

Herefordshire's Ecological Footprint



Report prepared by



*Best Foot Forward,
The Future Centre,
115 Magdalen Road,
Oxford OX4 1RQ.*

November 2001

Contents:

INTRODUCTION.....	3
Table 1: Age, Ethnicity and Population Growth for Herefordshire and UK.....	3
Table 2 : Distribution of businesses by sector in Herefordshire and the UK as a whole.....	4
Table 3: Type of dwelling for Herefordshire and the UK.....	4
RESOURCE CONSUMPTION.....	5
DATA AVAILABILITY	5
DIRECT ENERGY	6
Table 4: Energy consumption data broken down by category.....	6
Table 5: Carbon and carbon dioxide emissions by fuel type.....	7
MATERIALS & WASTE.....	7
Table 6: Waste data for Herefordshire.....	8
FOOD	9
Table 7: Food consumption based on West Midlands regional data.....	9
PASSENGER TRANSPORT	10
Table 8. Estimated distance travelled by different modes of transport in Herefordshire.....	10
Table 9: Carbon and carbon dioxide emissions from passenger transport.....	10
FREIGHT TRANSPORT.....	11
Table 10: Origin of Road Freight (by region) with Herefordshire destination	11
Table 11: Freight transportation by mode. Based on UK proxy data	11
Table 12: Carbon and carbon dioxide emissions from freight transport.....	12
WATER & SEWAGE.....	12
Table 13: Domestic and commercial water consumption (April 199 - Mar 2000).....	13
SUMMARY MASS BALANCE.....	14
Figure 1: Waste production and management routes for Herefordshire (000's tonnes).....	15
Figure 2: Carbon dioxide emissions by category.....	16
ECOLOGICAL FOOTPRINT ANALYSIS.....	17
WHAT IS FOOTPRINT ANALYSIS?.....	17
Figure 3: The bioproductive categories used for Ecological Footprinting.....	18
Figure 4: Comparison of the ecological footprints of various countries (1996 data).....	20
THE ECOINDEX™ METHODOLOGY.....	20
<i>The Component Approach.....</i>	<i>20</i>
Table 14: An example analysis for the Footprint of UK car travel (per passenger-km)	21
<i>The Double Counting Demon.....</i>	<i>22</i>
HEREFORDSHIRE'S ECOLOGICAL FOOTPRINT	23
Table 15a: The Ecological Footprint of Herefordshire by Component.....	23
Table 15b: The Ecological Footprint of Herefordshire by Component.....	24
Table 15c: The Ecological Footprint of Herefordshire by Component.....	25
Figure 5: Component breakdown of the Ecological Footprint of Herefordshire	25
Table 16: Overall and per capita Ecological Footprints after adjusting for double-counting	26
Table 17: Per Capita Ecological Footprints for Herefordshire and the UK by land types	26
Figure 6: Summary component breakdown of the per capita EF for Herefordshire and the UK.....	26
THE BIOCAPACITY OF HEREFORDSHIRE.....	27
SEA.....	27
BIODIVERSITY LAND	27
HEREFORDSHIRE'S BIOCAPACITY	28
Table 18: Biocapacity scenarios using different biodiversity set-asides (incl. tourists).....	28
Table 19: Biocapacity scenarios using different biodiversity set-asides (excl. tourists).....	29
ECOLOGICAL SUSTAINABILITY.....	30
GLOBAL ECOLOGICAL SUSTAINABILITY	30
Table 20: The Ecological Footprint (demand) shown against the Biocapacity (supply)	30
REFERENCES.....	32

Introduction

Herefordshire is located just south of the West Midlands – it is sandwiched between the County of Worcestershire to its east and the Brecon Beacons to its west.

Herefordshire local authority came into existence in April 1998, taking over the responsibilities of a number of previous authorities - Leominster District Council, South Herefordshire District Council, Hereford City Council and Hereford-Worcester County Council. It also took over parts of Malvern Hills District Council.

The County has a resident population of 166,000, which is projected to rise to 190,000 by 2021, and a land area of 216,200 hectaresⁱ. It is predominantly a rural area. Land use is mainly agricultural.

Population profile is given in Table 1 below. The Herefordshire population tends to be older than the UK average, is growing at a faster rate and has a lower proportion of ethnic minorities.

Table 1: Age, Ethnicity and Population Growth for Herefordshire and UK

	0 - 4 (%)	5 - 15 (%)	16 - 19 (%)	20 - 24 (%)	25 - 44 (%)	45 - 59 (%)	60 - 65 (%)	66 - 79 (%)	80 and over (%)	Ethnic minorities (%)	Total change 1981-99 (%)
Herefordshire	5.6	14.0	4.5	3.6	27.3	20.3	5.5	14.3	4.9	0.5	12.7
UK	6.1	14.3	5.0	5.9	29.9	18.4	4.8	11.7	3.9	5.5	5.6

The Herefordshire average GDP is below the UK average; £9,984 compared with a UK figure of £10,711. Salaries are also below the National average at £16,613 compared to £17,564 per annum.

Tourism is big business in the County and there are an estimated 6.5 million visitors per annum.

Businesses are concentrated in two sectors; agriculture and tourism. The proportion of businesses in each sector is compared with the UK-wide distribution in Table 2.

Agriculture, however, employs relatively few people (8.4% of Herefordshire jobs) compared with the tourism industry (23.6%), public sector (21.4%) and manufacturing (21.3%). The other significant sectors are financial and business services (9.6%) and construction (4.8%).

Table 2 : Distribution of businesses by sector in Herefordshire and the UK as a whole.

	Agriculture, hunting, forestry and fishing (%)	Mining & quarrying, energy, water supply & manufacturing (%)	Construction (%)	Distribution, hotels & catering repairs (%)	Transport & communications (%)	Financial intermediation, real estate, renting & bus. activities (%)	Education & health (%)	Public administration & other service (%)
Herefordshire	26.1	7.4	9.6	25.3	3.5	15.3	5.4	7.3
UK	7.2	8.4	8.9	29.6	4.3	25.1	6.5	10.0

Herefordshire has 66,000 dwellings of the type set out in Table 3. Herefordshire residents are twice as likely to live in a detached house than the average UK resident. 70.1% of properties are owner-occupied, which is slightly higher than the National figure of 67.6%.

Table 3: Type of dwelling for Herefordshire and the UK.

	Detached house (%)	Semi-detached (%)	Terraced house (%)	Purpose-built flat (%)	Converted or partly converted accommodation (%)	Shared dwellings (%)
Herefordshire	42.2	26.2	19.9	8.9	2.5	0.2
UK	20.2	29.1	29.2	17.2	4.0	0.3

Resource Consumption

This section reviews and summarises the available data on the energy and materials consumption of Herefordshire. Such an analysis is a necessary pre-cursor to undertaking ecological footprint calculations.

