Mae'n bosib na fydd rhai safonau dangosol ar gyfer rhai llygryddion ansawdd aer (megis osôn) **sydd heb eu cynnwys yn y Rheoliadau** yn cael eu bodloni bob amser mewn rhannau o Geredigion. Gall llygredd aer osôn fod yn fwy problematig mewn ardaloedd gwledig nag ardaloedd trefol ac yn draws-ffiniol ei natur (gan darddu o bosib o ardaloedd eraill ac yn croesi ffiniau), sy'n golygu bod angen gweithredu ar lefel genedlaethol / rhyngwladol er mwyn rhoi sylw i'r broblem.

Gweithredu i Wella Ansawdd Aer

Mae ansawdd aer yn cael ei fonitro yng Ngheredigion ar gyfer pedwar llygrydd aer â blaenoriaeth ac mae'r canlyniadau yn cael eu cymharu â safonau a'r dystiolaeth arall sydd ar gael megis monitro mewn ardaloedd awdurdod lleol eraill ac unrhyw fodelu

cyfrifiadurol sydd ar gael ac ati. Mae'r tueddiadau a welir mewn ddata a fesurwyd yn dangos bod y crynoadau o rai llygryddion aer â blaenoriaeth yn lleihau yng Ngheredigion. Er enghraifft, mae'r crynodiadau o'r llygrydd aer nitrogen deuocsid yn parhau i leihau wrth ochr y ffordd ac mewn lleoliadau mannau poeth ym mhrif dref Aberystwyth. Mae'r tuedd ar y lawr hwn mewn crynoadau o'r llygryddion wedi cael ei gynnal dros sawl blwyddyn.

Yn wir, erbyn hyn mae ansawdd aer yng Ngheredigion wedi'i restru gyda'r gorau yng Nghymru ar sail tri Dangosydd Ansawdd Aer newydd Cymru ar gyfer y llygryddion aer cysylltiedig ag iechyd nitrogen deuocsid a gronynnau (PM10 a PM2.5) sydd wedi'u cynnwys yn y Rheoliadau ar hyn o bryd.

DANGOSYDDION ANSAWDD AER YNG NGHYMRU, 2016			
Llygrydd----->	Nitrogen Deuocsid	PM10	PM2.5
Ynys Môn	4.74	8.54	5.37
Gwynedd	4.91	8.66	5.55
Ceredigion	**5.01**	**9.44**	**5.79**
Powys	5.12	9.73	6.20
Sir Ddinbych	6.56	10.07	6.60
Sir Gaerfyrddin	6.86	10.95	6.67
Conwy	7.10	9.39	6.09
Sir Benfro	7.45	11.20	6.47
Wrecsam	9.19	11.52	7.62
Blaenau Gwent	10.14	11.83	7.74
Merthyr Tudful	10.51	11.90	7.67
Sir y Fflint	10.53	11.40	7.55
Sir Fynwy	11.14	12.35	7.90
Abertawe	11.18	11.87	7.46
Cymru (Cymedrig)	11.36	11.75	7.50
Rhondda Cynon Taf	11.48	12.11	7.78
Castell-nedd Port Talbot	11.70	11.87	7.36
Pen-y-bont ar Ogwr	11.95	12.04	7.54
Bro Morgannwg	12.71	12.16	7.78
Torfaen	13.04	12.51	8.28
Caerffili	13.11	12.47	8.12
Casnewydd	19.26	14.07	9.01
Caerdydd	20.92	14.33	9.31

Er hynny, erys blaenoriaethau a heriau lleol.

Blaenoriaethau a Heriau Lleol

1. Amcangyfrifwyd bod crynodiadau blynyddol cymedrig o PM2.5 cefndirol a fodelwyd gan DEFRA yn 2015 oddeutu 10.45µg/m^3 ym mhrif dref Aberystwyth yng Ngheredigion. Mae'r crynodiad cefndirol hwn yn **uwch na'r** safon yng nghanllawiau Sefydliad Iechyd y Byd (WHO) a safon orfodol yr Alban, sef 10µg/m^3 (**sydd heb gael ei mabwysiadu eto fel safon yng Nghymru a Lloegr).** Fodd bynnag, mae'n cydymffurfio â'r targed safonol o 25µg/m^3 sydd

wedi'i gynnwys ar hyn o bryd yn Rheoliadau Safonau Ansawdd Aer (Cymru) 2010. Mae'r crynodiadau cefndirol o PM2.5 yn cynyddu wrth ochr y ffordd gan draffig ffyrdd gan oddeutu 8% (i oddeutu 11µg/m^3 mewn rhai lleoliadau ochr y ffordd yn Aberystwyth). Mae'r rhain hefyd yn uwch na'r safonau yng nghanllawiau WHO a safon orfodol yr Alban.

Mae'r arsylwadau hyn, mewn tref weddol fach mewn sir wledig fel Ceredigion, yn awgrymu bod safon orfodol yr Alban a Chanllawiau WHO ar gyfer PM2.5 sef 10µg/m^3 yn un gaeth iawn. Mae'n safon y gall fod yn anodd i'w chyflawni mewn lleoliadau ar ochr y ffordd yn y DU os yw'n cael ei mabwysiadu fel safon genedlaethol (fel yr hyrwyddir gan Lys Archwilwyr Ewrop). Gall crynodiadau o PM2.5 sy'n deillio o halen môr yn unig mewn trefi glan môr fel Aberystwyth ffurfio oddeutu 10% o gyfanswm y crynodiad cefndirol ar gyfer PM2.5, a gall hyd at 40 - 50% o'r crynodiad a fesurwyd o PM2.5 ddeillio o ffynonellau sydd y tu allan i ffin ac ardal rheoli'r awdurdod lleol. Mae Panel Arbenigwyr Llywodraeth y DU ar Safonau Ansawdd Aer (EPAQS) yn derbyn bod PM2.5 yn llygrydd pwysig cyn belled ag y bo effeithiau iechyd aciwt dan sylw, ond mae wedi datgan yn y gorffennol bod rhaid i unrhyw safon seiliedig ar iechyd ar gyfer PM2.5 gael ei seilio ar dystiolaeth epidemiolegol a thocsiolegol penodol. Nodant y bydd lleihau PM10 hefyd yn lleihau crynodiadau o PM2.5, ac os caiff safon ei chyflwyno ar gyfer PM2.5 byddai'n rhaid cadw safon ar wahân o hyd ar gyfer y ffracsiwn gronynnol garw PM10. Byddai dwy safon ar gyfer llygredd gronynnol yn arwain at gostau ychwanegol sylweddol gyda manteision iechyd cyhoeddus ansicr.

2. Sefydlir unwaith eto yn yr Adroddiad hwn nad yw Safonau ac Amcanion anstatudol ar gyfer y llygrydd aer osôn **(sydd heb eu cynnwys yn y Rheoliadau)** efallai'n cael eu bodloni mewn rhai rhannau o Geredigion yn ystod digwyddiadau llygredd osôn. Bydd achosion o lygrydd osôn yn digwydd pan fydd crynodiadau yn cynyddu dros dro mewn mannau penodol ac mewn ffordd anrhagweladwy. Yn Ebrill 2008, ym mhrif dref Aberystwyth yng Ngheredigion, er enghraifft, cofnodwyd crynodiad misol cymedrig o osôn oedd yn uwch na 1000µg/m3. Roedd hyn bron deg gwaith y safon DANGOSOL gymedrig 8 awr ar gyfer y mis cyfan a mwy na phedwar gwaith trothwy rhybudd yr Undeb Ewropeaidd (ar 240µg/m3). Yn yr un modd yn 2016, roedd crynodiadau cymedrig blynyddol o osôn yr uchaf a welwyd erioed yn y ddwy brif dref arall yng Ngheredigion (Llanbedr Pont Steffan ac Aberteifi). Mae hyn yn cyfateb â'r flwyddyn gynhesach a gofnodwyd yn fyd-eang yn 2016. Mae cynhyrchu osôn yn cael ei ysgogi gan adweithiau ffotogemegol (goleuni'r haul) ac fel arfer mae'n fwy arwyddocaol ym misoedd / blynyddoedd twymach a brafiach. Mae'r Llywodraeth yn derbyn, hyd yn oed ar ôl gweithredu polisïau cyfredol i leihau rhagsylweddion osôn, bod achosion o lefelau uwch ar draws llawer o ardal ddeheuol Prydain yn debygol yn ystod cyfnod twymach a brafiach. Er mwyn bodloni'r Amcanion yn llawn ar gyfer osôn, cydnabyddir oherwydd ei fod yn llygrydd traws-ffiniol, fod angen mwy o weithredu ar y cyd ar lefel ryngwladol. Nid oes modd rheoli llygredd osôn ar lefel leol.

Mae Prif Swyddog Meddygol Cymru wedi rhybuddio bod llygredd aer, a'r twymo byd-eang a newid hinsawdd cysylltiedig, yn debygol o gael effaith llawer mwy arwyddocaol ar iechyd y genedl yn y dyfodol, a gallai arwain at fwy o bobl sâl yn cael eu derbyn i'r ysbyty. Disgrifiodd effaith bosibl newid

hinsawdd fel rhywbeth "brawychus" gan nodi y bydd effaith fyd-eang newid hinsawdd yn cael ei deimlo i'r un graddau yng Nghymru. Mae crynodiadau a "chyfnodau brig" o osôn yn debygol o gynyddu fel rhan o'r newid, a gallai hyn arwain at dderbyn mwy o bobl i'r ysbyty (a mwy o farwolaethau). Gall crynodiadau uchel o osôn gael effaith arbennig ar y system resbiradu, gan arwain at asthma, broncitis, trawiadau ar y galon a phroblemau cardiofasgwlaidd eraill.

3. Cafodd lefelau sŵn ar ochr y ffordd yn y nos CYFARTALOG (mewn dB) ar rai ffyrdd ac wrth ddynesu at Aberystwyth, ac Aberteifi eu HAMCANGYFRIF ar fapiau sŵn cenedlaethol 2012 gan nodi eu bod yn amrywio rhwng 50 a 60dB. Mae'r AMCANGYFRIFON hyn yn uwch na'r lefelau canllaw o 40dB (ac o bosib y lefel interim 55dB) ar gyfer sŵn yn y nos a argymhellir gan Sefydliad Iechyd y Byd. Fodd bynnag, mae'r lefelau sŵn yn y mapiau hyn wedi'u modelu (a'u hamcangyfrif) yn hytrach na'u mesur ac yn seiliedig ar dybiaethau amrywiol. Dylent gael eu hystyried fel man cychwyn yn unig ar gyfer adnabod yr ardaloedd lle y gallai fod angen gweithredu fel blaenoriaeth. Er hynny, pwysleisiant yr angen i awdurdodau lleol fod yn wyliadwrus o ran sut y mae effeithiau cysylltiedig â sŵn traffig ffyrdd yn effeithio ar boblogaethau lleol.

Traffig yw prif ffynhonnell llygredd aer yn yr awyr agored, ac yn un o brif ffynonellau llygredd sŵn sy'n bodoli mewn ardal wledig fel Ceredigion lle nad oes llawer o brosesau diwydiannol. Felly mae gwella ansawdd aer yn yr awyr agored yn dibynnu'n bennaf ar ddatblygiadau sy'n rheoli ac yn lleihau allyriadau traffig (gan gynnwys gwelliannau technolegol sy'n lleihau capasiti llygru cerbydau). Ar hyn o bryd mae ymgyrch rhyngwladol i gael injans sy'n creu llai o lygredd (trydanol neu hybrid) i gymryd lle injans hylosgi disel a phetrol). Bydd rhai gweithgynhyrchwyr ceir yn rhoi'r gorau i werthu cerbydau gydag injans hylosgi confensiynol erbyn y flwyddyn nesaf (2019).

Ceir mesurau lleol hefyd y gellir eu hannog i leihau allyriadau o gerbydau megis cyfyngu ar nifer y teithiau mewn ceir a hyrwyddo'r defnydd o drafnidiaeth gyhoeddus. Dylai cynigion ar gyfer trafnidiaeth gyhoeddus geisio cyflawni newid moddol i ffwrdd o ddefnyddio ceir preifat.

Mae Cyngor Sir Ceredigion wedi'i ymrwymo i gyfrannu at ddatblygu cynllun trafnidiaeth rhanbarthol, integredig a chynaliadwy trwy Drafnidiaeth Canolbarth Cymru (TraCC). Consortiwm trafnidiaeth gwirfoddol yr awdurdod lleol yw hwn ar gyfer Canolbarth Cymru sy'n ceisio darparu gwelliannau i'r system drafnidiaeth yn yr ardal. Mae'n cwmpasu'r tair sir, sef Ceredigion, Powys a rhan o Wynedd (cyn ardal Meirionnydd). Mae awdurdodau lleol Canolbarth Cymru, trwy'r consortiwm hwn, yn cynllunio ar gyfer ac yn darparu system drafnidiaeth integredig yn yr ardal sy'n hwyluso datblygu economaidd, yn sicrhau bod pawb yn cael mynediad i bob gwasanaeth a chyfle, yn cynnal ac yn gwella ansawdd bywyd cymunedol, ac **yn gwneud cyfraniad gweithredol at reoli carbon ac ansawdd yr amgylchedd - gan gynnwys ansawdd aer ac effaith sŵn traffig ffyrdd**.

Mae datblygiadau manwerthu y tu allan i'r dref wedi tueddu i gynyddu'r ddibyniaeth ar geir preifat. Cydnabyddir bod angen annog datblygiadau masnachol a phreswyl yn y canol trefi presennol, yn hytrach na lleoliadau y tu allan i'r dref, er mwyn i drigolion allu wneud teithiau aml-foddol, aml-bwrpas. Yna bydd trafnidiaeth gyhoeddus, beicio

a cherdded yn ddewisiadau go iawn i nifer fwy o bobl ac ar gyfer amrywiaeth o deithiau.

Dylid annog rhieni â phlant i ystyried dewisiadau eraill yn hytrach na defnyddio ceir preifat. Mae teithio i'r ysgol yn sector mawr o ran defnyddio ceir preifat yn y DU a gall hyn arwain at broblemau ansawdd aer a diogelwch ar y ffyrdd yn agos i ysgolion ar ddechrau a diwedd y diwrnod ysgol. Mae mwy o blant yn teithio ar y bws erbyn hyn i nifer lai o ysgolion mawr yng Ngheredigion.

Ar raddfa fyd-eang, mae llygredd aer a'i effeithiau yn enghraifft dda o'r cydbwysedd pwysig sy'n bodoli mewn natur a'r cysylltiadau lleol / byd-eang sy'n ffurfio conglfaen y ddelfryd datblygu cynaliadwy. Mae llygredd aer traws-ffiniol, glaw asid, gwanhau'r haen osôn, twymo byd-eang a newid hinsawdd yn gronnol, yn hirdymor ac weithiau yn para'n hir, ac yn ganlyniadau i ddigwyddiadau llygredd aer lleol. Gallai crynodiadau o'r nwy tŷ gwydr carbon deuocsid sydd eisoes wedi'i allyrru i'r atmosffer barhau am ganrifoedd i ddod gan gynyddu twymo byd-eang i lefel llawer uwch na'r hyn a welwyd eisoes (~1.1 gradd Celsius ers dechrau'r chwyldro diwydiannol).

Mae Llywodraeth y DU wedi ymrwymo i leihau allyriadau o nwyon tŷ gwydr gan 80% erbyn 2050 fel rhan o'i hymgyrch *"Bil Newid Hinsawdd".* Dylai hyn hefyd arwain at wella ansawdd aer yn gyffredinol. Mae Cyngor Sir Ceredigion wedi llunio rhaglen gyda'r Ymddiriedolaeth Carbon i dorri lefelau ei allyriadau carbon deuocsid ei hun yn lleol. Mae'r Cyngor wedi llwyddo i roi mesurau ar waith sydd erbyn 2018, ynghyd â'i ddulliau rheoli asedau, wedi arwain at leihad mewn allyriadau carbon o fwy na 42% ers 2008 (mwy na 50% o darged Llywodraeth y DU o leihad o 80%, yn seiliedig ar lefelau 1990 i'w cyflawni erbyn 2050). Mae hyn eisoes yn cyrraedd targed Llywodraeth Cymru o leihad o 40% erbyn 2020.

Cyfanswm yr arbedion ariannol cronnus i'r Cyngor, o ganlyniad i'w Gynllun Rheoli Carbon, am y cyfnod 2012/13 i 2016/17 yw £4,175,034 yn erbyn senario busnes fel arfer. Mae hyn wedi creu arbedion ariannol mawr iawn i Gyngor bach, gwledig gan ddangos bod rheoli carbon yn gwneud synnwyr ariannol da, yn ogystal â synnwyr amgylcheddol da.

Bydd y mesurau sydd wedi cael eu rhoi yn eu lle gan Gyngor Sir Ceredigion i roi sylw i newid hinsawdd hefyd yn cael effaith gadarnhaol mewn ffyrdd eraill. Bydd lleihau allyriadau o nwyon tŷ gwydr hefyd yn lleihau allyriadau o lygryddion aer eraill yn lleol, gan wella ymhellach ansawdd aer ac iechyd a llesiant cyffredinol y boblogaeth yn unol â dyheadau Deddf Llesiant Cenedlaethau'r Dyfodol (Cymru) 2015.

Sut i Gymryd Rhan

Mae rhagor o wybodaeth am ansawdd aer, allyriadau lleol, rheoli carbon a materion cysylltiedig, megis trafnidiaeth neu weithgareddau diwydiannol a ganiateir yn y sir a allai effeithio ar ansawdd aer, i'w cael trwy gysylltu â'r Cyngor yn:

https://www.ceredigion.gov.uk/resident/contact/

Executive Summary: Air Quality in Our Area

Air Quality in Ceredigion

1. In this 2018 Air Quality Progress Report for Ceredigion, assessments are reviewed for the various air pollutants contained in the UK National Air Quality Strategy (NAQS). The report takes on board current legislative requirements and reviews previous conclusions, estimates, and projections in light of any new evidence, including from monitoring, computer modelling and the requirements contained in Technical Guidance (LAQM.TG[16]). Local measures are one of the most important means by which the UK Government can meet its national air quality objectives. Local authorities have a duty to take steps to protect and improve the health of people in their local areas (including in relation to air quality).
2. Ceredigion County Council is a member of the Welsh Air Quality Forum. This Forum brings together local authorities and other Agencies in Wales (such as Public Health Wales, Natural Resources Wales etc) to assess and report on air quality and to develop ways of improving air quality. Information on air quality is available on the Welsh Air Quality Forum website at:

   https://airquality.gov.wales/

3. Ceredigion is a rural county and one of the largest in Wales. It has a very low population but the highest relative population growth in Wales due to inward migration. It has six market towns where the majority of its population reside and work - Aberaeron, Aberystwyth, Cardigan, Lampeter, Llandysul and Tregaron. Aberystwyth is the largest town in Ceredigion where most traffic related air pollution occurs.
4. There are very few industrial sources of air pollution in Ceredigion and no motorways or heavily trafficked roads (in terms of the national descriptors). The total extent of the trunk road network in Ceredigion is around 115 km.
5. Air pollution is considered to be the most important environmental contributor to the burden of human disease in the UK with **costs implications valued at more than £20** billion a year. Poor air quality has significant health consequences and current air pollutant concentrations are believed to cause the deaths of around **40,000** people in the UK each year with an order of magnitude greater impact on morbidity (illnesses related to air quality). Such is the scale of the problem that deaths associated with poor air quality **now exceeds the combined total attributed to obesity, alcohol, drugs misuse and excess winter deaths** with Government statistics also suggesting that air pollution in the UK reduces the life expectancy of every person by an average of 7–8 months. There is a clear public health case, therefore, for more action on air quality. People suffering from poor health and / or who live in poorer urban communities may be disproportionately affected by air pollution.
6. Studies for the Department of Health indicate that one air pollutant alone, PM2.5 (small, air-borne particulate matter), is the sixth most important lever for improving public health in the UK. Epidemiologists continue to

improve their understanding, and attempt to quantify the full effects on health, of other air pollutants such as nitrogen dioxide.

7. Air pollution is also recognized as being the biggest environmental risk to public health across Europe with the EU Court of Auditors accusing Governments of failing to deal with the crisis. Air pollution kills an estimated **400,000** Europeans each year. Some of Europe's air pollution standards are "weaker" than World Health Organisation guidelines (WHO guidelines) and air quality in some parts of Europe does not comply with the less stringent standards. In their audit, the EU Court calls for Europe's air quality laws to be brought into line with WHO standards, which are at least twice as exacting for particulate (PM2.5 and PM10) emissions and six times stricter for the air pollutant sulphur dioxide (there are currently NO standards for PM2.5 in England and Wales).
8. The UK government has been in breach of some EU air quality objectives since 2010 and could face multimillion pound fines in the European court. The UK is one of 11 countries accused by the European Environmental Bureau in 2018 of using an "inventory adjustment" loophole to effectively raise the limit on past nitrogen dioxide emissions (one of the priority air quality pollutants).
9. Whilst Local Air Quality Management has been successful in identifying a large number of air pollution hotspots in Wales, it has had limited success in eradicating them. The Cabinet Secretary for Environment and Rural Affairs in the Welsh Government acknowledged in March 2017 that ways had to be found to break down the barriers to enable more effective action to be taken on improving air quality.
10. Poor air quality also impacts on the natural environment, harming ecosystems and biodiversity. Some of the most widespread and significant effects on ecosystems include the damage to vegetation by pollution such as exposure to ozone, eutrophication and acidification.
11. **Noise pollution is now considered to be the second biggest environmental contributor to the burden of diseases in the UK** with cost implications valued at around £10 billion a year. Noise maps, developed in 2012, indicate that the homes of more than 200,000 people in Wales are exposed to levels of **road traffic noise** that exceeds World Health Organisation night noise guidelines. Air pollution and noise are often emitted from the same sources (notably road traffic). Measures to tackle air quality may also have the effect of improving noise pollution.
12. **Emissions to the atmosphere also drive global warming and climate change**. Warming of the climate system is unequivocal and, since the 1950s, many of the observed changes are unprecedented in human history. Some of the possible consequences of climate change locally and globally have been highlighted in 2018 (variable and extreme weather, drought and water supply issues, wildfires, the impact on agriculture, melting ice, storm damage and flooding etc).

FROM EXTREME COLD TO AN EXTREME DRY SPELL IN CEREDIGION IN 2018

13. Air quality and climate change are inter-related and strategies should be developed that recognise this. There will be situations where policies to reduce greenhouse gas emissions will have beneficial effects for air quality, and vice versa. Welsh Government has stipulated that where practicable synergistic policies encompassing air quality and climate change should be developed in tandem by local authorities.
14. Welsh Government, through the Well-being of Future Generations (Wales) Act 2015, requires local authorities to set well-being objectives and publish an annual report showing progress they have made in achieving objectives. Air quality review and assessment, and carbon reduction programmes, should inform and feed into the local Well-being Plan.
15. Air quality standards have been set purely with regard to the available medical and scientific evidence of the known effects of the various pollutants on health. If the Standards are complied with there should be minimum or no significant risk to health. Standards have not been based on an assessment of costs and benefits or issues of technical feasibility. Air quality objectives, however, do reflect the Governments' judgement of achievable air quality by target dates on the evidence of costs, benefits and technical feasibility.
16. Concentrations of the priority air pollutants in rural Ceredigion are low compared with levels that can be found in more industrial and urbanised parts of the country. This Progress Report confirms, as in previous years, that **all existing statutory air quality Standards and Objectives** have been complied with, by specified dates, at all locations (including roadsides) in Ceredigion. Longer-term, and indicative, standards are also complied with **for the air pollutants contained in Regulations**. As in previous years, therefore, it is not considered necessary to progress to more detailed assessments of air quality in Ceredigion or to declare any Air Quality Management Areas (AQMAs).
17. Some indicative standards for some air quality pollutants (such as ozone) **that are not contained in Regulations** may not always be complied with in parts of Ceredigion. Ozone air pollution can be more problematic in rural than in urbanised areas and is transboundary in nature (possibly originating from other areas and crossing boundaries) requiring action at the national / international levels to address the issue.

Actions to Improve Air Quality

Air quality is monitored in Ceredigion for four priority air pollutants and results are compared with standards and other available evidence such as monitoring in other local authority areas and any available computer modelling etc. Trends from measured data demonstrate that the concentrations of some of the priority air

pollutants are falling in Ceredigion. Concentrations of the air pollutant nitrogen dioxide, for example, continue to fall at road-side and hot-spot locations in the main town of Aberystwyth. This downward trend in pollutant concentrations has been maintained over many years.

In fact, air quality in Ceredigion now ranks with the best in Wales on the basis of three new Welsh Air Quality Indicators for the health–related air pollutants nitrogen dioxide and particulates (PM10 and PM2.5) currently contained in Regulations.

AIR QUALITY INDICATORS IN WALES, 2016			
Pollutant----->	Nitrogen Dioxide	PM10	PM2.5
Isle of Anglesey	4.74	8.54	5.37
Gwynedd	4.91	8.66	5.55
Ceredigion	**5.01**	**9.44**	**5.79**
Powys	5.12	9.73	6.20
Denbighshire	6.56	10.07	6.60
Carmarthenshire	6.86	10.95	6.67
Conwy	7.10	9.39	6.09
Pembrokeshire	7.45	11.20	6.47
Wrexham	9.19	11.52	7.62
Blaenau Gwent	10.14	11.83	7.74
Merthyr Tydfil	10.51	11.90	7.67
Flintshire	10.53	11.40	7.55
Monmouthshire	11.14	12.35	7.90
Swansea	11.18	11.87	7.46
Wales (Mean)	11.36	11.75	7.50
Rhondda Cynon Taf	11.48	12.11	7.78
Neath Port Talbot	11.70	11.87	7.36
Bridgend	11.95	12.04	7.54
Vale of Glamorgan	12.71	12.16	7.78
Torfaen	13.04	12.51	8.28
Caerphilly	13.11	12.47	8.12
Newport	19.26	14.07	9.01
Cardiff	20.92	14.33	9.31

Nevertheless, there remain local priorities and challenges.

Local Priorities and Challenges

1. Annual mean **background** PM2.5 concentrations modelled by DEFRA in 2015, were estimated to be around 10.45µg/m^3 in the main town of Aberystwyth in Ceredigion. This background concentration **exceeds** the Scottish mandatory and World Health Organisation (WHO) guideline standard of 10µg/m^3 (**that has not yet been adopted as a standard in England and Wales**). It complies, however, with a target Standard of 25µg/m^3 currently contained in the Air Quality Standards (Wales) Regulations 2010. PM2.5 background concentrations are increased at the roadside by road traffic by

about 8% (to around 11µg/m^3 at some road-side locations in Aberystwyth). These also exceed the mandatory Scottish and WHO guideline standards.

These observations, in a relatively small town in a rural county like Ceredigion, suggest that the WHO Guideline and Scottish statutory standard for PM2.5 at 10µg/m^3 is a very stringent one. It is a standard that may be difficult to achieve at road-side locations in the UK if adopted as a national standard (as the EU Court of Auditors advocates). PM2.5 concentrations arising from sea-salt alone in coastal towns like Aberystwyth can amount to around 10% of the total background concentration for PM2.5 and up to 40 - 50% of the measured PM2.5 concentration may arise from sources that are outside a local authority's boundary and area of control. The UK Government's Expert Panel on Air Quality Standards (EPAQS) accepts that PM2.5 is an important pollutant as far as acute health impacts are concerned but has stated in the past that any health based standard for PM2.5 must be based on specific epidemiological and toxicological evidence. They point out that reducing PM10 will also reduce PM2.5 concentrations and if a standard is introduced for PM2.5 a separate standard would still need to be retained for the coarse particulate fraction PM10. Two standards for particulate pollution would lead to considerable additional expense with uncertain public health gains.

2. It is established again in this Report that non-statutory Standards and Objectives for the air pollutant ozone (**that are not contained in Regulations**) may not be complied with in some parts of Ceredigion during ozone pollution events. Ozone pollution episodes occur when concentrations increase in a temporary, localised and unpredictable way. In April 2008, in the main town of Aberystwyth in Ceredigion, for example, a mean monthly ozone concentration exceeding 1000µg/m3 was recorded. This was almost ten times the 8-hour mean INDICATIVE standard for the whole of the month and more than four times the EU alert threshold (at 240µg/m3). Likewise in 2016, annual mean ozone concentrations were the highest ever observed in the two other main towns in Ceredigion (Lampeter and Cardigan). This corresponded with the warmest year recorded globally in 2016.The production of ozone is driven by photochemical (sun light) reactions and is usually more significant in warmer and sunnier months / years. The Government accepts that, even after the implementation of current policies to reduce ozone precursors, there are likely to be exceedances across much of southern Britain during warmer, sunnier periods. To fully achieve the Objectives for ozone it is recognised, because it is a transboundary pollutant, that more concerted action, at an international level, is required. It is not possible to control ozone pollution at the local level.

   A Chief Medical Officer for Wales has warned that air pollution, and associated global warming and climate change, is likely to impact much more significantly on the nation's health in the future and could lead to more sick people being admitted to hospital. He described the potential impact of climate change as "frightening" and pointed out that the global impact of climate change will be no less felt in Wales. Concentrations, and "peak episodes", of ozone are likely to increase as part of the change, potentially leading to increased hospital admissions (and deaths). High concentrations of ozone can particularly affect the respiratory system, resulting in asthma, bronchitis, heart attacks and other cardiovascular problems.

3. AVERAGE, roadside, night time noise levels (in dB) on some roads in and approaching Aberystwyth, and Cardigan, were ESTIMATED in 2012 national noise maps to vary between 50 and 60dB. These ESTIMATES are above the 40dB (and possibly the 55dB interim) guideline levels for night time noise recommended by the World Health Organisation. Noise levels in these maps, however, are modelled (estimated) rather than measured and are based on various assumptions. They should only be considered as a starting point for identifying areas that may need priority action. Never-the-less, they emphasize the need for local authorities to be vigilant as far as the road traffic related noise impacts on local populations are concerned.

Traffic is the main source of outdoor air pollution, and is one of the main sources of noise pollution, that exists in a rural area like Ceredigion, with very few industrial processes. Improving outdoor air quality, therefore, is largely dependent on developments that control and reduce traffic emissions (including technological improvements that reduce the polluting capacity of vehicles). There is currently an international drive to replace traditional diesel and petrol combustion engines with less polluting engines (all electric or hybrid). Some car manufacturers will stop selling vehicles with conventional combustions engines by next year (2019).

There are also local measures that can be encouraged to reduce emissions from vehicles such as limiting the number of car journeys and promoting the use of public transport. Public transport proposals should aim to achieve a modal shift away from the use of the private car.

Ceredigion County Council is committed to contributing to the development of a regional, integrated and sustainable transport plan through Trafnidiaeth Canolbarth Cymru (TraCC). This is a voluntary local authority transport consortium for Mid Wales that seeks to deliver improvements to the transport system in the region. It covers the three counties of Ceredigion, Powys and a part of Gwynedd (the former Merionnydd district). The mid Wales local authorities, through this consortium, plan for and deliver an integrated transport system in the region that facilitates economic development, ensures access for all to services and opportunities, sustains and improves the quality of community life, and **makes an active contribution to the management of carbon and the quality of the environment – including air quality and the impact of road traffic noise**.

Out of town retail developments have tended to increase dependency on the private car. It is recognised that commercial and residential developments need to be encouraged in existing town centres, rather than in out of town locations, so that residents can make multi-modal, multi-purpose trips. Public transport, cycling and walking then become real options for a greater number of people and range of journeys.

Parents with children should be encouraged to consider alternatives to the private car. Commuting to school is a major sector of private car use in the UK and this can result in air quality and road safety problems in the vicinity of schools at the start and close of school times. More children now travel by bus to a fewer number of larger schools in Ceredigion.

On a global scale, air pollution, and its effects, is a good example of the fine balance that exists in nature and of the local / global connection that forms a cornerstone of the sustainable development ideal. Transboundary air pollution, acid rain, ozone depletion, global warming, and climate change are cumulative, long ranging, and sometimes long lasting, outcomes of local air pollution events. Concentrations of the greenhouse gas carbon dioxide already emitted to the atmosphere could persist for centuries to come increasing global warming to well above that already observed (~1.1 degrees Celsius since the start of the industrial revolution).

The UK Government is committed to reducing emissions of greenhouse gases by 80% by 2050 as part of its *"Climate Change Bill".* This should also have the effect of improving air quality generally. Ceredigion County Council has entered into a programme with the Carbon Trust to cut its own emissions of carbon dioxide locally. The Council has been successful in implementing measures which, along with their approach to asset management, have by 2018 resulted in a reduction in carbon emissions of over 42% since 2008 (more than 50% of the UK Government's target of an 80% reduction, based on 1990 levels, to be achieved by 2050). This also already achieves the Welsh Government target of achieving a 40% reduction by 2020.

The cumulative total financial savings for the Council, as a consequence of its Carbon Management Plan, for the period 2012/13 to 2016/17 amounts to £4,175,034 against a business as usual scenario. This equates to a very big financial saving for a small, rural Council demonstrating that carbon management makes good financial, as well as environment, sense.

Measures put in place by Ceredigion County Council to address climate change will also impact positively in other ways. Reducing emissions of green-house gases will also reduce the emissions of other air pollutants locally further improving air quality and the general health and well-being of the population in line with the aspirations of the Well-being of Future Generations (Wales) Act 2015.

How to Get Involved

Further information on air quality, local emissions, carbon management and related issues, such as transport or permitted industrial activities in the county that can affect air quality, can be obtained by contacting the Council at:

https://www.ceredigion.gov.uk/resident/contact/

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1. Actions to Improve Air Quality

1.1 Previous Work in Relation to Air Quality

In previous annual rounds of review and assessment, it was established that there were no exceedances of air quality standards for any of the priority air pollutants contained in Regulations at any location in Ceredigion (including roadsides) and no exceedances were anticipated in the future on the basis of observed trends. These conclusions were arrived at using a checklist approach and screening tools to identify potential sources of air pollution in the county. The approach was augmented with the results of extensive mapping and monitoring of air quality in the county using passive diffusion tubes for five pollutants (nitrogen dioxide, sulphur dioxide, benzene, 1,3 butadiene and ozone) and an instantaneous monitor for the particulate pollutant (PM10)). A significant amount of other available evidence was reviewed including air quality measurements using instantaneous monitors in neighbouring local authority areas (some contributing to the national air quality network), trends from other parts of the country, estimates and projections from background pollution concentrations, various other extrapolations of recorded data, known and expected new developments in the county, and estimates and projections from Government modelling etc. The last Progress Report for Ceredigion was submitted in May, 2017. This and all previous reports completed by the Council were appraised by DEFRA / Welsh Government and accepted as being an accurate report on the state of air quality etc. in Ceredigion.

Previous Reviews and Assessments have established that there were no significant sources of industrial air pollution in Ceredigion and little evidence of **significant** air pollution arising from plume migration from outside the county (except for the pollutant ozone that is not contained in Regulations). In rural Ceredigion, industrial, road and other developments in recent years have been relatively low impacting in air quality terms. All the possible sources of air pollution suggested in Technical Guidance have been considered and evaluated in arriving at previous conclusions. The only pollutants of concern are ozone and fine particulates (PM2.5). It is well established that ozone pollution can be more of a problem in rural than in urban areas. Standards for this pollutant, however, are not contained in Regulations. It is recognised that this pollutant is transboundary in nature requiring action at the international level to control and limit precursor pollutants that enable ozone to be produced and travel long distances (usually affecting rural more than urban areas). Ozone is produced by photochemical (sun light drven) reactions in the atmosphere and becomes more of a problem during warmer and sunnier periods.

Likewise for PM2.5, no standards for this pollutant currently exist in Regulations in Wales. Some modelled concentrations for Ceredigion at road-sides, however, are modelled to be around 10µg/m^3 and may exceed a Scottish standard set at 10µg/m^3 (that is in line with the World Health Organisation guideline standard of 10µg/m^3). This is a very stringent standard that may be difficult to achieve at many roadside locations in the UK.

It has not been considered necessary to declare any air quality management areas in Ceredigion or to develop action plans to improve air quality in the county. There have been no significant new developments in the county in the last year (roads / industry etc) that have significantly affected air quality. Local Transport Plans, a Carbon Management Plan and Economic Development and Planning Strategies consider air quality with the aim of limiting or reducing the impact of local emissions on air quality in the county.

1.2 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when air quality is close to or above an acceptable level of pollution (known as the air quality objective - see Appendix A)). After declaring an AQMA a local authority must prepare an Air Quality Action Plan (AQAP) within 18 months setting out measures it intends to put in place to improve air quality to at least the air quality objectives, if not better. AQMA(s) are seen by local authorities as focal points to channel resources into the most pressing areas of air pollution in their districts.

Cyngor Sir Ceredigion County Council does not currently have any Air Quality Management Areas (AQMAs) and has not needed to develop Air Quality Action Plans or an Air Quality Strategy.

1.3 Implementation of Action Plans

There are no Air Quality Management Areas in Ceredigion and no Action Plans, or an Air Quality Strategy, have needed to be developed for the County.

2. Air Quality Monitoring Data and Comparison with Air Quality Objectives

2.1 Summary of Monitoring Undertaken in 2017

2.1.1 Automatic Monitoring Sites

No automatic monitoring is currently undertaken in Ceredigion.

2.1.2 Non-Automatic Monitoring Sites

Non-automatic (passive) monitoring was undertaken for four pollutants in 2017. Table 2.1 shows the sites where monitoring was undertaken – more details, with photographs etc., are available in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) and bias adjustment for the diffusion tubes used are included in Appendix C.

Three pollutants lie at the core of Local Air Quality Management (LAQM) delivery in the UK; nitrogen dioxide (NO2), particulate matter (PM10 and increasingly PM2.5) and sulphur dioxide (SO2). All current Air Quality Management Areas (AQMAs) across the UK are declared for one or more of these pollutants, with nitrogen dioxide accounting for the majority.

Non-automatic monitoring of air quality in Ceredigion is undertaken for two of these priority pollutants (nitrogen dioxide and sulphur dioxide). Monitoring is also undertaken for the pollutant benzene and the pollutant ozone (standards and objectives for the pollutant ozone are not contained in Regulations). Ozone is often more problematic in rural areas like Ceredigion than in larger urban conurbations.

Monitoring locations are strategically chosen to assess emerging issues and to follow trends particularly at “worst case” locations (where the highest concentrations of pollutants have traditionally been observed and / or where the largest numbers of people could be exposed to pollution). All monitoring is undertaken on a monthly basis over four weeks with the calendar year data capture rate usually being 100%.

All passive tube monitoring locations are 1.5 – 3 metres above ground level, none were co-located with continuous monitors in 2017, those for nitrogen dioxide are located within a metre of the road (except at a background location) to assess the impact of road traffic, all (except for the background) are at locations where there is relevant public exposure and many represent worst case exposure locations.

In 2017 in Aberystwyth, monitoring continued to be undertaken to look for any traffic related impacts following the completion of Welsh Assembly and Council office buildings in the town. Monitoring was also undertaken at the busiest roundabout in

Ceredigion (close to these new office developments) and in the vicinity of a new super-store development in Mill Street, Aberystwyth that opened at the end of 2016.

Monitoring locations have been carefully chosen to include the worst case locations as suggested in Technical Guidance - such as narrow congested streets (canyon locations), kerbside locations (with greatest volumes of traffic and largest concentrations of buses and HGVs), locations with residential properties close by, alongside busy junctions and roundabouts, in the vicinity of schools, and at busy streets where people may spend one hour or more close to slow moving traffic.

Table 2.1 – Details of Non – Automatic Monitoring Sites

Details of Non-Automatic Monitoring Sites, 2017											
Site Name	Site Type	X Grid Ref	Y Grid Ref	Pollutant	In AQMA	Co-located	Relevant Exposure	Nearest road	Site Height	Worst-case site	Comment
Terrace Road, Aberystwyth	Urban hot-spot	258470	281700	NO2	N	N	1m	1m	2.5m	Y	Highest traffic flows / NO2 concentrations
Thespian St., Aberystwyth	Urban hot-spot	258630	281800	NO2	N	N	10m	1m	2.5m	Y	High traffic flows / NO2 concentrations
Railway Station, Aberystwyth	Urban hot-spot	258500	281620	NO2	N	N	1m	1m	2.5m	Y	High traffic flows / NO2 concentrations
Morrisons Roundabout, Aberystwyth	Busiest roundabout	259590	280570	NO2	N	N	200m	1m	1.5m	Y	High traffic flows / busiest roundabout
Park Avenue, Aberystwyth	Development Site	258590	281310	NO2	N	N	20m	1m	2.5m	N	Increasing traffic flows
High Street, Lampeter	Urban hot-spot	257790	248140	NO2	N	N	1m	1m	2.5m	Y	Highest traffic flows / NO2 concentrations
High Street, Cardigan	Urban hot-spot	217790	246180	NO2	N	N	1m	1m	2.5m	Y	Highest traffic flows / NO2 concentrations
Pendam	Rural Background	272240	283330	NO2	N	N	Farms, 500m	3m	2.5m	N	Background Monitoring Site
Aberystwyth	Urban hot-spot	258510	281550	SO2	N	N	20m	20m	2.5m	Y	Close to steam miniature railway
Lampeter	Urban hot-spot	257790	248140	SO2	N	N	1m	1m	2.5m	Y	Close to coal burning area
Cardigan	Urban hot-spot	217790	246180	SO2	N	N	1m	1m	2.5m	Y	Close to coal burning area
Pendam	Rural Background	272240	283330	SO2	N	N	Farms, 500m	3m	2.5m	N	Background Monitoring Site
Aberystwyth	Urban hot-spot	258380	281540	Benzene	N	N	20m	1m	2.5m	Y	Close to petrol filling station
Lampeter	Urban hot-spot	257700	248790	Benzene	N	N	10m	1m	2m	Y	Close to petrol filling station
Cardigan	Urban hot-spot	217950	246090	Benzene	N	N	2m	1m	2.5m	Y	Close to petrol filling station
Pendam	Rural Background	272240	283330	Benzene	N	N	Farms, 500m	3m	2.5m	N	Background Monitoring Site
Aberystwyth	Urban	258470	281700	Ozone	N	N	2m	3m	2.5m	N	Some elevated ozone concentrations
Lampeter	Urban	257790	248140	Ozone	N	N	1m	5m	2.5m	N	Some elevated ozone concentrations
Cardigan	Urban	217790	246180	Ozone	N	N	1m	10m	2.5m	N	Some elevated ozone concentrations
Pendam	Rural Background	272240	283330	Ozone	N	N	Farms, 500m	3m	2.5m	Y	Consistently high ozone concentrations
Adpar	Small town	230920	240900	Ozone	N	N	10m	5m	2m	N	Some elevated ozone concentrations
Tregaron	Small town	267970	259730	Ozone	N	N	5m	2m	2.5m	N	Some elevated ozone concentrations

All air quality results reported below are compared with national standards and objectives.

2.2 2017 Air Quality Monitoring Results

NITROGEN DIOXIDE

Diffusion tubes can be used to sample air for nitrogen dioxide over a period of, for example, one month. Diffusion tubes are useful for assessing the annual objective of 40µg/m^3 for nitrogen dioxide, the most stringent standard for this pollutant, but cannot be used to assess the number of hours when concentrations are greater than 200µg/m^3 (the hourly objective for nitrogen dioxide).

The reference method for nitrogen dioxide is chemiluminescence and a number of instruments have been approved under the *MCERTS SCHEME*. Because diffusion tubes are not the reference method, and have a lower accuracy, results have to be adjusted with a bias that is determined by local or national collocation studies with chemiluminescent analysers. It is also necessary to calculate data capture and if this is less than 75% over a year results need to be "annualised".

Nitrogen dioxide was monitored at eight key and on-going locations in Ceredigion in 2017 using diffusion tubes. These locations have been selected to monitor trends, following mapping and screening exercises over many years, and some represent the "worst case" locations for nitrogen dioxide in Ceredigion.

A summary of annual mean results over the last eleven years are reproduced in the table below. All results are bias corrected and are well below the most stringent annual standard for nitrogen dioxide at 40µg/m^3. The European, Air Quality Directive requires that compliance with the nitrogen dioxide limit values should have been achieved by 01/01/2010 (and this was the case in Ceredigion).

