Mid Devon District Council

Renewable Energy, Carbon Reduction & Air Quality Study

Report

4.50

Issue | 19 June 2014

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Job number 235489-00

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Document Verification

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Job title		1TRenewable Energy, Carbon Reduction & Air Quality Study		**Job number** 235489-00
Document title		Report		**File reference**
Document ref		4.50		
Revision	**Date**	**Filename**		
Draft 1	20 Mar 2014	**Description**	First draft	
			Prepared by	Checked by	Approved by
		Name	Sophie England / Lesley-Anne Stone	Michael Bull / Liz Meddings / Ann Cousins	Simon Power
		Signature			
Issue	19 Jun 2014	**Filename**	Mid Devon Renewables, Carbon and AQ Study Draft 2 SE changes 13.06.2014 AC.docx		
		Description	Updated to incorporate client comments		
			Prepared by	Checked by	Approved by
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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Executive Summary

Introduction

Arup was commissioned by Mid Devon District Council (MDDC) to assess carbon reduction, low emission strategies, renewable energy capacity and air quality improvements in relation to the 'Site Allocations' chapter of the Mid Devon Local Plan Review: Options Consultation Document (2014). This report provides an update to the 2009 '*Local Development Framework Housing Preferred Options: Renewable Energy Capacity, Carbon Impacts and Low Emission Strategies*', hereinafter called 'the 2009 Study', with the additional consideration of air quality impacts.

Policy Background

Both national and local carbon reduction and renewable energy policies have changed significantly since 2009 and there remains some uncertainty at a national level, particularly following the Housing Standards Review. There has been a move towards a simplification of national planning policy, which may make it more challenging to justify significantly more demanding local energy and carbon targets.

Air quality legislation and policy has been strengthened since 2009.

Baseline

There are few suitable sites for installation of further large-scale, stand-alone generation, particularly wind power, in the Mid Devon District. Some smaller technologies have limited potential the region due to constraints over suitable sites, such as hydropower. There are also restrictions to placement of technologies due to landscape sensitivity, transport of large technology components on unsuitable size roads and the dispersed nature of settlements across Mid Devon.

Mid Devon has significantly higher per capita carbon emissions than the rest of Devon, South West England and the England wide average. This is mainly due to the rural nature of the district and thus far larger than average carbon emissions from road transport.

There are some areas of the district where monitored pollutant concentrations exceed relevant air quality objectives. As such, Crediton and Cullompton have been designated as AQMA and air quality action plans are in place. These aim to improve local air quality in these areas. These areas of exceedences are primarily caused by emissions from traffic which is the greatest source of pollution throughout the district. Private car use is high and public transport is not well used throughout the district.

Monitored data in Tiverton indicates pollutant levels well below the relevant air quality objectives and this area is not currently at risk of being declared an AQMA.

Impacts and Options

Development within the district will lead to increases in traffic and combustion plant such as boilers, Combined Heat and Power Systems (CHP) or energy from waste plants required to provide energy. As a result it is likely that pollutant concentrations in the vicinity of these developments will increase. If appropriate measures are taken to minimise the impact on local air quality, it is unlikely that this increase will be significant and cause new AQMAs to be declared. Where possible, development should be limited within Crediton and Cullompton town centres where exceedences of the relevant air quality objectives exist.

Option 1, 2a and 2b satisfy the same growth need but will have different impacts locally due to the location of the proposed options. With regard to local air quality, Option 2a – development at Willand is preferable as this moves the majority of development away from sensitive areas such as Cullompton and Crediton to an area where monitored pollutant concentrations are currently well below the relevant air quality objective.

Much of the suitable renewable energy for each option is relatively similar. This is because many of these options, such as roof mounted PV and air source heat pumps are suitable for individual dwellings and so will be a viable option for a development of any size. This means that for most of these development sites individual dwelling size renewable energy is most suitable unless gas district heating/ CHP can be used in conjunction with existing dwellings.

The exceptions are in Option 2a and 2b; the large single developments at either Cullompton or Willand. At this scale, renewable technology at an individual dwelling scale will still be suitable. However, gas or biomass powered district heating or CHP could be suitable as the development size could be large enough to make these options viable. This will particularly be the case with mixed-use development, where there is greater variation in heat demand.

The Mid Devon Low Emission Strategy from the 2009 has been reviewed and has been found to still be pertinent.

Conclusions and Recommendations

It can be seen that whilst there are important considerations in respect of energy efficiency, renewable energy, air quality and low emission strategies, these do not generally differentiate between the draft policy options on potential site allocations. Policies associated with the concentration of development around existing built development are likely to favour improved integration of renewable energy and also assist in the most optimum public transport options, which will help with the development of low emission strategies. Air quality factors are likely to count against this – as air quality considerations would naturally lead towards a “dispersal” rather than a “concentration” approach to site allocations.

Recommendations have been made in relation to the proposed policies as set out in Local Plan Review. Little change is recommended. However, it is noted that with changes to national policy since 2009, and further uncertainty around allowable solutions and the wind up of the Code for Sustainable Homes, some flexibility may be required.

1 Introduction

Arup was commissioned by Mid Devon District Council (MDDC) to assess carbon reduction, low emission strategies, renewable energy capacity and air quality improvements in relation to the 'Site Allocations' chapter of the Mid Devon Local Plan Review: Options Consultation Document (2014). This report provides an update to the 2009 '*Local Development Framework Housing Preferred Options: Renewable Energy Capacity, Carbon Impacts and Low Emission Strategies*', hereinafter called 'the 2009 Study', with the additional consideration of air quality impacts.

1.1 Aims of Study

The overarching objectives of the study are;

- To provide information on opportunities and capacity for renewable and low carbon energy development in Mid Devon;
- To assess the carbon impacts, mitigation and renewable energy potential of the potential site allocations in the Local Plan Review options document;
- Advise on low emission strategies and their application in planning policy;
- To assess the air quality impacts of the potential site allocations on existing Air Quality Management Areas (AQMAs) at Crediton and Cullompton, and impacts that could lead to the designation of an AQMA at Tiverton.

1.2 Report Structure and Content

The remainder of the report is structured as follows.

- **Section 2** set out the **background and context** to Mid Devon Local Development Plan Review, air quality legislation, and renewable energy and carbon reduction policies;
- **Section 3** assesses the **baseline conditions** of the current installed renewable capacity and air quality and carbon emissions, including a review of previous studies in the area;
- **Section 4** considers the potential **carbon and air quality impacts** of new development in Mid-Devon;
- **Section 5** presents the **low carbon energy options** for new development;
- **Section 6** explores possible **air quality improvements**;
- **Section 7** begins to develop a **Low Emission Strategy** for new development; and
- **Section 8** provides **conclusions and recommendations** from the study.

2 Background

2.1 Mid Devon Context

Mid Devon District Council is carrying out a comprehensive review of Local Plan policies, including the Core Strategy, the Allocations and Infrastructure Development Plan Document and development management policies.

A second stage of consultation on the new Local Plan was held between 24 January and 24 March. Mid Devon Council is aiming to consult on the final version of the Local Plan in September 2014.

In the second stage consultation document[1] draft planning policies are presented with options for how these may be revised through the Local Plan Review. The Council has identified two strategic policy options for how development could be distributed around the district, only one of which will be in the final draft of the Local Plan. Both options will provide for the estimated requirement of 8,400 new dwellings and 154,000 m^2 of commercial floor space, as detailed in Table 1.

Option 1 has a town focus, with the development being focused around Tiverton, Cullompton and Crediton, on a scale which suits the local area, shown in Figure 1. Other rural settlements will have limited development.

Option 2 continues to focus growth in the towns early in the plan period, but changes focus to a new community with approximately 2,840 dwellings, with connections to the M5 motorway later in the plan period. This option has two alternatives depending on where the new community is situated. Option 2a refers to a new community connecting Junction 27 on the M5 to Willand, shown in Figure 2. Option 2b refers to a large expansion of Cullompton to the east of Junction 28 on the M5, shown in Figure 3. These large scale developments could double the size of towns by which they are situated. Other settlements will also see development in Crediton and spread among rural villages.

Table 1: The number of dwellings and the floor space of commercial for each of the three options detailed in the local plan[2]

Area	Option1 (town focus)		Option 2a (new community at Willand)		Option 2b (new community at Cullompton)	
	Housing (dwellings)	Commercial (m^2)	Housing (dwellings)	Commercial (m^2)	Housing (dwellings)	Commercial (m^2)
Tiverton	3,600	49,000	2,340	31,800	2,340	31,800
Cullompton	2,400	46,700	1,560	30,400	4,500	84,400
Crediton	800	5,300	520	3,400	520	3,400
Rural	1,600	53,000	3,980	88,400	1040	34,400
Total	8,400	154,000	8,400	154,000	8,400	154,000

The options for development are based on an adjusted annual Core Strategy target, but these may change following the completion of a new Strategic Housing Market Assessment (SHMA).

[1] Mid Devon District Council, *Local Plan Review, Options Consultation*, 2014,
[2] *ibid*

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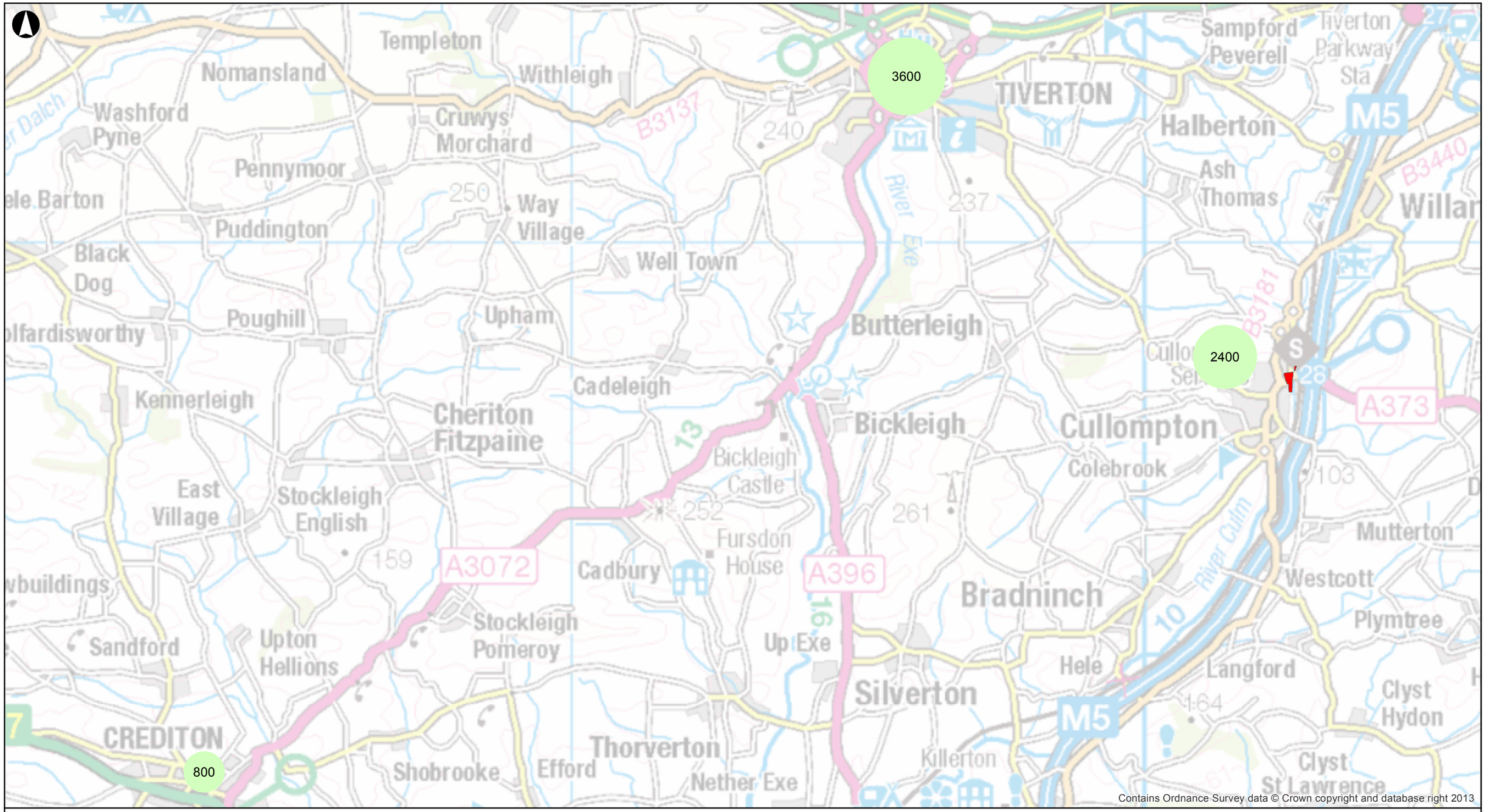

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Legend

- Development Size
- Railway Station Option - Local Plan Review

Issue	Date	By	Chkd	Appd
P1	2014-06-02	FG	SE	SP

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Drawing Ttitle

Option 1
Town Focus

Scale at A3

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Job No
235489-00

Drawing Status
Preliminary

Drawing No
Figure 1

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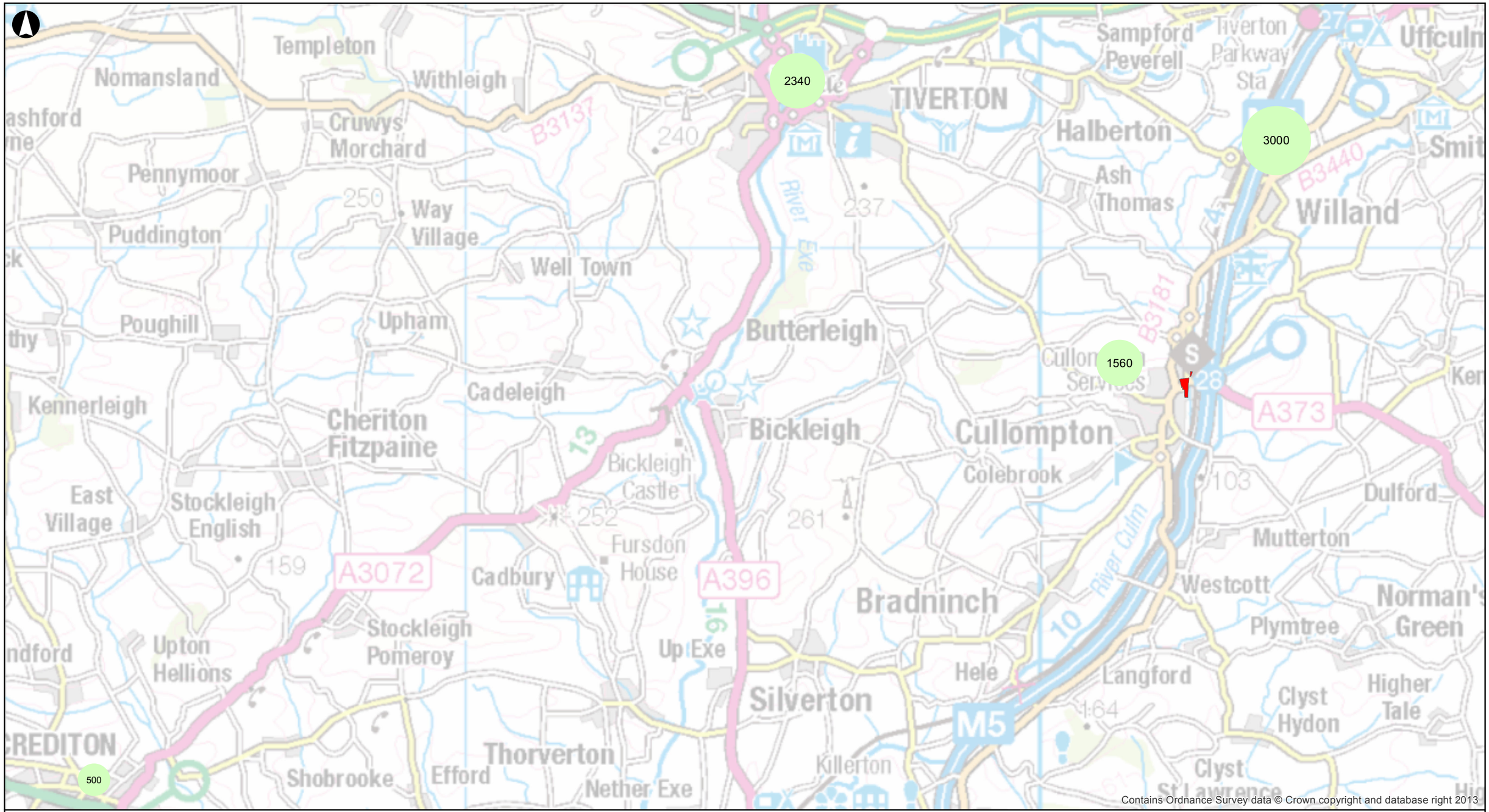

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- Development Size
- Railway Station Option - Local Plan Review

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Drawing Ttitle

Option 2a
New Community at Willand

Scale at A3
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Job No
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Drawing Status
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Figure 2

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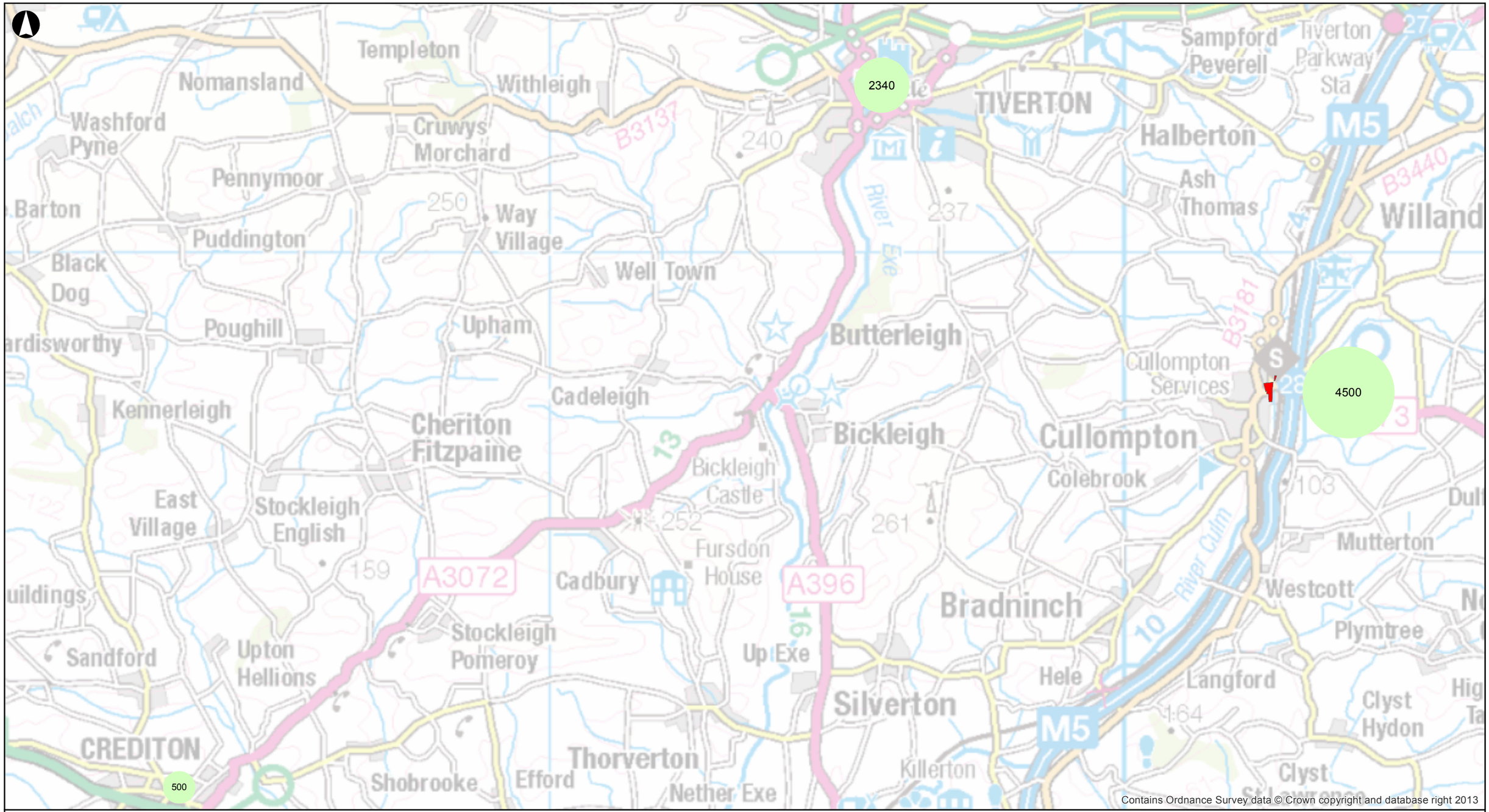

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Legend

- Development Size
- Railway Station Option - Local Plan Review

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Option 2b
New Community at Collumpton

Scale at A3
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Job No
235489-00

Drawing Status
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Drawing No
Figure 3

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2.2 Renewable Energy and Carbon Reduction Policy Context

2.2.1 Changes to policy since 2009

National Policy

The Fourth Carbon Budget, 2011[3], covers the period of 2013-27 and commits the UK to reduce Greenhouse Gas (GHG) emissions by 32% in 2025 on 2012 levels (50% on 1990 levels).