Data Availability

The limitation of this project has meant that the authors have had to rely on an analysis of existing data sources. The methodology used follows that described in the Island State report, which considered the resource consumption of the Isle of Wight, but unlike that study it has not been possible to undertake any primary data collection.

A wide range of secondary sources has been scoured to identify Herefordshire-specific data. Where such local data has not been available, estimates of Herefordshire consumption have been made by proxying West Midlands or National sources, using per capita averages.

The use of proxy data does, however, tend to mask regional differences in consumption and this should be born in mind when considering the figures presented here.

The number of tourists can significantly effect such calculations and it has therefore been necessary to take the tourist population into account when estimating per capita consumption. This avoids inflating the actual consumption of residents. For the purposes of this analysis is has been assumed that each of Herefordshire's 6.5 million visitors stay for two nights. This figure is based on the average spend per tourist of £192. This is equivalent to an annum 'permanent population' of 203,916.

Data for the year 2000 is used where possible. Where earlier data is used this is indicated.

Resource data is presented below by category:

- Direct Energy
- Materials & Waste
- Passenger Transport
- Freight Transport
- Water & Sewage

Direct Energy

It is notoriously difficult to obtain energy data, and particularly electricity data, due to de-regulation of the market. Whereas electricity companies previously distributed to one region they now sell more widely making it difficult to secure local consumption data. Commercial confidentiality has also become more of an issue.

The available energy data is listed in Table 4 along with details of sources and any breakdown.

Total energy consumption is estimated to be 3,129 GWh per annum. No detail was available on the independent supply and uptake of renewable energy but this is thought to be limited to small-scale biomass and wind generation. Renewable electricity supplied through the national grid is included in the main figure given for electricity. Similarly, the use of oil for energy generation (outside of that for domestic use and for grid electricity generation) has not been accounted.

Table 4: Energy consumption data broken down by category.

	GWh
Electricity <i>of which</i>	1,319
domestic	384
commercial <i>of which</i>	227
schools	4
Industrial	384
Other	324
Gas <i>of which</i>	1,608
domestic	676
commercial <i>of which</i>	150
Schools	12
industrial	404
other	377
Heating Oil Domestic <i>of which</i>	202
Schools	1
Total	3,129

Sources: DUKES 2001, HEID, Transco 2000

As elsewhere in the UK, Herefordshire's energy supply is fossil fuel-based. The carbon emissions arising from the energy consumption given in Table have been calculated using

CarbonCalc™, a software package produced by Best Foot Forward, which uses standard Government conversion factors to estimate pollution.

Carbon emissions are estimated at 255, 377 tonnes per annum. This is equivalent to 936, 380 tonnes of carbon dioxide. See Table 5 for a breakdown by fuel type.

Table 5: Carbon and carbon dioxide emissions by fuel type.

	Carbon (tonnes)	Carbon dioxide (tonnes)
Electricity	158,280	580,360
Gas	83,324	305,520
Heating Oil	13,773	50,500
Total	255,377	936,380

Sources: Carboncalc, DETR 1999

Materials & Waste

Materials and waste are grouped together as they are essentially two sides of the same coin. Waste is merely the product of some process or activity which is perceived to have little value.

Material flows, in the form of raw materials and manufactured products, can be easily tracked at a national level by using trade statistics but no such comprehensive data sets exist for sub-national regions such as Herefordshire. The exception is food data, which are collected regionally by the Office of National Statistics (ONS). Consumption of foodstuffs is dealt with in a separate section.

Thus consumption at a local level can, at best, be estimated by either 'back-casting' from local waste statistics or profiling from local consumer spending. Both approaches have their advantages. In this study the author's have chosen the former approach. It should be noted that estimating material consumption from waste ignores those materials which are retained within the economy (for example, materials that are used for construction).

Table 6 presents waste data for Herefordshire categorised by into municipal, industrial and commercial. Where further breakdowns by material are available these are shown.

Table 6: Waste data for Herefordshire.

	Tonnes
Municipal <i>of which</i>	70,000
Recycled <i>of which</i>	5,000
Paper & card	1,789
Glass	668
Plastics	0
Cans	22
Scrap metals/white goods (assume steel)	668
Other Mixed	302
Compost	1,487
Textiles	65
Commercial <i>of which</i>	64,000
inert/ construction & demolition	0
paper & card	6,000
Food	1,000
general commercial	48,000
General & biodegradable	5,000
metals & scrap equipment	1,000
contaminated general	2,000
minerals wastes & residues	0
Chemicals & other	1,000
Industrial <i>of which</i>	113,000
Inert/construction & demolition	5,000
Paper & card	5,000
food	5,000
general industrial	33,000
General & biodegradable	28,000
metals & scrap equipment	8,000
contaminated general	12,000
minerals wastes & residues	4,000
Chemicals & other	13,000
Total	247,000

Sources: DOES 2000, SWMA West Midlands 2001, DEFRA 2001

Food

Consumption of food produce within the West Midlands region is recorded by the National Food Survey. Data for Herefordshire has been proxied from this source assuming a similar per capita profile. Most food waste finds its way into the sewage system but it should be borne in mind that some unused solids (scraps, peelings, leftovers and so on) do find their way into the municipal, commercial or industrial waste streams as indicated above (c.7,500 tonnes of food waste has been identified in these waste streams plus a considerable tonnage of waste classified as biodegradable) and this needs to be discounted to avoid double-counting total consumption. A breakdown of food items is shown in Table 7.

Table 7: Food consumption based on West Midlands regional data.

	Tonnes
Milk and cream (t)	21,703
Cheese (t)	1,108
Meat and meat products (t)	8,825
Fish (t)	1,531
Eggs	1,454
Fats	2,227
Sugar and preserves	1,731
Vegetables - fresh potatoes	7,252
Vegetables - fresh green	2,702
Vegetables - other fresh	5,014
Vegetables - processed other veg	5,901
Fruit - fresh	7,263
Fruit - processed	3,230
Bread (White)	7,643
Cereals	7,379
Tea/Coffee/Other beverages	687
Soft drinks	14,768
Alcoholic drinks	3,505
Confectionery	633
Miscellaneous	4,085
Total	108,639

Sources: DEFRA 2000

Passenger Transport

Only limited transport data is available which specially relates to Herefordshire though there are many interesting facts and figures. In 1991, for example, 72,000 cars were on the road and registered to Herefordshire residents (about 1.1 cars per household).

In comparison, last year (2000) there were just 81 buses engaged in providing local services within the County. In the same year there were more licensed hackney carriages and private hire vehicles (a total of 314).

Travel data indicates that the 75% of Herefordshire *journeys* are made by car. In the West Midlands as a whole 77% of *passenger kilometres* are travelled by car. Assuming motorised journeys by car or public transport are of roughly the same length then the per capita West Midlands figure for distance travelled by car can be adjusted downwards accordingly to better reflect County travel patterns. Table 8 provides a breakdown with average West Midlands figures used for ferry and air travel.