Table 2.2.1 Summary of annual mean nitrogen dioxide results, using passive diffusion tubes, in Ceredigion over the last eleven years

Site	GRID REFERENCE	Within AQMA	2017 Data Capture	Annual mean, bias corrected concentrations (ug/m3) (Annual Bias Corrections in brackets)										
				2017 (0.77)	2016 (0.79)	2015 (0.81)	2014 (0.81)	2013 (0.8)	2012 (0.79)	2011 (0.84)	2010 (0.85)	2009 (0.81)	2008 (0.78)	2007 (0.82)
Railway Station, Aberystwyth	SN5850 8162	No	100%	24.13	24.98	23.25	23.48	25.98	26.97	26.55	29.61	28.92	27.65	28.91
Thespian Street, Aberystwyth	SN5863 8180	No	100%	20.77	23.83	22.14	23.25	24.84	23.74	26.06	29.03	28.65	26.84	32.86
Morrisons, Aberystwyth	SN5959 8057	No	92%	18.53	20.36	18.78	18.69	20.15	23.49	20.73	20.51	23.72	22.96	23.38
Terrace Road, Aberystwyth	SN5847 8170	No	92%	21.37	22.26	19.78	22.77	25.53	25.31	26.37	28.31	30.1	28.27	29.74
Park Avenue, Aberystwyth	SN5859 8131	No	100%	12.57	16.38	14.50	15.36	16.78	16.81	16.4	19.18	14.8	No results	11.89
High Street, Lampeter	SN6792 5963	No	100%	22.72	26.45	24.61	26.36	28.17	27.33	27.17	30.03	30.68	29.75	30.4
High Street, Cardigan	SN1779 4618	No	100%	17.88	20.16	18.73	20.67	20.85	20.44	24.42	25.83	31.21	30.38	32.3
Background (Pendam)	SN7224 8333	No	100%	3.33	4.13	3.80	3.94	4.30	4.23	3.91	5.15	4.61	4.51	4.61

Highest nitrogen dioxide concentrations have usually been found at monitoring locations in Aberystwyth - by the Railway Station, in Thespian Street and at Terrace

road (where there is the highest flows of traffic in the county) or at High Street locations in Lampeter and Cardigan.

Monthly and annual monitoring results for nitrogen dioxide in 2017 are shown in table 2.2.2. Because diffusion tubes can over or under estimate concentrations for nitrogen dioxide (when compared with the chemiluminescence reference method), the mean annual measured data is corrected with the appropriate bias adjustment for 2017(see the bias correction factors in the table below). Bias adjusted results for nitrogen dioxide in 2009 are also shown in the table below for comparison

Table 2.2.2 Annual Mean Results at Some Key Monitoring Locations for Nitrogen Dioxide in Ceredigion in 2017 (and in 2009 shown for comparison)

Results in: ug/m3		ABERYSTWYTH					LAMPETER	CARDIGAN	PENDAM
		Railway St	Thespian St	Morrisons	Terrace Rd	Park Avenue			Background
	Jan	36.6	42.6	27.9	44.7	27.5	33.4	33.1	9.2
	Feb	39.3	32.5	31.6	37.2	20.7	39.1	27.4	9.5
	Mar	44.2	37.8	24.9	42.6	15.9	37.9	24	4.3
	Apr	28.7	23.3	22.4	26.5	17.9	28	25.8	4.1
2	May	33.2	30	20.3	31.1	13	29.4	20.2	4.1
0	Jun	24.5	18.1	21.3	20.1	9	22.4	17.5	2.3
1	Jul	22.3	20.1	24.8	18.3	11	28.2	18	2.8
7	Aug	23.5	17.7	22	20.6	11.4	23	22.2	2
	Sep	30.7	22.5	25.5	21.3	14.4	17	20.8	3.4
	Oct	28.8	23.9		22.9	13.8	27	18.6	2.5
	Nov	35.9	32.3	25.7		24.9	37.1	28.7	3.9
	Dec	28.4	23	18.4	19.9	16.5	31.6	22.3	3.8
Mean'17		31.34	26.98	24.07	27.75	16.33	29.51	23.22	4.33
Mean '17	(bias corr - 0.79)	24.13	20.77	18.53	21.37	12.57	22.72	17.88	3.33
Standard		40	40	40	40	40	40	40	40
% of Standard		60.33%	51,93%	46.33%	53.42%	31.43%	56.80%	44.70%	8.33%

Results in: ug/m3		ABERYSTWYTH					LAMPETER	CARDIGAN	PENDAM
		Railway St	Thespian St	Morrisons	Terrace Rd	Park Avenue			(background)
	Jan	44.7	41.5	32.4	39.2		43.8	49.7	13.5
COLD >	Feb	62.5	58.7	54.9	63.7	New	54.2	67.5	11.7
	Mar	51.6	41.3	35.1	40.3	Developments	50.8	39.9	5.4
	Apr	40.4	35.9	37.4	41.9	in Park Avenue	33.9	36.5	5.3
2	May	19.7	29	18.7	27.7		38.8	36.9	7
0	Jun	31.5	33	28			38.1	36.9	5.4
0	Jul	14.2	18.2		21.7	12.3	17.4	32.7	2
9	Aug	20.7	20.4	20.9		12.4	26	26.6	2.7
	Sep	29.7	24.3	22.5	28.8	18.5	32.2	35.7	4.4
	Oct	31.9	29.4	18		17.1	38.5	39.5	4
	Nov	29.6	25.4	20.4	22.7	16.3	30.7	22.3	
COLD >	Dec	51.9	67.3	33.9	48.5	33.1	50.2	38.1	
Mean '09		35.70	35.37	29.29	37.17	18.28	37.88	38.53	6.14
Mean '09	(bias corr - 0.81)	28.92	28.65	23.72	30.1	14.8	30.68	31.21	4.97
Standard		40	40	40	40	40	40	40	40
% of Standard		72.30%	71.62%	59.30%	75.25%	37.00%	76.70%	78.00%	12.40%

The analytical laboratory ("SOCOTEC") used by Ceredigion to determine nitrogen dioxide concentrations has estimated, from co-location studies, that their tubes **overestimated** nitrogen dioxide concentrations by around 20% in 2017 requiring that a correction factor of 0.77 (based on 27 co-location studies) be applied to their measured data for the year. The correction in 2009 was 0.81 (from 19 co-location studies).

Bias adjustments for nitrogen dioxide diffusion tubes supplied by "SOCOTEC" are available on the DEFRA website:

BIAS ADJUSTMENTS

Annual corrections have been based on an increasing number of comparison studies over the years improving confidence levels. In 2000 the bias estimated was based on only two studies, in 2003 and 2004 it was based on 8 studies, in 2010 and 2011 it was based on 18 studies and since 2012 it has been based on over 20 comparison studies.

Web Based Bias Corrections		
Year	Bias	Studies
2000	0.79	2
2001	0.78	5
2002	0.84	4
2003	0.87	8
2004	0.88	8
2005	0.88	14
2006	0.79	13
2007	0.82	18
2008	0.78	14
2009	0.81	19
2010	0.85	18
2011	0.84	18
2012	0.79	26
2013	0.8	28
2014	0.81	22
2015	0.81	21
2016	0.79	29
2017	0.77	27

The highest **annual mean** and corrected nitrogen dioxide concentration in Aberystwyth in 2017 was recorded at a monitoring location ("Railway Station" in table 2.2.1 above) close to the railway station, a bus station, traffic lights and a busy junction. The concentration measured at 24.13µg/m^3 was significantly lower than the 2009 annual mean concentration, recorded at the same location, at 28.92µg/m^3 - all bias corrected. Nitrogen dioxide concentrations at all other sampling locations in Aberystwyth were below this annual mean in 2017 ranging from between 12.57 and 21.37µg/m^3 (bias corrected). These are all well below the annual standard of 40µg/m^3 (around 40% to 70% below the standard) at all monitored location in Aberystwyth - the most heavily trafficked town in Ceredigion.

In 2017, the second highest bias corrected **annual mean** concentration of nitrogen dioxide recorded in Ceredigion was at a sampling location at High Street in Lampeter (at 22.72µg/m^3, ~43% below the mean annual standard).

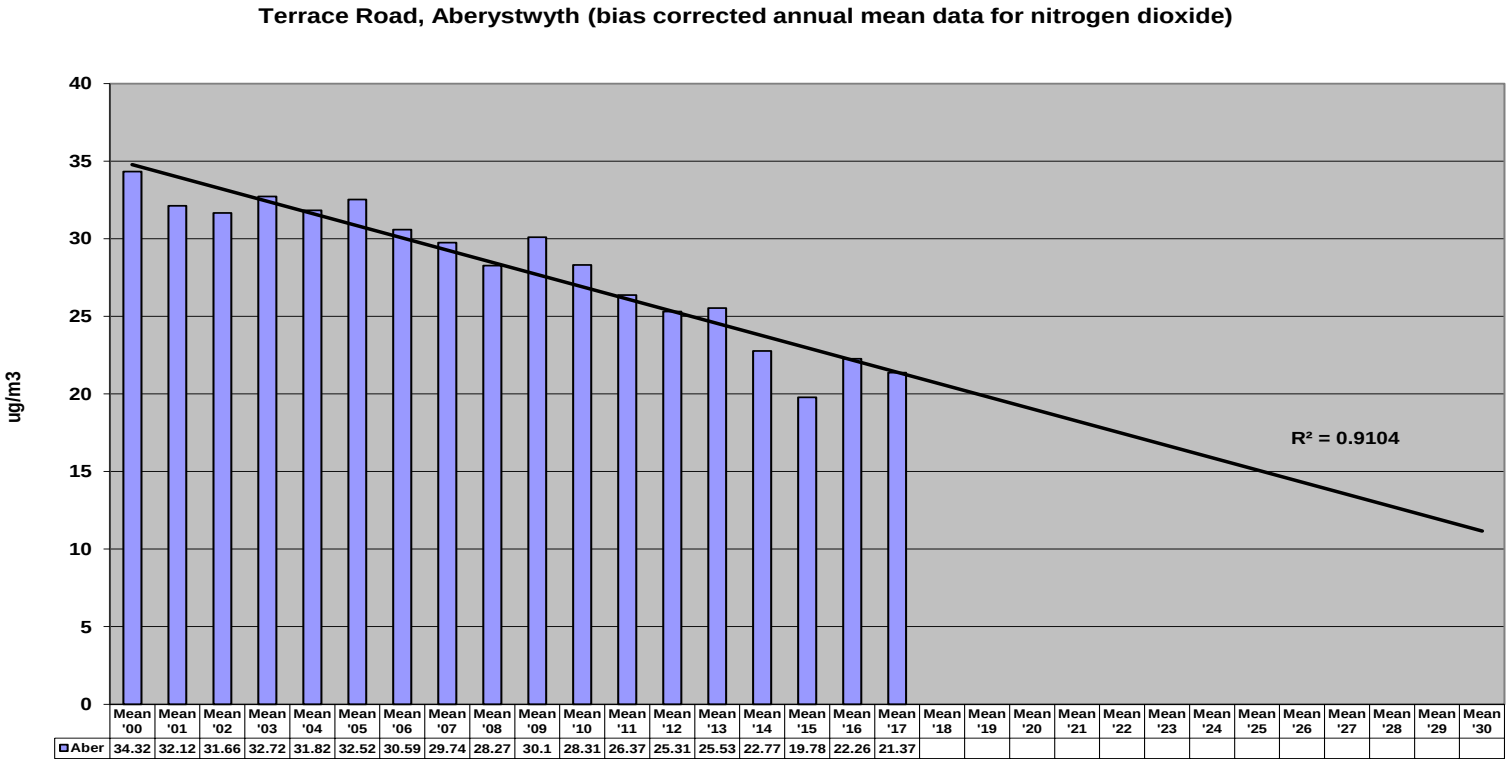
The highest **monthly mean** nitrogen dioxide concentration in 2017 was recorded in January at Terrace Road in Aberystwyth at 44.7µg/m^3 [uncorrected]. This concentration was still well below 60µg/m^3 - the monthly concentration at which *there is a risk* that the 1-hour objective could have been exceeded. Highest nitrogen dioxide concentrations are often recorded in colder, winter months (as on this occasion in January, 2017).

Table 2.2.2 demonstrates, as for previous years, that the annual mean standard of 40µg/m3 for nitrogen dioxide was not exceeded at any of the key monitoring sites in Ceredigion in 2017 (including at the worst case locations that are most relevant for public exposure). The annual mean concentrations of nitrogen dioxide had DECREASED significantly at all monitoring locations in 2017 relative to 2009 (including at the rural location, Pendam, used for background monitoring purposes). There were no monthly exceedances of 60µg/m^3, when there is a risk of the 1-hour objective being exceeded, at any of the monitoring locations.

Trends in Annual Mean Nitrogen Dioxide Concentrations

With the corrections applied for the appropriate years, the trend in annual mean nitrogen dioxide concentrations recorded at Terrace Road in Aberystwyth (one of the most heavily trafficked locations in Ceredigion) is shown below where a projection is made to 2030:

Figure 2.2.1



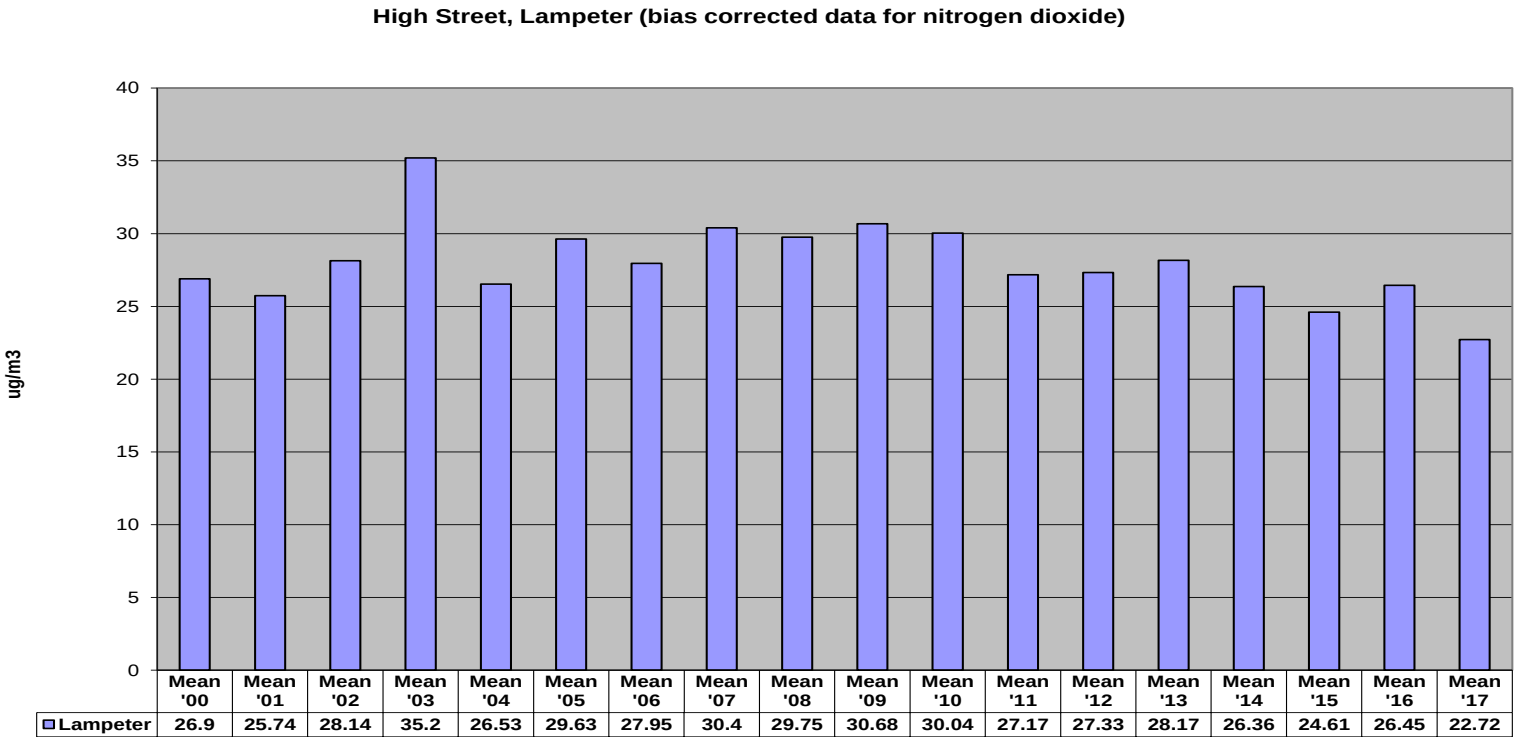
The trend at this monitoring location in Aberystwyth, over the last eighteen years, is downwards with annual mean concentrations of nitrogen dioxide (bias corrected) falling from around 34µg/m^3 to around 21µg/m^3 in this period (in each year the annual mean concentration was well below the annual mean standard). This is a road-side and canyon monitoring location in Aberystwyth where some of the highest volumes of traffic have been consistently recorded in the county.

In Technical Guidance it is shown how to project annual mean roadside nitrogen dioxide concentrations to future years on the basis of expected trends and reductions as a result of national policies. The 2006 measured nitrogen dioxide concentration at Terrace Road in Aberystwyth (30.59µg/m3), for example, needed to be corrected with the adjustment factor of 0.861 to give a projected concentration of 26.34µg/m3 by 2010. The actual measured annual mean concentration of nitrogen dioxide at Terrace Road in Aberystwyth in 2010 was 28.31µg/m3. This agreement provides confidence in the accuracy of the data being recorded and the significance of the extrapolations made.

Concentrations have declined at this worst case monitoring location since 2010 and in 2017 the mean at Terrace Road in Aberystwyth (21.37µg/m3) was well below the national standard of 40µg/m3 and well below the WHO critical standard for the protection of vegetation at 30.5µg/m3**.** It is also well below well the first Air Quality Daughter Directive limit (40µg/m3) to be achieved by the first of January in 2010. Extrapolations of the graph above show that concentrations of nitrogen dioxide at this monitoring location are expected to continue to fall to around 11µg/m3 by 2030.

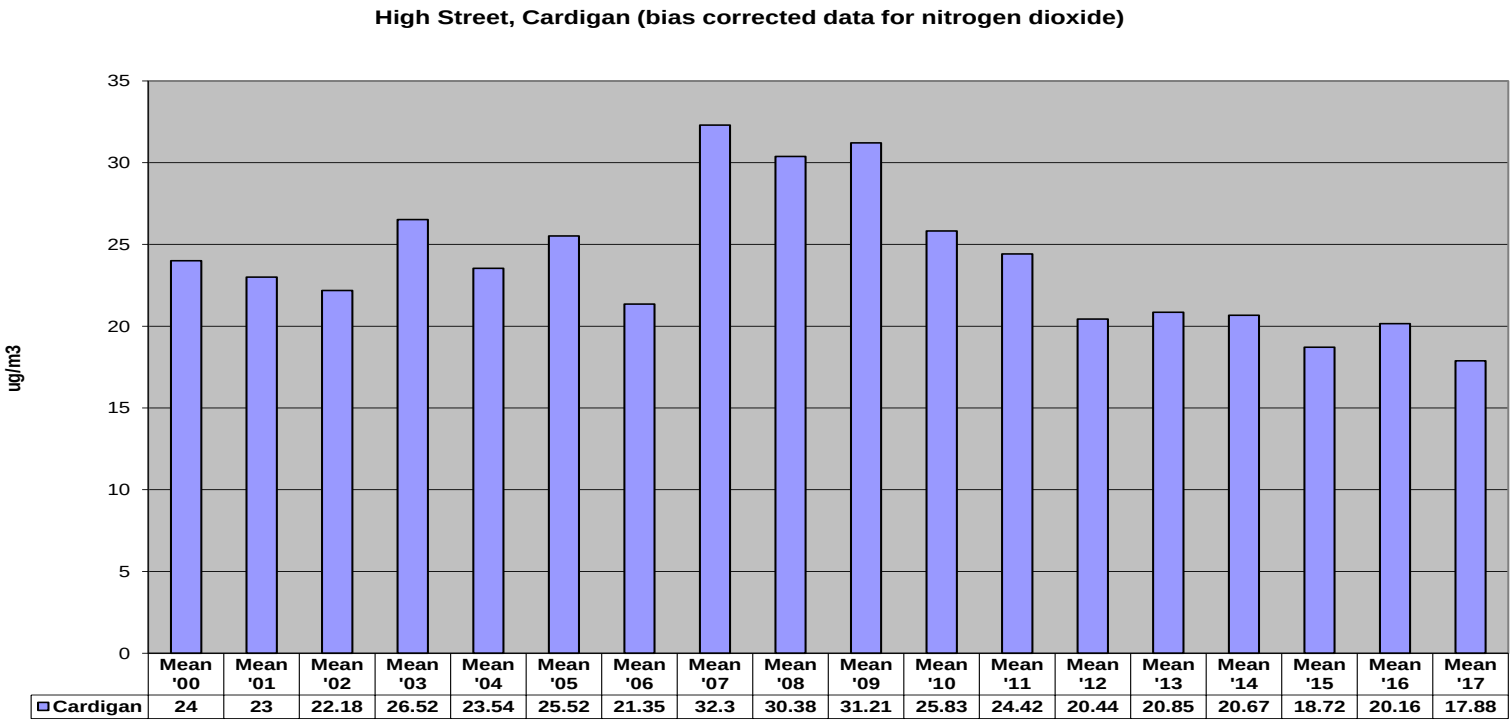
Likewise at High Street in Lampeter, the 2017 annual mean concentration of nitrogen dioxide at 22.72µg/m^3 was again well below the annual standard of 40µg/m^3. Bias corrected nitrogen dioxide concentrations at this location have also fallen since 2009:

Figure 2.2.2



There has also been a decrease in nitrogen dioxide concentrations at High Street in Cardigan since 2007 - when traffic calming measures were introduced in the town to slow down traffic and improve pedestrian safety:

Figure 2.2.3



Concentrations of nitrogen dioxide, at all the worst case monitoring locations (the Railway Station, Thespian Street and Terrace Road in Aberystwyth and High Street, in Lampeter) in Ceredigion in 2017 were of a similar magnitude at about 20 to 24µg/m^3 corrected (~ 40 to 50% below the standard of 40µg/m^3). Concentrations at all other monitoring locations in Ceredigion in 2017 were lower again (more than 50% below the standard at the busiest roundabout in Ceredigion, for example, at 18.53µg/m^3 corrected). Concentrations of nitrogen dioxide at this roundabout have fallen over the last nine years from around 23 to 18.53µg/m^3 as an annual and bias corrected mean.

Nitrogen dioxide concentrations were almost 70% below the standard (12.57µg/m^3 corrected) in Park Avenue in Aberystwyth (close to a new Welsh Assembly and Council office buildings and a new retail development – a Tesco / Marks and Spencer's Superstore) where traffic flow has increased since the completion of the developments. The increases in traffic flows, as a result of the first of these developments (Welsh Government and Council offices) impacted slightly on nitrogen dioxide concentrations in following years but in 2017 nitrogen dioxide concentrations had fallen below the pre-development concentrations in 2009 (14.8µg/m^3 pre-development in 2009 and 12.57µg/m^3 in 2017).

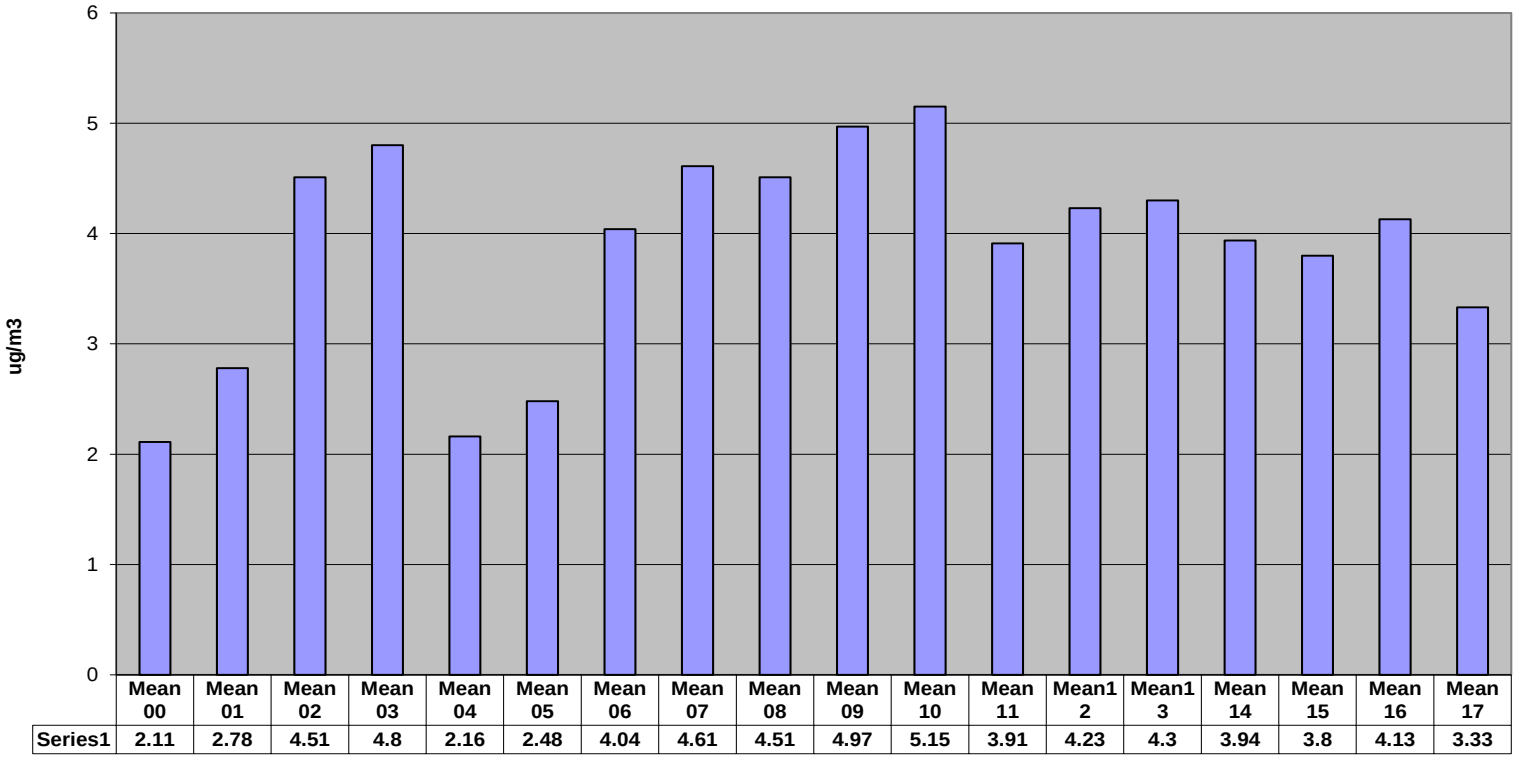
Background nitrogen dioxide concentrations continue to be monitored in Ceredigion for comparison purposes and to check trends (Pendam in the table 2.2.2 above) where the impact of traffic emissions is very low. A background annual mean

concentration in 2017 of 3.33μg/m3 (corrected) compares well with national estimates for nitrogen dioxide in Ceredigion and background results recorded using the reference monitoring method in other parts of the UK. This provides a good consistency check.

Bias corrected annual mean, **background**, concentrations of nitrogen dioxide in Ceredigion since 2000 are shown in the graph below:

Figure 2.2.4

Bias Corrected, Background ("Pendam") Concentrations of Nitrogen Dioxide in Ceredigion (2000 - 2017)
(NB Catalytic converters were fitted to all new cars in 2003)



	Mean 00	Mean 01	Mean 02	Mean 03	Mean 04	Mean 05	Mean 06	Mean 07	Mean 08	Mean 09	Mean 10	Mean 11	Mean12	Mean13	Mean 14	Mean 15	Mean 16	Mean 17
Series1	2.11	2.78	4.51	4.8	2.16	2.48	4.04	4.61	4.51	4.97	5.15	3.91	4.23	4.3	3.94	3.8	4.13	3.33

The trend in measured annual mean **background** concentrations in Ceredigion before 2003 was upwards. In 2004, when catalytic filters were fitted on all new cars, there was a sharp decrease in the annual mean concentration measured at this background location. Between 2004 and 2010 there was a steady increase in recorded background concentrations (presumably as gains made by fitting catalytic converters to all new cars were offset by the increasing volume of cars on the roads). Background concentrations since 2010 have mostly shown a downward trend.

Some roadside ambient air quality concentrations are available as interactive maps on the DEFRA website:

DEFRA INTERACTIVE MAPS

Roadside concentrations are estimated using Defra's national pollution climate mapping model. Results in Aberystwyth for nitrogen dioxide in 2015 (most recent available data) are shown below:

Figure 2.2.5

Roadside Annual Mean Nitrogen Dioxide Concentrations Modelled by DEFRA in Aberystwyth in 2015

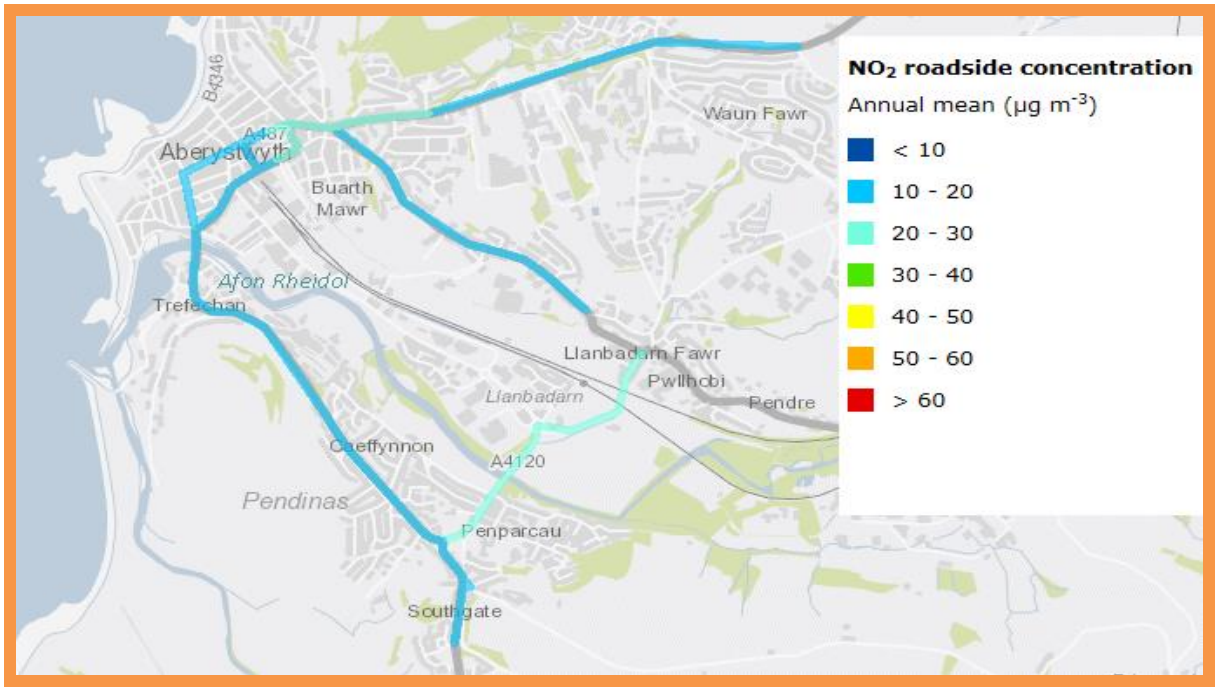


Figure 2.2.6

Roadside Annual Mean Nitrogen Dioxide Concentrations Modelled by DEFRA at Thespian Street in Aberystwyth in 2015

At Thespian Street (highlighted in red on map below) in Aberystwyth in 2015, modelled concentrations (DEFRA) were estimated, as an annual mean, to be 23.52µg/m^3. This compared well with the measured concentration using diffusion tubes in 2015 at 22.14µg/m^3.

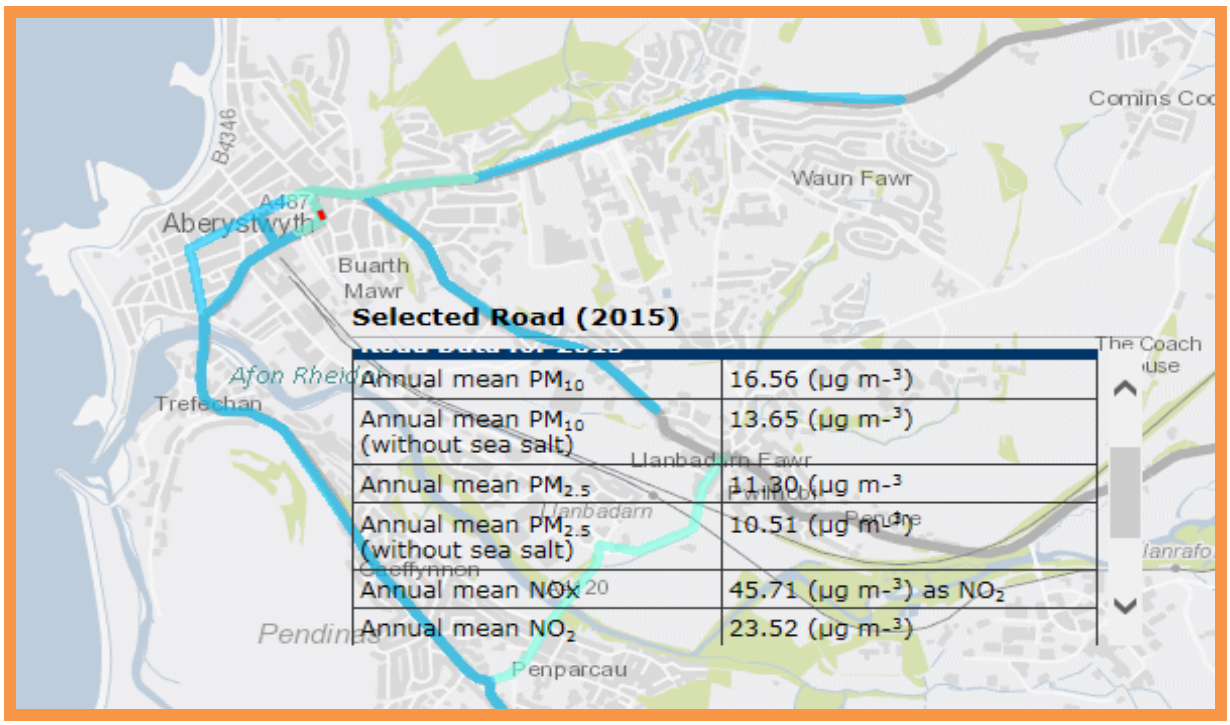


Figure 2.2.7

<u>Roadside Annual Mean Nitrogen Dioxide Concentrations Modelled by DEFRA at Terrace Road in Aberystwyth in 2015</u>

At Terrace Road (highlighted in red on map below) in Aberystwyth, the modelled concentration in 2015 was 16.54µg/m^3 which was slightly lower than a measured concentration of 19.78µg/m^3.

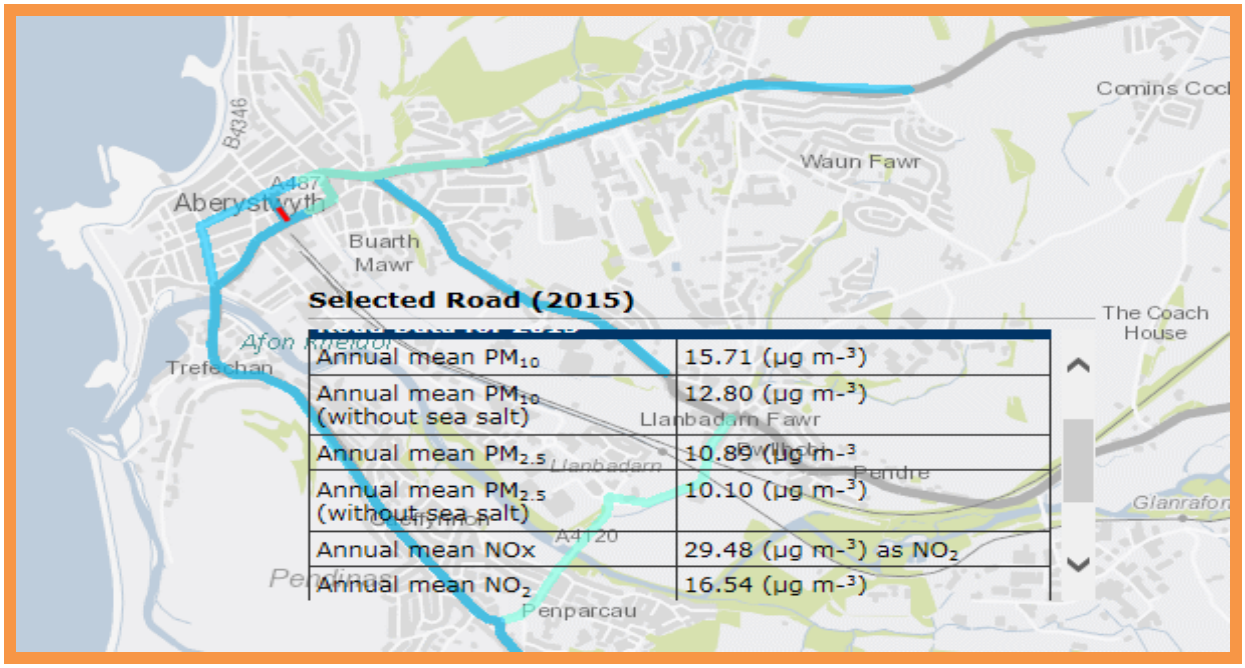
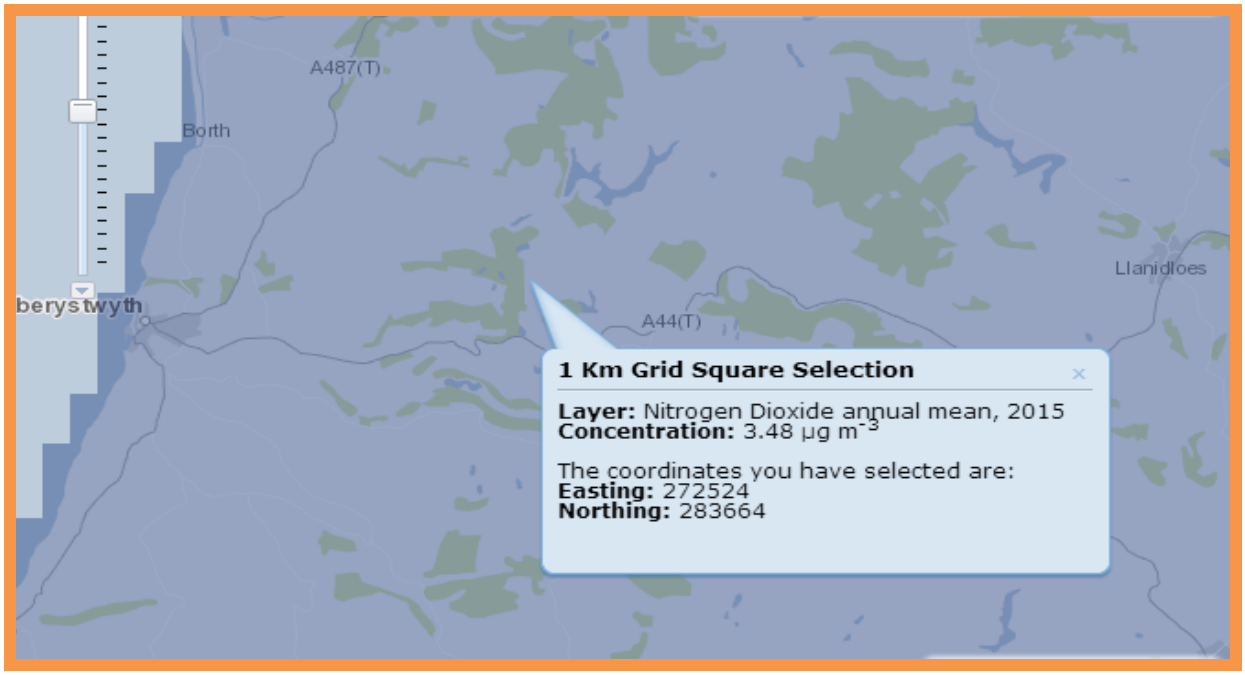


Figure 2.2.8

Background Annual Mean Nitrogen Dioxide Concentrations Modelled by DEFRA at Pendam in Ceredigion in 2015

Defra's modelled **background concentration at Pendam** in Ceredigion in 2015 estimated at 3.48µg/m^3 compared with a measured concentration of 3.8µg/m^3.



The agreement between locally measured and nationally modelled results (background and at the roadside) is a good consistency check for results recorded in Ceredigion using diffusion tubes.

Background concentrations in Ceredigion have been modelled to be less than 3.5µg/m^3 by 2030 and concentrations at the most heavily trafficked locations in Ceredigion (roadsides in Aberystwyth) could be around 11µg/m^3 by 2030 based on our own projections and less than 20µg/m^3 based on Welsh Government projections made in 2015. Measured concentrations at **worst case, "hot-spot" and roadside locations in Ceredigion** are already similar in magnitude to **background** concentrations in some urban conurbations in South Wales and could actually be less than some of these background concentrations in South Wales by 2030 on the basis of these projections.

The UK Government published a plan for reducing roadside nitrogen dioxide concentrations further in 2017:

UK Government Plan for Nitrogen Dioxide

The documents and zone plans set out a comprehensive approach to meeting the statutory limits for nitrogen dioxide, and the policy background. Ceredigion falls in the South Wales Zone Plan:

South Wales Zone Plan

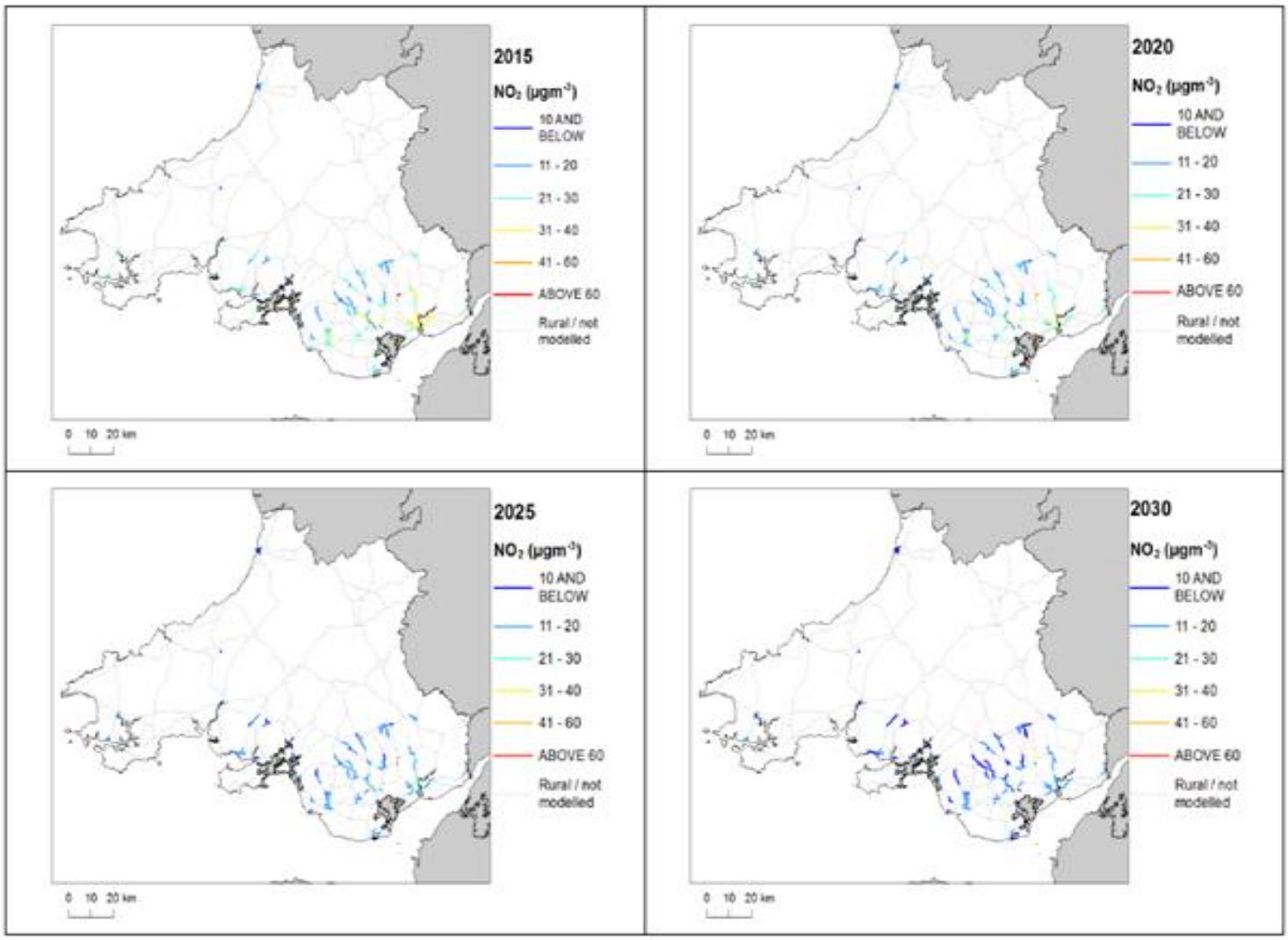
A technical report details the modelling techniques and assumptions used in developing the plan. The Direction requires **specified local authorities** to carry out studies to identify how to meet legal limits for nitrogen dioxide in the shortest possible time, and sets deadlines. The documents detail how the UK will meet its legal requirements to reduce nitrogen dioxide as set out in Regulations:

- Air Quality Standards Regulations 2010
- Air Quality Standards (Scotland) Regulations 2010
- Air Quality Standards Regulations (Northern Ireland) 2010
- Air Quality Standards (Wales) Regulations 2010

The Welsh Government has published projections for background baseline and roadside annual mean nitrogen dioxide concentrations for 2020, 2025 and 2030 (with 2013, the baseline year, also shown for reference) for the South Wales Region (including Ceredigion) in its “Air Quality Plan”, September, 2015. The projections are reproduced in the maps below.