The Zero Carbon Buildings policy[4] forms part of the Government's wider strategy for achieving the Carbon Budget targets. The policy requires that all new homes from 2016 will mitigate, through various measures, all the carbon emissions produced on-site as a result of the regulated energy use i.e. energy used to provide space heating and cooling, hot water and fixed lighting.

This policy aligns with European Policy, specifically the Energy Performance of Buildings Directive (recast) which requires, in Article 2, all new buildings to be nearly zero energy buildings from 2020.

The main instrument to reduce carbon emissions in buildings are the national Building Regulations. Building Regulations Part L has been updated since 2009, by Building Regulations 2010, which was further amended in 2013, reducing the allowable carbon emissions from buildings.

The Government is planning further changes to these Building Regulations[5] and planning practice guidance and have set up a roadmap which aims to provide a simplified standard for design and construction of new homes. This will consolidate essential requirements into one national building regulation framework, reducing the number of technical standards which apply when building new homes. This will apply nationally across England. The introduction of new powers into the Building Act has been proposed which would enable different levels of performance, where these were necessary, to meet certain local circumstances. This means that many of the requirements for the Code of Sustainable Homes (the Code) will be consolidated into these Building Regulations. This will most likely result in the Code being slowly wound- down, with some of the non-regulated elements being taken forward on a voluntary basis.

National Planning Policy Framework (NPPF)[6] consolidated and superseded Planning Policy Statements and Planning Policy Guidance notes. The NPPF must be taken into account when creating Local Plans and is material in planning decisions. One of its roles is environmental and it aims to contribute to protecting and enhancing the natural, built and historic environment, by various means

[3] Based on the Climate Change Act (2008)
[4] From www.zerocarbonhub.org
[5] Written Ministerial Statement, Department for Communities and Local Government, Building regulations, March 2014 (https://www.gov.uk/government/policies/providing-effective-building-regulations-so-that-new-and-altered-buildings-are-safe-accessible-and-efficient/supporting-pages/technical-housing-standards-review)
[6] Department for Communities and Local Government, *National Planning Policy Framework*, March 2012

including minimising waste and pollution and to mitigate climate change by moving to a low carbon economy. It promotes the use of renewable energy, sustainable development, conversion of existing housing and sustainable transport (especially transport which reduces GHG emissions).

The Regional Spatial Strategies (RSS), which set housing targets, have been revoked.

When building social housing, the Homes and Communities Agency (HCA) still uses the Housing Corporation Design and Quality Standards, which require buildings to meet Code for Sustainable Homes Level 3.

Existing Local Policy

Devon County Council has no regional policies or targets for renewable energy or carbon emission since the South West Regional Strategy was revoked in 2013[7].

The Core Strategy[8], adopted by MDDC in 2007, contains a Climate Change policy, COR5, which contains measures to develop renewable energy capacity in areas with acceptable impact; to support energy efficiency measures; and to take positive measures to reduce carbon emissions to a realistic minimum. It also contains the intent that all new developments will be carbon neutral in both development and use. However, the detail of how this would be achieved was intended to be developed through a Supplementary Planning Document (SPD). The overall core spatial strategy also includes plans to reduce carbon emissions in support of regional and national targets and reduce car travel by increasing the provision of public transport, walking and cycling.

Policy AL/IN6 of the Allocations and Infrastructure Development Plan Document includes a provision that developments of 10 or more dwellings or 1000 m^2or more of non-residential floor space will make provision for at least 10% of the energy to be used in the development to come from decentralised on-site renewable or low-carbon sources rising incrementally to 20% by 2020.

Renewable technologies particularly suggested by this policy are: biomass CHP, large-scale wind, micro-scale wind, hydroelectricity, ground and water-source heat pumps, solar PV panels, solar thermal panels, anaerobic digestion and energy from waste.

Local Plan Part 3 was adopted in 2013, and contains a number of relevant policies;

- Policy DM3, which requires the use of sustainable design and construction methods. It requires major housing developments to meet Level 3 of the Code for Sustainable Homes from 2013, rising to Level 5 from 2016. It also requires major commercial development to achieve BREEAM ‘Very Good’ standard from 2013 and ‘Excellent’ from 2016.
- Policy DM5, which is designed to maximise renewable and low carbon development while ensuring that adverse impacts are address satisfactorily, including cumulative landscape and visual impact.

[7] http://www.devon.gov.uk/devon_county_structure_plan
[8] Mid Devon District Council, *Mid Devon Local Development Framework, Core Strategy 2026*, July 2007 (http://www.middevon.gov.uk/CHttpHandler.ashx?id=7872&p=0)

2.2.2 Renewable Energy Subsidies

There are a range of renewable energy subsidies available from the government, which aim to provide funding to promote the inclusion of a mix of renewable energy generation technologies. These subsides are complex and changeable, meaning reliance on them as a major source of funding for renewable energy projects can be unreliable and means that there is a risk that some projects could become undeliverable over time. Detail of the major subsidies and financing mechanisms, including recent changes, is set out in appendix B.

2.3 Air Quality Legislation and Policy

2.3.1 Legislation

Part IV of the Environment Act 1995[9] places a duty on the Secretary of State for the Environment to develop, implement and maintain an Air Quality Strategy with the aim of reducing atmospheric emissions and improving air quality. The Air Quality Strategy[10] for England, Scotland, Wales and Northern Ireland provides the framework for ensuring the air quality limit values are complied with based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to undergo a process of local air quality management and declare Air Quality Management Areas (AQMA) where necessary, which is undertaken by MDDC, throughout the administrative area.

Air quality (standards) regulations 2010[11], merge the requirements of Council Directive 2004/107/EC and Council Directive 2008/50/EC into one statutory instrument. This replaces the Air Quality Standards Regulations 2007 (SI 2007 no. 64), though most of the provisions remains the same, and sets out air quality objectives/limit values for pollutants of concern at a local scale. The objectives for the pollutants of concern in Mid Devon, nitrogen dioxide (NO_2) and particulate matter (PM_{10}), are presented in Table 2.

Table 2: Air Quality Objectives

Pollutant	Averaging Period	Limit Value/ Objective	Date for Compliance	Basis
Nitrogen Dioxide (NO_2)	1 hour mean	200µg/m^3, not to be exceeded more than 18 times a year	31 Dec 2005	UK
			1 Jan 2010	EU
	Annual mean	40µg/m^3	31 Dec 2005	UK
			1 Jan 2010	EU
Fine Particulates (PM_{10}) Measurement	Daily Mean	50µg/m^3, not to be exceeded more than 35 times a year	31 Dec 2004	UK
			None specified	EU

[9] Environment Act 1995, Chapter 25, Part IV Air Quality
[10] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 1, July 2007
[11] https://www.gov.uk/government/policies/protecting-and-enhancing-our-urban-and-natural-environment-to-improve-public-health-and-wellbeing/supporting-pages/international-european-and-national-standards-for-air-quality

Technique: Gravimetric	Annual Mean	40µg/m^3	31 Dec 2004	UK
			None specified	EU
Very Fine Particulates ($PM_{2.5}$)	Annual Mean	25µg/m^3	1st January 2015	UK/ EU

The Secretary of State for the Environment is required under European Law to ensure the air quality limit values are complied with, whereas local authorities are only obliged under national legislation to undertake best efforts to comply with the air quality objectives. To assist local authorities in demonstrating best efforts, the Environment Act 1995 requires that when carrying out their local air quality management functions, local authorities shall have regard to guidance issued by the Secretary of State.

2.3.2 National Policy

The Gothenburg Protocol was amended in 2012, and sets national emission reduction targets, including for fine particulate matter, to be achieved by 2020.

The European Commission has undertaken a review of the air quality policy framework which had culminated with The Clean Air Policy Package[12], which will be considered by other EU institutions with a view to negotiate on the package over the next 1-3 years[13].

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality consideration that relates to land use and its development can be a material planning consideration in the determination of planning applications, dependent upon the details of the proposed development.

National Planning Policy Framework (2012)

The National Planning Policy Framework[14] (NPPF) was published in March 2012 with the purpose of planning to achieve sustainable development. Paragraph 124 of the NPPF on air quality states that:

> *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."*

Planning Practice Guidance (2014)

As part of the NPPF, planning practice guidance on various topics was recently published[15]. In relation to air quality, the guidance refers to the significance of air

[12] http://ec.europa.eu/environment/air/clean_air_policy.htm
[13] http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm
[14] Department for communities and local government, *National Planning Policy Framework*, March 2012

quality assessments to determine the impacts of proposed developments in the area and describes the role of local and neighbourhood plans with regard to air quality. It also provides a flowchart method to assist local authorities in determining how considerations of air quality fit into the development management process.

2.3.3 Existing Local Policy

The Core Strategy 2026[16], adopted by MDDC in 2007, outlines a number of core policies including COR1 – Sustainable communities, which ensures that growth will be managed so that development meets sustainability objectives including supporting improvements to local air quality levels.

As part of the wider Local Plan Review, the review document highlights Policy DM6 which focuses on transport and air quality and the synergies between these two aspects. This policy includes assessing the impact of development proposals to Air Quality Management Areas, modelling local residual road transport emissions and onsite mitigation measures to reduce negative impacts on local air quality.

The Local Plan Review document also includes various policies to ensure new developments are sustainable, such as:

- Policy S2 – Sustainable Development Priorities;
- Policy S10 – Environment;
- Policy S12 – Cullompton – which acknowledges the existing air quality issues in Cullompton; and
- Policy S13 – Crediton - which acknowledges the existing air quality issues in Crediton.

An Air Quality and Development Supplementary Planning Document[17] (SPD) has also been adopted by MDDC, outlining the type and scale of development that will require an air quality assessment and references local policy as above that is key to proposed development not resulting in a significant effect on local air quality.

There are two areas in MDDC, Crediton and Cullompton, for which local pollutant concentrations exceed air quality objectives and an air quality management area has been declared. Under the Environment Act, Air Quality Action Plans have been produced by MDDC for both areas and contain measures aimed at improving local air quality in the area. The proposed developments outlined in the Local Plan Review should not prevent the implementation of such measures to improve air quality.

[15] Department for Communities and Local Government *Planning Practice Guidance: Air Quality*, 2014
[16] Mid Devon District Council, *Mid Devon Local Development Framework, Core Strategy 2026*, July 2007
[17] Mid Devon District Council, *Supplementary Planning Document on Air Quality and Development*, May 2008

2.4 Summary

Both national and local carbon and renewable energy policies have changed significantly since 2009 and there remains some uncertainty at a national level, particularly following the Housing Standards Review.

There has been a move towards a simplification of national planning policy, which may make it more challenging to justify significantly more demanding local energy and carbon targets.

There have been extensive changes to funding for renewables since 2009 and this continues with proposals, currently under consultation, to cut Renewables Obligations for PV power over 5MW so that only Contracts for Difference can be applied for.

Air quality legislation and policy has been strengthened since 2009.

There are a number of existing Mid Devon District Council policies relating to renewable energy, carbon emissions and local air quality through the Core Strategy and Local Development Framework. These form an important part of the baseline for this study.

3 Assessment of Baseline Conditions

3.1 Introduction

This chapter present an assessment of baseline conditions for renewable energy, carbon emissions and local air quality.

The baseline conditions presented for large scale renewable energy include the wind and solar projects going through planning, as well as a review of findings from the 2005 renewables report, the 2009 Local development framework housing report and the 2013 landscape sensitivity report. The air quality baseline includes the Crediton and Cullompton AQMAs and information provided in the 2013 Air quality progress report[18].

3.2 Renewable Energy and Carbon Baseline

3.2.1 Previous Reports

There have been previous studies that have considered the suitable renewable energy generation capacity of Mid Devon.

The previous renewable energy report (2005)[19] focused on three renewable energy generation methods: hydropower, biomass, and wind. This study concluded that the district has few opportunities for the development of large-scale wind energy developments, due to technical and environmental constraints, particularly noise

[18] Mid Devon District Council, *2013 Air Quality progress Report*, April 2013
[19] Dulas Ltd, *Planning for Renewable Energy: planning review and constraints mapping for Mid Devon District Council*, June 2005.

and environmentally designated areas. In addition it was noted that the transport network in unconstrained areas would not have capacity to take large-scale wind turbine components. However, where there is potential for wind energy, fewer large-scale turbines are more appropriate that a greater number smaller-scale turbines.

There is a significant biomass resource in the district in the form of woodland (both forestry commission and private owners), and there is considerable potential for the growing of short rotation coppice as Mid Devon has a wide expanse of good agricultural land. Monoculture and landscape impact issues should be considered, however.

The study concluded that hydropower viability could only be assessed based on the presence of water channels as any further analysis would require advanced catchment modelling and abstraction data for the district which would require considerable time and expense. The hydropower potential was predicted to be limited to old mill sites, which are likely to be low head schemes with small power generation.

The 2009 study[20] built on this by undertaking more in-depth constraints mapping. However the potential suitability for renewable energy generation was focused on the development sites suggested in the LDP (2007) rather than in the district as a whole. This study concluded that onsite gas combined heat and power (CHP), solar thermal, solar PV and ground source heat pumps would be suitable. Some sites would be likely to be suitable for anaerobic digestion, energy from waste, biomass CHP and micro-wind.

The effect that wind energy and large scale PV was considered in a landscape sensitivity report (2013)[21]. This concluded that the landscapes are relatively small and highly rural in character. Thus the whole landscape is highly sensitive to large scale of renewable energy development, and the sensitivity increases with the size of development. Sensitivity increases in areas with high scenic quality; this can be nationally designated areas (Blackdown Hill AONB and Dartmoor National Park) or locally important areas of ‘archetypal Devon farmland and valleys’. Some Landscape Character Types (LCT) in the district, such as lowland plains and upper farmed and wooded valley slope, are less sensitive to medium and larger scale wind turbines, but all are highly sensitive to the largest turbines. Single or small clusters of wind turbines would be most suitable, the scale of which is determined by the scale of the landscape. This conclusion differs from the 2005 renewable energy report[22] which advocates fewer large scale turbines rather than larger numbers of small scale turbines.

Most LCTs in the district have moderate sensitivity to developments of less than 5ha, i.e. small PV developments. A few LCTs, such as secluded valleys and steep wooded slopes, are very sensitive to even this size development. The landscape is highly sensitive to any PV developments over 10ha. This it is suggested that PV developments of up to 10ha may be suitable in enclosed areas and on lower slopes which avoid highly visible slopes.

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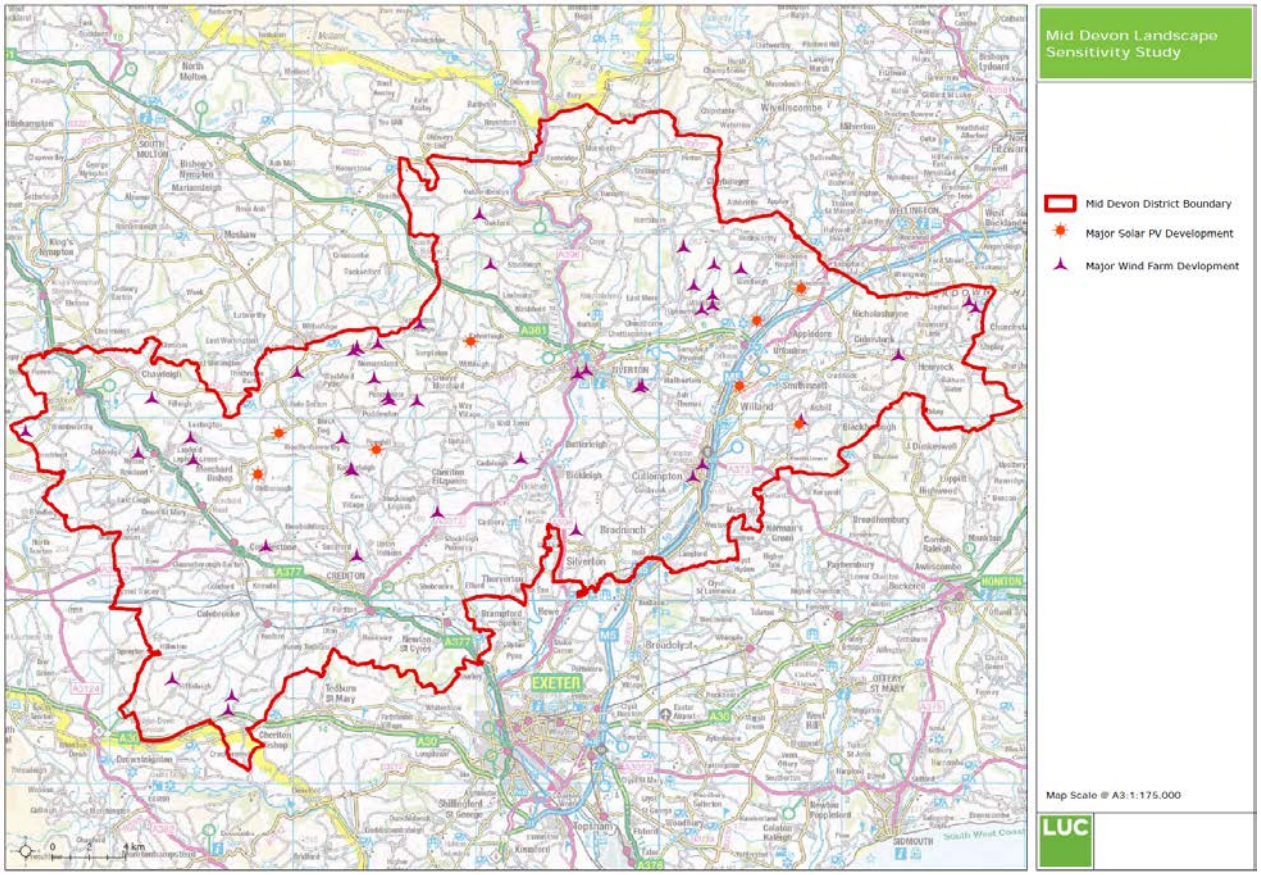
[20] Mid Devon District Council, *Local Development Framework Housing, preferred options, renewable energy capacity, carbon impacts and low emission strategies,* March 2009.
[21] LUC for Mid Devon District Council, *An Assessment of the Landscape Sensitivity to Onshore Wind Energy and Large Scale Photovoltaic Development in Mid Devon District*, 2013.
[22] Dulas Ltd, *Planning for Renewable Energy: planning review and constraints mapping for Mid Devon District Council*, June 2005.

Areas which are Historic Landscape Types (HLT), like ancient woodland, water meadows and rough ground, have a higher sensitivity to both wind and PV developments.

Large scale renewable development is also constrained by the proximity to housing. Mid Devon is a rural landscape with a dispersed settlement pattern, as noted in both the Landscape Character Assessment[23] and the Landscape Sensitivity Assessment[24]. Renewable technologies which require a specific distance buffer zone between them and dwellings, such as large wind turbines, will be limited in development sites that are appropriate, due to this dispersed pattern.

[23] Mid Devon District Council, Landscape Character Assessment, October 2011.
[24] Mid Devon District Council, An Assessment of the Landscape Sensitivity to Onshore Wind Energy and Large Scale Photovoltaic Development in Mid Devon District, October 2011.

3.3 Current Installed Renewable Energy



Figure, from the Landscape Sensitivity Study, shows the major wind and solar generation developments going through the planning system over the past few years. These are spread across the region and suggest that the physical capacity for further standalone generation is limited.

Continually updated figures are available from http://restats.decc.gov.uk/

Figure 4: Permitted Major Wind and Solar PV developments in Mid Devon District.

3.4 Carbon Baseline

Total emissions in the UK have decreased by 29% since 1990, mostly due to decreases in emissions from energy supply, industrial processes and waste. Emissions in the transport sector have remained similar to 1990 levels[25]. In comparison, Mid Devon has seen a reduction in total carbon emissions of 17% from 2005 to 2011, based on 'Local and Regional CO2 Emissions Estimates for 2005-2011' from DECC[26].

Carbon emissions in Mid Devon in 2011 were 30% higher per person than the English average (see Figure 5), 40% of these emissions are from road transport.

Industry and commercial and domestic carbon emission per capita in Mid Devon are similar to those of the rest of England. However, per capita road transport emissions are 76% greater than English average and 43% greater than the Devon average.