Table 8. Estimated distance travelled by different modes of transport in Herefordshire.

	Passenger Travel (000's pass. Km/yr)
Travel by car	1,709,066
Travel by bus	282,173
Travel by train	265,790
Travel by air	20,128
Travel by ferry	1,597
Total	2,278,754

Sources: Transport Statistics Great Britain 2000, DTLR, ONS 2000, Herefordshire Council 2000

Table 9: Carbon and carbon dioxide emissions from passenger transport.

	Carbon (tonnes)	Carbon dioxide (tonnes)
Travel by car	58,264	213,633
Travel by bus	5,772	21,163
Travel by train	4,349	15,947
Travel by air	988	3,623
Travel by ferry	109	400
Total	69,482	254,767

Sources: Carboncalc, DETR 1999

Freight Transport

It is difficult to attribute freight transport to a particular region as many goods produced in an area are exported and many items are freighted though an area to another destination.

Figures are available on origins and destinations of road freight for the West Midlands as a whole. Estimating this for Herefordshire, based on population, suggests that most road freight bound for Herefordshire originates from within the West Midlands. This data also suggests that at least 5 million tonnes of goods are required by Herefordshire's economy each year. Of course, some of this may well be 'exported' out of Herefordshire as finished product. It should be noted that rail freight is not included although, nationally, this still remain a relatively small portion of freight carriage.

Table 10: Origin of Road Freight (by region) with Herefordshire destination

	Tonnes
North East	31,484
North West	377,811
Yorkshire & the Humber	220,390
East Midlands	472,264
West Midlands	3,085,457
East of England	220,390
London	62,969
South East	188,906
South West	157,421
Wales	188,906
Total	5,005,997

Source: Transport of Goods by Road in Great Britain 2000, DTLR

Freight transportation by mode is given in Table 10 broken down by mode of transit. Data is based on National figures proxied for Herefordshire.

Table 11: Freight transportation by mode. Based on UK proxy data

	000's Tonne kilometres
Road freight	538,982
Rail freight	63,059
Sea freight	181,637
Air freight	19,062
Total	802,739

Source: Transport Statistics Great Britain 2000, DTLR

Combining data from Table 9 and Table 10 suggests that each tonne of goods arriving in Herefordshire by road travels a minimum of 107 kilometres. This does not consider the full distance travelled, merely the final stage of freighting.

Table 12: Carbon and carbon dioxide emissions from freight transport.

	Carbon (tonnes)	Carbon dioxide (tonnes)
Road freight	23,382	85,734
Rail freight	516	1,892
Sea freight	1,186	4,348
Air freight	8,214	30,118
Total	33,290	122,092

Sources: Carboncalc, DETR 1999

Water & Sewage

The West Midlands public water supplies are provided primarily by Severn Trent Water, South Staffordshire Water and Dwr Cymru (Welsh Water).

According to the Environment Agency's Water Resources Strategy for the West Midlands:

"Parts of the West Midlands are among the driest areas of England and Wales with annual totals in the Vale of Evesham less than 650 mms on average. In a typical year, the West Midlands receives enough rain to cover its entire area to a depth of around 750 mms."

Rainfall varies considerably across Herefordshire County. In the North East the rainfall is close to that in the Vale of Evesham. Rainfall increases as one moves across the County reaching a figure of 1,100mm per year at the South West border.

The total rainfall across the West Midlands is equivalent to around 2,000 litres per day for every person that lives in the region. This compares with an average annual usage of about 145 litres per day. Of course, not all of the rainfall is available for consumption and water resources are under considerable stress throughout the West Midlands.

Surface water throughout Herefordshire is already fully committed to existing abstractions and the environment in the summer. Groundwater abstractions in central Herefordshire exceed sustainable levels.

Over 1400 million litres per day are abstracted in the West Midlands for public supply. Data for Herefordshire suggests that residents use slightly more than the West Midlands average. Herefordshire data is shown in Table 12. Included in 'other' is industrial and agricultural abstraction. Two companies, HP Bulmers Limited and SunValley Limited, are responsible for most of the industrial usage.

Table 13: Domestic and commercial water consumption (April 199 - Mar 2000)

	MI/year
Domestic/household	9,490
Commercial	6,424
Industrial	1,329
Total	17,243

Source: Environment Agency, 2000, Herefordshire Council, 2000

Summary Mass Balance

Drawing together energy and materials data it is possible to estimate waste outputs and carbon emissions for the Herefordshire economy. All waste data has been aggregated by material (where known) and waste management routes have been identified.

Some key points should be noted:

- Due to a lack of materials consumption data, no attempt has been made to calculate the capital stock; those materials (typically construction materials) retained within the economy (as roads, housing or other infrastructure).
- Foodstuffs not finding their way into the recorded waste streams as food waste, compost or biodegradables are assumed to have been consumed and turned into the products of digestion (energy and sewage) with no loss of mass.
- Water consumption has been excluded. Most household and commercial water is put into the sewerage system. Water that is used for agricultural and industrial purposes typically finds its way more directly to the rivers or watercourse.
- Agricultural wastes are excluded. These are accounted by the Environment Agency but the vast majority is animal waste which is processed on farm.
- Fuel tonnages are not included in the material flows but have been considered in terms of their carbon emissions.

Total accounted waste is 317,000 tonnes or 1.9 tonnes per permanent resident or 1.6 tonnes if the impact of tourists is estimated. Of course, this is not all direct personal consumption. Some relates to industrial and commercial outputs.

Carbon dioxide emissions are summarised in Figure 2. Total emissions are 1,358,239 tonnes or 8.18 tonnes per permanent resident or 6.7 tonnes if the impact of tourists is estimated. This compares with a UK average of 9.01 tonnes per capita (DEFRA 2001b).