Modelled exceedances of the annual standard for nitrogen dioxide are shown in orange and red. There were no such exceedances at roadside locations in Ceredigion in 2015 (shown for comparison) or any projected roadside exceedances in 2020, 2025 and 2030. Most of the exceedances are restricted to the busiest road locations in the more urbanized and populated regions of South Wales.

Figure 2.2.9
WELSH GOVERNMENT ROADSIDE NITROGEN DIOXIDE PROJECTIONS



GENERAL REMARKS

There are no airports with passenger throughputs in excess of 5 million in Ceredigion and no roads with significantly changed traffic flows since previous air quality reviews and assessments.

The busiest road junctions in Ceredigion have been carefully assessed as has the concentrations of nitrogen dioxide at the busiest roundabout in the County. All are well below the standards.

There are no new mineral or landfill developments that could contribute to increased emissions of air pollutants (including nitrogen dioxide) in Ceredigion – indeed, there are no operational landfills in Ceredigion.

The Air Quality Standards (Wales) Regulations 2010 sets alert thresholds for nitrogen dioxide to be measured over three consecutive hours at locations representative of air quality over at least 100 km^2 or an entire zone, whichever is smaller.

Regulations 17, 21(1) and (3), 23(1) and 24(2)

SCHEDULE 4

Alert thresholds for nitrogen dioxide

Pollutant	*Alert threshold*
Nitrogen dioxide	400µg/m^3

Instantaneous monitoring is necessary to determine if this alert threshold is exceeded. However, **it is recognised that if the annual mean standard (the most stringent standard) is complied with for nitrogen dioxide it is likely that the hourly standards will also have been complied with**.

In Ceredigion, the most stringent annual Standard for nitrogen dioxide was complied with at all monitored locations (including roadside, "hot-spot" locations) in 2017. The annual mean is the most stringent standard. If the annual mean Standard is complied with it is likely that the hourly standards are also complied with throughout Ceredigion.

A Welsh, national air quality indicator has been introduced for nitrogen dioxide. This indicator is very low for Ceredigion - amongst the lowest in Wales.

Government factors to estimate concentrations of this pollutant suggest that concentrations of nitrogen dioxide should continue to fall in Ceredigion in the future. Concentrations of nitrogen dioxide recorded in the county in 2017 fully complied with European, national and World Health Organisation standards.

PARTICULATE MATTER

No new monitoring of particulate pollution was undertaken in Ceredigion in 2017. The Review and Assessment process for particulate matter attempts to identify contributions **that local emissions make to air quality**. Any subsequent actions necessary should aim to control local emissions at source. **Transboundary pollution is outside the scope of local air quality management and control**.

All local authorities were required to undertake Updating and Screening Assessment for the 2004 objectives for the PM10 fraction of particulate pollution and, in particular, were encouraged to undertake an assessment for the 2010 objectives (significantly more stringent). The 24-hour objective was more stringent than the annual mean objective for 2004, but the opposite was true for the 2010 objective (where the annual mean was the most difficult target). All recent assessments of PM10 particulate pollution in Ceredigion have focused on the more stringent annual mean.

The assessment of the likelihood of particulate concentrations (PM10 and PM2.5) exceeding national standards and objectives presented below is based on national modelling (background and at the roadside), monitoring undertaken in other parts of the UK and previous measurements and appraisals etc.

PM10

Local authorities have been encouraged to concentrate on locations in their districts where PM10 concentrations are likely to be highest. If there are no exceedances of the objective at the most high risk (of exceeding objectives) locations, then it can be reasonably assumed that there will be no exceedances elsewhere. It is also important to consider the extent of public exposure. Highest PM10 concentrations associated with road traffic is found close to the road and at street “canyon” locations (as for nitrogen dioxide) where road traffic is the primary source of particulate pollution.

Modelled, roadside ambient air quality concentrations for PM10 are available as an interactive map on the DEFRA website:

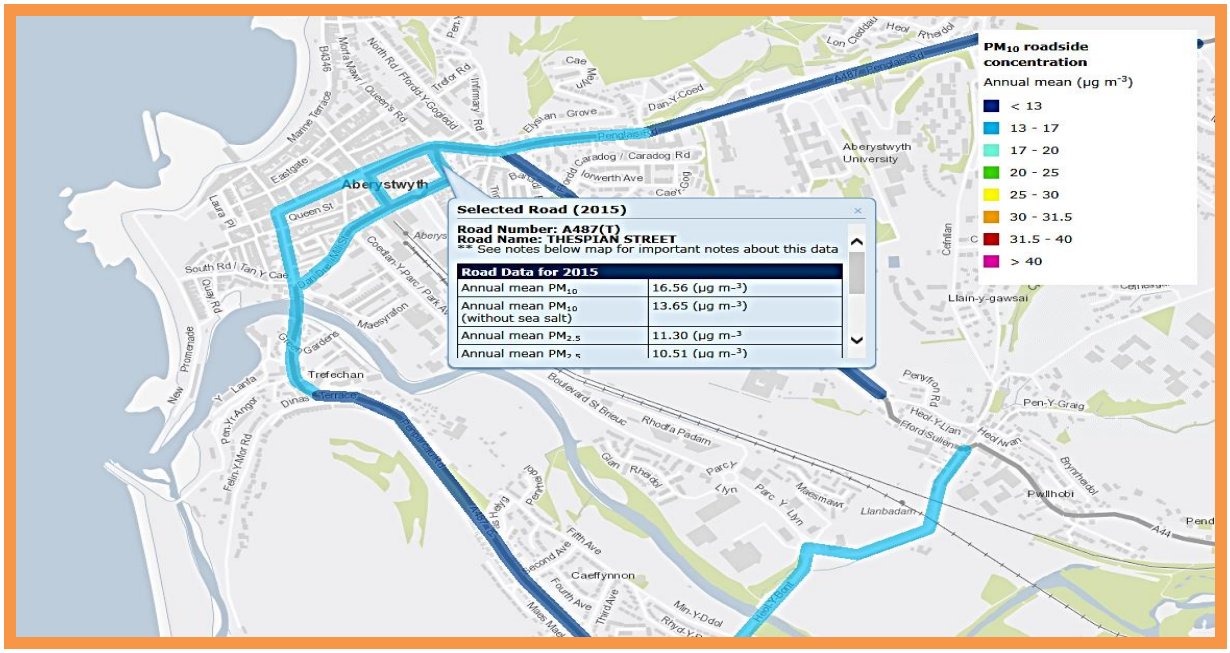
DEFRA INTERACTIVE MAPS

These concentrations are derived from Defra’s national pollution climate mapping model. Estimated, roadside results in Aberystwyth for PM10 are shown below for 2015 (the last year for which data is available):

Roadside Annual Mean PM10 Concentrations Modelled by DEFRA in Aberystwyth in 2015

Figure 2.2.10

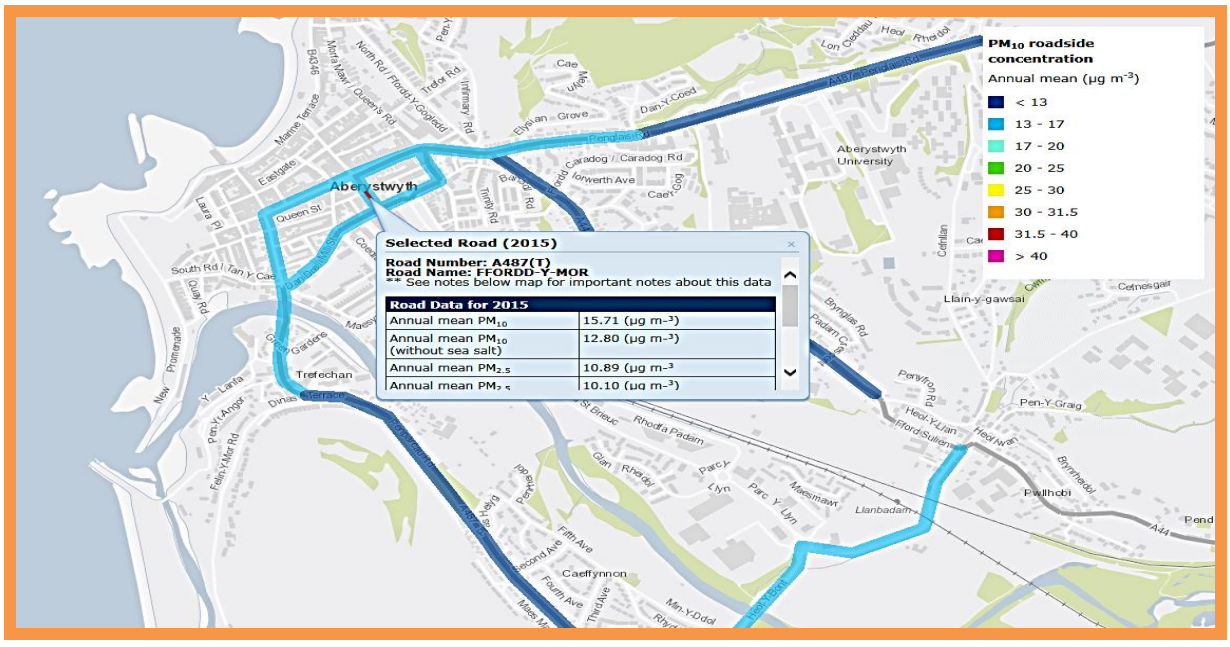
Thespian Street



At Thespian Street (indicated by arrow from text-box on map above) in Aberystwyth in 2015, concentrations of PM10 from DEFRA's modelling method were estimated to be 16.56µg/m^3 (13.65 without sea salt) as an annual mean. This is well below the annual mean standard of 40µg/m^3. Thespian street is one of the most heavily trafficked locations in Ceredigion, is close to busy junctions, is a canyon location and is in a well populated area.

Figure 2.2.11

Terrace Road

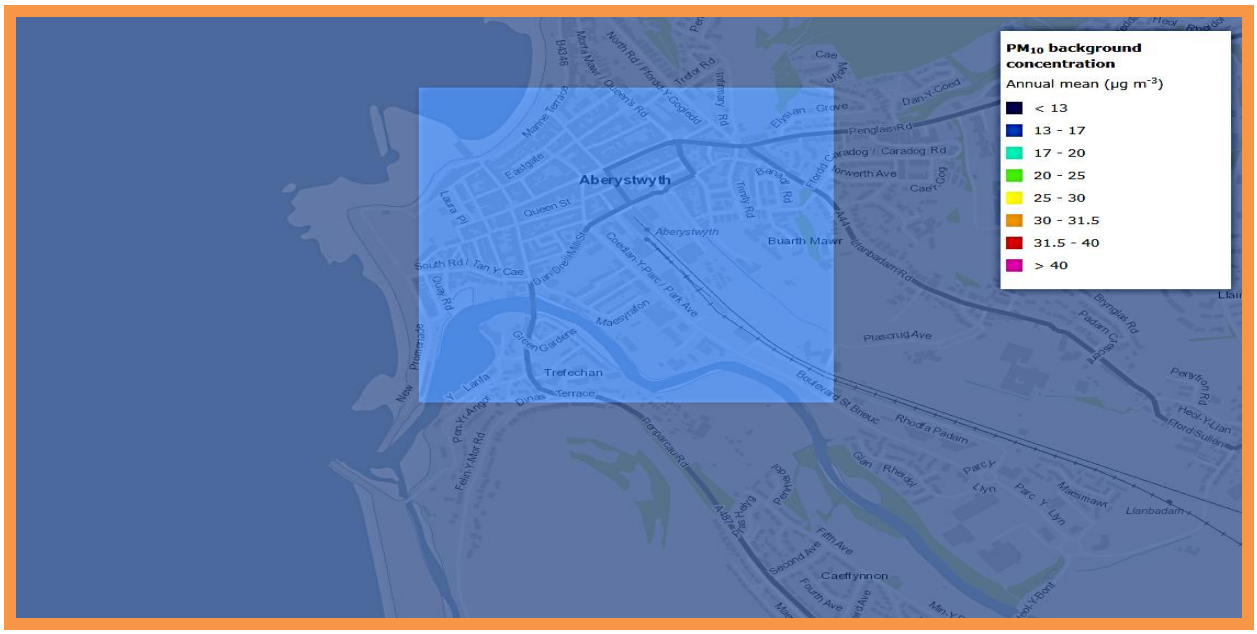


At Terrace Road (indicated by arrow from text-box on map above) the modelled concentration as an annual mean in 2015 was 15.71µg/m^3 (12.8 without sea salt). This concentration, again at a "worst, roadside and hot-spot location" in Ceredigion, is well below the annual PM10 standard of 40µg/m^3.

Modelled background PM10 concentrations, see figure below, in Aberystwyth in Ceredigion in 2015 were estimated to be between 13 and 17µg/m^3. **So, modelled roadside PM10 concentrations in Ceredigion, even at hot-spot locations in the main town of Aberystwyth, currently approach background levels**.

Figure 2.2.12

Modelled Background PM10 Concentrations in Aberystwyth in Ceredigion in 2015



In the rest of the county, modelled background PM10 concentrations are less than 13µg/m^3.

To summarise for PM10 particulate pollution in Ceredigion:

1 A Welsh, national air quality indicator exists for PM10 particulate pollution. This indicator is very low for Ceredigion – amongst the lowest in Wales

2 No Air Quality Management Areas have been declared in Ceredigion for particulates (or any of the other priority pollutants included in the National Air Quality Strategy).

3 There are no roads / junctions in Ceredigion meeting a "heavily trafficked" classification. Even at the most congested, "hot-spot" locations in Ceredigion the proportion of buses and / or heavy goods vehicles does not approach the

threshold of 20% of total vehicle flow (or is expected to exceed this level in the future).

4 National estimates of annual mean background levels for PM10 in Ceredigion are low (mostly below 13μg/m^3). Roadside concentrations, even at the most traffic congested locations, currently approach background levels.

5 No annual mean exceedances, even of the more stringent 2010 standard, were reported at an AURN monitoring site (Narberth) in a neighbouring local authority (Pembrokeshire) over many years - nor were there any exceedances of the running 24-hour mean objective. The annual mean concentration at the Narberth AURN site in Pembrokeshire was consistently well below the annual mean standard of 40μg/m3. Likewise, the maximum daily mean concentration at Narberth was also consistently below the 24hour mean standard of 50μg/m3. PM10 concentrations have been shown in the past to be higher in Pembrokeshire (where there are major industrial sources of particulate emissions and more and heavier road traffic) than in Ceredigion.

6 Some studies suggest that background particulate concentrations can be increased by as much as 60% at the roadside, **in major urban areas**, as a result of emissions from road traffic. In general, however, and in the relatively small towns that exist in Ceredigion, increases at the roadside tend to be more moderate (DEFRA interactive maps above suggest somewhere around 25%) with annual mean concentrations of PM10 in Ceredigion **at busiest "hot-spot" and roadside locations** estimated to be around 16 - 17μg/m3 (and well below the standard).

7 An empirical relationship exists relating annual mean concentrations to the 90th percentile of daily means (which is roughly equivalent to 35 exceedance days per year), namely:

PM10 (90th %ile of daily means) = PM10 (annual mean) * 1.79.

This relationship shows that the 24-hour Objective is unlikely to be exceeded if the mean annual concentration is below 28μg/m3 (gravimetric). An annual mean of below 17μg/m3 equates with very few, if any, exceedances of the 24-hour mean standard even at the busiest roadsides in Ceredigion.

8 There are no existing roads, or roads being constructed or proposed, in Ceredigion that would be expected to be close to the objectives and there are no "**heavily trafficked"** roads in the county that have recently experienced a significant (and > 25%) increase in traffic.

9 Industrial sources of particulates are not expected to make significant contributions to the annual mean but could be important in terms of the 24-hour objective. In particular, fugitive sources, coal burning boilers, and steel works are potentially the most significant industrial sources of particulates. There are no new industrial sources completed or planned in Ceredigion. There are no industrial sources with substantially increased emissions that have not been assessed previously.

10 For fugitive and uncontrolled emissions from quarrying etc., there is no need to progress to a Detailed Assessment for PM10 from these sources, even if there

are relevant locations for public exposure within 200-400metres of the dust emission source, if background levels are less than 16μg/m3 – as is the case in rural Ceredigion where concentrations are less than 13μg/m^3.

11 Potential sources of particulate pollution from outside the county have been assessed in previous rounds of Review and Assessments. When industry is a main source of particulate pollution, particulate levels are normally expected to exceed the standards when sulphur dioxide exceeds the standards. In extensive monitoring of sulphur dioxide in Ceredigion over many years no evidence has been found of any likelihood of the standards for this pollutant being exceeded from industrial activity outside (or inside) the county. There is occasionally some evidence in Ceredigion of plume migration of sulphur dioxide from outside the county. Sulphur dioxide concentrations, however, have consistently been found to be very low, in national terms, in monitoring undertaken over many years in the county.

12 It was concluded in previous Reviews and Assessments for Ceredigion that there were no “significant” (as defined in Guidance) coal burning areas in the county and this remains the case.

13 Continuous PM10 monitoring was undertaken at potentially “hot-spot / worst-case” locations in Ceredigion in 2004 and 2005 to check assessments at that time and to confirm compliance with standards. Recorded 24-hour mean concentrations of particulates were in line with expectations and generally well below 20μg/m3 (gravimetric) at some of the most traffic congested locations in Ceredigion (and in some important domestic coal burning areas in the county in winter months). Estimates available in Guidance were used in Ceredigion to calculate annual mean PM10 concentrations on the basis of this short-term monitoring. Estimated annual mean concentrations, at all locations, were significantly less than 20μg/m3 and well below the 2010 annual mean standard of 40μg/m3. Particulate pollution has fallen significantly since 2004 / 2005.

14 There are no other transport sources in Ceredigion (aircraft, railways, shipping etc) that have the potential for significant emissions of PM10 (airports, for example, where the airport passenger throughput exceeds 10 million passengers per annum).

15 Previous assessments have concluded that no landfill sites (there are no landfill sites in Ceredigion), large poultry farms, quarries, opencast mining, waste transfer sites, and / or material handling locations have the potential for important emissions of PM10 in Ceredigion.

16 National policies already in place are likely to lead to more significant reductions in the levels of PM10 in the future. Emissions from electricity generation have declined dramatically, due to the move from coal to natural gas and because of improvements in the performance of electrostatic precipitators at coal fired power stations. Diesel vehicle emissions of particulates have also declined significantly in recent years because of the penetration into the fleet of new diesel vehicles meeting tighter particle emission standards. Among the non-combustion and non-transport sources, the major emissions of PM10 are from a range of industrial processes and quarrying. Here emissions have remained fairly constant over the last decade (and are likely to remain so in the future).

17 The UK Government expects, as a result of existing national policy measures, that exceedances of the 2004 objective for particulates are **only** likely to be found

at urban backgroud sites in central London; at locations adjacent to busy roads **in major urban areas**; in areas where there are **significant** emissions from the domestic burning of solid fuels; in the vicinity of major industrial plant or in regions where there is **significant** uncontrolled fugitive emissions (for example, from extensive quarrying, mining etc).

18 National assessments have also been carried out for the 2010 objective for PM10. These indicate that, depending upon meteorological conditions, exceedances of the annual mean objectives are only likely to occur in the SE of England (and in London in particular). Exceedances of the annual mean objective are expected at some of the busiest roadsides in the UK. There are no such roads in Ceredigion.

19 A large percentage of local air quality management areas declared in the UK have been as a result of exceedances of the 2004, 24-hour mean PM10 objective. The majority of these have been in combination with nitrogen dioxide and associated with road traffic sources. ***Where nitrogen dioxide is elevated and breaches standards at the roadside there is a good chance that particulates will also be elevated and could breach standards.*** In extensive and on-going monitoring of nitrogen dioxide in Ceredigion (as summarised in the previous section of this Report) no non-compliance with the standards has been observed (even at the busiest roadsides and worst case monitoring locations) in Ceredigion.

20 The Government expects the policies already in place to lead to significant reductions in the levels of PM10 in the future. Local primary particulates were expected to decline significantly and likewise for secondary particulates. Coarse particle concentrations were expected to remain about constant.

21 Exceedances of the standards could become more of an issue during prolonged dry spells that may become more frequent in the future as local climates warm (pollution from wildfires have been an issue in some parts of the country in the warm summer of 2018). Elevated PM10 pollution may also occur following periods of air movement from central Europe or following natural events such as the Eyjafjallajökull glacier volcano eruption that occurred in April 2010 (with similar smaller eruptions in 2014) and Saharan dust episodes. Iceland's giant volcano Katla is currently emitting large amounts of carbon dioxide suggesting that a very large eruption, that could dwarf the one observed in 2010, may be imminent. Scope for action at the local level, however, is limited and confined to that part of the primary particle fraction that is derived from local sources. The secondary fraction of particulates that may arise from elsewhere, including events such as volcanic eruptions / Saharan dust etc, <u>cannot be controlled by local, or national, measures</u>.

In previous reviews, all the relevant sources relating to PM10 pollution in the county have been considered and assessed. There are no known new sources of PM10 pollution, no sources that have not been previously considered, and no significant changes that could affect previous assessments for PM10 pollution in Ceredigion.

PM2.5

In recent years, finer particulate pollution (PM2.5) has become more of a health concern. In a report published in 2014, it was estimated that in Wales in 2010 around 1320 deaths could be attributed to long-term exposure to PM2.5. An estimated cost to the UK of fine (PM2.5) particulate pollution was valued at £16 billion a year. As a consequence, local authorities in England have a new flexible role to work towards reducing emissions and concentrations of PM2.5. In Scotland, local authorities have a statutory duty to achieve a 10µg/m^3 annual mean objective standard for PM2.5 (the same as the World Health Organisation standard):

World Health Organisation Guideline Standards for some Air Pollutants

Local authorities in Wales are not yet required to work towards the achievement of this PM2.5 objective. It is believed that measures to reduce emissions and concentrations of other pollutants (including PM10) will also reduce the levels of PM2.5. The Government's Expert Panel on Air Quality Standards (EPAQS) has pointed out that even if a standard was introduced for PM2.5 it would still be necessary to retain the separate standard for the coarse fraction of particulate pollution (PM10). There could be a considerable additional expense involved, with little or no additional public health gains, from introducing a PM2.5 standard (with the requirements for extra monitoring and / or modelling).

Due to its extremely small size, air borne PM2.5 can travel very long distances. It is estimated that as much as 40% - 50% of the levels found locally have originated from sources outside a local authority's boundary and area of control (that is, a large part of PM2.5 pollution is transboundary). Local actions can only address and influence local sources of PM2.5 pollution.

Most reductions in PM2.5 pollution to date have tended to be achieved locally by concentrating on, and reducing, other pollutants (such as nitrogen dioxide, sulphur dioxide and PM10). Very little PM2.5 monitoring is undertaken in Wales (and none currently in Ceredigion). Hand held and instantaneous monitors are available but have not been approved and are only useful for mapping and general guide purposes.

DEFRA commissioned research to develop a toolkit to help local authorities and public health professionals tackle air pollution in their areas with a particular focus on PM2.5.

The toolkit provides a one-stop guide to the latest evidence assisting local authorities in the use of tools to appraise the scale of any air pollution issue in its area:

PM2.5 Toolkit

In brief, the toolkit comprises the following key guides:

- Getting to grips with air pollution – the latest evidence and techniques
- Understanding air pollution
- Engaging with local decision-makers about air pollution

- Communicating with the public on air pollution
- Air pollution: an emerging public health issue: Briefing for elected members.

The Toolkit can play an important role in achieving a deeper cultural shift in the approaches taken to air quality improvement. Local authorities are encouraged to make use of all available sources of information to aid the identification of any "hot-spot" areas of elevated PM2.5 within their areas.

Supporting information that is available includes:

National PM2.5 monitoring sites: *AURN SITES*
National PM2.5 modelling: *Air Pollutant Background Maps*

Some modelled, roadside (and background) ambient air quality concentrations for PM2.5 are available as an interactive map on the DEFRA website:

DEFRA INTERACTIVE MAPS

Concentrations in these maps are derived from Defra's national pollution climate mapping model. DEFRA modelled results in Aberystwyth for PM2.5 are shown in the maps below for 2015:

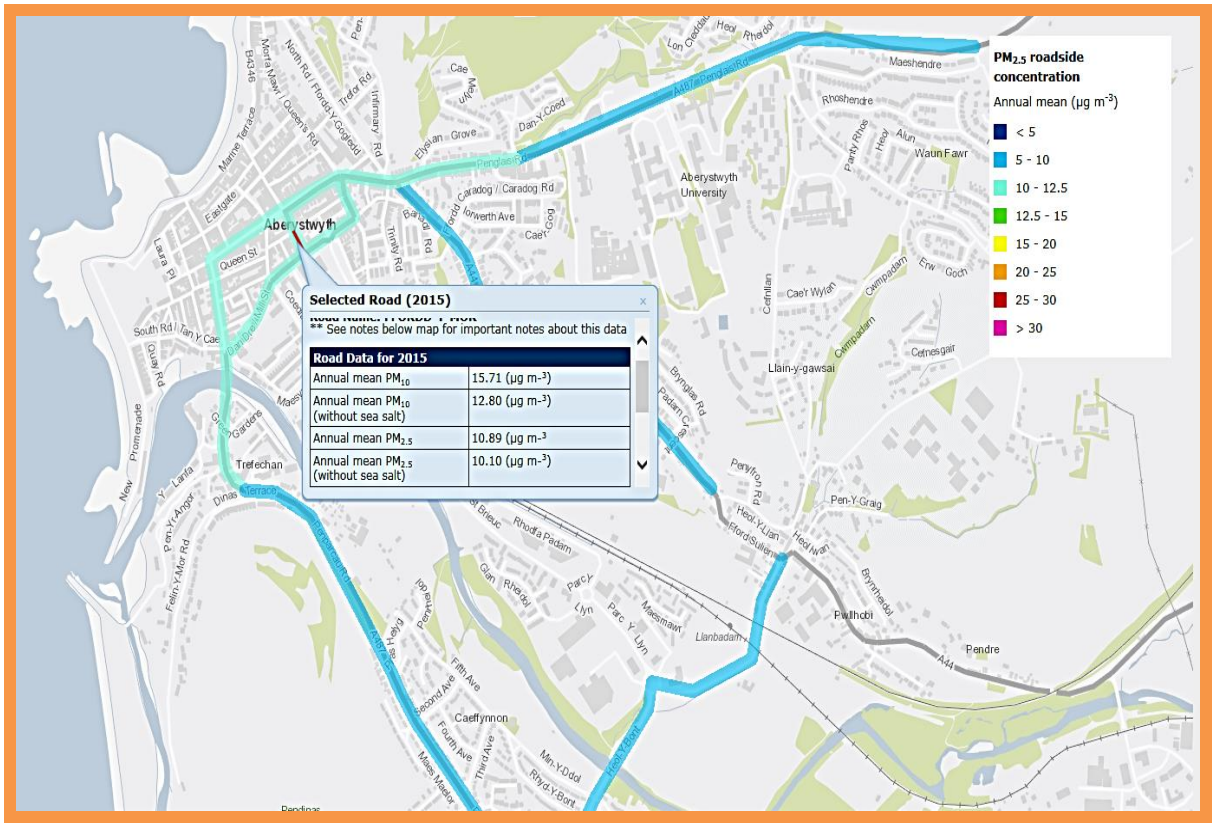
Figure 2.2.13

Roadside Annual Mean PM2.5 Concentrations Modelled by DEFRA at Thespian Street in Aberystwyth in 2015

At Thespian Street (highlighted in red on map above) in Aberystwyth in 2015, the annual mean concentration of PM2.5 estimated using DEFRA's modelling method was 11.30µg/m^3 (10.51µg/m^3 without sea salt). This EXCEEDS the standard set in Scotland at 10µg/m^3 suggesting that the Scottish standard for PM2.5 is a very stringent one. Sea salt alone, in a coastal location like Aberystwyth, makes a contribution of about 10% to the mean annual PM2.5 concentration. This standard has not been adopted in England or Wales and may be difficult to achieve at many road-side locations.

Figure 2.2.14

Roadside Annual Mean PM2.5 Concentrations Modelled by DEFRA at Terrace Road in Aberystwyth in 2015



At Terrace Road (highlighted in red on map above) in 2015, the estimated modelled concentration, as an annual mean, was 10.89µg/m^3 (10.1 without sea salt). This was a significant increase (~20 to 25%) on that estimated in 2014 by DEFRA using the same modelling tool (8.48 and 7.76 [without sea salt] µg/m^3 respectively).Once again, this EXCEEDS the mandatory standard set in Scotland (and the World Health Organisation guideline standard) at 10µg/m^3.

Box 7.7 of Technical Guidance (TG6) shows how to estimate PM2.5 annual mean concentrations from annual mean PM10 concentrations using a nationally derived correction factor of 0.7. The modelled annual PM10 concentration of 15.71µg/m^3 at Terrace Road in Aberystwyth would then equate to a PM2.5 concentration of

10.99µg/m^3 using this national correction factor. This compares well with the modelled concentrations for PM2.5 of 10.89µg/m^3 above establishing the consistency of the modelled results and the correction factor.

There is currently no statutory standard for PM2.5 set in Regulations in Wales but there is a target standard in the Air Quality Standards (Wales) Regulations 2010:

FINE PARTICULATES $PM_{2.5}$	
Averaging period	*Target value*
Calendar year	25µg/m^3

If the correction factor (relating PM10 concentrations to PM2.5 concentrations) of 0.7 is applied to the annual PM10 standard of 40µg/m^3, this would equate to a PM2.5 annual mean concentration of 28µg/m^3 (which is in line with the Welsh Government target value for PM2.5 above).

This target standard is larger, and more achievable, than the stringent WHO guideline standard for PM2.5, that has been adopted in Scotland as a mandatory standard, at 10µg/m^3. Modelled concentrations of around 11µg/m^3 (at worst-case, roadside locations in the main town of Aberystwyth in Ceredigion) are well below the Welsh Government target value of 25µg/m^3.

The Scottish Standard, and guideline value recommended by the World Health Organisation (WHO), at 10µg/m^3 was chosen because it:

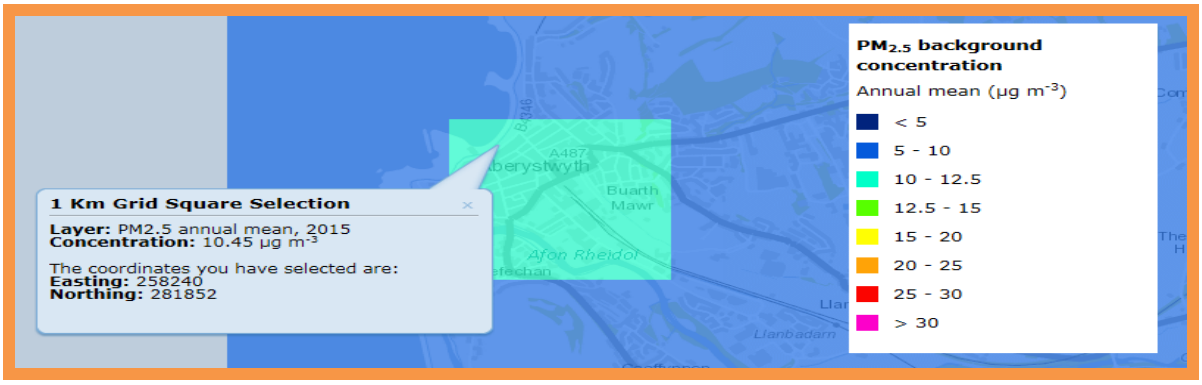
"Represented the lower end of the range over which significant effects on survival were observed in an American Cancer Society's (ACS) study……..."

Adoption of a guideline at this level places significant weight on the long-term exposure studies that use the ACS and a Harvard University, Six-City study. In both of these studies, robust associations were reported between long-term exposure to PM2.5 and mortality. The historical mean PM2.5 concentration was 18µg/m3 (range, 11.0–29.6µg/m3) in the Six Cities study and 20µg/m3 (range, 9.0–33.5µg/m3) in the ACS study. Thresholds for effects on health were not apparent in any of these studies, although the precise period(s) and pattern(s) of relevant exposure could not be ascertained. In the ACS study, statistical uncertainty in the risk estimates became apparent at concentrations of around 13µg/m3.

Annual mean background PM2.5 concentrations modelled by DEFRA for 2015 were estimated to be around10.45µg/m^3 at Aberystwyth in Ceredigion – **which also exceeds the Scottish and WHO standards**.

Figure 2.2.15

BACKGROUND PM2.5 CONCENTRATIONS ESTIMATED BY DEFRA IN ABERYSTWYTH IN CEREDIGION IN 2015



Modelled roadside concentrations in Ceredigion, therefore, at around 11µg/m3 at "hot-spot" locations in the main town of Aberystwyth, are very close to the estimated background concentrations.

Reducing PM2.5 concentrations in Aberystwyth to below the Scottish mandatory and WHO guideline standard would, therefore, require that background concentrations themselves be reduced. This would be very difficult to achieve locally when 40% - 50% of the concentrations of PM2.5 can be from sources from outside the region and outside a local authority's area of control.

Nevertheless, health risks associated with PM2.5 particulate pollution continue to be a cause of concern. A working group under the EU Clean Air for Europe (CAFÉ) programme recommended more than 10 years ago that PM2.5 should be made the "principal metric" for assessing exposure to particulates because it is more relevant for acute health impacts.

The Air Quality Standards (Wales) Regulations 2010 places a duty on Welsh Ministers to limit exposure to PM2.5:

> ***19.***—*(1) The Welsh Ministers must ensure that all necessary measures not entailing disproportionate costs are taken to reduce exposure to* $PM_{2.5}$ *with a view to attaining the national exposure reduction target by 2020.*

Addressing PM2.5 pollution, however, will require more concerted action at national and international levels.

No Air Quality Management areas have been declared in Ceredigion and no monitoring of particulate pollution was undertaken in Ceredigion in 2017. Background PM10 concentrations modelled by DEFRA in Ceredigion in 2015 (the most recent year for which data is available) were estimated to be around 13µg/m^3 (except in the main town of Aberystwyth where modelled background concentrations were in the range 13 to 17µg/m^3). Modelled roadside concentrations at hot-spot locations in the main town of Aberystwyth were up to 16.5µg/m^3 .These estimates approach background levels even at the worst, roadside and hot-spot locations in Ceredigion. They are well below the annual mean PM10 standard of 40µg/m^3 and below the stringent World Health Organisation GUIDELINE Standard of 20µg/m^3:

Background PM2.5 concentrations modelled by DEFRA in Ceredigion in 2015 (the most recent year for which data is available) were estimated to be around 10.45µg/m^3 at Aberystwyth in Ceredigion. This exceeds the Scottish mandatory and WHO guideline standard of 10µg/m^3 (that has not been adopted in England and Wales). It complies, however, with a target Standard of 25µg/m^3 contained in the Air Quality Standards (Wales) Regulations 2010.

On the basis of DEFRA's modelled results for 2015, PM2.5 concentrations are only increased by around 0.85µg/m^3 (less than 8%) at the roadside in Aberystwyth from background levels by road traffic. Modelled roadside PM2.5 concentrations, even at "hot-spot" locations in the main town of Aberystwyth in Ceredigion, are, therefore, close to modelled background concentrations.

These observations, in a relatively small town in a rural county like Ceredigion, suggest that the WHO Guideline and Scottish annual mean statutory standard for PM2.5 is a stringent one and may be difficult to achieve. A large portion of PM2.5 pollution is transboundary and 40% - 50% of the concentrations of PM2.5 may arise from non-local sources. The contribution from sea-salt alone in coastal towns can amount to around 10% of the total background concentration for PM2.5. Reducing PM2.5 concentrations, to below the WHO guideline and Scottish mandatory standards if this became necessary in Wales, would require that background PM2.5 concentrations be reduced and this would fall outside the scope of local air quality management and control.

Welsh, national air quality indicators exist for PM10 and PM2.5 particulate pollution. These indicators are low for Ceredigion – amongst the lowest in Wales

SULPHUR DIOXODE

Sulphur dioxide monitoring was undertaken in Ceredigion in 2017 using diffusion tubes at a small number of key and worst case monitoring locations (in terms of potential public exposure) for compliance testing and trend monitoring purposes:

Table 2.2.3

Measured Monthly Concentrations of Sulphur Dioxide in Ceredigion in 2017

2017	Aberystwyth	Lampeter	Cardigan	Background
Jan	0	0	0	0
Feb	2.7	2.7	3.3	2.7
Mar	2.3	2.3	2.3	2.3
Apr	0.05	0.05	0.05	0.05
May	2.5	2.5	2.5	2.5
Jun	2.4	2.4	2.4	2.4
Jul	2.6	3	2.6	2.9
Aug	2.5	2.5	2.5	2.5
Sep	5.1	2.5	2.5	2.5
Oct	2.5	2.4	2.4	2.4
Nov	2.6	2.6	2.7	2.6
Dec	2.4	2.4	2.4	2.4
Ann. Mean	2.30	2.11	2.14	2.10

In 2017, the highest **monthly mean** concentration of sulphur dioxide was recorded in September in the main town of Aberystwyth (where the concentration measured was 5.1µg/m^3). Even this concentration of sulphur dioxide is very low in national terms. Elevated concentrations of sulphur dioxide, periodically observed in the past, are most likely to have been associated with plume migration from outside the county (there are no significant sources of sulphur dioxide emissions in Ceredigion itself). The **annual mean** concentrations at all sampling locations in Ceredigion in 2017 were similar at between ~ 2.1 to 2.3µg/m^3 (again very low in national terms).

Annual mean background concentrations for sulphur dioxide have been modelled and mapped by DEFRA and for Ceredigion are reproduced below:

DEFRA INTERACTIVE MAPS

Figure 2.2.16

Sulphur dioxide background concentrations are estimated to be less than 2µg/m^3 in most of the county. Background levels are slightly higher in the main town of Aberystwyth at between 2 and 4µg/m^3.

Measured concentrations in Ceredigion in 2017, therefore, are in excellent agreement with background concentrations modelled by DEFRA in 2015 (the most recent year for which modelled data is available).

Sulphur dioxide has continued to be monitored in Ceredigion because this pollutant also provides a guide to particulate pollution - when sulphur dioxide concentrations are high particulate pollution can also be elevated.