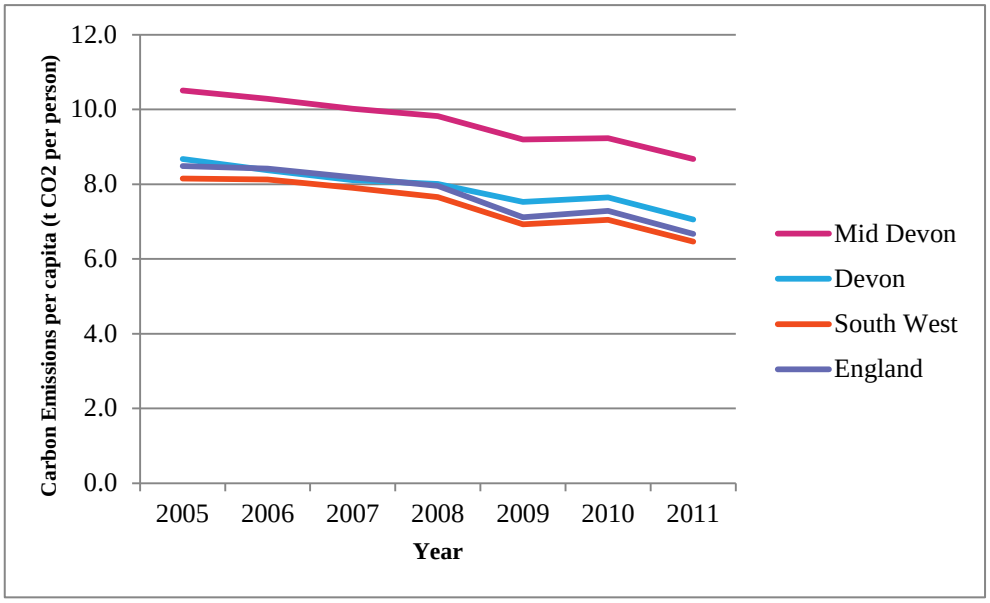


Figure 5: Carbon Emissions Per Capita for Mid Devon, Devon County, the South West Region and England from 2005 to 2011[27].

It could be expected that this higher level of carbon emissions, particularly from road transport, was largely due to Mid Devon's rural nature. However, there is some variation in carbon emissions, and when compared to rural local authorities such as Cornwall or West Somerset, Mid Devon has higher levels of per capita transport emissions than these. However, per capita transport emissions are similar in neighbouring West Devon, and in comparably commutable rural areas, such as Cotswold District, South Derbyshire or Monmouthshire, for example.

[25] An introduction to the UK's Greenhouse Gas Inventory, 2013 Ricardo-AEA for DECC (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/239043/IntroToInventory_2013.pdf)
[26] Local and Regional CO2 Emissions Estimates for 2005-2011', produced by Ricardo-AEA for DECC (see https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/sub-national-greenhouse-gas-emissions-statistics)
[27] Ibid

3.5 Air Quality Baseline

3.5.1 Local Air Quality Management

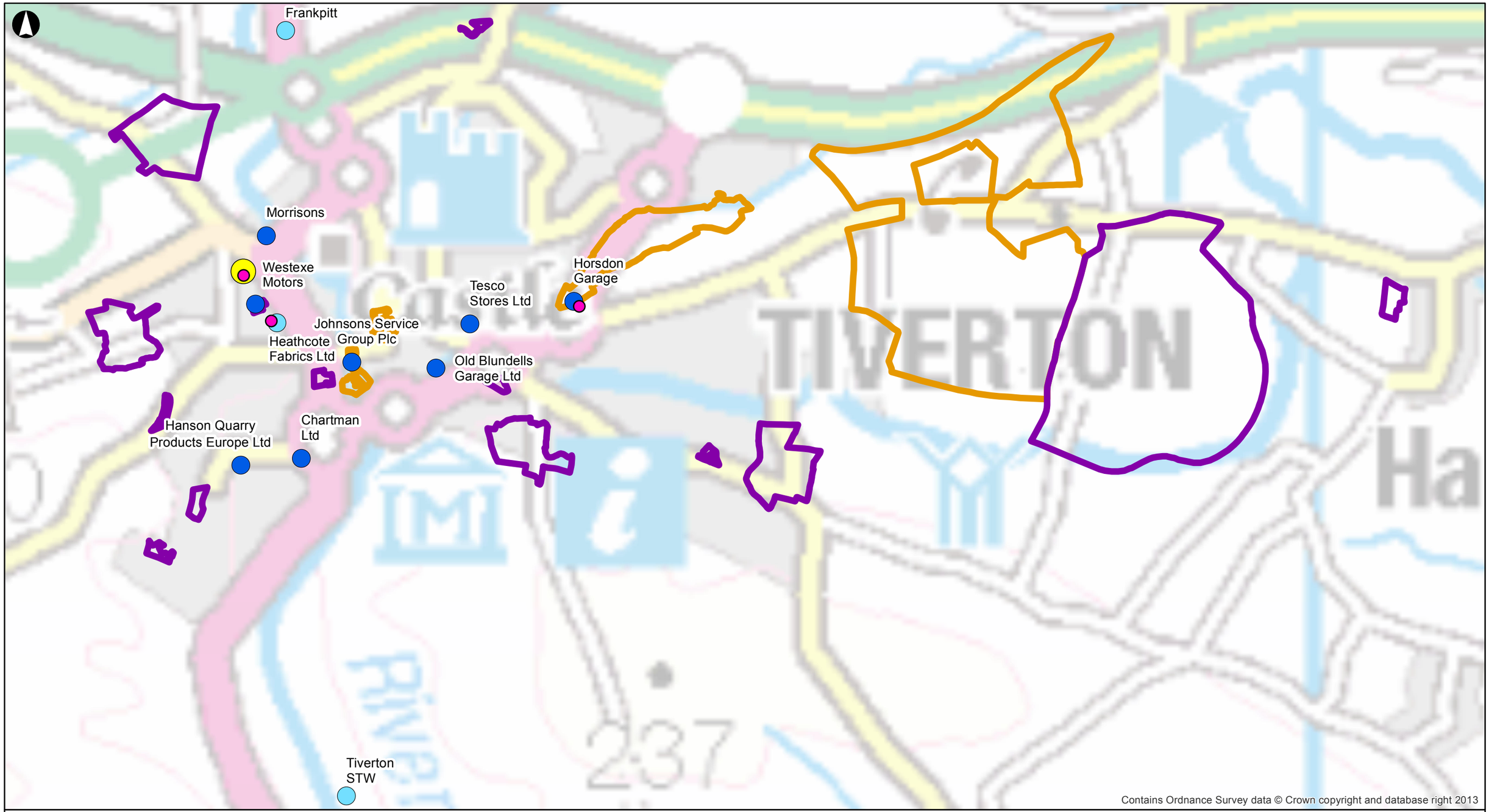
As mentioned previously, the Environment Act 1995 requires local authorities to review and assess air quality with respect to the objectives for seven pollutants specified in the National Air Quality Strategy. Local authorities are required to carry out an Updating and Screening Assessment (USA) of their area every three years. If the USA identifies potential hotspot areas likely to exceed air quality objectives, then a Detailed Assessment of those areas is required. Where objectives are not predicted to be met, local authorities must declare the area as an AQMA. In addition, local authorities are required to produce an Air Quality Action Plan (AQAP) which includes measures to improve air quality within the AQMA. This process has been followed in the case of Crediton and Cullompton where review of local air quality indicated that pollutant concentrations exceed the air quality objectives.

The 2013 Air Quality Progress Report[28], outlines the latest air quality monitoring data for the area. MDDC undertake monitoring using both automatic and passive methods focussing on nitrogen dioxide (NO_2) and particulate matter (PM_{10}) which are the pollutants of greatest concern on a local scale. Road traffic is the greatest source of pollution in Mid Devon, where the majority of rural communities rely heavily on private car use and public transport is not well used.

Figures 6, 7, 8 and 9 show the location of air quality monitoring sites in relation to the areas proposed for future development as part of the options set out in the LDP. A review of local monitoring data has been undertaken based on each of the three options under review considered within the Local Plan Review.

[28] Mid Devon District Council, *2013 Air Quality progress Report for Mid Devon District Council*, April 2013

A3



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Legend

- Non-Automatic Monitoring Sites
- Automatic Monitoring Sites
- Mid Devon Part B
- EA Part A
- Housing Consultation Sites - Local Plan Review
- Proposed Mixed Use Consultation Site

Issue	Date	By	Chkd	Appd
P0	2014-05-09	FG	LAS	SP

ARUP

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(T)+441179765432 (F)+441179765433

Metres
0 225 450 900

Client
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Job Title
Renewable Energy, Carbon Reduction & Air Quality Study

Drawing Ttitle
Air Quality Monitoring - Tiverton

Scale at A3
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Job No
235489-00

Drawing Status
Preliminary

Drawing No
Figure 6

Issue
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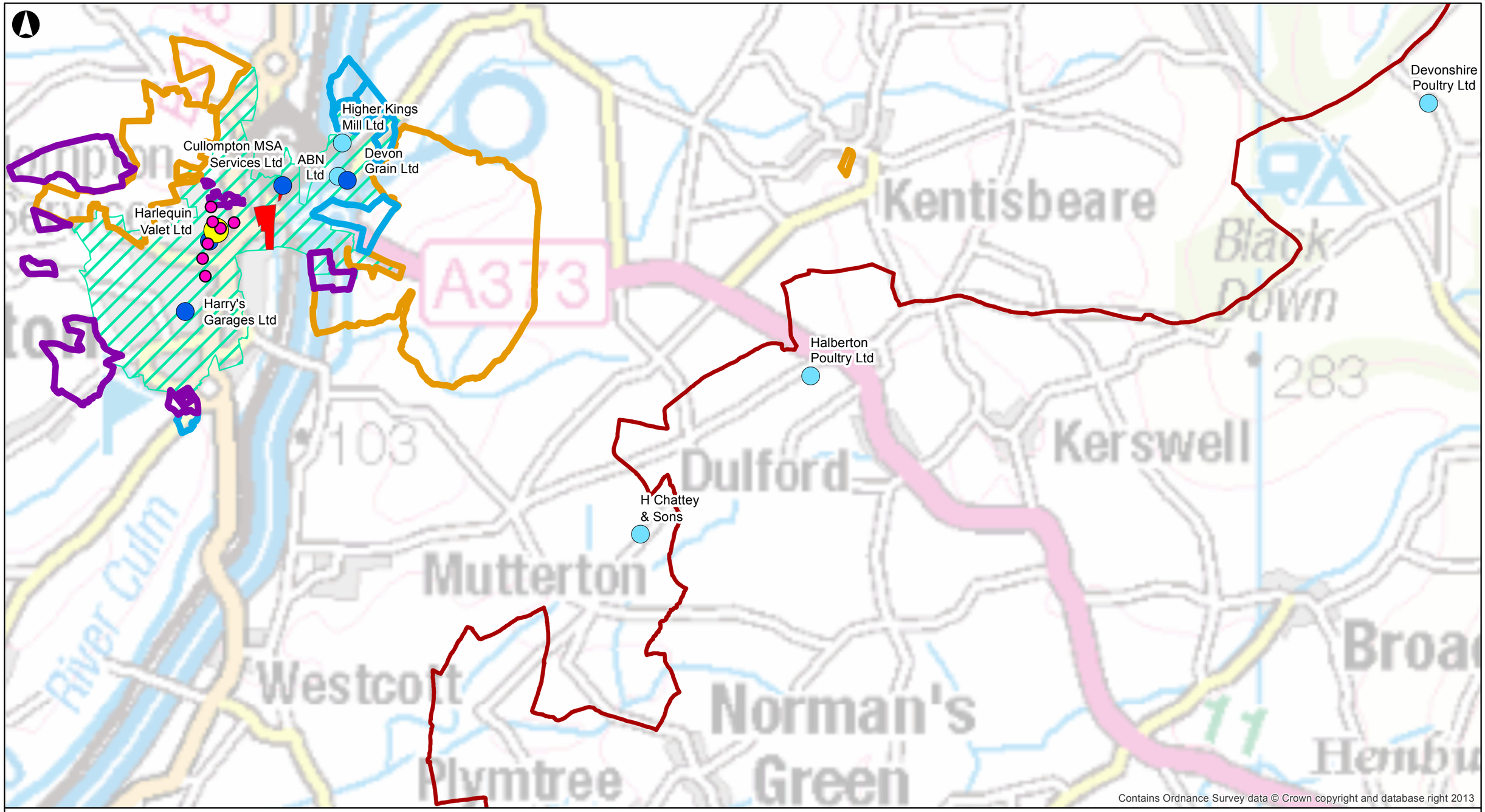

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Legend

- Non-Automatic Monitoring Sites
- Automatic Monitoring Sites
- Mid Devon Part B
- EA Part A
- Cullompton AQMA
- Railway Station Option - Local Plan Review
- Mid-Devon District
- Housing Consultation Sites - Local Plan Review
- Commercial Consultation Sites - Local Plan Review
- Proposed Mixed Use Consultation Site

Issue	Date	By	Chkd	Appd
P0	2014-05-09	FG	LAS	SP

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0 355 710 1,420

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Job Title
Renewable Energy, Carbon Reduction & Air Quality Study

Drawing Ttitle
Air Quality Monitoring - Cullompton

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Job No
235489-00

Drawing Status
Preliminary

Drawing No
Figure 7

Issue
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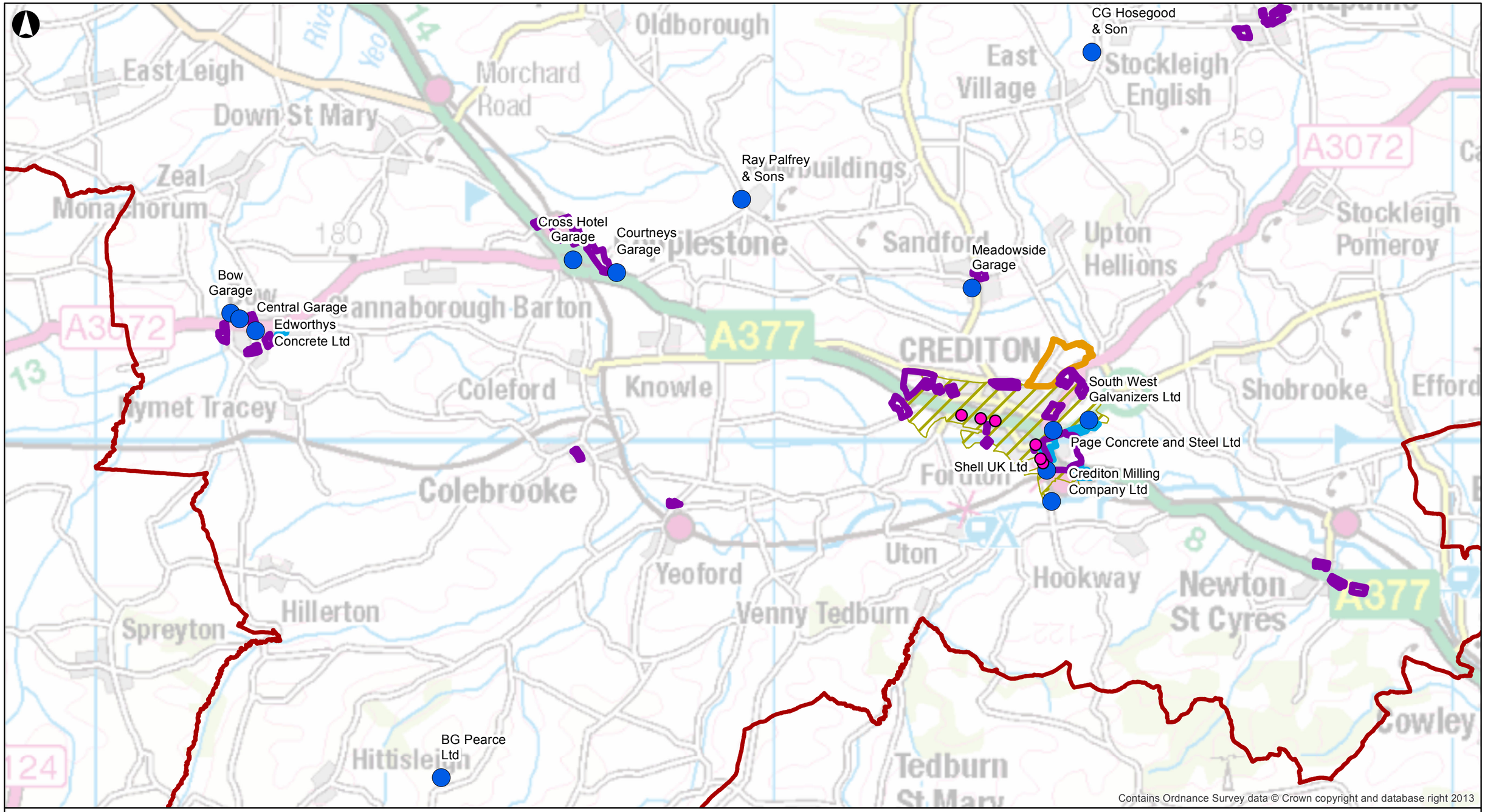

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Legend

- Non-Automatic Monitoring Sites
- Automatic Monitoring Sites
- Mid Devon Part B
- EA Part A
- Crediton AQMA
- Mid-Devon District
- Housing Consultation Sites - Local Plan Review
- Commercial Consultation Sites - Local Plan Review
- Proposed Mixed Use Consultation Site

Issue	Date	By	Chkd	Appd
P0	2014-05-09	FG	LAS	SP

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0 700 1,400 2,800

Client
Mid Devon District Council

Job Title
Renewable Energy, Carbon Reduction & Air Quality Study

Drawing Ttitle
Air Quality Monitoring - Crediton

Scale at A3
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Job No
235489-00

Drawing Status
Preliminary

Drawing No
Figure 8

Issue
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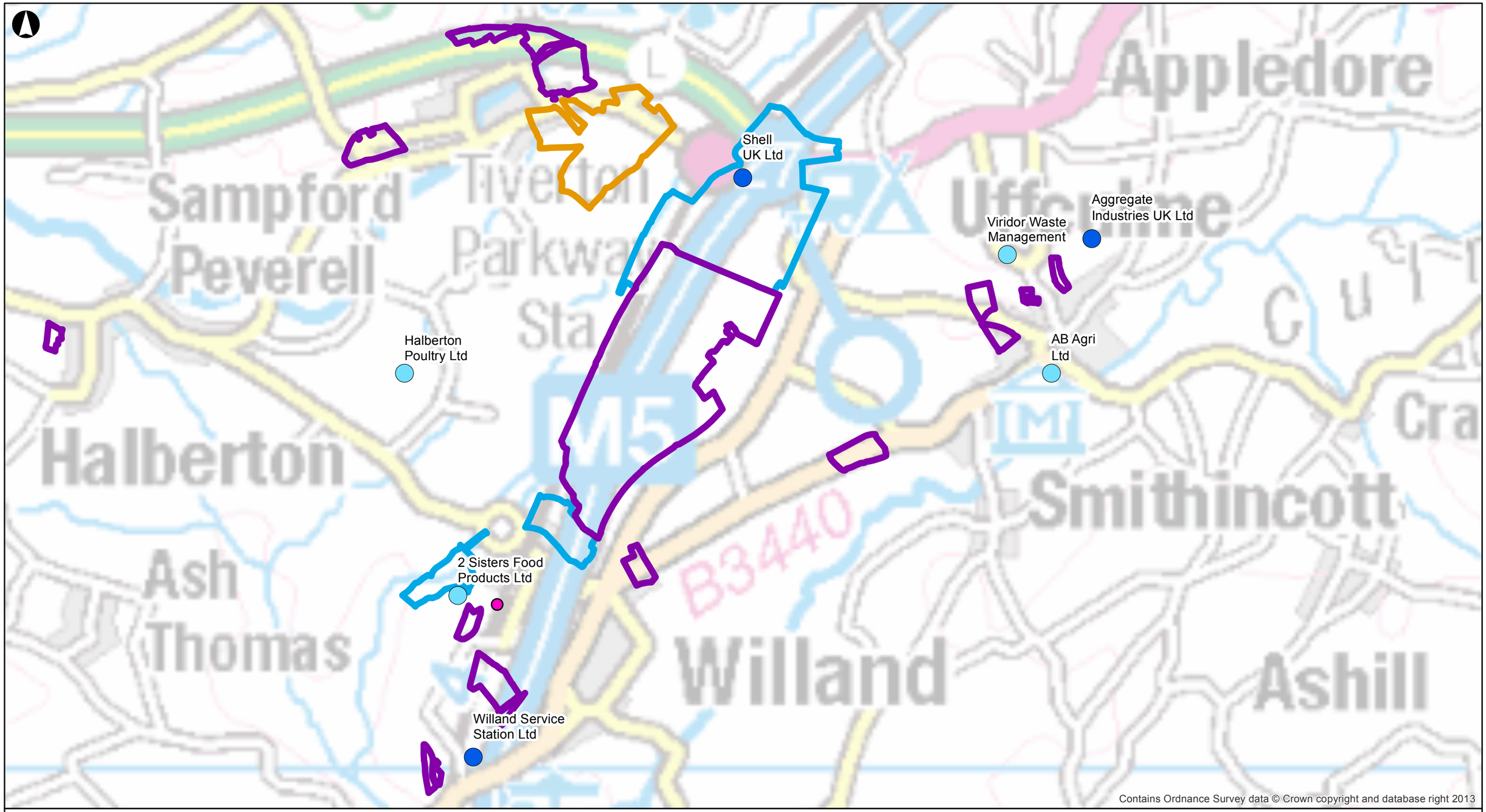

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Legend

- Non-Automatic Monitoring Sites
- Mid Devon Part B
- EA Part A
- Housing Consultation Sites - Local Plan Review
- Commercial Consultation Sites - Local Plan Review
- Proposed Mixed Use Consultation Site

Issue	Date	By	Chkd	Appd
P0	2014-05-09	FG	LAS	SP

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63 St. Thomas St
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Metres
0 310 620 1,240

Client
Mid Devon District Council

Job Title
Renewable Energy,
Carbon Reduction & Air Quality Study

Drawing Ttitle
Air Quality
Monitoring - Willand/J27

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Job No
235489-00

Drawing Status
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Figure 9

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3.5.2 Option 1 – Town Focus

MDDC undertake automatic monitoring of NO_2 in all three towns considered in Option 1, automatic monitoring of PM_{10} is also undertaken in Crediton and Cullompton. The results of this monitoring for recent years are presented in Table 3.