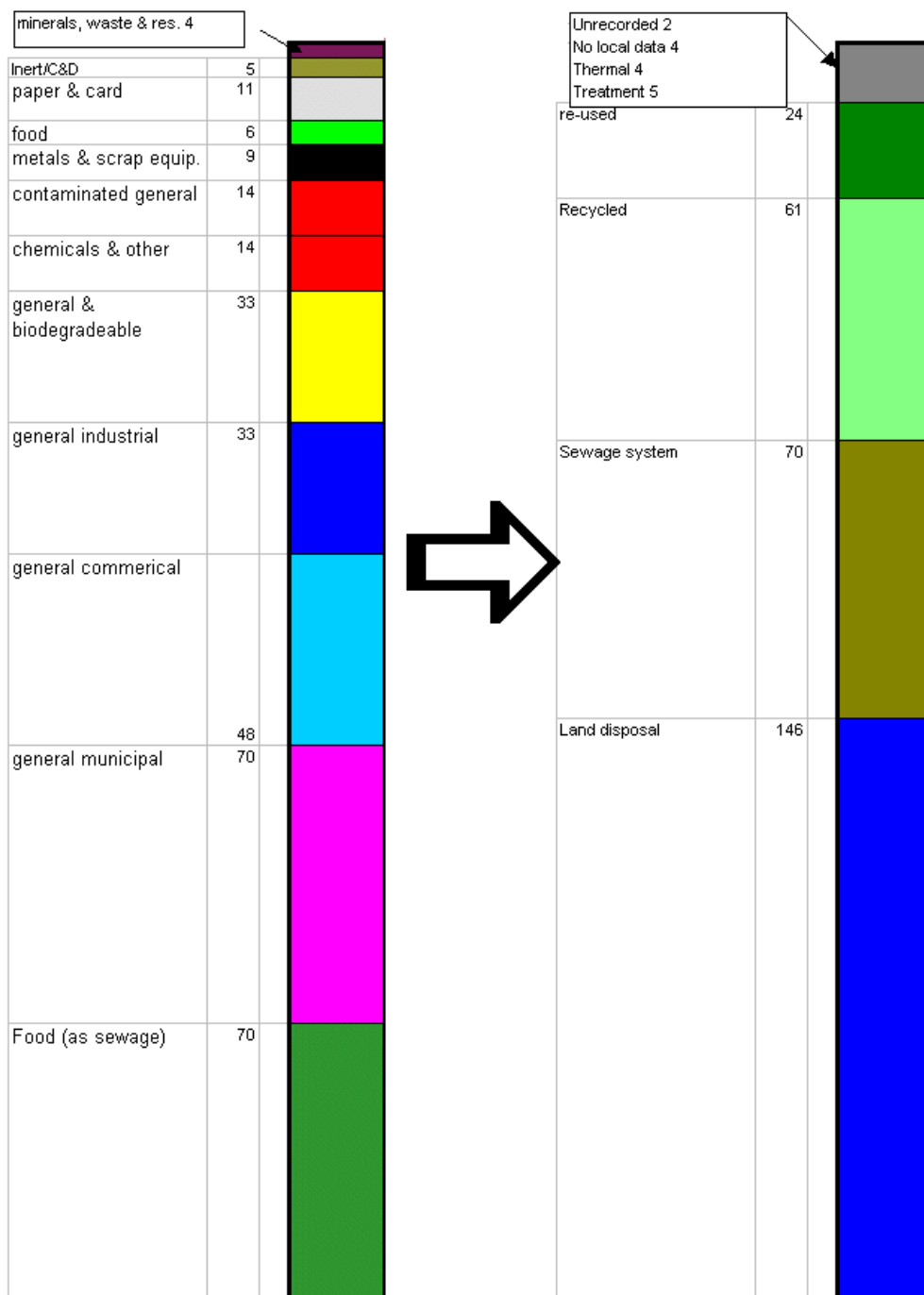


Figure 1: Waste production and management routes for Herefordshire (000's tonnes).

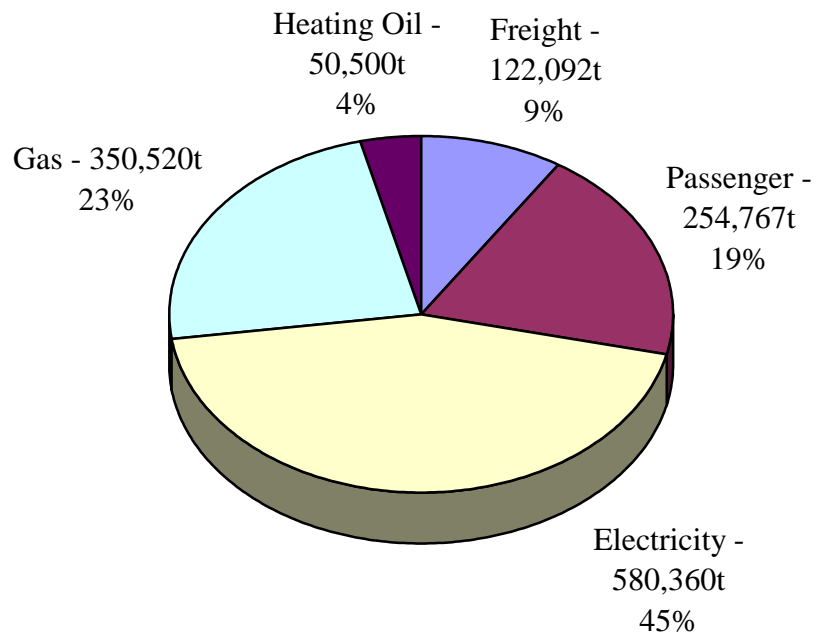


Figure 2: Carbon dioxide emissions by category.

Ecological Footprint Analysis

What is Footprint Analysis?

Although Ecological Footprint Analysis¹ only gained widespread publicity in 1995, it has rapidly taken hold and is now in common use in many countries at the national and local levels; for example, Mexico, US, Canada, Holland, Denmark, Sweden, Norway, Italy, Spain and Australia. The Ecological Footprint of a region or community can be said to be the bioproductive area (land and sea) that would be required to sustainably maintain current consumption, using prevailing technology.

Imagine a glass dome over Herefordshire - what area would this dome have to cover to ensure that the population could maintain their current lifestyles using only the productive area enclosed within the dome?

For the purposes of the Ecological Footprint calculation, land and sea area is divided into four basic types; bioproductive land, bioproductive sea, energy land (forested land required for the absorption of carbon emissions) and built land (buildings, roads etc.). A fifth land type, biodiversity land, refers to the area of land that would need to be set-aside to preserve biodiversity (see Figure 3).

¹ Those wishing to understand more about the ecological footprint, its benefits, strengths and weaknesses, are referred to two background papers supplied as Annex 1: *More about Ecological Footprint Analysis*; and *Critiques of Ecological Footprint Analysis*. Those wishing to go beyond the outline given in these summary papers are recommended to read to the book *Sharing Nature's Interest* (www.ecologicalfootprints.com)

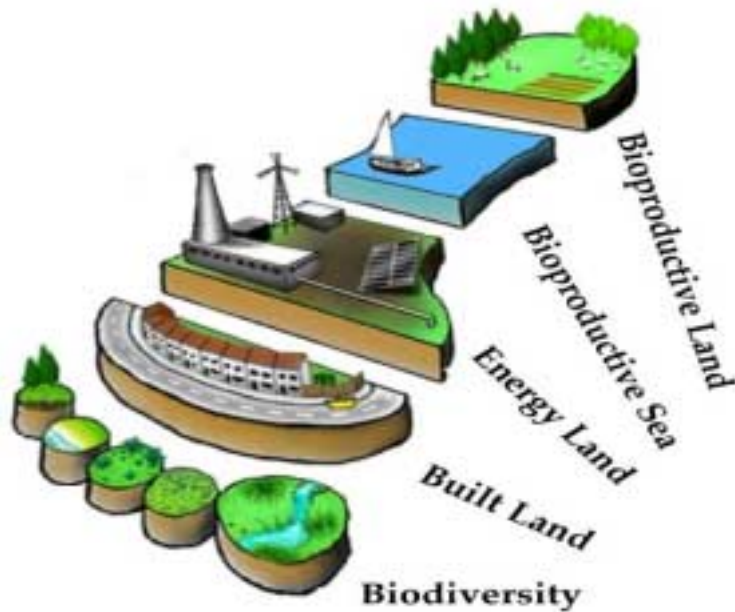


Figure 3: The bioproductive categories used for Ecological Footprinting

Example 1: A cooked meal of fish and rice would require bioproductive land for the rice, bioproductive sea for the fish, and forested 'energy' land to re-absorb the carbon emitted during the processing and cooking.

Example 2: Driving a car requires built land for roads, parking, and so on, as well as a large amount of forested 'energy' land to re-absorb the carbon emissions from petrol use. In addition, energy and materials are used for construction and maintenance.

Once a total Ecological Footprint for a region is calculated, this figure can be divided (normalised) in different ways, or used to investigate future scenarios. For example, by comparing the use of bioproductive area by an 'average' Welsh resident with the available average 'earthshare', we can estimate ecological sustainability. The earthshare is calculated by dividing the total amount of productive land on the planet by the global population. The most recent studies (Loh *et al.* 2000) estimate the average 'earthshare' to be about 1.9 hectares². This earthshare can be considered as the maximum, equitable Ecological Footprint allowance, without depriving either future generations or those now living.

² The actual figures given by Loh *et al.* (2000) are 2.18 hectares for an average earthshare, which reduces to 1.92 hectares when 12% provision for biodiversity protection is considered. Figures are rounded in this report.

An annual Footprint of Nations study, now published in the *Living Planet Report* (Loh *et al.* 2000), provides a national context for considering regional Ecological Footprints. The second of these reports (Wackernagel *et al.* 2000), based on 1996 data, gives an Ecological Footprint for the United Kingdom of 6.3 hectares per person³ compared with a bioproductive capacity of just 1.8 hectares (not including biodiversity considerations) – a deficit of almost 4.5 hectares. Fifteen industrialised nations had even larger Ecological Footprints than the UK in 1996 (Figure 4), but 135 nations' Ecological Footprints were smaller (the Czech Republic and Germany had the same Ecological Footprint as the UK making up the 152 Nations studied).

Globally, the average Ecological Footprint was 2.85 hectares in 1996 – as opposed to an available capacity of 2.18 hectares (excluding biodiversity considerations) - suggesting that humanity is using more natural resources than can be sustained in the longer term.

³ Comparing the Welsh average per capita Ecological Footprint to the average earthshare, addresses the question: Is the average Welsh resident living ecologically sustainably? Comparing the figure with the UK average answers the question: How is Wales performing ecologically compared to the UK as a whole?

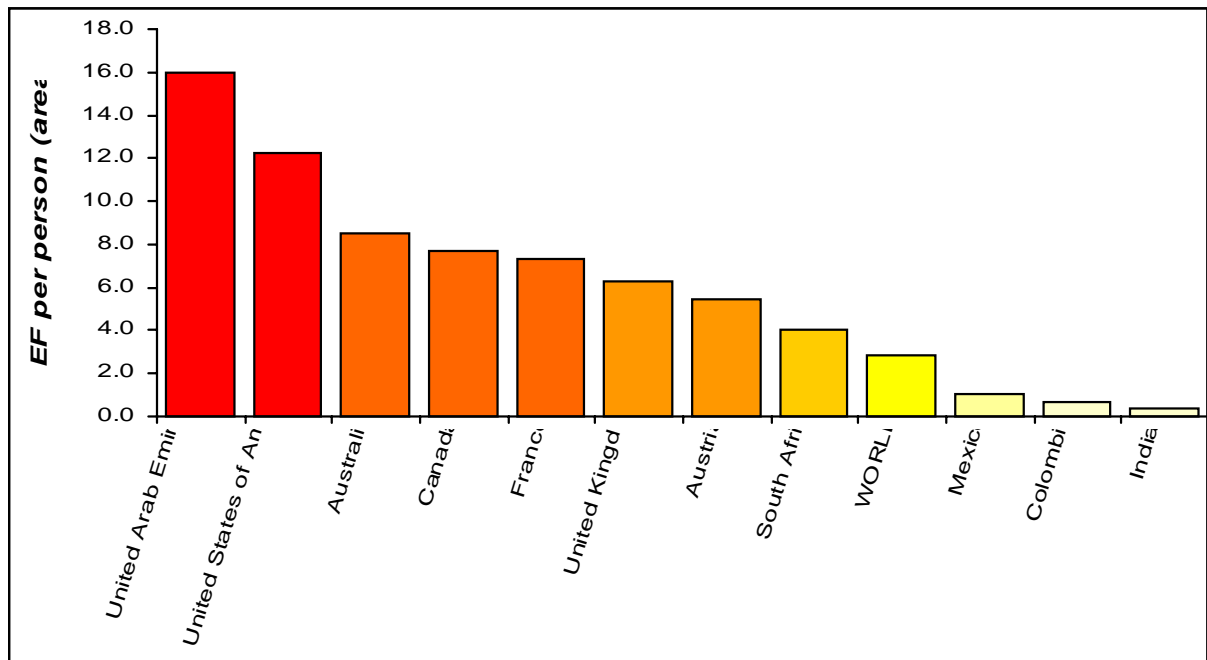


Figure 4: Comparison of the ecological footprints of various countries (1996 data)

The EcoIndex™ Methodology

The Component Approach

The EcoIndex™ Methodology (Chambers, Simmons and Wackernagel 2000) uses a component approach to perform Ecological Footprint Analysis. This is different, but wholly compatible with, the approach taken by Wackernagel *et al.* (1999) in the Footprint of Nations study which uses national consumption data as a starting point.

In the EcoIndex™ methodology, wherever possible, full Life Cycle impact data is used to derive Ecological Footprint conversion factors for key activities or ‘components’. For example, to calculate the Ecological Footprint of a car passenger-kilometre, fuel use, materials and energy for manufacture and maintenance of the vehicle, and the share of UK roadspace appropriated by

⁴ The actual figures given by Wackernagel *et al.* (1999) are 2.23 hectares for an average earthshare which reduces to 1.87 hectares when 12% provision for biodiversity protection. Figures are rounded in this report.

⁵ Comparing the Herefordshire average per capita Ecological Footprint to the average earthshare addresses the question: Is the average Herefordshire resident living ecologically sustainably? Comparing the figure with the UK average answers the question: How is Herefordshire performing ecologically compared to the UK as a whole?

the car are accounted for (Table 12). This conversion factor is then applied to the number of passenger-kilometres travelled.

Table 14: An example analysis for the Footprint of UK car travel (per passenger-km)

COMPONENT	Inputs	CO₂ Emissions	Built-Upon Land	FOOTPRINT
Petrol	0.094 Litres	0.22 Kg		0.000031 ⁱⁱ area unit-yrs
Maintenance & Manufacture	0.0423 Litres equivalent	0.10 Kg		0.000014 ⁱⁱⁱ area unit-yrs
Road Space	258,175 Ha		^a 817,043 area units (Note 1)	
Car Road Share	^b 86%			
Car Kms	^c 362,400,000,000			
Calculation				i+ii+iii
FOOTPRINT			0.000001 ⁱ area unit-yrs	0.000046 area unit-yrs/pass-km

Note 1: This figure is the 'global average' land equivalent to the actual UK area built on by roads. Sources: DETR 2000, Wackernagel & Rees 1996, BRF 2000, DETR 1999c.

A similar approach is used to derive a range of Ecological Footprint component values, representing the main categories of impact, before summing them to calculate a total Ecological Footprint for Herefordshire. The key components we have used in this study are:

- Materials consumption (including waste)
- Energy use
- Passenger transport
- Freight transport
- Water use
- Built (degraded) land

Many of these components are broken down into smaller sub-categories. For example passenger transport is further broken down by mode of travel. The level of detail provided reflects both data availability and the effort put into the data research.

The Double Counting Demon

In this component approach it is important the impacts of consumption are not double counted. For example, the Ecological Footprints of materials inclusive of freight transport are given to show the true 'cost' of consumption. Freight transport as a separate component is also given in its own right to show the relative impacts of transporting goods. Similarly, the Ecological Footprint of water consumption includes the energy used to treat and supply the water, although this energy is also included in the energy component. In both these situations, the same impact is included in different categories, and therefore when all the Ecological Footprint components are added an allowance is made for any likely double counted impacts.

Using this 'bottom up' approach enables the calculation of Ecological Footprints at any level – for a product, organisation, activity or region.

Box 1: Take only pictures - leave only footprints

It is important to note that Ecological Footprint Analysis is a 'snapshot' methodology. It tells us how much bioproductive area would be required based on a specific data set - it does not attempt to predict future or past impacts.

It is likely that, due to technology changes and variations in material flows into the economy, the Ecological Footprint will change over time.

In the period of data recording some of the input flow of materials will stay in the economy, as stock, and some will flow out as waste. In both cases these materials are considered to have been 'consumed'.

Exports, on the other hand, of agricultural products for example, are discounted. The analysis therefore uses net consumption, which is calculated by adding production to imports and then subtracting exports.

All data used relates to the Herefordshire economy in 2000 (except where indicated)

Herefordshire's Ecological Footprint

Table 15 and Figure 4 below summarises the ecological footprint of Herefordshire drawing on the earlier materials data. Figures relate to annual consumption.

Table 15a: The Ecological Footprint of Herefordshire by Component.

	Footprint (area units)
Energy of which	211,626
Electricity - domestic	37,149
Electricity - commercial	22,014
Electricity - industrial	37,149
Electricity - other	31,385
Gas - domestic	30,433
Gas - commercial	6,764
Gas - industrial	18,203
Gas - other	16,964
Heating Oil - domestic	11,567
Passenger Travel of which	93,610
Travel by car	78,369
Travel by bus	5,494
Travel by train	8,056
Travel by air	1,593
Travel by ferry	99
Freight Transport of which	57,714
Road freight - import	47,527
Rail freight	3,091
Sea freight	145
Air freight	6,951

Table 15b: The Ecological Footprint of Herefordshire by Component.

Agricultural Produce of which	343,723
Milk and cream	50,864
Cheese	11,160
Meat and meat products	134,536
Fish	7,741
Eggs	9,395
Oils/Fats	32,226
Sugar and preserves	748
Vegetables - fresh potatoes	2,202
Vegetables - fresh green	1,518
Vegetables - other fresh	2,817
Vegetables - processed	3,369
Fruit - fresh	5,553
Fruit - processed	2,689
Bread (White)	23,512
Cereals	24,823
Tea	1,094
Coffee	551
Other Beverage	1,131
Soft drinks	4,486
Alcoholic drinks	6,905
Confectionery	7,775
Miscellaneous	8,627
Built Land	18,289
Diverted Waste of which	70,784
Paper - household & commercial	15,094
Paper - Industrial	9,371
Glass	575
Plastics	0
Aluminium - household & commercial	17
Aluminium - industrial	119
Steel - household & commercial	201
Steel - industrial	921
Inert - commercial	0
Inert - industrial	0
Other Mixed - household & commercial	1,723
Other Mixed - industrial	4,200
Compost - household & commercial	5,039
Compost - industrial	1,806
Incineration - household & commercial	18,836
Incineration - industrial	12,882

Table 15c: The Ecological Footprint of Herefordshire by Component.

Landfilled Waste of which	394,449
Household	217,008
Commercial	72,701
Industrial	104,587
Inert - household & commercial	0
Inert - industrial	153
Water of which	1,417
Domestic	780
Commercial	528
Industrial	109

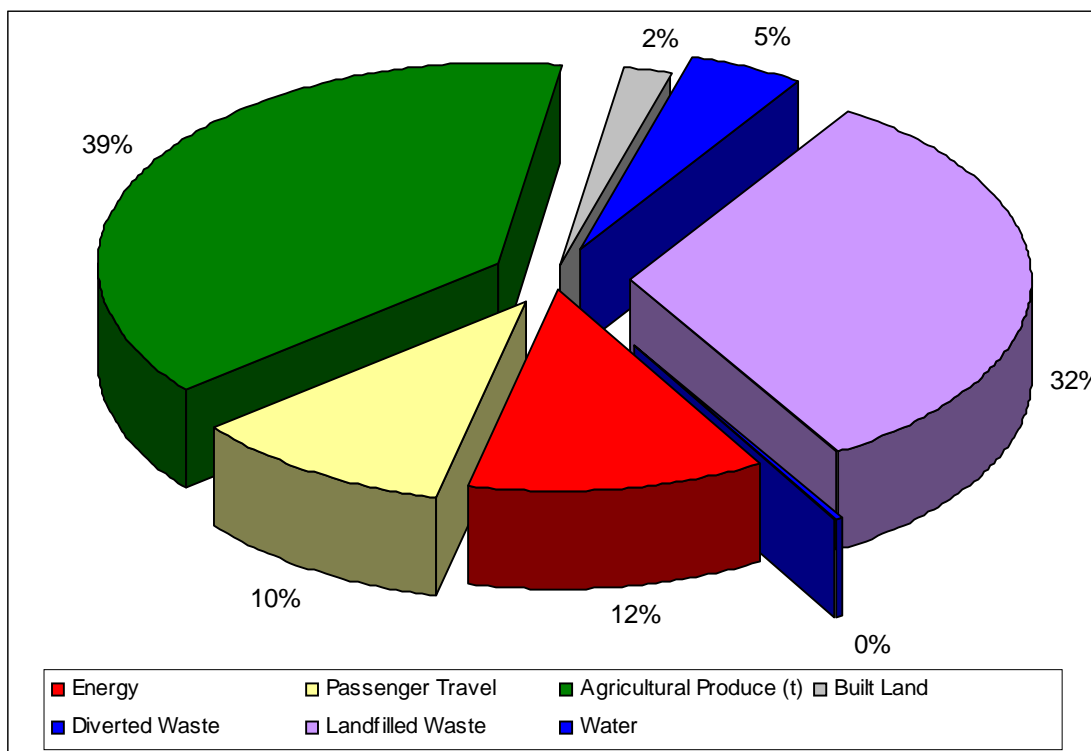


Figure 5: Component breakdown of the Ecological Footprint of Herefordshire

Table 16 (below) shows the ecological footprint for Herefordshire as a whole, and on a per capita basis, after adjusting for double counting. The final per capita figure is shown with and without accounting for the impact of tourists to illustrate their relative impact. A land type breakdown (Table 15) and summary component breakdown by percentage (Figure 5) are also given for both Herefordshire and the UK per capita Ecological Footprints. Figure 6 illustrates the contribution each component activity gives to the total Ecological Footprint for the UK and Herefordshire on a per capita basis.

Table 16: Overall and per capita Ecological Footprints after adjusting for double-counting

Total EF of Herefordshire (area units) – with tourists	896,049
EF Per capita (area units) - with tourists	4.39
EF Per capita (area units) - without tourists	5.32

Table 17: Per Capita Ecological Footprints for Herefordshire and the UK by land types

Arable	Pasture	Forest	Energy	Built	Sea	TOTAL	
1.59	0.38	0.70	3.15	0.15	0.04	6.01	UK
1.78	0.42	0.54	2.41	0.13	0.04	5.32	Herefordshire (excl. tourists)
1.47	0.35	0.45	1.99	0.10	0.04	4.36	Herefordshire (incl. tourists)

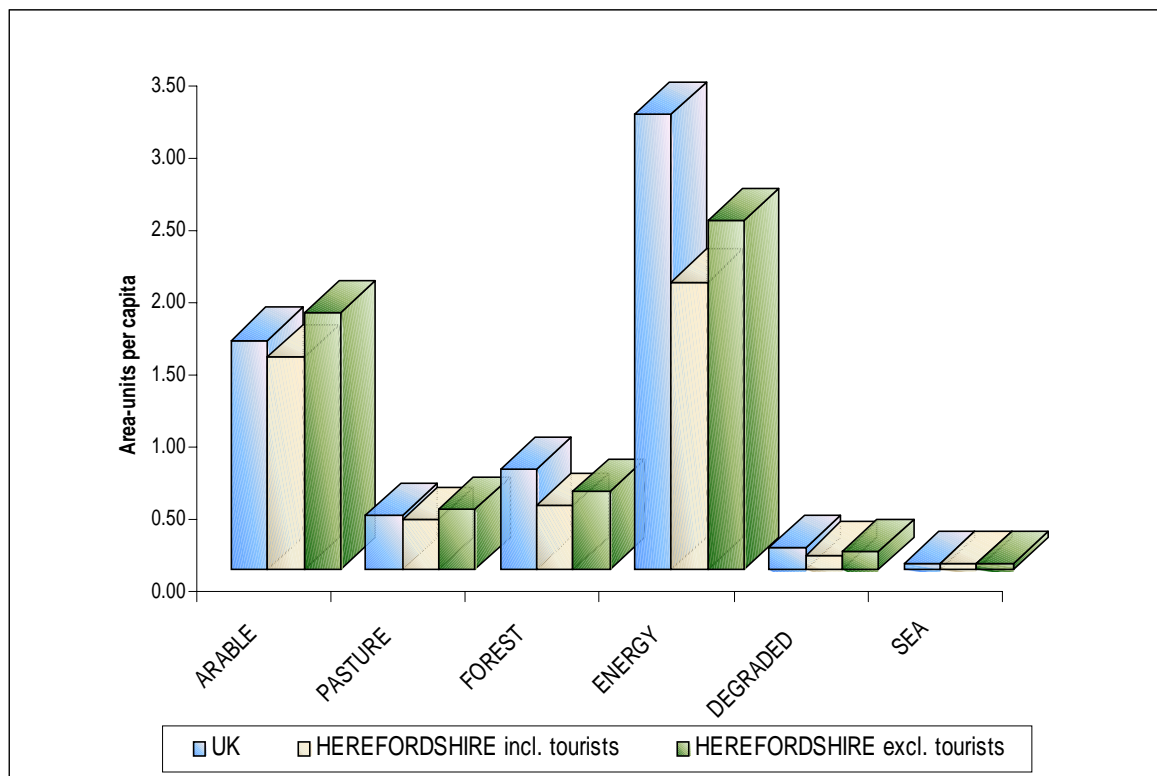


Figure 6: Summary component breakdown of the per capita EF for Herefordshire and the UK

The Biocapacity of Herefordshire

The actual geographical size of Herefordshire is 218,283 hectares. The biocapacity of Herefordshire derives from the bioproductivity of this land plus an allocated amount of the UK's surrounding sea. This bioproductivity is expressed in 'area units'⁶ to be comparable with the Ecological Footprint. To enable this, a number of 'factors' are applied to the actual Herefordshire land cover to convert hectares into normalised 'area units'.

Firstly, yield factors are applied to translate local bioproductivity into 'global average' bioproductivity. For this study, UK yield factors have had to be applied as a proxy. As the UK as a whole is more bioproductive than the world in average, this increases its biocapacity.

Secondly, 'equivalence' factors, developed by Wackernagel *et al.* (in Loh *et al.* 2000), are applied to convert different land (and sea) types into 'global average' land (and sea). For example, 'global average' arable land is over 3 times more biologically productive than 'global average' land. Therefore, the second stage is to convert 'global average' arable, pasture, forest and built land into 'global average' land.

Sea

To account for bioproductive sea, this report uses the area within the UK's Economic Exclusive Zone (up to 200 nautical miles offshore). If this is allocated equally amongst the population of the UK, then the share 'available' to people of Herefordshire is 12,843 area units.

Biodiversity Land

An additional land category is biodiversity land. This represents the area required to be set aside for the preservation of non-human species. There are many different estimates of how much this should be – ranging from 12% to 75% of the Earth's surface for example⁷.

⁶ Area units are the preferred unit for Ecological Footprint Analysis. They were first introduced in the *Living Planet Report* 2000, in which 'one area unit' is described as being equivalent to one hectare of biologically productive space with world average productivity (Wackernagel *et al.* in Loh *et al.* 2000).

⁷ The World Commission on Environment and Development (The 'Brundtland Report') in 1986 stated that 12% of the Earth's surface should be set-aside for biodiversity. In 1970, the ecologist Eugene Odum proposed that this figure should be 40%. Further estimates from Reed Noss and Allen Cooperrider (1994) state that this figure should be a minimum of 25% with a potential maximum of 75%.

At least 9% of Herefordshire is currently designated as having varying conservation importance, which it can be argued is essential to protect biodiversity. However, for consistency with other analyses this report uses the conservative estimate of 12% of the adjusted biocapacity (as suggested by the Brundtland Report in 1986) to determine the bioproductive area available to service human consumption.

Herefordshire's Biocapacity

The total Biocapacity of Herefordshire is 1,077,764 area units or 5.29 area units per capita. Setting aside a modest 12% for biodiversity conservation leaves a biocapacity of 4.65 area units per person. Yet, as discussed above the extent to which bioproductivity needs to be 'set-aside' in order to preserve 'enough' biodiversity to maintain the conditions required to sustain human existence varies greatly; experts argue between 12% and 75%.

To examine the impact of these various estimates, a range of biodiversity 'set-aside' scenarios are presented. These scenarios range from actual designated areas to the higher estimates. These scenarios also act to focus on the issue of regional sustainability highlighting land use management and biodiversity concerns.

The scenarios are presented in Tables 18 and 19 and present the Biocapacity allocation and reference alongside the Biocapacity total and total per capita.

Table 18: Biocapacity scenarios using different biodiversity set-asides (incl. tourists).

	% of Herefordshire		
Biocapacity	7.5%	17%	25%
Allocations:	SSSIs	Equal to current EF	Noss & Cooperrider 1994 - minimum
TOTAL (area units)	996,935	896,049	808,326
TOTAL Per Capita (area units)	4.89	4.39	3.96
Biocapacity	52%	63.6%	75%
Allocations:	AGLVs	Equal to current Earthshare	Noss & Cooperrider 1994 - maximum
TOTAL (area units)	517,328	392,306	269,442
TOTAL Per Capita (area units)	2.54	1.92	1.32

Table 19: Biocapacity scenarios using different biodiversity set-asides (excl. tourists).

	% of Herefordshire		
Biocapacity	7.5%	17%	25%
Allocations:	SSSIs	Equal to current EF	Noss & Cooperrider 1994 - minimum
TOTAL (area units)*	994,857	896,049	806,641
TOTAL Per Capita (area units)	5.91	5.32	4.79
Biocapacity	52%	70%	75%
Allocations:	AGLVs	Equal to current Earthshare	Noss & Cooperrider 1994 - maximum
TOTAL (area units)	516,250	322,656	268,880
TOTAL Per Capita (area units)	3.07	1.92	1.60

*Differences occur in the available biocapacity as sea area is allocated per capita (Table 18 = 203,916, Table 19 = 168,300).

Ecological Sustainability

This section of the report assesses the ecological sustainability of Herefordshire comparing consumption with global capacity.

To facilitate Ecological Footprint comparisons between regions and nations this report uses 'area units'. These present the Ecological Footprints in a common unit, independent of the actual bioproductivity of the area appropriated and therefore where this area is located on the planet. The use of 'area units' enables questions such as 'How does the 'average' Herefordshire resident compare to other 'average' residents in different regions and countries?' and 'Is the 'average' Herefordshire resident living in an ecologically sustainable manner?'

Global Ecological Sustainability

Perhaps the most illuminating question is:

'If everyone lived like the population of Herefordshire, how many planets would we need to sustain current lifestyles?'

This study is able to measure ecological sustainability by comparing the 'average' Herefordshire resident's Ecological Footprint, with the biocapacity available locally and globally - the average earthshare - per person.

The average earthshare is derived by dividing the planet's bioproductive areas by the global population. In 1996 (the latest year for which all data is available for the calculation) the average earthshare was estimated to be 2.18 hectares (Wackernagel et al. in Loh et al. 2000), which becomes 1.92 hectares when 12% is set aside for biodiversity conservation.

Table 20: The Ecological Footprint (demand) shown against the Biocapacity (supply)

Average earthshare	Biocapacity of Herefordshire	Current Ecological Footprint	
1.92	4.65	4.39	<i>Includes Tourists</i>
1.92	5.62	5.32	<i>Excludes Tourists</i>

This assessment indicates that the 'average' Herefordshire resident is currently living within the Biocapacity of Herefordshire, but they are still using over 2 times (228%) the earthshare

(including tourists), or almost 3 times (277%) the earthshare (excluding tourists). This is still less than the UK 'average' resident who uses over 3 times (326%) the earthshare.

To look at this finding in another way, if everyone on the planet consumed the same as the average Herefordshire resident, we would need around 1½ additional Earths to support current global demand.

References

- Best Foot Forward & Imperial College, 2000. *Island State: An ecological footprint analysis of the Isle of Wight*. Funded by Biffaward & supported by Isle of Wight Council. Pub: BFF.
- Chambers, N., Simmons, C. & Wackernagel, M., 2000. *Sharing Nature's Interest: Ecological footprints as an indicator of sustainability*. Earthscan: London.
- Department of Environment, Food & Rural Affairs (DEFRA), 2001. *Municipal Waste Survey, 1999-2000*.
- DEFRA, 2001(b) *UK Greenhouse Gas Inventory 1990 -1999*.
- DEFRA, 2000. *National Food Survey*.
- DEFRA, 2000. *A Bulletin of Transport Statistics: Great Britain*.
- Department of Trade & Industry, 2001. *Digest of United Kingdom Energy Statistics*.
- Department of Transport & Local Regions, 2001. *Strategic Rail Authority Bulletin: Rail statistics: Quarter 1 2000/2001*.
- Environment Agency, 2000. *Strategic Waste Management Assessment: West Midlands*.
- Herefordshire Council, 2001. *DRAFT: Herefordshire's Environmental Inventory*. Contributions by Welsh Water, Environment Agency, Farming and Rural Conservation Association, MAFF and Herefordshire and Worcestershire RIGS Group.
- Loh, J. (ed.), *Living Planet Report 2000*. WWF International, Switzerland.
- Morris, R.M., Oreszczyn, S., Blackmore, C.P. & Ison, R.L. 2001. *A Scoping Study for "Sustainable Herefordshire" as a Sustainable Land-based Community*. The Open University, Milton Keynes.
- Office for National Statistics, 1999. *Regional Trends No. 34*. Government Statistical Service.
- Office for National Statistics, *Regional trends: West Midlands Winter 2000*. No. ISSN 1472-6262 Office of National Statistics.
- Transco, 2000. *Gas Consumption Data*.
- Wackernagel, M.; Callejas, A.; Deumling, D.; Schulz, N.; Sanchez, M. & Falfan, I., 2000. *The Ecological Footprint* in J. Loh (ed.), *Living Planet Report 2000*. WWF Intl, Switzerland.