Graphs below show the results of monitoring sulphur dioxide in the three main towns in Ceredigion over a number of years. The trends at all three locations have been very similar with mean annual concentrations of sulphur dioxide falling significantly up to 2002, increasing up to 2013 before decreasing again in the last five years. **In 2017, mean annual sulphur dioxide concentrations measured in all three main towns in Ceredigion were the lowest recorded in 25 years of monitoring.**

Figure 2.2.17

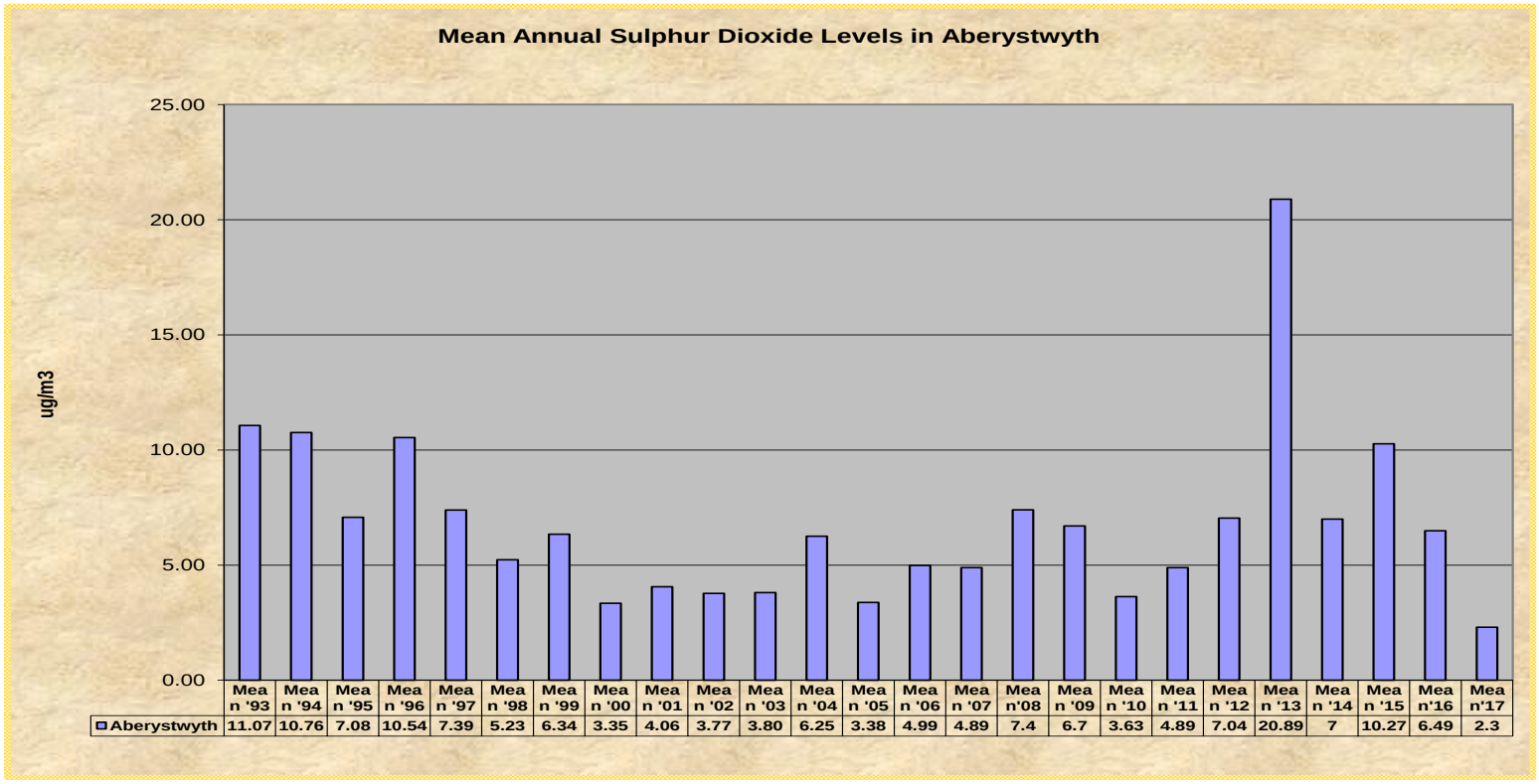


Figure 2.2.18

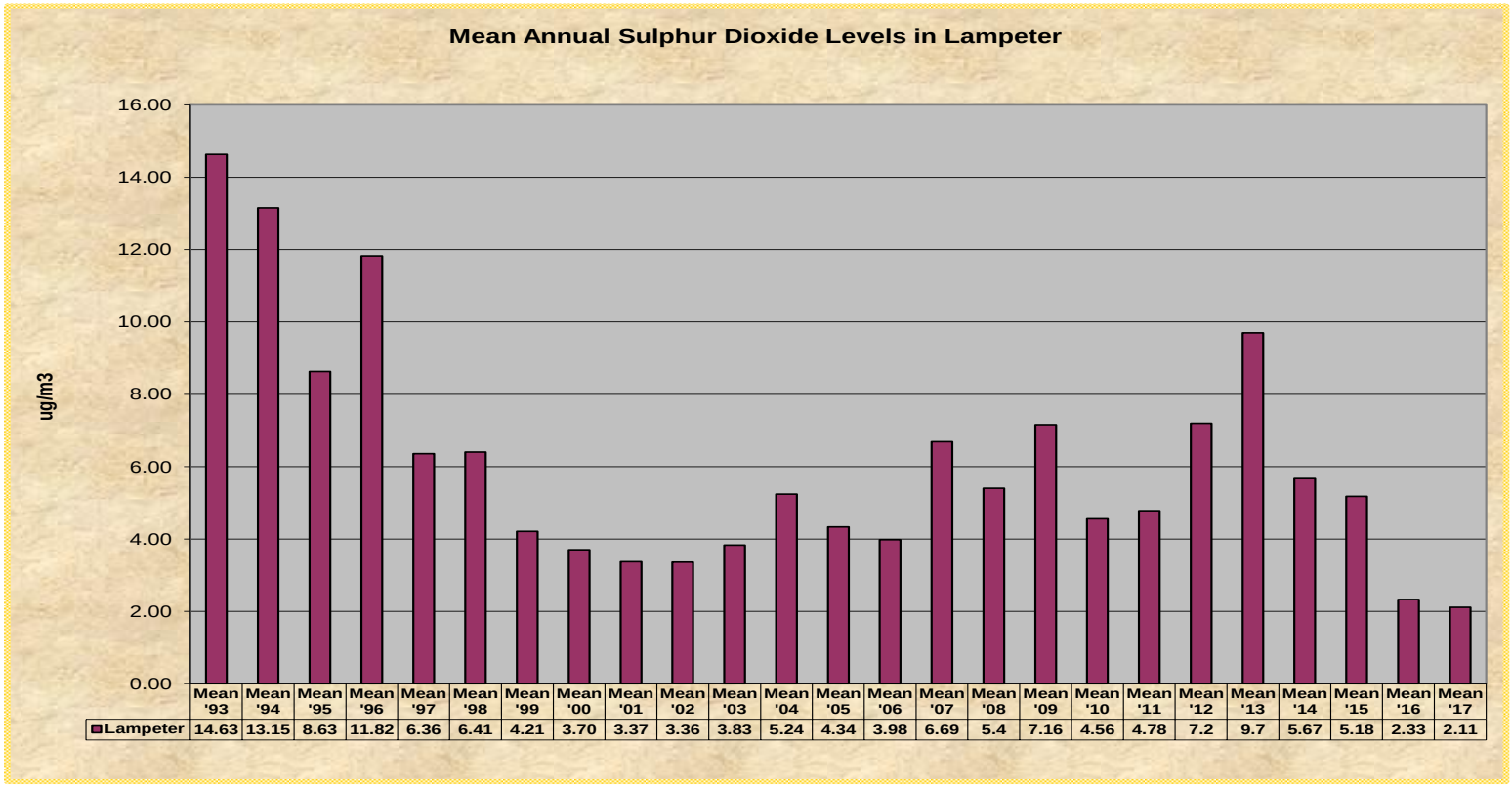
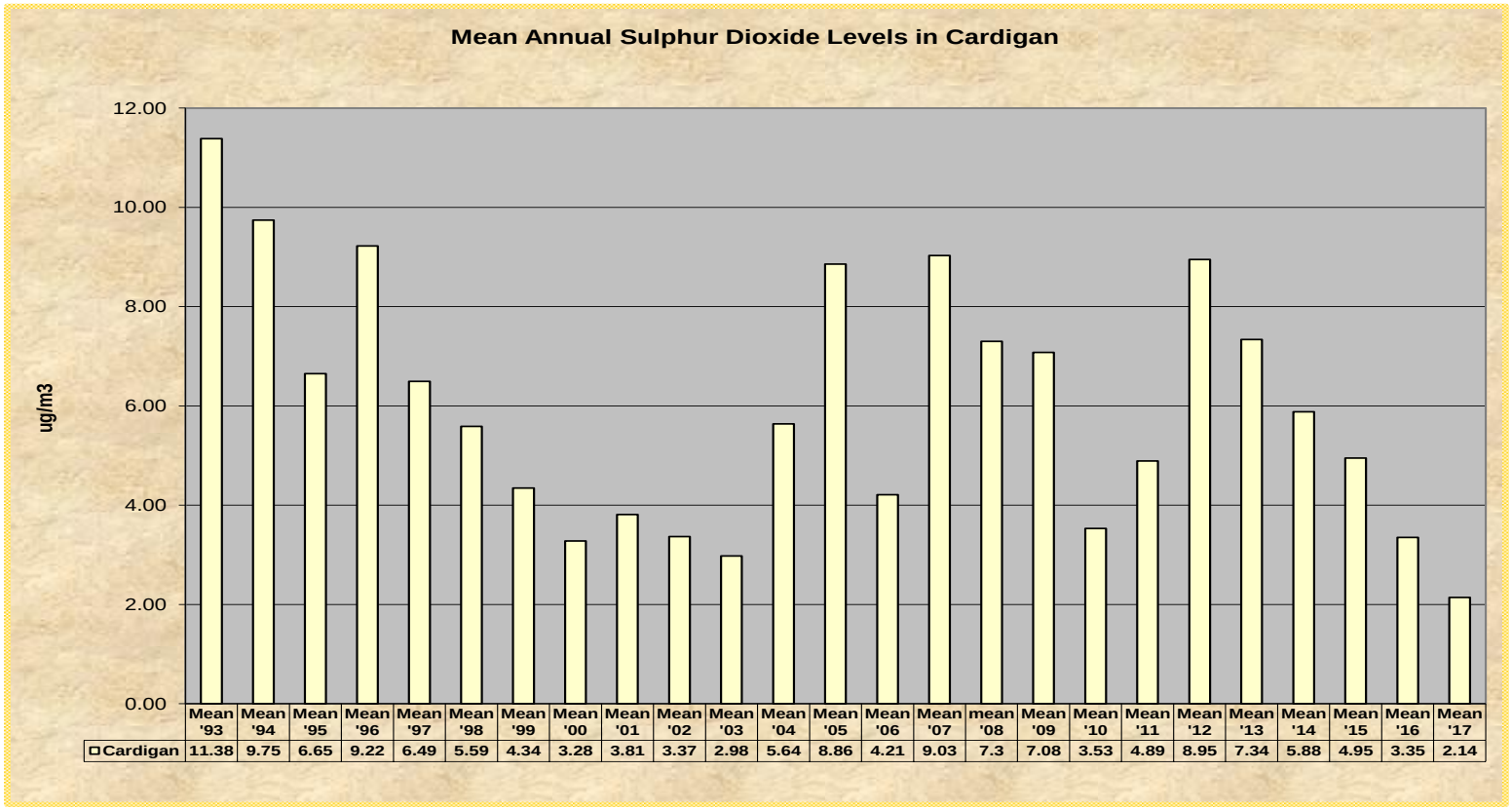


Figure 2.2.19



	Mean '93	Mean '94	Mean '95	Mean '96	Mean '97	Mean '98	Mean '99	Mean '00	Mean '01	Mean '02	Mean '03	Mean '04	Mean '05	Mean '06	Mean '07	mean '08	Mean '09	Mean '10	Mean '11	Mean '12	Mean '13	Mean '14	Mean '15	Mean '16	Mean '17
Cardigan	11.38	9.75	6.65	9.22	6.49	5.59	4.34	3.28	3.81	3.37	2.98	5.64	8.86	4.21	9.03	7.3	7.08	3.53	4.89	8.95	7.34	5.88	4.95	3.35	2.14

The World Health Organisation has set a guideline standard of 45µg/m^3 as an annual average concentration for sulphur dioxide in response to concerns about the possible effects of long-term exposure to this pollutant on health and the EU Court has called for Europe's air quality laws to be brought into line with WHO standards, which are much stricter for sulphur dioxide. Concentrations recorded in Ceredigion **at all monitoring locations,** over twenty five years, have been well below this World Health Organisation annual guideline value. Annual mean concentrations of sulphur dioxide in Ceredigion have also been well below the annual mean standards set for the protection of vegetation and ecosystems at 21µg/m^3 (except for an annual mean recorded in Aberystwyth in 2013 that approached this level).

In monitoring undertaken at coal burning areas in towns / villages in Ceredigion in the past, including in winter months, mean monthly and six-monthly concentrations of sulphur dioxide were consistently closer to background levels than to any of these annual mean standards.

The Air Quality Standards (Wales) Regulations 2010 sets an alert threshold for sulphur dioxide to be measured over three consecutive hours at locations representative of air quality over at least 100 km^2 or an entire zone, whichever is smaller. No sulphur dioxide concentrations in Ceredigion are likely to have approached this alert threshold since monitoring has been undertaken:

Regulations 17, 21(1) and (3), 23(1) and 24(2)

SCHEDULE 4 Information and alert thresholds

Alert thresholds for Sulphur Dioxide

Pollutant	*Alert threshold(1)*
Sulphur dioxide	500μg/m^3

The most stringent national standard for sulphur dioxide is based on a 15-minute mean. Research involving comparative studies with instantaneous measurements has suggested that annual mean concentrations of below 5μg/m3, and monthly means of less than 26μg/m^3 (as is usually observed in Ceredigion) equates with highest maximum hourly averages of around 40μg/m3 and highest maximum 15-minute means of around 53μg/m^3. On this basis it is unlikely that the most stringent 15-minute mean standard of 266μg/m3 (and the alert threshold of 500μg/m3) have been breached in Ceredigion.

When these standards are complied with it is expected that the 1-hour and 24-hour Objectives in the First Air Quality Daughter Directive are also complied with. In fact, monitoring results at an AURN site in a neighbouring county Pembrokeshire in the past (where there were industrial emissions of sulphur dioxide) were consistently less than 10μg/m^3 as a maximum 24-hour mean level – an order of magnitude below the standard of 125μg/m^3.

Box 5.1 of LAQMTG(16) identifies emission sources that have the potential to emit significant quantities of sulphur dioxide. These include railways and stream trains, ports (shipping) and domestic solid fuel burning and industrial installations. All of these sources have been carefully assessed in Ceredigion in previous rounds of Review and Assessment and there were no changes in the county in 2017 that could have affected previous assessments from these types of emission sources.

There are no new or significant sources of sulphur dioxide in the county and coal burning areas that existed in some smaller towns / villages have been thoroughly assessed in previous rounds of review and assessment - with no issues identified.

Most sulphur dioxide air pollution episodes in the UK are now characterised by the sort of short-term peak concentrations observed in Aberystwyth in October 2013 (when a measured monthly mean concentration reached 162.4μg/m^3 in October). These plume migrations from outside the county typically last only a few hours at some point downwind of an industrial source where the plume reaches ground level. Emissions of sulphur dioxide in the UK are dominated by a relatively small number of rural point sources (large power stations and other industrial plant). Plumes from

these plants, however, can travel long distances. These pollution episodes cannot be controlled by local measures.

Sulphur dioxide concentrations will continue to be monitored in Ceredigion using passive diffusion tubes at a smaller number of key monitoring locations to follow trends and to look for any future episodes of significant plume migration from outside the county.

Mean monthly and annual sulphur dioxide concentrations in Ceredigion were very low in 2017. The annual means were between 2.2 and 2.3 μg/m3 at all monitoring locations – the lowest ever recorded in the county.

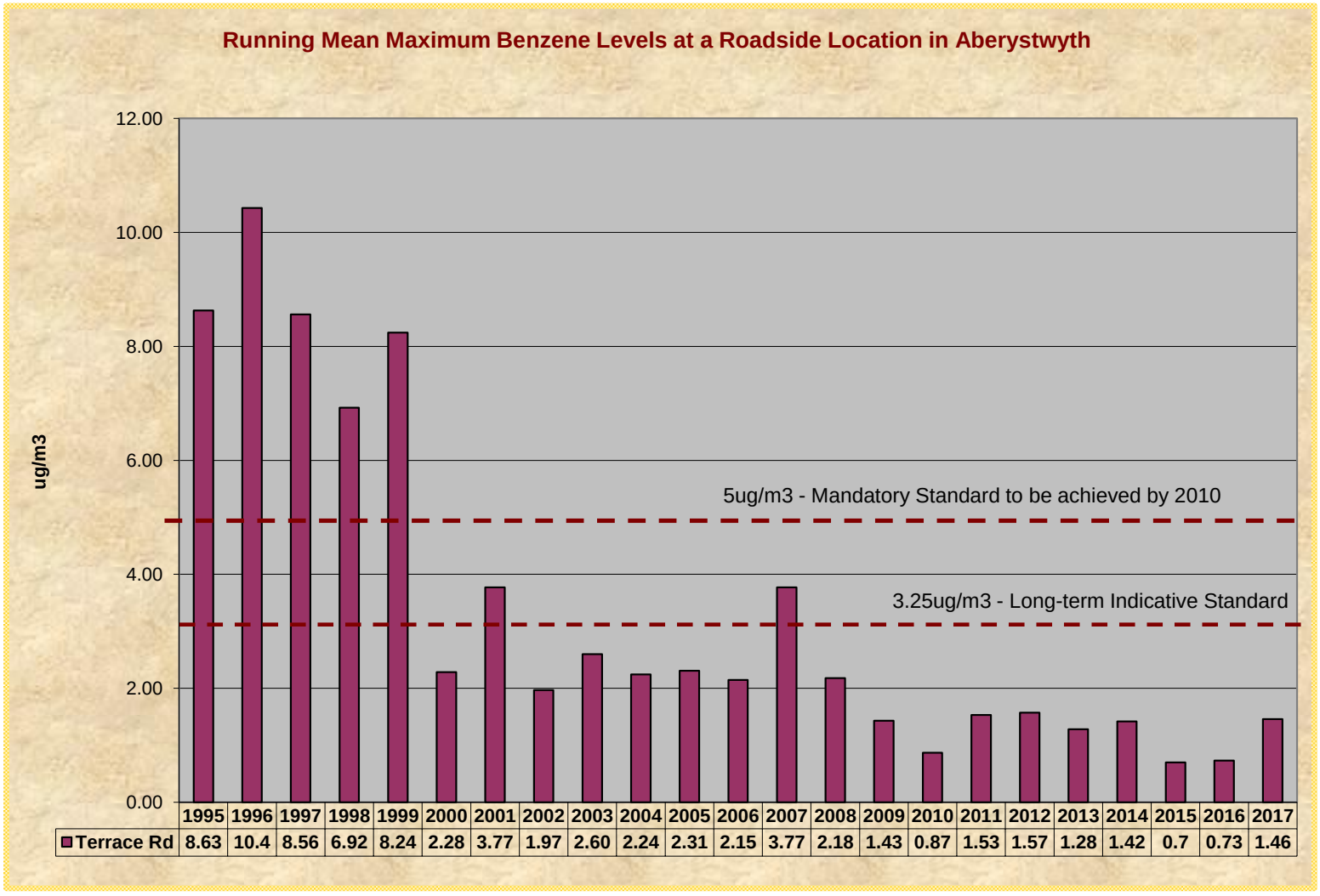
These measured concentrations are well below the annual mean World Health Organisation Guideline Standards (set for the protection of health) and well below UK mean annual Standards (set for the protection of ecosystems and vegetation). They are also well below alert thresholds set in Air Quality Standards (Wales) Regulations 2010.

Benzene

Concentrations of benzene were measured in Ceredigion in 2017 using diffusion tubes for compliance testing and trend monitoring purposes. Monitoring was undertaken at three key locations, in terms of public exposure, in main towns (and close to petrol filling stations) and at a rural background location. Results are shown in graphical form below covering the period 1995 to 2017. Data is shown as a running mean max (defined as the average annual concentration X 1.2).

Figure 2.2.20

Benzene Concentrations in Aberystwyth



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Terrace Rd	8.63	10.4	8.56	6.92	8.24	2.28	3.77	1.97	2.60	2.24	2.31	2.15	3.77	2.18	1.43	0.87	1.53	1.57	1.28	1.42	0.7	0.73	1.46

Figure 2.2.21 Benzene Concentrations in Lampeter

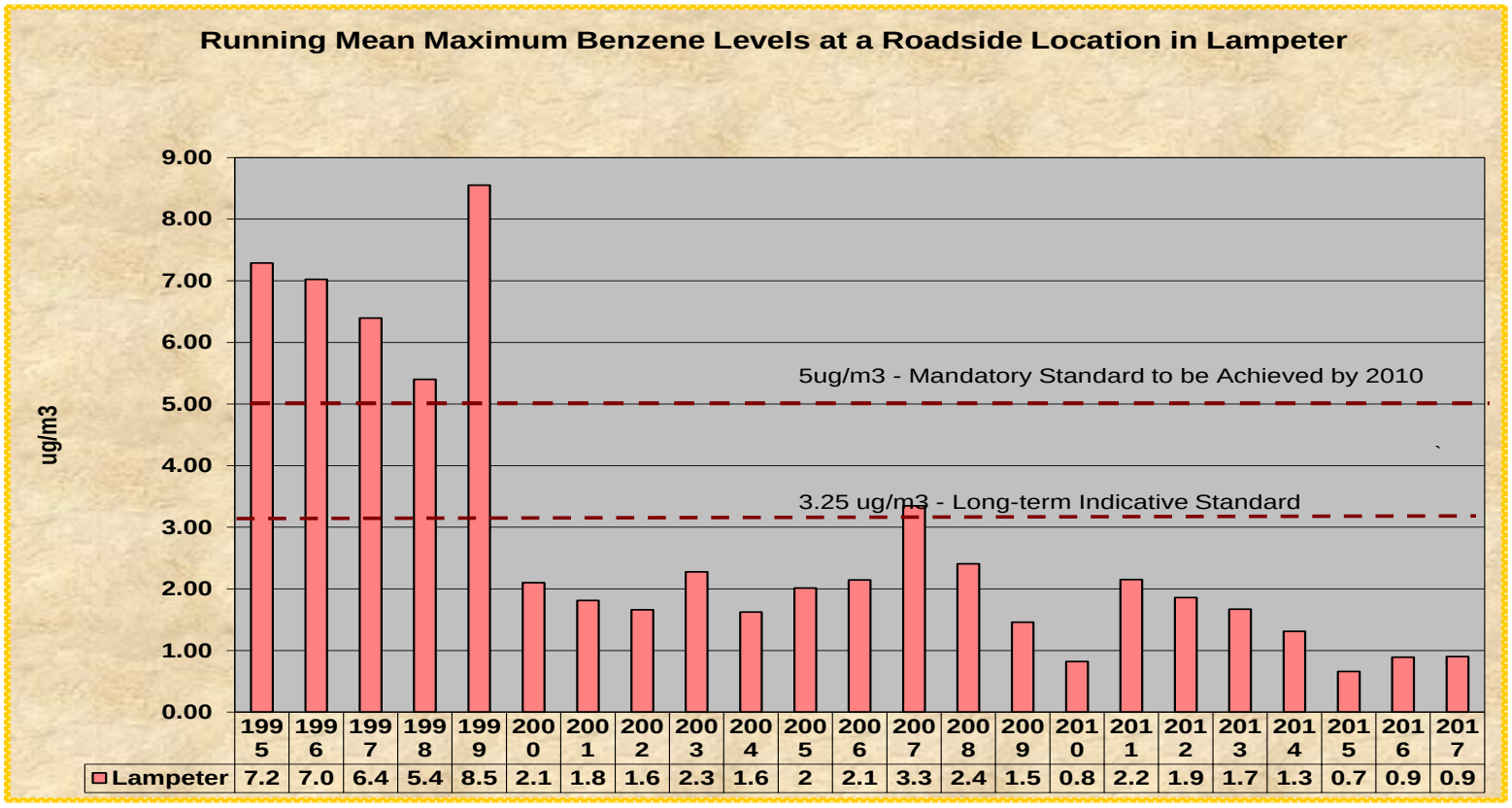
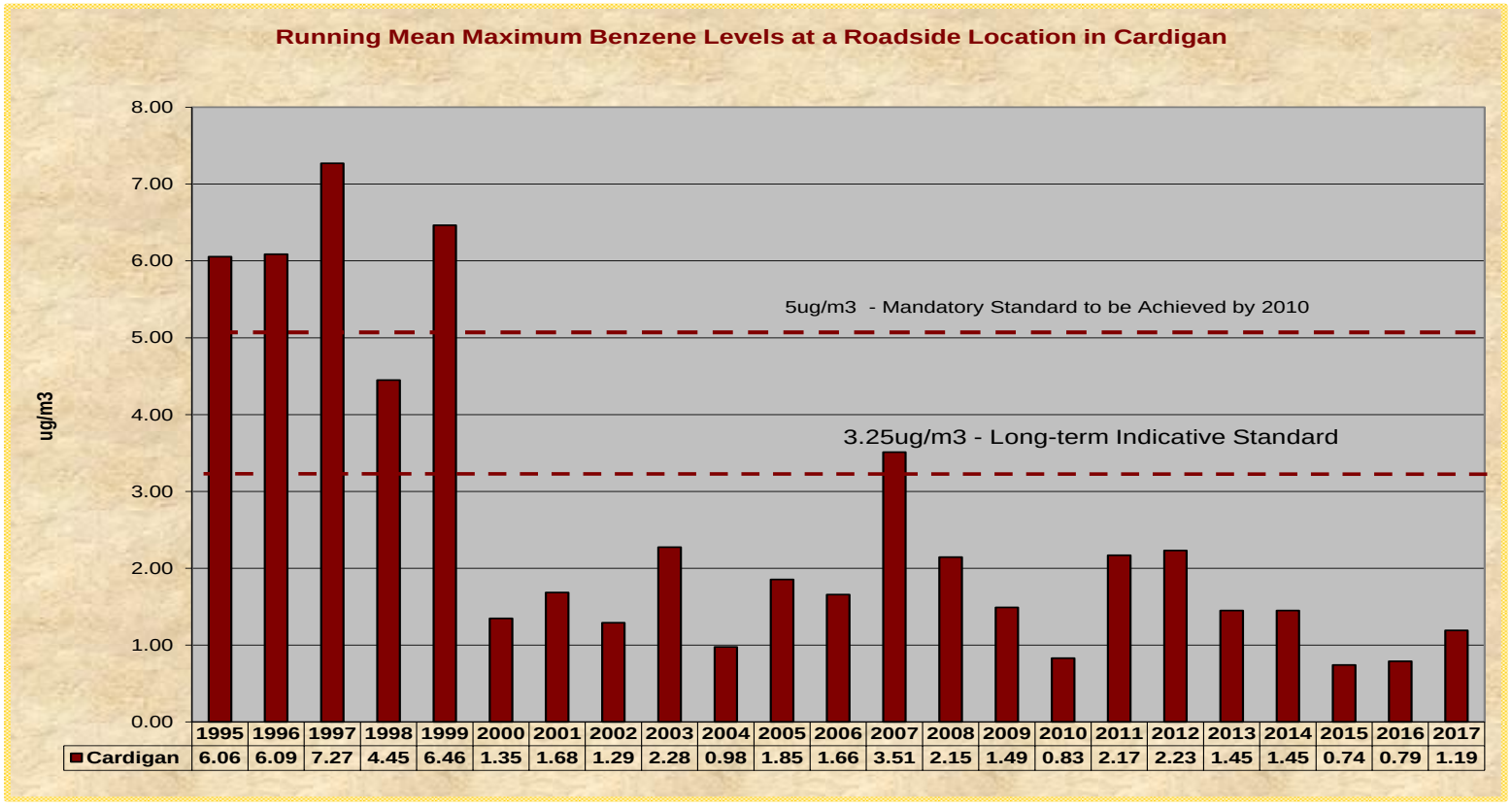


Figure 2.2.22 Benzene Concentrations in Cardigan



The graphs show that the mandatory standards for benzene have been complied with at all “hot-spot” locations in Ceredigion **since the benzene content of petrol was reduced in 2000**. The annual mean concentrations at the three strategic locations above in 2017 were well below the 16.26µg/m3 mandatory standard to be achieved by 2003 and below the 5µg/m3 mandatory standard to be achieved by 2010. These were all kerb-side monitoring locations, **close to petrol stations**, in the busiest towns in Ceredigion where public exposure is important.

The mandatory standard of 16.26µg/m3, to be achieved by 2003, has in fact been complied with at all monitoring locations in Ceredigion since monitoring began in 1995. The standard of 5µg/m3, to be achieved by 2010, has been complied with at all monitoring locations over the last eighteen years. Likewise, the most stringent long-term indicative standard of 3.25µg/m3 has been complied with at all the monitoring locations since 2000 (with the exceptions of Terrace Road in Aberystwyth in 2001 and 2007, High Street in Lampeter in 2007 and High Street in Cardigan in 2007).

There are no petrol stations in Ceredigion with an annual throughput in excess of 2000m^3 of petrol located near to a busy road (more than 30,000 vehicles a day) and no significant benzene elevations have been found in the vicinity of any petrol station in the three main towns in Ceredigion as demonstrated in the graphs above. There are no major fuel storage depots or petrochemical works in the county.

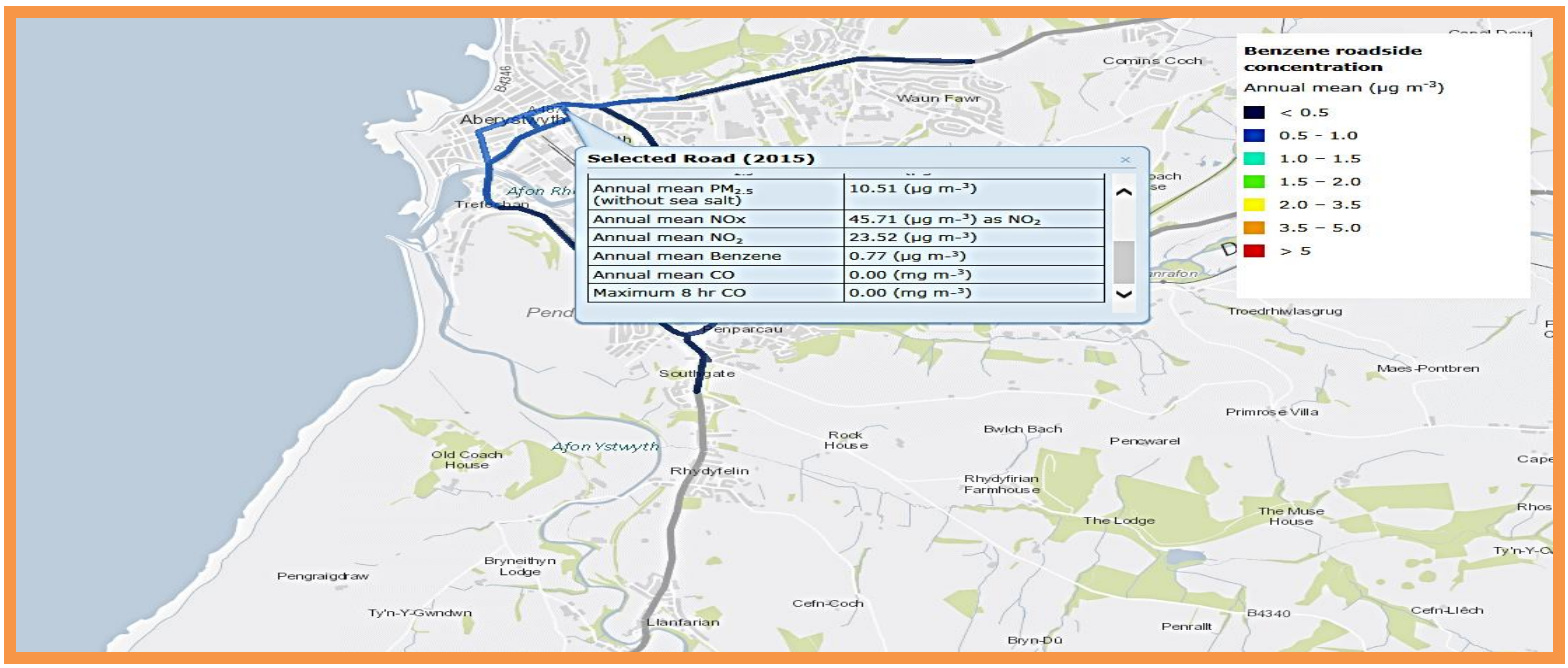
Modelled, roadside ambient air quality concentrations for benzene, at some locations in main towns, are available as an interactive map on the DEFRA website (for 2015):

DEFRA INTERACTIVE MAPS

These concentrations are derived from Defra’s national pollution climate mapping model. Roadside results in Aberystwyth for benzene are shown below:

<u>Roadside Annual Mean Benzene Concentrations Modelled by DEFRA in Aberystwyth in 2015</u>

Figure 2.2.23



At Thespian Street in Aberystwyth in 2015, concentrations of benzene from DEFRA's modelling method were estimated to be 0.77µg/m^3 as an annual mean. At Terrace Road, the most traffic congested road in Ceredigion, the modelled concentration, as an annual mean, in 2015 was 0.75µg/m^3. These modelled concentrations in 2015 at "hot-spot" locations in Aberystwyth were well below the long term indicative standard of 3.25µg/m^3. Modelled results are in excellent agreement with measured results – 0.7µg/m^3 measured in Terrace road in Aberystwyth in 2015 compared with 0.75 µg/m^3 modelled in 2015 (the last available set of modelled results).

Background modelled results are shown below:

Figure 2.2.24

The modelled background concentration for a large part of Aberystwyth in 2015 was 0.73µg/m^3. This compares well with the measured roadside concentrations in 2015 at Terrace Road at 0.7µg/m^3 – that is, measured roadside benzene concentrations at Aberystwyth in 2015 were very low and approached modelled background concentrations. Both were also in excellent agreement with measured background concentrations at rural Pendam in Ceredigion – where the measured annual mean background benzene concentration in 2015 was 0.64µg/m^3. There is excellent consistency, therefore, between all the measured and modelled results in Ceredigion from the available sources.

The Expert Panel on Air Quality Standards has recommended a target level of 3.25µg/m^3 as a running annual mean for benzene. The UK Government included this recommended target in the National Air Quality Strategy in 2000 as an indicative level and long-term policy aim. Indicative levels are intended to act as pointers to the direction of future policy and are not included in Regulations. However, the aim is to

reduce concentrations of benzene as far as is practicable towards the indicative level. Measured (and modelled) results in Ceredigion already comply with this long term indicative standard at all “hot-spot”, road-side and “worst case” locations that are relevant to public exposure.

Benzene concentrations will continue to be monitored in Ceredigion in the future, but at a smaller number of strategic kerb side locations (or locations where changes have occurred and issues may arise), to investigate any potential emerging problems and confirm continuing compliance with this long term indicative standard.

Mandatory (and long-term indicative) standards for benzene were complied with in Ceredigion in 2017 at all monitored “hot-spot” and road-side locations that are relevant to public exposure. The longer term indicative standard of 3.25µg/m3 (that is not contained in Regulations but was recommended by the Expert Panel on Air Quality Standards) is also complied with at worst case locations in the three main towns in Ceredigion.

Results modelled by DEFRA (background and roadside) and measured results have been in excellent agreement.

OZONE

No standards for ozone have been adopted in Regulations. Long term objectives for ozone are available in schedule 3 of the Air Quality Standards (Wales) Regulations 2010:

Regulations 8(2), 16, 23(1), 24(2)

SCHEDULE 3 Long-term objectives for ozone

Objective	Averaging period	Long-term objective	Date by which long-term objective should be met
Protection of human health	Maximum daily eight hour mean within a calendar year	120µg/m^3	Not defined
Protection of vegetation	May to July	AOT 40 (calculated from 1h values) 6000µg/m^3 · h	Not defined

No target dates by which these long-term objectives are to be achieved have been set.

Schedule 4 sets Information and Alert thresholds for ozone:

Regulations 17, 21(1) and (3), 23(1) and 24(2)

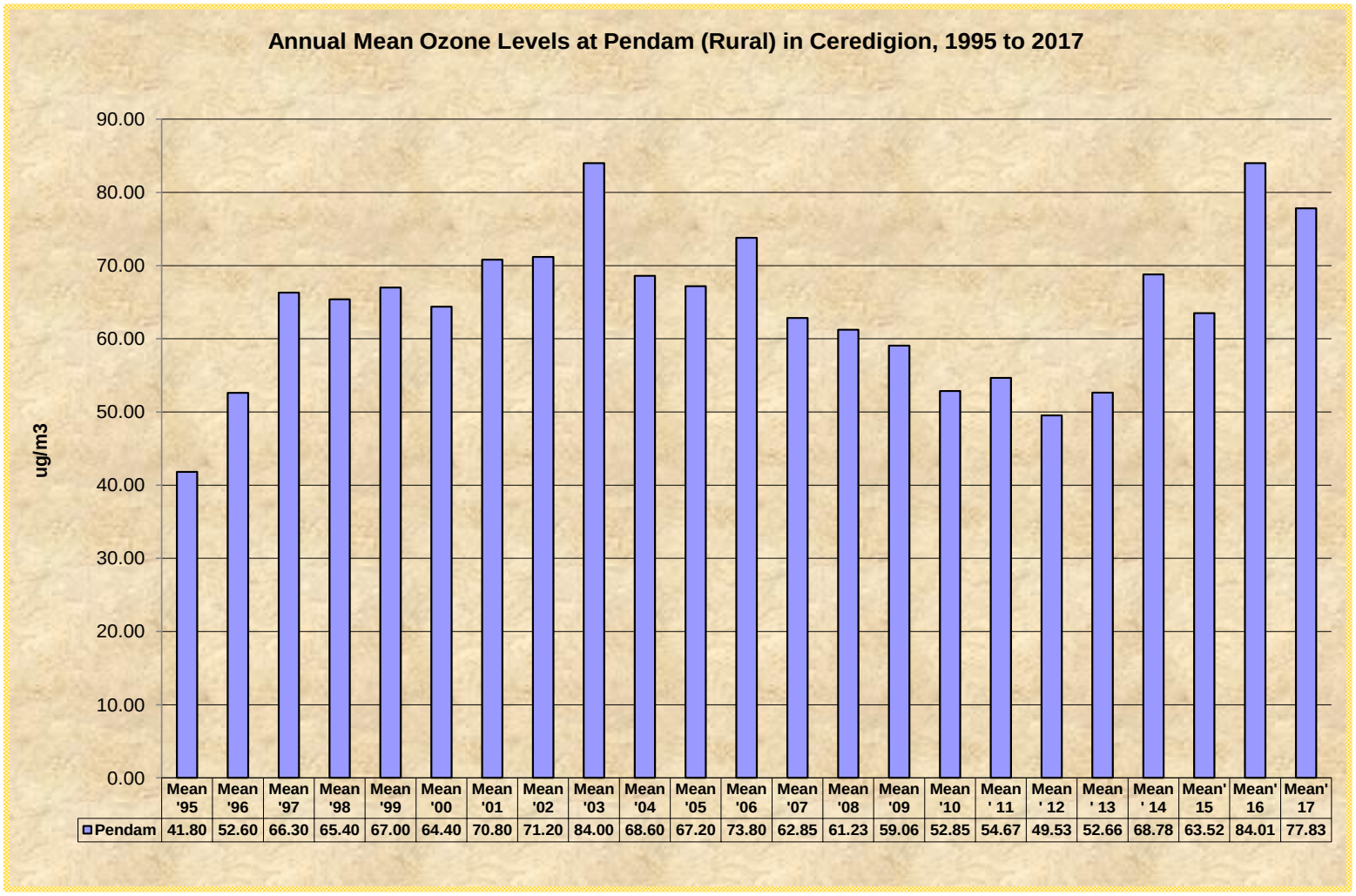
SCHEDULE 4 Information and alert thresholds

Purpose	Averaging period	Threshold
Information	1 hour	180µg/m^3
Alert	1 hour	240µg/m^3

The relevant workable objective, therefore, for the protection of public health, is the maximum daily eight hour mean within a calendar year of 120µg/m3.

Annual mean monitoring results for ozone in Ceredigion, at an elevated, rural location (where the highest concentrations of ozone in Ceredigion have consistently been observed over many years) are shown below:

Figure 2.2.25



Ozone monitoring is undertaken in Ceredigion, even though statutory standards and objectives for this pollutant are not contained in Regulations, because of local concerns about its links to health and because of its emergence as an important pollutant in the global warming / climate change debate. Ozone levels tend to be highest at locations away from busy roads and towns because nitrogen dioxide, from car emissions, reacts with ground level ozone reducing its concentration in urban areas. Ozone is produced by photochemical reactions that take place in the atmosphere and concentrations tend to be highest in warmer summer months. Ozone plumes, as with sulphur dioxide and particulates, can travel long distances causing transboundary air pollution.

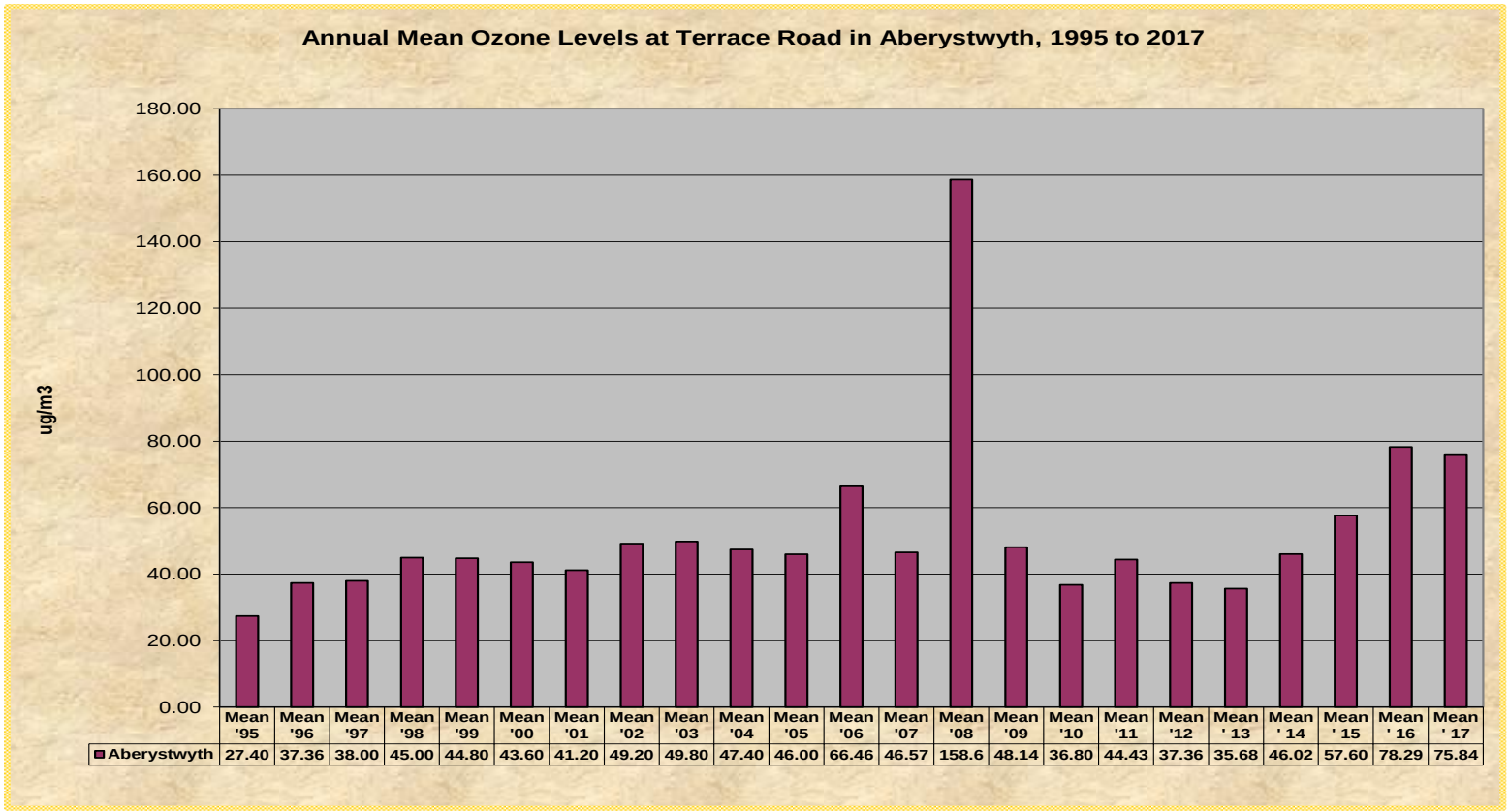
As can be seen in the graph above, Ozone concentrations increased steadily at rural Pendam in Ceredigion, a hot-spot location, in the period 1995 to 2003 (where it peaked during the long, hot summer of 2003 with an annual mean concentration of 84µg/m^3). This mean in 2003, **over the whole of the year**, was 70% of the 8-hour mean standard at 120µg/m3. A high annual mean concentration of ozone was also measured at this rural monitoring location in 2006 (another hot summer). After 2006, when there were relatively wet and cooler summers, annual mean concentrations of ozone decreased steadily up to 2012. Since 2013, as the summers have got warmer again, annual mean ozone concentrations have increased at this rural monitoring

location (to 84.01µg/m3 – almost 70% of the 8-hour mean standard **as an annual mean** in 2016). In 2017 there were issues at the laboratory supplying and analysing ozone diffusion tubes and results can only be reported as an upper limit. The trend for ozone, however, since 2012 remains upwards. Globally, 2017 ranked as the third warmest year on record - 2016 was the warmest year on record. More ozone is produced in the atmosphere in warmer summer months because ozone is produced by photochemical (sunlight driven) reactions in the atmosphere. An 8-hour mean standard of 120µg/m^3 could have been breached for long periods during 2017, 2016, 2006 and 2003 – years with warm summers. The summer of 2018 has once again been one of the warmest on record.

The most significant ozone episode to have been observed in Ceredigion occurred in 2008 when an unprecedented mean monthly concentration for ozone of 1190.6µg/m3 was recorded in April in the main town of Aberystwyth. This concentration is still the highest mean monthly concentration of ozone recorded in Ceredigion, was almost 10 times the **eight hour standard** of 120µg/m^3 **and more than four times the alert thresholds above which it is believed effects on otherwise healthy individuals could possibly occur**. This was a particularly severe ozone pollution episode that affected the main town of Aberystwyth but with elevations of ozone also observed in other parts of Ceredigion. In May, 2008 an ozone concentration of 106.8µg/m^3 was subsequently recorded in Tregaron and a concentration of 93.4µg/m^3 at Ysbyty Ystwyth as the ozone plume migrated inland from Aberystwyth before slowly dispersing.