The monitoring indicates that the annual mean NO_2 and daily mean PM_{10} objective are exceeded along Exeter Road in Crediton. For the first time in 2013, the hourly mean NO_2 objective was also exceeded and this was due to a large spike in levels during October and November for which no reason has been identified, however this corresponds with other monitoring data in Crediton.

Relevant air quality objectives are met in Cullompton and Tiverton with the exception of an exceedence of the annual mean NO_2 objective in Cullompton in 2010.

Table 3: Automatic Monitoring Pollutant Concentrations (2010-2012), exceedences of the relevant air quality objectives are highlighted as bold.

Site Name	Site Type	Year	Annual Mean NO_2	Hourly Mean NO_2	Annual Mean PM_{10}	Daily Mean PM_{10}
			µg/m^3	Hours	µg/m^3	Days above 50µg/m^3
Objective			**40µg/m^3**	**18 Hours**	**40µg/m^3**	**35 Days**
Exeter Road (Crediton)	Roadside	2010	**55.6**	0	38.0	56
		2011	**44.9**	0	31.3	16
		2012	**81.3**	**29**	36.7	**55**
Station Road (Cullompton)	Roadside	2010	**49.0**	0	23.0	11
		2011	31.9	0	19.3	7
		2012	28.9	0	22.8	8
Leat Street (Tiverton)	Roadside	2010	31.5	0	-	-
		2011	24.4	0	-	-
		2012	14.7	0	-	-

Passive diffusion tube monitoring of NO_2 is also undertaken in all towns in order to achieve a wider understanding of air quality issues throughout the town. Results from diffusion tubes are presented in Table 4. The location at Horsden Terrace in Tiverton was added to the network in 2009 to inform major development allocations for the LDP. Monitored data indicated no exceedences of the annual mean NO_2 objective in Tiverton and throughout the majority of Cullompton, with the exception of Fore Street, near the Manor Hotel. Continued exceedences of the annual mean NO_2 objective have been recorded throughout Crediton in recent years.

Table 4: Diffusion Tube Monitored Concentrations (2010 – 2012), Exceedences of the relevant air quality objectives are highlighted as bold.

Site Name	Site Type	Annual Mean NO_2 (µg/m^3)		
		2010	2011	2012
3 Horsden Terrace (Tiverton)	Roadside	24.9	23.1	24.4
17 Leat Street (Tiverton)	Roadside	35.3	30.4	29.9
11 Elm Terrace (Tiverton)	Roadside	26.5	26.1	25.3
Police Station, Station Road (Cullompton)	Roadside	31.0	27.1	27.2
No. 49 Station Road, Cullompton	Roadside	27.3	27.3	26.1
No. 15 Higher Street	Roadside	30.4	28.2	22.9
No. 31 Higher Street	Roadside	25.0	22.3	21.5
No. 17 High Street	Roadside	28.3	26.6	25.6
Manor Hotel, Fore Street (Cullompton)	Roadside	38.5	**41.1**	**41.5**
No. 45 Fore Street (Cullompton)	Roadside	39.5	35.3	32.4
Exeter Road South (Crediton)	Roadside	**44.5**	**44.3**	**40.5**
Exeter Road Mid (Crediton)	Roadside	**40.3**	37.5	37.8
Exeter Road North (Crediton)	Kerbside	**46.0**	**43.0**	**43.7**
HSBC High Street (Crediton)	Kerbside	42.6	**40.8**	37.6
High Street Mid (Crediton)	Roadside	34.6	35.1	32.1
Duke of York High Street (Crediton)	Kerbside	**42.1**	**42.0**	**41.2**

It can be observed that at the majority of monitoring locations a downward trend in monitored concentrations is recorded. This is to be expected as the vehicle fleet throughout the UK changes to cleaner fuel technologies and cars are manufactured to stricter emission controls. It is predicted that if traffic volumes were to be held constant, concentrations would continue to decrease as the effect of stricter emission controls were felt.

3.5.3 Option 2A – Junction 27 M5, Willand

Diffusion tube monitoring is undertaken at Somerville Close, 30m from the M5, in Willand. It is likely that this monitoring location would be representative of the proposed housing, commercial and mixed use allocations in the vicinity of Junction 27 of the M5. Table 5 presents monitored data recorded in recent years and indicates that annual mean NO_2 concentrations are well below the annual mean NO_2 objective. It is therefore likely that the areas proposed for housing would not be exposed to pollutant concentrations above the relevant air quality objectives.

Table 5: Diffusion Tube Monitored Concentrations at Willand (2010 – 2012)

Site Name	Site Type	Annual Mean NO_2 (µg/m^3)		
		2010	2011	2012
Somerville Close (Willand)	Roadside	27.3	26.7	24.9

3.5.4 Option 2B – Cullompton

All local monitoring data for Cullompton is shown in Table **3**andTable **4**; none of the monitoring data is located to the eastern side of the M5 where development allocations are proposed. However given the nature of current land uses it is not anticipated that pollutant concentrations would be higher than those measured within the centre of Cullompton.Rural Areas.

In addition to the main towns considered for development, diffusion tube monitoring is also undertaken in the more rural settlements of Bampton and Burlescombe. Table 6 presents monitored data in rural areas recorded in recent years. Monitoring data indicates that annual mean NO_2 concentrations are well below the annual mean NO_2 objective (<21µg/m^3 at both sites in all years) this is likely to be representative of the majority of rural settlements throughout MDDC unless another source of pollution, other than road traffic is present.

Table 6: Diffusion Tube Monitored Concentrations at Burlescombe and Bampton

Site Name	Site Type	Annual Mean NO_2 (µg/m^3)		
		2010	2011	2012
6 Fore Street (Bampton)	Roadside	18.6	16.2	18.0
Wingfield House Station Road (Burlescombe)	Kerbside	13.8	11.9	12.2

3.5.5 Industrial Processes

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes. Part A processes are regulated through the Pollution Prevention and Control (PPC) system (EC Directive 96/91/EC on Pollution Prevention and Control originally implemented into law via the Pollution Prevention and Control Act (1999)) which was superseded in 2007[29] and updated in 2010. Generally, the larger, more polluting processes are regulated by the Environment Agency (EA) and smaller, less polluting ones by the local authorities. Local authorities tend also to regulate only for emissions to air whereas the EA regulate emissions to air, water and land.

There are a number of processes regulated by the EA within MDDC, those within five miles of the main towns of Tiverton, Cullompton and Crediton, where the majority of development will take place, are listed in Table 7. Due to the rural nature of the district the majority of industry is related to agriculture.

Table 7: Part A Processes in Mid Devon

Name	X	Y	Type of Process
Frankpitt	295190	114080	Intensive Farming
Heathcote Fabrics Ltd	295150	112710	Coating, Printing and Textiles
Tiverton STW	295475	110493	Sewage Treatment Works
2 Sisters Food Products Ltd	303030	111120	Animal, Vegetable and Food

[29] Environmental Permitting (England and Wales) Regulations 2010 (SI 675).

AB Agri Ltd	306930	112580	Animal, Vegetable and Food
ABN Ltd	303070	107940	Animal, Vegetable and Food
H Chattey & Sons	305340	105250	Intensive Farming
Halberton Poultry Ltd	302680	112580	Intensive Farming
Halberton Poultry Ltd	306620	106440	Intensive Farming
Higher Kings Mill Ltd	303100	108190	Paper, Pulp & Board
Viridor Waste Management	306640	113360	Waste Landfilling
Devonshire Poultry Ltd	311260	108490	Intensive Farming
Hook 2 Sisters Limited	305000	117500	Intensive Farming

All processes release emissions to air and have environmental permits which are regulated by the EA. There are also 33 Part B processes regulated by the local authority within Mid Devon. Emissions from operational sources for Part A and Part B processes are accounted for within estimates of local pollutant concentrations by Defra, which are discussed below, and are unlikely to have a significant effect on any of the potential allocation sites.

3.5.6 Background Pollutant Concentrations

Defra has produced estimated background air pollution data for each 1x1km OS grid square for each local authority area across the UK[30]. Background maps are available for 2010 and projected through to 2030. Average, maximum and minimum background pollutant concentrations across MDDC are provided in Table 8 for 2013. The background pollutant concentrations reflect the rural nature of the district as even maximum concentrations are well below the relevant air quality objectives (see Table 2).

In recent years background air quality concentrations have not improved as forecast as such monitored data as presented in Section 3.5.2 to 3.5.4 is considered to be more representative in the main towns of the district. In more rural areas, background concentrations estimated by Defra are likely to be representative of the current situation.

Table 8: Annual Mean Background Pollutant Concentrations (µg/m^3)

Pollutant	Mean Concentration (µg/m3)	Maximum Concentration (µg/m3)	Minimum Concentration (µg/m3)
NOx	7.2	23.9	5.3[SE6]
NO2	5.4	16.3	4.1
PM10	12.1	16.0	10.8
PM2.5	7.7	10.2	7.2

3.6 Summary

There are few suitable sites for installation of further large-scale, stand-alone generation, particularly wind power, in the Mid Devon District. Some smaller technologies have limited potential the region due to constraints over suitable

[30] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

sites, such as hydropower. There are also restrictions to placement of technologies due to landscape sensitivity, transport of large technology components on unsuitable size roads and the dispersed nature of settlements across Mid Devon.

Mid Devon has significantly higher per capita emissions than the rest of Devon, South West England and the England wide average. This is mainly due to the rural nature of the district and thus far larger than average carbon emissions from road transport.

There are some areas of the district where monitored pollutant concentrations exceed relevant air quality objectives. As such, Crediton and Cullompton have been designated as AQMA and air quality action plans are in place. These aim to improve local air quality in these areas. These areas of exceedences are primarily caused by emissions from traffic which is the greatest source of pollution throughout the district. Private car use is high and public transport is not well used throughout the district.

Monitored data in Tiverton indicates pollutant levels well below the relevant air quality objectives and this area is not currently at risk of being declared an AQMA.

4 Carbon Impacts and Air Quality Impacts of New Development

4.1 Introduction

As part of this study, it is necessary to consider the opportunities to reduce carbon emissions, by following the energy hierarchy. Also considered are the likely carbon emission and air quality impacts of each of the development options.

4.2 Options Available

Mid Devon has higher per capita emissions than the rest of Devon and the English average. 27% of these emissions are from industry and commerce, 12% of emissions are domestic and 40% of emissions are from transport. This is different from the national average which has 41% of emission from industry and commerce, 30% of emissions from domestic sources and 29% of emissions from transport[31].

There are three main options for reducing a development's potential carbon emissions relating to energy use within buildings, this is called the Energy Hierarchy, see Figure 10. The first option to focus on is reducing energy demand through fabric energy efficiency, then on-site low and zero carbon heat and power, then allowable solutions (such as offsite carbon reduction projects).

[31] Local and Regional CO2 Emissions Estimates for 2005-2011', produced by Ricardo-AEA for DECC (see https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/sub-national-greenhouse-gas-emissions-statistics)

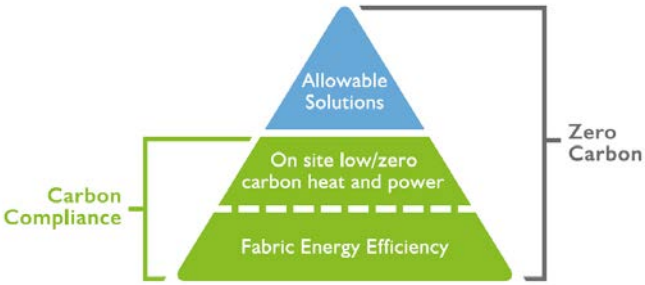

Figure 10: Energy Hierarchy[32]

Energy efficiency is the highest priority on the energy hierarchy. The more energy efficient a building is the lower its carbon emissions, as less energy has to be supplied to it to maintain the required internal conditions.

The second area to be targeted should be the assessment of the appropriateness of on-site low and zero carbon energy generation technologies to replace carbon-intensive centrally generated energy. Transport should also be considered for developments as significant emissions can be attached to travel. Renewable technology and energy efficiency options are listed in Appendix C.

There are however trade-offs between the different options. For example one development site could be ideal for renewable energy generation but means that the travel to work by car will significantly increase. There are also trade off in feasibility for example the more houses that are very energy efficient, the less need for renewable energy, thus renewable energy becomes more expensive and less viable.

UK households use 66% of their total energy on space heating, 17% on water, 15% on lighting appliances and 3% on cooking[33]. Thus reducing the energy used for space heating buy increasing energy efficiency of building has the largest potential to save energy.

4.3 Carbon Impacts of Travel

4.3.1 Travel Emissions Associated with Development Options

The carbon impacts of travel in this report are split into travel to and from work, school and retail. Each option has been compared based on the distance residents would likely have to travel; the percentage of residents in the are currently using different travel modes (e.g. car, public transport, cycling); and differences in number of dwellings for each Local Development Review option (the number of houses used for calculation in each option is detailed in Appendix E Table E.1).

[32] Zero carbon homes and nearly zero energy buildings. UK building regualtions and EU Directives. April 2014 (http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCHomes_Nearly_Zero_Energy_Buildings.pdf)

[33] Energy Consumption in the UK, Chapter 3: Domestic data Tables, Government Statistics (https://www.gov.uk/government/publications/energy-consumption-in-the-uk)

The carbon impacts of travel to work and school are based on 2011 census data and assume that travel patterns will remain the same in the future. Greenhouse Gas emissions[34] are calculated using DECC 2013 emission factors, and are based on typical vehicles. Data for travel to work, school and retail and the total emissions are detailed in Table 9. The methodology and full data sets for Table 9 can be found in Appendix E, the datasets in Tables E.2, E.3, and E.4.

Travel to work, school and retail cover the main transport emissions associated with the new developments. However, there will be other travel emissions associated with developments not included in these calculations such as travel to recreation, holidays and other emissions such as waste collection and street cleaning. This follows normal carbon accounting guidelines.

The highest emission type for all development options is travel to work, shown in Table 9. Option 1 (Town Focus) has the lowest transport emissions of the three options, followed closely by Option 2b (Cullompton development). Option 2b (Willand Development) has significantly higher emissions per dwelling than the other options, 73% higher than emissions per dwelling for Option 1. The is likely mainly because Option1 and Option 2b have similar distances travelled to work 19km for Option1 and 21km for Option 2. Option 2a, however, has about 50% greater distance to travel on average than the other two, of 31km. The same trend is seen in travel to school and retail, with Option 1 having the least emissions and Option 2a having the highest emissions.

The method of travel is also likely a factor in the amount of travel emissions between options. Option 1 may have had lower emissions, partly because only 44% of commuters use car to travel to work, compared to 48% in Option 2a and 2b. Option 1 also has a higher level of walking to work, 12.2%, compared to 2b: 9.8% and 2a: 1.8%, likely due to its rural setting.

Total emissions for Option 1 are the lowest, Option 2b has emissions which are 13% higher and Option 2a has 63% higher total emissions. Thus from a travel emissions perspective, Option 1 would be the most preferable.

Table 9: Carbon emissions from travel for each of the large development expansion options, including travel to and from, work, school and retail outlets.

		Option 1: Town Focus Development (kg CO_2e/year)	**Option 2a: Willand Development (kg CO_2e/year)**	**Option 2b: Cullompton Development (kg CO_2e/year)**
Travel to Work: carbon equivalent emissions	Car	993,196	2,319,393	1,385,326
	Public transport	33,084	43,986	48,933
	Taxis	58,105	0	0
	Motorbikes	8,351	8,412	13,082
	Total	1,092,734	2,371,790	1,447,340

[34] Greenhouse Gas emissions are expressed as Carbon Dioxide Equivalents (CO_2e), but the terms carbon emissions, greenhouse gas emissions, carbon dioxide, and simply emissions are used interchangeably in this report for ease of use.

	Total per dwelling	455	791	492
Travel to school	Total	1342	3,214	2,409
	Per Dwelling	0.6	1.1	0.8
Travel to retail	Total	812,200	1,500,000	1,176,000
	Per dwelling	338	500	400
Travel Carbon emissions for the development	Total	1,906,276	3,875,004	2,625,749
	Per dwelling	794	1292	893

4.3.2 Travel Emissions Associated with Rural Development

There are twenty-seven possible rural locations considered for development in the Local Development Review. These locations have been grouped into three categories for ease of comparison. The categories are based on travel time to urban areas and the size of the urban area; more details are available in Appendix E. These have been named 'Close to an Urban Hub', 'Close to a Town' and 'Rural Setting' and the full list of where each rural area falls is in Appendix E Table E.5. A potential development site has been picked in each of the categories to act as an example of likely travel emissions, and detailed in Table 10. Emissions have been compared per dwelling, as the sizes of developments differ widely.

Table 10: The carbon emissions (per dwelling) for travel to work, school and retails for a selection of rural developments (full data in Table E.6 in Appendix E).

	Close to an Urban Hub	**Close to a Town**	**Rural setting**
	Wooldleigh Hall, Cheriton Bishop (kg CO_2e/year/ dwelling)	Newton Square, Bampton (kg CO_2e/year/ dwelling)	Culmbridge Farm, Hemyock (kg CO_2e/year/ dwelling)
Travel to Work	842	553	730
Travel to school	0.6	0.7	1.0
Travel to retail	500	720	700
Total travel	**1,343**	**1,274**	**1,431**

Transport carbon emissions for the rural developments are significantly higher than those associated with Option 1 and 2b. The emissions are similar to Option 2a as development is situated in Willand which is in the 'Close to a Town' category, and so has comparable emissions to Bampton, see Table 10. Although Cheriton Bishop is within 25 minute commute to an urban hub, Exeter, more emissions are associated with travel than for Bampton, which is close to Tiverton. There is no urban hub within Mid Devon, and so to reach Exeter residents must travel outside the District. This is reflected in the average distances travelled, with Cheriton Bishop residents traveling 2km further a day. Hemyock, or the rural

setting, has the highest likely emissions associated; this is mainly due to relatively high travel to work emissions, owing to a 20km commute and 47% of residents travelling by car.

Thus the travel emissions associated with rural developments do not differ hugely and are highly dependent on the distance they are from urban areas.

4.4 Local Air Quality Impacts

In contrast to the assessment of carbon impacts, which are more relevant on a regional scale, the assessment of air pollutant levels must be done on a local scale.

The impact of a potential allocation site on local air quality relates primarily to the size and scale of the proposal, including the number of additional vehicles on the local road network and any combustion plant to be installed within the development, as well as its proximity to other sensitive receptors such as residential properties. Larger developments will therefore have a greater impact on local air quality due to additional vehicles travelling to and from the development and the potential need to provide energy on site rather than part of a heating network.

The baseline assessment indicates that the areas of Crediton and Cullompton are most sensitive with regard to changes in local air quality as monitoring indicates the annual mean NO_2 objective is currently exceeded. All other air quality objectives are met in these areas, with the exception of the hourly mean NO_2 objective in Crediton. Objectives are also met in Tiverton and more rural areas of the district. As such, air quality will likely be a material planning consideration for those allocations within Crediton and Cullompton.

The Design Manual for Roads and Bridges[35] (DMRB) includes criteria for changes in traffic on the local road network as a result of developments which may be significant for local air quality, these are:

- Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more; or
- Heavy Duty Vehicles (HDVs) flows will change by 200 AADT or more; or
- Daily average speed will change by 10kph or more; or
- Peak hour speed will change by 20kph or more.

Where these criteria are met, the effect on local air quality as a result of the allocated site should be quantitatively assessed, once appropriate data is available such as design and changes to traffic as a result of the development, to determine the significance of effects with relation to local air quality.

Currently the trip generation of each of the potential allocations is unknown. However, an estimation of likely daily traffic flows has been made for each of the options to determine if there is likely to be an effect on local air quality. The Air Quality and Planning SPD indicates that predicted average daily vehicle trips are 9.5 trips per residential unit, 14 trips per employment unit and 187 trips per $100m^2$ of retail space according to the TRICS (Trip Rate Information Computer System) database. As a result, all potential allocation sites of 100 residential dwellings or more or greater than $500m^2$ of retail space have the potential to affect local air

[35] Highways Agency, The Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality, May 2007

quality. It is understood that this represents a worst case scenario and daily trips associated with residential and commercial properties are likely to be lower in most developments.

There are a number of potential allocation sites outlined in the Local Plan Review which are subject to the implementation of 'air quality improvements'. This is primarily due to the size of the development as well as the location in built up areas of the district, these are listed in Table 11. Each of these sites meet the criteria set out in DMRB based on the number of residential or commercial properties. The impact of the potential allocation sites on local air quality is discussed below.