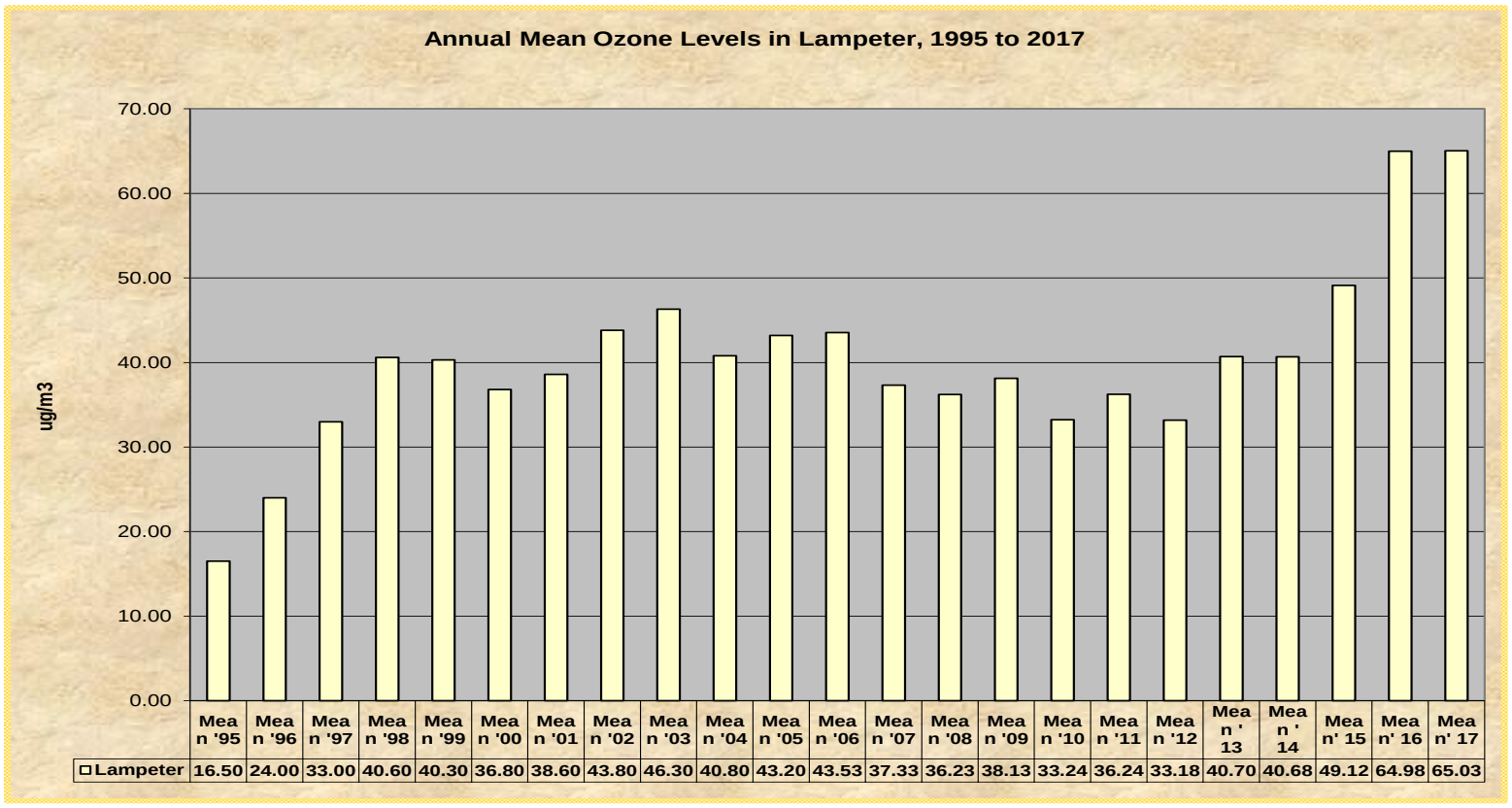
Trends for ozone in the three main towns in Ceredigion are shown below:

Figure 2.2.26



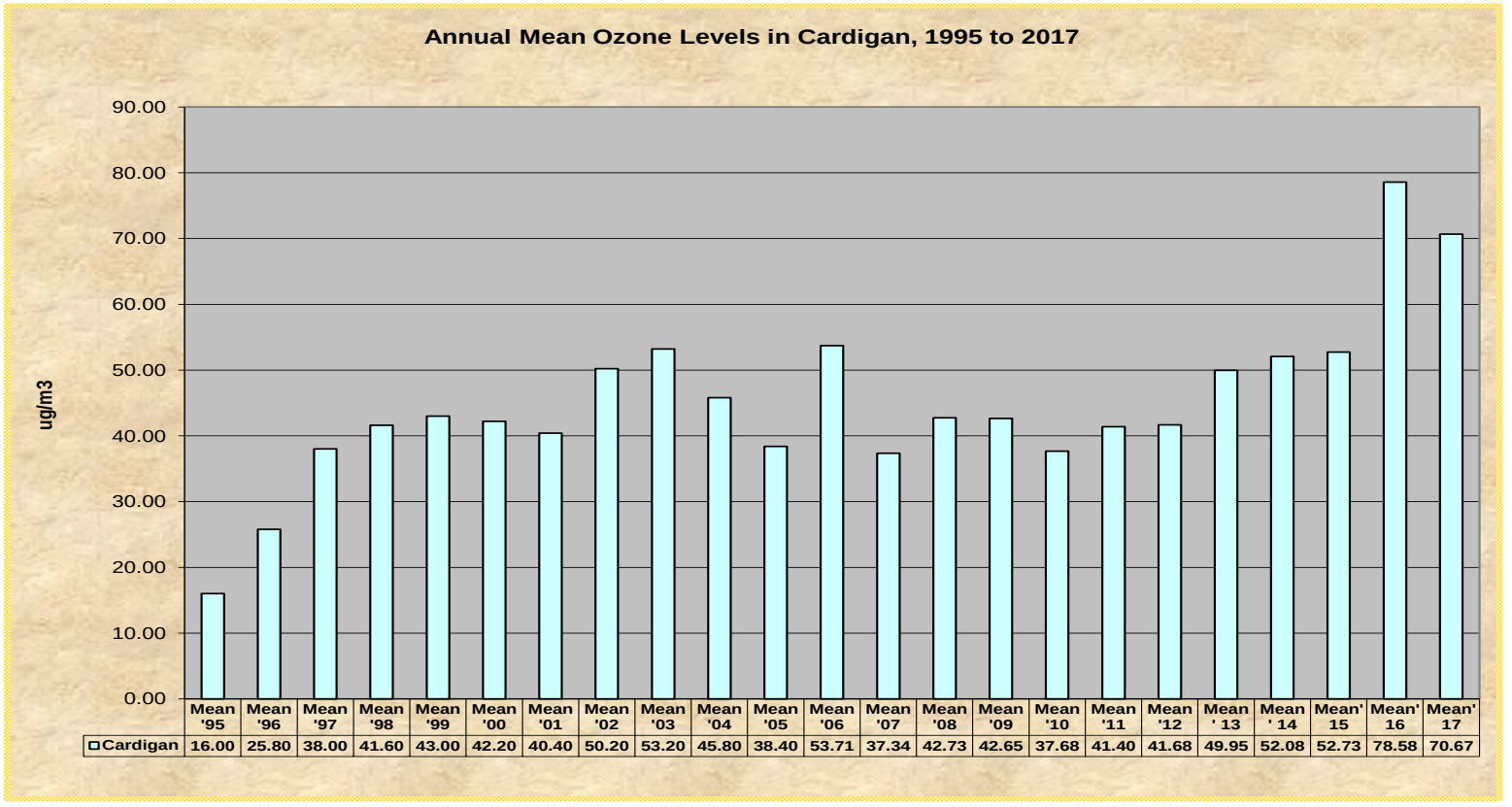
	Mean '95	Mean '96	Mean '97	Mean '98	Mean '99	Mean '00	Mean '01	Mean '02	Mean '03	Mean '04	Mean '05	Mean '06	Mean '07	Mean '08	Mean '09	Mean '10	Mean '11	Mean '12	Mean ' 13	Mean ' 14	Mean ' 15	Mean ' 16	Mean ' 17
Aberystwyth	27.40	37.36	38.00	45.00	44.80	43.60	41.20	49.20	49.80	47.40	46.00	66.46	46.57	158.6	48.14	36.80	44.43	37.36	35.68	46.02	57.60	78.29	75.84

Figure 2.2.27



	Mean '95	Mean '96	Mean '97	Mean '98	Mean '99	Mean '00	Mean '01	Mean '02	Mean '03	Mean '04	Mean '05	Mean '06	Mean '07	Mean '08	Mean '09	Mean '10	Mean '11	Mean '12	Mean ' 13	Mean ' 14	Mean' 15	Mean' 16	Mean' 17
Lampeter	16.50	24.00	33.00	40.60	40.30	36.80	38.60	43.80	46.30	40.80	43.20	43.53	37.33	36.23	38.13	33.24	36.24	33.18	40.70	40.68	49.12	64.98	65.03

Figure 2.2.28



	Mean '95	Mean '96	Mean '97	Mean '98	Mean '99	Mean '00	Mean '01	Mean '02	Mean '03	Mean '04	Mean '05	Mean '06	Mean '07	Mean '08	Mean '09	Mean '10	Mean '11	Mean '12	Mean ' 13	Mean ' 14	Mean' 15	Mean' 16	Mean' 17
Cardigan	16.00	25.80	38.00	41.60	43.00	42.20	40.40	50.20	53.20	45.80	38.40	53.71	37.34	42.73	42.65	37.68	41.40	41.68	49.95	52.08	52.73	78.58	70.67

In Lampeter and Cardigan, the highest annual mean ozone concentrations, over twenty three years of monitoring, have been observed in the last two years (corresponding to the warmest and third warmest years globally on record). In Aberystwyth, the highest annual mean ozone concentration was observed in 2008 (an annual mean that was skewed by the exceptionally high monthly ozone mean in April at 1190.6µg/m^3). The second and third highest annual mean ozone concentrations recorded in Aberystwyth also occurred in 2016 and 2017. In 2017 in November, there were **mean monthly exceedances** of the 120µg/m^3 8-hour mean standard in Aberystwyth, Pendam and Tregaron. The eight hour mean standard of 120µg/m^3 would have been breached for long periods at these three locations in this month.

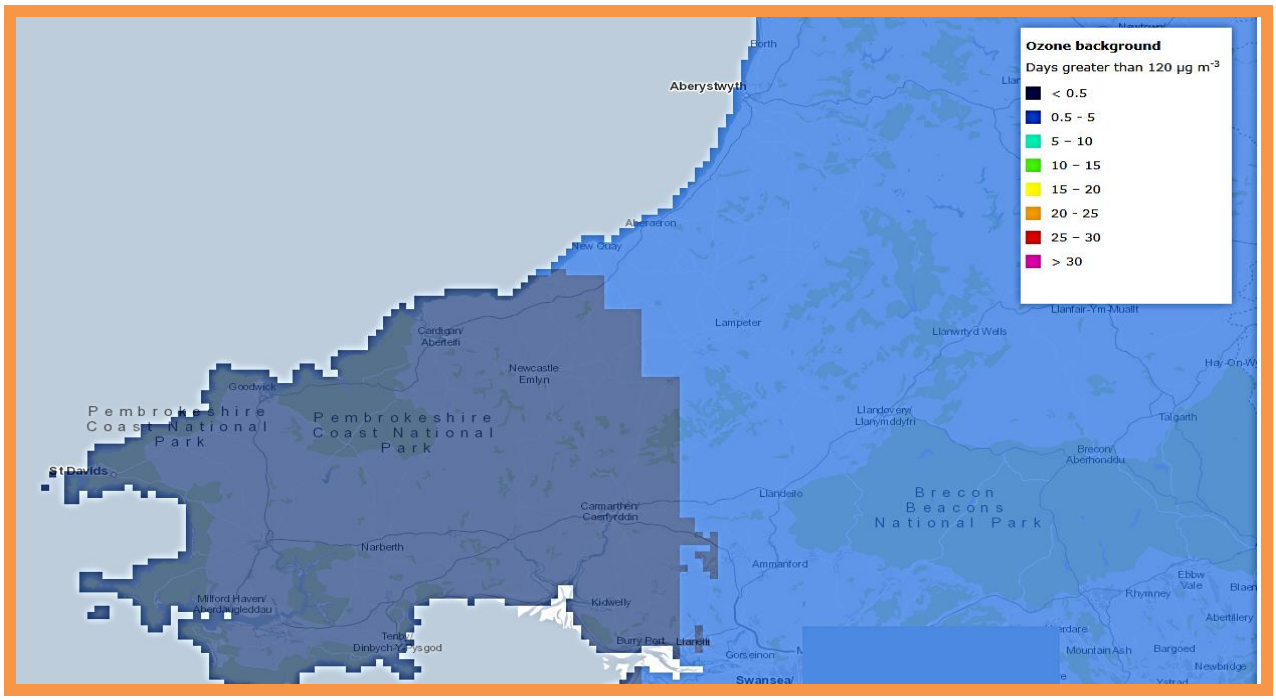
Ozone at ground level is an air pollutant that has important health implications. Concentrations and “peak episodes” of ozone may increase in the future as global warming and climate change progresses. The Chief Medical Officer for Wales has warned that this could potentially lead to increased deaths and hospital admissions. High concentrations of ozone can particularly affect the respiratory system, resulting in asthma, bronchitis, heart attacks and other cardiovascular problems. Had the ozone episode observed in Aberystwyth in April 2008 occurred during a peak summer month, when temperatures were higher, rather than in the spring, when temperatures were lower, the health consequences could have been significant. It has been estimated that the number of deaths among the over-55s rises sharply when the average temperatures exceeds 25C (77F) over a few consecutive days particularly when accompanied by high ozone levels. The August heat wave in 2003 caused more than 2,000 deaths across the UK with linked increases in ozone air pollution probably causing a further 1,500 deaths. In France, more than 14,000 people died when temperatures hit 40C in the same hot summer. The 2003 summer heat wave, and simultaneous incident of high ozone pollution in France and the South East of England, highlighted the adverse health effects associated with a combination of heat and ozone air pollution on sensitive and susceptible individuals.

The Government acknowledges that the concentration of ozone recorded at monitoring locations around the UK shows that the strategy objective is being exceeded at many locations. UK computer scale modelling shows that even after the implementation of current policies to reduce emissions of ozone precursors, there are still likely to be exceedances of the objective across much of southern Britain.

DEFRA interactive maps are available for ozone:

DEFRA INTERACTIVE MAPS

Figure 2.2.29



The results of DEFRA modelling mapped above suggest that the 120µg/m^3 8-hour mean standard could have been breached across the whole of Ceredigion on between 0.5 to 5 complete days in 2015 (using this most recent modelled data for ozone that is available). This is consistent with Ceredigion's monitoring results and conclusions. Modelling also suggests that even the adoption of additional measures to reduce ozone precursors might not be sufficient to remove all the exceedances of the strategy objective. The Government believes, however, that the adoption of the 120µg/m3, 8-hour standard should help to keep maximum ozone values below the level of around 200µg/m3 at which adverse effects on otherwise healthy individuals could occur.

Ozone is the only pollutant of those included in the National Air Quality Strategy that can be more problematic in rural than in urban areas. Because sunlight drives the reactions that produce ozone, it is understood why ozone is usually more of a problem in the summer, and in the south of the country, rather than in the north. Highest levels are more likely to occur during hot sunny days, months and years. Levels increase during periods following the heavy production, and poor dispersion, of traffic fumes that are necessary for the precursor photochemical reactions to take place.

Further action to reduce ozone is necessary but as part of a coherent European strategy because of the importance of transboundary effects. "Photochemical smog" can migrate large distances and is an international problem. In November 2017, monitoring in Ceredigion suggested that an ozone smog had been present that stretched from the town of Aberystwyth (ozone concentration as a monthly mean of 115.5µg/m^3) to the hills in the north around Pendam (concentration of 141.2 µg/m^3), in land towards the town of Tregaron (concentration of 133.3 µg/m^3) and down to Newcastle Emlyn in the south of the county (where a mean monthly ozone concentration of 92.2µg/m^3 was observed).

Improvements and abatement measures need to be targeted specifically at the key constituents of ozone production – hydrocarbons and the nitrogen oxides. Interestingly, however, some computer modelling suggests **that reducing nitrogen oxides could increase the ozone problem in urban areas**. It is estimated that annual ozone concentrations **could actually increase if nitrogen oxide emissions fall** (because nitrogen oxides reduce ground level ozone).

Nevertheless, significant reductions in concentrations of ground level ozone are necessary because of the associated health related risks and because of its effects on vegetation and the contributions it makes to global warming and climate change.

Annual mean ozone concentrations were amongst the highest ever recorded in Ceredigion in 2016 and 2017. This corresponded with the warmest year ever recorded globally in 2016 and the third warmest in 2017.

An indicative 8-hour Standard for Ozone would probably have been breached at some locations in Ceredigion over extended periods of time in 2016 and 2017. It was probably also breached for long periods of time in previous years - particularly those with warm summers. An exceedingly high concentration of ozone was recorded in Aberystwyth in April 2008 and this remains the most severe ozone episode to have been observed in Ceredigion to date.

No mandatory standards for ozone have been adopted in Regulations. Long term indicative objectives are available in Schedule 3 of the Air Quality Standards (Wales) Regulations 2010 (a standard of 120µg/m3 but with no objective date set).

The Government accepts that the indicative ozone standards have been, and will continue to be, breached with exceedances occurring more often in the south of the UK and in rural areas rather than cities and large towns.

Global warming could exacerbate this problem increasing public health and environmental concerns about ozone pollution. For this reason ozone will continue to be monitored in Ceredigion – though at a reduced level in future years.

2.3 Comparison of 2017 Monitoring Results with Previous Years and the Air Quality Objectives

Ceredigion County Council has no Air Quality Management areas and has no areas close to Air Quality Strategy Objectives for any of the priority air quality pollutants contained in Regulations. It has not been considered necessary, therefore, to declare any Air Quality Management Areas or to prepare Action Plans and a Local / Regional Air Quality Strategy. The monitoring results for 2017 presented in Section2.2 above continue to show a downward trend for the priority pollutant nitrogen dioxide and remain low for all the other pollutants monitored (except for the pollutant ozone - standards for which are not contained in Regulations).

In 2017, road traffic continued to be the dominant source of air pollution in Ceredigion even though the volume of road traffic in the county remains relatively low in national terms and does not approach the heavily trafficked classification described in Guidance at any locations in the county. The ratio of heavy goods vehicles to the total number of vehicles is also low in Ceredigion because of the lack of industry.

Monitoring was undertaken in the most traffic congested and sensitive areas of Ceredigion (where public exposure is important) for three of the pollutants contained in Regulations to confirm continuing compliance with national standards and objectives and to monitor trends. Monitoring is also undertaken periodically at new locations to identify any impacts associated with changes in industrial activity, changes of road lay-outs, changes in the volume and composition of traffic and any impacts from new local developments and other factors that could contribute to air pollution in the county. Monitoring has been focused on sensitive areas - in the vicinity of schools, industrial sites, garages, the rail network, bus stations, dry cleaning and paint shops etc (as suggested in Technical Guidance).

As in previous rounds of Review and Assessment, results reported in Section 2 of this Progress Report indicate that all statutory air quality Standards and Objectives are complied with in Ceredigion by specified dates at all locations (including at the most heavily trafficked roadside locations). Data capture, using diffusion tubes, was 100% for most of the pollutants monitored in 2017 and consequently it was not necessary to “annualise” any results.

Monitoring and new assessments in this report have not revealed any places in Ceredigion where the combustion of fuels (in motor vehicles, industry, or in domestic properties) or fugitive emissions are causing, or are likely to cause, significant air quality problems. No traffic-related air quality issues have been identified at the busiest roads and at the most congested town locations in Ceredigion. There were no major industries close to heavily populated areas that were causing issues in 2017 and there are only a small number of Part B processes and small combustion plants in the county (mostly categorised as “low risk”).

Non-statutory Standards and Objectives for ozone, however, may not be complied with in some parts of Ceredigion and this pollutant will continue to be monitored in

the county. Periodic exceedances of this pollutant can only be addressed by national / international measures.

Likewise, some annual mean roadside PM2.5 concentrations modelled by DEFRA for 2015 have been estimated to exceed the Scottish mandatory and a World Health Organisation guideline standard of 10µg/m^3 in parts of Aberystwyth. These standards have not been adopted in England and Wales and are also not contained in Regulations. All the modelled results for PM2.5, however, comply with a target Standard of 25µg/m^3 contained in the Air Quality Standards (Wales) Regulations 2010.

2.3.1 Nitrogen Dioxide (NO_2)

In Ceredigion, the most stringent annual Standard of 40µg/m^3 for nitrogen dioxide was complied with at all monitored locations (including roadside, "hot-spot" locations and those most relevant for public exposure) in 2017. The annual mean is the most stringent standard. If the annual mean Standard is complied with it is likely that the hourly standards are also complied with throughout Ceredigion (that is, it is unlikely that there were any exceedances of the 1-hour mean standard of 200µg/m3 -18 exceedances are permitted in a year). No monthly mean concentrations recorded exceeded 60µg/m^3 - the concentration at which there is a risk of the 1-hour objective being exceeded.

Data capture, using diffusion tubes, was 100% for nitrogen dioxide monitored on a monthly basis, over the full year, in 2017 at all monitoring locations except two (Morrison's and Terrace Road in Aberystwyth where the data capture rate was 92% because of "missing tubes"). No results needed to be "annualised" in 2017.

No monitoring was co-located in 2017 and no results shown are the mean of multiple tube exposures. All results have been appropriately bias corrected using the correction factor of 0.79 in 2017 supplied by the analysing laboratory. Trends have been reviewed for nitrogen dioxide and are shown at one of the most significant hot-spot locations in Ceredigion (Terrace Road in Aberystwyth) in Section 2.2 above. Trends over the last eighteen years are downwards with annual mean concentrations of nitrogen dioxide (bias corrected) falling from around 34µg/m^3 to around 21µg/m^3 in this period at one of the heaviest trafficked and most important canyon locations in the county.

Government factors to estimate future concentrations of this pollutant suggest that concentrations of nitrogen dioxide will continue to fall and this is in accord with projections made in Ceredigion based on measured data for nitrogen dioxide. Concentrations of nitrogen dioxide recorded in the county in 2017 easily complied with the First European Air Quality Daughter Directive to be achieved by the objective date of 2010.

2.3.2 Particulate Matter (PM_{10})

No monitoring of particulate (PM10) pollution was undertaken in Ceredigion in 2017. Background PM10 concentrations modelled by DEFRA in Ceredigion in 2015 (the

most recent year for which data is available) were estimated to be around 13µg/m^3 (except in the main town of Aberystwyth - where modelled background concentrations were in the range 13 to 17µg/m^3). Modelled roadside concentrations at hot-spot locations in the main town of Aberystwyth were estimated to be around 16.5µg/m^3 .These estimates approach background levels even at the worst, roadside and hot-spot locations in Ceredigion. They are well below the annual mean PM10 standard of 40µg/m^3 and even below the stringent World Health Organisation GUIDELINE Standard of 20µg/m^3:

2.3.3 Particulate Matter ($PM_{2.5}$)

No monitoring of particulate (PM2.5) pollution was undertaken in Ceredigion in 2017. Background PM2.5 concentrations modelled by DEFRA in Ceredigion in 2015 (the most recent year for which data is available) were estimated to be around 10.45µg/m^3 at Aberystwyth in Ceredigion. This exceeds the Scottish mandatory and World Health Organisation guideline standard of 10µg/m^3 (that has not been adopted in England and Wales). It complies, however, with a target, indicative Standard of 25µg/m^3 contained in the Air Quality Standards (Wales) Regulations 2010.

On the basis of DEFRA's modelled results for 2015, PM2.5 concentrations are increased by less than 8% (around 0.85µg/m^3) at the roadside in Aberystwyth above background levels by road traffic. Modelled roadside PM2.5 concentrations, therefore, even at "hot-spot" locations in Ceredigion, are close to background concentrations. Nevertheless, concentrations of PM2.5 at some roadside locations in Aberystwyth may also exceed the Scottish mandatory and World Health Organisation guideline standards.

These observations, in a relatively small town in a rural county like Ceredigion, suggest that the Scottish and World Health Organisation Standard for PM2.5 are stringent and could be difficult to achieve at many road-side locations in the UK. A large portion of PM2.5 pollution is transboundary with 40% - 50% of the concentrations of PM2.5 likely to arise from non-local sources that cannot be controlled by local measures. The contribution from sea-salt alone in coastal towns can amount to around 10% of the total background concentration for PM2.5.

Reducing PM2.5 concentrations, to below the WHO guideline and Scottish mandatory standards, might, therefore, require that the background PM2.5 concentration itself be reduced. This would fall outside the scope of local air quality management and control.

Studies for the Department of Health suggest that PM2.5 is the sixth most important lever for improving public health in the UK and air pollution in general is acknowledged as being "the biggest environmental risk" to public health across Europe with air pollution killing an estimated **400,000** Europeans each year. The EU Court of Auditors in 2018 has accused Governments of failing to deal with the crisis pointing out that some European air quality standards are lower than World Health Organisation guidelines – and many European Union countries do not comply with even the less stringent standards. In their audit, the European Union Court calls for Europe's air quality laws to be brought into line with WHO standards, which are at least twice as exacting for particulate (PM2.5 and PM10) emissions and six times stricter for sulphur dioxide. There are no standards for PM2.5 in England and Wales at this time and it would pose a significant challenge if standards were introduced at

levels in line with World Health Organisation guidelines as suggested (particularly for PM2.5).

2.3.4 Other Pollutants Monitored

Sulphur Dioxide

Mean monthly and annual sulphur dioxide concentrations in Ceredigion were very low in 2017. The annual means were between 2.2 and 2.3μg/m3 at all monitoring locations – the lowest ever recorded in the county.

These measured concentrations are well below the annual mean World Health Organisation Guideline Standards (set for the protection of health) and well below UK mean annual Standards (set for the protection of ecosystems and vegetation). They are also well below alert thresholds set in Air Quality Standards (Wales) Regulations 2010.

Benzene

Mandatory (and long-term indicative) standards for benzene were complied with in Ceredigion in 2017 at all monitored “hot-spot” and road-side locations that are relevant to public exposure. The longer term indicative standard of 3.25μg/m3 (that is not contained in Regulations but was recommended by the Expert Panel on Air Quality Standards) is also complied with at worst case locations in the three main towns in Ceredigion.

Results modelled by DEFRA (background and roadside) and measured results have been in excellent agreement.

Ozone

Annual mean ozone concentrations were amongst the highest ever recorded in Ceredigion in 2016 and 2017. This corresponded with the warmest year ever recorded globally in 2016 and the third warmest in 2017.

An indicative 8-hour Standard for Ozone was probably breached at many locations in Ceredigion in 2016 and 2017 over extended periods of time. It was probably also breached for long periods of time in previous years - particularly those that were similarly warm and with good summers. An exceedingly high concentration of ozone, for example, was recorded in Aberystwyth in April 2008. This was the most severe ozone episode observed in Ceredigion to date.

No standards for ozone have been adopted in Regulations. Long term indicative objectives are available in Schedule 3 of the Air Quality Standards (Wales) Regulations 2010 - a standard of 120μg/m3 but with no objective date set.

The Government accepts that ozone standards have been, and will continue to be, breached with exceedances occurring more often in the south of the UK and in rural areas rather than cities and large towns.

Global warming could exacerbate this problem increasing public health and environmental concerns about ozone pollution. For this reason ozone will continue to be monitored in Ceredigion – though at a reduced level in the future.

2.4 Summary of Compliance with AQS Objectives in 2017

Ceredigion County Council has examined new results for air pollutants **contained in Regulations** in the district and compared them with statutory standards, other available measurements and data modelled by DEFRA etc - including at worst case roadside locations. **Concentrations of all the pollutants** contained in Regulations **are well below the standards in Ceredigion and are fully compliant with all statutory objectives**. It is not considered necessary, therefore, to undertake Detailed Assessments for any of the priority pollutants or to declare any Air Quality Management Areas in the county.

New Air Quality Indicators for Wales, for nitrogen dioxide and particulates (PM10 and PM2.5), suggest that air quality in Ceredigion ranks with the best in Wales on the basis of these indicators.

3. New Local Developments

Ceredigion County Council confirms that there are no new or newly identified local developments that currently impact significantly on air quality within the Local Authority area.

Ceredigion County Council confirms that all the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources**

There were no new developments in Ceredigion in 2017 that were expected to impact significantly on air quality in the county. There are no locations that have not been assessed in previous rounds of review and assessment.

The most significant developments in Ceredigion in recent years have been the completion of two new offices in Aberystwyth (a Welsh Assembly Building and new Council Offices)**. Monitoring for nitrogen dioxide has continued at a strategic location in the vicinity of these developments to observe any changes in air quality.** Annual mean nitrogen dioxide concentrations at this monitoring location have remained relatively low and well below the annual mean standard for nitrogen dioxide. Monitoring will be continued in the vicinity of these new buildings because of the increase in flow of road traffic in the area and because of another new development (a Tesco / Marks and Spencer's superstore) that has opened in the same part of town. This development was the subject of an air quality assessment and was not expected to impact on air quality in Aberystwyth. Monitoring at locations around the development since the opening has so far confirmed this assessment.

A proposed new re-cycling development near Aberystwyth was also the subject of an air quality impact assessment in 2015 (see section 3.2 below) and again is not expected to impact significantly on air quality. Background monitoring is currently being undertaken at a strategic location in the vicinity of this development and will be continued after the facility is operational.

A new development in the town of Cardigan (Bath Street Development), involving a mix of commercial and residential properties, was also the subject of an air quality assessment. Again, this development was not expected to impact on air quality locally. Work to complete this development is currently on hold.

A new school serving the catchment around Llandysul has been constructed in an out of town location and well away from residential properties. Background pollution levels are very low and it is not anticipated that traffic emissions will impact on air quality in the vicinity of this new school.

3.1 Road Traffic Sources (& other transport)

Ceredigion County Council confirms that there are no new narrow congested streets, busy streets, new roads with a high flow of buses or HGVs, junctions, bus or coach stations or roads with significantly changed traffic flows in Ceredigion, since the last Progress Report that have not been previously assessed.

Ceredigion County Council has followed the procedures set out in the various sections of Technical Guidance 09 and 16, has reviewed all new developments in the county, road lay-outs, change in traffic flow patterns and any new sources of potential exposure and confirms that there are no locations that:

- have not been assessed during earlier rounds of Review and Assessment
- have experienced significant changes
- have an important new development that could impact on air quality
- have a new exposure potential that has not been assessed previously

Ceredigion County Council confirms that there are no new airports, locations where diesel or steam trains are regularly stationary for long periods, or locations with a large number of movements of diesel locomotives, or ports for shipping that have not been considered previously and since the last Updating and Screening Assessment

3.2 Industrial / Fugitive or Uncontrolled Sources / Commercial Sources

Ceredigion County Council confirms that there are no new installations operational in the county since the last Progress Report. There are no industrial installations where emissions have increased substantially or new relevant exposure has been introduced. There are no new or significantly changed installations that have not been previously assessed. There are no new major fuel storage depots, no new petrol filing stations and no new poultry farms.

Ceredigion received an application for a new recycling development at the Glan Yr Afon Industrial Estate near Aberystwyth. This development was the subject of an air quality assessment. The development has now received planning approval.

Resource and Environmental Consultants Ltd were commissioned by Exova (UK) Ltd, acting on behalf of CB Environmental Ltd, to undertake the Dispersion Modelling Assessment and to quantify impacts associated with the operation of the proposed CB Environmental Ltd facility at Rheidol Recycling Park, Llanbadarn Fawr, Ceredigion. The operation of the facility had the potential to increase pollutant concentrations in the vicinity of the site. As such, there were concerns that atmospheric emissions from the operation of the installation could have caused air quality impacts and loss of amenity at nearby sensitive locations.

The facility is to be operated under a Part B Environmental Permit setting out emission limits for a range of pollutants including:

- Particulate matter with an aerodynamic diameter of less than 10µm (PM10);
- Sulphur dioxide (SO2);

- Heavy Metals, including:
- Lead and its compounds, expressed as lead (Pb);
- Cadmium and its compounds, expressed as cadmium (Cd);

- Chloride, expressed as hydrogen chloride (HCl);
- Fluoride, expressed as hydrogen fluoride (HF); and

- Dioxins, expressed as:

Polychlorinated dibenzodioxins (PCDDs); and
Polychlorinated dibenzofurans (PCDFs).

The Dispersion Modelling Assessment was undertaken to quantify effects, in the vicinity of the site, and to determine their significance. Relevant data describing the facility indicated that emission levels would result in air pollutant concentrations that were well below the relevant air quality standards at all sensitive locations in the vicinity of the installation. As such, impacts associated with the operation of the Foundry were not predicted to be significant. The impacts were actually based on a worst-case assessment scenario of the stacks constantly emitting the maximum anticipated level of each pollutant throughout its operation. As such, predicted results were a significant overestimate of actual impacts. Proposed operational periods were only for one day per month (dependent on workload). As a consequence, the assessment represented a robust and worst case scenario.

The site may, following suggested new Regulatory changes, eventually be permitted by Natural Resources Wales.

EXISTING AUTHORISED PROCESSES

A list of the existing authorised (Environmental Permitting) processes in Ceredigion is displayed below. Most processes in this list have risk ratings classified as LOW with little, or no, expected impact on air quality. Two have risk ratings classified as medium – one because of sub-standard management practices and the other because of a new process that has been introduced together with a temporary increase in activity at the site. Air quality monitoring is currently being undertaken around this site with the early results indicating that nitrogen dioxide and particulate concentrations are close to background levels.

Ceredigion County Council confirms that there are no new biomass burners (or areas where the combined impact of several biomass combustion sources may be relevant) or areas of domestic solid fuel burning that have not been assessed previously.

Ceredigion County Council confirms that there are no landfill sites in Ceredigion, no new quarries, no unmade haulage roads or industrial sites, no new waste transfer stations and no known other sources of fugitive or uncontrolled particulate emissions that have not been considered previously.

CYNGOR SIR CEREDIGION - ENVIRONMENTAL PERMITTING				
Name and Address of Premises	Address of HQ	Permit Reference	Process	Risk Rating
D D Evans & Sons Ltd North Road Service Garage Lampeter Ceredigion SA48 7JA	D D Evans & Sons Ltd North Road Service Garage Lampeter Ceredigion SA48 7JA	LAEPR/1.4/B/02	Petrol Station (PVR I)	LOW
Shell Service Station Aberystwyth Mill Street Aberystwyth SY23 3TL	John Thomas & Sons (Aberaeron) Ltd 20, 21 Market Street Aberaeron, Ceredigion, SA46 0AS	LAEPR/1.4/B/04	Petrol Station (PVR I)	LOW
Seabank Garage Service Station Llanrhystud Ceredigion SY23 5BT	John Thomas & Sons (Aberaeron) Ltd 20, 21 Market Street Aberaeron, Ceredigion, SA46 0AS	LAEPR/1.4/B/05	Petrol Station (PVR I)	LOW
Padarn Service Station, Pwllhobi, Llanbadarn Fawr, Aberystwyth, SY23 3RF	John Thomas & Sons (Aberaeron) Ltd 20, 21 Market Street Aberaeron, Ceredigion, SA46 0AS	LAEPR/1.4/11	Petrol Station (PVR I)	LOW
Llanina Service Station, Llanarth, Ceredigion, SA47 0NP	John Thomas & Sons (Aberaeron) Ltd 20, 21 Market Street Aberaeron, Ceredigion, SA46 0AS	LAEPR/1.4/12	Petrol Station (PVR I)	LOW
Rheidol Filling Station Ponterwyd Aberystwyth Ceredigion	Kerry Waunfawr Aberystwyth Ceredigion SY23 3BW	LAPPC/1.4/B/06	Petrol Station (PVR I)	LOW
Ty Mawr Penrhyncoch Aberystwyth Ceredigion SY23 3EH	Kerry Waunfawr Aberystwyth Ceredigion SY23 3BW	LAPPC/1.4/B/07	Petrol Station (PVR I)	LOW
Penparc Motors, Penparc, Cardigan, Ceredigion, SA43 1SB	O.C Davies & Son Ltd Penparc Motors, Penparc, Cardigan, Ceredigion, SA43 1SB	LAEPR/1.4/13	Petrol Station (PVR I)	LOW

Aeron Coast Filling Station, North Road, Aberaeron, Ceredigion, SA46 0JF	Aeron Coast Filling Station, North Road, Aberaeron, Ceredigion, SA46 0JF	LAEPR/1.4/14	Petrol Station (PVR I)	LOW
Dryslwyn Stores & Filling Station, B.P Thomas & Co., Llwyncelyn, SA46 OHF	B.P Thomas & Co., Dryslwyn Stores & Filling Station, Llwyncelyn, Ceredigion, SA46 0HF	LAEPR/1.4/15	Petrol Station (PVR I)	LOW
Gogerddan Garage Limited, Gogerddan Garage, Tanygroes, Cardigan, Ceredigion, SA43 2HR	Gogerddan Garage Limited, Gogerddan Garage, Tanygroes, Cardigan, Ceredigion, SA43 2HR	LAEPR/1.4/B/16	Petrol Station (PVR I)	LOW
Hoffnant Stores Ltd Brynhoffnant Llandysul Ceredigion SA44 6DX	Hoffnant Stores Ltd Brynhoffnant Llandysul Ceredigion SA44 6DX	LAEPR/1.4/B/08	Petrol Station (PVR I)	LOW
Ystrad Garage Felinfach Lampeter SA48 8AE	John Thomas & Sons (Aberaeron) Ltd 20, 21 Market Street Aberaeron, Ceredigion	LAEPR/1.4/B/10	Petrol Station (PVR I)	LOW
Siop y Ffrydiau Cenarth Newcastle Emlyn Ceredigion SA38 9JP	Mr A James Siop y Ffrydiau Cenarth Newcastle Emlyn Ceredigion SA38 9JP	LAEPR/1.4/B/09	Petrol Station (PVR I)	LOW
Tesco Stores Limited, Aberystwyth Road, Cardigan, Ceredigion	Tesco Stores Limited Tesco House Delamare Road Cheshunt Hertfordshire, EN8 9SL	LAEPR/1.4/SII/01	Petrol Station (PVR I & II)	Medium
Morrison Petrol Station Llanbadarn Road Aberystwyth Ceredigion SY23 3TL	WM Morrison Supermarkets Plc Hilmore House Gain Lane Bradford BD3 7DL	LAEPR/1.4/B/SII/03	Petrol Station (PVR I & II)	LOW

Alltgoch Quarry Cwrtnewydd Llanybydder Ceredigion SA40 9YL	G D Harries & Sons Ltd Cwrtnewydd Llanybydder Ceredigion SA40 9YL	LAEPR/3.1/06	The batching of ready-mixed concrete	LOW
Breedon Cement Cardigan. Tanybryn, Penparc Cardigan Ceredigion SA43 1RB	Breedon Cement Limited, Pinnacle House, Breedon Quarry, Breedon On The Hill, Derby, England, DE73 8AP	LAEPR/3.1/B/03	The batching of ready-mixed concrete	LOW
D R & T Davies Minimix, Olmarch Villa, Llangybi, Lampeter, Ceredigion, SA48 8NH	Olmarch Villa, Llangybi, Lampeter, Ceredigion, SA48 8NH	LAEPR/3.1/B/05	ete batch works / using c	LOW
Glanyrafon Ind Estate Llanbadarn Fawr Aberystwyth Ceredigion SY23 3RJ	Tudor Griffiths Ltd. Wood Lane, Ellesmere, Shropshire, SY12 0HY	LAEPR/3.1/B/01	The batching of ready-mixed concrete	LOW
R.J Edwards, Cwrt Farm Buildings, Penrhyncoch, Aberystwyth, Ceredigion, SY23 3EG	R.J Edwards, Cwrt Farm Buildings, Penrhyncoch, Aberystwyth, Ceredigion, SY23 3EG	LAEPR/3.5/B/04	bile Crushing and Screen	LOW
JD Evans (Water Services) Limited Penparc Llanarth Ceredigion SA47 0NR	The Company Secretary, JD Evans (Water Services) Limited Penparc Llanarth Ceredigion SA47 0NR	LAEPR/3.5/B/07	Mobile Crushing	LOW
C B Environmental Ltd. Cwm Nant Yard, Capel Bangor, Aberystwyth, Ceredigion, SY23 3LL	C B Environmental Ltd. Cwm Nant Yard, Capel Bangor, Aberystwyth, Ceredigion, SY23 3LL	LAEPR/3.5/B/08	Mobile crusher / screen	LOW

Alltgoch Quarry Cwrtnewydd Llanybydder Ceredigion SA40 9YL	G D Harries & Sons Ltd Cwrtnewydd Llanybydder Ceredigion SA40 9YL	LAEPR/3.4/B/01	Roadstone coating	MEDIUM
Amlosgfa Aberystwyth Crematorium, Clarach Road, Aberystwyth, Ceredigion, SY23 3DG	Crematoria Management Limited Chapel View, Westerleigh Road, Westerleigh, Bristol, BS37 8QP	LAEPR/5.1/B/01	Crematorium	LOW
Swanson Cleaning Services, 7 North Parade, Aberystwyth, SY23 2JH	Mr. Geraint Ap Daniel Dafis, Bronwen House, Park Avenue, Aberystwyth, Ceredigion SA48 8BO	LAEPR/7.0/B/01	Dry Cleaning Process	LOW
James Davies (Abercych) Ltd. , Newbridge Sawmills, Cenarth, Newcastle Emlyn, Ceredigion	James Davies (Abercych) Ltd. , Newbridge Sawmills, Cenarth, Newcastle Emlyn, Ceredigion	LAEPR/6.6/B/01	Timber Process	LOW
Autocraft Arc (Wales) Llp 8-9 Glan Yr Afon Industrial Estate Llanbadarn Fawr Aberystwyth SY23 3JQ	Autocraft Arc (Wales) Llp 8-9 Glan Yr Afon Industrial Estate Llanbadarn Fawr Aberystwyth SY23 3JQ	LAEPR/7.0/B/01	Vehicle refinishing	LOW
James Davies (Abercych) Ltd. , Newbridge Sawmills, Cenarth, Newcastle Emlyn, Ceredigion	James Davies (Abercych) Ltd. , Newbridge Sawmills, Cenarth, Newcastle Emlyn, Ceredigion	LAEPR/6.6/A2/01	Checmial Timber Treatment	LOW
Aberystwyth Heat and Power Limited Rheidol Recycling Park Glanyrafon Industrial Estate Abersywtyth SY23 3JQ	Cwm Nant yard Capel Bangor Aberystwyth Ceredigion SY23 3LL	LAEPR/SCH13/01	Small Waste Incineration Plant	Not Yet Determined

3.3 Planning Applications

In Ceredigion, Planning and Environmental Health Officers work closely together to ensure that the land use planning system is used to best effect to maintain and improve air quality in the district. A senior Environmental Health Officer works closely with Planning Officers, meeting with them on a weekly basis, to review all new planning applications and pre-application enquiries. In this way, applications which are likely to impact on air quality within the county, either positively or negatively can be highlighted and appropriate comments, recommendations, and or conditions included.

No new planning applications have been approved (or are yet to be approved) that are expected to impact appreciably on air quality in Ceredigion - requiring detailed air quality assessments in the future.

Discussions are taking place with neighbouring local authorities to develop a consistent approach from the planning stages to the assessment of impacts of new developments on air quality. It is also being proposed that neighbouring local authorities could work more closely together in other ways, possibly sharing resources and expertise on air quality and related matters.

3.4 Other Sources

There were no sources such as bonfires, incidents, firework displays, domestic wood burning appliances etc that impacted on air quality in Ceredigion in 2017.

Cyngor Sir Ceredigion County Council confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

Cyngor Sir Ceredigion County Council confirms that all the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources.**

4 Polices and Strategies Affecting Airborne Pollution

4.1 Local / Regional Air Quality Strategy

Cyngor Sir Ceredigion County Council has no air quality management areas in its district and no areas where on-going monitoring / national modelling has revealed any locations close to Air Quality Objectives for any of the priority air pollutants contained in Regulations. The Council will not be producing an Air Quality Strategy at this time but will continue to review the situation and monitor developments, as far as emissions and air quality is concerned, including following any changes to legislation for pollutants currently not contained in Regulations in Wales (such as PM2.5 and ozone).

4.2 Air Quality Planning Policies

Pollution control and planning systems have tended to evolve over the years as separate entities. Authorisations under the pollution control regimes aim to control the ways in which prescribed processes operate, in order to limit and render harmless any pollution emitted to the atmosphere. The planning system, however, regulates the location of development and the control of operations in order to avoid or minimise the adverse effects that any potential for pollution may have on the use of land and the environment, to the extent that it may affect present or future land use. Planning Policy Guidance Note (PPG) 23 explains the relationship between land use planning and pollution control systems.

It is recognised in Ceredigion that land use planning is an important part of an integrated approach to achieving air quality objectives and reducing the emissions of air pollutants (including those that contribute to global warming). A Ceredigion Unitary Development Plan (UDP) provided guidance on how planning applications should be viewed by the Local Planning Authority. The main objectives of the UDP, that impact on air quality included:

a. Objective Gen 1 - to encourage a pattern of land use that focuses development in areas that minimize demand for travel and have the capacity to support it;
d. Objective GEN 4 - to ensure development is appropriately located, well designed and minimizes impacts on the environment;
e. Objective ENVE1 - to promote efficient uses of energy in development and to encourage environmentally friendly energy generation systems;
g. Objective ENVU 1 - to encourage sustainable investment and improvements in infrastructure facilities to cater for existing and future needs, without compromising the quality of the environment.

The UDP also contained specific policy relating to Air Quality as follows:

ENVP1.4 Air Quality (UDP) – states that:

"Proposals should not pose significant additional harm to air quality". Where possible proposals should:

1. Be appropriately located in order to reduce the need to travel
2. Be accessible by a choice of means of transport
3. Promote the use of energy efficient methods

.

Work on the UDP was stopped when the Authority resolved to develop a local development plan (LDP) for Ceredigion.This is a live and on-going Plan, that carefully considers matters relating to air quality, that will continue to be developed and reviewed in the future.

Other policies that have been developed in Ceredigion that impact on air quality include sustainable development and carbon management.

4.3 Local Transport Plans and Strategies

The last column in table 8 in the Welsh Government's Statistical Bulletin below provides traffic flow data, by local authority and class of road, in Wales for 2016 (the last available year for which data is available) - for all traffic.

WG Statistical Bulletin, Road Traffic in Wales 2016

Traffic flow data for Ceredigion is reported as 0.76 - which is higher than for Merthyr, Blaenau Gwent and Torfaen (at 0.43, 0.44 and 0.64 respectively) in South Wales. On this basis it may appear that Ceredigion could have "more of a traffic related problem" (and possibly more air quality issues) than some highly populated and traffic congested areas in South Wales.

It is not, however, the **number / volume** of cars that is reported in this table but **traffic flow**. **Traffic flow** is determined by multiplying the number of vehicles on a given road (or network) by the average length of their trips measured in kilometres (the units used to measure traffic flow are "billion vehicle kilometres"). In rural Ceredigion, trips tend to be longer on average than those made in the South Wales regions but there is, of course, a much higher volume of traffic, emitting much higher concentrations of air pollutants, in congested parts of the road network in urbanised South Wales (one road in Crumlin in Blaenau Gwent, for example, supposedly has the poorest air quality outside of London). From an air quality perspective, **traffic flow** is not the most appropriate way of reporting traffic data - more useful is the actual volume (number of vehicles) passing a given location in a given time.

Traffic flow in Ceredigion (in billion vehicle kilometres) has remained fairly constant in the period 2006 to 2016 (0.71 in 2006 to 0.76 in 2016). This compares with a traffic flow in Cardiff of 2.99, in Rhondda Cynon Taf at 2.17, in Carmarthenshire at 2 and in Newport at 1.95 - all measured in 2016.

Traffic flows have increased in most of Wales during the period 1993 to 2016. Cars and taxis constitute by far the greatest contribution to the volume of traffic on roads in Wales. Improving air quality, and reducing carbon emissions, will require, therefore, a significant reduction on the dependency of the private car (unless technological

innovation improves the polluting capacity of combustion engines and / or replaces them with a cleaner type of engine).

Highways departments, planners and architects can help to reduce air pollution (and noise) from road traffic by carefully designing roads and by incorporating traffic management systems that ease congestion, take traffic away from key “hot-spots” in towns, and keeps traffic flowing.

A Regional Transport Plan was developed for md-Wales (including Ceredigion) in 2009 and was subsequently updated with a Mid Wales Joint Local Transport Plan (LTP) in 2015. “TraCC” (Trafnidiaeth Canolbarth Cymru), the regional transport partnership for the mid-Wales, seeks to deliver improvements to the transport system in the region. It covers Ceredigion, Powys and part of Gwynedd (the former Merionnydd district).

The Joint LTP was submitted to Welsh Government on 30th January 2015 providing a detailed programme from 2015-2020 and a framework for schemes until 2030. The LTP is a statutory document that sits alongside the Local Development Plans and other policies and plans of each of the Local Authority areas.

The Local Transport Plan Vision

Most of the air pollution in rural Ceredigion is traffic related so the Local Transport Plan is key to maintaining, and improving, air quality standards in Ceredigion. The Plan for mid-Wales is available in the link below:

Mid Wales Local Development Plan

Vision for Transport in Mid Wales:

“Mid Wales Local Authorities will plan for, and deliver in partnership, an integrated and affordable transport system in the region that facilitates economic development, ensures access for all to services and opportunities, sustains and improves the quality of community life, and makes an active contribution to the management of carbon and the quality of the environment”.

This is a vision that by its nature is aspirational. It sets out what the Mid Wales local authorities are seeking to achieve. The degree to which it can be achieved will depend on the level of investment available in transport from all sources in coming years. Working closely with Welsh Government, neighbouring English local authorities, other transport stakeholders, developers and businesses offers the best opportunity for achieving the vision.

Key Transport Issues

The LTP discusses the most significant issues and opportunities for transport in Mid Wales and identifies nine key factors:

1. Employment and Tourism Access
2. Inclusive Access to Services
3. Integration of Public Transport
4. Active Travel Potential
5. Journey Time Reliability and Strategic Connections
6. Freight Connections
7. Highway Condition and Road Safety
8. Resilience to Climate Change
9. Availability and Sustainability of Funding

Local Transport Plan Outcomes

The plan aims to provide:

1. **Access to Key Destinations and Markets**: Economic growth in the region will have been supported, through an improvement in the efficiency, reliability, resilience, and connectivity of movement, including freight, within Mid Wales and to and from other key destinations and markets.
2. **Access to Employment and Services**: Social equality and employability will have been promoted through inclusive, integrated and affordable access to employment and key health, education and social services and facilities, with a focus on tackling access to the Enterprise Zone and Local Growth Zones and those areas particularly deprived in terms of access to services.
3. **Improving Health and Well-being by Increasing Walking and Cycling**: Levels of cycling and walking for both necessary active travel and recreation, by residents and visitors, will have been increased.
4. **Improved Safety and Security**: The actual and perceived safety and security of travel by all modes will have been improved.
5. **Benefits and Minimised Impacts on the Environment**: The potential for transport improvements to reduce air (including carbon) emissions and improve the local and global natural and built environment will have been maximised and negative impacts minimised, including adaptation to the effects of climate change.

Higher Level Interventions

A set of higher level interventions have been developed which will aim to deliver the vision, address the issues and maximize the opportunities. The interventions are for the short, medium and longer term with timescale within the period up to 2030.

The interventions are those that are within the remit of the Local Authorities. The interventions intend to compliment and support those within the Welsh Government's National Transport Plan (NTP) and were put forward prior to the draft NTP being available.

Higher Level Intervention	**Description**
Improving Strategic Connections	Transport network reliability and resilience improvements to key county highway corridors to remove/ improve resilience problems and improve journey

	times. The improvement of strategic highway connections will address issues for buses as well as cars and goods vehicle traffic.
Improving Accessibility to Employment and Services	Schemes to provide improved access to growth zones, employment sites and town centres and sustain access to health services as well as education, community, shopping and other services. May include car share sites, bus services, active travel measures as well as road improvements
Encouraging Walking and Cycling	Infrastructure improvements and behavioral change initiatives to increase levels of walking and cycling both for necessary, active travel and for leisure. May include road and rail bridges/ crossings, cycle routes, footway/ footpath provision, safe routes to school, travel planning as well as road safety measures to assist vulnerable users
Integrated Public Transport Networks	Schemes to sustain/ provide infrastructure for public transport and community transport networks, improve access to bus and rail stations and interchange facilities, support for park and ride, walking and cycling routes and facilities
Improving Safety and Security	Road safety schemes and initiatives to reduce casualties

Plan Period 2015-2020

Five Year Programme

Schemes to deliver the interventions over the plan period of 2015 to 2020 comprise the five year programme for the LTP. The schemes are for transport projects that fall within the remit of the local authorities and as such do not include improvements to rail infrastructure and services or the trunk road network (that are addressed by the National Transport Plan). The schemes do, however, compliment Welsh Government

priorities for the trunk roads and the rail network as well as cross border schemes in England as appropriate.

Scheme Prioritisation

The guidance from Welsh Government requires that schemes are prioritised. Tracc has, therefore, identified the projects that will make the largest potential contribution to meeting the vision and outcomes. These are highlighted as 'Regional Priority Projects' in each of the tables below. Other projects are identified as 'County Priority Projects'.

A list of the proposed schemes, for 2015 to 2020, are tabulated below (schemes affecting Ceredigion are coloured green):

Table 1:	**Local Authority**	**Priority**
Improving Strategic Connections		
Scheme Name		
A486 Post Bach to Synod Inn Highway Improvement Phase 2	Ceredigion	Regional Priority Project
A44/A4120 Llanbadarn Fawr Technical Appraisal	Ceredigion	Regional Priority Project
Teifi Valley Strategic Signing	Ceredigion	Regional Priority Project
A496 Llandecwyn Roundabout	Gwynedd	Regional Priority Project
A496 Maentwrog to Blaenau Ffestiniog	Gwynedd	Regional Priority Project
Pont Briwet Bridge Replacement Scheme	Gwynedd	Regional Priority Project
A44 Radnor Forest Bends and East-West Routes	Powys	Regional Priority Project
Strategic Routes Alleviation of Flood Risk Areas	All Authorities	County Priority Project
Pont Rheidol, Rhiwarthen, Capel Bangor	Ceredigion	County Priority Project
Bridge Strengthening (Pinch Points)	Gwynedd	County Priority Project
Route Restrictions - Structures height	Powys	County Priority Project

Table 2:

Improving Accessibility to Employment and Services

Scheme Name	Local Authority	Priority
Aberystwyth Area Active Travel Project - Improving Walking and Cycling infrastructure	Ceredigion	Regional Priority Project
Llanbedr Airfield Access	Gwynedd	Regional Priority Project
Newtown Active Travel Centre (pre & post bypass) Study and Detailed Design	Powys	Regional Priority Project
Park & Ride Hubs	All Authorities	County Priority Project
Devils Bridge Footway Scheme Phase 3 Safe Routes in Communities Scheme	Ceredigion	County Priority Project
Central Wales Sustainable Distribution Project	Ceredigion	County Priority Project
Aberystwyth Park & Ride	Ceredigion	County Priority Project
Active Travel for Growth Zones	Powys	County Priority Project
Local Growth Zones - Congestion & Parking	Powys	County Priority Project

Table 3:

Encouraging Walking and Cycling

Scheme Name	Local Authority	Priority
Active Travel for "designated" localities	All Authorities	Regional Priority Project
Bow Street to Aberystwyth & C1010 links to Penrhyncoch (Phases 1 to 2) Cycle Route	Ceredigion	County Priority Project
Ystwyth Trail Extension - Cors Caron to Tregaron and Tynygraig Section	Ceredigion	County Priority Project

Rheidol Cycle Trail - Off road options at Capel Bangor	Ceredigion	County Priority Project
Lon Tryweryn Multi User Path	Gwynedd	County Priority Project
Tywyn to Aberdyfi Multi User Path	Gwynedd	County Priority Project

Table 4:	**Local Authority**	**Priority**
Integrated Public Transport Networks		
Scheme Name		
Strategic Bus Corridor Infrastructure Improvements	**All Authorities**	**Regional Priority Project**
Capital Enhancements for Public, Fleet and Community Transport	**All Authorities**	**Regional Priority Project**
Rail Hub Improvements	**All Authorities**	**Regional Priority Project**
Public Transport Information	**All Authorities**	**County Priority Project**
Actual Time 'Passenger Transport Information via Smart Mobile App	**All Authorities**	**County Priority Project**
Bwcabus Capital Investment Programme	**Ceredigion**	**County Priority Project**
Ceredigion Passenger Transport Infrastructure	**Ceredigion**	**County Priority Project**

Table 5:	**Local Authority**	**Priority**
Improving Safety and Security Scheme Name		
Motorcycle	All Authorities	Regional Priority Project
Interactive Traffic Speed Signing	All Local Authorities	County Priority Project
Energy Efficiency/Safety - Street Lighting Renewal	All Authorities	County Priority Project
Junction Safety Enhancements	All Authorities	County Priority Project

Schemes currently being developed in Ceredigion are tabulated below:

Figure 6.1 : Mid Wales LTP Schemes

Number	Scheme Name	Local Authority
Improving Strategic Connections		
1	A486 Post Bach to Synod Inn Highway	Ceredigion
2	A44/A4120 Llanbadarn Fawr Technical	Ceredigion
3	A496 Llandecwyn Roundabout	Gwynedd
4	A496 Maentwrog to Blaenau Ffestiniog	Gwynedd
5	Pont Briwet Bridge Replacement Scheme	Gwynedd
6	A44 Radnor Forest Bends and East-West	Powys
7	Pont Rheidol, Rhiwarthen, Capel Bangor	Ceredigion
Improving Accessibility to Employment and Services		
8	Aberystwyth Area Active Travel Project - Improving Walking and Cycling infrastructure	Ceredigion
9	Llanbedr Airfield Access (SEZ)	Gwynedd
10	Newtown Active Travel Centre (pre & post bypass) Study and Detailed Design	Powys
11	Devils Bridge Footway Scheme Phase 3 Safe Routes in Communities Scheme	Ceredigion
12	Aberystwyth Park & Ride	Ceredigion
13	Active Travel for Growth Zones	Powys
14	Local Growth Zones - Congestion & Parking	Powys
Encouraging Walking and Cycling		
15	Bow Street to Aberystwyth & C1010 links to Penrhyncoch (Phases 1 to 2) Cycle Route	Ceredigion
16	Ystwyth Trail Extension - Cors Caron to Tregaron and Tynygraig Section	Ceredigion
17	Rheidol Cycle Trail - Off road options at Capel Bangor	Ceredigion
18	Lon Tryweryn Multi User Path	Gwynedd
19	Tywyn to Aberdyfi Multi User Path	Gwynedd

Programmes 2020-2030

It is anticipated that the programme from 2020 to 2030 will be composed of those schemes from 2015 to 2020 that could not be delivered together with any new schemes introduced in response to developments evolving from the Welsh Government's National Transport Plan.

Some projects may not have been fully implemented in the 2015-2020 programme even when development work has taken place. Some projects are complex, some depend on other programmes (such as rail or trunk road development emanating from the National Transport Plan) and some may have potentially significant environmental impacts associated with them requiring careful appraisal.

The projects (highlighted in green for Ceredigion) identified in Table 6 under each intervention are those that are currently known and expected to be delivered after 2020:

Table 6:

Medium and Longer Term Schemes 2020-2030	Scheme Name	Local Authority	Priority
Integrated Public Transport Networks	Rail Hub Improvements	All Authorities	Regional Priority Project
Improving Strategic Connections	Central Powys E-W Links: B4358 Beulah to A4081 Llanyre	Powys	County Priority Project
Encouraging Walking and Cycling	Bow Street to Aberystwyth & C1010 links to Penrhyncoch (Phases 3) Cycle Route	Ceredigion	County Priority Project
Encouraging Walking and Cycling	A486 Footway/Cycleway	Ceredigion	County Priority Project
Integrated Public Transport Networks	Access Improvements to the Rail Network	All Authorities	County Priority Project
Integrated Public Transport Networks	Bow Street Railway Station	Ceredigion	County Priority Project

Local developments and road improvement schemes in Ceredigion are already carefully assessed in terms of their impact in increasing the volume of traffic (particularly in sensitive areas and on congested roads in towns and villages). The aim has been to minimise the volume of traffic in areas where air pollution levels (and any associated noise) are highest and / or where large numbers of people could be exposed to pollutants emitted by slowly passing vehicles. Improved infrastructure has also aimed to provide alternatives enabling more walking and cycling - particularly in more urban environments. The Council and TraCC have actively promoted local bus and rail services (for example, the “Cardi Bach” bus service that calls at coastal areas in the south of the county, “Bucabus” [“book a bus”] and an improved hourly rail service).

4.4 Active Travel Plans and Strategies

The Active Travel (Wales) Act 2013 was introduced in 2014 and required local authorities to continuously improve facilities and routes for pedestrians and cyclists and to prepare maps identifying current and potential future routes for their use. The Act required new road schemes (including road improvement schemes) to consider the needs of pedestrians and cyclists at the design stage. The Act is intended to enable more people to walk and cycle and generally travel by non-motorised means. Making walking and cycling safer and more practical encourages healthier lifestyles, reduces air pollution, reduces noise, reduces carbon emissions and improves the environment.

The aim of the Active Travel Plan in Ceredigion is to improve Health and Well-being by increasing walking and cycling by residents and visitors alike. Infrastructure improvements and behavioral change initiatives in Ceredigion aim to increase levels of walking and cycling both for necessary, active travel and for leisure and includes factors such as road bridges, cycle routes, footway/ footpath provision, safe routes to school, travel planning as well as road safety measures to assist vulnerable users

Cyngor Sir Ceredigion County Council submitted route maps to Welsh Government in 2015. Some of the schemes proposed are considered in the LTP above and are displayed on the map and summarized below:

8 on map – Aberystwyth Active Travel Plan – Improving Walking and Cycling
11 on map – Devils Bridge Footway, Safe Routes in Communities Scheme

15 on map – Bow Street to Aberystwyth cycle route
16 on map – Ystwyth Trail Extension
17 on map – Rheidol Cycle Trail – with off road options at Capel Bangor

4.5 Local Authorities Well-being Objectives

Air pollution is considered to be the biggest environmental contributor to the burden of disease in the UK. A report published in 2014 estimated that in Wales in 2010, around 1,320 deaths could be attributed to the long term exposure of particulates (in the form of PM2.5) alone. People already suffering from poor health and/or who live in the areas of poorest air quality are more likely to be affected by air pollution. Poorer urban communities are disproportionately affected.

The associated health effects do not only relate to the more obvious and direct impacts of air pollution. Air pollution affects the growth of crops and contributes to the acidification of inland and coastal waters. This can lead to important impacts on the food chain.

The Welsh Government considers it important that all local authorities commit themselves to ensuring that air pollution remains below objective levels. The Welsh Government has suggested that local authorities should include air quality management in corporate and over-arching strategies to raise its profile and deliver actions in an integrated manner. To this end, it is important that local authorities apply the sustainable development ideal in their work and are able to demonstrate to the public that they are making progress towards achieving the seven well-being goals defined in the, "Well-being of Future Generations (Wales) Act 2015";

Well-being of Future Generations (Wales) Act 2015

The Act requires local authorities to set well-being objectives and publish an annual report showing the progress made in achieving the objectives. Local authorities are required to ensure that information from reviews and assessments of local air quality informs local well-being and is incorporated into the local well-being plan. This should emphasise the local authority's role in delivering cleaner air. It should aim to raise the profile of air quality keeping the issue high on its list of local priorities. Welsh Government encourages local authorities to deliver air quality improvements in a corporate and multi-disciplinary way enabling them to build air quality considerations into wider policy areas - such as land use planning, transport planning, energy efficiency, waste management, economic development and regeneration. Local authorities are also urged to attempt to work more closely with neighbouring authorities - thereby strengthening the role of regional groupings.

The Act recognises that Wales also faces other major global challenges - such as climate change. Global warming and climate change are driven by emissions to the atmosphere. National targets have been set for reducing carbon emissions.

AIR QUALITY INDICATORS FOR WALES

A list of indicators, to measure the Nation's progress, was laid before Welsh Government on the 16th of March, 2016.

A Description of the National Indicators for Wales

Welsh indicators have been set for air quality for the first time (allowing any progress made towards achieving the well-being goals relating to air quality to be quantified).The fourth National Welsh Indicator is:

INDICATOR 4: Levels of nitrogen dioxide (NO2) pollution in the air

This air quality indicator is based on the average concentration of nitrogen dioxide where people live. Figures are calculated using nationally modelled annual average

concentrations which have been calibrated / validated against monitoring data. A value is then obtained for each square kilometre of Wales, and weighted by the population density or number of dwellings in each square kilometer (estimated from census data) in order to calculate a national (or local authority) population average. It was considered that using measured data alone would be inappropriate, could be potentially misleading and might provide unrepresentative data because:

• Monitoring locations are not evenly distributed across Wales and thus an indicator based solely on monitoring data would not provide representative information on average population exposure.

• Monitoring locations are predominantly selected where there is a suspicion that one or more air quality target(s) will not be met. In other words, air pollution is generally monitored in worst case locations. Any indicator based solely on this data would give the impression that average pollutant exposure in Wales is much higher than it actually is.

• Monitoring locations (both passive and automatic) can and will be moved when circumstances change, e.g. to investigate other pockets of suspected air pollution. This would invalidate annual average trends and make inter-annual comparisons meaningless.

• Monitoring techniques (such as diffusion tubes or non-approved hand held meters etc.), that are not the reference method for recording the concentration of a pollutant, should only be used indicatively.

• A national or local authority air quality indicator derived solely from measured concentrations would be susceptible to distortion by localised interventions that improve air quality in the immediate vicinity of the measurement sites but that have little, no, or even adverse impacts on air quality in locations where there are no monitors present. To maximise the benefits of improved air quality for the population as a whole, the indicator must reflect widespread air quality improvements – and not just localised ones.

National air quality indicators have also been derived for particulate pollution (PM10 and PM2.5) in a similar way. Deriving the indicators from nationally modelled pollutant exposure figures (noting that the model output for past years is calibrated / validated against measurements) rather than raw measured data will more adequately reflect air quality improvements that occur over a widely populated area - rather than those confined to the immediate vicinity of air quality monitors. It should provide robust indicators of the population's overall exposure to the air pollutants nitrogen dioxide, PM10 and PM2.5.

A first set of national indicators was published by Welsh Government in November 2017:

Welsh Air Quality Indicators for 2016

Air Quality indicators for these three pollutants have been calculated on a county wide basis in Wales:

AIR QUALITY INDICATORS IN WALES, 2016			
Pollutant----->	Nitrogen Dioxide	PM10	PM2.5
Isle of Anglesey	4.74	8.54	5.37
Gwynedd	4.91	8.66	5.55
Ceredigion	**5.01**	**9.44**	**5.79**
Powys	5.12	9.73	6.20
Denbighshire	6.56	10.07	6.60
Carmarthenshire	6.86	10.95	6.67
Conwy	7.10	9.39	6.09
Pembrokeshire	7.45	11.20	6.47
Wrexham	9.19	11.52	7.62
Blaenau Gwent	10.14	11.83	7.74
Merthyr Tydfil	10.51	11.90	7.67
Flintshire	10.53	11.40	7.55
Monmouthshire	11.14	12.35	7.90
Swansea	11.18	11.87	7.46
Wales (Mean)	11.36	11.75	7.50
Rhondda Cynon Taf	11.48	12.11	7.78
Neath Port Talbot	11.70	11.87	7.36
Bridgend	11.95	12.04	7.54
Vale of Glamorgan	12.71	12.16	7.78
Torfaen	13.04	12.51	8.28
Caerphilly	13.11	12.47	8.12
Newport	19.26	14.07	9.01
Cardiff	20.92	14.33	9.31

On the basis of these new national indicators for nitrogen dioxide and particulates, air quality in Ceredigion ranks with the best in Wales.

Air pollution affects the atmosphere disturbing natural balances such as the carbon cycle resulting in global issues such as climate change. There are also two Welsh Indicators to measure Global Warming and Climate Change:

INDICATOR 41: Emissions of greenhouse gases within Wales

INDICATOR 42: Emissions of greenhouse gases attributed to the consumption of global goods and services in Wales.

The latter recognises that consumption in Wales can have an effect on parts of the world from which goods used in Wales are sourced. For example, when goods are purchased from another country, the production / manufacture etc of these goods may have impacted on air quality (and the environment more generally) in that country. That is, this indicator recognises that life in Wales can leave a "footprint" in other parts of the world.

Health issues associate with air pollution and climate change could become more significant as global temperatures rise in the future. It is predicted that large populations (of humans and animals) could become affected by food and water shortages and there could be more unpredictable and extreme weather. Existing, and new, diseases may also evolve and spread to new regions.

Poor air quality impacts on the natural environment harming ecosystems and biodiversity. Some of the most widespread and significant effects on ecosystems, that are already recognised, are damage to vegetation from pollutants such as exposure to ozone, eutrophication and acidification.

The Welsh Government expects local authorities to take an increasingly integrated approach to dealing with environmental issues such as air quality and climate change. Where practicable, synergistic policies (beneficial to both air quality and climate change) should be developed and followed.

AIR QUALITY AND TRAFFIC NOISE

Noise pollution is considered to be the second (after air quality) biggest environmental contributor to the burden of disease in the UK, with a cost valued at more than £7-10 billion per year. Noise maps produced in 2012 indicate **that homes of more than 200,000 people in Wales are exposed to levels of road traffic noise exceeding World Health Organisation night noise guidelines**. A level of 40dB was set as the target for night noise to protect the public - including the most vulnerable groups such as children, the chronically ill and the elderly. A value of 55dB was recommended as an interim target for countries where 40dB could not be achieved in the short term for various reasons, and where policy-makers chose to adopt a stepwise approach.

The purpose of local air quality management, and traffic noise management, is to improve health and the quality of life. Air pollution and noise are often emitted from the same sources (notably road traffic) and locations of poor air quality often coincide or overlap with locations subject to high noise levels. Measures to tackle air quality, such as speed restrictions, may also have an impact on noise pollution. It is important to develop measures in a joined up way so that whenever possible improvements to both air quality and noise reduction are achieved at the same time using the same measures.

The Environmental Noise Directive (2002/49/EC) aims to define a common approach intended to avoid, prevent or reduce (on a prioritised basis) the harmful effects, including annoyance, resulting from the exposure to noise. To this end, the Welsh Government commissioned the production of a noise map for Wales. The map can be viewed at:

NOISE MAP FOR WALES

The noise map displays estimated levels of road traffic, railway and industrial noise in the three largest urban areas in Wales, and noise from the busiest roads and railways across Wales (including at Aberystwyth and Cardigan in Ceredigion). This map was required to be prepared under the Environmental Noise Directive and was first reported to the European Commission in December 2012. Welsh Government was also required to describe what they would do about transportation and industrial noise in the noise-mapped areas from 2013 to 2018 (that is, to develop and implement a Noise Action Plan - *Welsh Noise Action Plan*). Welsh Government, with other organizations responsible for managing noise in Wales, agreed to produce a single plan for the whole of Wales. It covers all of the major forms of man-made noise, including neighborhood noise.

Noise levels in this map are modelled (calculated) rather than measured and are based on various assumptions. They should only be considered as a starting point for identifying areas that may need priority action. The map should not be used to indicate how noisy it actually is at a specific property alongside a particular road. More details are available on the Welsh Government Website:

Welsh Government Website

1. ABERYSTWYTH (ROADSIDE)

DAY- EVENING NOISE LEVELS ALONG ROADS IN ABERYSTWYTH

The map above shows AVERAGE roadside, **day–evening** noise levels (in dB) on roads in and approaching Aberystwyth. Levels vary between 55 and 70dB at locations alongside the mapped roads. The most affected stretches of road include the approaches to Aberystwyth (through Llanfarian, Rhydyfelin, Southgate, Penparcau and down to Llanbadarn). Also affected are traffic congested roads in the centre of Aberystwyth itself. These include Terrace Road and Thespian Street – locations with the highest concentrations of air pollutants such as nitrogen dioxide and particulates. Lastly, the road out of Aberystwyth to the north (along Penglais Hill) is also shown as being affected by an elevated noise level.

The railway station, and businesses and industry in and around Aberystwyth, do not make any significant contributions to noise levels in the town based on the estimates in these maps.

NIGHT NOISE LEVELS ALONG ROADS IN ABERYSTWYTH

AVERAGE, roadside, **night time** noise levels (in dB) on the roads in and approaching Aberystwyth in the map displayed above are estimated to vary between 50 and 60dB. These ESTIMATES are above the 40dB (and possibly the 55dB interim) guideline levels for night time noise recommended by the World Health Organisation.

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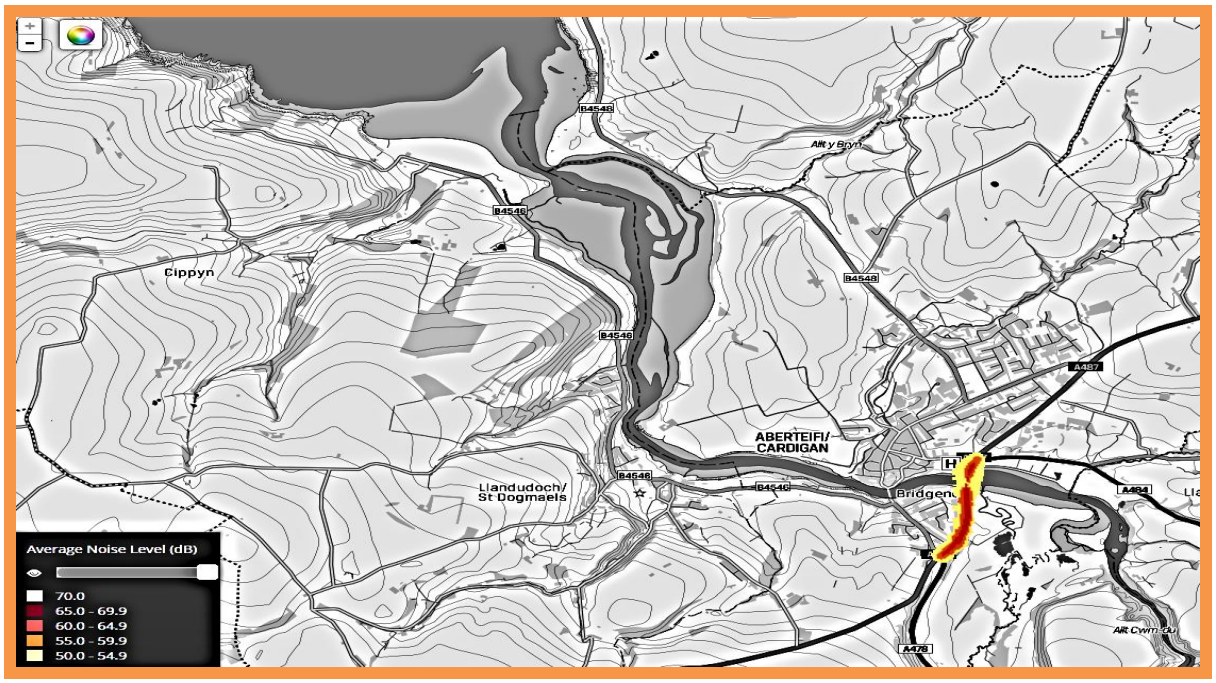
2. CARDIGAN ROADSIDE

DAY- EVENING NOISE LEVELS ALONG ROADS IN CARDIGAN

Likewise in Cardigan, AVERAGE roadside **day-evening** noise levels (in dB) on roads in and approaching Cardigan are estimated to vary between 55 and 70dB. Again, businesses and industry in and around Cardigan do not make any significant contributions to noise levels in the town, and its approaches, based on the estimates in these maps.

NIGHT NOISE LEVELS ALONG ROADS IN CARDIGAN



AVERAGE, roadside, **night time** noise levels (in dB) on roads in and approaching Cardigan are estimated to vary between 50 and 60dB. These ESTIMATES are also above the 40dB (and possibly the 55dB interim) guideline levels for night time noise recommended by the World Health Organisation.

Noise exposure categories have been derived to assist local planning authorities in their consideration of planning applications for residential developments near transport-related noise sources. For example, planning permission should normally be refused where the day/evening average "A - weighted" level for road traffic noise exceeds 72 decibels, or the night-time level exceeds 66 decibels. Where the day/evening average level for road traffic noise is between 63 and 72 decibels, or the night-time level between 57 and 66 decibels, **planning permission should not normally be granted**, and where it is considered that permission should be given, for example, because there are no alternative quieter sites available, **conditions should be imposed to ensure a commensurate level of protection against noise.**

Some roads in and around Aberystwyth and Cardigan, therefore, fall within this second classification, based on the estimates displayed in these maps, requiring a careful assessment of noise impacts in any new developments.

4.6 Green Infrastructure Plans and Strategies

Green Infrastructure Plans and Strategies is a new requirement under Planning Policy Wales10 that has recently been consulted on. The preparation of policies and plans in this respect will be coordinated by the Planning Policy Team of Ceredigion County Council.

Local authorities are required to adopt a strategic and proactive approach to green infrastructure and biodiversity by producing up to date inventories and maps of existing green infrastructure and ecological assets and networks. Such Green Infrastructure assessments should make timely, pragmatic and inclusive use of existing datasets, and the best available information, to develop an integrated map-based evidence resource. Doing so will facilitate a proactive approach and enable contributions towards the well-being goals to be maximised.

The Green Infrastructure Assessment should be used to develop a robust approach to enhancing biodiversity, increasing ecological resilience and improving wellbeing outcomes, and should identify key strategic opportunities where the restoration, maintenance, creation or connection of green features and functions can deliver the most significant benefits.

Planning authorities should use the best available data to monitor a set of key species and habitats, and incorporate these indicators into their Annual Monitoring Reports. At the end of each reporting period they should use this data to indicate whether there has been a net gain or loss of biodiversity, and should use the trends identified to determine future priorities for planning and decision making. The need

for ecosystems, habitats and species to adapt to climate change should be considered as part of the Green Infrastructure Assessment.

4.7 Climate Change Strategies

Around 40,000 deaths a year in the UK are now attributed to poor air quality and the profile of air quality has been raised considerably as a consequence. The most significant long-term impact of emissions to the atmosphere, however, is likely to be in driving global warming and climate change. Air pollution, and its effects, is a good example of the fine balances that exist in nature and of the local / global connection that forms a cornerstone of the sustainable development ideal. Transboundary air pollution, acid rain, ozone layer depletion, global warming, and **climate change** are cumulative, long ranging (and sometimes long lasting) outcomes of local air pollution events.

Carbon dioxide is the most important long-lived, global warming gas. It is emitted naturally during respiration (by animals and plants) but also by other human activities such as burning fossil fuels (coal, gas and oil). Human activities have significantly disturbed the natural carbon cycle by releasing carbon dioxide (and other greenhouse gases) that has been stored in these fossil fuels in the ground, sometimes for millions of years, back into the atmosphere.

In nature, carbon dioxide is exchanged continuously between the atmosphere, plants and animals through photosynthesis, respiration, and decomposition. It is transferred between the atmosphere and the oceans by gas exchange. Additional carbon dioxide from burning fossil fuels (and deforestation) has disturbed the very fine balances that make up this “carbon cycle”.

Natural processes that restore the balances are too slow compared to the rates at which human activities are adding carbon dioxide to the atmosphere. As a result, a substantial fraction of the carbon dioxide emitted from human activities accumulates in the atmosphere, where some of it will remain for centuries or thousands of years to come. These extra concentrations of green-house gases increase global temperatures with consequences that we are starting to see in a warming world (more extreme weather, greater fluctuations of weather, drought, wild-fires, flooding, wind and storm impacts etc). The extra energy in the atmosphere disturbs and modifies heat circulation systems - such as the Jet Stream that plays a significant part in controlling weather in the UK.

1. **Emissions of carbon dioxide to the atmosphere**

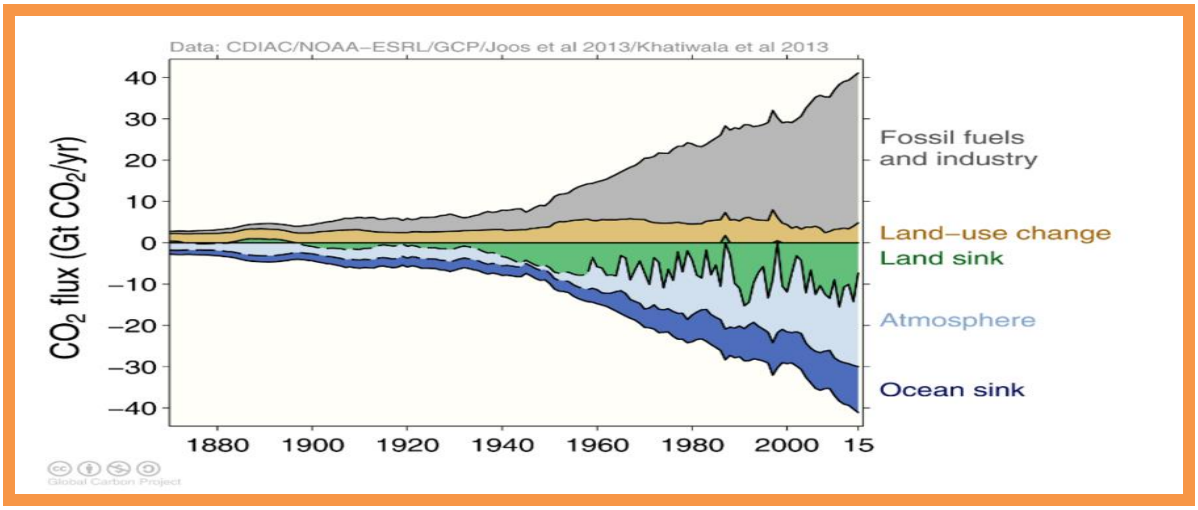
Every year, the World Meteorological Organization (WMO) issues a Statement on the State of the Global Climate based on data provided by National Meteorological and Hydrological Services (NMHSs) and other national and international organizations. For more than 20 years, these reports have been published in the six official languages of the United Nations to inform governments, international agencies, other WMO partners and the general public about the global climate and significant weather and climate trends and events at the global and regional levels.

Preliminary data for 2017 shows that emissions of carbon dioxide from fossil fuels and industry resumed growing at about 1.5% to a record high in 2017 – 65% higher than in 1990.

The graph below shows how emissions of carbon dioxide from burning fossil fuels and industry (grey area on graph) have increased since the mid nineteenth century. Emissions have remained fairly constant from land use change (gold area on graph). Not all of the carbon dioxide emissions remain in the atmosphere. Trees and plants on land absorb carbon dioxide as do the oceans. These are the natural sinks – the means by which carbon dioxide is removed from the atmosphere maintaining the natural balance that makes up the carbon cycle. This has maintained an environment on Earth that has enabled life to exist and develop as we know it.

The responses of the sinks to the increases in emissions in the last 150 – 200 years are also shown in the graph below. Below the x-axis, about 30% of the carbon dioxide emitted by human activities (green on graph) has been absorbed by the land sink (trees and plants etc), about 26% (dark blue on graph) has been absorbed by the oceans but around 44% of all the extra carbon dioxide emitted by human activity has remained in the atmosphere.

Even as global carbon dioxide emissions are reduced in coming years, more than 40% of all emissions will still be added to and remain in the atmosphere - increasing the concentration of carbon dioxide and enhancing global warming. The amount of carbon dioxide that remains in the atmosphere may even increase in the future as the natural carbon sinks saturate and become less effective at absorbing carbon dioxide. There is already enough carbon dioxide in the atmosphere (above 400ppm for the whole of 2017) to warm the Earth very significantly. Natural events like volcanic activity can also add carbon dioxide, and other gases, to the atmosphere.



Three of the most current and authoritative reports on global warming and climate change include:

1. *WMO Statement on the State of the Global Climate in 2017*
2. *The Intergovernmental Panel on Climate Change Synthesis Report 2014*
3. *The World Wide Fund Living Planet Report 2016*

The latest WMO report confirms that 2017 was one of the three warmest years on record (the warmest ever non El Nino year). 2013 – 2017 was the warmest 5 years on record, 2016 remains the warmest year on record. 2018 has also been exceptionally warm, dry and record breaking in parts of the world.

The world's warmest years on record

Year	Anomaly in respect of the 1981–2010 average (°C)
2016	+0.56
2017	+0.46
2015	+0.45
2014	+0.30
2010	+0.28
2005	+0.27
2013	+0.24
2006	+0.22
2009	+0.21
1998	+0.21

Green-house gas concentrations, sea levels and ocean acidification continued to rise with the global ocean heat content also at record levels.

Values of key climate indicators

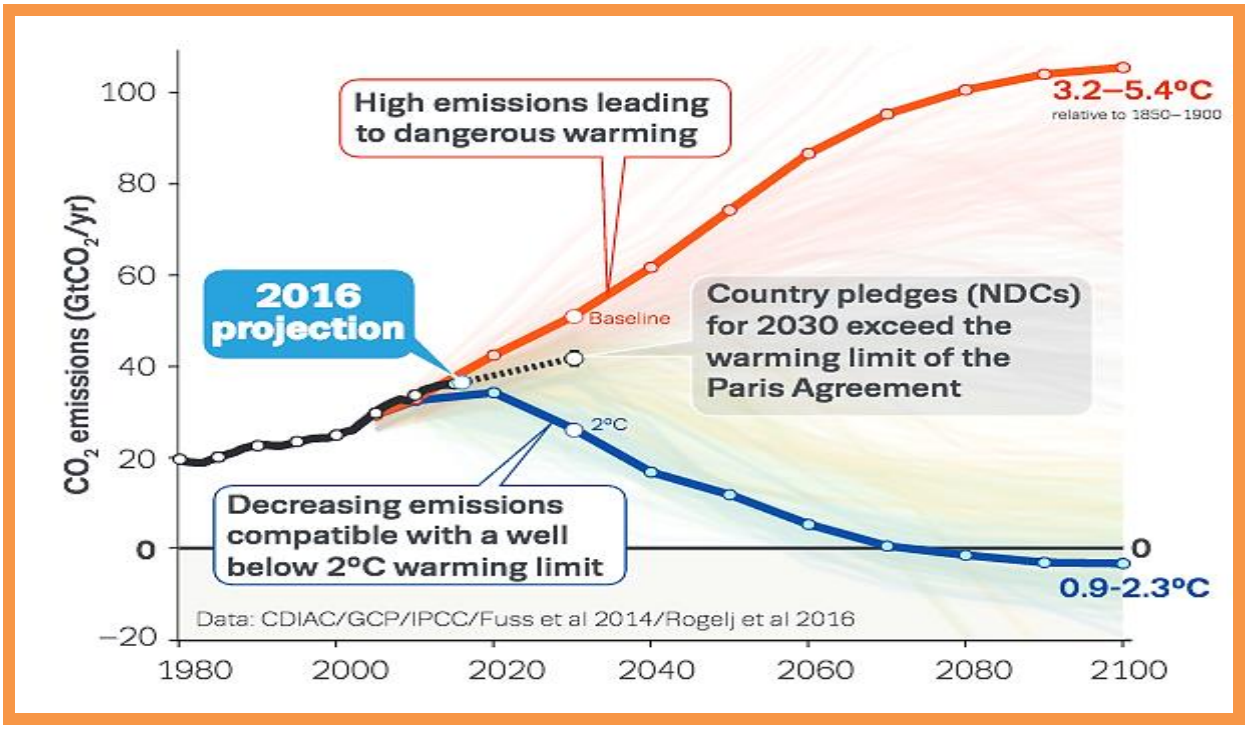
Indicator	Time period	Value	Ranking
Global mean surface-temperature anomaly (1981–2010 baseline)	2017, annual mean	+0.46°C	Second-highest on record
Global ocean heat content change, 0–700 metre layer	2017, annual mean	1.581 x 1023 J	Highest on record
Global mean CO_2 surface mole fraction	2016, annual mean	403.3 parts per million	Highest on record
Global mean sea-level change since 1993	2017, December	8.0 cm	Highest on record
Arctic sea-ice extent summer minimum	2017, September	4.64 million km²	Eighth-lowest on record

[1] World Economic Forum, 2018: *The Global Risks Report 2018.*

2017 was the most costly hurricane season on record, 41 million people were affected by flooding in south Asia, there were continuing severe droughts in parts of East Africa, there were destructive wildfires around the world, 30% of the World's population faced extreme heatwaves and it was the second consecutive year of major bleaching of the Great Barrier Reef. 2017 was the year with the highest documented economic losses associated with severe weather and climate events.

The entry into force of the Paris Agreement, under the UN Framework Convention on Climate Change (UNFCCC) on 4 November 2016, represented a historic landmark. This Agreement will be used to guide the global community in addressing climate change by curbing greenhouse gases, fostering climate resilience and mainstreaming climate adaptation into national development policies.

The global mean temperature in 2017 was 1.1 °C (+ or – 0.1) above the pre-industrial level. Emission reductions will need to increase significantly and widely to limit global warming to the target agreed in this Paris agreement to two degrees above pre-industrial levels (blue line on graph below).



Legend - carbon dioxide emissions since 1980 (solid black line) and country pledges under the Paris Agreement (dashed line) compared to a high emissions scenario (orange line) and a scenario compatible with limiting warming to the target of two degrees Celsius above pre-industrial levels (blue line on graph).

If the world pursues the Paris Agreement's more ambitious limit of 1.5 degrees Celsius warming above pre-industrial levels, the timescales over which global emissions need to peak and start falling rapidly are much shorter. Expressed in a different way, there are around three years' worth of current emissions left before it becomes unlikely that the world can meet the 1.5C Paris target without overshooting and relying on unproven *"negative emissions"* technologies to remove large amounts of carbon dioxide from the atmosphere later in the century. To keep warming well below two degrees Celsius, and pursue efforts to limit it to 1.5 degrees Celsius in the most cost effective way, **wealthy developed counties need to phase out coal-fired electricity completely by 2030** (only twelve years away), China by 2040 (having invested heavily in recent years in a new generation of coal fired power stations) and the rest of the world by 2050.

To put into context the significance of the Paris agreement, and how important it is to reduce green-house gas emissions, a research study reported in 2017 suggested that fossil fuel use, if unabated, could risk raising carbon dioxide concentrations, BY THE MIDDLE OF THIS CENTURY, to values not seen since the early *Eocene* period (50 million years ago). If carbon dioxide concentrations continue to rise beyond this, the global climate could be forced into a state not seen in the last half billion years.

By mid-century, the atmosphere could reach a state last seen when global mean temperatures were 10°C warmer, ice was almost absent on the planet and oceans were dramatically higher than they are today. The implication of the research, published in April 2017 in the journal "Nature", is the starkest warning yet that humanity could potentially be facing a crisis with the urgent need to curtail carbon pollution to the point of **zero carbon emissions** - or risk pushing the climate outside the bounds that have enabled human civilization to exist:

Nature Communications, April, 2017

An interactive map of how global warming / climate change is likely to affect various parts of the world in the future is available in the link below:

Likely Impact of Global Warming / Climate Change on Regions of the World - Interactive Map

Projected climate change will affect millions of people, particularly those with low capacity to adapt, through increases in malnutrition and consequent disorders. This will have implications for child growth and development; increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts, the altered burden of water-related diseases; the increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone, and the movement of some infectious disease carriers into new regions. Climate change is likely to have some mixed effects, such as the expansion and contraction of the range of malaria in different regions. In some places, climate change is likely to bring some benefits to health such as fewer deaths from cold exposure.

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea level has risen".

"Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems".

International Panel on Climate Change (IPCC), Synthesis Report, November, 2014

2. Concentrations of carbon dioxide in the atmosphere

The need to significantly reduce carbon emissions has become ever more apparent. In 2013, atmospheric carbon dioxide concentrations, monitored at the most important monitoring site in the world, crossed the 400ppm for the first time. In 2016 the annual mean carbon dioxide concentrations exceeded 400ppm – the first time for this to happen in human history. Atmospheric carbon dioxide concentrations increased by 3.76ppm between February 2015 and February 2016. This was the single largest annual jump in recorded history. The previous record rise, of 2.82 ppm, occurred during 1997-1998.