Table 11: Site options allocated subject to air quality improvements

Site	Policy Option Reference	No. of Dwellings	Allocated Subject to the following conditions
Tiverton			
Eastern Urban Extension	TIV1	1,000-1,500	Air quality improvements
Hartnoll Farm	TIV2	1,100	Air quality improvements
Farleigh Meadows	TIV3	300	Measures to mitigate impact on air quality at Leat Street
Blundells School	TIV4	200	Implementation of transport plans and other transport measures to minimise air quality impacts
Cullompton			
North West Cullompton	CU1	1100	Air quality improvements
Growen Farm	CU2	400	Implementation of transport plans and other transport measures to minimise air quality impacts
Knowle Lane	CU3	340	Implementation of transport plans and other transport measures to minimise air quality impacts
Land south of Tiverton Road	CU4	45	Implementation of transport plans and other transport measures to minimise air quality impacts
Ware Park and Footlands	CU5	38	Implementation of transport plans and other transport measures to minimise air quality impacts
Court Farm	CU6	35	Implementation of transport plans and other transport measures to minimise air quality impacts
Land at Exeter Road	CU7	35	Implementation of transport plans and other transport measures to minimise air quality impacts
Bradninch Road	CU8	25	Implementation of transport plans and other transport measures to minimise air quality impacts
Land at Colebrook Lane	CU9	300	Development will not commence until the Eastern Relief Road has been provided;

Site	Policy Option Reference	No. of Dwellings	Allocated Subject to the following conditions
			Implementation of transport plans and other transport measures to minimise air quality impacts
Land at East Culm Farm	CU10	120	Provision of improved pedestrian and cycle links to the town centre; Implementation of transport plans and other transport measures to minimise air quality impacts
East Cullompton Urban Extension	CU11	3,000	Provision of dedicated pedestrian and cycle route to the town centre; Air quality improvements
Eastern Relief Road	CU14	-	Provision of an Eastern Relief Road linking Station Road and Meadow Lane is essential if the objectives of air quality improvement are to be met
Crediton			
Cromwells Meadow	CRE3	50	Development will not commence until the Crediton Link Road is in operation
The Woods Group, Exeter Road	CRE5	8	Mitigation for potential on site air quality issues with specific design to prevent worsening of air quality on Exeter Road and to avoid potential air quality issues for future occupants
Pedlerspool	CRE6	165	Development will not commence until the Crediton Link Road is in operation unless the council is satisfied that air quality and traffic impacts as a result of the development would not be material
Sports field, Exhibition Road	CRE7	50	Implementation of transport plans and other transport measures to minimise air quality impacts
Junction 27 and Willand			
Land at M5 Junction 27 and adjoining Willand	J27	3,000	Air quality improvements

In addition to those above, a number of other potential allocation sites throughout the three major towns meet the DMRB criteria; these are listed in Table. The potential effect on local air quality from these sites is also discussed below.

Table 12: Additional Sites which meet the DMRB Criteria with the potential to affect local air quality

Site	Policy Option Reference	No. of Dwellings	Commercial Space
Tiverton			
Tidcombe Hall	TIV10	200	-
Wynnards Mead, Bakers Hill	TIV11	100	-
Phoenix Lane	TIV16	60	9,300 m^2
Land at Bampton Street/William	TIV17	60	9,300 m^2

Street Car Park			
Crediton			
Wellparks	CRE1	185	-
Red Hill Cross	CRE2	135	-
Land at Chapel Down Farm	CRE11	120	-

There are also a number of rural sites where more than 100 dwellings or greater than 500m^2 of retail space are suggested, these are listed below:

- Land adjacent to Woodleigh Hall, Cheriton Bishop;
- Land north of Brakes View, Cheriton Bishop;
- Land adjacent to Dulings Meadow, Copplestone;
- Land at Mountain Oak Farm, Sampford Peverell;
- Morrels Farm, Sampford Peverell;
- Land east of the M5, Willand;
- Bourchier Close, Bampton;
- South of Iter Cross, Bow;
- South West of Junction Road, Bow;
- Land E of M5 at Junction 27, Junction 27;
- Morrells Farm, Sampford Peverell;
- Willand Industrial Estate, Willand; and
- Lloyd Maunder, Willand

However it is not expected that the Council will allocate this level of development in villages. The maximum number of residential properties likely to be permitted will be approximately 35 houses per village.

It is unlikely that any of these potential allocation sites will be affected by existing poor air quality or will have a significant effect on local air quality.

All other potential allocation sites listed in the Local Plan Review are unlikely to have a significant effect on local air quality due to their relatively small size.

An assessment of cumulative effects on local air quality of preferred sites to be taken forward will be undertaken as a supplementary exercise to this assessment.

4.5 Option 1 – Town Focus

The assessment of carbon impacts indicates that Option 1 would result in the lowest carbon emissions associated with travel of the three options primarily as residents have to travel less distance to reach workplaces and schools. This theory can also be applied to regional emissions of nitrogen dioxide and particulate matter.

4.5.1 Potential Allocation Sites in Tiverton

Option 1 focusses much of the growth in the area within Tiverton. This is appropriate with regard to local air quality as this area is not as sensitive to changes in local air quality as Cullompton and Crediton. However, development in Tiverton will increase pollutant concentrations along the local road network as a result of associated additional vehicles, The Eastern Urban Extension and Hartnoll Farm allocations are likely to result in the largest change in local air quality as both developments are large in size.

The Eastern Urban Extension consists of 1,000-1,500 residential dwellings and a large amount of employment space increasing the likely vehicle trips to and from the site. This site is located along Blundells Road to the south of the A361, and as part of the development a new junction would be built giving direct access to the A361. This link road ensures good transport links to the M5 and its surroundings; it also limits the requirement for through traffic to use the town centre which has the potential to lead to congestion in the area. The proposals also allow for an energy centre or energy-from-waste plant, emissions from this would need to be considered to limit the impact on air quality. As this option is an existing allocation, Policy AL/TIV/5[36] exists to consider carbon reduction and air quality. This states that a low emission strategy would be required for this site and as such appropriate measures as set out in section 7 would need to be implemented, this is particularly relevant for encouraging the use of sustainable modes of transport, as well as controlling emissions from the proposed energy plant.

Proposed development to the east of Tiverton town centre, including Hartnoll Farm and Blundells School, would result in an increase in pollutant concentrations along the local road network including the A361, A396 Heathcote Way and Blundells Road. It is unlikely that this would result in an exceedence of the relevant air quality objectives as monitoring in the area (3 Horsdon Terrace) indicates that existing pollutant concentrations are well below the annual mean NO_2 objective (40µg/m^3).

Land proposed for development at Farleigh meadows already has a resolution to grant planning permission and an air quality assessment has been produced as part of the planning process. The air quality assessment concluded that the significance of the allocation is negligible to slight adverse. During consultation, concerns were raised by local residents about the amount of additional traffic needing to use Leat Street to access the allocated site; it is likely that the air quality assessment has resulted in the condition to mitigate air quality impact at Leat Street. Mitigation measures therefore need to focus on transport related measures to either discourage the use of Leat Street or improve the junction with Kennedy Way to ensure additional traffic moves through Leat Street efficiently and does not result in congestion which could lead to a worsening in air quality in the area.

Development at Farleigh Meadows will result in an increase in pollutant concentrations along Rackenford Road and Leat Street however the air quality assessment indicates that this will not result in an exceedence of the relevant air quality objectives.

The primarily commercial site of Pheonix Lane is located in the town centre and includes enhancement of the bus station. It is anticipated that this would provide an opportunity to improve local bus services and encourage the use of these, which has the potential to have a beneficial effect on air quality as a result.

Due to existing concentrations within Tiverton being well below the relevant air quality objective it is unlikely that the options set out in the Local Plan Review would result in an increase of pollutant levels for which an AQMA would need to be declared. It is likely that preferred options taken forward which meet the DMRB criteria will require an air quality assessment to quantify the effect of the development on local air quality.

[36] Mid Devon District Council, Allocations and Infrastructure Development Plan Document, January 2011

4.5.2 Potential Allocation Sites in Cullompton

All sites within Cullompton are subject to the implementation of transport plans and measures to minimise the impact of development on local air quality, given the existing AQMA which has been declared for the town. The majority of potential allocation sites lie outside of the existing AQMA, with the exception of Court Farm, however it is likely that traffic associated with all development will need to pass through the AQMA.

The North West Cullompton and East Cullompton options are likely to result in the largest change in local air quality as both developments are large in size.

Development in Cullompton will increase pollutant concentrations as a result of additional traffic using the local road network; however the existing allocation for an Eastern Relief Road linking Station Road and Meadow Lane is particularly important for air quality. This option has the potential for improvements in air quality through the town centre by diverting through traffic away from sensitive receptors along Station Road, Fore Street and Exeter Hill. This could result in the AQMA being revoked as current monitoring indicates exceedences of the annual mean NO_2 objective are limited to Fore Street.

One of the options in Cullompton, Knowle Lane, has a resolution to grant planning permission and an air quality assessment[37] has been undertaken for the site. This assessed the development of 285 dwellings, slightly less than that considered in the Local Plan Review, and concluded that the development would have a negligible effect on local air quality both within and outside the AQMA.

It is likely that the smaller options within Cullompton would also have a similar effect to that presented in the assessment for Knowle Lane. As there will be a number of developments required to provide the growth needs of the Local Plan there is the potential for cumulative effects and these should be assessed once preferred options are taken forward.

It is likely that preferred options taken forward will require an air quality assessment to quantify the effect of the development on local air quality both within and outside the AQMA during the planning process.

4.5.3 Potential Allocation Sites in Crediton

It is appropriate, with regard to local air quality, that the amount of development in Crediton is less than Cullompton and Tiverton. A new link road is currently under construction in Crediton linking the A377 to Marsh Lane and The Lord Meadows Industrial Estate in an attempt to cut congestion and improve air quality along the A377 through Crediton. Two Options, Cromwell Meadows and Pedlerspool, are subject to the Link Road being in operation prior to its development.

Development in Crediton will increase pollutant concentrations as a result of additional traffic using the local road network and has the potential to significantly affect local air quality should additional vehicles need to travel through the town centre.

[37] ENVIRON, Air Quality Assessment, Knowle Lane, Cullompton, January 2013

Four allocation options along the A377 have the potential to be most affected by existing poor air quality. These are listed below:

- Barn Park;
- Barnfield;
- The Woods Group; and
- Wellparks.

With the exception of Wellparks, the size of development is relatively small (less than 10 properties at each site). It is noted in the Local Plan Review that properties at The Woods Group would require mitigation to be built into design to avoid potential air quality issues for future occupants. This could include mechanical ventilation and filtration. This may also need to be considered for the residential development in Barnfield and areas of the Wellparks development closest to the A377.

Should the Link Road not lead to a revocation of the AQMA, it is likely that preferred options taken forward in Crediton would require an air quality assessment to quantify the effect of the development on local air quality both within and outside the AQMA during the planning process.

4.6 Option 2a – J27 and Willand Development

Option 2a would result in the need for significantly less housing and commercial development in Tiverton, Cullompton and Crediton, which would be preferable with regard to local air quality.

This area is predominantly rural in nature and therefore existing air quality is well below the relevant air quality objectives as shown in the baseline assessment. It is understood that should this option be taken forward policies similar to that outlined for the Eastern Urban Extension in Tiverton would be drawn up for carbon reduction and air quality, this should include the need for a low emission strategy to minimise the impact on local air quality.

Due to the location of the development within close proximity to the M5 it is likely that additional traffic on the local road network as a result of the development would be limited.

Inevitably, pollutant concentrations in this area will increase with a development of this size, but due to the existing pollutant levels at this location it is unlikely that this would result in an exceedence of the relevant air quality objectives for which an AQMA would need to be declared. However, a development of this size would require a detailed air quality assessment should this be taken forward for planning.

4.7 Option 2b – Cullompton Development

Option 2b focusses the majority of development in Cullompton itself with the East Cullompton Urban Extension option. The majority of this development lies outside of the Cullompton AQMA and to the east of the M5. The area to the east of the M5 is predominantly rural however there is a small industrial estate and residential population currently along the A373, Honiton Road. Although there is no air quality monitoring in place it is likely that pollutant concentrations are much lower than those currently monitored throughout Cullompton town centre.

As with Option 2a, it is understood that should this option be taken forward policies similar to that outlined for the Eastern Urban Extension in Tiverton would be drawn up for carbon reduction and air quality, this should include the need for a low emission strategy to minimise the impact on local air quality.

The location of this development proposal directly adjacent to the M5 will limit the amount of additional traffic along the local road network, however the potential remains to increase traffic flows in Cullompton itself. Provision of a dedicated pedestrian and cycle route to the town centre, as suggested in the Local Plan Review, should be included to encourage sustainable travel to and from the site.

Inevitably pollutant concentrations in this area will increase with a development of this size and have the potential to affect the currently declared AQMA. Existing monitoring indicates that local air quality exceedences in cullompton are confined to the town centre, in particular Fore Street, therefore appropriate public transport links should be put in place to limit the impact of additional vehicles in the town centre. A development of this size in such close proximity to an AQMA would require a detailed air quality assessment to quantify the effect of the development on local air quality both within and outside the AQMA should this be taken forward through the planning process.

4.8 Summary

Development within the district will lead to increases in traffic and combustion plant such as boilers, Combined Heat and Power Systems (CHP) or energy from waste plants required to provide energy. As a result it is likely that pollutant concentrations in the vicinity of these developments will increase. If appropriate measures are taken to minimise the impact on local air quality, it is unlikely that this increase will be significant and cause new AQMAs to be declared. Where possible, development should be limited within Crediton and Cullompton town centres where exceedences of the relevant air quality objectives exist.

Option 1 and 2 satisfy the same growth need but will have different impacts locally due to the location of the proposed options. With regard to local air quality, Option 2 – J27 and Willand is preferable as this moves the majority of development away from sensitive areas such as Cullompton and Crediton to an area where monitored pollutant concentrations are currently well below the relevant air quality objective.

Existing monitoring in rural areas indicate that pollutant levels are well below the relevant air quality objectives, due to fairly limited development suggested for these areas it is unlikely that any significant air quality effects will arise.

Measures to limit the impact of any development option on air quality are discussed in Section 6. These should be implemented wherever possible, particularly within Crediton and Cullompton, which have been assessed to be sensitive to changes in local air quality.

5 Renewable and Low Carbon Energy Options for New Development

5.1 Feasibility, Cost Implications and Deliverability

5.1.1 Feasibility and Applicability

The feasibility of renewable and low carbon energy technologies is dependent on various constraints. The elements which need to be considered are the size and type of development that the technology will be installed in, the ease of access to the gas grid, and physical constraints that may affect energy output such as slope and shading, or availability of feedstock.

There are some constraints that are applicable for all technologies such as the skill set of the local workforce to install and maintain the renewable technologies. Other constraints are applicable for specific technologies. These are listed in Table 13 below. More details on these renewable energy technologies are in Appendix C.

Table 13: Comments on the feasibility of renewable and low carbon options

Renewable and Low Carbon Technology		Comments on Feasibility
Solar Energy	PV farm	This is a large scale off-site solution. There are landscape sensitivity constraints on suitable sites for this technology.
	Roof mounted PV array	These technologies would be suitable on all size of MDDC potential developments as they are individual house options. Shading and suitably angled roofs are the constraints related to this technology. For apartment blocks and multi-storey mixed-use buildings, the area of roof available to each unit will be limited. Therefore, an array linked to the central or common power supply may be preferable to panels linked in to each unit's individual supplies. In addition, there may be competition for roof space, e.g. from solar thermal or green roofs.
	Solar Thermal	These are suitable for installation onto south facing roofs of dwellings. Similarly to PV, shading and suitably angled roofs will be constraints. For apartment blocks and multi-storey mixed-use buildings, the area of roof available to each unit will be limited, therefore, an array linked to a central or common heating and/or domestic hot water supply may be preferable to panels linked in to each unit's individual systems. In addition, there may be competition for roof space, e.g. from solar PV or green roofs.
Gas Combined Heat and Power (CHP)	Large Scale	CHP is most suited to developments which have a steady base heat load, thus have some non-domestic heat load. If the site has a current gas connection gas CHP would be viable. If there is no current connection, other energy technologies may be more suitable such as heat pumps, biomass or energy from waste. It should be noted that the recent update to building regulations Part L has made gas-fired CHP less impactful, as a result of the new carbon emission factors (which assume greater decarbonisation of the grid).

	House Scale	Although single house size gas CHP boilers can be installed, these are not yet main stream technology. Therefore, there may not be a suitable technology at the current time. However, this could change over the lifetime of the Local Plan to 2033.
Biomass Boilers		Biomass boilers are suitable for public buildings and mixed used developments but are less well suited to domestic applications. They are ideal to be installed centrally and energy to be distributed to various buildings. There are constraints associated with the size of biomass boilers and the supply chain, storage capabilities and availability and price variability of feedstocks.
District Heating		District heating is most appropriate in large mixed use developments. They are mostly installed in dense urban environments. However the large urban extensions (Willand) may provide enough demand to make this viable, dependent on the phasing of development. Heat can be generated by gas CHP or biomass, as described above. It is possible to change the heat source to one with a lower carbon impact as technology changes, with more ease than changing the heat source on every individual building.
Wind	Large scale	This is a large scale off site solution. There are wide range of considerations (e.g. wind speed, ecology), but in particular landscape and visual sensitivity constraints, and issues related to road suitability for construction vehicles have been identified in Mid Devon.
	Micro	Micro-wind is often feasible. However, constraints associated with lack of consistent strong winds in developments due to the turbulence caused by surrounding houses, means that they are often do not produce enough energy to make them an appropriate choice.
Ground Source Heat Pumps (GSHP)		This is a low carbon technology as the pump requires an input of electricity to operate. This can be installed on an individual building scale. However, to ensure a balanced heat transfer this technology is more advisable for mix use developments which also have a cooling load. In addition, a certain amount of space is required underground, which tends to favour less dense areas.
Air Source Heat Pumps		This is a low carbon technology as the pump requires an input of electricity to operate. These are suited to individual building installations, rather than a centralised solution, as heat losses from distribution networks would be too great.
Energy From Waste		This is currently an off-site solution. This is feasible option in the area, but relies on suitable sites available without a detriment to landscape sensitivity. Mid Devon's waste is currently not sent to any of the existing energy from waste plants in Devon and is an available resource[38]. Smaller scale plants are an emerging technology, but still may be more appropriate to be linked to the main grid.
Landfill Gas		This is an off-site solution. This is feasible technology but requires a suitable site close to landfill sites.
Anaerobic Digestion (AD)		This is likely to be an off-site solution. In particular, odour issues make AD plants in close proximity to housing an unattractive proposition. In addition, availability and supply of feedstock will be a central consideration. Suitable sites may include farms or central facilities.
Hydroelectric Power		Though this technology is technically feasible, there are few sites on rivers which may be suitable, but there is not large amount of capacity.

[38] Devon County Council, *Waste and Resource Management Strategy for Devon Review*, March 2013

There is a wide range of renewable and low carbon energy options available. Some of these options are offsite renewable energy which will mostly feed into the national grid, such as PV farms, large scale wind, energy from waste, landfill gas and anaerobic digestion, each of which has specific constraints, listed in Table 13. Other large scale options are suitable for large development sites such as large gas combined heat and power (CHP), biomass boilers and district heating, often most suitable in mix-use development.

There is also a range of suitable onsite options, generally installed at an individual dwelling scale, such as roof mounted PV, solar thermal, micro wind, ground source heat pumps, and air source heat pumps. House scale gas CHP is also available but is new technology and relatively untested for suitability. Hydroelectric power can be onsite or offsite but is highly constrained by the availability of suitable watercourses.

5.1.2 Cost Implications

There is a continuing reduction in the cost of various energy efficiency and renewable measures for homes. Particular reductions have been seen in costs for solar PV, air tightness, and thermal bridging components.

Thus the cost allowances to create Zero Carbon Standard homes are listed below in Table 14. These have been updated from the Zero Carbon Hub report[39] to allow for the change to Building Regulations Part L1A 2013 being the current baseline.

Table 14: Costs associated with Zero Carbon Homes

Element	Detached house (£)	Semi-detached house (£)	Mid-terraced house (£)	Low-rise Apartment (£)
Fabric Energy Efficiency Standards (FEES)	2,000-7,000	350-5,000	450-4,500	0-3,500
Heating and LZC technology	3,200-11,500	2,800-10,500	2,400-10,500	950-8,500
Allowable Solutions	1,800-2,200	1,000-1,550	1,400-1,550	1,000-1,500
Total	8,500-21,800	4,500-17,100	4,100-15,200	2,300-13,500

The solutions included in the costs above include:

- Meeting the FEES insulation, thermal bridging and air tightness levels
- Meeting an advanced fabric standard which is similar to the Passivhaus standard and includes mechanical ventilation with heat recovery.
- Gas boilers or air-source heat pumps
- Photovoltaic panels and/or solar hot water panels

There is a range of costs for each element in each house type because there is a range of fabric and renewable and low carbon technology options which will meet these standards and the actual cost will depend on design.

[39] Zero Carbon Hub, *Cost Analysis: Meeting the Zero Carbon Standard*, February 2014.

In all of the cases above, it was found that paying into an Allowable Solutions fund was more cost effective than reducing the regulated carbon emissions of the building to zero by on-site means. It is also likely that the relative costs of these elements will reduce further between 2012 and 2016 and continue to reduce to 2020.

5.1.3 Deliverability

Deliverability of renewable and energy efficiency measures is largely driven by the market appetite for investing in renewables and how this affects the saleability and tenant demand for housing. These drivers are likely to be different depending if the dwellings will be private sector or social housing. Deliverability will also change over time, as the market changes. For this study we have considered a number of case studies (see appendix D for full details) to assess deliverability of different solutions at different scales.

The private sector is largely market lead, and there are few other drivers; little risk will be taken unless there is a likely reward. Since there is little proof currently that home owners will pay more for housing which is low carbon, incentives for developers to create such housing are low. The Cranbrook development, (more details in Appendix D) is an open market development powered by a gas and biomass CHP plant. Although this suggests that there is some market demand for renewable energy in new developments it should be taken into account that this CHP plant was only made viable by the Skypark business development, which will also use it.

Deliverability of renewable energy and energy efficiency solutions in social housing developments will encompass other considerations. Social landlords can reduce the risk of unpaid rent by reducing the risk of fuel poverty. Fuel poverty is when a household has fuel cost that are above average and were they spend so much that their residual income drops below the official poverty line[40]. Thus, there are many examples of social housing is being retrofitted with energy efficiency measures like insulation and mechanical ventilation with heat recovery. For new homes, the HCA currently requires developments to meet Code for Sustainable Homes Level 3. However, this may change following the housing standards review.

Regulation and policy would be required from central government in order to encourage delivery of low carbon solutions. There has been a changeable approach to this in recent years, and often a loosening of standards. The reduction in the low carbon homes definition (now excluding non-regulated energy) is an example of this.

This means that, particularly in the private sector, delivery of low carbon solutions is low.

Although the housing market in larger urban areas (particularly London) has become more buoyant in the last few years, the housing market in Mid Devon has remained relatively stable[41]. This housing market position could be beneficial in

[40] Fuel Poverty: a framework for future action, 2013 (https://www.gov.uk/government/publications/fuel-poverty-a-framework-for-future-action)
[41] For example, average house price in EX17 in Feb 2014 was approx. £209,000 compared to £208,000 in Feb 2011 (rightmove.com data)

terms of stability, but may also represent lower profit for developers (and thus less scope for investment in renewables).

Whether the development is private sector or social housing, the deliverability of projects will vary over time as markets fluctuate and policies change. Thus, the deliverability renewable and energy efficiency measures detailed only relate to the current time and the likelihood of future change should be considered. This is an important factor in considering the lessons that can be taken from the case studies.

5.1.4 Conclusions

Table 16, below, demonstrates the results from the analysis above; setting out the potential technology mix that, based on current technologies, costs and markets, are likely to be feasible, cost effective and deliverable.

It is important to note that technologies, costs and subsidies are changing fast and therefore this is a snapshot of the most applicable technologies in May 2014.

Table 16: Potential energy mix suitable for different sizes of development

LDP Option	Area	Scale	Potential Technology Mix	Relevant case studies
Option 1: Town Focus	Tiverton (dispersed)	3,600 dwellings 49,000m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; Gas district heating /CHP may be viable for larger sites and could link to existing buildings	Bath Western House Hanham Hall Houndwood Housing Mid Street
	Cullompton (dispersed)	2,400 dwellings 46,700m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; Gas district heating/ CHP may be viable depending on non-domestic use or link to existing buildings	
	Crediton (dispersed)	800 dwellings 5,300m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps	
	Rural (dispersed)	1,600 dwellings 53,000m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps	Rocks Green Mid Street Houndwood
Option 2a: New community at Willand	Tiverton (dispersed)	2,340 dwellings 31,800m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; Gas district heating/ CHP may be viable depending on non-domestic use or link to existing buildings	Bath Western House Rocks Green Mid Street
	Cullompton (dispersed)	1,560 dwellings 30,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; Gas district heating/ CHP may be viable depending on non-domestic use or link to	

			existing buildings	
	Crediton (dispersed)	520 dwellings 3,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps	
	Willand	2,940 dwellings 54,000m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; gas district heating /CHP Willand does not appear to have an existing gas supply. This may also mean that biomass could be considered.	Cranbrook and Skypark
	Rural (dispersed)	1,040 dwellings 34,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps;	Rocks Green Mid Street Houndwood
Option 2b: New community at Cullompton)	Tiverton (dispersed)	2,340 dwellings 31,800m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; Gas district heating/ CHP may be viable depending on non-domestic use or link to existing buildings	Bath Western House Hanham Hall Rocks Green Mid Street
	Cullompton	4,500 dwellings 84,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps; gas district heating /CHP	Cranbrook and Skypark
	Crediton (dispersed)	520 dwellings 3,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps	Hanham Hall Rocks Green Mid Street
	Rural (dispersed)	1,040 dwellings 34,400m^2 commercial	Solar PV; solar thermal; ground source heat pumps; air source heat pumps	Rocks Green Mid Street Houndwood

A list of the potential development sites and the planned number of dwellings non-domestic floor space can be found in Appendix A.

Much of the suitable renewable energy for areas in each option is relatively similar, refer to Table 16. This is because many of these options, such as roof mounted PV and air source heat pumps are suitable for individual dwellings and so will be a viable option for a development of any size. This is also because many of the development sites for all options is dispersed, thus the actual development size for most sites anything from a few houses to hundreds. This means that for most of these development sites individual dwelling size renewable energy is most suitable unless gas district heating/ CHP can be used in conjunction with existing dwellings.

The exceptions are in Option 2; the large single developments at either Cullompton or Willand. At this scale, renewable technology at an individual dwelling scale will still be suitable. However, gas or biomass powered district heating or CHP could be suitable as the development size could be large enough

to make these options viable. This will particularly be the case with mixed-use development, where there is greater variation in heat demand.

6 Options for Minimising Air Quality Impacts from New Development

As discussed, by its very nature, development to satisfy the need for residential housing and commercial and employment development will lead to increase in traffic across the local road network and the need for combustion plant to provide energy for development. As such, pollutant concentrations will increase in the vicinity of a development, however measures can be included to minimise the impact on local air quality. These relate primarily to transport and reducing emissions from buildings as part of a development. These measures are discussed in section 7.

It should be noted that pollutant concentrations across the UK are predicted to decrease in future years due to the introduction of cleaner vehicle technologies to the fleet. The latest Euro 6/VI emission controls are expected to result in substantial reductions in nitrogen oxide (NOx) emission rates. It is anticipated that these will emission controls will have an effect of local pollutant concentrations from 2017. For instance, the Euro VI emission controls should reduce NOx emission rates from HGVs by more than 90% compared with the current average HGV in the UK vehicle fleet. This alone has the potential to reduce the sensitivity of areas such as Cullompton and Crediton to changes in local air quality.

7 Low Emission Strategies

7.1 Overview

Following the 2009 Study[42] and the Air Quality and Development SPD, a Sustainable Development study[43] for air quality was produced by MDDC in 2012. This study contains updated guidance from the Low Emissions Strategies Partnership (LESP) with regard to when Low Emissions Strategies (LES) should be put in place, and the type of measures that can be included. This should be applied to preferred options which are taken forward to ensure that for those developments which require one, an LES is developed. This suggests that an LES should be required for larger developments, or those which are situated within an AQMA.

The 2009 study included measures to minimise the impact of development on air quality relate to emissions from transport and buildings as part of the development. These still remain pertinent today and should continue to be considered in the revised LDP, along with the methodology to determine if an

[42] Mid Devon District Council, *Local Development Framework Housing Preferred Options. Renewable energy capacity, carbon impacts, and low emission strategies*, 2009
[43] Mid Devon District Council, *Sustainable Development Study: Air Quality*, September 2012

LES is required for any of the potential allocation options set out in the Local Plan Review. Other councils have also created Low Emissions Strategies. York City Council, Leeds City Council, Oxford City Council, and Bradford MDC are each working to roll out LES across their regions. These strategies have all been reviewed and incorporated into this LES where appropriate. However, given that MDDC's current LES appears comprehensive, and this study has found few significant differences with other council's LESs. The updated review of LES from the 2009 study is detailed in Table 17.

Table 17: Low Emission Strategy Measures

Measures		Benefits		Cost***	Comment
		Air Quality*	Climate Change**		
General	Require a LES to be submitted with a planning application	0	0	£	No direct air quality/ climate change gains
	Building regulations ensuring low carbon, energy efficient developments	0	+	£	Set zero carbon targets for new development
	Encourage inter-authority partnerships	0	0	£	No direct air quality/ climate change gains
Transport	Encourage behavioural change through targeted information packs or community websites	+	+	££	Have a marketing campaign, use to local media
	Development Wide Sustainable travel plan	+	+	£	
	Encourage walking and cycling	+	+	£	Promote and develop cycling infrastructure
	Enhance local bus service	+	+	£-££	
	Free bus use for new residents	+	+	£	
	Enhancements to train service	+	+	?	More details needed to estimate cost
	Low Emissions Zones	+	+	££-£££	Assumed to be a package of measures
	Car Club	=	+	£-££	
	Liftsharing	+	+	0	Assuming use of existing resource
	Low emission vehicles	+	+	££-£££	
	Electric Cars	+	+	££	
	Dial-and-Ride	+	+	£-££	
Housing	Renewable energy	+	++	£££	Provide support for community energy projects
	Smoke Free Zones	+	0	£££	
	Retrofitting existing properties	0	+	££-£££	

	Central Parcel drop off point	0	0	££	Assumes a staffed facility
Construction	Considerate constructor scheme	0	0	£	Temporary impact over small area, assumed no measurable impact.
	Encourage best practice	0	0	££	
	Encourage use of low emission vehicles and plant	0	0	££	

*** Air Quality:**

0 negligible change in air quality anticipated (<1%)

+ Small improvement in air quality anticipated. Moving in the right direction but not likely to make a measurable improvement

++Larger, possibly measurable improvement in air quality anticipated (>2%)

**** Climate Change:**

0 Negligible change in carbon emissions anticipated (<1%)

+ Small reduction in carbon emissions anticipated (1-2%)

++ Larger reduction in carbon emissions anticipated (2-5%)

***** Cost (per development):**

0 zero of negligible cost

£ small cost (£100s-£1,000s)

££ Medium Cost (£10,000s)

£££ Large Cost (>£100,000s)

Those measures which will have the greatest impact on air quality are those which reduce private car use and the number and length of vehicle journeys made by each future resident of any development. These include promotion of sustainable modes of transport and encouragement of a behavioural change towards low emission vehicles. This should not be limited to residential properties and the council should work with businesses to ensure commercial fleets are low emission where possible through the Eco Stars scheme already adopted by MDDC since the 2009 study.

In addition, larger development where significant amount of new infrastructure is required should provide charging points for electric cars to encourage their use throughout the district.

Although measures related to construction in the 2009 study indicate a neutral impact on air quality, best practice measures should be implemented at any construction site to reduce dust nuisance and potential exposure to elevated levels of particulate matter. Earlier in 2014 the Institute of Air Quality Management has published guidance[44] which outlines appropriate mitigation measures to be implemented depending on the risk of the construction site giving rise to dust. Reference should be made to this when considering measures to be included in a low emissions strategy.

[44] Institute of Air Quality Management Guidance, *Assessment of dust from demolition and construction*, January 2014

7.2 Links to Planning Policy

It is clear that many of the low emissions strategy measures outlined in Table 17 above do not have to be implemented through planning policy, and indeed might be more effective if delivered outside the planning system.

There are a number of ways in which LES could be linked to the planning process. These include;

- Setting a requirement in policy for developments over a certain size to produce an LES (in line with the requirement for an Air Quality Assessment, for example);
- Ensuring the delivery of LES measures through planning conditions; and
- Ensuring the delivery of LES measures through CIL or S106 agreements (as explored in more detail in the 2012 *Sustainable Development: Air Quality Study*[45]).

8 Conclusions

This report provides an update to the 2009 'Local Development Framework Housing Preferred Options: Renewable Energy Capacity, Carbon Impacts and Low Emission Strategies', hereinafter called 'the 2009 Study', with the additional consideration of air quality impacts.

The overarching objectives of the study were:

- To provide information on opportunities and capacity for renewable and low carbon energy development in Mid Devon.
- To assess the carbon impacts, mitigation and renewable energy potential of the potential site allocations in the Local Plan Review options document.
- Advice on low emission strategies and their application in planning policy.
- Assessment of the air quality impacts of the potential site allocations on existing Air Quality Management Areas (AQMAs) at Crediton and Cullompton, and impacts that could lead to the designation of an AQMA at Tiverton.

The outcomes from each of these are dealt with in turn below.

Opportunities and capacity for renewable and low carbon energy development in Mid Devon

Through literature review, this study has identified only modest potential opportunities for "stand alone" i.e. grid connected renewable heat and electricity generation. Mid Devon is relatively constrained with respect to resource availability and it has a number of technical and environmental constraints and some of the resources are already being harnessed.

[45] Mid Devon District Council, *Sustainable Development Study: Air Quality*, September 2012

To assess the carbon impacts, mitigation and renewable energy potential of the potential site allocations in the Local Plan Review options document

As noted previously, the Mid Devon Local Plan Review[46] is a consultation document, with draft planning policies and options for how these may be revised through the Local Plan Review.

The Council has identified two strategic policy options for how development could be distributed around the Mid Devon district, only one of which will be in the final draft of the Local Plan. Both options will provide 8,400 new dwellings and 154,000m^2 of commercial floor space between April 2013 and March 2033. Option 1 has a town focus, with the development being focused around Tiverton, Cullompton and Crediton, on a scale which suits the local area. Option 2 is focuses on creating a new community with approximately 2,840 dwellings with connections to the M5 motorway. There are two alternatives depending on where the new community is situated. These are explained further again in table 18 below.

Table 18 potential site allocation options in the Local Plan Review options

Option 1 (town focus)	Option 2a (Willand)	Option 2b (Cullompton)
Option 1 has a town focus, with the development being focused around Tiverton, Cullompton and Crediton, on a scale which suits the local area. Other rural settlements will have limited development.	Option 2a is focuses on creating a new community with approximately 2,840 dwellings with connections to the M5 motorway. Option 2a refers to a new community connecting Junction 27 on the M5 to Willand	Option 2b is focuses on creating a new community with approximately 2,840 dwellings with connections to the M5 motorway. Option 2b refers to a large expansion of Cullompton to the east of Junction 28 on the M5.

Table 19: Conclusions on the carbon impacts, mitigation and renewable energy potential for the draft policy options

Element	Conclusions
Carbon Impacts - Overview	Reviewing existing data on carbon emissions in Mid Devon, this study has identified that transport makes up 40% of emissions in the district, compared to domestic emissions, which make up 26%. Transport constitutes a higher proportion than the national average.
Carbon Impacts - Fabric Energy Efficiency	Via building regulations, seeking improved fabric energy efficiency is considered a minimum requirement for all new development in the draft Mid Devon plan.
Carbon Impacts - Transport	Carbon emissions from transport suggest that as would expected that the two new community development options perform more poorly than the town focus option (1). However the difference between option 1 and option 2b is modest and option 2a has the greater carbon emissions.
On site renewable energy potential	This study has identified a limited range of onsite renewable energy solutions that will be applicable at the larger scales of development as proposed in the draft Mid Devon local plan. Consideration has been given to technical feasibility, cost and deliverability. Appropriate technologies include roof mounted PV, solar thermal, ground source and air source heat pumps. District heating/Gas CHP might well be

[46] Local Plan Review, Options Consultation, 2014, Mid Devon District Council

	possible – but only on the largest proposed housing allocations and when combined with other commercial development. Thus strategic policy Option 2b with the slightly higher concentration of commercial development (and the housing in closer proximity to the town) might well favour delivery of more integrated solutions.

There is a continuing reduction in the cost of various energy efficiency and renewable measures for homes. Particular reductions have been seen in costs for solar PV, air tightness, and thermal bridging components. Paying into an Allowable Solutions fund is likely to be more cost effective than reducing the regulated carbon emissions of the building to zero by on-site means.

Advice on low emission strategies and their application in planning policy

This study has presented a range of potential low emission strategies which have the potential to assist in reducing the carbon and air quality effects of the proposed allocations. However these are largely independent of the draft policy options under consideration. It is clear that many of the low emissions strategy measures outlined in Section 7 do not have to be implemented through planning policy, and indeed might be more effective if delivered outside the planning system.

Assessment of the air quality impacts of the potential site allocations on existing Air Quality Management Areas (AQMAs) at Crediton and Cullompton, and impacts that could lead to the designation of an AQMA at Tiverton

Generally speaking the air quality in Mid Devon is good and additional effects resulting from new development will not add significantly to existing pollutant levels. Air quality is unlikely to be a factor that discriminates between the policy options. However, due to minor exceedances of current air quality in Crediton and Collumpton, there is likely to be a minor preference for encouraging new development towards options 2a/2b.

The Eastern Urban Extension and Hartnoll Farm allocations at Tiverton are likely to result in the largest change in local air quality as both developments are large in size. However, the air quality assessment indicates that this will not result in an exceedence of the relevant air quality objectives and thus would not necessarily lead to the designation of an AQMA at Tiverton.

8.1 Overall conclusions

In conclusion, by reference to the sections above, it can be seen that whilst there are important considerations in respect of energy efficiency, renewable energy, air quality and low emission strategies, these do not generally differentiate between the draft policy options on potential site allocations. Policies associated with the concentration of development around existing built development are likely to favour improved integration of renewable energy and also assist in the most optimum public transport options, which will help with the development of low emission strategies. Air quality factors are likely to count against this – as air quality considerations would naturally lead towards a “dispersal” rather than a “concentration” approach to site allocations.

9 Recommendations

This study has presented a range of information on renewable, low carbon, air quality and low emission strategies for new development. It has also considered the more modest potential for 'stand-alone' grid connected renewable development – and concluded the potential for the latter is more limited. In light of this a review has been undertaken of the current policies contained within the Local Plan Review Options Consultation.

9.1 Current Proposed Policies

Mid Devon's Development Plan includes the local policies that determine how much development should take place, what type and in which locations. The Council is therefore reviewing the targets, allocations and policies contained in the current plan to reflect the latest evidence and guidance including the National Planning Policy Framework (2012) and the current needs and aspirations of Mid Devon and its residents. In Table 20 below, advice is offered in respect of potential modifications to the current proposed draft policies

Table 20: Review and commentary on the Local Plan Review Options Consultation January 2014

Draft Policy	Commentary/Recommendation
S3 Amount and distribution of development *The diverse development needs of the community will be met through the provision of approximately 8,400 dwellings and 154,000 square metres of commercial floor space between 1st April 2013 and 31st March 2033.* *Development will be concentrated at Tiverton, Cullompton and Crediton, to a scale and mix appropriate to their individual infrastructures, economies, characters and constraints.* *Other settlements will have more limited development which meets local needs and promotes vibrant rural communities.*	This study suggests that this proposed policy remains valid. Reference could be made to the benefits of a 'concentration' rather than a 'dispersal' approach in respect of effects upon overall transport emissions and thus carbon impacts.
DM3 Sustainable Design *Development proposals involving the construction of new buildings must demonstrate how sustainable design and construction methods will be incorporated to achieve energy and water efficiency and resilience to climate change. Designs must use landform, layout, building orientation, massing and landscaping to minimise energy consumption.* *Major housing developments will be required to meet Level 3 of the Code for Sustainable Homes from 2013, rising to Level 5 from 2016.* *Major commercial development will be required to achieve BREEAM 'Very Good' standard from 2013 and 'Excellent' from 2016.* *If evidence demonstrates that meeting the minimum standard under the Code for Sustainable Homes or BREEAM would render the development unachievable, the Council will balance the overall benefits of the development against the objectives of this policy.*	Given the changing nature of government policies in the area of energy efficiency and renewable energy in the built environment – this policy, particularly the section on Code for Sustainable Homes – should encourage flexibility. Reference in this policy should also be made to the focus on reducing energy demand through fabric energy efficiency, then on-site low and zero carbon heat and power, then allowable solutions (such as offsite carbon reduction projects).
Policy AL/IN/6 *Policy AL/IN/6 of the Allocations & Infrastructure Development Plan Document (Local Plan Part 2) states that:*	This study suggests that the reference to a specific 10% target (rising to 20% by 2020) may not be practicable/cost effective and

Carbon Footprint Reduction on Development of 10 or more dwellings or 1000 square metres or more of non-residential floorspace will make provision for at least 10% of the energy to be used in the development to come from decentralised on-site renewable or low-carbon sources rising incrementally to 20% by 2020. A Carbon Reduction Strategy outlining this and other methods to reduction development carbon footprint will need to accompany planning applications.	this policy should focus on the production of a carbon reduction and low emission strategy and potentially allowable solutions – so that a case by case approach to onsite renewable energy can be established. The detail required should be commensurate with the size and scale of the development.
DM5 - Renewable and low carbon energy *The benefits of renewable and low carbon energy development will be weighed against its impact. Proposals for renewable or low carbon energy will be permitted where they do not have significant adverse impacts on the character, amenity and visual quality of the area, including cumulative impacts of similar developments within the parish or adjoining parishes. Where significant impacts are identified through Environmental Impact Assessment, the Council will balance the impact against the wider benefits of delivering renewable and low carbon energy.* *Development must consider:* *a) Landscape character and heritage assets;* *b) Environmental amenity of nearby properties in accordance with Policy DM7;* *c) Quality and productivity of the best and most versatile agricultural land (grades 1, 2 and 3a);* *d) Biodiversity (avoiding habitat fragmentation).*	This policy remains robust and allows flexibility whilst safeguarding the local environment
DM6 Transport and air quality *Development proposals that would give rise to significant levels of vehicular movement must be accompanied by an integrated Transport Assessment, Travel Plan, traffic pollution on assessment and Low Emission Assessment. The traffic pollution on assessment must consider the impact of traffic-generated nitrogen oxides on environmental assets including protected sites listed in Policy DM30, and propose mitigation on measures where appropriate.*	This policy remains robust and contains a suitable linkage to the requirement to produce a low emission assessment

9.2 Future Considerations

9.2.1 Allowable Solutions

A UK government consultation on allowable solutions ran between August and October 2013[47]. Responses to this consultation are currently under review.

As part of this consultation, the government proposed that builders will have a choice of four routes to deliver the remaining carbon abatement above the onsite minimum likely to be required by the Building Regulations from 2016:

i. Undertaking the full 100% of carbon abatement on site.

ii. Meeting the remaining carbon abatement requirement themselves through off-site carbon abatement actions – the 'do-it-yourself' option. This could include improving other existing buildings (e.g. retrofit installations), renewable heat

[47] Department for Communities and Local Government, *Next steps to zero carbon homes – Allowable Solutions: Consultation*, 2013

or energy schemes, or to build to a higher standard than the current Part L Building Regulations' requirements on developments with extant planning permission before October 2016 and 'banking' the difference.

iii. Contracting with a third party Allowable Solutions private sector provider or work with the local authority for them to deliver carbon abatement measures sufficient to meet the house builders' obligations.

iv. Making a payment which is directed to a fund which then invests in projects which will deliver carbon abatement on their behalf.

It would be useful for Mid Devon District Council to engage in the possible options for facilitating the delivery of allowable solutions through options (iii) and (iv), exploring options to do this, either alone or through partnerships with others. This will become increasingly important, given the restrictions of onsite options.

9.2.2 Housing Standards Review and the Future of the Code for Sustainable Homes

In March 2014, the UK Government announced that "many of the requirements of the Code for Sustainable Homes will be consolidated into Building Regulations". As a result of this, the Government has proposed that the current Code will need to be wound down.

Further announcements have been promised on the transitional arrangements. In addition, consideration is being given to use of the Code for Sustainable Homes on a voluntary basis. Mid Devon District Council should continue to monitor developments in this area.

Appendix A

Local Development Plan
Development Areas

A1 Possible areas for development

Policy	Name	Residential (Dwellings)	Commercial (M2)
TIV1	Eastern Urban Extension	1000-1500	35,000-40,000
TIV2	Hartnoll Farm	1100	-
TIV3	Farleigh Meadows	300	-
TIV4	Blundells School	200	7000
TIV5	Howden Court	10	
TIV6	Town Hall/ St Andrews Street	55	
TIV7	Roundhill	13	
TIV8	Hay Park, Canal Hill	13	
TIV9	The Avenue	15	
TIV10	Tidcombe Hall	200	
TIV11	Wynnards Mead, Bakers Hill	100	
TIV12	Land at Moorhayes Park	12	
TIV13	Exeter Hill	55	
TIV14	Leat Street	8	
TIV15	Palmerston Park	15	
TIV16	Phoenix Lane	60	9300
TIV17	Land at Bampton Street / William Street car park	60	9300
CU1	North West Cullompton	1100	10,000
CU2	Growen Farm	400	
CU3	Knowle Lane	240	
CU4	Land south of Tiverton Road	45	
CU5	Ware Park and Footlands	38	
CU6	Court Farm	35	
CU7	Land at Exter Road	35	
CU8	Bradninch Road	25	
CU9	Land at Colebrook	300	
CU10	Land at East Culm Farm	120	
CU11	East Cullompton	3000	54000
CU12	Week Farm		15,000
CU13	Additional sites		51,310
CRE1	Wellparks	185	
CRE2	Red Hill Cross	135	
CRE3	Cromwells Meadow	50	
CRE4	George Hill	19	

CRE5	The Woods Group, Exeter Road	8	
CRE6	Pedlerspool	165	21000
CRE7	Sports field, Exhibition Road	50	
CRE8	Land at Barn Park	20	
CRE9	Stonewall Lane playing field	60	
CRE10	Land at Westwood Farm	50	
CRE11	Land at Chapel Down Farm	120	
CRE12	Barnfield	6	
CRE13	Land at Alexandra Close	15	
CRE14	Wellparks		4150
CRE15	Additional		22690
	Rural- Option 1	1,281	0
	Rural- option2- J27	3661	34,549
	Rural Option 2 –J28	721	0
J27	M5 J27	3000	96ha

Appendix B

Renewable Energy Subsidies

B1 Renewable Energy Subsidies

Renewable Obligation Certificates

Renewables Obligation Certificates (ROCs, 2009) aim to incentivise renewable energy deployment in the UK by requiring licensed electricity suppliers to source a specified and increasing proportion of their electricity from renewable sources. Licensed renewable electricity suppliers receive ROCs for each megawatt hour (MWh) of electricity generated. These certificates can then be sold to suppliers, in order to fulfil their obligation, thus they are tradable commodities with no fixed price. Suppliers can either present enough certificates to cover the required percentage of their output, or they can pay a 'buyout' price for any shortfall. All proceeds from buyout payments are recycled to suppliers in proportion to the number of ROCs they present. ROCs have increased the profitability of renewable energy generation as the certificates have an additional value over and above the price of electricity itself.

Feed-in-Tariffs

Feed-in-Tariff (FiTs) schemes were introduced in the UK on 1 April 2010, under the Energy Act 2008. FiTs encourage the deployment of small-scale (less than 5MW) low-carbon electricity generation, particularly by organisations, businesses, developers, communities and individuals that have not traditionally engaged in the electricity market. The financial benefits of FiTs are:

- Generation tariff – the electricity supplier will pay for each unit (kilowatt) of electricity generated;
- Export tariff – if electricity generated that is not used by the generator, it can be exported back to the grid. Payment will be made for exporting electricity as an additional payment (on top of the generation tariff); and
- Energy bill savings – less electricity is imported from suppliers because a proportion of energy used will have generated by on-site renewables.

Small-scale wind, solar photovoltaic panels (PV), hydro, anaerobic digestion, and domestic scale micro CHP are eligible for FiTs. FiTs work alongside ROCs which is the primary mechanism to support deployment of large-scale renewable electricity generation.

Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was introduced (for non-domestic properties) in 2011, under the Energy Act 2008. The RHI acts in a similar way to FiTs but for renewable heat rather than electricity generation. Types of heating covered by the scheme are biomass, ground source and water source heat pumps, geothermal, solar thermal collectors, commercial and industrial energy from waste, biomethane and biogas. The domestic RHI scheme was opened on 9 April 2014. This financial incentive aims to encourage the uptake of renewable heating among consumers. It will not be open to new build properties other than self-build.

Electricity Market Reform

The Electricity Market Reform (EMR) puts in place measures to attract the £110 billion investment required by 2020 which is needed to replace current generating capacity with greener and more reliable supplies at the lowest possible cost. The EMR Draft Delivery Plan[48], aims to give investors further certainty of how the Government is supporting private sector investment in new energy infrastructure. This includes a new-style FiT Contracts for Difference (CfD) renewables support contracts and details of the Capacity Market mechanism design.

CfD payments would provide a contractual form of guarantee to generators to protect their level of revenue by removing volatility in power prices. Generators will continue to sell their electricity into the market and then receive variable payments based on estimated market electricity prices to ensure that they obtain the agreed 'strike price'. As a result, a generator may receive payments to top-up its electricity sales to the strike price; on the other hand a generator will be obliged to pay back money where the electricity reference price exceeds the strike price. It will provide a predictable revenue stream to capacity providers in Britain, which are not supported by FiT or ROC. It will be regular retainer payment to reliable forms of capacity (both demand and supply side), in return for such capacity being available when electricity supply is squeezed.

Consultation is currently underway regarding financial support for large scale PV. The proposal is to close RO to new solar PV capacity above 5MW from 1st April 2015, so that only CfD can be applied for. Project under 5MW can still apply for RO. There are also proposal to provide a slower reduction in tariffs to building mounted PV compared to ground mounted panels. These are particularly focused on commercial and industrial building mounted PV.

The consultation closes 7th July 2014, and the decision will the implemented through legislation in late 2014[49].

Green Investment Bank

The Green Investment Bank aims to 'to accelerate the UK's transition to a green economy and to create an enduring Institution, operating independently of Government'[50]. It has a "double bottom line" which means that their Green Impact and financial returns are equally important.

Investments need to deliver a demonstrable green impact, financial return and leverage co-investment or demonstrate wider added value. Overall, the potential exists to invest up to £3 billion by 2015 when borrowing powers will be available subject to national debt falling as a proportion of GDP. The initial investment focus is within five technologies and sectors. These are waste processing and recycling, and energy from waste generation with up to £80 million of investment this year, alongside non-domestic energy efficiency, the Green Deal domestic energy efficiency scheme, and offshore wind projects.

Green Deal

[48] EMR Draft Delivery Plan was published for consultation in September 2013
[49] Consultation on changes to financial support for solar PV. 13th May 2014 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310524/Consultation_on_changes_to_financial_support_for_solar_PV_.pdf)
[50] http://www.greeninvestmentbank.com/who-we-are/default.html

The Green Deal, launched January 2013, is a government initiative that is designed to help business and home owners to employ more green technologies in their properties. It allows new green technology to be added to a property with no up-front costs, instead the cost will be paid back the costs through energy bills over a period of time. The Green Deal will allocated between £6,500- £10,000 per property, with the longest re-payment period being 25 years. The Green Deal will provide funding for loft insulation, solid wall insulation, cavity wall insulation, and microgeneration like solar panels, wind turbines and heat pumps.

Appendix C

Renewable Energy Technologies and Fabric Energy Efficiency

C1 Large-scale Stand Alone Renewable Technologies

C1.1 Solar Farms

Solar farms are large scale photovoltaic (PV) systems which provide large amounts of energy to the electricity grid, rather than local users. This power is produced by different types of solar arrays: fixed (which are on a fixed inclination), duel access trackers (which track the sun on its daily orbit and elevation changes throughout the year) and single axis trackers (which only track the suns daily orbit).

C1.2 Large Scale Wind Power

Wind turbines use the wind's lift forces to turn a rotor, which in turn generates electricity. Large scale wind stand-alone wind turbines and wind farms are often preferred to smaller scale wind turbines as, proportionally to their height, large turbines generate far greater energy and hence increased CO_2 savings. It is also usually considered preferable, on visual grounds, to have a small number of larger turbines than a large number of smaller turbines to meet the targets.

Possible locations for large wind turbines are limited by a number of factors including proximity to high buildings, available grid connection, shadow flicker and noise. The noise produced by large scale wind turbines requires them to be located as much as 500m from residential areas. In non-residential areas noise is not as critical, so the limiting factor influencing the turbines' location may be their proximity to buildings; they should not be so close as to affect the air stream.

C1.3 Biomass

Producing energy from biomass can be from a diverse range of available fuels, fuel conversion technology and type of energy output. Generally, biomass fuel can arise from plants (energy crops, wood chip), animals (manure, slurry) and human activity (commercial, industrial and municipal waste).

A biomass boiler can be one of the most cost effective forms of renewable energy technologies if the fuel source, is sourced from a sustainable supplier. Biomass fuel is considered low carbon rather than zero carbon, due to the carbon emissions involved with harvesting, processing and delivering the fuel source. Output can be heat or energy. A heat distribution network is required to supply the heat and energy generated to dwellings.

The optimum location for biomass schemes is close to areas of high demand for the heat and electricity which they generate and to transport the feedstock to site. The biomass fuel source must be stored onsite prior to being burnt; therefore there is a compromise to be made over the area allocated for storage space and the frequency of deliveries.

Although biomass offers a very effective solution to reducing carbon emissions, the operation of the plant is more complicated and labour-intensive than a conventional gas system. It should also be noted that biomass plant are more polluting than equivalent gas-fired plant, as such the location of the boiler should be taken into consideration with regard to local air quality. Regular deliveries of fuel are also required dependant on the size of the store accommodated onsite.

C1.4 Energy from Waste Plants

Energy from waste is the process of generating electricity and/or heat from waste material. These waste categories consist of household waste, commercial and industrial waste and include construction and demolition debris, sanitation residue and waste from streets.

The most common method is waste incineration, which is direct combustion of waste to energy. Waste incineration may not be counted as renewable energy, but if used with a district heating infrastructure, could reduce carbon emissions. Other methods include pyrolysis, which is the production of a fuel gas at high temperature in the absence of oxygen prior to combustion or gasification, and gasification, which is the partial combustion of a feedstock to produce a fuel gas. These would only reduce carbon emissions if they are in association with a district heating system.

C1.5 Landfill gas

Landfill gas produced from the microbes breaking down the biodegradable waste in landfill sites. It is a mix of mainly methane and carbon dioxide with small and varying amounts of nitrogen, oxygen, hydrogen sulphide and other contaminants. The quantity of gas that is generated depends of various factors including the types and age of waste buried in the landfill, quantity and types of organic compounds in the waste and moisture content and temperature of the waste.

This gas can then be collected and either electricity can be produced through the use of micro-turbines, steam turbines and fuel cells, or the gas can be processed and sold off and added to natural gas pipelines.

C1.6 Anaerobic digestion (AD)

Anaerobic digestion (AD) is the controlled breakdown of organic matter in the absence of oxygen, producing combustible biogas and nutrient rich organic by-product. AD systems can be located either on-site or at a larger Centralised Anaerobic Digestion management facility (CAD plant).

Feedstocks can include biodegradable waste materials, such as crop residues, leftover food, sewage, energy crops and animal waste. Biogas can be injected into the natural gas grid or used on site. The solid by-product and digester liquid can be used as a fertiliser.

C1.7 Hydro-electric power

Hydroelectric systems use the flow of water to turn a turbine to generate electricity. They can either be installed on an existing flowing river or on a man-made reservoir. The feasibility of micro-hydro-plant is therefore heavily site dependant.

C2 Development-scale Renewable Technologies

C2.1 Roof-mounted PV

Photovoltaic (PV) panels convert sunlight into electricity and therefore are most effectively mounted on an unobstructed south facing roof area, angled at an elevation of around 30 degrees. PV panels can easily be integrated into south facing roofs with the electricity generated used preferentially by the dwelling before any excess is sold into the national grid. Systems which include battery storage are also becoming more widely available.

C2.2 Solar thermal

Solar thermal panels absorb sunlight to heat hot water that can then be used within the development. The maximum potential CO_2 savings of solar hot water panels is therefore limited by both the hot water consumption of the development and the space available for the location of the panels.

As the heat generated from solar thermal panels is low grade it is important the heat is used close to where it is generated. For this reason solar thermal panels do not lend themselves to a centralised installation with a distribution main. They are however well suited to integration into south facing roofs.

C2.3 District Heating

District heating is a means of distributing heat and hot water generated in a centralized location for residential and commercial heating requirements through a network of underground pipes. This is often fuelled by gas but could also be fuelled by renewable fuel sources like biomass and waste to energy.

District heating networks are especially suitable for mixed-use development, which ensure there is a constant demand for heating and hot water.

C2.4 Ground Source Heat Pumps (GSHP)

Ground source heat pumps (GSHP) are a central heating and/or cooling systems that transfer heat to or from the ground. GSHP come in two forms; open loop and closed loop.

Closed loop GSHP work by pumping a refrigerant around a network of pipes in contact with the earth. The system adds heat to or removes heat from the water circuit before passing it back through the ground once again. Closed loop heat pumps work most effectively when the approximate heating and cooling loads are matched over the year as this ensures that the overall yearly average ground

temperature is maintained. Open loop ground source heat pumps extract water from below-ground water sources and pass this directly through the heat pump equipment as the energy source to either chill or warm a building.

A heat pump requires a fuel input in the form of electricity. If the electricity is not generated from a renewable source, the technology is only considered a low-carbon technology. The net overall carbon emissions for a ground source heat pump are relatively high because of the carbon intensive electricity required to run the heat pump.

The potential for the use of ground source heat pumps (GSHP) and thus their CO_2 reduction potential is dependent on: the heat to electricity demand, the area of ground available to locate them in, and their efficiency.

GSHP are most effective when they provide energy for both domestic and non-domestic buildings. This is because domestic houses have a very limited cooling load; a GSHP will lead to an un-balanced annual heat transfer to the ground. Over time this will act to freeze the ground reducing the efficiency of the system.

C2.5 Air Source Heat Pumps (ASHP)

Air source heat pumps are fitted to individual buildings. They work in a similar manner to a ground source heat pump but ambient air is used as a heat source/sink as opposed to the ground. The net overall carbon emissions for an air source heat pump are relatively high because of the carbon intensive electricity required to run the heat pump. There can also be concerns over about noise and appearance which need to be taken into account.

As the ambient air temperature varies far more than the ground temperature the efficiencies are generally lower than for a GSHP system. ASHPs are more suited to building specific installation as the heat losses from a district heat distribution main are likely to make the system un-workable. A domestic installation will require a hot water storage tank.

C2.6 Micro-wind

There are two types small-scale wind turbines: roof-mounted and free-standing mast-mounted. Home wind turbines can either be connected to the national grid or stand alone, storing the energy they produce in a battery.

Domestic scale wind turbines have been proven ineffective in generating reasonable amounts of electricity due to the general low build quality and the lack of consistent strong wind due to the turbulence caused by surrounding houses.

C2.7 Combined Heat and Power (CHP)

Combined Heat and Power (CHP) plants generate electricity with waste heat used for space heating, cooling, humidification and dehumidification. CHP systems can be powered by many fuels including biomass, waste materials or gas. However gas powered CHP is only treated as an energy efficiency measure not as a renewable fuel source. Compared to grid electricity and separate gas boilers carbon savings are made by using the heat from electricity generation.

Heat is distributed from CHP plants to consumers using piped hot water or steam. The heat is usually transmitted from the district heating circuit to the heating circuits of each individual building using heat exchangers. The cost of the district heating network is often the largest cost in a CHP scheme and its economic value is dependent on the density of the buildings served. For CHP systems to be the most effective a steady base heat load must be present thus are most suitable for a development with some non-domestic heat load.

C3 Fabric Energy Efficiency Measures

Fabric energy efficiency should be the foundation of all highly energy efficient homes. Fabric Energy Efficiency (FEE) methodology considers: the building fabric U-Values, thermal bridging, air permeability, thermal mass and features which affect lighting and solar gains[51].

U-values are a measure of the heat lost from a building element like a wall, floor or roof. This means that the higher the U-value the worse the thermal performance of a building. Thus effective building insulation, reducing air permeability by a rigorous attention to airtightness and ventilation are essential.

As well as good U-values and airtightness, the contribution to heat less from other mechanisms should be considered, such as thermal bridging and thermal bypass, as well as the effect of thermal mass[52].

Thermal bridges occur where the continuity of the insulation is broken and pathways are created for higher heat loss than through the adjoining elements. These can be ‘repeating’ which are due to thermal bridges, due to fixings, frames and joists, are accounted for in the U-value calculations for the particular elements. These can also be ‘Non-repeating’ which occur around windows and doors or at eaves and corners.

The impact of thermal bridges can be minimised by good design which reduces complex forms, and using thermal breaks at weak points such as balconies and lintels.

[51] Fabric Energy Efficiency for Part L 2013, Zero Carbon Hib, Febuary 2012. (http://www.zerocarbonhub.org/sites/default/files/resources/reports/Fabric_Energy_Efficiency_for_Part_L_2013-Classification_Methodology_for_Different_Dwelling_Types.pdf)
[52] Designing Homes for the 21st Century for Low Energy Design, Zero Carbon Hub. May 2013 (http://www.zerocarbonhub.org/sites/default/files/resources/reports/Designing_Homes_for_the_21st_Century-Lessons_for_Low_Energy_Design%28NF50%29.pdf)

‘Thermal bypass’ should also be avoided which is where the insulation layer must prevent any cold air circulating within cavities or voids within the heated envelope of the home.

The ‘thermal mass’ of a material refers to its ability to absorb and retain (and eventually re-emit) heat. Dense materials, such as concrete, often have a high thermal mass. This can be an effective method of capturing heat from the sun through south and west facing windows in the winter, reducing demand for heating. In summer, however, unless heat gains are controlled by shading and ventilation, high thermal mass can increase the risk of uncomfortably high temperatures in dwellings.

Other energy efficient measures which should be considered are: mechanical ventilation with heat recovery, on-demand ventilation, advanced controls, low-energy lights, and low-power fans and pumps[53].

[53]http://www.zerocarbonhub.org/sites/default/files/resources/reports/Zero_Carbon_Strategies_for_Tomorrows_New_Homes.pdf

Appendix D

Case Studies

D1 Rocks Green[54]

EcoHomes 'excellent' standard

Competed: **2008**

Location: **Ludlow**

Developer: **South Shropshire Housing Association (SSHA)**

Type of development: **Open Market and Social Housing**

Number of Houses in development: **91**

Building Cost per m^2: **£1378/m^2**

Fabric

- **Roof:** 0.13 W/m2K - 200mm mineral quilt; 200mm ridged urethane insulation.
- **Wall:** 0.20 W/m2K - 140mm mineral wool batts; 35mm rigid urethane
- **Floor:** 0.2 W/m2K
- **Glazing:** 1.7 W/m2K
- **Airtightness:** 5 m^3 /m2hr at 50 Pa
- **Ventilation:** Natural Ventilation
- Energy Performance Certificate (EPC) **B**

Heat and Power Generation

District Biomass provides water and space heating. Two 150kW biomass boilers, two 100kW oil boilers, and two 10,000 litre buffer tanks. Biomass boiler had an additional cost of £73,000 compared to the cost of gas heating and solar hot water[55.] Total System Cost; £850,000

Local Policy

South Shropshire's Sustainable Development Policy stated that 'the Council seeks to ensure development will contribute to the principles of sustainable development', and included objectives in relation to:

- vibrant, safer and healthier communities;
- high quality environment by conservation and design;
- broadening the economic base of the District;
- increasing access to facilities, whilst reducing the need to travel;
- conserving energy and use of renewables;

[54] http://www.insidehousing.co.uk/ihstory.aspx?storyCode=6510055
[55] http://www.forestry.gov.uk/pdf/eng-cs-rocks-green-woodfuel.pdf/$FILE/eng-cs-rocks-green-woodfuel.pdfcode

D2 Mid Street[56]

Overview

Code for Sustainable Homes level 5

Competed: **April 2008**

Location: **Rural village, South Nutfield**

Type of development: **Social Housing**

Developer: **Osborne and Raven Housing Trust**

Number of Houses in development: **2**

CO2 emissions: **100% reduction over Part L1A 2006.**

Fabric

- **Walls:** 0.14 W/m2K. Innovare SIPS system + additional 50mm external insulation.
- **Roof:** 0.11 W/m2K. 400mm of mineral wool insulation.
- **Ground Floor:** 0.13 W/m2K. Tetris beam and block floor + 75mm of additional insulation.
- **Windows:** 0.8 W/m2K. Reversible UPVC triple glazed windows.
- **Airtightness**: permeability target of no more than 3.0 m3/m2/hr at 50Pa.
- **Ventilation:** Whole House Mechanical Ventilation with Heat Recovery (MVHR).

Heat and Power Generation

- Independent Auto-feed Wood Pellet Boiler, 14-28kW shared between 2 units, with a high performance thermal store (210 liters) providing hot water and underfloor and radiator heating.
- PV Roof Tiles: 1.59kWp per unit.

Local Policy

Policy CSP 14'The Council will encourage all residential development (either new build or conversion) to meet Code level 3 as set out in the published Code for Sustainable Homes. Commercial* development with a floor area of 500m2 or greater will be encouraged to meet the BREEAM "Very Good" standard.'[57]

[56] Building the first Code level 5 homes: a case study of Mid Street, South Nutfield CE300, Energy Saving Trust, 2009
[57] Tandridge District Local Plan 2001, Sustainable Construction.

D3 Hanham Hall[58]

Overview

Code for sustainable homes level 6

Competed: **due June 2015**

Location: **Bristol**

Developer: **Barratt Homes**

Type of development: **HCA Carbon Challenge**

Number of Houses in development: **220**

CO2 emissions: **Zero Carbon Homes**

Fabric

New homes will be constructed using energy efficient materials, with very high insulation standards to conserve energy and water use in a design integrating buildings in a landscaped setting that benefits residents and local wildlife.

Façade design was based upon minimising heat loss, maximising natural daylight and balancing use of passive heating and natural ventilation during winter and summer.

Heat and Power Generation

The use of a biomass (woodchip) fuelled CHP unit achieved the zero carbon (regulated + unregulated energy) target. Excess zero carbon heat could be exported to the local doctor surgery, health facility and local school, further enhancing local (off-site) carbon reduction strategies.

Local Policy

South Gloucestershire's Local Plan (2006) was in place at the time of application and included some detail on achieving energy efficiency through site layout and building design, but this is unlikely to have been instrumental in achieving a zero carbon development, given the drivers for the development through the Homes & Communities Agency's Carbon Challenge[59].

[58] http://www.building4change.com/page.jsp?id=162
[59] http://www.homesandcommunities.co.uk/ourwork/carbon-challenge

D4 Houndwood Housing

Overview

Code for Sustainable Homes Level 3

Competed: **January 2014**

Location: **Street, Somerset**

Developer: **CJ Clarks Properties, Crest Nicholson**

Type of development: **Mix of Open Market and Social Housing.**

Number of Houses in development: **260**

CO2 emissions: **25% reduction over Part L1A 2006**

Fabric

- **Walls:** 0.15 W/m2K.
- **Roof:** 0.1 W/m2K.
- **Ground Floor:** 0.1 W/m2K.
- **Windows:** 1.4 W/m2K.
- **Airtightness:** permeability target of no more than 4.0 m3/m2/hr at 50Pa.

Heat and Power Generation

A **shared biomass boiler** was considered but found to be economically unfeasible at that time. PV panels were installed on suitable roofs instead. For a typical household the required area of roof panel was approximately 4m^2

Local Policy

Mendip District Local Plan 2006-2028 Policy DP7 Design and Amenity of New Development 'incorporate all practical measures to achieve energy efficiency through siting, layout and design and promote increased energy production from renewable sources'.

D5 Cranbrook and Skypark

Code for sustainable homes level 3 leading to zero carbon onsite compliance

Completion: Cranbrook- Phase 1: some homes occupied from March 2014 and phase 2 will be from September 2015[60], Skypark due 2027.

Location: **Exeter, Devon**

Developer: **New Community Partners**

Type of development: **Open Market**

Number of Houses in development: **2,900 homes** (will eventually be a new community of 7,000 homes) and 1.4m sq. ft business park

Heat and Power Generation

District Heating and Biomass Combined Heat and Power (CHP) (5.5 MWe electricity and 17 MWth heat) serves both Cranbrook and Skypark business park.

The heat is distributed to homes and businesses through a network of highly-insulated underground district heating pipes to metered heat exchangers in each building. It will be fuel at first by natural gas but will develop over time to run on waste wood biomass.

Total capital costs of the energy centre was £3m[61]

Local Policy

Policy RE6[62]

- a 12.5% reduction in greenhouse gas emissions below 1990 levels by 2008 - 2012 and a 20% reduction (from 1990 levels) in carbon dioxide emissions by 2010.
- a minimum of 11 - 15% of electricity production to be from renewable energy sources by 2010."

[60] http://www.exeterandeastdevon.gov.uk/cranbrook-new-community/
[61] http://www.ukgbc.org/content/eon-sustainable-energy-case-study
[62] Regional planning Guidance for the South West, Adopted East Devon Local Plan 2006 Chapter 3 http://www.eastdevon.gov.uk/forwardplan1995-2011#pdfs

D6 Bath Western Riverside[63]

Code for Sustainable Homes Level 4

Completed: **Phase 1 completed Spring 2012**

Location: **Bath**

Developer: **Crest Nicholson**

Type of development: **Mix of Open Market and Social Housing**

Number of houses: Phase 1: 59 houses. **Total development will be over 2000 houses.**

Phase 1 units costs: **£1,512.20 per m^2** (excluding land costs and professional fees).

Fabric

- Materials selected using the BRE green guide to specification and are A rated.
- External Walls: 0.25 W/m2K
- Roof: 0.11 W/m2K
- Windows: 1.2 W/m2K
- Airtightness: 4-6 m3/(h.m2) depending on dwelling type
- Mechanical ventilation with heat recovery (achieving 93% heat recovery)

Heat and Power Generation

Biomass combined heat and power centre, providing heat and power to 813 units. The other 1,200 units will receive power from a second energy centre.

Local Policy

Require 10% of the sites energy demand to be met from renewable energy[64]. 'Permission for new buildings will be granted only where the design, orientation, and layout of the buildings and outside areas have taken into account the need to minimise energy consumption over the lifetime of the development'[65].

[63] Code for Sustianable Homes Case Studies: Volume 4, Department for Communities and Local Government. August 2013. https://www.gov.uk/government/publications/code-for-sustainable-homes-case-studies-volume-4
[64] Policy ES.1 Bath & North East Somerset Local Plan, adopted October 2007 http://www.bathnes.gov.uk/services/planning-and-building-control/planning-policy/local-plan#jwcs ()
[65] Policy ES.2 Bath & North East Somerset Local Plan, adopted October

Appendix E

Transport Calculations

E1 Travel Emissions Calculation Methodology

The same methodology was used as detailed in the 2009 study for each kind of travel emission.

E1.1 Travel to Work

Equation 1: A / B x C = D

Equation 2: E x D x F = G

Equation 3 H x G = K

Equation 4 _K x L = M

Where:

A = Number of people of employment age
B = Number of dwellings in ward
C = Number of dwellings in proposed development
D = Number of likely people of employment age in the proposed development
E = distance that a % of the population travel to work (and back)
F = 220 working days in a year
G = distance that the proposed development population will travel to work (and back) in a year
H = % of people who travel by a specific mode of transport
ΣK = distance travelled by mode of transport by population of proposed development
K = sum of all the distance ranges travelled by mode of transport by population of proposed development
L = emission factor for mode of transport
M = carbon dioxide in kg/year for mode of transport used

E1.2 Travel to School

The following equations were then used to assess the likely weight of carbon dioxide emissions from
the proposed development:
Equation 5 N / O x C = P
Equation 6 P x Q x R = S

Where:

N = Number of eligible school children in Mid Devon (either primary or secondary)
O = Number of dwellings in Mid Devon
C = Number of proposed dwellings in development
P = Number of likely eligible school children from proposed development
Q = Emission factor for a full school bus

R = Distance travelled to and from school to development per annum (190 day school year)
S = Carbon dioxide emission kg/year for either primary or secondary.

E1.3 Travel to Retail.

The travel emissions are taken from the average emissions in each area from the 2009 report as the recent update in 2012 of the retail study did not detail quantifiable vales for distance travelled for each mode of transport in the region meaning these calculations could not be updated. The following equations were used in the 2009 report to assess the likely weight of carbon dioxide emissions from the proposed development:

Equation 7 T x U x V = W

Equation 8 W x X x L = Y

Equation 9 _Y = Z

Where:

T = Proposed Number of Dwellings in development taken as one shopping unit.
U = % of the population that travel to the retail store
V = Distance travelled to and from the retail store in a year (assuming a shopping trip once aweek) either as a main shopping trip or a top up trip.
W = Distance travelled by population to retail store in a year (either as a main shopping trip or top up)
X = % of people who use a mode of transport to go to shop
L = Emissions factor for the mode of transport
Y = carbon dioxide emissions from mode of transport
ΣY = Sum of the carbon dioxide emissions form all modes of transport
Z = carbon dioxide emissions

E2 Travel emissions for Mid Devon

The travel emissions calculations for each option aim to study the differences in emissions between housing allocation option. Thus a 'base' number of houses have been assumed to be built in each area for all options. Since these are all the same for each option these have been removed from the calculation. These are 2,340 houses in Tiverton, 500 houses in Crediton, 1,560 houses in Cullompton. Table E.1 details the number of houses uses for each option.

	Option 1: Town focus			**Option 2a**	**Option 2b**
Number of dwellings in each area	Tiverton	Crediton	Cullompton	Willand	Cullompton
	1,260	300	840	3000	2940

Table E.1: The difference in potential number of houses which may be developed in each area.

E2.1 Travel to work emissions for each option

	Option 1-Town Focus			Option 1: Total	Option 2a: Willand	Option 2b: Cullompton
	Cullompton	Crediton	Tiverton			
Number of people of employment age (16-74 years of age)	1,649	2,804	4423	8,876	2,403	1,649
Number of dwellings currently	1,629	1,678	4,956	8,263	2,115	1,629
Number of dwellings in proposed development	840	300	1,260	2,400	3,000	2,940
Likely number of residents in work in proposed development	850	501	1124	2,475	3,409	2,977
Distance that a % of the population travel to work and Back (km)	21	19	18	19	31	21
Number of working days per year	220	220	220	220	220	220
Distance that the proposed development population will travel to work and back per year (km)	4,004,203	2,149,800	4,574,393	10,728,396	23,580,264	13,751,635
Distance travelled by car by population of proposed development	1,934,030	898,617	1,934,968	4,767,615	11,412,848	6,642,040
Distance travelled as a passenger in a car by population of proposed development	204,214	85,992	201,273	491,479	589,507	701,333
Distance travelled by bus by population of proposed development	124,130	83,842	73,190	281,162	259,383	426,301
Distance travelled by train by population of proposed development	8,008	12,899	13,723	34,630	306,543	27,503
Distance travelled by taxi by population of proposed development	0	0	402,547	402,547	0	0
Distance travelled by motorbike by population of proposed development	32,034	10,749	27,446	70,229	70,741	110,013
Carbon equivalent emissions produced by car travel (CO_2e kg/year)	383,151	178,025	383,337	944,513	2,260,999	1,315,855
Carbon equivalent emissions produced by passengers in cars (CO_2e kg/year)	20,228	8,518	19,937	48,683	58,394	69,471
Carbon equivalent emissions produced by bus travel (CO_2e kg/year)	13,856	9,359	8,170	31,385	28,953	47,584
Carbon equivalent emissions produced by train travel (CO_2e kg/year)	393	633	673	1,699	15,033	1,349
Carbon equivalent emissions produced by Taxi Travel (CO_2e kg/year)	0	0	58,105	58,105	0	0
Carbon equivalent emissions produced by Motorbike travel (CO_2e kg/year)	3,809	1,278	3,264	8,351	8,412	13,082
Total travel to work carbon equivalent emissions (CO_2e kg/year)	**421,437**	**197,812**	**473485**	**1,092,734**	**2,371,790**	**1,447,340**
Total CO_2/ dwelling (CO_2e kg/year)	**502**	**659**	**376**	**455**	**791**	**492**

Table E.2: The transport emissions produced by travel to work emissions for each potential development option. These are based on distances and ratios of transport from the Office of National Statistics[66] and the latest 2013 carbon emission factors from DECC.

[66] Neighbourhood Statistics, Office for National Statistics, (http://www.neighbourhood.statistics.gov.uk/dissemination/LeadHome.do?m=0&s=1401439472096&enc=1&nsjs=true&nsck=false&nssvg=false&nswid=1366)

E2.2 Travel to school emission for each option

Travel to retail emissions are based on the average emissions for each area from the 2009 'Renewable Energy Capacity, Carbon Impacts and Low Emission Strategies Report' for Mid Devon. Travel to school was assumed to be by bus. The schools travel is assume to are the closest to the developments, primary secondary and 6th form. For Tiverton the schools are Wilcombe Primary School and Tiverton High School. For Willand the schools are Willand Primary School and Uffculme School. For Cullompton the schools are St. Andrews Primary School and Cullompton Community College. Clyst Vale Community College is assumed to be the 6th form college for all three development options. The schools assumed for Crediton are Crediton Haywards Primary and Queen Elizabeth Academy.

Table E.3: The travel to school emissions for each housing options. These are based on travel to the nearest primary, secondary and 6th form schools from each development area.

	Option 1: Town focus.			**Option2a: Willand**	**Option 2b: Cullompton**
	Cullompton	Crediton	Tiverton		
Number of eligible schoolchildren	434	417	1473	812	434
Number of likely eligible schoolchildren in development	224	75	374	1,152	783
Emission factors for a school bus	0.111621	0.111621	0.111621	0.111621	0.111621
Distance travelled to school (km)	18	1.7	21	25	18
Total travel to school carbon equivalent emissions (CO_2e kg/year)	450	14	878	3,214	2409
Travel to school emissions per dwelling CO_2e kg/year	0.54	0.05	0.70	1.07	0.82
Travel to school emissions per dwelling for Option 1 (CO_2e kg/year):			0.43		

E2.3 Travel to retail emissions for each option

Table E.4: The travel to retail emissions for each option, these are based on the per dwelling average emissions from the 2009 Mid Devon Low Carbon and Low Emissions Strategies Report, but adjusted for the current local plan review housing options.

	Option 1: Town Focus			**Option 1a Total**	**Option 2a**	**Option 2b**
	Tiverton	Cullompton	Crediton		Willand	Cullompton
Per dwelling	126	1,200	350	338	500	400
Total	158,200	360,000	294,000	812,200	1,500,000	1,176,000

E3 Rural Development travel emissions

These were split into three categories and one example from each category was used as an example for the emission likely from developments. The three categories were: close to a large urban hub (less than 25 minutes commute to an urban areas with at least 100,000 residents), close to a town (less than 25 minutes commute to an urban area of less than 100,000 residents), and rural setting (more than 25 minutes commute to an urban area). The categories that each potential rural development sites falls into are listed in Table E.5.

Table E.5: Rural areas where potential developments could be situated as detailed in the new Local Plan Review. These areas are split into categories depending on their proximity to urban areas. The categories are ‘close to large urban hubs’, less 25 minute drive to urban centre of more than 100,000 people, ‘close to a town’, is less than 25 minute drive to an urban areas of less than 100,000 people, and ‘Rural setting’ is 2 minute or more drive from an urban area.

Close to a large urban hub	**Close to a town**	**Rural Setting**
Cheriton Bishop	Bampton	Hemyock
Bickleigh	Bow	Chawleigh
Bradninch	Burlescombe	
Copplestone	Butterleigh	
Newton St Cyres	Cheriton Fitzpaine	

Silverton	Colebrooke	
Thorverton	Culmstock	
	Halberton	
	Kentisbeare	
	Lapford	
	Morchard Bishop	
	Oakford	
	Sampford Peverell	
	Sandford	
	Uffculme	
	Willand	
	Yeoford	

E3.1 Rural Development Calculations

Table E.6 The travel emissions associated with developments the rural areas selected to show likely emissions, Bampton, Hemyock, Cheriton Bishop. The distance to work and percentage of travel method is from the office of national statistics, and the carbon emission factors are 2013 DECC data. The travel to retail is manipulated from the 2009 Mid Devon Low Carbon and Low Emission Strategies report, the emissions from retail for Cheriton Bishop is taken to be similar to Copplestone as they are located a similar distance form Exeter and are in the same Category, see Table E.5. The Travel to school is assumed to be by bus and the distance is taken form the nearest school. The schools for Bampton were assumed to be: Bampton Church of England, Tiverton High School, Queen Elizabeth Academy. The schools for Hemyock were: Hemyock Primary, Uffculme School and Clyst Vale Community College. The Schools for Cheriton Bishop were assumed to be: Cheriton Bishop Primary, Steiner Academy and Queen Elizabeth Academy.

	Newton Square, Bampton	**Culmbridge Farm, Hemyock**	**Woodleigh Hall, Cherition Bishop**
Ward	Clare and Shuttern	Upper Culm	Yeo
Travel to Work			
Number of people of employment age (16-74 years of age)	2,518	2,905	2,586

Number of dwellings currently	1,616	1,749	1,457
Number of dwellings in development	8	80	221
Likely no. of residents in work in proposed development	12	133	392
distance that a % of the population travel to work and back (km)	19	20	21
number of working days per year	220	220	220
Distance that the proposed development population will travel to work and back in a year (km)	52,966	573,239	1,853,479
Residents travelling by car (%)	40.3	49.1	47.1
Residents travelling as passengers in a car (%)	2.4	2.5	3.1
Residents travelling by bus (%)	0.6	0.6	1.7
Residents travelling by train (%)	0.6	0.8	1.8
Residents travelling by taxi (%)	0.0	0.0	0.1
Residents travelling by motorbike (%)	0.3	0.7	0.8
Distance travelled by car/ year (km)	21,350	281,588	872,984
Distance travelled as a passenger in a car/ year (km)	1,283	14,405	57,339
Distance travelled by bus/ year (%)	294	3,552	31,536
Distance travelled by train/ year (%)	337	4,539	32,970
Distance travelled by taxi/ year (%)	0	197	1,433
Distance travelled by motorbike/ year (%)	147	3,749	15,051
Carbon Emissions per year from car travel (kgCO_2e)	4,230	55,785	172,947
Carbon Emissions per year from car passenger travel (kgCO_2e)	127	1,427	5,680
Carbon Emissions per year from bus travel(kgCO_2e)	33	396	3,520
Carbon Emissions per year from train travel (kgCO_2e)	17	223	1,617
Carbon Emissions per year from taxi travel (kgCO_2e)	0	28	207
Carbon Emissions per year from motorbike travel (kgCO_2e)	21	541	2,173

Carbon Emissions per year in total ($kgCO_2e$)	4,427	58,401	186,143
Carbon Emissions per year in total per dwelling ($kgCO_2e$)	553	730	842
School travel emissions			
Number of eligible schoolchildren	329	558	455
Number of likely eligible schoolchildren in development	2	26	69
Emission factors for a school bus	0.112	0.112	0.112
Distance travelled to school	28.8	26.7	17.8
Total carbon emissions per year from school travel ($kgCO_2e$)	5	76	137
Total carbon emissions per year from school travel per dwelling ($kgCO_2e$)	0.7	1.0	0.6
Retail emissions			
Carbon emissions per year from retail travel per dwelling ($kgCO_2e$)	720	700	500
Total	1,274	1,431	1,343