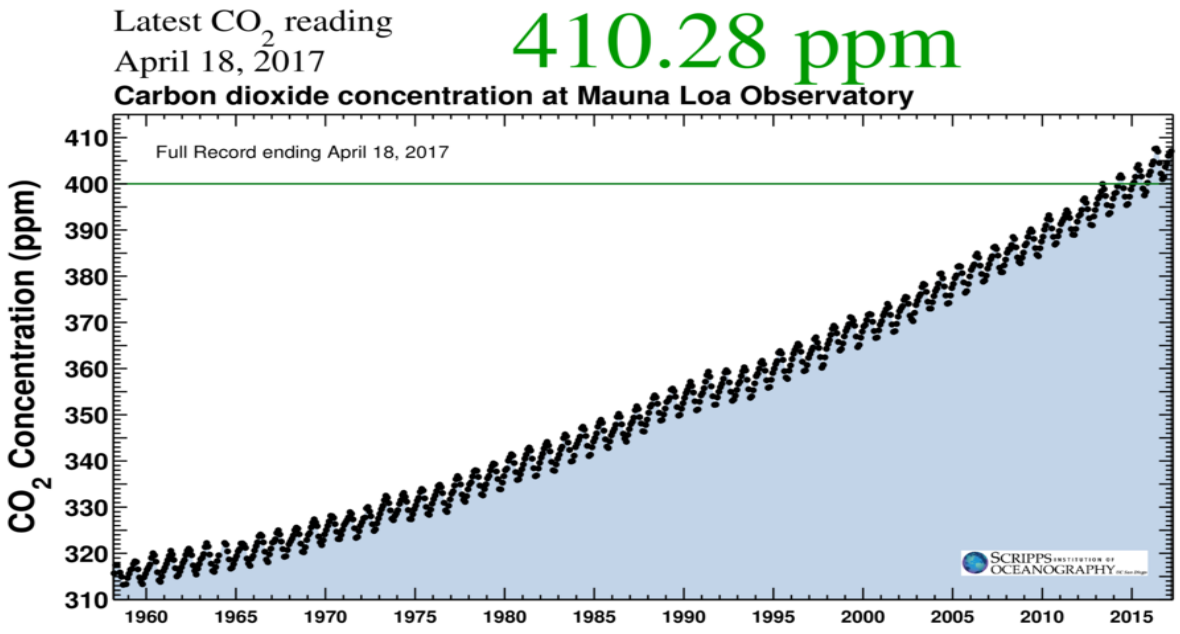
Ralph Keeling, the climate scientist who established the Mauna Loa carbon dioxide curve in the 50s, captures both the significance and uncertainty of the 400 ppm milestone in the statement:

"400 ppm is not a magic number for climate, but it does nicely symbolize that we are in a new era of Earth history."

The available scientific evidence suggests that **in the entire history of human civilization**, **carbon dioxide levels have not been this high previously - and may not have been this high for around 15 million years.** The last time atmospheric carbon dioxide concentrations exceeded 400ppm humans did not exist on Earth; global temperatures were substantially warmer than today and there was very little ice on the planet. Sea levels were also considerably higher — around 100 feet higher (as a global average) than they are today.

"Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years".
"In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate".
International Panel on Climate Change (IPCC), Synthesis Report, November, 2014

Concentrations of the greenhouse gas carbon dioxide in the atmosphere have increased by 40% in just 200 years as a result of human activities. Whilst a concentration of 400 ppm for carbon dioxide is mostly a symbolic number, THE RATE AT WHICH THE CURRENT INCREASE HAS OCCURRED, since the pre-industrial era, is unprecedented.



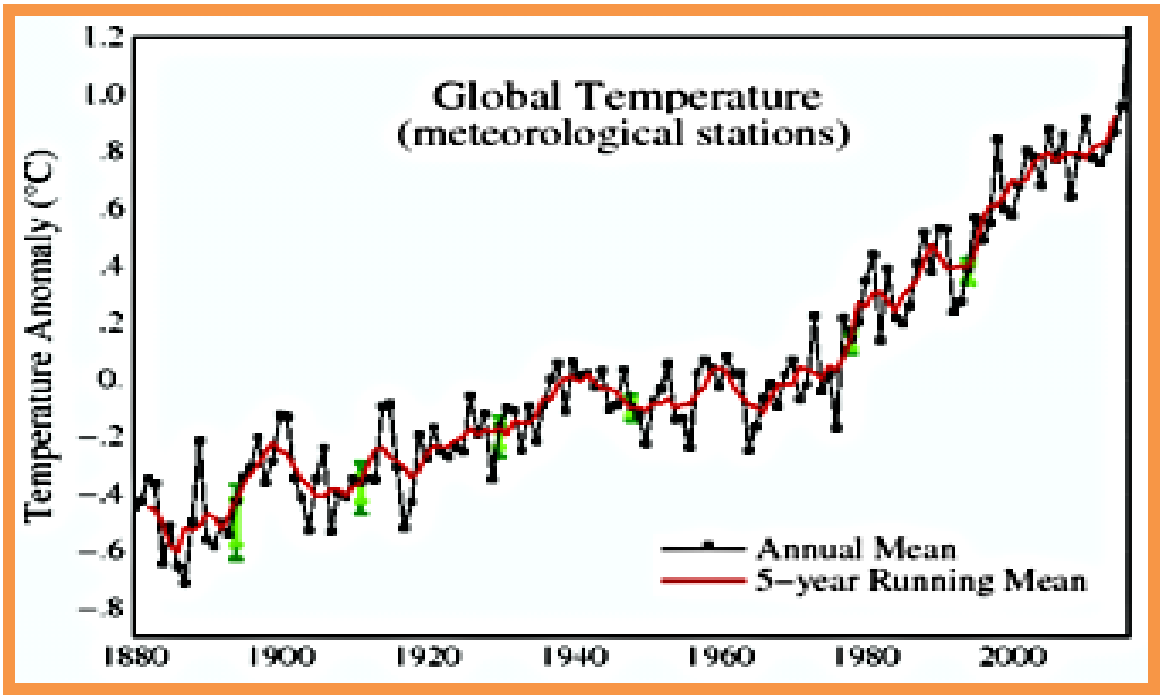
The significance of this increase in carbon dioxide concentration is more clearly seen by extending the Keeling curve backwards over a much longer period of time (and by combining recent measured atmospheric carbon dioxide concentrations with historical levels obtained from, for example, ice-core studies). This produces a graph of carbon dioxide concentrations spanning hundreds of thousands of years that clearly demonstrates that the present rate of carbon dioxide increase is far above natural cycles and anything previously observed in the entire span of human history:

Increased carbon dioxide heats the planet's surface and warms the oceans - which in turn melts ice, raises ocean levels, increases the acidity of oceans and affects weather patterns. Oceans have already risen by 8 inches and could rise by another 36 inches by the end of the century with potentially grave consequences for coastal communities. A small sea level rise can significantly increase the flood risk for coastal communities (particularly in combination with storm surges and big seasonal tides).

It is indisputable that concentrations of greenhouse gases in the atmosphere are increasing, that the atmosphere and oceans are warming, that sea-levels are rising, that oceans are becoming more acidic and that sea ice is melting. Global warming and climate change have consequently become **"**THE DEFINING ISSUES OF OUR TIMES**".** Climates (local and global) have always changed in response to natural events but the concern today is THE SPEED OF CHANGE. The speed is much faster than most known climate changes of the past making it much more difficult for human societies, and the natural world, to adapt. The most significant natural climate changes of the past are known to have resulted in the extinction of many species, in large scale population migrations, and in pronounced changes in atmospheric and ocean circulation patterns.

Since the end of the last ice age, global average temperatures have increased by 4 to 5°C. This change occurred over a period of about 7,000 years, starting 18,000 years ago. The Earth is currently well away from another natural ice age. The current

increases in greenhouse gas concentrations have so far warmed the Earth by around an extra 1.1°C above normal and natural variability:



If the rise in carbon dioxide concentrations continues unchecked, additional warming **of the same magnitude as the increase that occurred during the period coming out of the last ice age could occur by the end of this century (or soon after)**. The current speed of warming is MORE THAN TEN TIMES FASTER than that which occurred at the end of the last ice age, is man induced AND IS THE FASTEST KNOWN, SUSTAINED CHANGE IN THE TEMPERATURE OF THE ATMOSPHERE OF THE EARTH ON A GLOBAL SCALE.

The effects of this warming can be seen in a number of ways:

Effects on Sea Levels

Oceans have already risen 9 inches in the past century and may rise another 36 inches by the end of the century potentially with grave consequences for coastal communities. Sea levels could rise by another 15.75 inches above today's heights, as a mean global average, by as early as 2050. A small sea level rise can significantly affect the flood risk for coastal communities (particularly with the compounding effects of storm surges and big, seasonal tides etc.). When carbon dioxide was last at these levels, polar ice melted and flooded the oceans, raising levels up to 130 feet higher than they are today. Such a rise today would catastrophically alter coastlines around the world affecting a large portion of the population of the world (many of whom live and work in coastal communities).

Effects on Weather - Extreme Weather Events

An area of active on-going research is the link between climate change and extreme weather events. Factors that affect the climate (local and global) and the weather are complex and evidence continues to be gathered but links are emerging between climate change and extreme weather events that are being observed with increasing regularity around the world:

"Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions".
International Panel on Climate Change (IPCC), Synthesis Report, November, 2014

EXTREME WEATHER IN ABERYSYTH IN THE WINTER OF 2013 / 2014.

There have been great storms that have affected coastal towns like Aberystwyth in the past. The promenade was devastated in the 1930s and damaged again in the 1950s. Coastal towns in the UK have completely disappeared in the past following extreme winter storms. It cannot be said with certainty that the storms of the winter of 2013 / 2014 were associated with global warming and climate change but the evidence for the links between extreme weather events and global warming / climate change is increasing. Global warming affects atmospheric circulation systems, like the Jet Stream, sooner than ocean circulation systems, like the Gulf Stream. The Jet Stream plays an important role in controlling weather patterns in the UK and can affect local weather in pronounced and varying ways resulting in extreme cold or extreme warm and dry spells (as witnessed in 2018):

FROM EXTREME COLD TO AN EXTREME DRY SPELL IN CEREDIGION IN 2018

2016 was the warmest year globally since modern records began in 1880. This made 2016 the third successive year to set a new record high for the global mean surface temperature. The current global temperature increase of 1.1 degrees Celsius is approaching the target level of 1.5 degrees Celsius contained in the *Paris Agreement.* The 1.5 degrees Celsius limit is a critical one. Above it, climate impacts are expected to rise significantly.

The 2 degrees Celsius mark is held as a significant point for life on earth itself, and has traditionally featured strongly in climate discussions. Climate *researchers believe* that an increase in global average temperatures of 2 degrees Celsius above pre-industrial levels would take the world into unchartered territory, with potentially unforeseen consequences in terms of extreme weather and climate feedbacks that could accelerate the melting of permafrost (that will release more green-house gases into the atmosphere) and polar ice (that will raise sea levels).This threshold of 2 degrees Celsius warming is actually increasingly considered to be unsafe – it would not prevent potentially dangerous climate change impacts (including more extreme weather events, droughts affecting a large part of the Earth, food security and the impacts on human health and ecosystems etc) and could unleash some positive feed-backs that would exacerbate and accelerate changes possibly resulting in abrupt climate change(s).

The risks of abrupt or irreversible changes occurring will increase as the magnitude of warming increases. An abrupt climate change, one occurring in a very short period of time, could have devastating global consequences. Without mitigation measures, beyond those in place today, warming by the end of the 21st century could lead to a high to a very high risk of severe, widespread, and irreversible impacts globally. The risks are unevenly distributed and are generally greater for disadvantaged people and coastal communities etc.

A recent article in the journal “New Scientist” has suggested that:

“*An entire Arctic ecosystem that supports polar bears, seals and ice algae could be gone within a decade. The northern part of the Barents Sea, located north of Norway and Russia, supports sea ice in the winter, but from 2010 onwards, sea ice cover has fallen sharply.* ***The collapse could be the largest, fastest impact of climate change seen to date, and the first example of a regional "tipping point" being passed***”

New Scientist, June, 2018

The effects of climate change already built into the Earth’s system are likely to persist for centuries to come even if man-made emissions of greenhouse gases could be stopped altogether.

3. Council Action – the Carbon Management Plan

Ceredigion County Council continues to work towards integrating its duties in relation to local air quality management with the wider issues of climate change and global warming. **The Welsh Government considers it particularly important that climate change and air quality policies are properly integrated**. Policies that are targeted

at improving air quality may have benefits in reducing greenhouse gas emissions, and vice versa. The National Air Quality Strategy recognises that there will often be co-benefits for air quality and climate change policies, such as reduced consumption of fossil fuel. The Welsh Government expects local authorities to consider the impact on greenhouse gas emissions of the measures that they propose to implement in air quality action plans and in any local air quality strategies.

The UK government has set challenging targets for reducing national carbon dioxide production by 80% by 2050 based on 1990 levels. Ceredigion County Council is committed to achieving the targets locally and reducing the environmental impact of its activities. Ceredigion County Council recognises that carbon management is both environmentally and financially necessary and beneficial - reducing energy use saves on fuel consumption and reduces costs. Energy price increases in recent times have demonstrated the significance of energy costs to the financial viability of the Council's buildings and the services provided by the Authority.

Cutting carbon emissions, as part of the fight against climate change, has become a priority for all tiers of Government in most of the countries in the world. The general aim is to demonstrate responsible action, to lead by example and to put "own houses in order".

Ceredigion County Council itself entered into a programme with the Carbon Trust to cut its own emissions of carbon dioxide initially setting a reduction target of 34% by 2013 based on 2008 levels. The Council recognized the significance of climate change and the long-term impact that it could have on communities and lifestyles and so committed itself to reducing its carbon footprint. It established a Carbon Management Group and appointed an Energy and Carbon Reduction Programme Manager to take the initiative forward. The Council believes that reducing its carbon-based energy consumption is not only an environmental necessity but also makes good economic sense.

The Council's Well-being of Future Generations Plan will also be used to reinforce its determination to work with partners to apply the sustainable development ideal and show the public that the Council is making progress towards achieving the seven well-being goals. To this end, the Council will promote practices that use natural resources wisely, sparingly and to their best advantage thereby reduce its impacts on the environment and protecting communities from the worst effects of climate change

Carbon emissions in the county were reduced by over 21% in the period 2007/08 to 2011/12. This equated to a cost saving to the Council in the region of £1.2 million on the annual energy bill. The savings were achieved with a range of projects - several identified in the original Carbon Management Plan (but others emerging as the plan developed). Some of the key projects included:

1. Improvements to street lighting - and a revision of street lighting policies
2. Reducing the business mileage
3. Improving the efficiency of fleet vehicles and usage
4. Rationalizing the building stock and installing biomass facilities in some public buildings

SOME CARBON MANAGEMENT PROJECTS IN CEREDIGION – PHASE 1

Figure 1

Legend to Figure

THE CARBON MANAGEMENT PLAN, PHASE 1 – PROJECTS ABOVE

(left to right)

Top

- Plascrug biomass boiler in Aberystwyth
- Flue of Plascrug biomass installation
- 3D computer model of the proposed Llandysul 3-19 School

Middle

- New Library in refurbished former Aberystwyth Town Hall
- Carbon footprint logo
- Pupils of Beulah and Ciliau Parc County Primary Schools at an a Operation Energy workshop in Aberaeron

Bottom

- One of the new Council refuse collection vehicles
- Canolfan Rheidol Council offices in Aberystwyth
- New street lighting near the war memorial in Aberystwyth

The original Carbon Management Plan was updated in 2013 and a new 5-year strategy prepared to reduce carbon emissions by at least another 15% by 2016 / 17. This was expected to equate to another potential reduction in the Council's energy bill of £1million per year by 2016 / 17 - against a business as usual (BAU) scenario. The Council also set an aspirational target of a 20% reduction highlighting its ambition to go beyond a 3% year on year benchmark saving. The Carbon Management Plan (CMP) encompasses carbon emissions created by the following sources:

- The Council's operational building stock (buildings used to provide a service e.g. schools, leisure centres, care homes, libraries etc.)
- Street lighting for all roads adopted by the Council,
- The Council's operational fleet
- The Council's use of private vehicles for business travel.
- Street signs and signals, which were included for the first time in 2015.

More projects were developed / added to the second phase including:

Figure 2

PHASE 2 of the Carbon Management Plan

Legend to Phase 2 above

Top (left to right)

- Front elevation of Ysgol Bro Teifi (the new Llandysul 3-19 School)
- Bow Street Replacement Lighting Scheme
- Ysgol T Llew Jones, Brynhoffnant PV installation

Middle (left to right)

- Plascrug Biomass woodstore
- Carbon footprint logo
- Refuse collection vehicle

Bottom

- Ysgol Bro Teifi, Llandysul PV installation

The Council achieved an actual reduction of 21.2% in carbon dioxide reductions by the 2016 / 2017 target date (against the "aspirational target" of 20%):

2016/17 Emissions

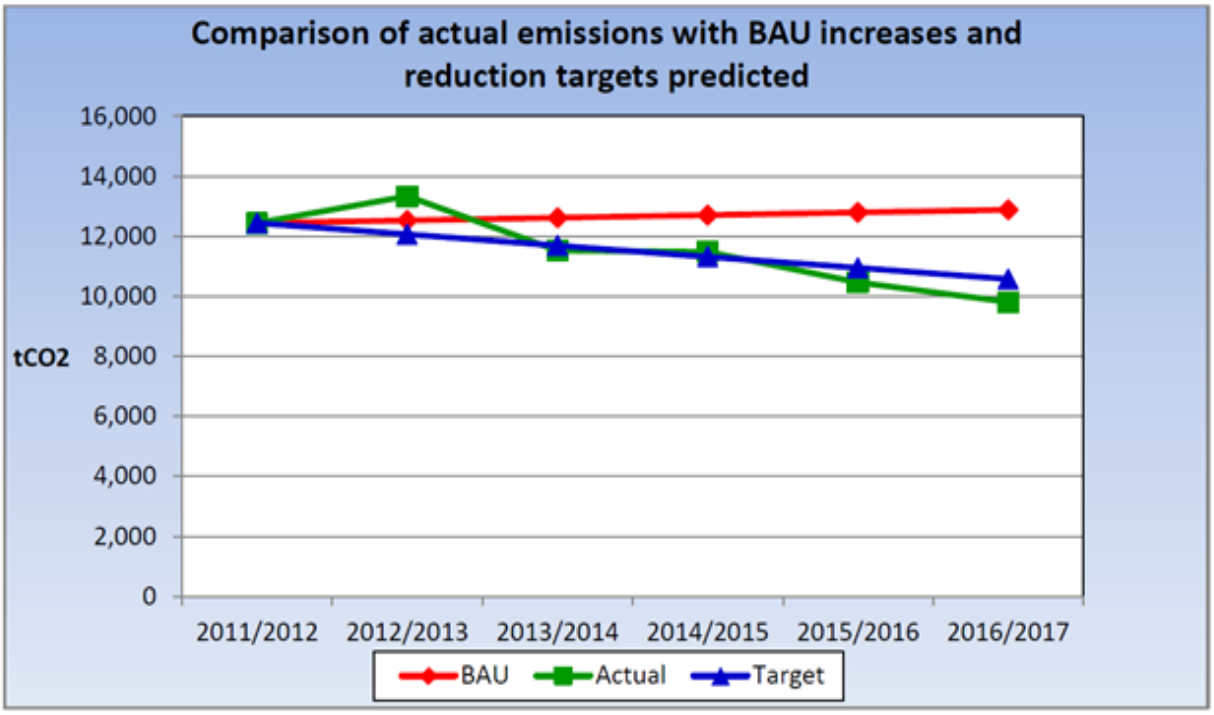
Actual

Baseline Year	Baseline tCO_2	2016/17 Actual tCO_2	% Dif.	2016/17 target tCO_2	2016/17 target % Reduction	% of target Achieved
2011/12	12,442	9,810	21.2%	10,576	15.0%	141.0%

The Authority has achieved an actual reduction of 21.2% (2,632 tCO_2) in CO_2 in the 5 years of this CMP to March 2017. This reduction means that the Council has exceeded both the minimum target reduction of 15%, but also the step reduction target of 18%.

Actual carbon emissions savings to date means that cost savings against the business as usual (BAU) scenario are calculated at approximately £2,000,000. **The**

cumulative total savings for the period 2012/13 to 2016/17 are then £4,175,034 against a BAU scenario. This equates to a very big financial saving for a small, rural Council.



Emissions from energy consumed by all of the Council's operational properties (buildings used for service provision) accounted for 67.28% of the Council's carbon emissions in 2016/17. Of this buildings-only footprint, electricity consumption accounts for 59.5% of carbon emissions, gas consumption accounts for 24%, oil/LPG consumption 16% and biomass 0.5%. Emissions from the County's schools accounted for 54.3% of Council's operational property carbon emissions in 2016/17. This represents 37% of Ceredigion's overall Carbon Footprint. This highlights the requirement for energy reduction in Schools and highlights the role that schools have in reducing the Authority's carbon emissions.

There are a number of factors that have contributed to this success over the last 5 years. These include:-

• Level of investment – Ceredigion County Council has committed over £2.1 million to energy initiatives. These schemes have contributed to emission reductions in Ceredigion's buildings and include; Plascrug Biomass extension; PV schemes at Canolfan Rheidol, Penmorfa, Penrhos and Ysgol Bro Teifi; as well as lighting and boiler replacements.

• Carbon emission factors – these are updated every year by DEFRA and are applied to the Council's annual energy data when calculating carbon emissions. With the exception of 2014/15, the carbon factor used for electricity when producing emission figures has gradually reduced over the Plan period.

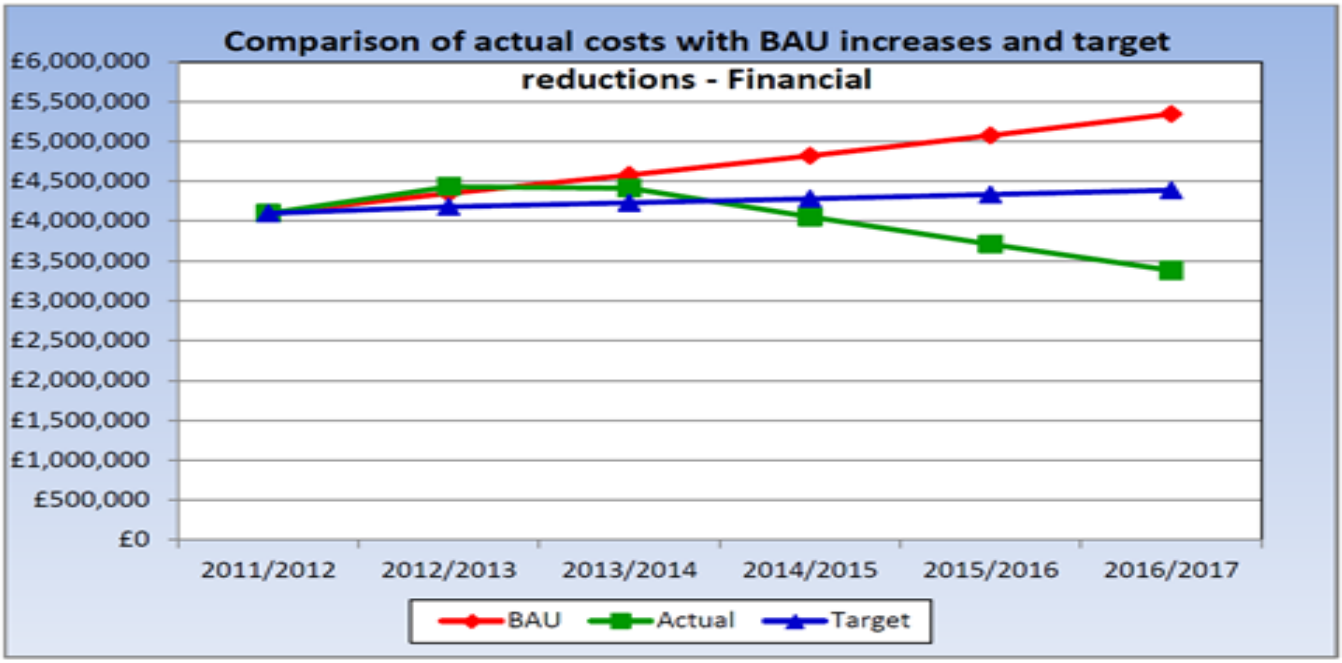
• Building Rationalization – it is important that buildings are operated as efficiently as possible and occupied in the most cost-effective way. Ceredigion has an ongoing programme of building rationalization to ensure that buildings are used to their full potential and are not being under-utilized.

• 21st Century Schools Programme - A number of area schools have been constructed in Ceredigion, these include T Llew Jones in Brynhoffnant and Dyffryn Cledlyn in Drefach. These two new schools replaced a number of smaller primary schools in these areas. Ysgol Bro Teifi, a new 3-19 School, opened in 2016. This school replaced one secondary and four smaller primary schools in the local area. These new schools are much more energy efficient than the buildings they have replaced, providing energy and carbon savings.

Calculations in the updated Carbon Management Plan suggested that by achieving a minimum target reduction of 15%, the Council would save annually in the region of £1 million by 2016/17 relative to a business as usual scenario, and around £2.7 million cumulative savings by the same year. This emphasized that good environmental management, reducing waste and using resources wisely can make good economic sense.

The actual financial savings made have been much larger than this. **In 2016/17, total cost of energy and fuel reported within the scope of this Plan was £3,381,914. These costs were £1,963,847 (36.7%) lower that the expected BAU costs and £1,006,232 (22.9%) lower than the target cost figure. Cumulative savings to date, based on the business as usual (BAU) scenario are in excess of £4,000,000.**

Ceredigion County Council spent £717,322 less on energy in 2016/17 than they did in the 2011/12 baseline year. When considering inflation and utility price increases during this time, in real terms savings equate to significantly more than this.



Ceredigion County Council has committed a significant level of investment to energy saving initiatives during the life of this Plan. These schemes alone have provided at least a 750t reduction in CO2 emissions and should continue to provide these savings in future years.

As with all implemented projects, these schemes will be monitored via the Council's energy management system to verify cost and carbon savings going forward. A number of projects have contributed to this success including:

	Project	Cost Estimate	2012 / 13	2013 / 14	2014 / 15	2015 / 16	2016 / 17	Savings	Status
1	Canolfan Rheidol Server Room energy Reduction	£30,000	£5,000	£25,000				Savings are in the region of £18,000 p.a. with CO_2 reduction of 76 tonnes pa. Payback period – 24 months.	31/03/2014
2	Operation Energy - Energy Monitors for ten schools. Energy engagement with schools / energy reduction project. Workshops held to provide energy information and	£2,000		£2,000				Varying CO_2 and cost reductions across participating sites.	31/03/2014
3	Aberystwyth Biomass Phase 2 – Plascrug Leisure Centre and Penweddig	£980,000			£980,000			RHI income £95k per annum, CO_2 savings - 437 tonnes pa	03/03/2015
4	Lampeter 3-19 School – Sustainable Building Envelope Demonstration, installation of a transpired solar collector in collaboration with cardiff University - fully fulnded by WEFO.	£80,000			80,000			£2,000 annual saving on gas & CO_2 Savings – 14 tonnes p.a	31/03/2015
5	PV Panels at Penmorfa - 50kW	£65,000			£65,000			Penmorfa – 20 tonnes CO_2 p.a. 45,000kWh annual reduction in electricity, which has reduced the building's electricity bill by up to £5,000, with a feed in tariff income of £5,000pa	31/03/2015
6	PV Panels at Minaeron - 30kW	£42,000			£42,000			Min Aeron – 12 tonnes CO_2 p.a. 26,000kWh annual reduction in electricity, which has reduced the building's electricity bill by up to £3,000, with a feed in tariff income of £3,000pa	31/03/2015
7	Aberaeron Secondary replacement boilers, Oil to LPG heating	£400,000				£400,000		26ton reduction in CO_2 and a fuel cost saving of £14,000	31/03/2016
8	Penmorfa corridor lights, replace with LED				£22,000			40,000 kWh reduction in electricity, providing an annual saving of £4,000p.a. 20t reduction in CO2 with 5.5 year payback	31/03/2015
9	Minaeron ground and first floor rear office LED	32000			£32,000			10,000 kWh reduction in electricity, providing an annual saving of £1,000p.a. 5t reduction in CO_2	31/03/2015

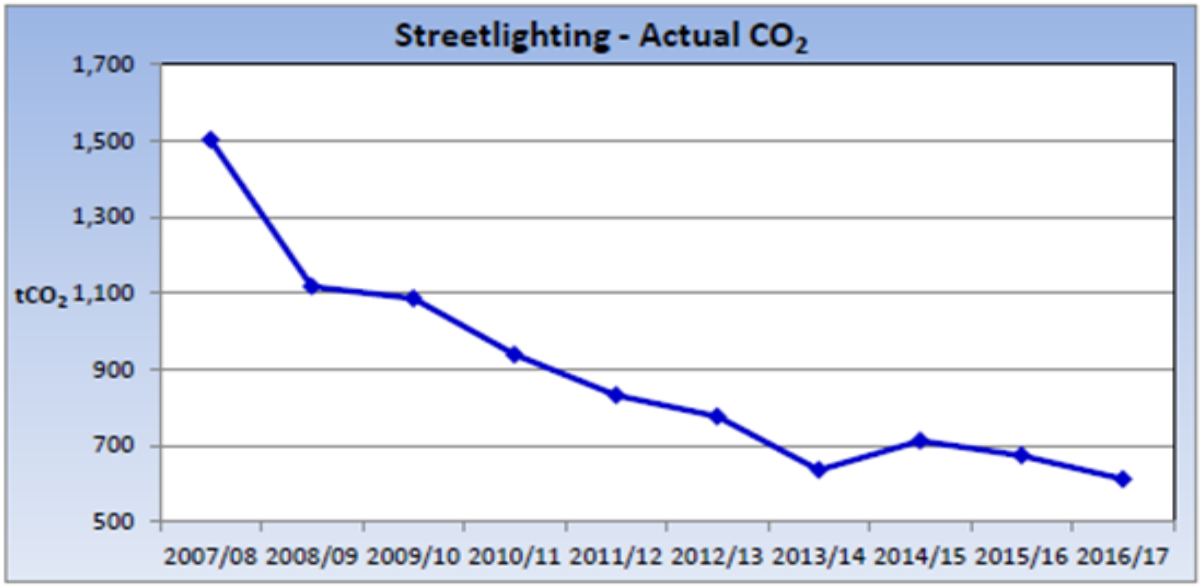
	Project	Cost Estimate	2012 / 13	2013 / 14	2014 / 15	2015 / 16	2016 / 17	Savings	Status
10	Felinfach CP replace obsolete T12 fittings	3500			£3,500			LED lighting upgrade	31/03/2015
11	Commins Coch CP – installation of cavity wall insulation, loft insulation and hall end glazing	£7,000				£7,000		9,300kWh reductionin gas usage which equates to a 2t reduction in CO_2, saving £540pa	30/04/2015
12	Llandysul 3-19 School - Construction of a new 3-19 school, which replaces four primary and one secondary school in the Llandysul area.	£240,000					£240,000	108t reduction in CO_2 and annual energy saving of £17,000 when compared to the previous sites. Includes installation of 180kW PV array and LPG gas fired boilers. Cost relates to PV.	01/09/2016
13	Canolfan Rheidol PV installation - 50 kW	£55,000				£55,000		20 tonnes CO_2 p.a. 45,000kWh annual reduction in electricity, which has reduced the building's electricity bill by up to £5,000, with a feed in tariff income of £5,000pa	31/03/2016
14	Penrhos Depot PV installation – 22.79kW	£30,000				£30,000		18,000 kWh reduction in electricity, equicalent too £2,000 saving and a 7.5t CO_2 saving.	31/03/2016
15	Glanyrafon TMU - Lighting	£8,445				£7,125	£1,320	LED Lighting Upgrades - Office & MOT Bay	31/03/2017
16	Llanllar CP School - Electric to LPG heating	£103,907					£103,907	Replace electric heating with new, more efficient wet LPG boiler and heating system	30/08/2016
17	Trewen CP - Oil to LPG heating	£85,574					£85,574	Replace existing oil boiler with new, more efficient LPG boiler - emergency repair	30/08/2016
18	Cardigan Leisure Centre	£4,970					£4,970	LED Lighting Upgrades	31/03/2017
19	Penrhos Depot Lighting	£7,830					£7,830	LED Lighting Upgrades	31/03/2017
20	Ceredigion Museum - PV installation 7.98kW	£10,000					£10,000	Installation of a 7.98kW PV array. Annual saving in the region of 7,000 kWh / approx £800pa / 3t/CO_2	31/03/2017
		£2,187,226	**£5,000**	**£27,000**	**£1,224,500**	**£499,125**	**£453,601**	**750.5tCO_2**	

Some of the projects included:

Canolfan Rheidol PV installation –49.75kW

34.75kW of solar photovoltaic panels were installed on the roof of the Canolfan Rheidol offices, with a further 15kW on the biomass building. It is estimated that this installation will generate approximately 45,000kWh of electricity, which could reduce the building's annual electricity bill by up to £5,000, The scheme will also provide an annual Feed in Tariff income in the region of £5,000pa and a 20 ton annual carbon saving.

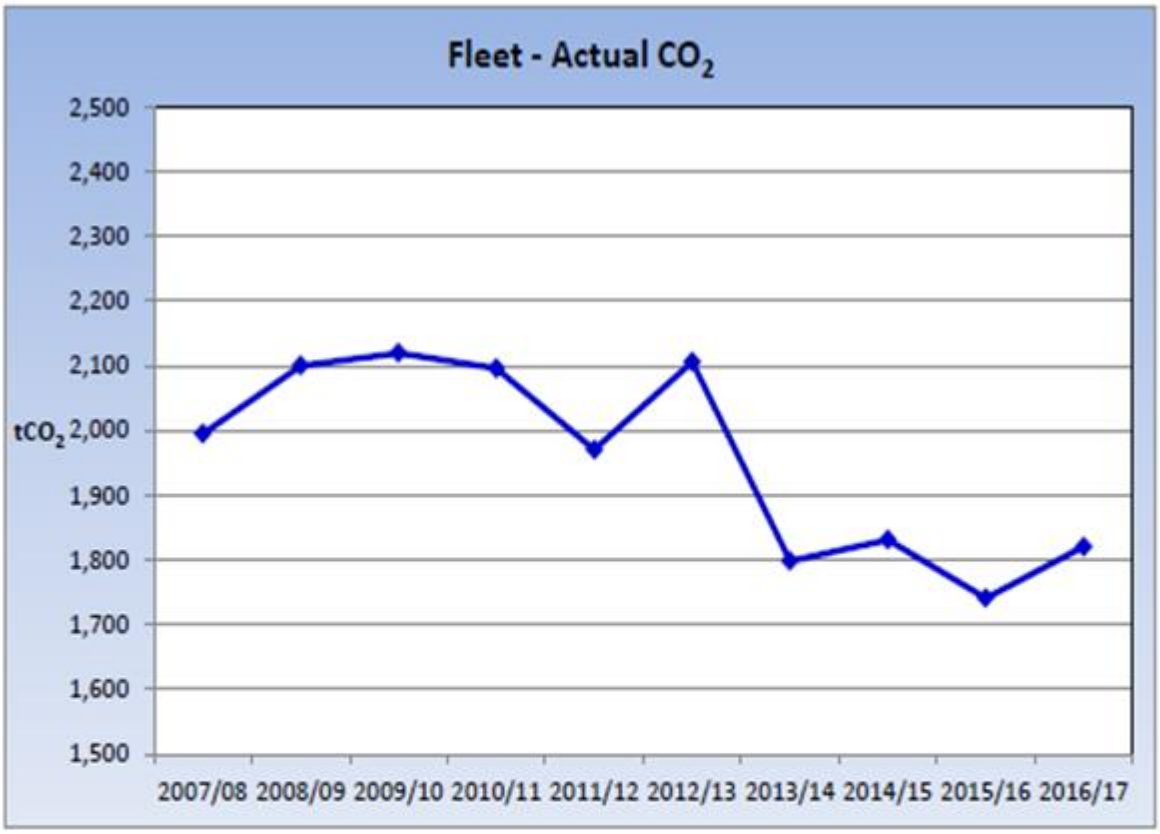
1. Penrhos Depot PV installation – 22.79kW - as part of the construction of the new offices at Penrhos depot, a 22.79kW solar photovoltaic system was installed at the site.
2. Emissions from the County's schools accounted for over 50% of Council's operational property carbon dioxide emissions in 2015/16. The 21st Century Schools Programme is contributing to energy reductions in the Council's school portfolio. Bro Teifi 3-19 School in Llandysul opens in September 2016. This new school is modern, energy efficient and promotes the use of renewable technology with a 180kW solar PV installation.
3. The graph below illustrates the reductions in street lighting emissions since 2008 (following LED lighting upgrades etc):



During 2016/17, streetlighting emissions were reduced by 61 t/CO_2, equivalent to 9.06% when compared to the previous year. This reduction is mostly attributed to a reduction in the emission factor for electricity, however future streetlighting projects are being looked at to further reduce electricity consumption in this area.

The Council has made significant investment in the street lighting portfolio since 2008, replacing old lamps with more efficient LED lanterns, as well as part-night dimming. As a result, carbon emissions from street lighting have been reduced by 830 tonnes, which is a 59% reduction in street lighting emissions since 2007/08. This is a significant reduction and is providing an annual cost saving to the Authority of almost £200,000pa.

The graph below shows the reductions in the Council's fleet since 2008:

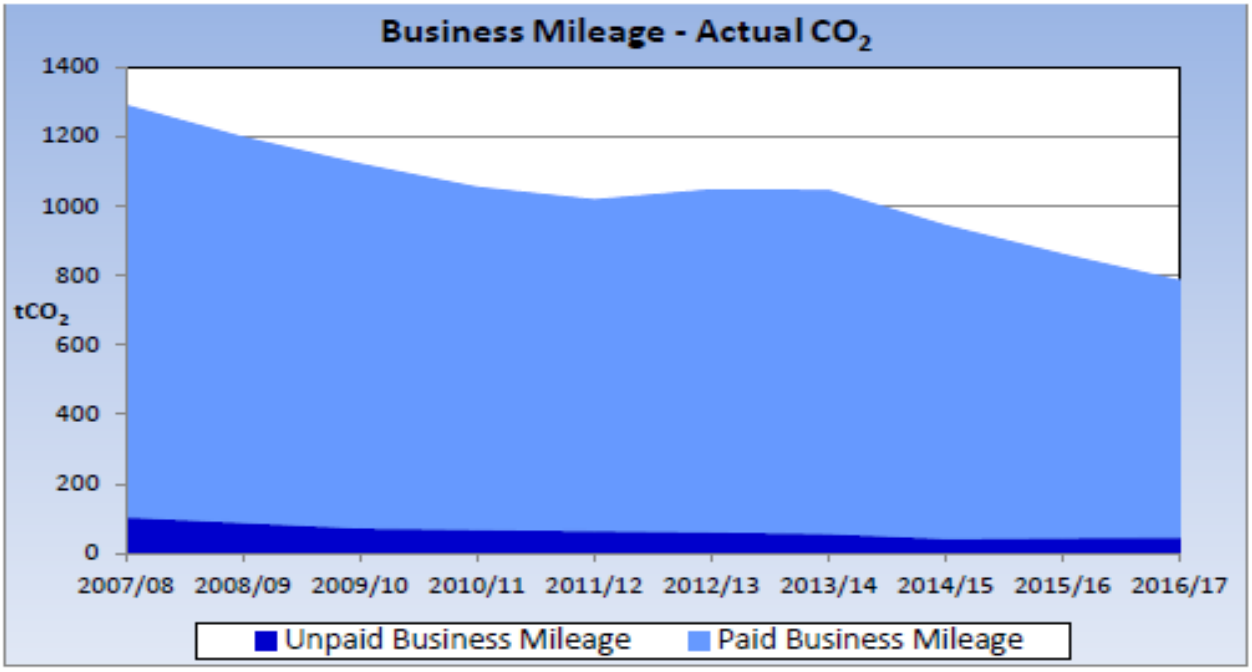


Fleet emissions are heavily influenced by the weather and the winter maintenance requirement e.g. gritting of roads. Fleet emissions during 2016/17 increased by 79 t/CO_2, equivalent to a 4.5% increase when compared to the milder winter of 2015/16.

Despite this, during the 5 year period of this Plan, overall fleet emissions have reduced by 13.58%, which is equivalent to a 286 tonne reduction in CO_2.

The graph below shows the reductions in business mileage since 2008. Business travel is the use of private vehicles by Council staff to undertake their duties. During 2016/17 Council employees travelled **2.59 million business miles**, which generates an additional 8% of the Council's total baseline emissions. Business mileage emissions reduced by 80 t/CO2 in 2016/17, when compared with the previous year – a 9.3% year on year reduction. Since 2011/12 emissions from business mileage have

reduced by 239 t/CO2. This is equivalent to a 23.5% reduction for the 5-year period of this Carbon Management Plan.



Since 2007/08 overall business mileage has been reduced by 39.16%. Paid business mileage has been reduced by 1,157,438miles, which at current HMRC mileage rate of 45p per mile, equates to an annual cost saving of approximately £520,847.

The UK and Welsh Governments have both identified the public sector as key to achieving carbon reductions in line with their own Climate Change targets. Ceredigion County Council now has a proven record of environmental achievement, having worked in partnership with the Carbon Trust for the last decade. In this time the Council has gained a better understanding of the emissions from their estate and the potential for improvement.

The Council has been successful in implementing measures which, along with their approach to asset management, have already resulted in a reduction in carbon emissions of over 42% since 2008 (more than 50% of the UK Government's target of a 80% reduction, based on 1990 levels, to be achieved by 2050). This also already achieves the Welsh Government target of achieving a 40% reduction by 2020. This Welsh Government target was described as being "very challenging" in a 2017 report:

https://gov.wales/docs/desh/publications/170412-advice-on-the-design-of-welsh-carbon-targets-en.pdf

Emissions reductions had only reached 18% in 2015 for Wales as a whole compared with 36% for the UK as whole (relative to 1990 levels) and the 42% achieved in Ceredigion by 2017.

A third phase Ceredigion Carbon Management Plan currently being drafted will continue to challenge the Council by identifying where new actions are needed to achieve future efficiencies and savings. **The plan has already highlighted the importance of placing carbon management at the heart of the Council's culture.** Limiting climate change will require substantial and sustained reductions in greenhouse gas emissions. The continued build-up of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system (local and global) increasing the likelihood of severe, pervasive and irreversible impacts on people and ecosystems. The surface temperature of the world is projected to continue to rise over the 21st century under all currently assessed emission scenarios. As a consequence, ***it is very likely that heat waves (as observed in the summer of 2018) will occur more often and last longer, there will be more droughts (and drought affected areas), extreme precipitation events will become more intense and more frequent in many regions, the oceans will continue to warm and acidify and sea levels continue to rise***.

Measures put in place by Ceredigion County Council to address climate change will also impact positively in other ways. Reducing emissions of green-house gases will improve air quality locally and the general health and well-being of the population in line with the requirements of the Well-being of Future Generations (Wales) Act 2015.

Recognising that actions today determine outcomes tomorrow, Ceredigion County Council has adopted the Mission Statement:

"GOFALU AM YFORY, HEDDIW – CARING FOR TOMORROW, TODAY"

THE CARBON MANAGEMENT STATEMENT, CEREDIGION COUNTY COUNCIL

"Ceredigion County Council recognises that climate change is going to have impacts on the local environment and communities in the County. Whilst measures will have to be put in place to respond to the challenges that climate change will present, it is also acknowledged that greenhouse gas emissions must be reduced significantly and, as an organisation, we must radically reduce our use of carbon-based energy. This will inevitably have implications for the planning and delivery of services. However, with energy costs predicted to rise significantly in coming years, reducing carbon-based energy consumption not only makes environmental sense, but economic sense for the County.

Our Corporate Strategy reinforces the Council's determination to work with partners to protect communities from the effects of climate change. We shall promote practices that use natural resources wisely, sparingly and to their best advantage. We shall promote energy efficiency in Council buildings and support measures to reduce our carbon footprint.

This Carbon Management Plan outlines how we will reduce our carbon emissions and make carbon management an important part of everything we do. Climate change is a global challenge and requires a global, and local, response. ***We will need all our staff and partners to support us in becoming a low carbon authority.*** *This plan should take us in the right direction and may help others to take similar action".*

CARBON MANAGEMENT STATEMENT, THE CARBON TRUST

"Cutting carbon emissions as part of the fight against climate change should be a key priority for local authorities – it is all about getting your own house in order and leading by example. The UK government has identified the local authority sector as key to delivering carbon reduction across the UK in line with its Kyoto commitments and the Local Authority Carbon Management programme is designed in response to this. It assists councils in saving money on energy and putting it to good use in other areas, whilst making a positive contribution to the environment by lowering carbon emissions.

Ceredigion County Council was selected in 2009, amidst strong competition, to take part in this ambitious programme. Ceredigion County Council partnered with the Carbon Trust on this programme in order to realise vast carbon and cost savings……

There are those that can and those that do. Local authorities can contribute significantly to reducing CO_2 emissions. The Carbon Trust is very proud to support Ceredigion County Council in their on-going implementation of carbon management".

Ceredigion County Council remains committed to reducing its green-house gas emissions further. Emerging evidence suggests that green-house gas emissions may need to APPROACH ZERO LEVELS BY THE END OF THE CENTURY. This is a measure of the task at hand. **Not only do green-house gas emissions need to be reduced but they largely need to be eliminated**. Achieving such reductions will pose substantial technological, economic, social, and institutional challenges – challenges that increase with delays.

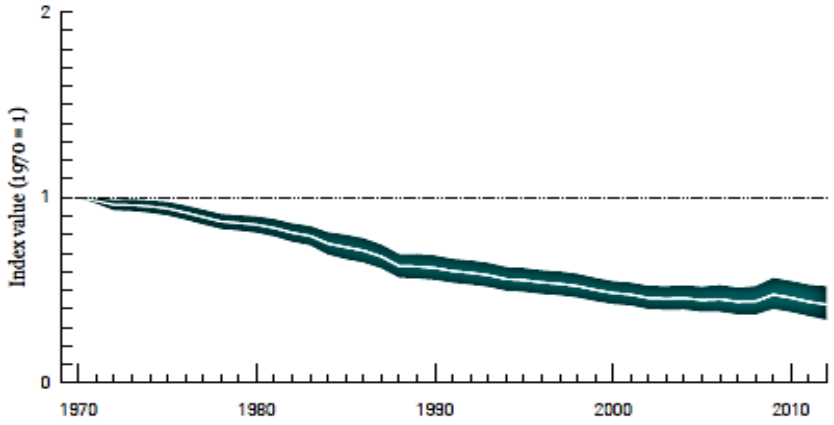
Effective adaptation and mitigation responses will depend on policies and measures developed across multiple scales: international, regional, national and local. Local Government has a key role to play in addressing local impacts of climate change and success will depend on suitable governance and structures, the availability of sufficient resources and relevant tools and the capacity to be able to respond quickly and appropriately to events and challenges as they unfold (such as the cold winter followed by summer drought in 2018 that posed many challenges as far as the impact on drinking water supplies, wild fires and consequences for the agricultural sector etc were concerned).

The challenges are apparent. In the World Wildlife Fund (WWF), "Living Planet Report", 2016 it is concluded that, quote:

1. The evidence has never been stronger and our understanding never been clearer. Not only are we able to track the exponential increase in human pressure over the last 60 years—the so-called "Great Acceleration" and the consequent degradation of natural systems, but we also now better understand the interdependencies of Earth's life support systems and the limits that our planet can cope with.
2. The richness and diversity of life on Earth is fundamental to the complex life systems that underpin it. Life supports life itself. We are part of the same equation. Lose biodiversity and the natural world and the life support systems, as we know them today, will collapse.

3. We completely depend on nature, for the quality of the air we breathe, water we drink, climate stability, the food and materials we use and the economy we rely on, and not least, for our health, inspiration and happiness.
4. For decades, scientists have been warning that human actions are pushing life on our shared planet toward a sixth mass extinction. Evidence in the 2016 *Living Planet Report* reinforces this. Wildlife populations have already shown a concerning decline, on average by 58 per cent since 1970 (and likely to reach 67 per cent by the end of the decade).
5. A Living Planet Index, which measures biodiversity abundance levels based on 14,152 monitored populations of 3,706 vertebrate species, shows a decline of 58 per cent between 1970 and 2012 with greatest losses in freshwater environments.

Figure 2: The Global Living Planet Index shows a decline of 58 per cent (range: -48 to -66 per cent) between 1970 and 2012
Trend in population abundance for 14,152 populations of 3,706 species monitored across the globe between 1970 and 2012. The white line shows the index values and the shaded areas represent the 95 per cent confidence limits surrounding the trend (WWF/ZSL, 2016).



6. Monitored species are increasingly affected by pressures from unsustainable agriculture, fisheries, mining and other human activities that contribute to habitat loss and degradation, overexploitation, climate change and pollution.
7. In the 40 years, from 1970 to 2010, 52 percent of the populations of many of the planet's vertebrates (mammals, birds, reptiles, amphibians and fish) have vanished. Humans are largely to blame for this decline as animals are killed for food in unsustainable numbers and their habitats destroyed. If current trends continue up to the year 2020, vertebrate populations may decline by an average of 67 per cent compared to 1970.
8. Of all of the species studied, freshwater wildlife has declined at the most alarming rate, by 81 percent.

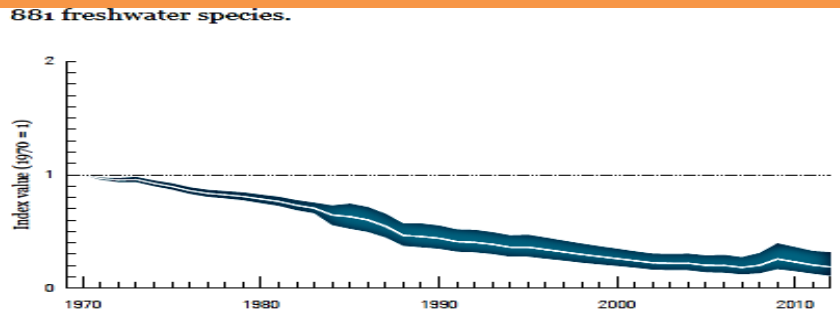
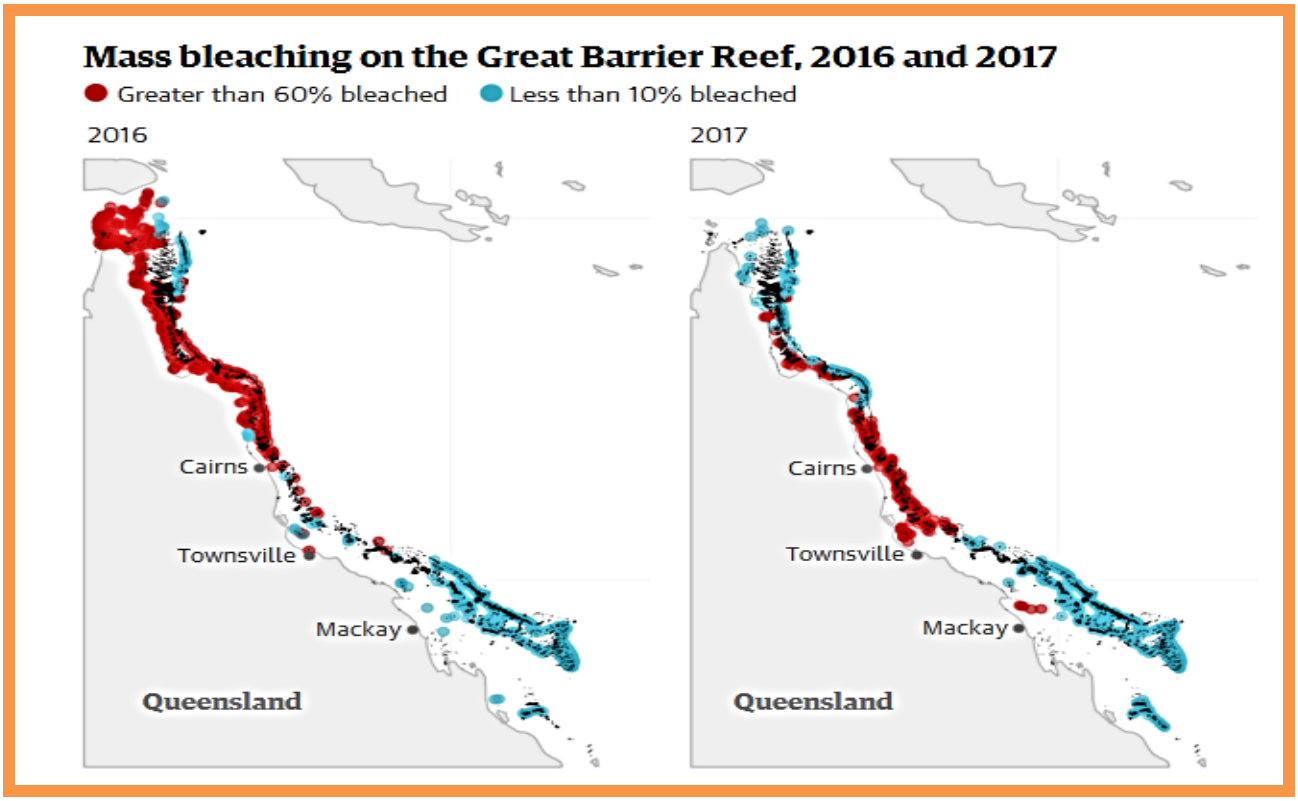


Figure 12: The freshwater LPI shows a decline of 81 per cent (range: -68 to -89 per cent) between 1970 and 2012
Trend in population abundance for 3,324 populations of 881 freshwater species monitored across the globe between 1970 and 2012 (WWF/ZSL, 2016).

Key
Freshwater Living Planet Index
Confidence limits

9. Marine wildlife populations have decreased by 36 percent.

10. **Three-quarters** of the world's coral reefs are now threatened and the species they support are subject to high and increasing pressure. Coral reefs are highly biodiverse habitats located in shallow parts of the ocean. Thousands of species take advantage of the food, protection and nursery habitat provided by reefs. While reefs cover less than 0.1 per cent of the total area of the world's ocean, they support over 25 per cent of all marine fish species. Coral reefs could face large-scale extinction by mid-century, due to widespread and regular mass coral bleaching events and acidification. This has happened at Australia's Great Barrier Reef in two consecutive years – 2016 and 2017. To put this into context, mass bleaching at the Great Barrier Reef has only occurred four times in all of recorded history.



11. Increased human pressure threatens the natural resources that humanity depends upon, increasing the risk of water and food insecurity and competition over natural resources.
12. **The present population of the world actually requires 1.6 Planet Earths to sustain humanity at current levels.** A growing population means there are more mouths to feed. For the past 40 years natural resources have been used faster than they can be replenished. Trees are cut down before they mature, oceans are fished faster than they can repopulate and more carbon dioxide is produced than the planet can absorb. We are quickly using up more than the planet can provide. This is going to make it more difficult to sustain the needs of future generations.
13. On a positive note, whilst environmental degradation continues, there are signs that the World is beginning to embrace a transition towards ecologically more sustainable practices. The impact of plastic waste on the natural environment, including on the oceans of the world, received world-wide press

attention in 2017 and action is being taken to address the issue on local and global scales.

14. There are other positive developments in that China's huge coal burning expansion may have finally peaked. Also, the rampant poaching and wildlife trafficking, that has devastated some ecosystems, is being treated much more seriously by Governments. The U.S., and more notably China, is now committed to a historic ban on domestic ivory trade as an example.
15. The World enters a new era in its history – one that is being called the "*Anthropocene*". It is an era in which humans rather than natural forces are the primary drivers of planetary change. The human population must redefine its relationship with the planet, from a wasteful, unsustainable and predatory one, to one where people and nature coexist in harmony.
16. During this *Anthropocene* era, our climate is changing rapidly, oceans are acidifying and entire biological species are disappearing – all at a rate measurable during a single human lifetime.
17. Already the magnitude of the human impact on the planet in this *Anthropocene* era is such that the world's sixth mass extinction event is a possibility. In the past, such extinction events took place over hundreds of thousands to millions of years. What makes the *Anthropocene* era so remarkable is that these changes are occurring within an extremely contracted period of time. This is the first time a new geological epoch may be marked by what a single species (*Homo sapiens*) has consciously (or subconsciously) done to the planet – as opposed to what the planet has imposed on its resident species in the past.

5 Conclusions and Proposed Actions

5.1 Conclusions from New Monitoring Data

Ceredigion County Council has no Air Quality Management areas and has no areas close to Air Quality Strategy Objectives. It has not been considered necessary, therefore, to declare any Air Quality Management Areas or to prepare a Local / Regional Air Quality Strategy. On the basis of the three new National Air Quality Indicators for Wales (for nitrogen dioxide, PM10 and PM2.5) air quality in Ceredigion ranks with the best in Wales.

As in previous rounds of Review and Assessment, results reported in this Report indicate that all statutory air quality Standards and Objectives are complied with in Ceredigion by specified dates at all locations (including the most heavily trafficked roadside locations).

Monitoring and new assessments for this report have not revealed any places in Ceredigion where the combustion of fuels (in motor vehicles, industry, or in domestic properties) or fugitive emissions are causing, or are likely to cause, significant air quality problems. The review suggests that there are no traffic-related air quality problems at the busiest road locations and in the most congested towns in Ceredigion. There are no major industries close to heavily populated areas and only a small number of Part B processes and small combustion plants, in the county (mostly categorised as "low risk").

Non-statutory Standards and Objectives for ozone, however, may not be complied with in some parts of Ceredigion and this pollutant will continue to be monitored in the county. Periodic exceedances of this pollutant can only be addressed by national / international measures.

Likewise, annual mean background PM2.5 concentrations modelled by DEFRA for 2015 were estimated to be around 10.45µg/m^3 at some roadside locations in Aberystwyth in Ceredigion. This exceeds a Scottish mandatory and World Health Organisation guideline standard of 10µg/m^3 (that has not been adopted as a standard in England and Wales). It complies with, however, with a target Standard of 25µg/m^3 currently contained in the Air Quality Standards (Wales) Regulations 2010.

5.2 Conclusions relating to New Local Developments

Ceredigion County Council confirms that there are currently no new local developments that will require more detailed consideration and none that give rise for any Detailed Assessments. An air quality assessment has been carried out for a proposed new re-cycling development in Ceredigion. This is not expected to give rise to appreciable air quality impacts.

5.3 Other Conclusions

The current Progress Report on Air Quality in Ceredigion re-assesses results for the various pollutants included in the National Air Quality Strategy and considers and reviews new developments in the district. Ceredigion is rural with very few air-polluting industries. This list of air polluting industries has not changed since the last Progress Report for Ceredigion.

Road traffic continues to be the dominant source of air pollution in Ceredigion with the volume of road traffic increasing though remaining relatively low in national terms.

Air quality continues to be monitored in the most congested and sensitive areas of Ceredigion for three of the pollutants contained in Regulations. The purpose of this is to check compliance and confirm local and national projections. Monitoring is also undertaken as required to identify any changes associated with changes in industrial activity, the volume and composition of traffic, road layouts, new local developments and other factors that contribute to air pollution in the county.

The pollutant ozone, which is not contained in Regulations, continues to be monitored because it can be more problematic in rural than urban areas and because of health links and its significance in the global warming / climate change debate.

Monitoring using passive diffusion tubes is used from time-to-time in periodic baseline and screening exercises to identify any new, emerging air pollution “hot-spots” focusing in particular on schools, industrial sites, residential areas, various businesses, garages, the rail network, bus stations, dry cleaning and paint shops, and in the vicinity of new road layouts etc. Passive samplers are inexpensive and can be deployed in relatively large numbers to provide the spatial coverage and resolution necessary to effectively map an area and identify potential sources of pollution.

Traffic volumes and flows in the county are monitored by the Highways, Property and Works Department of the Council. Largest traffic flows have consistently been observed at Terrace Road and Thespian Street in Aberystwyth. A new road layout and one-way system has continued to improve air quality at these locations in recent years as monitoring demonstrates.

Volumes of traffic in the county, even in the most congested town (Aberystwyth), are relatively low when compared with other parts of the country and do not approach the heavily trafficked classification described in Guidance. The ratio of heavy goods vehicles to the total number of vehicles is also low in Ceredigion because of the lack of industry.

5.4 Proposed Actions

This air quality review for Ceredigion has not identified the need to progress to more detailed assessments for any of the priority air pollutants. New National Air Quality Indicators are very low for nitrogen dioxide, PM10 and PM2.5 in Ceredigion – supporting observations from monitoring and air quality assessment presented in this report. This work has not identified the need for any additional monitoring in the future. Monitoring will be continued, but at a lower level, for the three priority pollutants nitrogen dioxide, sulphur dioxide and benzene at "hot-spot" and other locations considered necessary to monitor trends and ensure continuing compliance with existing and any new standards.

For nitrogen dioxide, measured trends in recent years at all "hot-spot" locations are downward with no exceedances of the standards detected at any locations (including road-side and worst case locations).

For sulphur dioxide, concentrations can periodically (and for short durations) increase across the county (as a result of transboundary plume migration from outside the county) but generally remain very low in national terms and well below the standards.

For benzene, there is also full compliance with standards at all key monitoring locations. Monitoring will be continued at strategic locations in the future to ensure continuing compliance with the most stringent standards (there are no "safe levels" for benzene).

For particulates, PM2.5 particulate pollution could become an issue, even in rural Ceredigion, at roadside locations **if the stringent standard for PM2.5, which is now in place in Scotland, becomes adopted in Wales**.

A Carbon Management Plan to reduce carbon emissions will continue to be developed in Ceredigion and the Council will work with other local authorities and external partners to develop a consistent, and where possible, shared approach to air quality and carbon management etc. Steps being taken to reduce carbon emissions should further improve air quality in the county.

A Green Infrastructure Strategy and Plans will be developed and feed into the "Well-being of Future Generations Plan" for Ceredigion.

The next Progress Report for Air Quality in Ceredigion will be prepared and submitted in September 2019.

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27. *The Intergovernmental Panel on Climate Change Synthesis Report 2014*
28. *The World Wide Fund Living Planet Report 2016*

Appendices

Appendix A: Monthly Diffusion Tube Monitoring Results

Appendix B: A Summary of Local Air Quality Management

Appendix C: Air Quality Monitoring Data QA/QC

Appendix D: Grid References and Photographs of Monitoring Locations

Appendix A: Monthly Nitrogen Dioxide Diffusion Tube Monitoring Results

Table A.1 – Full Monthly Diffusion Tube Results for Nitrogen Dioxide for 2017

Nitrogen Dioxide Mean Concentrations (µg/m3)															
													Annual mean		
Site ID	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Raw data	Bias Adjusted and Annualised	Distance Corrected to nearest exposure
Railway Station, Aberystwyth	36.6	39.3	44.2	28.7	33.2	24.5	22.3	23.5	30.7	28.8	35.9	28.4	31.34	24.13	24.13
Thespian Street, Aberystwyth	42.6	32.5	37.8	23.3	30	18.1	20.1	17.7	22.5	23.9	32.3	23	26.98	20.77	20.77
Morrisons, Aberystwyth	27.9	31.6	24.9	22.4	20.3	21.3	24.8	22	25.5		25.7	18.4	24.07	18.53	18.53
Terrace Road, Aberystwyth	44.7	37.2	42.6	26.5	31.1	20.1	18.3	20.6	21.3	22.9		19.9	27.75	21.37	21.37
Park Avenue, Aberystwyth	27.5	20.7	15.9	17.9	13	9	11	11.4	14.4	13.8	24.9	16.5	16.33	12.57	12.57
High Street, Lampeter	33.4	39.1	37.9	28	29.4	22.4	28.2	23	17	27	37.1	31.6	29.51	22.72	22.72
High Street, Cardigan	33.1	27.4	24	25.8	20.2	17.5	18	22.2	20.8	18.6	28.7	22.3	23.22	17.88	17.88

Notes:

Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

(1) See Appendix C for details on bias adjustment (and annualisation if required).

(2) Distance corrected to nearest relevant public exposure.

Appendix B: A Summary of Local Air Quality Management

Purpose of an Annual Progress Report

This report fulfils the requirements of the Local Air Quality Management (LAQM) process as set out in the Environment Act 1995 and associated government guidance. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas and to determine whether or not the air quality objectives are being achieved. Where exceedances occur, or are likely to occur, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) within 18 months of declaration setting out the measures it intends to put in place in pursuit of the objectives. Action plans should then be reviewed and updated where necessary at least every 5 years.

For Local Authorities in Wales, an Annual Progress Report replaces all other formal reporting requirements and have a very clear purpose of updating the general public on air quality, including what ongoing actions are being taken locally to improve it if necessary.

Air Quality Objectives

The air quality objectives applicable to LAQM in Wales are set out in the Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138), Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298), and are shown in Table B.1.

The table shows the objectives in units of microgrammes per cubic metre µg/m3 (milligrammes per cubic metre, mg/m3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table B.1 – Air Quality Objectives Included in Regulations for the Purpose of LAQM in Wales

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40µg/m^3	Annual mean	31.12.2005
Particulate Matter (PM_{10})	50µg/m^3, not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	18µg/m^3	Annual mean	31.12.2010
Particulate Matter ($PM_{2.5}$)	10µg/m^3	Annual mean	31.12.2020
Sulphur dioxide (SO_2)	350µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005
Benzene	3.25µg/m^3	Running annual mean	31.12.2010
1,3 Butadiene	2.25µg/m^3	Running annual mean	31.12.2003
Carbon Monoxide	10.0mg/m^3	Running 8-Hour mean	31.12.2003
Lead	0.25µg/m^3	Annual Mean	31.12.2008

Appendix C: Air Quality Monitoring Data QA/QC

RECORDING CONCENTRATIONS OF NITROGEN DIOXIDE IN AMBIENT AIR

The reference method for recording nitrogen oxide concentrations, to comply with EC Directive 85/203/EEC, is automatic chemiluminescence, as described in ISO standard 7996. However, a simple and cost effective way of measuring nitrogen dioxide levels that complies with requirements under the National Air Quality Strategy is using diffusion tubes.

It is recognised that whilst diffusion tubes can provide data that are comparable with the chemiluminescence reference method care must be taken with storage, handling, and analyses of the tubes. It is important that suitable QA/QC procedures are used and that diffusion tubes are validated against a reference method so that a “bias correction” can be applied to recorded data. Diffusion tubes prepared by different laboratories have been shown, in various collocation studies, to produce results that are largely dependent on the tube preparation method. There are four tube preparation methods in common use: 50% triethanolamine in acetone, 50% triethanolamine in water, 20% triethanolaminein water, and 10% triethanolamine in water. If a laboratory performs at a consistent level over a period of time any bias correction can easily be allowed for. Bias adjustment factors should be based on collocation of diffusion tubes with a chemiluminesence monitor. It is important to determine the bias adjustment factor for the specific tube preparation method, the actual laboratory used, and based on a collocation study over a full year (the time span of the annual standard). There can be seasonal variations in the bias. Bias adjustment factors must also be based on the same exposure periods (1-week, 2-weeks, or monthly recorded data, for example).

Monitoring ambient nitrogen dioxide concentrations, using passive diffusion tubes, provides an integrated, average concentration for the pollutant over the exposure period (usually 4 weeks) and is particularly well suited to baseline and screening studies for the assessment of spatial distribution of nitrogen dioxide concentrations in the urban environment. The technique is also useful for identifying 'hotspots' where nitrogen dioxide concentrations are elevated and that may, therefore, warrant further investigation.

In baseline and screening monitoring exercises carried out in Ceredigion over many years, to identify “hot-spots” and test the significance of results, diffusion tubes have been co-located at the same monitoring site on some occasions. Reproducibility has always been very good with observed variations always less than 10%. Nitrogen dioxide concentrations have also been monitored in a rural location to determine background levels and for direct comparison with national estimates of background levels in the county. As reported in previous reports, this agreement has always been excellent.

Some collocation studies undertaken nationally, using nitrogen dioxide diffusion tubes with simultaneous chemiluminescent measurements, have shown good agreement. More generally, however studies suggest that, over the typical range of concentrations found in urban areas in the UK, nitrogen dioxide diffusion tubes, exposed for one month, tend to overestimate actual concentrations compared with the chemiluminescent method. A correction needs to be applied, therefore, to

measured data. In Ceredigion, using the nationally accredited laboratory "SOCOTEC" (previously "Scientifics") this correction has tended to be around 0.8 – that is, the diffusion tubes over estimate NO2 concentrations by around 20%.

The UKAS accredited laboratory; "SOCOTEC" has been used by Ceredigion County Council for the supply and analysis of diffusion tubes. Under the accreditations all the appropriate network and laboratory based QA/QC protocols are assured. On a network-wide basis such protocols include documentation of criteria for sampler location, record keeping of the sampler locations, procedures for tube handling and exposure and the compilation of a timetable for sample exposure (as required and documented for nitrogen dioxide diffusion tube survey work).

Further QA/QC systems are also important for the actual analysis and preparation of diffusion tubes and are essential if uncertainties in data are to be minimised. "SOCOTEC" is UKAS accredited for this task and can adequately demonstrate their analytical competency through involvement in laboratory inter-comparisons and performance testing schemes.

The laboratory has calculated a bias adjustment factor of 0.77 for their nitrogen dioxide diffusion tubes supplied in 2017 (using collocation studies and comparison with a chemiluminescent analyser).

All samples are analysed in accordance with the SOCOTEC standard operating procedures HS/GWI/1015 issue 8. Tubes are prepared by spiking acetone: triethanolamine (50:50) onto grids prior to the tubes being assembled. Tubes are desorbed with distilled water and the extract analysed using a segmented flow autoanalyser with ultra violet detection. This analysis of diffusion samples to determine the amount of nitrogen dioxide present is within the scope of their UKAS schedule. In WASP inter-comparisons schemes for comparing spiked nitrogen dioxide diffusion tubes, SOCOTEC is currently ranked as a **Category Good** laboratory.

For general screening purposes an overall uncertainty in measured nitrogen dioxide concentrations of <30% has been recommended. For more detailed assessments, an overall uncertainty of <20% is required. A less than 10% uncertainty indicated by co-location studies undertaken in Ceredigion is well within both ranges.

Nitrogen dioxide diffusion tubes have been used extensively in Ceredigion to provide the spatial coverage and resolution required to identify nitrogen dioxide "hot-spots" and to monitor and report on trends for this pollutant. Technical guidance recommends that local authorities focus on "hot-spots" and "worst case" locations in undertaking assessments. If there are no exceedances of standards and objectives at these locations it is reasonable to assume that there should be no exceedances at other locations. It is also impressed in guidance that monitoring should be concentrated at locations that are appropriate for public exposure.

Exceedances of the annual mean objective for nitrogen dioxide are most likely to occur within about 10m of the kerbside. Exceedances may occur, however, alongside roads with relatively low traffic flows (10,000 – 20,000 vehicles per day) **if** such locations are in congested town centres with narrow streets and tall buildings (which can result in "canyon effects"). It is important, therefore, to focus monitoring for

nitrogen dioxide **in the most congested parts of main towns and villages, at kerb-side locations and at identified hot-spot locations**. These include canyon locations in narrow streets with residential properties in close proximity, at busy junctions, in shopping areas where members of the public may spend one hour or more close to traffic, and at other roadside locations with the highest flows of buses and / or heavy goods vehicles. In Ceredigion monitoring has been undertaken at all the appropriate locations over a number of years and also in the vicinity of bus stations, roundabouts, schools, and where members of the public have expressed concerns about air quality. The location of "hot-spots are well established in Ceredigion. Periodic screening, however, continues in line with any new developments and changes to the existing local infrastructure.

RECORDING CONCENTRATIONS OF SULPHUR DIOXIDE IN AMBIENT AIR

In the past, passive sulphur dioxide diffusion tubes were used extensively by local authorities to monitor sulphur dioxide concentrations and there exists a large amount of historical diffusion tube data for sulphur dioxide (see, for example, the Welsh Air Quality Forum database). Many earlier air quality reviews and assessments for sulphur dioxide were based, to some extent, on diffusion tube results.

This is a relatively inexpensive monitoring technique that was used to provide an integrated average concentration for the pollutant over the exposure period (usually four weeks). As for other pollutants, it was generally found to be well suited for baseline and screening studies and for the assessment of the spatial distribution of sulphur dioxide concentrations. Results enabled local authorities to identify "hot-spots" and, over the course of time, to monitor trends. Sulphur dioxide monitoring can also assist in assessments of particulate pollution. When industry is a main source of particulate pollution, particulate levels are normally expected to exceed the standards when sulphur dioxide exceeds the standards.

Protocols for sampler preparation and analysis by photospectrometry and ion chromatography are available in the scientific literature for sulphur dioxide diffusion tubes - with the ion chromatographic technique being informally accepted as the standard method of analysis. Results using diffusion tubes for sulphur dioxide are not acceptable for detailed assessments where continuous automatic monitoring methods, using equipment capable of appropriate concentration and time resolution, should be used.

There were conflicting messages in Technical Guidance LAQM(TG.03) concerning the use of sulphur dioxide diffusion tubes **for general monitoring and screening purposes**. Advice issued in the Guidance varied from "not fully validated and should be used with caution" (Table A1.2) to "not recommended for Review and Assessment" (7.14), to "diffusion Tubes should not be used" (A1.20).

In Technical Guidance LAQM.TG(09) it is stated that "Diffusion tubes are available for sulphur dioxide monitoring, but they are not suitable for LAQM". The reasons given are that:

a) They are unable to detect short term changes in concentration attributed to emissions from point sources
b) They are unable to monitor compliance with 24-hour, 1-hour and 15-minute air quality strategy objectives.

Never-the-less, sulphur dioxide monitoring using diffusion tubes has been continued in Ceredigion, at a few locations, to confirm past assessments, to continue to monitor trends and to observe periodic episodes of sulphur dioxide plume migration originating from outside the county. Ceredigion County Council believes that the use of passive diffusion tubes for sulphur dioxide monitoring for such purposes is justified on the grounds of:

1) **Cost** – Ceredigion is a small rural authority with very limited resources available for air quality monitoring and assessment. Diffusion tubes are a cost-effective option that allows actual data to be collected and spatial distribution, hot-spots and trends to be identified and monitored.
2) **Continuity** – historically, sulphur dioxide has been monitored widely using diffusion tubes producing results that were generally in good agreement with those from other sources. Trends have been observed that are in accord with national predictions.
3) **Scale of the problem** – sulphur dioxide concentrations are relatively low in Ceredigion, with no significant industrial sources, but some episodes of plume migration from outside the county have been observed.
4) **Confidence in the analysis** – the laboratory used by Ceredigion is UKAS accredited ("Environmental Scientific Group, ESG") for the analytical work. Samples are analysed in accordance with their standard operating procedure HS/GWI/1011 issue 7 that is within the scope of their UKAS schedule of accredited tests.
5) **Associated uncertainties** – most estimates suggest that associated uncertainties are less than 30% which is no higher than the uncertainties associated with measurement techniques for some other pollutants. An uncertainty of less than 30% is usually acceptable for general screening purposes. Associated uncertainties are no higher than those associated with many modelling techniques.
6) **Comparison** – some comparative studies using passive sulphur dioxide diffusion tubes and simultaneous measurements from an UV fluorescence analyser have been reported to show "reasonable agreement". On average, sulphur dioxide diffusion tubes exposed for one month tended to underestimate ambient sulphur dioxide by approximately 30% compared with the UV fluorescence analyser. Background results for sulphur dioxide using diffusion tubes in Ceredigion have consistently compared well with estimated background concentrations and background results reported at other rural UK sites (for example, at Harwell) using approved and continuous instrumental measuring techniques. The reproducibility of results in Ceredigion, determined by exposing two diffusion tubes at the same locations over the same periods of time, has also been very good with variations observed at around 10%. This is comparable with the reproducibility observed using diffusion tubes for other pollutants.
7) **Annual Standards** – the main argument against using diffusion tube for sulphur dioxide is that these provide longer-term average concentrations for the pollutant whereas the main UK Objective applies to a 15-minute, 1-hour and 24-hour mean. There are, however, World Health Organisation annual Guideline standards available for more direct comparison (which have not been transposed into UK legislation) and annual standards for the protection of vegetation and ecosystems (which have been transposed into UK legislation). Computer generated annual background concentrations are also available for direct comparison with measured background levels.

As stated above, therefore, limited monitoring for sulphur dioxide, using diffusion tubes, has been continued in Ceredigion to monitor trends and observe episodes of plume migration from outside the county.

The laboratory used by Ceredigion, “SOCOTEC”, has demonstrated appropriate laboratory-based quality assessment and quality control protocols for this pollutant. Their protocols include criteria for record keeping, tube handling and an exposure timetable. They have in place quality control systems for the analysis and preparation of diffusion tubes, which is essential to minimize uncertainties. The laboratory is UKAS accredited for these tasks and has adequately demonstrated their analytical competency through involvement in laboratory inter-comparisons and performance testing schemes.

RECORDING CONCENTRATIONS OF BENZENE IN AMBIENT AIR

Benzene concentrations are now only recorded in Ceredigion, using diffusion tubes, in three main town locations focusing on identified (from screening exercises in the past) “hot-spots” where traffic congestion occurs and in the vicinity of petrol stations etc. These are also locations where members of the public may be exposed over the relevant averaging period.

The prescribed Objectives for benzene are annual averages so sampling has been undertaken at these sites in Ceredigion over the period of a month and then used to calculate annual means. Monitoring is also undertaken at a rural background location (where there is very little road traffic) for comparison purposes. To test for accuracy and reproducibility, two diffusion tubes have periodically been exposed at the same location over the same monitoring duration – results have always been acceptable (within the range 10 – 15%).

The measurement of benzene concentrations using diffusion tubes is a convenient and cost effective method for determining long-term average concentrations. The diffusive sampler used is a Perkin Elmer design available from the “SOCOTEC” in Oxfordshire (a UKAS accredited laboratory). Although other types of tubes, and also badge sampler designs are available for descriptive purposes, only this type of diffusion tube is recommended in national guidance for measuring benzene levels.

The sampler consists of a stainless steel tube packed with a suitable absorbent for benzene. The absorbent is held in place with stainless steel gauze. Initially, both ends of the tube are sealed, with one end subsequently opened for sampling. During exposure, the cap at the sampling end of the tube is removed and replaced with a diffusion cap. The tube is then exposed vertically with the diffusion cap at the bottom and the sealed end at the top. The normal sampling period is one month.

There is some evidence that the uptake rate of benzene may change significantly after sampling periods longer than 2 weeks and in the national guidance that has been drafted **2-week sampling is recommended.** Monthly monitoring, however, is

the most convenient exposure period allowing monitoring for all the pollutants to be coordinated and undertaken at the same time and over the same period.

All diffusive samplers utilise the principle of molecular diffusion, whereby molecules of a gas diffuse from an area of high concentration to an area of low concentration at a rate governed by Fick's Diffusion Law. For consistency with the 1992 National BTX Diffusion Tube Study, Chromosorb 106 is used as the absorbent in the diffusion tubes supplied by Scientifics, with an uptake rate of 1.6 ng ppm-1 min-1 for this type of sampler.

The accuracy of the benzene diffusion tube method, as determined by comparison tests, is reported as being ±10% of the measured value (the range has generally been 10 – 15% in collocation studies in Ceredigion). For general screening purposes an overall uncertainty of <30% is recommended. For more detailed assessments, an overall uncertainty of 20% is desirable. Recorded measurements in Ceredigion are, therefore, within the recommended uncertainty levels.

Diffusion tubes are exposed at locations where there is a suitable free flow of air. Benzene has been monitored in the past in Ceredigion in the vicinity of potential sources. Monitoring has continued at locations where members of the public are regularly exposed. Sites have been selected where the terrain surrounding the sampling tube is considered unlikely to impact on the levels of benzene recorded. The effect of nearby trees on benzene uptake, for example, can be considerable and can vary with the season.

In principle, the method of analysis consists of thermal desorption of the species collected in the absorbent followed by gas chromatography (GC) or mass spectrometry (MS). The mass of desorbed material is quantified by reference to calibration standards. From the mass determined and the exposure duration of the sampler, the average ambient concentration can be calculated.

Good laboratory practice and high standards of cleanliness are required for accurate analysis of benzene diffusion tubes. In Ceredigion the chosen laboratory has in place a regime of system blank and calibration runs incorporated into the analysis of exposed tubes. The laboratory maintains quality control charts of calibration records and participates in inter-laboratory exercises (to monitor their own performance). SOCOTEC is a fully, UKAS accredited laboratory for these procedures so that appropriate network and laboratory based QA/QC protocols are assured. Information on analytical calibration and quality control procedures, and an estimation of the accuracy and precision of the results, is available on request.

RECORDING CONCENTRATIONS OF OZONE IN AMBIENT AIR

Ozone concentrations are recorded in Ceredigion using diffusion tubes exposed at six, representative and strategic locations. In the past, concentrations have been monitored in the three main towns in Ceredigion, in some of the smaller towns and villages, and at rural and elevated locations where the highest levels of ozone in Ceredigion have been observed. Diffusion tubes provide an integrated, average concentration for ozone and, as for other pollutants, have been used in Ceredigion for screening purposes in order to assess the spatial distribution of ozone concentrations, to locate “hot-spots”, to observe episodes of ozone plume migration probably originating from locations well outside the county and to monitor trends etc.

There is very little hard information available on uncertainty levels for ozone diffusion tubes in the literature. The concentrations of ozone that have been measured in Ceredigion, however, seem to be consistent and follow expected and national trends. The accuracy of results for ozone using diffusion tubes is believed to be around 10% and collocation studies undertaken in Ceredigion, when two tubes have been exposed simultaneously at the same location, seem to support this with variations mostly around 10%.

The UKAS accredited laboratory “SOCOTEC” is used for the supply and analyses of ozone diffusion tubes. Their protocols include acceptable criteria for record keeping and tube handling and exposure. They have in place quality control systems for the analysis and preparation of diffusion tubes, which is essential to minimise uncertainties. The laboratory can adequately demonstrate their analytical competency through involvement in laboratory inter-comparisons and performance testing schemes.

Samples are analysed in accordance with the SOCOTEC standard operating procedure HS/GWI/1025 issue 4. Analysis of the material in the sample is within the scope of their UKAS schedule of accredited tests.

Appendix D: Grid References and Photographs of Monitoring Locations

NITROGEN DIOXIDE

Nitrogen dioxide was monitored at the following strategic locations in Ceredigion in 2017:

Terrace Road

(Grid Reference: SN5847 8170)

This is a “hot-spot” and “worst case” location with the largest urban traffic flows in the county (but not a heavily trafficked location in national terms as defined in guidance). This is a kerb-side, narrow, congested, “canyon” location with junctions, a bus terminal, a railway station and town residences close by. This is a hot-spot location where historically the highest concentrations of nitrogen dioxide have consistently been found in the county. There is a periodic flow of buses / goods vehicles at this monitoring location. It is a busy shopping location where people may spend more than one hour in close proximity to traffic.

(Relevant exposure - shoppers 1m, residences 20m, distance from road 1m)

Thespian Street

(Grid Reference: SN5863 8180)

This is a “hot-spot” and “worst case” location with some of the largest urban traffic flows in the county. This is a kerb-side and congested “canyon” monitoring location with many residences, and a very busy junction, close by. Historically some of the highest concentrations of nitrogen dioxide have been detected in the county at this monitoring location.

(Relevant exposure - residences 10m and distance from road 1m)

Railway Station

(Grid Reference: SN5850 8162)

This is a “hot-spot” and “worst case” location with some of the largest urban traffic flows in the county. This is a busy shopping route and a congested location with

junctions, a pedestrian crossing, a bus terminal, a railway station and residences close by. There is a steady flow of buses and goods vehicles at this monitoring location. Historically some of the highest concentrations of nitrogen dioxide in Ceredigion have been detected at this monitoring location.

(Relevant exposure - shoppers 1m, residences 50m, distance from road 1m)

Morrison's roundabout

(Grid Reference: SN5959 8057)

This is a developing "hot-spot" and "worst case" location with some of the largest traffic flows in the county. This monitoring location is alongside the largest and most congested roundabout in Ceredigion. A retail park, junctions, residences, and a hotel are in close proximity. There is a steady flow of buses / heavy goods vehicles at this monitoring location.

(Relevant exposure - residences 200m. Distance from road and passing traffic 1m)

Park Avenue

(Grid Reference: SN5859 8131)

This is potentially a developing “hot-spot” and “worst case” location with increasing traffic flows as a result of new developments in the area. New Council Offices and a Welsh Assembly Government building have recently been completed in the area. There is also a bus station, a narrow gauge railway line, a railway station and a new retail area in close proximity (shopping centre / public building developments / residences in close proximity).

(Relevant exposure - shoppers 20m, residences 50m, distance from road 1m)

High Street, Lampeter

(Grid Reference: SN5779 4814)

This is a “hot-spot” and “worst case” location where some of the highest concentrations of nitrogen dioxide in the county are currently being detected. This is a kerb-side monitoring location at a congested “canyon” location with junctions, residences and a university close by. There is a steady flow of buses / goods vehicles at this monitoring location. It is a shopping area where people may spend one hour or more in close proximity to traffic.

(Relevant exposure - shoppers 1m, residences 100m, distance from road 1m)

High Street, Cardigan

(Grid Reference: SN1779 4618)

This is a “hot-spot” and “worst case” location where some of the highest concentrations of nitrogen dioxide in the county are currently being detected. This is a kerb-side monitoring location at a congested location with junctions, a retail market and a pedestrian crossing close by. There is a flow of buses / goods vehicles at this monitoring location. It is a busy shopping street where people may spend one hour or more in close proximity to traffic.

(Relevant exposure - shoppers 1m, residences 50m, distance from road 1m)

Pendam

(Grid Reference: SN7224 8333)

This is a rural monitoring location with very little traffic and only a few isolated mountain farms in close proximity. Results are collected here for background comparison and consistency checking purposes.

(Relevant exposure – isolated farms 500m, distance of monitoring location from quiet mountain road 3m)

SULPHUR DIOXIDE

Sulphur dioxide was monitored at the following locations in Ceredigion in 2017 using passive diffusion tubes:

Aberystwyth

(Grid Reference: SN5851 8155)

This is a “hot-spot” and “worst case” location that is close to a railway station (including a narrow gauge steam railway) and a population centre.

(Relevant exposure - shoppers 20m, residences 100m, distance from road 20m)

Lampeter

(Grid Reference: SN5779 4814)

This is a ”hot-spot” and ”worst case” location in a large population centre. Some domestic burning of solid-fuel takes place in the town.

(Relevant exposure - shoppers 1m, residences in vicinity, distance from road 1m)

Cardigan

(Grid Reference: SN1779 4618)

This is a ”hot-spot” and ”worst case” location in a large population centre. Some domestic burning of solid-fuel takes place in the town.

(Relevant exposure - shoppers 1m, residences 50m, distance from road 1m)

Pendam

(Grid Reference: SN7224 8333)

This is a remote monitoring location with very little traffic, no houses and only a few isolated mountain farms in close proximity. Results are collected here for background comparison and consistency checking purposes.

(Relevant exposure – isolated farms - 500m, distance from quiet mountain road - 3m)

BENZENE

Benzene was monitored at the following locations in Ceredigion in 2017 using passive diffusion tubes:

Aberystwyth

(Grid Reference: SN5838 8154)

This is a kerb-side, ”hot-spot” and “worst case” monitoring location close to a petrol station and a large population centre.

(Relevant exposure - shoppers 20m, residences 20m, distance from garage 10m, distance from road 1m)

Lampeter

(Grid Reference: SN5770 4879)

This is a kerb-side, ”hot-spot” and “worst case” monitoring location close to a petrol station and a large population centre.

(Relevant exposure - residences 10m, distance from petrol station 50m, distance from road 1m)

Cardigan

(Grid Reference: SN1795 4609)

This is a kerb-side, ”hot-spot” and “worst case” monitoring location close to a petrol station and a large population centre.

(Relevant exposure - residences 2m, distance to garage, 5m, distance from kerb1m)

Pendam

(Grid Reference: SN7224 8333)

This is a remote monitoring location with very little traffic and only a few isolated mountain farms in close proximity. Results are collected here for background comparison and consistency checking purposes.

(Relevant exposure – isolated farms, 500m, distance from mountain road 3m)

OZONE

Ozone was monitored at the following locations in Ceredigion in 2017 using passive diffusion tubes:

Aberystwyth

(Grid Reference: SN5847 8170)

This is an urban monitoring location where lots of people could be affected by ozone pollution and where the single highest mean monthly ozone concentration in Ceredigion was detected in 2008.

(Relevant exposure - shoppers 2m, residences 20m, distance from road 3m)

Lampeter

(Grid Reference: SN5779 4814)

This is an urban monitoring location where lots of people could be affected by ozone pollution.

(Relevant exposure - shoppers 1m, residences 150m, distance from road 5m)

Cardigan

(Grid Reference: SN1779 4618)

This is an urban monitoring location where lots of people could be affected by ozone pollution.

(Relevant exposure - shoppers 1m, residences 50m, distance from road10m)

Pendam

(Grid Reference: SN7224 8333)

This is a rural monitoring, ”worst case”, mountainous and exposed monitoring location, with very little traffic, but where some of the highest concentrations of ozone have consistently been found in Ceredigion. This is considered o be a good location for monitoring trends in ozone concentrations in the district.

(Relevant exposure – isolated farms 500m, distance from mountain road 3m)

Adpar

(Grid Reference: SN3092 4090)

This is a small town monitoring location in Ceredigion where some periodic elevations of ozone have been observed.

(Relevant exposure - shoppers 10m, residences 10m, distance from road junction 5m)

Tregaron

(Grid Reference: SN6797 5973)

This is a small, town monitoring location in Ceredigion where some periodic elevations of ozone have been observed.

(Relevant exposure - shoppers 5m, residences 10m distance from road junction 2m)

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
APR	Air quality Annual Progress Report
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide