Appendix D
Detailed Topic Assessments

Appendix D (of the SEA of the WMPE) contains the collated contextual and baseline information to inform the assessment of the draft WMPE and reasonable alternative for the following topics:

- D1: Biodiversity and Nature Conservation;
- D2: Population, Economics and Skills;
- D3: Human Health;
- D4: Land Use, Geology and Soils;
- D5: Water;
- D6: Air Quality;
- D7: Climatic Factors;
- D8: Flood Risk and Coastal Change;
- D9: Waste and Resources;
- D10: Traffic and Transport;
- D11: Cultural Heritage;
- D12: Landscape and Townscape.

Each topic chapter contains:

- an introduction to the topic under consideration;
- a review of plans and programmes at international, UK and national (England) scales;
- an overview of the baseline (UK and England);
- a summary of the existing problems relevant to waste and resources;
- a description of the evolution of the baseline;
- an overview of the evidence for effects of waste management on the topic;
- an assessment of the likely significant effects of the Draft WMPE and reasonable alternative;
- a summary of any identified mitigation measures; and
- an overview of uncertainties that have been taken into account in the assessment.

This information is also summarised in the Non-Technical Summary of the Environmental Report.

For the purposes of the review of the international plans and programmes for this SEA, it is assumed that the broad objectives of extant European Union (EU) legislation will be maintained once the UK has left the EU and that similar or equivalent environmental protections will remain in place.

D1. Biodiversity and Nature Conservation

D1.1 Introduction

D1.1.1 Biodiversity in this context is defined by the Convention on Biological Diversity[1] as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". Biodiversity is integral to the functioning of ecosystems and these, in turn, provide 'ecosystem services' which include food, flood management, pollination and the provision of clean air and water.

D1.1.2 There are links between the biodiversity and nature conservation topic and other topics in the SEA, including water quality, water quantity, land use, geology and soils, climate change and landscape and townscape.

D1.2 Review of plans and programmes

D1.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D1.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to biodiversity and nature conservation. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D1.1 Biodiversity and Nature Conservation Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
Convention on the Conservation of Migratory Species of Wild Animals (1979) The Bonn Convention
Council of Europe (1982) The Bern Convention. Council Decision 82/72/EEC of 3 December 1981 concerning the conclusion of the Convention on the conservation of European wildlife and natural habitats
Convention on Biological Diversity (2010) Strategic Plan for Biodiversity 2011-2020
European Commission (1979) Council Directive 79/409/EEC on the Conservation of Wild Birds
European Commission (1992) Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (and subsequent amendments
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2008) Marine Strategy Framework Directive 2008/56/EC
European Commission (2009) Directive on the Conservation of Wild Birds (2009/147/EC) (Amended Directive 79/409/EEC)
European Commission (2011) EU Biodiversity Strategy to 2020 – towards implementation
UNESCO (1971) The Ramsar Convention on Wetlands
National Plans and Programmes
Defra (2011) Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services
Defra (2011) Natural Environment White Paper: The Natural Choice: Securing the Value of Nature
Defra (2012) UK Post 2010 Biodiversity Framework
Defra (2013) A Simple Guide to Biodiversity 2020 and Progress Update

[1] The convention uses this definition to describe 'biological diversity' commonly taken to mean the same as biodiversity

Box D1.1 Biodiversity and Nature Conservation Plans and Programmes Reviewed for the SEA of the Draft WMPE
HM Government (1981) Wildlife and Countryside Act
HM Government (2006) The Natural Environment and Rural Communities (NERC) Act 2006
HM Government (2009) Marine and Coastal Access Act 2009
HM Government (2000) Countryside and Rights of Way Act 2000
HM Government (2011) UK Marine Policy Statement
HM Government (2017) The Conservation of Habitats and Species Regulations 2017
HM Government (2018) A Green Future: Our 25 Year Plan to Improve the Environment
MHCLG (2016) Planning Practice Guidance (PPG) on the Natural Environment
MHCLG (2019) National Planning Policy Framework (NPPF)

D1.3 Overview of the Baseline

D1.3.1 Good quality habitats are those which, for a given habitat type, have a larger range of features. For example, a habitat that has varying topography, water distribution or appropriate grazing by animals. This provides a broader variety of conditions and resources that a greater number and diversity of species can exploit. A good quality habitat needs to be large enough to support populations of species over a long period of time. Additionally, some species require large areas of consistent habitat, whilst others thrive in mosaics and therefore the best sites need to be of a size that allows both species to be accommodated.

D1.3.2 Habitat and habitat quality are therefore commonly used as indicators of biodiversity as good quality, diverse habitats with consistent resources and conditions generally allow for a greater diversity of species to survive and reproduce.

D1.3.3 Given the national scope of the WMPE, the baseline data presented in this section takes a comprehensive look at the overall national baseline for biodiversity. The relationship between the baseline environment and the potential effects of the plan will become increasingly clear as the assessment progresses. Inevitably this means that in some instances the link between the baseline environment discussed here and the WMPE are not directly clear; however, the baseline environmental information is included to ensure that the assessment is based on a comprehensive dataset from the outset.

D1.3.4 This section details the baseline, issues of interest and evolution of the baseline for biodiversity, flora and fauna. The topics have been collated within one chapter due to the overlapping nature of each topic and due to the national coverage of the WMPE which is not location specific.

UK

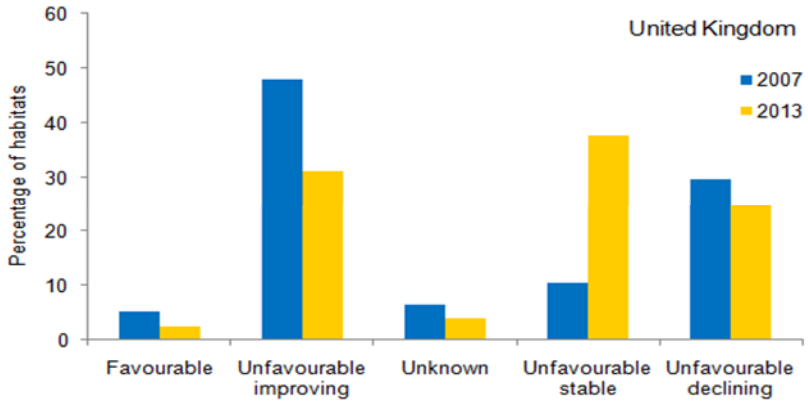
D1.3.5 Special Areas of Conservation (SACs), Sites of Community Importance (SCIs), Special Protection Areas (SPAs) and Ramsar sites are important for biodiversity at the international level. In the UK there are 658 SACs/SCIs, 280 SPAs and 248 Ramsar sites (179 designated and 69 proposed).[2]

[2] Joint Nature Conservation Committee (2017) *UK Protected Sites*. Available online at: http://jncc.defra.gov.uk/page-23

Conservation Status of UK Habitats Listed under the Habitats Directive

D1.3.6 In 2007 and again in 2013, the Joint Nature Conservation Committee (JNCC)[3] published reports identifying the change in status of UK habitats of European importance. The 2007 Report identified that 5% of UK habitats listed in Annex I of the Habitats Directive were in favourable conservation status, with that number declining to 3% in the 2013 report. The next report is due this year (2019). The conservation status of 48% of habitats was improving in 2007, while in 2013, 31% were found to be improving. The conservation status of 30% of the habitats was declining in 2007, whereas in 2013 only 25% were declining (see **Figure D1.1**).

Figure D1.1 Percentage of UK habitats of European importance in improving or declining conservation status in 2007 and 2013.



Source: UK Habitats Directive (Article 17) reports: 2nd UK Report on Implementation of the Habitats Directive (2007) and 3rd UK Habitats Directive Reporting (2013).

Notes: Graph based on 77 habitats listed on Annex I of the Habitats Directive.
The aim of the Habitats Directive is to achieve favourable conservation status for the species and habitats listed in its Annexes. An assessment of status and trends for each species and habitat is undertaken every six years. Trends in unfavourable conservation status allow identification of whether progress is being made, as it will take many years for some habitats and species to reach favourable conservation status.

D1.3.7 Relating specifically to the condition of freshwater habitats in the UK, **Table D1.1** identifies the favourability status of SSSIs / ASSIs.[4]

Table D1.1 SSSI / ASSIs status of UK Freshwater Habitats (2006/07)

	Favourable	Unfavourable recovering	Unfavourable not recovering (declining or no change)	Destroyed or part destroyed
Standing water	49%	12%	38%	1%
Rivers	32%	11%	56%	1%

[3] UK Habitats Directive (Article 17) reports: 2nd UK Report on Implementation of the Habitats Directive (2007) and 3rd UK Habitats Directive Reporting (2013)
[4] Joint Nature Conservation Committee (2016) *Condition of UK Freshwater Habitats.* Available online at: http://jncc.defra.gov.uk/page-6695

D1.3.8 The favourability status of freshwater SACs is set out in **Table D1.2**.

Table D1.2 SAC Status of Freshwater SACs (2006/07)

	Favourable	Unfavourable recovering	Unfavourable not recovering (declining or no change)	Destroyed or part destroyed
Standing water	49%	12%	38%	1%
Rivers	32%	11%	56%	1%

D1.3.9 Further detail on the status of SACs into EU Habitats Directive Annex 1 types is provided in **Table D1.3.**

Table D1.3 SAC Status by Annex 1 habitat types (2006/07)

Annex I habitat type	Favourable	Unfavourable recovering	Unfavourable not recovering
H3170 Mediterranean temporary ponds	100%	0%	0%
H3160 Natural dystrophic lakes and ponds	99%	<1%	1%
H3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	80%	6%	14%
H3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation	61%	9%	30%
H3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. dunes along the shoreline with Ammophila arenaria ('white dunes')	38%	4%	58%
H3110 Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	22%	78%	0%
H3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	3%	0%	97%
H3180 Turloughs	0%	0%	100%

D1.3.10 UK freshwater habitats and their associated species are threatened by a range of factors. **Table D1.4** provides a summary of the major threats. These are based on information in the 3rd UK Report on Implementation of the Habitats Directive and the UK Biodiversity Habitat Action Plans.[5] It is notable that the consequences of waste volumes, littering, fly-tipping, infrastructure and collections logistics can impact upon the habitats through pollution and climate change.

[5] Joint Nature Conservation Committee (2016) *Threats to UK Freshwater Habitats*. Available online at: http://jncc.defra.gov.uk/page-6694

Table D1.4 Threats to UK Freshwater Habitats

	Eutrophic standing waters	Mesotrophic lakes	Oligotrophic and dystrophic lakes	Aquifer-fed naturally fluctuating water bodies	Ponds	Rivers
Pollution	✓	✓	✓	✓	✓	✓
Abstraction and flow regime	✓	✓	✓	✓	✓	✓
Invasive alien species	✓	✓	✓		✓	✓
Recreation	✓	✓	✓			
Fisheries management	✓	✓		✓	✓	
Climate change	✓			✓		✓
Grazing/control of scrub & trees				✓	✓	
Morphological alterations					✓	✓

Reviews of the UK SPA network

D1.3.11 The JNCC have undertaken three reviews of the UK SPA network. The first was published in 1989 (by the then Nature Conservancy Council), the second in 2001 and the most recent in 2016. The 2016 review identifies that whilst total numbers of breeding seabirds / waterbirds and of non-breeding waterbirds have increased, total numbers of breeding birds of prey have declined. This reflects major declines in Merlin and Peregrine within SPAs. Numbers of other raptors have either been stable or increased. It also identifies that overall the current SPA network appears to be relatively resilient to projected climate change. However, the spatial distribution, abundance and composition of species in the network will probably be different in the future, reinforcing the need for roughly decadal reviews of the UK SPA network. Advice to Government includes a recommendation that a separate assessment and review of SPA provision in both the inshore and offshore marine environment should be considered for at least 49 species.[6]

D1.3.12 Waste can act as a risk to wildlife; a reduction in the quantity and quality of suitable habitats, as a result of litter, pollution and infrastructure (including landfills) can eradicate safe ecosystems in communities. In contrast, historic landfill sites do offer some green spaces – most often in rural areas – where the species could recover.

England

D1.3.13 As of August 2017, there are approximately 4,766 sites designated for nature conservation in England covering over 5 million hectares.[7] The designations and corresponding areas are shown in **Table D1.5**.

[6] Joint Nature Conservation Committee (2016) *The status of UK SPAs in the 2000s: the third network review*. Available online at: http://jncc.defra.gov.uk/pdf/UKSPA3_StatusofUKSPAsinthe2000s.pdf

[7] Natural England (2017) *Designated Sites View database*. Available online at: https://designatedsites.naturalengland.org.uk/SearchEngland.aspx

Table D1.5 Nature conservation designation and area

Designation	No. of Sites	Total Area (ha)
Ramsar	73	404,232
SAC	254	1,467,085
SPA	89	1,981,304
NNR (National Nature Reserves)	224	93,912
SSSI	4,126	1,096,633

D1.3.14 Over a quarter of land in England is protected because of its biodiversity importance or because it is a high-quality landscape.[8] Areas known to have special importance in relation to biodiversity are protected under both national and international law.

[8] Natural England. See http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/englands/default.aspx

Figure D1.2 Natural Areas of England

D1.3.15 **Table D1.6** lists the Natural Areas identified in **Figure D1.2**.

Table D1.6 Natural Areas

Name	Reference	Name	Reference
North Northumberland Coastal Plain	1	East Anglian Chalk	51
Border Uplands	2	West Anglian Plain	52
Solway Basin	3	Bedfordshire Greensand Ridge	53
North Pennines	4	Yardley-Whittlewood Ridge	54
Northumbria Coal Measures	5	Cotswolds	55
Durham Magnesian Limestone Plateau	6	Severn And Avon Vales	56
Tees Lowlands	7	Malvern Hills And Teme Valley	57
Yorkshire Dales	8	Clun And North West Herefordshire Hills	58
Eden Valley	9	Central Hertfordshire	59
Cumbria Fells and Dales	10	Black Mountains and Golden Valley	60
West Cumbria Coastal Plain	11	Dean Plateau and Wye Valley	61
Forest of Bowland	12	Bristol, Avon Valleys and Ridges	62
Lancashire Plain and Valleys	13	Thames And Avon Vales	63
Southern Pennines	14	Midvale Ridge	64
Pennine Dales Fringe	15	Chilterns	65
Vale of York And Mowbray	16	London Basin	66
North York Moors and Hills	17	Greater Thames Estuary	67
Vale of Pickering	18	North Kent Plain	68
Yorkshire Wolds	19	North Downs	69
Holderness	20	Wealden Greensand	70
Humber Estuary	21	Romney Marshes	71
Humberhead Levels	22	High Weald	72
Southern Magnesian Limestone	23	Low Weald And Pevensey	73
Coal Measures	24	South Downs	74
Dark Peak	25	South Coast Plain and Hampshire Lowlands	75
Urban Mersey Basin	26	Isle of Wight	76
Mosses and Meres	27	New Forest	77
Potteries and Churnet Valley	28	Hampshire Downs	78
South West Peak	29	Berkshire And Marlborough Downs	79
White Peak	30	South Wessex Downs	80
Derbyshire Peak Fringe and Lower Derwent	31	Dorset Heaths	81
Sherwood	32	Isles Of Portland And Purbeck	82
Trent Valley and Rises	33	Wessex Vales	83
North Lincolnshire Coversands And Clay Vales	34	Mendip Hills	84

Name	Reference	Name	Reference
Lincolnshire Wolds	35	Somerset Levels and Moors	85
Lincolnshire Coast and Marshes	36	Mid Somerset Hills	86
The Fens	37	Exmoor And the Quantocks	87
Lincolnshire And Rutland Limestone	38	Vale of Taunton And Quantock Fringes	88
Charnwood	39	Blackdowns	89
Needwood And South Derbyshire Claylands	40	Devon Redlands	90
Oswestry Uplands	41	South Devon	91
Shropshire Hills	42	Dartmoor	92
Midlands Plateau	43	The Culm	93
Midland Clay Pastures	44	Bodmin Moor	94
Rockingham Forest	45	Cornish Killas And Granites	95
Breckland	46	West Penwith	96
North Norfolk	47	The Lizard	97
The Broads	48	Isles of Scilly	113
Suffolk Coast and Heaths	49	Lundy	114
East Anglian Plain	50		

Priority species and Habitats

D1.3.16 The Natural Environment and Rural Communities (NERC) Act came into force on 1st Oct 2006. Section 41 of the Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the Natural Environment and Rural Communities Act 2006, to have regard to the conservation of biodiversity in England, when carrying out their normal functions. **Table D1.7** identifies in particular priority species and habitats for the freshwater environment.

Table D1.7 Freshwater Priority Species and Habitats

Habitats	Species	
Aquifer-fed naturally fluctuating water bodies	*Branta bernicla*	Dark-bellied Brent Goose
Eutrophic standing waters	*Cygnus columbianus bewickii*	Bewick's Swan
Mesotrophic lakes	*Emberiza schoeniclus schoeniclus*	Reed Bunting
Oligotrophic and dystrophic lakes	*Motacilla flava*	Yellow Wagtail
Ponds	*Numenius arquata*	Curlew
Rivers	*Vanellus vanellus*	Lapwing
Reedbeds	*Arvicola terrestris*	Water Vole
Lowland fens	*Lutra lutra*	Otter
Coastal and floodplain grazing marsh	*Bufo bufo*	Common Toad

Habitats	Species	
Wet woodland	*Natrix natrix*	Grass Snake
	Triturus cristatus	Great Crested Newt
	Alosa alosa/fallax	Allis/Twaite Shads
	Anguilla anguilla	European Eel
	Lampetra fluviatilis	River Lamprey
	Osmerus eperlanus	Smelt
	Petromyzon marinus	Sea Lamprey
	Salmo salar	Atlantic salmon
	Salmo trutta	Brown/Sea trout
	Leersia oryzoides	Cut-grass
	Luronium natans	Floating Water Plantain
	Oenanthe fistulosa	Tubular Water-dropwort
	Potamogeton compressus	Grass-wrack Pondweed
	Pilularia globulifera	Pillwort
	Sium latifolium	Greater Water Parsnip
	Aeshna isosceles	Norfolk Hawker
	Austropotamobius pallipes	White-clawed Crayfish
	Coenagrion mercuriale	Southern Damselfly
	Margaritifera margaritifera	Freshwater Pearl Mussel
	Pisidium tenuilineatum	Fine-lined Pea Mussel
	Pseudanodonta complanata	Depressed River Mussel
	Valvata macrostoma	Large-mouthed Valve Snail
	Vertigo moulinsiana	Desmoulin's Whorl Snail

National Character Areas

D1.3.17 England has been divided into areas with similar landscape character, which are called National Character Areas (NCAs). A total of 159 NCAs have been identified in England.[9] The boundaries of the NCAs are not precise and many should be considered as broad zones of transition. Natural England have rewritten and redesigned all of England's 159 NCA profiles and published the revised profiles in September 2014.

D1.4 Summary of Existing Problems Relevant to Waste and Resources

D1.4.1 The SEA Directive requires consideration of any existing environmental problems which are relevant to the plan or programme, particularly those areas of environmental importance pursuant to

[9] Natural England (2014) *National Character Area profiles: data for local decision making*. Available online at: https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making

Directives 2009/147/EC and 92/43/EC (the Birds and Habitats Directives). An analysis[10] of the causes of unfavourable condition and threats to the range of habitats by Natural England has revealed the key pressures and risks to be outlined below. Those in bold are considered to be exacerbated by waste and waste management issues:

- **habitat destruction and fragmentation by development;**
- agricultural intensification and changes in agricultural management practices;
- changes in woodland and forestry management;
- **water abstraction, drainage or inappropriate river management;**
- inappropriate coastal management;
- lack of appropriate habitat management;
- atmospheric pollution (acid precipitation, nitrogen deposition);
- water pollution from both point and wider (diffuse) agricultural sources;
- **climate change and sea level rise;**
- sea fisheries practices;
- recreational pressure and human disturbance; and
- invasive and non-native species.

D1.4.2 While the Natural England report focused primarily on impacts resulting from landfill, it is considered that the development of any new waste management infrastructure could have an impact on these issues e.g. habitat destruction, water abstraction, atmospheric pollution, water pollution, although effects will be managed through the planning and permitting systems.

D1.4.3 **Table D1.8** presents an overview of the key issues for biodiversity and nature conservation relevant to the WMPE.

Table D1.8 Biodiversity and Nature Conservation Problems Relevant to the WMPE

Problem	Supporting Data	Potential Effects
Loss of biodiversity	The status of UK priority habitats and species in 2012 indicates that the decline of biodiversity is a long-term issue. Between 2007 and 2012, populations of priority species declined by 4 per cent relative to their value in 2007. This decrease is not statistically significant. Within the index over this short-term period, 47 per cent of species showed an increase and 53 per cent showed a decline. By 2012, populations of priority species overall had declined to 33 per cent of the 1970 index value, a statistically significant decrease. Over this long-term period 25 per cent of species showed an increase and 75 per cent showed a decline.	The construction of infrastructure, including waste management infrastructure, has the potential to affect biodiversity and ecosystem resilience. Impacts may be direct (for example, the loss of, or damage to, habitats and species) or indirect (for example, disturbance due to noise and emissions to air associated with construction works). The operation of waste management infrastructure (including landfills) could result in emissions to air, soils and water, which have the potential to affect
Risks to the condition of certain habitat features	For NNRs, SSSIs, SPAs, SACs and RAMSAR sites, typically around 95% of the total site area is either in a favourable or recovering state. Whilst this is a positive testament to the efforts to improve these sites, it should be noted that those sites that are 'recovering' remain in an unfavourable state at present and gains in their status could be reversed. This is particularly important for those sites that are vulnerable to changes in the local hydrological environment. It should be noted that those sites of nature conservation importance	

[10] Natural England (2008) *State of the Natural Environment Report*

Problem	Supporting Data	Potential Effects
	that were least favourable were often impacted by factors which operated outside the sites on which they were designated (e.g. drainage conditions for some isolated wetlands) and which require concerted effort by many agencies (e.g. water quality affecting fish).	habitats and species and wider ecosystem resilience. Transport, including waste collection logistics, could impact upon habitats through pollution and climate change. The release of litter into the environment, including marine litter, can cause harm to species. Using the waste hierarchy to improve resource efficiency could reduce the extraction of raw materials. The per-kg environmental impacts of secondary materials are estimated to be an order of magnitude lower than for primary materials. Waste practices may affect the spread of invasive species, for example through the disposal of soil or plant material contaminated with invasive non-native plants Ensure WMPE does not adversely affect the status of conservation features or contribute to those factors identified as a threat to freshwater habitats and species.
Threats to UK freshwater habitats	UK freshwater habitats and their associated species are threatened by a range of factors. These include: • Point and diffuse pollution; • Water abstraction for drinking water; agricultural or industrial uses; • Invasive alien species; • Morphological alterations; • Recreation; • Fisheries management; • Climate change; and • Grazing/control of scrub and trees. It is anticipated that waste local plans will have the ability to directly address a number of these affects, in particular pollution, water abstraction and addressing climate change. The planning and permitting systems would also be expected to control operational emissions to avoid significant effects to biodiversity receptors.	

D1.5 Likely Evolution of Baseline

UK

D1.5.1 The general global trend in biodiversity is towards a decreased level of variability among living organisms. The European Commission states that "The loss of biodiversity has accelerated to an unprecedented level in Europe and worldwide. It has been estimated that the current global extinction rate is 1,000 to 10,000 times higher than the natural background extinction rate. In Europe some 42% of European mammals are endangered, together with 15% of birds and 45% of butterflies and reptiles".[11]

D1.5.2 The global trend towards a decline in biodiversity is not mirrored in the UK. The annual review of UK Biodiversity Indicators comprises 24 indicators and 50 measures. In 2018, 41 measures within 18 indicators were updated. A total of 7 measures are not assessed in the long term and 10 are not assessed in the short term. Of the 43 long-term measures, 23 show an improvement, compared to 10 of the measures that were deteriorating (an improvement from 13 in the previous report). Of the 43 short term measures, 16 show an improvement, as compared to 9 in decline (compared to

[11] European Commission (2016) *Why do we need to protect biodiversity*. Available online at: http://ec.europa.eu/environment/nature/biodiversity/intro/index_en.htm

10 in the previous report). Measures that improved or deteriorated in the short term have not necessarily continued to improve or deteriorate respectively in the long term.[12]

D1.5.3 Measures showing an improvement in the short term include: sustainable fisheries; pressure from pollution; total extent of protected areas: at sea; status of UK species of European importance; plant genetic resources; fish size classes in the North Sea; greenhouse gas removals by UK forests; biodiversity data for decision making; and UK expenditure on international biodiversity.

D1.5.4 Measures which have improved in the long term include: volunteer time spent in conservation; area of land in agri-environment schemes; area of forestry land certified as sustainably managed; sustainable fisheries; pressure from pollution; protected areas; wintering waterbirds; mammals of the wider countryside; plant genetic resources; greenhouse gas removals by UK forests; cumulative number of records; and expenditure on UK and international biodiversity.

D1.5.5 Measures showing long-term deterioration include: pressure from invasive species; status of UK priority species (relative abundance); Birds of the wider countryside and at sea (farmland birds and woodlands birds); Insects of the wider countryside (semi-natural habitat specialists and species of the wider countryside); status of pollinating insects.

D1.5.6 Some of these measures have continued to deteriorate in the short term, including area of land in agri-environment schemes, status of UK habitats of European importance, status of UK priority species – relative abundance, birds of the wider countryside and at sea (farmland birds and wintering birds) and public sector expenditure on UK biodiversity.

D1.5.7 A 2016 report by the UK's non-statutory wildlife organisations[13] sets out the following headline results of their assessment of the state of the UK's biodiversity resource:

- using records of 3,816 species, some 56% of these have declined since 1970 and 44% have increased;
- of the nearly 8,000 species assessed using modern Red List criteria, 15% are extinct or threatened with extinction from Great Britain;
- an index of species' status, based on abundance and occupancy data, has fallen by 16% since 1970, and 3% from 2002. An index describing the population trends of species of special conservation concern in the UK has fallen by 67% since 1970 and 12% from 2002;
- policy-driven agricultural change was the most significant driver of declines, although climate change has also had a significant impact, which included both beneficial and detrimental effects on species. Climate change is highlighted as one of the greatest long-term threats to nature globally; and
- a new measure, which assesses how intact a country's biodiversity is, suggests that the UK has lost significantly more nature over the long term than the global average.

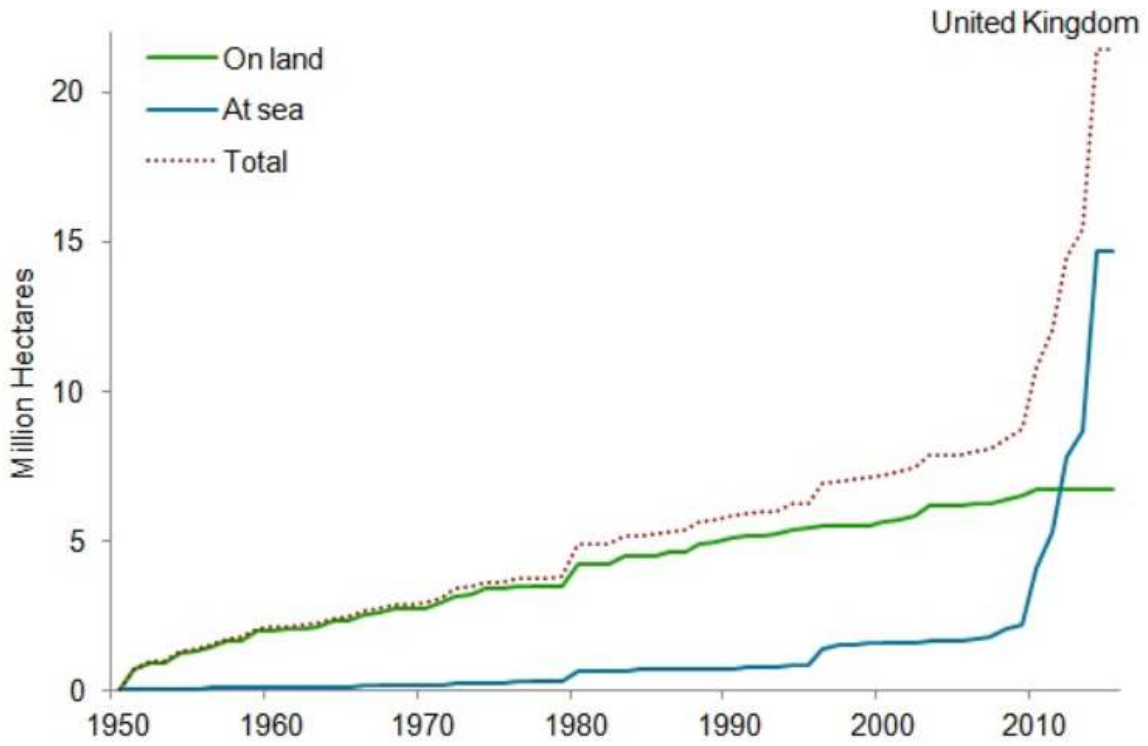
D1.5.8 In response to these challenges and to ensure habitats and species receive protection in the UK, there has been an increase in the number of sites and areas protected for biodiversity, flora and fauna[14] (see **Figure D1.3**).

[12]Defra (2018) *UK Biodiversity Indicators 2018*. Available online at: jncc.defra.gov.uk/pdf/UKBI_2018.pdf

[13] Hayhow DB, Burns F, Eaton MA, *et al*. (2016) *State of Nature 2016*. The State of Nature partnership. Available online at: http://www.rspb.org.uk/Images/State%20of%20Nature%20UK%20report_%2020%20Sept_tcm9-424984.pdf

[14] Joint Nature Conservation Committee (2015) *Protected Areas*. Available online at: http://jncc.defra.gov.uk/page-4241

Figure D1.3 Extent of UK Nationally and Internationally Important Protected Areas: (i) on-land; (ii) at-sea, 1950 to 2015



Source: Joint Nature Conservation Committee, Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage.

Notes: The boundary between protected areas on-land and at-sea is mean high water (mean high water spring in Scotland). Coastal sites in the indicator are split between 'on-land' and 'at-sea' if they cross the mean high water mark. At-sea extent includes offshore marine protected areas out to the limit of the UK continental shelf.

Based on calendar year of site designation. For 2015, the data cut-off is 31 July.

Extent is based on the following site designations: Areas of Special Scientific Interest, Sites of Special Scientific Interest, National Nature Reserves, Marine Conservation Zones, Nature Conservation Marine Protected Areas, Ramsar Sites, Special Areas of Conservation (including candidate Special Areas of Conservation and Sites of Community Importance), Special Protection Areas, Areas of Outstanding Natural Beauty, National Scenic Areas, National Parks.

D1.5.9 The overall total extent of land and sea protected in the UK through national and international protected areas and through wider landscape designations, has increased by 10.7 million hectares over five years, from 10.8 million hectares in December 2010 to 28.0 million hectares at the end of March 2018. This increase is almost entirely down to the designation of inshore and offshore marine sites.

D1.5.10 The indicator also shows the condition of Areas or Sites of Special Scientific Interest (A/SSSIs) on land. A/SSSIs are surveyed periodically to assess whether they are in good condition (favourable) or, if not, they are under positive management (unfavourable-recovering). Since 2005, the percentage of features or area of A/SSSIs in favourable or recovering condition has increased from 67% to 84% in 2010 and to 94.3% in 2017. This change reflects improved management of sites, but may also be affected by a greater number of sites/features having been assessed over time. The majority of protected areas on land are A/SSSIs, so the condition indicator is not representative of marine sites.

England

D1.5.11 Results of the 2018 reporting of biodiversity indicators for England[15] reveal that, of the 51 individual measures making up the indicators, 21 of the 37 measures assessed over the long term show an improvement, as do 17 of the 35 measures that are assessed over the short term. Some 11 measures (22%) show a decline in the short term and 10 show a decline in the long term.

D1.5.12 Those showing a deterioration over the long term are:

- change in the abundance of priority species – abundance;
- butterflies of the wider countryside on woodland;
- breeding farmland birds;
- butterflies of the wider countryside on farmland;
- woodland birds;
- status of pollinating insects;
- effective population size of native horse breeds at risk; and
- trends in pressures on biodiversity; invasive species (terrestrial species, freshwater species and marine coastal species)

D1.5.13 There has been a net decrease in the area of SSSIs in favourable condition; down from 44% in 2003 to 38.8% in March 2018. It is evident from this that restoring species and habitats to favourable condition is difficult and to reverse previous declines in species populations or to restore the ecological functioning of habitats will take many years.

D1.5.14 However, the area of SSSIs in unfavourable recovering condition increased substantially from 13% in 2003 to 55.5% in 2018. The overall proportion of SSSIs in favourable or recovering condition surpassed 95% since 2011 to 2017 but fell slightly to 94.3% in 2018.

D1.5.15 Identifying an overall trend for biodiversity in England would be to risk masking various significant trends at the species / habitat level. The interaction between trends is also highly uncertain. The biodiversity indicators for England identify an ongoing decline in both the abundance and distribution of priority species. It is possible that the increasing area of protected land may halt the decline in biodiversity, but there is a high degree of uncertainty.

D1.5.16 Two of the biodiversity indicators in decline relate directly to agricultural land, however agricultural practices may be affected by the UK's withdrawal from the European Union. How agricultural practices may change, and in turn the effect on biodiversity, is uncertain.

D1.6 Waste Management Effects on Biodiversity and Nature Conservation

D1.6.1 The approach to waste management can have direct and indirect effects on biodiversity, which are discussed in this section. As the WMPE does not contain specific location-based policies, the possible impacts of waste management on biodiversity are considered here in a generic manner.

[15] Defra (2015) *Biodiversity 2020: a strategy for England's wildlife and ecosystem services – Indicators*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/726851/England_biodiversity_indicators_2018_final.pdf

Waste Infrastructure

D1.6.2 Waste management infrastructure can include facilities such as landfill sites, incineration plants, recycling sorting facilities and reprocessing plants.[16] The construction of waste management infrastructure has the potential to affect biodiversity and ecosystem resilience. Impacts may be direct (for example, the loss of, or damage to, habitats and species) or indirect (for example, disturbance due to noise and emissions to air associated with construction works).[17] The nature and scale of many of these impacts are dependent upon the specific location, the scale, and the nature of specific waste facilities.

D1.6.3 As highlighted in the 2013 Environmental Report, the footprint of waste facilities varies depending on factors such as the type, configuration and scale of facility, and in specific circumstances, this could lead to habitat loss or fragmentation. However, this might be expected only in relatively extreme cases, and the planning system would be expected to prevent fragmentation and harm to habitats.

D1.6.4 The operation of waste management infrastructure (including landfills) could result in emissions to air, soils and water,[16] which have the potential to affect habitats and species and wider ecosystem resilience.[17] The nature and scale of emissions would again be dependent on the type of waste facility, the location, and sensitivity of the receiving environment. The planning and permitting systems would be expected to control operational emissions to avoid significant effects.

D1.6.5 In addition, greenhouse gas emissions from the waste sector accounts for 4% of the UK's total emissions, with methane from landfill accounting for the majority of these emissions.[18] The release of greenhouse gases is causing climate change, which is identified in the baseline as one of the key threats to biodiversity. The application of the waste hierarchy and the prevention of biodegradable waste going to landfill would therefore reduce greenhouse emissions. However, in the context of UK and global greenhouse gas emissions, any positive effects on biodiversity in this regard are likely to be limited.

D1.6.6 The 2013 Environmental Report also notes that "There may be impacts on the marine environment associated with some specific facilities. On the negative side, emissions from facilities, or mismanagement of wastes, could potentially have a negative effect on marine water quality, for example, through excessive nutrient run-off from some wastes spread on land under recovery operations. Equally, the use of some waste management techniques might have a positive effect in binding the same nutrients that might lead to such run-off to humus, thereby reducing the problems of excessive nutrient loading."

D1.6.7 It is also possible for former waste infrastructure sites to bring benefits for biodiversity. For example, the Thurrock Thameside Nature Park is a former landfill which has reclaimed 120 acres of land for a nature and wildlife site. Essex Wildlife Trust describes the site as "*a tremendous habitat for coastal and wetland wildlife, as well as very important grassland flora and fauna species*".[19] In addition, new facilities may offer opportunities to introduce biodiversity enhancement measures such as improving wildlife corridors.

[16] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Evidence Annex.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf
[17] Natural England (2008) *State of the Natural Environment Report.* Available online at: http://publications.naturalengland.org.uk/file/63039
[18] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf
[19] Essex Wildlife Trust (2019) *Thurrock Thameside Nature Park*. Available online at: https://www.essexwt.org.uk/nature-reserves/thurrock-thameside

D1.6.8 Transport, including waste collection logistics, also has the potential to impact habitats through pollution, noise and climate change.[17]

D1.6.9 The mismanagement of waste may affect the spread of invasive species, for example through the disposal of soil or plant material contaminated with invasive non-native plants,[20] although this is expected to be avoided through correct waste management. Non-native species cannot be composted as the invasive species are typically persistent, will survive the composting process and would go on to infect areas where the compost is used, with potential effects on local ecosystems.

Release of Waste

D1.6.10 The release of litter into the environment can cause harm to species. The Scottish Government highlights that in terms of biodiversity, the most significant effects are on the marine environment.[21] Beach litter is generally considered to be the best indicator of marine litter. It is difficult to trace a lot of marine litter to source, due to fragmentation. At the global scale it has been reported that up to 80% is derived from land based sources.[22] In the UK approximately 47% was from land based sources, 17% from fishing and shipping and a further 37% is non-sourced.[23] Effects on wildlife can include issues such as the entrapment and death of small mammals in discarded bottles or drinks cans, and entanglement in multi-pack plastic rings.[24,25] Additionally, the effects of litter on animals include suffocation or choking, ingestion, entanglement and lacerations.

D1.6.11 Litter is pervasive in the marine environment, and can be found along beaches, floating out at sea and on the sea floor, with plastic bags found in even the deepest part of the planet, the Mariana Trench.[26] For plastic waste alone, it was estimated that in 2010, between 4.8 million and 12.7 million tonnes of land-based plastic waste entered the oceans on a global scale.[27] In 2018, plastic/ polystyrene pieces were found to be the most prevalent type of litter on UK beaches, followed by glass, cigarette stubs, and food packets.[28] In the 2018 Great British Beach Clean, UK beaches were found to have 601 items of litter per 100 metres of beach surveyed.[28]

D1.6.12 Marine animals and sea birds can mistake marine litter for food. A review in 2012 found that 26% of all known species of marine mammels (30 species), 38% of known species of seabirds (119 species) and 86% of known species of sea turtles (6 species) were found to have records of ingestion of marine debris, the majority of which was plastic debris.[29] For example, KIMO found

[20] GOV.UK (2019) *Stop invasive non-native plants from spreading*. Available online at: https://www.gov.uk/guidance/prevent-the-spread-of-harmful-invasive-and-non-native-plants
[21] Scottish Government (2013) *National and Marine Litter Strategies: Strategic Environmental Assessment Environmental Report*. Available online at: https://www2.gov.scot/seag/seagDocs/SEA-00808/14357.pdf
[22] Faris, J., & Hart, K. (1994). *Seas of debris: a summary of the third international conference on marine debris. Miami, Florida*. Cited in Scottish Government (2012) *Marine Litter Issues, Impacts and Actions*. Available online at: https://www.gov.scot/binaries/content/documents/govscot/publications/impact-assessment/2012/09/marine-litter-issues-impacts-actions/documents/00402421-pdf/00402421-pdf/govscot%3Adocument
[23] Marine Conservation Society (2011) *Beachwatch Method and Results*. Available online at: https://www.mcsuk.org/downloads/pollution/beachwatch/latest2011/Methods%20&%20Results%20BW10.pdf
[24] Keep Britain Tidy (2018) *Journal of Litter and Environmental Quality: Volume 2, Number 1*. Available online at: https://www.keepbritaintidy.org/sites/default/files/resource/15913_Journal%20of%20Litter%20and%20Environmental%20Quality_v7-online%20%281%29.pdf
[25] European Environment Agency (2016) *Litter in our seas.* Available online at: https://www.eea.europa.eu/signals/signals-2014/close-up/litter-in-our-seas
[26] National Geographic (2019) *Plastic proliferates at the bottom of world's deepest ocean trench*. Available online at: https://news.nationalgeographic.com/2018/05/plastic-bag-mariana-trench-pollution-science-spd/
[27] Jambeck, J.R., et al (2015) *Plastic waste inputs from land into the ocean*, Science, 347, p. 768-771. Available online at: https://science.sciencemag.org/content/347/6223/768.abstract?ijkey=BXtBaPzbQgagE&keytype=ref&siteid=sci
[28] MCS (2018) *25th Great British Beach Clean: 2018 Report*. Available online at: https://www.mcsuk.org/media/gbbc-2018-report.pdf
[29] Secretariat of the Convention on Biological Diversity (2012) *CBD Technical Series No. 67: Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions*. Available online at: https://www.cbd.int/doc/publications/cbd-ts-67-en.pdf

that 98% of fulmars in the North Sea have plastic in their stomachs, which can affect digestion and lead to loss of physical condition and may lead to starvation.[30]

D1.6.13 Species such as seals, dolphins, sea turtles and fish can get entangled in larger pieces of plastic debris, including lost fishing nets and lines which can make up to 40% of marine litter by weight. This presents acute risk to mammals, fish and seabirds, by entangling and suffocating.

D1.6.14 Microplastics (<5mm in size) are also estimated to be widespread in the marine environment, with concentrations in some locations at the water surface ranging from thousands to hundred thousands of particles per km^2. Microplastics can be either primary: pre-production pellets and those intentionally added to products (the sale of personal care products containing microbeads is now banned in the UK[31]); or secondary: fragments of larger plastics resulting from exposure to sunlight and seawater. Determining the extent of harm from microplastics is very unclear due to insufficient data, however microplastics are thought to have the potential to cause harm to species through ingestion, and affect growth and reproduction.[32] They may also exacerbate the transfer of chemical contaminants. Evidence is also emerging which shows that microscopic species such as zooplankton have been observed to ingest microplastics, and this presents new direct and indirect issues to marine food webs.[32,33] While there is uncertainty about the current scale of effects, it is thought that at present, microplastic pollution does not constitute a widespread risk, but that microplastics could cause a widespread risk in the near future if releases are not managed[32], although the lack of data means that this is still highly uncertain.

D1.6.15 The 2013 Environmental Report also highlights the risks of transport of non-native and invasive species on marine litter[34] and the concentration of toxic chemicals from seawater[35].

Materials use

D1.6.16 The use of resources requires materials and energy for the extraction of raw materials, transportation and the manufacture of goods. The extraction of primary raw materials can have a range of effects on biodiversity, as detailed below. These extend consideration outside the UK, to reflect a full lifecycle approach to the effects of waste. The effects could be reduced through the application of the waste hierarchy to improve resource efficiency through waste avoidance, reuse of products and recycling, as this could reduce the need for extraction of primary raw materials.

D1.6.17 As highlighted in the 2013 Environmental Report, while there may be specific concerns relating to the impacts on biodiversity associated with the extraction of specific ores (e.g. the production of arsenic as a by-product of copper), there are more general biodiversity impacts related to minerals extraction. Typically, the greatest risks to biodiversity are when mining ventures enter relatively remote and undisturbed areas,[36] particularly those such as rainforests with high biodiversity value. The act of building access roads for exploration purposes brings significant risks to biodiversity, as the raised expectations of potential large-scale benefits often trigger rapid in-migration. Large scale biodiversity loss occurs as colonisers must clear land for settlement and farming and take out

[30] KIMO (2019) *Marine Litter*. Available online at: http://www.kimointernational.org/action-areas/marine-litter/
[31] Defra (2019) *World leading microbeads ban comes into force*. Available online at: https://www.gov.uk/government/news/world-leading-microbeads-ban-comes-into-force
[32] European Commission Scientific Advice Mechanism (2019) *Environmental and Health Risks of Microplastic Pollution.* Available online at: https://ec.europa.eu/info/publications/environmental-and-health-risks-microplastic-pollution_en
[33] House of Commons Environmental Audit Committee (2016) *Environmental impact of microplastics: Fourth Report of Session 2016–17*. Available online at: https://publications.parliament.uk/pa/cm201617/cmselect/cmenvaud/179/179.pdf
[34] Cheshire, A.C., et al (2009) *UNEP/IOC Guidelines on Survey and Monitoring of Marine Litter*. UNEP Regional Seas Reports and Studies, No. 186; IOC Technical Serious No. 83.
[35] Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts, National Research Council, Ocean Studies Board and Division on Earth
[36] International Institute for Environment and Development (2002) *Breaking New Ground: Mining, Minerals and Sustainable Development*, 1 May 2002

economically valuable wild species to supplement their income or for food. Sometimes new people and activities in an area can also bring in alien pests and diseases that have detrimental effects. It is worth noting that much of this may all be at its most intense before mining starts, and before any major mining company is involved, and activities are frequently ungoverned and unregulated.[36]

D1.6.18 The OECD highlights that effects associated with metals, minerals, wood and biomass include the release of toxic substances into aquatic and terrestrial ecosystems (ecotoxicity), habitat loss and alteration, and air and water pollution. [37] In addition, noise and vibration, dust, landslides and species disturbance and displacement can take place.[38] The OECD study found that, of the materials investigated in the report, copper and nickel had the greatest environmental impacts per kilogram of material. Primary copper production had the greatest effect on freshwater aquatic ecotoxicity, while nickel had the greatest effects on terrestrial ecotoxicity and eutrophication. Aluminium and nickel production also had the greatest land use requirements per kg, which could affect local habitats. Iron had the greatest overall impacts due to the large volumes used.

D1.6.19 Ore mining is particularly identified as placing pressure on biodiversity, and may temporarily or permanently alter wildlife habitats.[37] Open cast methods disturb larger surface areas than underground or deep open pit mining,[39] with resulting habitat loss in previous undeveloped areas. Increasing global demand for ores such as bauxite has led to the introduction of newly producing countries, and in some cases operators have limited experience and introduce poor mining practices. [39] This has the potential to have greater impacts on local species and habitats.

D1.6.20 Recycling materials also has environmental and biodiversity impacts, however the per-kg environmental impacts associated with the production, processing and use of secondary materials are estimated to typically be an order of magnitude lower than for primary materials.[37] The environmental effects for secondary copper production are a factor of 4-60 times lower than primary production, and secondary nickel production are 25-300 times lower than primary production. However, there is some variation within materials, as for example, secondary iron production has greater terrestrial ecotoxicity impacts than primary iron (although still much lower than other materials).

D1.6.21 The extraction and processing of primary raw materials can have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements. Refining mined ores into metal is particularly energy and water intensive.[37] The extraction of fossil fuels for energy can cause pollution and disturb habitats, depending on the location and nature of extraction. Consumption of fossil fuels also leads to the release of greenhouse gases which has global consequences for climate change, and is one of the key threats to biodiversity today. Water use also has the potential to place pressure on habitats and species, depending on the location and local water stress. Avoiding the need for production through the avoidance of waste or reuse of products reduces the associated need for energy and water, with consequential benefits for biodiversity.

D1.6.22 Recycling materials also reduces energy and water requirements, which would have beneficial effects for biodiversity (depending on energy source and water pressures). For example, recycling one tonne of steel uses 40% less water than primary steel production, and avoids the need for 630 kg of coal (assuming coal-based energy),[40] while recycling one tonne of paper would save 26,000

[37] OECD (2019) *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*. Available online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page1
[38] European Commission (2011) *Non-energy mineral extraction and Natura 2000: Guidance Document, 2011*
[39] World Aluminium (2018) *Sustainable Bauxite Mining Guidelines, First Edition*. Available online at: http://www.world-aluminium.org/media/filer_public/2018/05/18/170518_sbmg_final.pdf
[40] Bureau of International Recycling, *Ferrous Metals*. Available online at: https://bir.org/industry/ferrous-metals/

litres of water and 270 litres of oil.[41] However for some materials such as zinc, energy demand for secondary production can still be notable, although lower than for primary production.

D1.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D1.7.1 **Table D1.9** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D1.9 Assessment of the Draft WMPE and reasonable alternative

Biodiversity and Nature Conservation		
To protect and enhance biodiversity (habitats, species and ecosystems) working within environmental capacities and limits		
• Will the draft WMPE protect and/or enhance internationally designated nature conservation features and sites e.g. Special Areas of Conservation, Special Protection Areas, Ancient Woodlands, Marine Protected Areas and Ramsar Sites? • Will the draft WMPE protect and/or enhance nationally designated nature conservation sites e.g. Sites of Special Scientific Interest? • Will the draft WMPE protect and/or enhance priority species and habitats or species of conservation concern? • Will the draft WMPE affect non-designated habitats and species including protected species? • Will the draft WMPE affect the structure, function and resilience of natural systems (ecosystems)? • Will the draft WMPE lead to an improvement in natural capital and a net gain in biodiversity?		
	Effect	**Commentary**
WMPE		
Prevention	++	The Government's commitments include the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. While 'avoidable' waste includes waste that could have been reused, recycled, composted or when a reusable or recyclable alternative could have been used, it is assumed that waste prevention will have a central role in eliminating these waste streams. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The WMPE contains a commitment that 'the waste producer and the waste holder should manage waste in a way that guarantees a high level of protection of the environment and human health'. The plan is therefore expected to help protect habitats and species from impacts from waste. Waste prevention measures are expected to reduce volumes of residual waste being collected for disposal which may require changes to waste management infrastructure. This has the potential to reduce disturbance to sensitive species, depending on the locations involved. However, this is not certain as there could also be an increase in infrastructure for reuse and recycling as part of the elimination of avoidable waste. The extraction of primary raw materials can have a range of effects on biodiversity, which extend consideration outside the UK, to reflect a full lifecycle approach to the effects of waste. Effects associated with extraction of metals, minerals, wood and biomass include the release of toxic substances into aquatic and terrestrial ecosystems (ecotoxicity), habitat loss and alteration, and air and water pollution,[37] all of which can have detrimental effects on biodiversity. In addition, noise and vibration, dust, landslides and species disturbance and displacement can take place,[38] depending on the locations involved. Ore mining is particularly identified as placing pressure on biodiversity, and may temporarily or

[41] Bureau of International Recycling, *Paper*. Available online at: https://bir.org/industry/paper/

		permanently alter wildlife habitats.[37] Open cast methods disturb larger surface areas than underground or deep open pit mining,[39] with resulting habitat loss in previous undeveloped areas. Typically, the greatest risks to biodiversity are when mining ventures enter relatively remote and undisturbed areas,[36] particularly those such as rainforests with high biodiversity value. The effects could be reduced through waste avoidance, as this could reduce the need for extraction of primary raw materials, although the extent of any reduction is uncertain. The extraction and processing of primary raw materials can have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements. The extraction of fossil fuels for energy can cause pollution and disturb habitats, depending on the location and nature of extraction. Consumption of fossil fuels also leads to the release of greenhouse gases which has global consequences for climate change, and is one of the key threats to biodiversity today. Water use also has the potential to place pressure on habitats and species, depending on the location and local water stress. Avoiding the need for production through the avoidance of waste reduces the associated need for energy and water, with consequential benefits for biodiversity. Eliminating avoidable waste through waste prevention is expected to have beneficial effects on biodiversity through a reduction in releases of litter. On land, the greatest sources of litter are food and food packaging and alcoholic and non-alcoholic drinks packaging, while plastics, particularly single use plastic bags and drinks bottles, are the most significant type of litter in the marine environment. Litter can be mistaken for food causing starvation, may contain toxic chemicals, and can cause entrapment, entanglement and suffocation. Given the pervasiveness of marine litter and the extent of harm caused, reducing the release of litter has been determined as a significant positive effect on biodiversity. Microplastics (plastic particles <5mm in size) are also found to be widespread in the marine environment, which can form either from the breakdown of larger plastic items of litter, or the release of microfibers from clothes or plastic pre-production pellets.[36] Microplastics have the potential to cause harm to species through ingestion and effects on growth and reproduction, and have been found to enter the food chain. While there is uncertainty about the current scale of effects, it is thought that microplastics could cause a widespread risk in the near future if releases are not constrained. The prevention of waste could reduce the release of microplastics into the environment, which could help reduce the risk of harm to species. Overall, the WMPE is likely to have a significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	++	The commitments in the WMPE for the elimination of avoidable waste will include increases in reuse of products and materials. Reuse is also supported by Defra's target to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. Increased reuse of items in the home may lead to a reduction in waste and recycling collections, with associated reduced disturbance to species. However, reuse between businesses or through reuse networks may result in more vehicle movements, so the overall effect is uncertain. An increase in reuse may result in reduced production and manufacture of products, however the extent of this is not known. As set out above, the extraction and processing of primary raw materials can have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements, as a result of pollution, disturbance, climate change and potential water stress, depending on location and activities. Avoiding the need for production through the reuse of products reduces the associated need for energy and water, with consequential benefits for biodiversity. As for waste prevention, an increase in the reuse of products is expected to reduce littering, as fewer single use items such as plastic bags and drinks bottles are discarded. It is also expected to contribute to a reduction in the release of microplastics to the environment, potentially from reduced littering, reduced purchases of new clothing and reduced use of pre-production pellets (if manufacturing is reduced). For the reasons detailed above, this has the potential for a significant positive effect on biodiversity.

		As such, the WMPE is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling	++/-	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035, and to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. There are also commitments to reduce avoidable waste, which includes elements of recycling. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as a potential food waste collection system (this could be recycled through composting, or recovered, through AD plants). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. The WMPE will support the recycling however Tolvik (2017) highlight that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. As more waste material is collected for recycling, there may be a requirement for additional waste infrastructure or additional vehicle movements to take material to sites with capacity. Increased vehicle movements to collect and transfer recyclable materials could cause disturbance to sensitive species, depending on locations. The construction of recycling infrastructure has the potential to affect biodiversity and ecosystem resilience. Impacts may be direct (for example, the loss of, or damage to, habitats and species) or indirect (for example, disturbance due to noise and emissions to air associated with construction works).[17] The extent of many of these impacts are dependent upon the specific location, the scale, and the nature of specific waste facilities. The footprint of waste facilities varies depending on factors such as the type, configuration and scale of facility, and in specific circumstances, this could lead to habitat loss or fragmentation. However, this might be expected only in relatively extreme cases, and the planning system would be expected to prevent fragmentation and harm to habitats. In addition, new facilities may offer opportunities to introduce biodiversity enhancement measures such as improving wildlife corridors, although it is uncertain whether these would be incorporated. The operation of recycling infrastructure could result in emissions to air, soils and water,[16] which have the potential to affect habitats and species and wider ecosystem resilience,[17] including dust, vehicle emissions and disturbance from transport. The nature and scale of emissions would again be dependent on the type of waste facility, the location, and sensitivity of the receiving environment. The planning and permitting system would be expected to control operational emissions to avoid significant effects, for example on designated sites or features, or protected species. As set out above, the extraction and processing of primary raw materials can have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements, as a result of pollution, disturbance, climate change and potential water stress, depending on location and activities. Recycling materials also has environmental and biodiversity impacts, however the per-kg environmental impacts associated with the production, processing and use of secondary materials are estimated to typically be an order of magnitude lower than for primary materials[37] (although there is some variation depending on materials), thus reducing the effect on biodiversity. Recycling materials also reduces energy and water requirements, which would have beneficial effects for biodiversity (depending on energy source and water pressures). The planned reform of the packaging producer responsibility system aims to reduce unnecessary and hard to recycle packaging, which could provide a source of high quality secondary materials for use by domestic reproceesors. Introduction of a DRS could also

		provide a source of high quality separated materials that could be used by reprocessors and so further decrease the demand for virgin materials. An increase in recycling is expected to reduce littering, as fewer items are discarded as litter. One of the proposals set out in the recent consultation on reforming the packaging producer system is for producers to cover the cost of collecting packaging litter. Following the consultation, the Government is further exploring this proposal. Including the cost of litter collection under a reformed packaging producer responsibility system has the potential to help further reduce the impact and management of littering. The WMPE also reiterates interest in implementing a DRS in England, which following support in the recent consultation, could target single use drinks containers such as glass bottles, plastic bottles and cans. As drinks packaging is one of the greatest sources of litter, the introduction of a DRS has the potential to further reduce littering of bottles and cans, assuming that more container are returning for recycling rather than released as litter. Recycling is also expected to contribute to a reduction in the release of microplastics to the environment, potentially from reduced littering and reduced purchases of new clothing. Alongside reductions in littering, this has the potential for a significant positive effect on biodiversity. Pre-production pellets can be made from virgin or recycled plastic, so increased recycling is not expected to have an effect on the scale pellet production and potential loss to the environment.[42] Overall, the WMPE is expected to have a mixed significant positive effect and a minor negative effect, with some uncertainty relating to the requirements and location of new infrastructure, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	-	The WMPE seeks to improve recovery of materials, including anaerobic digestion (AD) and energy from waste (EfW). The WMPE highlights the Government's support for efficient energy recovery from residual waste as the best management option for waste that cannot be reused or recycled, and for AD as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. As highlighted for recycling, the construction of recovery infrastructure has the potential to affect biodiversity and ecosystem resilience. Impacts may be direct (for example, the loss of, or damage to, habitats and species) or indirect (for example, disturbance due to noise and emissions to air associated with construction works).[17] The nature and scale of many of these impacts are dependent upon the specific location, the scale, and the nature of specific waste facilities. The footprint of waste facilities varies depending on factors such as the type, configuration and scale of facility, and in specific circumstances, this could lead to habitat loss or fragmentation. However, this might be expected only in relatively extreme cases, and the planning system would be expected to prevent fragmentation and harm to habitats. New facilities may also offer opportunities to introduce biodiversity enhancement measures such as improving wildlife corridors, although it is uncertain whether these would be incorporated. The operation of recovery infrastructure could result in emissions to air, soils and water,[16] which have the potential to affect habitats and species and wider ecosystem resilience.[17] The nature and scale of emissions would again be dependent on the type of waste facility, the location, and sensitivity of the receiving environment. The planning and permitting system would be expected to control operational emissions to avoid significant effects, for example on designated sites or features, or protected species.

[42] OSPAR Commission (2018) *OSPAR Background document on pre-production Plastic Pellets*. Available online at: https://www.ospar.org/documents?v=39764

		In addition, mismanagement of wastes (where this occurs) could potentially have a negative effect on marine water quality, for example, through excessive nutrient run-off from some wastes spread on land under recovery operations. Equally, the use of some waste management techniques might have a positive effect in binding the same nutrients that might lead to such run-off to humus, thereby reducing the problems of excessive nutrient loading. An increase in vehicle movements associated with movement up the waste hierarchy (and therefore increased movements for collection and transport to recovery sites) could also result in disturbance to sensitive species, depending on the locations. Overall, the WMPE is expected to have the potential for a negative effect, with some uncertainty relating to the requirements and location of new infrastructure, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	Disposal options represent the bottom of the waste hierarchy, and are the least desirable waste management options. These include landfill and incineration without energy recovery, noting the government's intention to work closely with industry to secure a substantial increase in the number of EfW plants that are formally recognised as achieving recovery status. The WMPE outlines key targets which aim to reduce the use of landfill. This includes working towards eliminating food waste going to landfill by 2030, as well as a target within the Waste Framework Directive, which seeks to cut waste to landfill to 10% by 2035. The WMPE also states '*Waste is not accepted for disposal where appropriate opportunities exist to re-use, recycle or treat the waste without undue risks to either human health or the environment, or disproportionate costs*'. The WMPE also highlights that '*Those wishing to dispose of marine waste must demonstrate that appropriate consideration has been given to the internationally agreed hierarchy of waste management options for sea disposal*', meaning that disposal of waste to sea should be avoided, with other methods preferred. The range of commitments outlined in the WMPE will reduce the use of landfill, which include plans to introduce a household waste collection system for food wastes which will divert wastes from landfill into recycling or recovery. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. Closure of landfill sites could reduce adverse effects on species, such as disruption from waste vehicles depending on local circumstances, as well as potential adverse effects arising from leachate to water based habitats and ecosystems if uncontrolled. In addition, the closure of landfill sites can provide restoration opportunities, for example through the creation of nature reserves, such as Thurrock Thameside Nature Park. The reclamation of land for nature and wildlife can bring biodiversity benefits, with Thurrock Thameside identified as a habitat for important grassland flora and fauna species.[43] Greenhouse gas emissions from the waste sector accounts for 4% of the UK's total emissions, with methane from landfill accounting for the majority of these emissions.[18] The release of greenhouse gases is causing climate change, which is identified in the baseline as one of the key threats to biodiversity. The application of the waste hierarchy and the prevention of biodegradable waste going to landfill would therefore reduce greenhouse emissions. However, in the context of UK and global greenhouse gas emissions, any positive effects on biodiversity in this regard are likely to be limited. Overall, the WMPE is expected to have a positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	++/-	The WMPE brings together a range of aims and targets seeking to improve waste management by moving waste up the hierarchy. The reduced extraction of primary raw materials as a result of reduced demand due to waste prevention, reuse and recycling is also expected to avoid pressures on ecosystems. Indirect impacts on biodiversity associated with water and energy requirements (and associated extraction of fossil fuels) due to the extraction and processing of primary raw

[43] Essex Wildlife Trust (2019) *Thurrock Thameside Nature Park*. Available online at: https://www.essexwt.org.uk/nature-reserves/thurrock-thameside

		materials are expected to be reduced, in addition to reductions in greenhouse gas emissions. Eliminating avoidable waste through waste prevention, reuse and recycling is expected to have significant beneficial effects on biodiversity through a reduction in the release of litter, which can cause harm to species on land and in the marine environment. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of the new infrastructure to fill this gap has the potential for effects on biodiversity due to loss or damage of habitats, and potential disturbance and emissions associated with construction and operation. The nature and scale of emissions would be dependent on the type of waste facility, the location, and sensitivity of the receiving environment. The planning and permitting system would be expected to control operational emissions to avoid significant effects, for example on designated sites or features, or protected species, and the identification of sites through waste local plans would be subject to SEA and HRA. New infrastructure or the closure of old sites, such as landfills, may also present opportunities for biodiversity enhancement. Overall, the WMPE is expected to have a mixed significant positive and minor negative effect, relative to the current baseline for the issues covered by this SEA objective and guide questions, with some uncertainty relating to the requirements and location of new infrastructure.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++	The 'Direction of Travel' reasonable alternative seeks to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Less residual waste may be being generated under the reasonable alternative compared to the WMPE, which could result in changes to waste management infrastructure. This has the potential to further reduce disturbance to sensitive species, depending on the locations involved. However, this is not certain as there could also be an increase in infrastructure for reuse and recycling as part of the elimination of avoidable waste. Eliminating avoidable waste in a shorter timeframe may further reduce the requirements for extracting and processing raw materials. Effects associated with extraction of metals, minerals, wood and biomass include the release of toxic substances into aquatic and terrestrial ecosystems (ecotoxicity), habitat loss and alteration, and air and water pollution,[37] all of which can have detrimental effects on biodiversity. In addition, noise and vibration, dust, landslides and species disturbance and displacement can take place,[38] depending on the locations involved. The extraction and processing of primary raw materials can also have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements, and result emissions of greenhouse gases. These effects may be avoided to a greater extent under the reasonable alternative, compared to the WMPE. Meeting the commitments for the elimination of avoidable waste in a shorter timeframe would have similar effects as the WMPE due to the prevention of waste. This has the potential for benefits for biodiversity through the reduction in littering and reduction in the generation of microplastics. As such, the reasonable alternative is likely to have a significant positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	++/?	The reasonable alternative would involve meeting the commitments for the elimination of avoidable waste in a shorter timeframe, which would include an increase in the reuse of products and materials. Greater reuse of items in the home compared to the WMPE may lead to further reductions in waste and recycling collections, with associated reduced disturbance to species. However, increased reuse between businesses or through reuse networks may result in more vehicle movements, so the overall effect of collections under the reasonable alternative is uncertain. An increase in reuse under the reasonable alternative may result in a greater reduction in the production and manufacture of products. This has the potential to reduce the

		associated need for energy and water, with consequential benefits for biodiversity, however the extent of this is not known. Greater increase in the reuse of products may result in a small reduction in littering compared the WMPE, as fewer single use items such as plastic bags and drinks bottles are discarded. It is also expected to contribute further to a reduction in the release of microplastics to the environment, potentially from reduced littering, reduced purchases of new clothing and reduced use of pre-production pellets (if manufacturing is reduced). Overall, the reasonable alternative is likely to have an overall significant positive effect, relative to the baseline due to greater reductions in harm to biodiversity with some uncertainty for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	++/-/?	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE, or to exceed the WMPE's targets for the proportion of waste recycled. As more waste material is collected for recycling under the reasonable alternative, there may be greater requirements for additional waste infrastructure or additional vehicle movements to take material to sites with capacity. Increased vehicle movements to collect and transfer recyclable materials could cause disturbance to sensitive species, depending on locations. The construction and operation of recycling infrastructure has the potential to affect biodiversity and ecosystem resilience through loss or damage to habitats and well as potential disturbance or emissions. However as for the WMPE, the extent of many of these impacts are dependent upon the specific location, the scale, and the nature of specific waste facilities. The planning and permitting system would be expected to control emissions to avoid significant effects, for example on designated sites or features, or protected species. Increased requirements for new infrastructure may also offer greater opportunities to introduce biodiversity enhancement measures such as improving wildlife corridors, although it is uncertain whether these would be incorporated. As for the WMPE, the extraction and processing of primary raw materials can have indirect impacts on biodiversity associated with energy (and associated extraction of fossil fuels) and water requirements, as a result of pollution, disturbance, climate change and potential water stress, depending on location and activities. While recycling does also have environmental and biodiversity impacts, the per-kg impacts are lower and increased recycling would overall be expected to have beneficial effects for biodiversity compared to primary production. In addition, faster introduction of a DRS could provide a source of high quality separated materials that could be used by reprocessors more quickly, and so further decrease the demand for virgin materials. However as highlighted above, there are uncertainties relating to the extent that this would occur. Greater increases in recycling under the reasonable alternative may contribute to a small reduction in littering, particularly with the more rapid introduction of a DRS. The introduction of a DRS has the potential to reduce littering of bottles and cans if more containers are returning for recycling rather than released as litter, although this is uncertain. Overall, the reasonable alternative is expected to have a mixed significant positive effect and a minor negative effect, with some uncertainty relating to the requirements and location of new infrastructure for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	-	The 'Direction of Travel' reasonable alternative seeks to further improve recovery of materials, for example though AD and EfW. Whilst there is currently capacity remaining in AD plants, it is possible that the WMPE ambitions may lead to a need for increased capacity. So while some continued funding is expected as part of the WIDP (including investment in AD and MBT), significant further investment beyond this is not expected although this is not certain. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated.

		As for recycling, the construction and operation of recovery infrastructure has the potential to affect biodiversity and ecosystem resilience through loss or damage to habitats and well as potential disturbance or emissions. However as for the WMPE, the extent of many of these impacts are dependent upon the specific location, the scale, and the nature of specific waste facilities. The planning and permitting system would also be expected to control emissions to avoid significant effects, for example on designated sites or features, or protected species. In addition, a further SEA and HRA would be carried out on waste local plans (in which sites are identified) and EIA and HRA may be required for individual planning applications. Increased requirements for new infrastructure may also offer greater opportunities compared to the WMPE to introduce biodiversity enhancement measures such as improving wildlife corridors, although it is uncertain whether these would be incorporated. Excessive nutrient run-off from some wastes spread on land could have increased effects on water quality under recovery operations. Equally, the use of some waste management techniques might further increase positive effects in binding the same nutrients that might lead to such run-off to humus, thereby reducing the problems of excessive nutrient loading. Compared to the WMPE, a greater increase in vehicle movements associated with avoided disposal (and therefore increased movements for collection and transport to recovery sites) could also result in disturbance to sensitive species, depending on the locations. Overall, the reasonable alternative is expected to have the potential for a negative effect, with some uncertainty relating to the requirements and location of new infrastructure for the issues covered by this SEA objective and guide questions. Although it is also noted that the WMPE itself is anticipated to have a negative effect on the evolution of the baseline.
Disposal (decrease in disposal of waste streams compared to WMPE)	+	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The reasonable alternative will require a quicker adoption of new behaviours and technologies to lessen demand on landfill sites. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. Under the reasonable alternative, landfill sites may close more quickly, however this is uncertain. As for the WMPE, closure of landfill sites could reduce adverse effects on species, such as disruption from waste vehicles depending on local circumstances, as well as potential adverse effects arising from leachate to water based habitats and ecosystems, although any effects would be managed through the permitting system. The potential increased closure of landfill sites may provide more opportunities for restoration on a shorter timescale, with benefits for biodiversity through the provision of habitats. The faster prevention of biodegradable waste going to landfill would also be expected to further reduce greenhouse emissions. However, in the context of UK and global greenhouse gas emissions, as for the WMPE, any positive effects on biodiversity in this regard are likely to be limited. Overall, the reasonable alternative is expected to have a positive effect relative to the baseline for the issues covered by this SEA objective and guide questions.
Cumulative	++/-	Overall, the reasonable alternative is expected to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Increases in recovery, recycling and reuse at a faster rate than the WMPE is expected to have greater beneficial effects on biodiversity. Reduced demand of primary raw materials due to waste prevention, reuse and recycling is expected to avoid pressures on ecosystems. This would arise from reduced extraction of raw materials, and reduced requirements for water and energy compared to the WMPE. However, increases in recycling under the reasonable alternative may also result in requirements for more infrastructure than that required under the WMPE. Significant

		further investment in waste recovery beyond that set out in the WMPE is not expected. New infrastructure has the potential for effects on biodiversity due to loss or damage of habitats, and potential disturbance and emissions associated with construction and operation. The nature and scale of emissions would be dependent on the type of waste facility, the location, and sensitivity of the receiving environment. The planning system would be expected to control operational emissions to avoid significant effects, for example on designated sites or features, or protected species. Small reductions in the release of litter, which can cause harm to species on land and in the marine environment, may also benefit biodiversity. Additional new infrastructure or increased closure of old sites, such as landfills, compared to the WMPE may also present greater opportunities for biodiversity enhancement. Overall, the reasonable alternative is expected to have greater benefits for biodiversity, and has therefore been determined as having a significant positive effect relative to the baseline, for the issues covered by this SEA objective and guide questions, although some uncertainty remains relating to the scale of effects for potential new infrastructure.

Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D1.8 Mitigation

D1.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on biodiversity and nature conservation:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Biodiversity enhancement measures such as improving wildlife corridors could be included for new infrastructure.
- New infrastructure should be appropriately sited to avoid impacts on sensitive habitats and species, and to avoid habitat fragmentation.
- Restoration of landfill sites could provide nature reserves for wildlife.

D1.9 Uncertainties

- The overall change in waste collections and vehicle movements, and the resulting scale of effects on biodiversity, are not certain.
- The extent that the WMPE will reduce littering and release of microplastics is not certain.
- There is currently uncertainty regarding the effects of microplastics on biodiversity.
- The extent and location of avoided extraction of primary raw materials is not known.
- The scale, type and source of avoided energy consumption, and the volume and location of avoided water consumption, from reduced processing and manufacturing associated with primary raw materials is not certain.
- The scale, type and location of new infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The scale of improvements in recycling quality and the associated reduction in demand for virgin materials are not certain.
- The inclusion of biodiversity enhancement measures for new infrastructure is not certain.
- The scale of future landfill restoration is not certain.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.

D2. Population, Economics and Skills

D2.1 Introduction

D2.1.1 This section presents the overview of the baseline information for the assessment of the WMPE and reasonable alternatives in respect of population, economics and skills.

D2.1.2 There are links between the population, economics and skills topic and a number of other topics in the WMPE, in particular human health, traffic and transport, air quality and climate change.

D2.2 Review of plans and programmes

D2.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D2.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to population, economics and skills. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D2.1 Population, Economics and Skills Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2001) Strategy for Sustainable Development (COM/2001/0264) (Renewed in 2006)
European Commission (2006) European Employment Strategy
European Commission (2013) Towards Social Investment for Growth and Cohesion – including implementing the European Social Fund 2014-2020
World Commission on Environment and Development (1987) Our Common Future (The Brundtland Report)
The World Summit on Sustainable Development (WSSD), Johannesburg, September 2002 - Commitments arising from Johannesburg Summit (2002)
National Plans and Programmes
Department of Business, Energy and Industrial Strategy (BEIS) (2017) Clean Growth Strategy
Defra (2011) Mainstreaming sustainable development: the government's vision and what this means in practice
HM Government (2005) Securing the Future – the UK Sustainable Development Strategy
HM Government (2006) The Natural Environment and Rural Communities (NERC) Act 2006
HM Government (2013) The Community Infrastructure Levy (CIL) (Amendment) Regulations 2013
MHCLG (2019) National Planning Policy Framework (NPPF)

D2.3 Overview of the Baseline

Population and demographics

D2.3.1 The population of any given area and their behaviours are the key driver that can influence waste generation and waste management operations. If residents opt to recycle waste in local facilities, this material is of value and can be utilised to generate an income stream for collection authorities. If, in contrast, residents opt not to recycle, then the co-mingled waste is contaminated, of lower

quality and can undermine an authority's business case; as such, it is likely such wastes will end up in a landfill or an Energy from Waste plant.

D2.3.2 In mid-2017, the population of the UK was estimated to be 66million,[44] spread across 27.2million households; an increase of 6% in both population and households since 2007. The population has continued to grow across each of the four nations. In the year to mid-2017:

- England's population grew by 351,000 to 55.6 million (up 0.6% from mid-2016);
- Northern Ireland's population grew by 9,000 to 1.9 million (up 0.5%);
- Scotland's population grew by 20,000 to 5.4 million (up 0.4%);
- Wales's population grew by 12,000 to 3.1 million (also up 0.4%).

D2.3.3 2017 saw 19 million families living in the UK, which shows an increase of 8% from 2007:

- 12.9 million families (68%) featuring a couple married or in a civil partnership;
- 3.3 million families (17%) featuring a cohabiting couple (the fastest-growing family type);
- 2.8 million families (15%) featuring a lone parent with at least one dependent or non-dependent child.

D2.3.4 Aside from living as a family, 7.7 million UK residents aged 16 years or over were living alone in 2017, which shows a 4% increase from 2007. 3.9 million were aged 16 to 64 years, with the majority male (58.5%) and 3.8 million were aged 65 years and over, with the majority female (66.5%). One explanation for this disparity is that older women are more likely to be widowed – outliving men on average

D2.3.5 Young males were more likely to live with their parents than young females (32% of males aged 20 to 34 years, compared with 20% of females aged 20 to 34 years). In general, young adults in the UK are more likely to be living with their parents now than in any time for which comparable data exists (1996 onwards).

Education and Skills

D2.3.6 The breakdown of qualifications of the working age population in 2018 was as follows:

- 39.28 % had NVQ4;[45]
- 17 % had NVQ3;[46]
- 3% had trade apprenticeships;
- 15.8 % had NVQ2;[47]
- 10.4 % had NVQ1;[48;]
- 6.7 % had other qualifications; and
- 8.0 % have no qualifications.

D2.3.7 In 2018, the UK had a total of 32,117 schools, comprising:

[44] Office for National Statistics: https://www.ons.gov.uk/
[45] HND, Degree and Higher Degree level qualifications or equivalent
[46] 2 or more A levels, advanced GNVQ, NVQ 3, 2 or more higher or advanced higher national qualifications (Scotland) or equivalent
[47] 5 or more GCSEs at grades A-C, intermediate GNVQ, NVQ 2, intermediate 2 national qualification (Scotland) or equivalent
[48] Fewer than 5 GCSEs at grades A-C, foundation GNVQ, NVQ 1, intermediate 1 national qualification (Scotland) or equivalent.

- 3,037 nursery;
- 20,863 primary;
- 13 middle;
- 4,190 secondary;
- 2,404 non-maintained mainstream;
- 1,258 special; and
- 352 pupil referral units.[49]

Economic Baseline

D2.3.8 The working age population for the period January 2019 to March 2019 for the UK was broken down as follows:[50]

- 79.2% economically active, comprising:
- 76.1%[51] in employment; and
- 3.8%[52] unemployed.
- 20.8% economically inactive.

D2.3.9 In 2018, median gross weekly earnings for full-time employees were £569, up 3.5% from £527 in 2015. In the period January to March 2019, the UK had a total of 32,697,000 people in employment aged 16 and over.[53]

D2.3.10 The majority of employed residents are in Major Group 1-3 being professional occupations and managers, 20.3% are group 4-5 being administrative and skilled trades. 16.6% are employed in groups 6-7 being caring and sales roles whilst the remainder are in group 8-9 being machine operatives and elementary occupations.

D2.3.11 UK gross domestic product (GDP) is estimated to have increased by 0.5% in the first quarter of 2019, the highest rate of growth since Q3 in 2018. Construction industries grew 1% in Q1 of 2019, and the production sector saw growth of 1.4%.[54]

[49] Department for Education (2017) *Education and Training Statistics for the United Kingdom: 2017*. Available online at: https://www.gov.uk/government/statistics/education-and-training-statistics-for-the-uk-2018
[50] NOMIS (2019) *Labour Market Profile*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/contents.aspx
[51] % are for those aged 16-64
[52] % is a proportion of economically active
[53] Nomis (2019) *UK Labour Market: March 2019*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2092957698/report.aspx
[54] ONS (2017) *Gross domestic product.* Available online at: https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/gdpmonthlyestimateuk/march2019

England

Demographics

D2.3.12 In mid-2017, England had a resident population of 55,619,430 (49.4% males and 50.6% females) and 63.9% of the population was of working age (aged 16 to 64).[55] The total resident population accounts for 84% of the UK's population. The population of England increased by 351,300 (0.7%) between 2016 and 2017.

D2.3.13 In the period, January 2019 to March 2019, the working age population breakdown was as follows:[56]

- 79.5% were economically active, comprising:
- 76.3%[57] of working age population in employment; and
- 3.9%[58] of working age population unemployed.
- 20.5% were economically inactive.

Education and Skills

D2.3.14 The working age population in January to December 2018 had the following qualifications:

- 39.0% had NVQ4;
- 17.3% had NVQ3;
- 15.9% had NVQ2;
- 10.6% had NVQ1;
- 6.8% had other qualifications;
- 2.8% had trade apprenticeships; and
- 7.6% had no qualifications.

D2.3.15 In January 2018, England had 24,316 schools, comprising:

- 399 nursery;
- 16,766 primary;
- 3,463 secondary;
- 2,320 independent;
- 1,043 special; and

[55] ONS (2016) *Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2017*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland
[56] NOMIS (2019) *Labour Market Profile.* Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/contents.aspx
[57] % are for those aged 16-64
[58] % is a proportion of economically active

- 352 pupil referral units.[59]

D2.3.16 As of January 2017, there was total of 8.73 million pupils enrolled in schools in England. The total number of pupils has grown each year since 2009, and there are now over half a million more pupils in schools than at that point. Just over 3 million of the school pupils attend academies and free schools.[60]

Economic Baseline

D2.3.17 In 2015, England's per capita GVA was £26,159, which represents a 3% increase on 2014. England accounts for 86% of the UK's total GVA.[61]

D2.3.18 In 2016, the median full-time gross hourly pay in England was £13.73 (male median being £14.35 and the female median being £12.89).

D2.3.19 In April to June 2017, England had an unemployment rate of 4.4% (people aged 16 and over). This compares to same period in the previous year when the unemployment rate stood at 4.9%.[62]

Deprivation

D2.3.20 In England, 61% of local authority districts contain at least one neighbourhood that is assessed as the most deprived in the 2015 Index of Multiple Deprivation. Middlesbrough, Knowsley, Kingston upon Hull, Liverpool and Manchester are the local authorities with the highest proportions of neighbourhoods among the most deprived in England. On average, 37% of the population in the most deprived areas were income deprived. 83% of neighbourhoods that are the most deprived in 2015 were also the most deprived in 2010.[63]

D2.4 Summary of Existing Problems Relevant to Waste and Resources

D2.4.1 The following existing problems for the population, economics and skills topic have been identified:

- There is a broad level of consistency with regard to the qualifications of the working age population across the UK, with approximately 38% having a NVQ4 or equivalent qualification and above.
- Those with no qualifications remain relatively similar across the nations; any design and delivery of infrastructure arising from the WMPE should seek to provide apprenticeships, skills developments and qualification courses to address this issue.
- The respective indicators and areas of multiple deprivation in England, Scotland and Wales are similar in that there continues to be deep rooted deprivation in specific areas year after year. That said, there is also some broader variation to the areas of deprivation across the rest of the

[59] ONS (2018) Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland
[60] Department for Education (2018) *Education and training statistics for the UK: 2018.* Available online at: https://www.gov.uk/government/statistics/education-and-training-statistics-for-the-uk-2018
[61] ONS (2016) *Regional gross value added (income approach), UK: 1997 to 2015*. Available online at: https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/december2016
[62] NOMIS (2019*) Labour market profile – England*. Available online at: https://www.nomisweb.co.uk/reports/lmp/gor/2092957699/report.aspx
[63] DCLG (2015) *The English Indices of Deprivation 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf

country. Those who live in the most deprived places in the country, also live in the places where there is the most litter, graffiti and dog fouling.[64]

- The waste sector is a recruiter of apprentices and recruits a high level of skilled but unqualified personnel; from school leaver upwards. The sector is a leader in training and upskilling staff and employers – both public and private sector – are known to invest in training for staff.
- The UK Government and Devolved Administrations are exploring the options for a Deposit Return Scheme (DRS) together to ensure a coherent UK-wide system. This *may* lead to changes in employment opportunities in the waste sector, as it could create a greater number of vacancies to support the collection, counting, sorting and management of the DRS.

D2.5 Likely Evolution of Baseline

UK

Demographics

D2.5.1 The current UK population is generally increasing and is projected to reach 74.3 million by 2039, a rise of 9.7 million people. Assumed net migration accounts for 51% of the projected increase, with natural increase (more births than deaths) accounting for the remaining 49% of growth.[65]

D2.5.2 The age structure of the UK population is moving towards an ageing population, with the average (median) age rising from 40.0 years in 2014 to 42.9 by mid-2039. The number of people of State Pension Age and over is projected to increase by 32.7% to 16.5 million by mid-2039, despite increases to State Pension Age. By mid-2039 more than 1 in 12 of the population is projected to be aged 80 or over.

D2.5.3 Those aged under 14 is projected to increase from 11.4 million in 2014 to 12.3 million in 2024 and stay at approximately this level for the next 15 years. There are no formal targets for population growth in the UK.

Economics

D2.5.4 There are current uncertainties over market conditions, and the outlook for growth in the short to medium term has weakened. The Bank of England highlights that whilst financial conditions are stable, there are a number of domestic and international risks that could test the resilience of the financial system.[66]

[64] Keep Britain Tidy (2015) How clean is England? The Local Environmental Quality Survey of England 2014/15. Available online at: https://www.keepbritaintidy.org/sites/default/files/resources/KBT_How_Clean_Is_England_LEQSE_Report_2015.pdf
[65] ONS (2015) *National Population Projections: 2014-based Statistical Bulletin*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29
[66] Bank of England (2018) *Financial Stability Report: Executive summary June 2018*. Available online at: https://www.bankofengland.co.uk/financial-stability-report/2018/june-2018

England

Demographics

D2.5.5 Between 2014 and 2039, the population of England is projected to increase from 54.3 million to 63.3 million, an increase of 16.3%.[67]

Economics

D2.5.6 England's total GVA growth in 2015 was up 3% from 2014. GVA has risen year on year since 2009, so it could be expected that it will continue to increase in the future, although the rate may slow given the UK outlook.[68]

D2.6 Waste Management Effects on Population, Economics and Skills

D2.6.1 The population of any given area and their behaviours are a key driver that can influence waste generation and waste management operations, along with the economics of waste management options. The possible impacts of waste management on population, economics and skills are considered here in a generic manner in anticipation of the assessment of the WMPE in **Section 2.7**.

Waste Infrastructure

D2.6.2 Waste management infrastructure can include facilities such as landfill sites, incineration plants, household recycling centres, recycling sorting facilities, reprocessing plants and potential reuse areas. Depending on the type and scale of facility, the construction of waste management infrastructure can represent a significant capital investment for local economies. The waste sector contributed 0.47% of the UK economy's GVA in 2016, with waste collection the greatest component of the sector, accounting for £3.4 billion, followed by waste treatment and disposal (£1.8 billion), followed by materials recovery (£1.6 billion).[69] The Government is committed[70] to spending £3bn by 2042 on developing new waste infrastructure through the Waste Infrastructure Delivery Programme. This includes investment in facilities including energy from waste (EfW) and Mechanical Biological Treatment (MBT) sites. This has the potential to create employment opportunities, deliver supply chain benefits and contribute to skills development in the working population, which could generate substantial benefits for the local population depending on the scale of investment at a particular site.

D2.6.3 However, there are barriers to investment in waste facilities, including high upfront costs, market uncertainty and competition from abroad, which could prevent the investment benefits being realised.70 A stable, good quality supply of recyclable material is also required, which is dependent on a number of factors including, community awareness of collection and need for segregation, collection methods used and household and business participation rates. Extended Producer

[67] ONS (2015) *National Population Projections: 2014-based Statistical Bulletin*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29

[68] ONS (2016) *Regional gross value added (income approach), UK: 1997 to 2015*. Available online at: https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/december2016

[69] Defra (2018) *Digest of Waste and Resource Statistics – 2018 Edition.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710124/Digest_of_Waste_and_Resource_Statistics_2018.pdf

[70] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Technical Annex.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

Responsibility Schemes also have the potential to provide stable supplies of recyclable waste materials to provide value at end of life, which can contribute to the economy.[71]

D2.6.4 There were approximately 140,000 employees in the waste sector in Great Britain in 2016, with approximately half of the sector's jobs in waste collection.[69] Changes to waste collections may therefore also alter employment opportunities in the waste sector in the medium and long term.[72,73] WRAP estimates that moving towards a circular economy, which includes changes to the management of waste, could create 210,300 jobs by 2030 and be worth up to £100 billion to the UK economy.[74] A study by WRAP and Green Alliance (2015) estimated that a 0.28% reduction in unemployment could be made through a transformative change towards circularity, with many jobs being skilled or professional (such as remanufacturing and bio-refining), and that jobs would be expected to be created in areas of currently high unemployment.[75]

D2.6.5 The majority of waste sector employees were male, and the majority of roles were full-time. As a result, any changes to waste sector employment may predominantly affect male and full-time workers. However, in recent years there has been an increase in part-time roles and a reduction in full time workers, so any future changes to waste sector employment may create more balance between part- and full-time roles.[69]

D2.6.6 The construction and operation of waste management infrastructure including landfill sites has the potential to adversely affect businesses and communities, principally due to disruption. For example, collection or transfer vehicles may cause congestion, depending on local circumstances,[76] however planning and permitting systems seek to reduce or avoid effects.

D2.6.7 There may be future savings associated with separate collections of waste streams. Research by WRAP into the most effective kerbside collection regimes found that multi-stream and separate food collections was found to be the cost-effective collection regime (compared to existing collection systems and two-stream dry recycling), as a single vehicle can be used to collect food waste and separated dry materials on a weekly basis (compared to using an additional vehicle to collect food waste).[77] This could provide financial benefits to Local Authorities of up to £400 million over 8 years from reduced waste management costs, which may benefit the local community.[78] In addition, up to £478 million of materials could be returned to the economy from the sale of dry recyclables, and up to £33 million saved in reduced costs to reprocessors from not having to remove contamination from materials before processing. However, economic savings are uncertain and depend on assumptions around recycling rates and secondary material prices.[70]

[71] Committee on Climate Change (2019) *Net Zero – Technical Report*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf
[72] Zero Waste Scotland (2017) *Deposit Return Evidence Summary*. Available online at: https://www.zerowastescotland.org.uk/sites/default/files/Deposit%20Return%20Evidence%20Summary.pdf
[73] Defra (2019) *Introducing a Deposit Return Scheme on beverage containers*. Available online at: https://consult.defra.gov.uk/environment/introducing-a-deposit-return-scheme/supporting_documents/depositreturnconsultia.pdf
[74] WRAP (2019) *New circular economy jobs created by 2030*. Available online at: http://www.wrap.org.uk/content/new-circular-economy-jobs-created-2030
[75] WRAP, Green Alliance (2015) *Employment and the circular economy: job creation in a more resource efficient Britain.* Available online at: http://www.wrap.org.uk/sites/files/wrap/Employment%20and%20the%20circular%20economy%20summary.pdf
[76] Halton Council, Knowsley Council, Liverpool City Council, Sefton Council, St.Helens Council and Wirral Council (2013) *Joint Waste Local Plan.* Available online at: http://www.meas.org.uk/media/4981/ADP-001-WasteLocalPlan_Final_LoRes_opt.pdf
[77] Defra (2019) *Consultation on consistency in household and business recycling collections in England*. Available online at: https://consult.defra.gov.uk/environmental-quality/consultation-on-consistency-in-household-and-busin/supporting_documents/recycleconsistencyconsultdoc.pdf
[78] WRAP (2016) *Supporting evidence and Analysis: The case for greater consistency in household recycling*. Available online at: http://static.wrap.org.uk/consistancy/Learn_more_about_the_evidence.pdf

D2.6.8 Research by Eunomia[79] also highlighted that separate collection results in higher quality, less contaminated material, which is more likely to be appropriate for higher value-added closed-loop uses, and is more likely to support the retention of material within the UK economy, with potential economic and social benefits.

D2.6.9 One of the drivers for determining how waste is managed is financial cost, with measures such as landfill tax aiming to make the least preferred disposal route more expensive than other options. This results in landfill facilities charging an average of £107 per tonne (including landfill tax) to take waste, while MRF and anaerobic digestion had the lowest costs at £22 and £26 per tonne respectively.[80] These measures can help create financial benefits for businesses by choosing to treat waste in ways further up the waste hierarchy that are less harmful to the environment.

Materials Use

D2.6.10 The growing population within the UK will increase population densities[81], which historically, had the potential to increase the pressure on resources and waste generation. Local authority collected waste has generally decreased across the last 15 years (although there has been a small rise in recent years).[82] This is thought to reflect changes in attitudes towards waste and behaviour by households, influenced by improved kerbside recycling and a general decrease in consumption of products.[83] The UK is also becoming more resource efficient, and is currently reducing waste and increasing production of secondary materials.[70]

D2.6.11 Waste can create value for the economy by providing materials for manufacturing through recycling or by conversion into energy.[84] This is partly related to the behaviour of the population. If residents opt to recycle waste in local facilities, this material is high value and can be utilised to generate an income for collection authorities. The correct use of recycling bins increases the quantity and quality of recycling, increasing the value that can be extracted from waste. Recycling that is cross contaminated by food or glass can reduce the quality and consequently the economic value.[70] Operators of Materials Recovery Facilities (MRFs) have reported a notable rise in non-recyclable material received, with recycling quality not notably improving.[70] Changes to global recycling markets, such as China's ban on certain waste streams, has further led to an increased need to improve the quality of what is recycled to maintain economic value.[85] If, in contrast, residents opt not to recycle, then the residual waste is contaminated, of lower quality and can undermine an authority's business case; as such, it is likely such wastes will end up in a landfill or an Energy from Waste plant.

[79] Eunomia (2016) *Review of the Welsh Government Collections Blueprint*. Available online at: https://gweddill.gov.wales/docs/desh/publications/160322-executive-summary-en.pdf
[80] WRAP (2018) *Comparing the costs of alternative waste treatment options*. Available online at: http://www.wrap.org.uk/sites/files/wrap/WRAP%20Gate%20Fees%202018_exec+extended%20summary%20report_FINAL.pdf
[81] Office for National Statistics (2018) *Overview of the UK population*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/overviewoftheukpopulation/november2018
[82] Defra (2018) *Digest of Waste and Resource Statistics: 2018 Edition*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710124/Digest_of_Waste_and_Resource_Statistics_2018.pdf
[83] DCLG (2013) *Strategic Environmental Assessment of the updated national waste planning policy.* Available online at: http://data.parliament.uk/DepositedPapers/Files/DEP2013-1395/SEA_Scoping_Report_DCLG.pdf
[84] HM Government (2018) *A Green Future: Our 25 Year Plan to Improve the Environment: Annex 1: Supplementary Evidence Report.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/673492/25-year-environment-plan-annex1.pdf
[85] Defra (2019) *Consistent municipal recycling collections in England: Impact Assessment*. Available online at: https://consult.defra.gov.uk/environmental-quality/consultation-on-consistency-in-household-and-busin/supporting_documents/recycleconsistencyconsultia.pdf

D2.6.12 The Evidence Report for the 25 Year Environment Plan identifies that use[84] of secondary materials is increasing, resulting in a decrease in raw material consumption per unit of GDP, thus helping to decouple economic growth and material consumption.[86] The report also highlights that financial savings can be made by businesses by moving up the waste hierarchy, thereby increasing resource efficiency. Potential business savings of £3 billion per year were identified at no or low cost, through more efficient use of materials and waste.[87] A net GVA gain could also be made through a large scale adoption of resource efficient business models in remanufacturing, leasing, repair and recycling, with potential gains of £4.2 billion.[88] Action to improve waste management could therefore have beneficial effects on businesses across England. However, waste services typically represent a small cost for most businesses, meaning there may be little incentive to improve, coupled with the current waste service arrangements for businesses which do not incentivise recycling over residual waste.[89]

D2.6.13 For the repair and reuse part of the waste hierarchy, the greatest contributors to the GVA in 2016 were renting, leasing and repair of motor vehicles (overall accounting for approximately half of the GVA), and the renting leasing and repair of machinery and equipment.[69] In addition, the reuse and repair sector has been identified as a sector that has traditionally created jobs and work experience opportunities for those who find it difficult to access employment.[70] Studies suggest that for every 1,000 tonnes of waste goods handled for reuse purposes, an average of 75 jobs could be created.[90] This could have a positive effect on local populations if jobs at the correct skill level are created in areas of need.

D2.6.14 Commercial and industrial organisations have key roles to play in designing out waste and preparing items for reuse.[71] Consumer behaviour further influences waste generation and waste management operations, for example, whether consumers purchase products that are able to be recycled or reused, or avoid consuming certain items (such as single use plastics) and subsequently prevent the generation of waste.[70] Preventing waste arisings also presents economic benefits, for example, it is estimated that over £20 billion worth of food purchased by households and business each year is wasted[91], and that £150 million of clothing goes to landfill each year[92]. Reductions in food waste present cost savings and economic benefits to households, the hospitality sector and companies in the manufacturing, wholsesale and retail of food.[71]

D2.6.15 Under the polluter-pays principle, the costs of waste management should be borne by the original waste producer and potentially others in the supply chain. This may result in the costs of disposing an item being more accurately reflected in the price of a product,[93] with potential price rises for

[86] ONS (2016) *UK Environmental Accounts: How much material is the UK consuming?* Available online at: https://www.ons.gov.uk/economy/environmentalaccounts/articles/ukenvironmentalaccountshowmuchmaterialistheukconsuming/ukenvironmentalaccountshowmuchmaterialistheukconsuming

[87] Defra (2017) *Business Resource Efficiency – Quantification of the no cost/low cost resource efficiency opportunities in the UK economy in 2014 (EV0482), Defra research report by Oakdene Hollins*. Available online at: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=19885&FromSearch=Y&Publisher=1&SearchText=EV0482&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

[88] WRAP (2016) *Extrapolating resource efficient business models across Europe*. Available online at: http://www.rebus.eu.com/wp-content/uploads/2017/07/Extrapolating-resource-efficient-business-models-across-Europe.pdf

[89] Defra (2019) *Consistent municipal recycling collections in England: Impact Assessment (IA).* Available online at: https://consult.defra.gov.uk/environmental-quality/consultation-on-consistency-in-household-and-busin/supporting_documents/recycleconsistencyconsultia.pdf

[90] RREUSE (2015) *Briefing on job creation potential in the re-use sector*. Available online at: http://www.rreuse.org/wp-content/uploads/Final-briefing-on-reuse-jobs-website-2.pdf

[91] WRAP (2018) *Food Surplus and Waste in the UK – Key Facts*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Food%20Surplus%20and%20Waste%20in%20the%20UK%20Key%20Facts%2014%205%2019.pdf

[92] WRAP (2019) *Clothing*. Available online at: http://www.wrap.org.uk/content/clothing-waste-prevention

[93] Scottish Government (2018) *Making Things Last: a circular economy strategy for Scotland: 7. Producer Responsibility for reuse and recycling.* Available online at: https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/pages/11/

consumers. However, a packaging producer responsibility system could lead to the full net costs of managing packaging waste being paid by producers.[70]

D2.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D2.7.1 **Table D2.1** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D2.1 Assessment of the Draft WMPE and reasonable alternative

Population, Economics and Skills		
To support a strong, diverse and growing economy through the provision of innovative and efficient waste management practices that minimise resource use and waste volumes		
• Will the draft WMPE help to ensure that sufficient waste infrastructure is in place to meet increased demand associated with population growth and to support economic development? • Will the draft WMPE help to ensure that all residents have equal access and ability to participate in waste and resource management practices irrespective of location? • Will the draft WMPE provide employment and skills development opportunities in areas of low employment or youth retention rates? • Will the draft WMPE support the incorporation of waste as a resource into community practices and infrastructure e.g. through, recycling feedstock to small reprocessors or recovery into local District Heating Networks? • Will the draft WMPE support business and businesses to grow? • Will the draft WMPE affect the social infrastructure and amenities available to local communities? • Will the WMPE facilitate a reduction in the need to export waste overseas?		
	Effect	**Commentary**
WMPE		
Prevention	+/-	The Government's commitments include the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. While 'avoidable' waste includes waste that could have been reused, recycled, composted or when a reusable or recyclable alternative could have been used, it is assumed that waste prevention will also have a role in eliminating this waste (although there is uncertainty regarding the extent). In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. Waste prevention measures are expected to reduce volumes of residual waste being collected for disposal which may require changes to waste management infrastructure, which has the potential to reduce disturbance to local businesses and communities, depending on local circumstances. Approximately half of the waste sector's 140,000 jobs were in waste collection[69], so if there were changes in residual waste management infrastructure this could have a negative effect on provision of employment in the waste sector. However, there may be a corresponding increase in employment arising from increases in reuse and recycling waste transport, with uncertainty over the final scale of change in employment. Additionally, if waste prevention results in reductions in production and manufacture of products, this could have further indirect effect on employment in other sectors, although the potential scale of this effect is uncertain. Improving resource efficiency and preventing waste has the potential for a positive economic effect for businesses and households. For example, over £20 billion worth of food purchased by households and business each year is currently wasted,[91] so the prevention of avoidable food waste could generate cost savings and economic benefits to households, the hospitality sector and companies in the manufacturing, wholesale and

		retail of food. In addition, waste prevention has the potential to reduce the export of waste overseas due to reduced volumes that require management. As such, the WMPE is likely to have a mixed positive and negative effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+	The commitments in the WMPE for the elimination of avoidable waste will include increases in reuse of products and materials. Reuse is also supported by Defra's target to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. An increase in product reuse has the potential for a positive effect on the local economy, as it is thought likely that a move towards circularity would generate remanufacturing jobs in areas of currently high unemployment.[75] Studies suggest that for every 1,000 tonnes of waste goods handled for reuse purposes, an average of 75 jobs could be created.[90] This could have a positive effect on local populations if jobs at the correct skill level are created in areas of need. Additionally, the proportion of part-time roles in the waste sector has been increasing, so new job creation may help may create more balance between part- and full-time roles. The reuse and repair sector has also traditionally created jobs and work experience opportunities for those who find it difficult to access employment[70], which would further enhance access to employment. Further to this, financial savings can be made by businesses by moving up the waste hierarchy, with business savings of £3 billion per year identified at no or low cost, through more efficient use of materials and waste.[87] Remanufacturing and repair can present opportunities for companies offering these services, which may support the growth of local buisnesses.[88] Action to improve waste management could therefore have beneficial effects on businesses across England. Increased reuse of items in the home may lead to a reduction in waste and recycling collections, which is a key source of employment in the waste sector. A reduction in the volume of residual waste being collected for disposal also has the potential to reduce localised disturbances to populations from fewer vehicle movements. However, reuse between businesses or through reuse networks may generate job opportunities associated with the transport and distribution of reusable items, so the overall scale of effect on employment is uncertain. As for waste prevention, an increase in the reuse of products may result in reduced production and manufacture of products, which could have a detrimental effect on employment in other sectors, however the scale of effect is uncertain. As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling	+	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035, and to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. There are also commitments to reduce avoidable waste, which includes elements of recycling. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as a potential food waste collection system (this could be recycled through composting, or recovered, through AD plants). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. Increased recycling rates can result in the return of materials to the economy from the sale of recyclables, which has the potential for economic benefits for businesses.[70] Recycling that is cross contaminated by food or glass can reduce the quality and consequently the economic value. The WMPE states support for helping local authorities to improve the

		quality of recycling collections so that its value can also increase. Following the outcome of the consultation on consistency in recycling, the Government is of the view that the quantity and quality of recycling will increase, with associated economic benefits. Improved quality of recycling also reduces costs to reprocessors from not having to remove contamination from materials before processing. Expansion of the recycling sector presents a potential increase in employment opportunities. WRAP estimates that moving towards a circular economy, which includes increases in recycling, could create 210,300 jobs by 2030 and be worth up to £100 billion to the UK economy,[74] with a 0.28% reduction in unemployment.[75] As more waste material is collected for recycling, there may be a requirement for additional waste infrastructure. Depending on the type and scale of facility, the construction of waste management infrastructure can represent a significant capital investment for local economies. Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The construction and operation of new infrastructure, and additional vehicle movements, may cause disturbance to local populations. However, these sites may also present opportunities for employment during both construction and operation. The WMPE reiterates interest in implementing a DRS in England, which could provide a source of high quality separated materials that could be used by reprocessors. Extended Producer Responsibility Schemes such as DRSs have the potential to provide stable supplies of recyclable waste materials to provide value at end of life, which can contribute to the economy.[71] Moreover, reforming the packaging producer responsibility system in line with the "polluter pays principle" would mean that producers would be responsibility for funding the net costs of managing the packaging they produce when it becomes waste. This would provide an incentive for producers to reduce the amount of difficult to recycle materials they use and increase the use of recyclable materials in their packaging. Increasing recovery compared to landfill disposal of waste can generate financial benefits for businesses choosing to treat waste in ways further up the waste hierarchy, as landfill facilities charge an average of £107 per tonne (including landfill tax) to treat waste, while MRF has the lowest costs at £22 per tonne.[80] The WMPE also states that, in accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer, or by the current or previous waste holders. This may mean there is an increased drive to make products more recyclable. Overall, the WMPE is expected to have a positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	+	The WMPE seeks to improve recovery of materials, including anaerobic digestion (AD) and energy from waste (EfW). The WMPE highlights the Government's support for efficient energy recovery from residual waste as the best management option for waste that cannot be reused or recycled, and for AD as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. This has the potential to create employment opportunities, deliver supply chain benefits and contribute to skills development in the working population, which could generate benefits for the local population depending on the scale of investment at a particular site. The proposed collection of food waste separately from all households could generate over 8Mt of food waste, with AD as the preferred management approach. This has the potential for economic benefits worth up to £280M in renewable energy sales.[70]

		As noted for recycling, increasing recovery compared to landfill disposal of waste can generate financial benefits for businesses choosing to treat waste in ways further up the waste hierarchy and AD has one of the lowest gate costs at £26 per tonne.[80] The WMPE also states that, in accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer, or by the current or previous waste holders. This may mean there is an increased drive to use more economic disposal options. An increase in vehicle movements associated with avoided disposal (and therefore increased movements for collection and transport to recovery sites) could result in disturbance to local populations. However, this may also present employment opportunities, as waste collections account for approximately half the jobs in the waste sector. It is also possible that any increases in recycling further up the hierarchy will divert materials from recovery facilities to reprocessors. Whilst this is overall a positive impact, it may have a detrimental effect on the operational efficiencies of recovery plants. Overall, the WMPE is expected to have a positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	Disposal options represent the bottom of the waste hierarchy, and are the least desirable waste management options. These include landfill and incineration without energy recovery. The WMPE outlines key targets which aim to reduce the use of landfill. This includes working towards eliminating food waste going to landfill by 2030, as well as a target within the Waste Framework Directive, which seeks to cut waste to landfill to 10% by 2035. The range of commitments outlined in the WMPE will reduce the use of landfill, which include plans to introduce a household waste collection system for food wastes which will divert wastes from landfill into recycling or recovery. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. This could reduce the availability of jobs related to landfill sites. It is assumed that jobs would be created elsewhere to manage waste through other means, however the numbers involved are not certain. Closure of landfill sites could also reduce any adverse effects on businesses and communities from landfill sites, such as disruption from waste vehicles, depending on local circumstances. The WMPE also states that, in accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer, or by the current or previous waste holders for a number of waste streams. This may mean there is an increased drive to avoid landfill, which is already the most expensive waste management option per tonne of material. The Resources & Waste Strategy sets out the intention to consider application of this principal for other waste streams. In addition, the closure of landfill sites can provide restoration opportunities, for example through the creation of nature reserves which can provide recreational amenities for the local community.[94] Overall, the WMPE is expected to have a positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+	The WMPE brings together a range of aims and targets seeking to improve waste management by moving waste up the hierarchy. Increases in recovery, recycling and reuse all give rise to potential economic benefits and employment opportunities. The scale of benefits is not certain, and will depend on the scale of infrastructure, number of vehicle movements required, the scale of investment and associated skill sets required. Waste prevention also presents opportunities for businesses and households in terms of financial savings. However, changes in residual waste collections and processing resulting from reduced waste generation may have a negative effect on employment in the waste

[94] Essex Wildlife Trust (2019) *Thurrock Thameside Nature Park*. Available online at: https://www.essexwt.org.uk/nature-reserves/thurrock-thameside

		sector. It is not certain to what extent this will offset any increases in employment further down the waste hierarchy, however a move towards a more circular economy is overall expected to benefit the economy. Overall, the WMPE is expected to have a positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++/-	The 'Direction of Travel' reasonable alternative seeks to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Meeting the commitments for the elimination of avoidable waste in a shorter timeframe would have similar effects as the WMPE due to the prevention of waste. Any changes in jobs relating to residual waste disposal would occur more quickly, as would reduced disturbance to communities. However as noted above, there may be an increase in employment arising from increases in reuse and recycling waste transport, with uncertainty over the final scale of change in employment. As for the WMPE, the reasonable alternative could also result in reductions in production and manufacture of products, with indirect effect on employment in other sectors, although the potential scale of this effect is uncertain. The financial savings for businesses and households associated with improving resource efficiency and preventing waste would also be achieved on a shorter timescale. Over the timescale of the plan, this would generate greater economic benefits than the WMPE, assuming savings are made on an annual basis rather than as a single occurrence. The reasonable alternative also has the potential to reduce the export of waste overseas due to reduced volumes that require management. As such, the reasonable alternative is likely to have a mixed significant positive and minor negative effect, relative to the baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	++	The reasonable alternative would involve meeting the commitments for the elimination of avoidable waste in a shorter timeframe, which would include an increase in the reuse of products and materials. Studies suggest that for every 1,000 tonnes of waste goods handled for reuse purposes, an average of 75 jobs could be created.[90] Increasing the amount of waste that is reused would therefore increase the positive effect on local populations if jobs at the correct skill level are created in areas of need, compared to the WMPE. Jobs are expected to be created in areas of high unemployment, so increases in employment in these areas could have a significant effect for the local population.[75] As the proportion of part-time roles in the waste sector has been increasing, further increases in new job creation beyond that expected from the WMPE may make further progress towards achieving a balance between part- and full-time roles. Estimated annual financial savings for businesses of £3 billion per year through more efficient use of materials and waste could be achieved more quickly under the reasonable alternative, which would generate greater economic benefits. Businesses involved in remanufacturing, repair and reuse networks would also have greater potential to grow more quickly under this alternative. Effects on employment associated with waste collection and transport is not certain. Greater reuse of products in the home will reduce residual waste volumes collected for disposal compared to the WMPE, however reuse between businesses or through reuse networks may generate new waste transport job opportunities. As for the WMPE, an increase in the reuse of products may result in reduced production and manufacture of products, which could have a detrimental effect on employment in other sectors, however the scale of effect is uncertain. Overall, the reasonable alternative is likely to have an overall significant positive effect, relative to the baseline, due to increased economic benefits for the issues covered by this SEA objective and guide questions.

Recycling (increase in recycling of waste streams compared to WMPE)	++	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE, or to exceed the WMPE's targets for the proportion of waste recycled. Increasing recycling rates more quickly or achieving higher recycling rates would result in greater economic benefits for businesses compared to the WMPE, through an increase in the return of materials to the economy from the sale of recyclables. Increasing the quality of recycling would also further increase the value of recycling and reduce costs for reprocessors, with financial benefits. Jobs could also be created more quickly under the reasonable alternative, which could also further reduce unemployment. Should recycling rates increase more quickly or higher recycling rates be achieved, more recycling infrastructure may be required compared to the WMPE. Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. Depending on the type and scale of facility, the construction of waste management infrastructure can represent a significant capital investment for local economies. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop, construct and operate. However, these sites may also present opportunities for employment during both construction and operation. Greater avoidance of landfill and management of waste through cheaper disposal options such as MRFs could also generate greater cost savings for businesses. Overall, the reasonable alternative is expected to have a significant positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	++	The 'Direction of Travel' reasonable alternative seeks to further improve recovery of materials, for example though AD and EfW. There is currently capacity remaining in AD plants, so while some continued funding is expected as part of the WIDP (including investment in AD and MBT), significant further investment beyond this is not expected, although this is not certain. AD is the preferred management approach for separately collected food waste, so increases in AD could result in increased renewable energy sales compared to the WMPE. Increasing recovery could result in greater avoidance of landfill, and the management of waste through more economic disposal options such as AD. This has the potential for increased cost savings for businesses. Avoiding disposal as a result of increased waste recovery could further increase vehicle movements compared to the WMPE. While this may cause disturbance to local populations, there may be greater employment opportunities, as waste collections account for approximately half the jobs in the waste sector. However, the scale of increased jobs is not certain. Overall, the reasonable alternative is expected to have a significant positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions.
Disposal (decrease in disposal of waste streams compared to WMPE)	++/?	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The reasonable alternative will require a quicker adoption of new behaviours and technologies to lessen demand on landfill sites. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. Under the reasonable alternative, landfill sites may close more quickly, however this is uncertain. As for the WMPE, there may be associated but uncertain effects on jobs, and reduced disruption from the facilities and vehicle movements. The closure of landfill sites may provide restoration opportunities on a shorter timescale, with recreation benefits for local communities. Overall, the reasonable alternative is expected to have a positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions. However,

		uncertainty remains relating to the effects on jobs and the timescales over which this may occur, compared to the WMPE.
Cumulative	++	Overall, the reasonable alternative is expected to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Increases in recovery, recycling and reuse at a faster rate than the WMPE is expected to give rise to greater economic benefits and employment opportunities. However, this will depend on the scale of infrastructure, number of vehicle movements required, the scale of investment and associated skill sets required to meet more ambitious commitments. Waste prevention also presents opportunities for businesses and households in terms of financial savings, and these are enhanced through the increased commitments of the reasonable alternative. However, reductions in residual waste volumes collected for disposal may have a negative effect on employment in the waste sector. It is not certain to what extent this will offset any increases in employment further down the waste hierarchy, however a move towards a more circular economy is overall expected to benefit the economy. Overall, the reasonable alternative is expected to have greater benefits for the population and economy, and has therefore been determined as having a significant positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions, although some uncertainty remains relating to the scale of effects.

Score Key:	+ + **Significant** positive effect	+ **Minor** positive effect	0 **Neutral** effect	- **Minor** negative effect	- - **Significant** negative effect	? **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D2.8 Mitigating Measures

D2.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on population, economics and skills, and could be implemented through local waste plan policies, development proposals and employers where relevant:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- New jobs generated in the waste sector could ensure a mix of part- and full-time roles.
- Opportunities could be created for those who have traditionally found it difficult to access employment.

- Employment opportunities at an appropriate skill level could be created in areas of high unemployment.
- Restoration of landfill sites could produce recreational sites and green space for local populations.

D2.9 Uncertainties and Risks

- The level of investment and type of infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The locations of new waste management infrastructure are unknown and the effects on local populations are not certain. However, the location of new sites would be identified in the relevant waste local plan which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct and environmental permits to operate.
- The number and type of jobs created and lost at various stages of the waste hierarchy are not certain. The skill sets required for new jobs are also not certain.
- The scale of improvements in recycling quality and the scale of associated financial benefits are not certain.
- The scale and type of products which would be reused or prevented cannot be quantified at this stage, and therefore the associated reductions in manufacturing and waste collections are not certain.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.

D3. Human Health

D3.1 Introduction

D3.1.1 This section presents the overview of plans, programmes and baseline information for the assessment of the WMPE and reasonable alternatives in respect of human health.

D3.1.2 There are links between the population, economics and skills topic and a number of other topics in the WMPE, in particular population, economics and skills, air quality, noise and water quality.

D3.2 Review of plans and programmes

D3.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D3.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to human health. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D3.1 Human Health Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2002) Environmental Noise Directive (Directive 2002/49/EC)
European Commission (2014) Third Health Programme (2014 – 2020) Regulation (EU) No 282/2014
The World Health Organisation (WHO) (2012) Health 2020
The World Summit on Sustainable Development (WSSD), Johannesburg, September 2002 - Commitments arising from Johannesburg Summit (2002)
National Plans and Programmes
Department of Business, Energy and Industrial Strategy (BEIS) (2017) Clean Growth Strategy
Defra (2011) Mainstreaming sustainable development: the government's vision and what this means in practice
HM Government (2005) Securing the Future – the UK Sustainable Development Strategy
HM Government (2010) White Paper: Healthy Lives, Healthy People: Strategy for Public Health in England
HM Government (2013) The Community Infrastructure Levy (CIL) (Amendment) Regulations 2013
MHCLG (2019) National Planning Policy Framework (NPPF)

D3.3 Overview of the Baseline

UK

D3.3.1 In the UK, life expectancy at birth during the period 2015-2017 was 79.2 years for males and 82.9 years for females; both increased 0.1 years from 2013-2015.[95]

[95] ONS (2016) *National life Tables, UK: 2013–2015*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/datasets/nationallifetablesunitedkingdomreferencetables

D3.3.2 In England and Wales, cancer accounted for 28.5% of all deaths registered in 2016 and remained the most common broad cause of death for both men and women (30.8% of all male deaths and 26.2% of all female deaths registered in 2016).

D3.3.3 Death rates from respiratory diseases (including influenza, pneumonia, chronic lower respiratory disease, bronchitis, emphysema and other chronic obstructive pulmonary diseases and asthma) in the UK were 138.3 per 100,000 population. In 2016, there were 161.9 deaths per 100,000 males and 114.7 deaths per 100,000 females from respiratory diseases.[96,97]

D3.3.4 Circulatory diseases, such as heart disease and stroke remained the second most common broad cause of death, accounting for just over a quarter (25.5%) of all deaths registered in 2016. Mortality rates for circulatory diseases decreased compared to 2015 and are now lower than in 2014 for both males and females.[98]

D3.3.5 There are high levels of hypertension and overweight/obesity in the UK.[99] Public health trends often correlate with deprivation and these figures for illness are invariably far less favourable in deprived areas.[100]

England

D3.3.6 In England, life expectancy at birth during the period 2015 and 2017 was 79.4 years for males and 83.1 years for females. The life expectancy of males in England has increased from 79.02 years for males and 82.83 years for females in 2010.[101]

D3.3.7 In 2011, 47.2% of the population in England rated their health as very good; 34.2% as good, 13.1% as fair, 4.2% as bad and 1.2% as very bad.[102].

D3.3.8 The Health Survey for England, published in 2017, sets out the following key findings:[103]

- 64% of adults were overweight or obese;
- 19% of adults had 3 or more out of 5 risk factors to their health;
- 14% of adults reported having a diagnosed cardiovascular disease; and
- 16% of adults were provided with unpaid support to at least one person with long term mental or physical health problems, a disability or with problems related to old age.

[96] Eurostat (2016) *Causes of Death Statistics*. Available online at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Causes_of_death_statistics
[97] ONS (2017) *Deaths registered in England and Wales* 2016. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2016
[98] ONS (2017) *Deaths registered in England and Wales* 2016. Available online at: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregisteredinenglandandwalesseriesdr/2015-11-09
[99] Health and Social Care Information Centre (2015) *Health Survey for England 2014: Trend Tables Commentary*. Available online at: http://content.digital.nhs.uk/catalogue/PUB19297/HSE2014-Trend-commentary.pdf
[100] ONS (2013) *General Health in England and Wales: 2011 and comparison with 2001*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/articles/generalhealthinenglandandwales/2013-01-30
[101] ONS (2018) *National life tables, UK: 2015 to 2017*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/2015to2017
[102] ONS (2013) *General Health in England and Wales: 2011 and comparison with 2001*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/articles/generalhealthinenglandandwales/2013-01-30
[103] Health and Social Care Information Centre (2018) *Health Survey for England 2017: Trend Tables Commentary*. Available online at: https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2017

D3.4 Summary of Existing Problems Relevant to Waste and Resources

D3.4.1 The following existing problems for health have been identified:

- Health inequalities exist in many communities. This is due a number of factors (and the interplay between them) including housing quality, economic wellbeing, employment, lifestyle, heredity factors, cultural and environmental factors.
- There are potential health impacts associated with the waste industry due to emissions to air, however the risk is very small.[104,105] There are also occupational effects on health for waste collection workers due to vehicle emissions, accidents and manual handling.[106]
- Methane emissions from landfill can also cause concerns, however the decreasing use of landfill, coupled with the robust monitoring of such sites, have lessened this issue.[107]
- Proven consequences as a consequence of pollution can include increase risk of heart and lung disease to worsening of asthmatic conditions, which often leads to a reduced quality of life.[108] The contribution of waste management to this overall impact is relatively small. Of the 5 most damaging air pollutants, the waste sector appears in the top 4 for ammonia emissions only, contributing 4% of the total ammonia emmissions in the UK.[109]
- At present, respiratory illness places a significant burden on the health service. Sustained exposure to elevated air pollution levels (including exposure to elevated concentrations of particulate matter, oxides of nitrogen and sulphur) contributes to this problem. According to WHO estimates, nearly 500,000 deaths in Europe in 2012 were linked to exposure to outdoor air pollution (WHO 2014).[110] There is the potential for significant level of dust and other emissions to arise during the construction phase as well as operational phase of waste management facilities (depending on their function, scale and location) that are related to respiratory illnesses.

[104] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf
[105] Public Health England (2014) *Incinerators and public health*. Available online at: https://www.gov.uk/government/publications/incinerators-and-public-health
[106] WRAP & CIWM (2009) *Scoping study of potential health effects of fortnightly residual waste collection and related changes to domestic waste systems*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Scoping%20study%20of%20potential%20health%20effects%20of%20fortnightly%20waste%20collection%20Final1.pdf
[107] Health Protection Agency (2011) *Impact on Health of Emissions from Landfill Sites*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/334356/RCE-18_for_website_with_security.pdf
[108] Defra. See http://www.defra.gov.uk/environment/quality/air/air-quality/eu/
[109] Defra (2019). Air quality: explaining air pollution – at a glance. Available online at: https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance
[110] WHO (2014) *Burden of disease from ambient air pollution for 2012*. Available online at: www.who.int/phe/health_topics/outdoorair/databases/AAP_BoD_results_March2014.pdf?ua=1

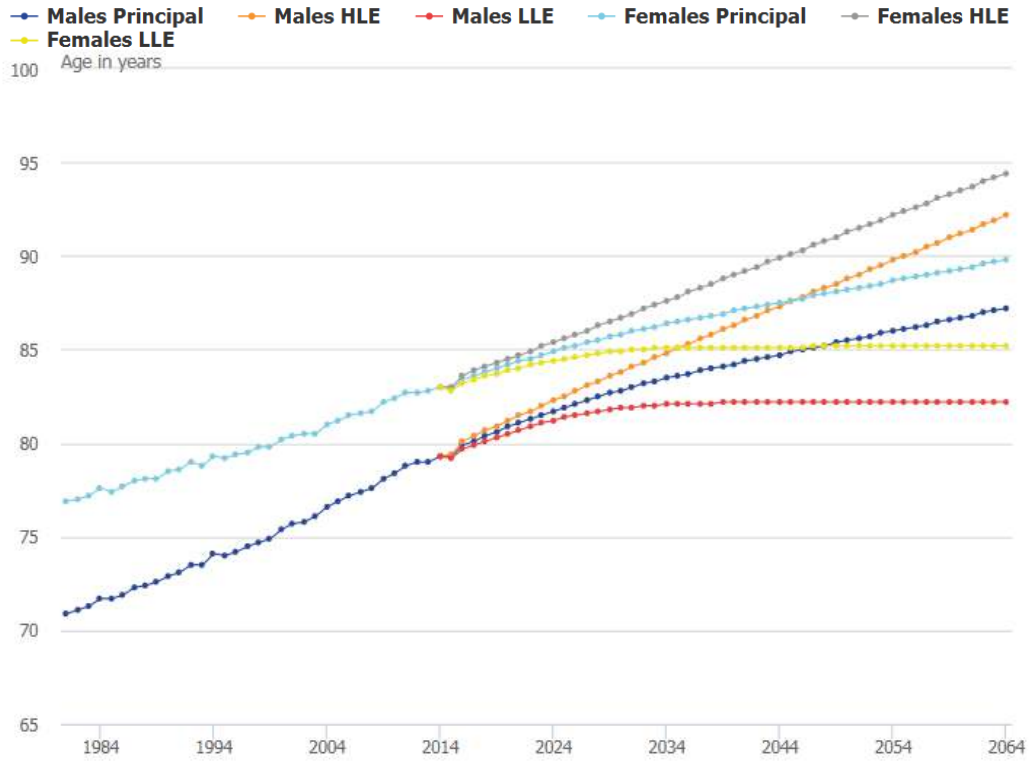
D3.5 Likely Evolution of Baseline

UK

D3.5.1 Life expectancy[111] at birth in the UK has reached its highest level on record for both males and females. From 1982 to 2017, life expectancy at birth has increased from 70.8 to 79.2 years for males and 76.8 to 82.9 years for females.[112]

D3.5.2 Period life expectancy[113] at birth is projected to rise by eight years for males and seven years for females across the 50-year projection period 2014 – 2064. **Figure D3.1** shows period life expectancy at birth for males and females 1981-2014 and then for each of the variant life expectancy projections to 2064. Under the principal projection, a baby boy born in 2064 is projected to live to 87.2 years and a baby girl to 89.8 years. In the high life expectancy variant, period life expectancy at birth is projected to reach age 92.2 and age 94.4 for males and females respectively in 2064, but the low life expectancy variant projects period life expectancy as low as 82.2 and 85.2 respectively.[114]

Figure D3.1 Period life expectancy at birth for males and females, UK, 1981-2064



Source: Office for National Statistics.

[111] The average period that a person may expect to live.
[112] *ONS (2018) National life Tables, UK: 2015 to 2017. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/2015to2017*
[113] Period life expectancy at a given age for an area is the average number of years a person would live, if he or she experienced the particular area's age-specific mortality rates for that time period throughout his or her life.
[114] ONS (2015) *Past and projected data from the period and cohort life tables: 2014-based, UK, 1981 to 2064.* Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/pastandprojecteddatafromtheperiodandcohortlifetables/2014baseduk1981to2064

England

D3.5.3 Life expectancy at birth for males in England has increased from 71.1 years in 1980-82 to 79.5 years in 2015-2017, an increase of 8.4 years. For females, life expectancy increased by 6.1 years from 77.0 to 83.1 years over the same period. As a result, the gap in life expectancy between genders over this time has decreased from 6 years to 2.3 years.

D3.5.4 Between 1993 and 2014, the proportion of the population in England reporting very good and good general health has fluctuated between 74% and 78% among men and between 73% and 76% among women, with no clear pattern of variation. The prevalence of very bad or bad general health has ranged from 4% to 8% across both sexes over the same period.

D3.5.5 The current general trend in human health is generally towards greater life expectancy and healthier lifestyles, including reductions in smoking prevalence and excessive alcohol consumption, and increases in fruit and vegetable consumption and physical exercise over the last 10 years. However, levels of obesity and the prevalence of certain conditions such as diabetes have increased across this period.[115]

D3.6 Waste Management Effects on Human Health

Waste Infrastructure

D3.6.1 Waste management has the potential for negative effects on human health, particularly for those living in close proximity to waste management sites.[116] Potential health hazards are associated with the handling, treatment and disposal of waste. These can arise both directly through exposure to hazardous substances in waste or to emissions from incinerators and landfill sites, vermin, odours and noise, or indirectly through ingestion of contaminated water, soil or food.[117] Leaks and improperly disposed of waste can also pose health hazards.116 Hazardous releases from waste sites are controlled through a variety of measures including permitting and compliance with regulation that drives best practise.

D3.6.2 The potential health impacts associated with the waste industry due to emissions to air have been identified as very low risk.[118,119] As highlighted in the 2013 Environmental Report, an extensive review into the health impacts of waste management facilities by Defra in 2004 considered a range of treatment facilities including composting and MBT plant as well as landfill and incineration sites. The study reviewed the impact of a wide range of pollutants, and particularly identified NOx, SOx and particulates as posing potential health risks. The analysis concluded that impacts from incineration plant were greater than those of the other facilities including landfill, but that even in this case the impacts were relatively minor.[120]

[115] HSCIC (2014) *Health Survey for England 2014: Trend Tables Commentary*. Available online at: http://content.digital.nhs.uk/catalogue/PUB19297/HSE2014-Trend-commentary.pdf

[116] WHO (2015) *Waste and human health: Evidence and needs*. WHO Meeting Report, 5–6 November 2015, Bonn, Germany. Available online at: http://www.euro.who.int/__data/assets/pdf_file/0003/317226/Waste-human-health-Evidence-needs-mtg-report.pdf

[117] L. Giusti (2009) *A review of waste management practices and their impact on human health*. Waste Management 29 (2009) 2227–2239

[118] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf

[119] Public Health England (2014) *Incinerators and public health*. Available online at: https://www.gov.uk/government/publications/incinerators-and-public-health

[120] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf

D3.6.3 Subsequent research has considered further the effects on health from waste incineration. In 2017/18, over 40% of the waste collected by Local Authorities was incinerated (primarily with energy recovery). Emissions from municipal waste incinerators depend of the composition of the materials incinerated, but may include particulate matter, sulphur dioxide (SO2), nitrogen oxides (NOx), hydrogen chloride (HCl), carbon monoxide (CO), volatile organic compounds (VOCs), persistent organic pollutants (POPs) including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals.[121]

D3.6.4 Public Health England (PHE) has stated that modern, well managed incinerators make only a small contribution to local concentrations of air pollutants. While it is possible that these small additions could have an impact on health, PHE has determined that such effects, if present, are likely to be very small and not detectable.[122] This has been further supported by one of the largest studies to date on health risks of municipal waste incineration, which reviewed all 22 British municipal waste incinerators operating between 2003 and 2010. The study found no evidence of a link between proximity or exposure to particulate matter (as a proxy for other emissions) from modern municipal waste incinerators and infant health outcomes.[123]

D3.6.5 Some studies have suggested an association between landfill sites and health risks, particularly relating to cancer (notably pancreas, larynx, liver, kidney and non-Hodgkin lymphoma). However, the findings are not conclusive and the potential of any harm to health is not certain. Studies into birth outcomes and links to landfill sites have identified statistically significant elevated risks for congenital abnormalities for people living within 2 km of hazardous and non-hazardous landfill waste sites. However there is still uncertainty and alternative explanations for the studies' findings, meaning that the effects on human health are possible but highly uncertain.[116] Landfills have also been identified as causing respiratory symptoms in the exposed population.[116] Methane emissions from landfill have historically caused health concerns, however the decreasing use of landfill, coupled with the robust monitoring of such sites, have lessened this issue.[124]

D3.6.6 Emissions to air from composting plant also has the potential to have harmful effects on health, although effects are uncertain. The release of dust, bacteria, fungi and other chemicals such as actinomycetes, endotoxins and 1-3 β glucans from composting sites can cause respiratory illnesses. While some studies have suggested an association between bioaerosols released from outdoor composting facilities and irritated respiratory symptoms in nearby residents, others have found inconclusive evidence.[117] The 2013 Environmental Report states that "To most individuals, exposure to bioaerosols does not appear to cause significant problems. However, as with some more conventional pollutants, certain individuals, for example asthmatics and the immuno-compromised, may suffer adverse health effects after exposure to bioaerosols."

D3.6.7 In addition, the spreading of animal manure or compost (particularly compost derived from the treatment of manure in windrows) can contain high levels of pathogens and viruses which are harmful to health, such as Salmonella and E. Coli. These can cause food poisoning where organic waste containing pathogens is applied to agricultural land and may result in contaminated crops, in addition to effects associated with the release of bioaerosols during landspreading, and contamination of surface water from runoff.[117]

[121] P. Douglas et al. (2017) *Estimating particulate exposure from modern Municipal Waste Incinerators (MWIs) in Great Britain.* Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6117747/
[122] Public Health England (2014) *Incinerators and public health*. Available online at: https://www.gov.uk/government/publications/incinerators-and-public-health
[123] R. Ghosh et al. (2018) *Fetal growth, stillbirth, infant mortality and other birth outcomes near UK municipal waste incinerators; retrospective population based cohort and case-control study*. Available online at: https://doi.org/10.1016/j.envint.2018.10.060
[124] Health Protection Agency (2011) *Impact on Health of Emissions from Landfill Sites*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/334356/RCE-18_for_website_with_security.pdf

D3.6.8 The UK Informative Inventory Report from the UK National Atmospheric Emissions Inventory (NAEI) Programme identifies that the biological treatment of waste/solid waste disposal on land sector accounted for 9% of the UK emissions for mercury, and the open burning of waste accounted for 8% of the UK's emissions of the dioxins PCDD/PCDF (Polychlorinated dibenzo-p-dioxins/Polychlorinated dibenzofurans). However, the report also confirmed that emissions from the waste sector have a negligible effect on overall UK emissions for most pollutants.[125] Therefore, in the context of national emissions affecting human health, any effects due to emissions to air from waste management are generally expected to have a limited impact, but this may depend on local factors and sensitivities.

D3.6.9 There is the potential for significant levels of dust and other emissions to arise during the construction phase of any new waste management infrastructure, which has the potential for adverse effects on health. Noise and odour nuisance and vibration associated with heavy goods vehicle movements from the construction and operation of waste management infrastructure can also have adverse effects on human health and wellbeing.[126] However the planning and permitting system would be expected to control operational emissions to avoid significant effects.

D3.6.10 There are also specific risks to health of workers in the waste sector, particularly in waste collection roles, including recycling, green waste and residual waste. The Health & Safety Executive (HSE) highlights that health and safety performance in the waste and recycling sector is poor, with RIDDOR reportable injuries over 4 times greater than most other industry sectors.[127] Health risks include being hit by moving objects or vehicles, needles/sharps and manual handing. In 2017/18, there were 12 fatal injuries to workers in the waste sector in Great Britain, predominantly due to contact with moving machinery or vehicles. There were 5,000 further non-fatal injuries, and 5,000 workers suffering from work related ill health such as musculoskeletal disorders.[128] There are also occupational effects on health for waste collection workers due to vehicle emissions.[129] Any increases in waste collections therefore has the potential for an increased risk of harm to waste collection workers.

D3.6.11 Reliable removal of waste from households and business has human health benefits, through the avoidance of the breakdown of uncollected waste in residential areas, and spread of pests in unmanaged waste.

D3.6.12 Some studies have also highlighted the possible effects on community mental health as a result of exposure to industrial hazardous waste sites, with some evidence supporting greater levels of psychiatric morbidity for residents exposed to such sites than residents who are not exposed. However, studies are limited and any specific links to human effects are uncertain.[130]

[125] Ricardo Energy & Environment (2019) *UK Informative Inventory Report (1990 to 2017).* Available online at: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1904121008_GB_IIR_2019_v2.0.pdf
[126] DCLG (2013) Strategic Environmental Assessment of the updated national waste planning policy. Available online at: http://data.parliament.uk/DepositedPapers/Files/DEP2013-1395/SEA_Scoping_Report_DCLG.pdf
[127] Health & Safety Executive (2019) *Municipal and commercial collections*. Available online at: http://www.hse.gov.uk/waste/municipal.htm
[128] Health & Safety Executive (2018) *Waste statistics in Great Britain, 2018.* Available online at: http://www.hse.gov.uk/statistics/industry/waste-recycling.pdf
[129] WRAP & CIWM (2009) *Scoping study of potential health effects of fortnightly residual waste collection and related changes to domestic waste systems*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Scoping%20study%20of%20potential%20health%20effects%20of%20fortnightly%20waste%20collection%20Final1.pdf
[130] Environment Agency (2005) *Health Impact Assessment of Waste Management: Methodological Aspects and Information Sources. Science Report P6-011/1/SR1.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291564/scho1205bimg-e-e.pdf

Materials Use

D3.6.13 The use of resources requires materials and energy for the extraction of raw materials, transportation and the manufacture of goods. The extraction of primary raw materials can have effects on health, which extend consideration outside the UK to reflect a lifecycle approach to the effects of waste. The effects could be reduced through the application of the waste hierarchy through waste avoidance, reuse of products and recycling, as this could reduce the need for extraction of primary raw materials.

D3.6.14 The OECD highlights that the health impacts associated with primary production of certain metals are greater than for secondary (recycled) metals. Of the materials investigated in the OECD report, primary production of copper and nickel had the greatest effects on human toxicity per kilogram of material. Human toxicity was substantially reduced for secondary metals, meaning that moving up the waste hierarchy to increase recycling, and keeping materials in use for longer or avoiding the need for raw materials can have associated health benefits by avoiding the need for extraction of raw materials.[131]

D3.6.15 For some materials such as plastics, recycling can pose risks as some primary plastics have hazardous additives which can be harmful to human health. Even if the substances have been restricted or banned in new materials, they can enter recycled products as there is currently a lack of transparency in the use of additives in plastic production. This is most relevant to toys and food packaging, which need to be non-hazardous.[132] However, there are few studies into the health impacts of recycling.[117]

D3.6.16 Microplastics (<5mm in size) can be either primary: pre-production pellets and those intentionally added to products; or secondary: fragments of larger plastics resulting from exposure to sunlight and seawater. The sale of personal care products containing microbeads is now banned in the UK.[133] Microplastics have the potential to cause harm through ingestion or inhalation, and under laboratory studies on animals (at higher concentrations than those found in nature) can cause inflammation, stress, growth and effects on reproduction.[134] It is not certain whether these effects would apply to human health, however occupational exposure to microplastics can cause respiratory problems, as well as reproductive toxicity and carcinogenicity.[134] There are currently no population-wide studies of the health effects of microplastics on humans, and there is not thought to currently be a widespread risk to health. However, effects are considerably uncertain and the toxicity of microplastics is expected to increase with decreasing size and increased concentrations. While there is uncertainty about the current scale of effects, it is thought that at present, microplastic pollution does not constitute a widespread risk, but that microplastics could present a risk to health in the near future if releases are not managed.[135]

D3.6.17 There is the potential for harm to human health elsewhere in the world though the illegal transport of waste, particularly hazardous waste, from industrialised countries to lower income countries, which presents a range of health risks for the local population.[116] However hazardous waste is not permitted to be exported from the UK to developing countries, and waste must only be exported for recovery when it will be treated in facilities that operate to a broadly equivalent standard to

[131] OECD (2019) *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*. Available online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page1
[132] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Technical Annex.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf
[133] Defra (2019) *World leading microbeads ban comes into force*. Available online at: https://www.gov.uk/government/news/world-leading-microbeads-ban-comes-into-force
[134] SAPEA (2019) *A Scientific Perspective on Microplastics in Nature and Society*. Available online at: https://www.sapea.info/wp-content/uploads/report.pdf
[135] European Commission Scientific Advice Mechanism (2019) *Environmental and Health Risks of Microplastic Pollution.* Available online at: https://ec.europa.eu/info/publications/environmental-and-health-risks-microplastic-pollution_en

those in the UK.[136] These legislative controls aim to prevent harm to human health as a result of processing the UK's waste elsewhere in the world, although illegal shipments may still result in harmful practices.

D3.6.18 Further to this, the prevention of waste, and the reuse of products and recycling (which avoid the need for primary manufacture) would have health benefits through the reduction in energy consumption and associated avoidance of greenhouse gases and emissions to air. Greenhouse gas emissions from the waste sector accounts for 4% of the UK's total emissions, with methane from landfill accounting for the majority of these emissions.[137] The release of greenhouse gases is causing climate change, which can have health impacts through extreme weather and temperature changes, among others. The application of the waste hierarchy and the prevention of biodegradable waste going to landfill would reduce greenhouse emissions, and reduce the contribution to climate change. However on a global scale, the greenhouse gas emissions associated with waste in England would be expected to have a negligible effect on human health.

D3.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

Table D3.1 presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D3.1 Assessment of the Draft WMPE and reasonable alternative

Human Health		
To ensure the protection and enhancement of human health, safety and wellbeing. To minimise disturbance to local communities.		
• Will the draft WMPE adversely affect human health by resulting in increased nuisance and disruption (e.g. as a result of increased noise levels, change in air quality or loss amenity)? • Will the draft WMPE disproportionately affect communities already identified as vulnerable / at risk? • Will the draft WMPE affect opportunities for recreation and physical activity?		
	Effect	**Commentary**
WMPE		
Prevention	+/?	The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery, although any such contribution to air pollution, and consequential effects on human health is considered to be very small. It is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. It is possible that the new service will require new fleets

[136] Defra (2013) *Waste Management Plan for England*
[137] Committee on Climate Change (2019) *Net Zero – Technical Report*. Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

		to collect and transport separated materials to recycling, composting or recovery sites. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. The elimination of avoidable plastics will reduce human exposure to microplastic hazards which can cause adverse effects to human health either by digestion or inhalation. The reduction of waste and the elimination of avoidable plastics will have a positive impact on human health by limiting exposure to harmful microplastics. However, the uptake of electric and hybrid vehicles cannot be certain and the effects of redistribution of waste collections cannot be quantified. As such, the WMPE is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+	The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material (potentially in the home). An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods, therefore potentially having a reduction in emissions which cause air pollution. In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by businesses that can use the byproducts from other processes. As such these reusers will generate new vehicle movements, and therefore emissions, between reusers. These waste vehicle movements would require new fleets. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	?	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as to require separate food waste collection for recycling (this could be recycled through composting, or through AD plants). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. If recycling is increased by diverting material from waste collection e.g. as a result of separate food waste collections, it is possible that reductions in residual waste collection fleets would be matched by an increase in additional movements from recycling fleets. It is also possible that the new service will require new fleets to collect and transport separated materials to composting or recovery sites. This presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. The WMPE will support the recycling of such material however Tolvik (2017) highlight that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Constructing and operating these sites near to vulnerable populations could have impacts on the health of residents, arising from noise, disturbance and localised emissions. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct and environmental permits to operate.

		Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. The WMPE reiterates interest in implementing a DRS in England. Whilst this will improve recycling, it is likely that the new service will require new vehicle fleets to collect and transport materials to counting and bulking sites (although to a degree this will reflect how it is implemented). In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements and therefore emissions, as there are few comparable circumstances to its implementation in England[138]; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that such trips would be combined with other journeys, depending on the location of the DRS facilities. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions harmful to human health, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. However, the introduction of new waste infrastructure sites and therefore fleets further presents an opportunity for the introduction of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The WMPE will support this ambition by seeking to improve the design of materials by promoting the benefits of the circular economy. As such, packaging will be redesigned to be compostable, recyclable or reusable. Any improvements to the design of plastics will open up new opportunities for the material to be reused. This will remove the plastics from landfill minimising emissions from landfill. An increase in composting (and the sites to undertake composting) creates a number of risks to human health, related to the release of dust, bacteria, fungi which can cause respiratory illnesses. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, human health. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality and therefore human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. In addition, while there are benefits of recycling diverting waste from landfill and incineration sites in terms of operational emissions, it cannot be assumed at vehicle emissions will decrease. As such, the WMPE is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	?	The WMPE seeks to improve recovery of materials; both by moving wastes from landfill into recovery and moving material from recovery into reuse and recycling. Recovery includes the use of AD technologies as well as EfW incineration. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. As the plan reiterates key targets - to cut municipal solid waste to landfill to just 10% by 2035. It is likely that landfilled wastes will move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise emissions resulting from localised

[138] Zero Waste Scotland (2017) *Deposit Return Evidence Summary*. Section 3.4. Available at: https://www.zerowastescotland.org.uk/sites/default/files/Deposit%20Return%20Evidence%20Summary.pdf and LARAC (2018) *The Future of Local Authority Waste Funding: A Larac Policy Paper*. Available at: https://larac.org.uk/sites/default/files/LARAC%20POLICY%20PAPER%20The%20future%20of%20LA%20Waste%20Funding%200418.pdf

		transport and "exporting" of wastes to other communities. However, Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Constructing and operating these sites near to vulnerable populations could have impacts on the health of residents, arising from noise, disturbance and localised emissions. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct and environmental permits to operate. Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. Public Health England (PHE) has stated that modern, well managed incinerators make only a small contribution to local concentrations of air pollutants. While it is possible that these small additions could have an impact on health, PHE has determined that such effects, if present, are likely to be very small and not detectable. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a minor positive effect of air quality by reducing emissions associated with such waste management facilities. However, it is possible that there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials; this cannot be quantified at this stage. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling can have positive impacts, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants, although there are proposals in the WMPE and RWS which also support greater efficiency of EfW plants, including through utilisation of the heat generated. To address this may then require increased traffic movements and therefore vehicle emissions, as recovery sites source alternative feedstock (potentially from further afield). The WMPE states that "*The Government continues to support anaerobic digestion (AD) as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. This ensures that food waste is diverted from landfill and reduces greenhouse gas emissions*." Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, human health. However, the government support stated in the plan for AD gives confidence that AD plant will continue to be in operation and contribute to waste processing in the medium term. The Health & Safety Executive (HSE) highlights that health and safety performance in the waste and recycling sector is poor, with RIDDOR reportable injuries over 4 times greater than most other industry sectors.[139] There are higher HSE risks associated with recovery sites due to the process involved and the potential for flammable gases to accumulate, as well as potential employee exposure to hazardous waste. However, through the application of regulation driving improving safety practises in the industry, the risk lessens. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. As such the WMPE is likely to have an overall negative/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut waste to landfill to just 10% by 2035.

[139] Health & Safety Executive (2019) *Municipal and commercial collections*. Available online at: http://www.hse.gov.uk/waste/municipal.htm

		The range of commitments outlined in the WMPE will reduce the use of landfill. These include plans to introduce a household waste collection system for food wastes which will divert wastes from landfill into recycling of recovery. The closure of any landfills due to a reduction in demand will reduce any adverse effects on health arising from existing sites (associated with noise, disturbance and localised emissions). It also provides opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. This could provide opportunities for developments which benefit the local community, for example, parks and recreational facilities. A reduction in the use of landfill and shift towards reuse, recycling and recovery as set out in the WMPE will allow for emissions from the waste sector as a whole to be reduced resulting in a positive effect on air pollution and therefore human health. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on human health, especially if located near to vulnerable population; this will be dependent on location, design, setting and construction and operational activities and is expected to have a minimal impact. As such the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+/?	Overall, the WMPE brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed to address the capacity gaps. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the impacts to human health. Constructing and operating these sites near to vulnerable populations would have significant impacts on the health of residents, however locating these sites in less vulnerable areas would have significantly lower impacts. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct and environmental permits to operate. Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants, although there are proposals in the WMPE and RWS which also support greater efficiency of EfW plants, including through utilisation of the heat generated. To address the change in calorific value may then require increased traffic movements and therefore emission, as recovery sites source feedstock from further afield. The elimination of avoidable plastics will reduce human exposure to microplastic hazards which can cause adverse effects to human health either by digestion or inhalation. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. The Health & Safety Executive (HSE) highlights that health and safety performance in the waste and recycling sector is poor, with RIDDOR reportable injuries over 4 times greater

		than most other industry sectors.[140] There are higher HSE risks associated with recovery sites due to the process involved and the potential for flammable gases to accumulate, as well as potential employee exposure to hazardous waste. However, through the application of regulation driving improving safety practises in the industry, the risk lessens. The closure of any landfills due to a reduction in demand will reduce any adverse effects on health arising from existing sites (associated with noise, disturbance and localised emissions). It also provides opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. This could provide opportunities for developments which benefit the local community, for example, parks and recreational facilities. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality and therefore human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. In addition, while there are benefits of recycling diverted waste from landfill and incineration sites in terms of operational emissions, it cannot be assumed at vehicle emissions will decrease. As such, the WMPE is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	**+/?**	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery, although any such contribution to air pollution, and consequential effects on human health is considered to be very small. It is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. It is possible that the new service will require new fleets to collect and transport separated materials to recycling, composting or recovery sites. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. The reasonable alternative to implement improvements at a quick rate could further impact the availability of comparable electric vehicles for collections. The elimination of avoidable plastics will reduce human exposure to microplastic hazards which can cause adverse effects to human health either by digestion or inhalation. The reduction of waste and the elimination of avoidable plastics will have a positive impact on human health by limiting exposure to harmful microplastics. However, the uptake of electric and hybrid vehicles cannot be certain and the effects of redistribution of waste collections cannot be quantified. As such, the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	**+**	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material (potentially in the home). An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods, therefore potentially having a reduction in emissions which cause air pollution.

[140] Health & Safety Executive (2019) *Municipal and commercial collections*. Available online at: http://www.hse.gov.uk/waste/municipal.htm

		In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by businesses that can use the byproducts from other processes. As such these reusers will generate new vehicle movements, and therefore emissions, between reusers. These waste vehicle movements would require new fleets. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. The reasonable alternative to implement improvements at a quick rate could further impact the availability of comparable electric vehicles for collections. As such the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	?	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as a potential food waste collection system (this could be recycled through composting, or recovered, through AD plants). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. If recycling is increased by diverting material from waste collection e.g. as a result of separate food waste collections, it is possible that reductions in residual waste collection fleets would be matched by an increase in additional movements from recycling fleets. It is also possible that the new service will require new fleets to collect and transport separated materials to composting or recovery sites. This presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. The reasonable alternative to implement improvements at a quick rate could further impact the availability of comparable electric vehicles for collections. Constructing and operating new waste management facilities near to vulnerable populations could have impacts on the health of residents, arising from noise, disturbance and localised emissions. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. The WMPE reiterates interest in implementing a DRS in England. Whilst this will improve recycling, it is likely that the new service will require new vehicle fleets to collect and transport materials to counting and bulking sites (although to a degree this will reflect how it is implemented). In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements and therefore emissions, as there are few comparable circumstances to its implementation in England; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that such trips would be combined with other journeys, depending on the location of the DRS facilities. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions harmful to human health, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. However, the introduction of new waste infrastructure sites and therefore fleets further presents an opportunity for the introduction of electric and

		hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. An increase in composting (and the sites to undertake composting) creates a number of risks to human health, related to the release of dust, bacteria, fungi which can cause respiratory illnesses. Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. Achieving this target in a shorter timeframe will open up new opportunities for the material to be reused sooner. This will remove the plastics from landfill sooner, therefore minimising emissions from landfill. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, human health. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality and therefore human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. In addition, while there are benefits of recycling diverted waste from landfill and incineration sites in terms of operational emissions, it cannot be assumed at vehicle emissions will decrease. As such, the reasonable alternative is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	?	The 'Direction of Travel' reasonable alternative seeks to improve the rate of recovery. This refers to materials that were previously landfilled and that have now moved up the hierarchy to recovery level. It also considers the removal of material from the recovery stage, to the recycling stage, which is possible in the event of improved recycling services and identification of new offtakers or reprocessors. The WMPE will support the recycling of such material however Tolvik (2017) highlight that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Constructing and operating these sites near to vulnerable populations could have impacts on the health of residents, arising from noise, disturbance and localised emissions. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. Public Health England (PHE) has stated that modern, well managed incinerators make only a small contribution to local concentrations of air pollutants. While it is possible that these small additions could have an impact on health, PHE has determined that such effects, if present, are likely to be very small and not detectable. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling can have positive impacts, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore vehicle emissions, as recovery sites source alternative feedstock (potentially from further afield). The WMPE states that "*The Government continues to support anaerobic digestion (AD) as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. This ensures that food waste is diverted from landfill and reduces*

		greenhouse gas emissions." Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, human health. However, the government support stated in the plan for AD gives confidence that AD plant will continue to be in operation and contribute to waste processing in the medium term. The Health & Safety Executive (HSE) highlights that health and safety performance in the waste and recycling sector is poor, with RIDDOR reportable injuries over 4 times greater than most other industry sectors.[141] There are higher HSE risks associated with recovery sites due to the process involved and the potential for flammable gases to accumulate, as well as potential employee exposure to hazardous waste. However, through the application of regulation driving improving safety practises, the risk lessens. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality and therefore human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. As such the reasonable alternative is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal (decrease in disposal of waste streams compared to WMPE)	+	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut municipal solid waste to landfill to just 10% by 2035. These targets will lead to a reduction in need and capacity for disposal. The closure of any landfills due to a reduction in demand will reduce any adverse effects on health arising from existing sites (associated with noise, disturbance and localised emissions). It also provides opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. This could provide opportunities for developments which benefit the local community, for example, parks and recreational facilities. Achieving this in a shorter timeframe will allow for earlier use of these example facilities, potentially preventing developments on greenfield land in the medium term. A reduction in the use of landfill and shift towards reuse, recycling and set out in the WMPE will allow for emissions from the waste sector as a whole to be reduced resulting in a positive effect on air pollution and therefore human health. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on human health, especially if located near to vulnerable population; this will be dependent on location, design, setting and construction and operational activities and is expected to have a minimal impact. As such the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+/?	Overall the 'Direction of Travel' reasonable alternative brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy at a quicker pace than the WMPE proposes. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed to address the capacity gaps. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the impacts to human health. Constructing and operating these sites near to vulnerable populations could have impacts on the health of residents, however locating these sites in less vulnerable areas could result in an increase in vehicle movements. Heat generated by these sites can be utilised by nearby populations providing added benefits (particularly for those households in fuel poverty. The location of new sites would be identified in the

[141] Health & Safety Executive (2019) *Municipal and commercial collections*. Available online at: http://www.hse.gov.uk/waste/municipal.htm

		relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on human health, would be minimised, reduced or mitigated. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants, althought the WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. To address the reduction in calorific value may require increased traffic movements and therefore emission, as recovery sites source feedstock from further afield. The elimination of avoidable plastics will reduce human exposure to microplastic hazards which can cause adverse effects to human health either by digestion or inhalation. Under laboratory studies on animals (at higher concentrations than those found in nature), microplastics can cause inflammation, stress, growth and effects on reproduction. It is not certain whether these effects would apply to human health, however occupational exposure to microplastics can cause respiratory problems, as well as reproductive toxicity and carcinogenicity.[142] An increase in composting (and the sites to undertake composting) creates a number of risks to human health, related to the release of dust, bacteria, fungi which can cause respiratory illnesses. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. The Health & Safety Executive (HSE) highlights that health and safety performance in the waste and recycling sector is poor, with RIDDOR reportable injuries over 4 times greater than most other industry sectors.[143] There are higher HSE risks associated with recovery sites due to the process involved and the potential for flammable gases to accumulate, as well as potential employee exposure to hazardous waste. However, through the application of regulation driving improving safety practises in the industry, the risk lessens. The closure of any landfills due to a reduction in demand will reduce any adverse effects on health arising from existing sites (associated with noise, disturbance and localised emissions). It also provides opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. This could provide opportunities for developments which benefit the local community, for example, parks and recreational facilities. Achieving this in a shorter timeframe will allow for earlier use of these example facilities, potentially preventing developments on greenfield land in the medium term. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality and therefore human health, especially if located near to a vulnerable population; however, this will be dependent on location, design, setting and construction and operational activities. In addition, while there are benefits of recycling diverted waste from landfill and incineration sites in terms of operational emissions, it cannot be assumed at vehicle emissions will decrease. As such, the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions

Score Key:	**+ +**	**+**	**0**	**-**	**- -**	**?**

[142] SAPEA (2019) *A Scientific Perspective on Microplastics in Nature and Society*. Available online at: https://www.sapea.info/wp-content/uploads/report.pdf

[143] Health & Safety Executive (2019) *Municipal and commercial collections*. Available online at: http://www.hse.gov.uk/waste/municipal.htm

	Significant positive effect	**Minor** positive effect	**Neutral** effect	**Minor** negative effect	**Significant** negative effect	**Uncertain** effect
NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.						

D3.8 Mitigating Measures

D3.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on human health:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Uptake of use of electric vehicles wherever possible for waste collection and transportation, subject to feasibility, applicability and cost.
- Uptake of renewable energy sources to power waste management sites wherever possible, subject to feasibility, applicability and cost. This could include on site electricity generation.
- Monitoring of effects from waste management sites including the delivery and disembarking activities, consistent with permitting and consent conditions.
- Avoiding AQMAs wherever possible for collection and waste management sites and ensuring monitoring is in place where not possible.
- Drive improvement in HSE performance in the waste sector as a whole through a variety of initiatives e.g. requirement for more detailed HSE policies and procedures including targets and requirements to install safety systems onto equipment where appropriate.
- Restoration of landfill sites to provide recreational sites and green space for local communities.

D3.9 Uncertainties and Risks

- The level and type of product which would be reused cannot be quantified at this stage, and therefore the reduction in manufacturing and waste collections also cannot be quantified.
- The level on investment and infrastructure required to close the waste management gap when diverting waste from landfill is not known at this stage.
- The type of infrastructure which will be built to close this gap is also not knows at this stage, however it is likely to be a combination of recycling and recovery sites.

- The extent that emissions from vehicles will change as a result of schemes e.g. the DRS scheme is not known at this stage.
- The uptake of electric and hybrid vehicles is unknown at this stage.
- It is expected that to achieve the SEA objectives more quickly, the infrastructure construction would significantly intensify, however, this cannot be quantified.
- The locations of new waste management infrastructure are unknown. This results in uncertainties regarding how the site construction will affect air quality and the impact in waste transportation distances.

D4. Land Use, Geology and Soils

D4.1 Introduction

D4.1.1 Land use is concerned with the effective use of land, i.e. by encouraging the reuse of land that has been previously developed (brownfield land) as well as promoting sustainable patterns of land use, e.g. in relation to the protection of open spaces and green infrastructure. Geology and soils are concerned with important geological sites, the contamination of soils and high quality agricultural land.

D4.1.2 There are links between the land use, geology and soil topic and other topics in this SEA around the WMPE, including biodiversity and nature conservation, human health, climate change, materials and landscape and townscape.

D4.1.3 Waste has a limited direct impact on land use through the construction of waste infrastructure such as sorting plants, Energy from Waste sites, fleet depots etc. Secondary impacts include those from leachate affecting soils and groundwater and littering on local environs.

D4.2 Review of plans and programmes

D4.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D4.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Land use, Geology and Soils. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D4.1 Land use, Geology and Soils Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2006) Thematic Strategy for Soil Protection
National Plans and Programmes
Defra (2009) Safeguarding our Soils: A Strategy for England
HM Government (1990) The Environmental Protection Act (as amended)
HM Government (1990) Town and Country Planning Act 1990
HM Government (2004) The Planning and Compulsory Purchase Act 2004
HM Government (2008) The Planning Act
HM Government (2016) Environmental Permitting (England and Wales) Regulations 2016
HM Government (2016) National Infrastructure Delivery Plan (NIDP) 2016 to 2021
Ministry of Housing Communities and Local Government (MHCLG) (2014) Planning Practice Guidance
MHCLG (2019) National Planning Policy Framework (NPPF)

D4.3 Overview of the Baseline

Geology

D4.3.1 The geology of the UK is diverse with almost 700 soil types in England and Wales alone.[144] As a broad overview the following rock types exist in a progression from North West to South East (predominant rock types): Tertiary Volcanic Rocks; Crystalline Rock of Pre-Cambrian and later age; Lower Carboniferous to Cambrian; Triassic and Permian; Early Precambrian and Devonian; Jurassic; Cretaceous; Tertiary and Marine Pleistocene; and finally a return to Cretaceous.[145]

D4.3.2 The UK has a diversity of mountain ranges and flood plains. In England, the southern part of the country is predominantly lowland, with mountainous terrain north-west of the Tees-Exe line (the Lowland-Upland divide across England), which includes the Cumbrian Mountains of the Lake District, the Pennines and limestone hills of the Peak District, Exmoor and Dartmoor.[146]

D4.3.3 The Geological Conservation Review (GCR) was launched in 1977 in order to identify and describe the most important (nationally and internationally) geological sites in Britain, and to create a suite of descriptions which collectively catalogue and display the full range of the UK's earth heritage features. The full geological chronology from the Cambrian period to the Quaternary is covered in 3,000 sites spanning 100 categories (or 'blocks').

D4.3.4 There are over 2,000 geological Sites of Special Scientific Interest (SSSIs) in the UK. Across the UK there are also a number of non-statutory geological and geomorphological sites designated at a local level, i.e. often known as Local Geological Sites (formerly Regionally Important Geological and Geomorphological Sites (RIGS)).

Land Use and Soils

D4.3.5 The UK covers an area of 24,853,200 hectares (248,532 km2). England comprises the largest land area in the UK, covering an area of 13,293,800 hectares (132,938 km2). The smallest land area in the UK is Northern Ireland, which covers an area of 1,413,000 hectares (14,130 km2).[147]

D4.3.6 Average population density of the UK in 2017 is 263 people per square kilometre.[148]

D4.3.7 **Table D4.1** shows land cover in the UK as it stood in 2007 and highlights that arable and horticulture and improved grassland are the most common land cover types, constituting 25.5% and 25.3% of total land area in the UK respectively.[149] *The UK Natural Capital: Interim Review and Revised 2020 Roadmap* sets out the commitment to complete a suite of accounts for broad habitats

[144] Natural England (2008) *State of the Natural Environment 2008*. Available online at: http://publications.naturalengland.org.uk/publication/31043?category=118044

[145] Natural England. *England's geology*. Available online at: http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/ourwork/conservation/geodiversity/englands/default.aspx

[146] Natural England (2008) *State of the Natural Environment 2008*. Available online at:. http://publications.naturalengland.org.uk/publication/31043

[147] ONS. *The Countries of the UK*. Available online at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/administrative/the-countries-of-the-uk/index.html

[148] ONS (2017) *Overview of the UK population: March 2017*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/overviewoftheukpopulation/mar2017

[149] Countryside Survey (2011) *Final Report for LCM2007*. Available online at: http://nora.nerc.ac.uk/14854/1/LCM2007_Final_Report_-_vCS_Web.pdf

in the UK in order to organise and analyse statistical evidence from disparate sources.[150] This will record the size and condition of board habitats.

Table D4.1 Estimated Areas of Broad Habitats in the UK in 2007

Land Type	'000 Hectares	% Land Area
Broadleaved, mixed and yew woodland	1,373.3	5.6
Coniferous woodland	1,505.7	6.1
Arable and horticulture	6,300.5	25.5
Improved grassland	6,237.7	25.3
Neutral grassland	1,589	6.4
Calcareous grassland	37.2	0.2
Acid grassland	1,647.1	6.7
Dwarf shrub heath	2,111.8	8.5
Fen, Marsh, Swamp	10.1	0.1
Bog	1,097.2	4.3
Freshwater	324.8	1.3
Montane	488.6	2.0
Inland Rock	131.4	0.5
Built-up Areas and Gardens	1,464.8	6.0
Other land	363.3	1.5
Total	**24,682.5**	**100%**

Source: Countryside Survey, LCM2007.

D4.3.8 According to the 2011 UK National Ecosystem Assessment, 6.8% of the UK's land area is classified as urban, the urban landscape accounts for 10.6% of England, 1.9% of Scotland, 3.6% of Northern Ireland and 4.1% of Wales (and encompass some agricultural land). The remainder of the population live in smaller towns and villages, with a very small proportion scattered through the countryside.[151]

D4.3.9 Within the rural areas, land use varies greatly on a very local basis, but there are clear regional trends. There is a much higher proportion of arable farming in the east than in the west, with most of East Anglia and the area around the Wash almost entirely arable or devoted to other forms of intensive agriculture. To the west, there is much more grassland, although a high proportion of it is improved grassland, particularly in lowland areas; this is often cultivated for fodder or silage as much as for grazing. Upland areas, particularly in the north, the west and Wales, tend to have a high proportion of unimproved land used for extensive rather than intensive grazing, mainly for sheep, and large areas of forestry.

[150] ONS (2018) *UK Natural Capital: interim review and revised 2020 roadmap*. Available online at: https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/methodologies/uknaturalcapitalinterimreviewandrevised2020roadmap

[151] UNEP (2011) *UK National Ecosystem Assessment, Synthesis of Key Findings 2011*. Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

D4.3.10 National Forest Inventory Woodland Area Statistics for Great Britain highlight that the area of woodland in Great Britain at 31 March 2010 is estimated to be 2,982 thousand hectares, around 13.0% of the total land area in Great Britain.[152]

D4.3.11 The quality of land across the UK varies, with the best and most versatile agricultural land generally situated in the lowland and valley areas of England. Due to the topography and terrain, much of Scotland and Wales is classified as lower grade land. An estimated 21% of all farmland in England is classified as Grade 1 ('Excellent') and 2 ('Very Good') land, with a similar percentage graded as Subgrade 3a ('Good') land. These grades are the best and most versatile land grades as classified under the Agricultural Land Classification System (ALC).[153]

D4.3.12 There is estimated to be around 400,000 hectares of contaminated land in the UK (around 1.6% of the total land area).[154] The UK has a substantial legacy of chemical contaminants in soil. Some contaminants may be present naturally, but more often they occur as a result of human industrial and domestic pollution. Such contamination is typically found in brownfield sites on former industrial land. The majority of such sites are in urban contexts, but a large number are not, particularly those associated with mining or other extractive industries, primary processing of bulk raw materials and power generation.

D4.3.13 The principal causes of accelerated erosion (i.e. that which exceeds background levels) in England, Wales and Scotland are:

D4.3.14 intensive cultivation - particularly where compacted by machinery and left open to rain;

- trampling by animals;
- poor forestry practice (e.g. during road construction and harvesting); and
- run-off from urban land surfaces.

D4.3.15 Other causes include wind erosion, tillage losses and soil co-extracted with root vegetables.[155] The rate of soil erosion due to agriculture is thought to have remained relatively stable across the period 1969 to 2010.[156]

England

Geology

D4.3.16 England's landscape is closely associated with its underlying geology. The topography of England is very varied. Lowland areas are generally found in the East of England. The North West is the

[152] Forestry Commission (2011) *National Forest Inventory Statistics for Great Britain*. Available online at: https://www.forestry.gov.uk/pdf/NFI_GB_woodland_area_stats_2010_FINAL.pdf/$FILE/NFI_GB_woodland_area_stats_2010_FINAL.pdf

[153] Natural England (2012) *Agricultural Land Classification: protecting the best and most versatile agricultural land, TIN049*. Available online at: http://publications.naturalengland.org.uk/file/4424325

[154] Department for International Trade (2015) *Land remediation: Bringing brownfield sites back to use.* Available online at: https://www.gov.uk/government/publications/land-remediation-bringing-brownfield-sites-back-to-use/land-remediation-bringing-brownfield-sites-back-to-use

[155] Quine TA Van Oost K, Walling DE and Owens PN (2006) *Development and Application of GIS-Based Models to Estimate National Rates of Soil Erosion by Tillage, Wind and Root Crop Harvest.* University of Exeter Report to Defra, Project SP08007, University of Exeter, UK, 59pp. Available online at: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCIQFjAA&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DSP08007_6584_FRA.pdf&ei=mBdnVdaOC4X2UvaVgPgK&usg=AFQjCNEcGiVgzMhyX0jjAa1ghaPkRmpA-Q&bvm=bv.93990622,d.d24

[156] Cranfield University (2015) *Research to develop the evidence base on soil erosion and water use in agriculture: Final Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2015/06/Cranfield-University-for-the-ASC.pdf

most mountainous area with other rugged areas found in the South West and central northern regions. There are a number of upland areas across England, such as the South Downs, Cotswolds, Peak District and North York Moors.

D4.3.17 In 2008 Natural England reported that there were 1,214 SSSIs designated for their geodiversity features covering 1,704 Geological Conservation Review (GCR) sites (which identified nationally important features of geological interest). Many SSSIs have more than one GCR feature and some GCR features extend over more than one SSSI, giving a total of 1,735 SSSI-GCR combinations, or 'geo-features'. The proportion of GCRs in favourable/recovering status varied between 76-94% depending on its category of GCR (each category is reported separately).[157]

D4.3.18 There are no formal international designations for geodiversity sites equivalent to the SPA and SAC designations for biological features, although the geodiversity of the Dorset and East Devon Coast is recognised through designation as a World Heritage Site.

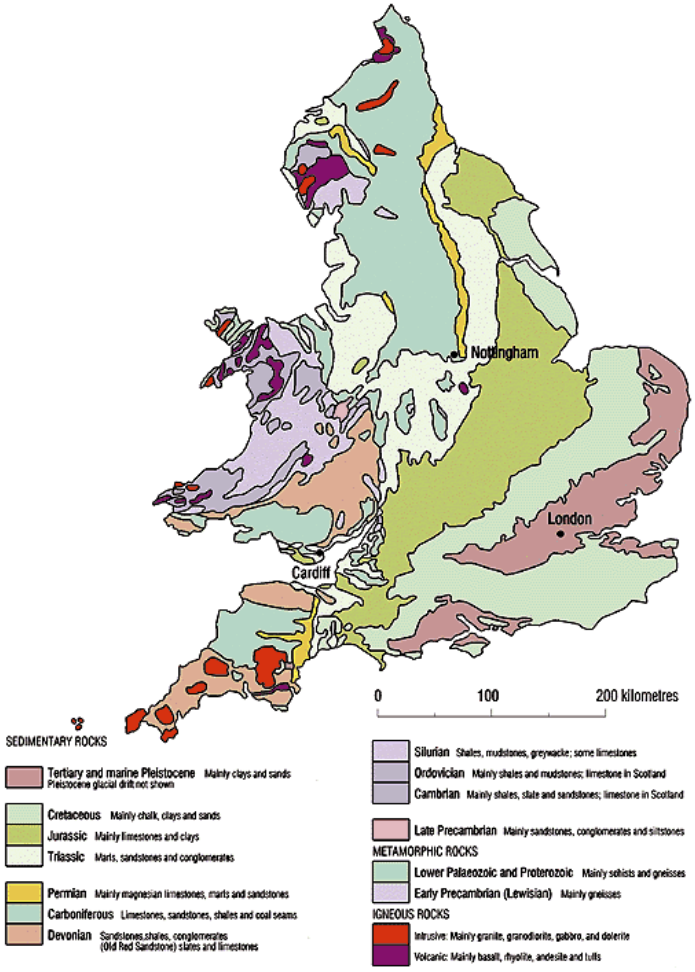
D4.3.19 England contains two Global Geoparks: the English Riviera in Devon and the North Pennines AONB. These are areas considered by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) to be of international importance for geological heritage that should be safeguarded and sustainably managed and include strong local involvement. Two further areas in England (Abberley and Malvern Hills and the Cotswold Hills) identify themselves as national Geoparks.[158]

D4.3.20 A depiction of the main rock types across England is shown in **Figure D4.1.**

[157] Natural England (2008) *State of the Natural Environment, Chapter 2: Landscapes*. Available online at: http://publications.naturalengland.org.uk/publication/31043

[158] UNESCO (2017) *Properties inscribed on the World Heritage List for the United Kingdom*. Available online at: http://whc.unesco.org/en/statesparties/gb

Figure D4.1 Geological Structure of England and Wales[159]



Land Use and Soils

D4.3.21 As of 2016, the average population density of England was estimated to be 427 people per square kilometre.[160]

D4.3.22 **Table D4.2** shows land cover in England as it stood in 2007 and highlights arable and horticulture and improved grassland as the most common land use covers (covering 40.5% and 27.1% of total land in England respectively).[161]

[159] British Geological Survey ©NERC 1995
[160] Statista (2017) Population density in the United Kingdom (UK) in from 2017 (people per sq. km), by country. Available online at: https://www.statista.com/statistics/281322/population-density-in-the-united-kingdom-uk-by-country/
[161] Countryside Survey (2011) *Final Report for LCM2007*. Available online at: http://nora.nerc.ac.uk/14854/1/LCM2007_Final_Report_-_vCS_Web.pdf

Table D4.2 Land Cover in England in 2007

England Land Cover 2007	'000 ha	% Area
Broadleaved, Mixed and Yew Woodland	930	7.1
Coniferous Woodland	303.3	2.3
Arable and Horticulture	5,332.9	40.5
Improved Grassland	3,568.4	27.1
Neutral Grassland	611	4.6
Calcareous Grassland	35.9	0.3
Acid Grassland & Bracken	317.1	2.4
Dwarf Shrub Heath	361.0	2.6
Fen, Marsh and Swamp	6.8	0.1
Bog	196.5	1.5
Freshwater	79.8	0.6
Montane	36.6	0.3
Inland rock	42.3	0.3
Built-up Areas and Gardens	1,169	8.9
Supra-littoral rock	1.0	-
Supra-littoral sediment	18.4	0.1
Littoral rock	11.2	0.1
Littoral sediment	161.7	1.2
TOTAL	**13,182.9**	**100**

Source: Countryside Survey, LCM2007.

D4.3.23 The majority of land in England (around 70%) is in agricultural use. A further 9% is used for woodland and forestry. Whilst urban areas account for around 10% of the total area, only a very small proportion of the land (1.1%) is occupied by domestic buildings (e.g. houses), with domestic gardens accounting for almost half of the 'developed area' (over 4% of the national land area). Marshland, bogs and freshwater areas account for a combined 2.4% of the land area.[162] Of the agricultural land, approximately 42% is classed as best and most versatile land grades ('good' or better).

D4.3.24 A total of 511 sites had been reported to the Environment Agency as 'contaminated land' at April 2016, however this is likely to be an underestimate due to a low response rate from local councils. Less than 2% of the land area of England is estimated to have been affected by industrial activities of a type that could have caused contamination.[163]

[162] UNEP (2011) *UK National Ecosystem Assessment, Chapters 10 (Urban) and 17 (England).* Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

[163] Environment Agency (2016) *Dealing with contaminated land in England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513158/State_of_contaminated_land_report.pdf

D4.4 Summary of Existing Problems Relevant to Waste and Resources

D4.4.1 The following existing problems for land use, geology and soils have been identified which are relevant to waste and resources – and for the WMPE:

- There is a need to protect, maintain and enhance geomorphological functions and services; the WMPE can support this approach by minimising demand for landfills, by supporting greater recycling and recovery of materials.
- The use of landfills should decrease in time due to stringent targets and legislation however it should be noted that local authorities must continue to monitor landfills that were closed before the need for capping and other measures. Closed and historic landfills present a risk of leaching of leachate and toxins into local lands and waterways. It is likely that landfills that pre-date 1980 will see a weathering of the top cap; this will expose historic waste materials to the elements. It should be noted that enterprising organisations are exploring the value of mining landfills to recover valuable resources. This is not yet operational at a commercial stage but may lead to the "reopening" of landfill site which lead to a perceived loss of greenspaces to local areas in proximity to the sites.
- As the climate (including temperature and rainfall patterns) changes in the future, it is likely that soils have the potential to be further degraded, as a result of increased seasonal aridity and wetness and variations in temperature.[164] The effect of industry, agricultural practices, forestry and climate change upon soils, particularly carbon rich peat soils, is also a key issue. Key pollutants include chemicals, oil or waste. Organic waste, including sewage sludge, is one of the main sources of heavy metal contamination of soils from human activity.
- As the amount of residual municipal waste produced each year is likely to decrease in future, this could see a decommissioning of local authority infrastructure as they seek to develop collaborative partnerships with neighbouring authorities.
- The planned Deposit Return Scheme (DRS), if implemented, could require new infrastructure; local authority assets could be repurposed, or new sites may be required for bulking sites, counting stations etc. which could have an impact on local soils and lands. The planned EPR for packaging may also require more reprocessing facilities with potential impacts on land use, particularly if the plastic packaging tax requires more domestically produced recyclable material.

D4.5 Likely Evolution of Baseline

UK

Geology

D4.5.1 As part of the JNCC Common Standards Monitoring for designated sites, the features for which certain sites are designated were assessed to determine site condition. For geological sites, the principal designations are GCRs and SSSIs, many of which occupy the same or part of the same area of land. Site attribute condition was compared with its target value, the outcome of which resulted in a site being classified as favourable, unfavourable, unfavourable-recovering, or destroyed (in whole or in part).

[164] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment*. Available online at: http://www.gis.naturalengland.org.uk/pubs/gis/tech_aw.htm

D4.5.2 The increase in public and policy awareness regarding geological SSSI sites and Geoparks may lead to an increase in the number of sites protected and managed. As quarries come to the end of their working lives there is potential for their identification and conservation as geologically important sites.

Land Use and Soils

D4.5.3 The estimated broad habitat type in the UK (Great Britain) and how it has changed from 1984 to 2007 was calculated by the Office of National Statistics[165] and is shown in **Table D4.3**. It shows that the area of land cover under arable and horticulture has decreased by 9.1% between 1998 and 2007. The area of grassland land cover has generally increased with improved grassland increasing by 5.7%. Built-up areas and gardens have increased by 3.4% between 1998 and 2007.

Table D4.3 Estimated Area ('000 ha) of Broad Habitats in the UK (Great Britain) in 1984, 1990, 1998 and 2007

Land Type	1984	1990	1998	2007	% Change between 1998 and 2007
Broadleaved, mixed and yew woodland	1317	1343	1328	1406	5.9
Coniferous woodland	1243	1239	1386	1319	-4.8
Linear features	491	581	511	496	-2.9
Arable and horticulture	5283	5024	5067	4608	-9.1
Improved grassland	5903	4619	4251	4494	5.7
Neutral grassland	467	1669	2007	2176	8.4
Calcareous grassland	75	78	61	57	-6.6
Acid grassland	1476	1821	1503	1589	5.7
Bracken	439	272	315	260	-17.5
Dwarf shrub heath	1388	1436	1299	1343	3.4
Fen, Marsh, Swamp	428	427	426	392	-8.0
Bog	2303	2050	2222	2232	0.5
Standing open waters	284	200	196	204	4.1
Rivers and streams	70	70	65	58	-10.8

[165] ONS (2011) *Land cover account, Great Britain.* Available online at: http://www.ons.gov.uk/ons/rel/environmental/environmental-accounts/2011/rftlandcover.xls

Land Type	1984	1990	1998	2007	% Change between 1998 and 2007
Montane	41	n/a	41	42	2.4
Inland rock	38	76	111	84	-24.3
Built-up areas and gardens	1268	1266	1279	1323	3.4
Other land	n/a	57	107	113	n/a
Unsurveyed land	n/a	522	522	522	n/a
Total	**22,514**	**22,632**	**22,601**	**22,627**	

Source: Countryside Survey 2007.

Note: Standing open waters and rivers and streams broad habitats are calculated using a different statistical model to the other broad habitats. The land in urban areas from within Great Britain was excluded from the estimation of broad habitats. The totals are therefore not equal to the sum of the column.

D4.5.4 It is not known whether the decrease in arable and increase in improved grassland is likely to continue at the same rate in the future although it does seem likely that the extent of built up areas will continue to increase as some development will inevitably take place on greenfield land.

D4.5.5 The clearest trend in land use change in the UK over the past quarter of a century has been the conversion of land from agriculture to forestry and woodland. Forestry Commission estimates of the area of forest and woodland cover in the UK imply an average annual net increase of 28,000 hectares from 1980 to 2016, equivalent to 0.11% increase in total UK land cover per year. This follows on from a slower but steady increase in woodland cover from the early 1900s onwards, and there has overall been a doubling of the area of UK woodland since World War II to reach 3.16 million hectares in 2016.[166]

D4.5.6 New planting has predominantly responded to subsidy and has involved the expansion of small broadleaved woodlands within agricultural holdings. The average annual increase in woodland on farms (14,500 hectares per annum) accounts for more than half of the net increase in the wooded area as a whole. The area of woodland within agricultural holdings has thus more than doubled since the early 1980s.[167]

D4.5.7 A number of threats to the UK soil resource have been recognised in England, Scotland and Wales including:

- loss of soil organic matter and erosion;
- climate change;
- loss of soil biodiversity;
- structural degradation and compaction;

[166] Forestry Commission (2016) *Forestry Statistics 2016: Chapter 1*. Available online at: http://www.forestry.gov.uk/pdf/Ch1_Woodland_FS2016.pdf/$FILE/Ch1_Woodland_FS2016.pdf
[167] Bibby, P. (2009) *Land Use Change in Britain. Land Use Policy, 26S, S2–S13.*

- contamination;
- loss of soil to development (e.g. soil sealing), including urbanisation and agriculture; and
- threat to soil as a cultural resource (e.g. archaeological protection and UK environmental records).

D4.5.8 UK soils store around 10 billion tonnes of carbon.[168] A study by the National Soil Inventory (NSI) found that between 1978 and 2003 there was a loss in soil organic carbon of 0.6% per year for all soil types, though with higher losses (2% per year) in those which are particularly organic rich.[169] However, between 1990 and 2014, the UK has gone from being a net source of Land Use, Land Use Change and Forestry (LULUCF) emissions to a net sink driven by land converted to cropland and forest land, with an increasing uptake of CO2 by trees as they reach maturity, in line with the historical planting pattern.[170]

D4.5.9 Soil chemical and biological processes are controlled by a complex set of factors, but most importantly by the balance between soil temperature and soil moisture. Temperature is a key factor that can control many terrestrial biogeochemical processes. Soils processes, properties and functions are therefore all sensitive to changes in climatic conditions.

D4.5.10 Future changes in temperature and precipitation could potentially have considerable impacts on soils and their biodiversity. Rising atmospheric concentrations of CO_2, are also likely to influence soils indirectly, via changes in plant growth. There is a high degree of uncertainty about how climate change will affect soils in the UK due to limitations on the current evidence and the difficulties of distinguishing the role of climate from other factors. Nevertheless, the majority of climate projections imply a trend towards reductions in soil moisture, most notably in the eastern districts of the UK, due to an increased frequency of warmer, drier summers. The consequent changes in soil water regimes will be highly dependent on soil type and, in combination with elevated temperatures and CO_2 levels, will have an impact on rates of soil physical, biological and chemical processes, and hence on soil function and ecosystem services.[171]

England

Geology

D4.5.11 Natural England[172] has identified the following key threats to geology (which are also equally applicable to Scotland and Wales):

- inappropriate development;
- natural degradation;
- irresponsible specimen collecting; and

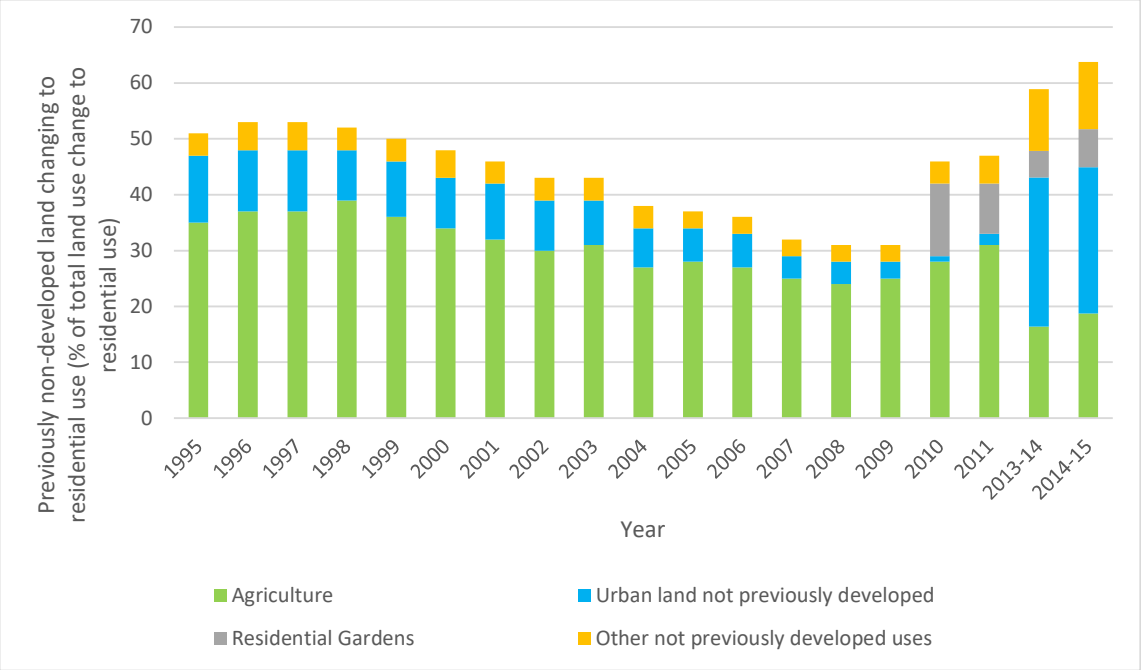
[168] Defra (2009) *Safeguarding our Soils – A Strategy for England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69261/pb13297-soil-strategy-090910.pdf
[169] Bellamy PH, Loveland PJ, Bradley RI, Lark RM and Kirk GJD (2005) *Carbon Losses from all Soils across England and Wales 1978-2003. Nature 437: 245-248*. Available online at: http://core.ac.uk/download/pdf/141023.pdf
[170] DECC (2016) *2014 UK Greenhouse Gas Emissions, Final Figures*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496942/2014_Final_Emissions_Statistics_Release.pdf
[171] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment*. Available online at: http://www.gis.naturalengland.org.uk/pubs/gis/tech_aw.htm
[172] Natural England. *What are the threats to geology?* Available online at: http://webarchive.nationalarchives.gov.uk/20140605090108/http://www.naturalengland.org.uk/ourwork/conservation/geodiversity/threats/default.aspx

- irresponsible recreational activities.

Land Use and Soils

D4.5.12 **Figure D4.2** shows the origin and proportion of non-previously developed land changed to residential use for each year from 1995 to 2014/15 for England. In 2013/14 and 2014/15, there was a notable rise in the proportion of undeveloped land being converted to residential use, with a corresponding decrease in previously developed land being used for residential development. Overall, the amount of soil lost to residential development (including previously developed land) gradually decreased from nearly 5,800 hectares in 1995 to 2,200 hectares in 2009 and has since risen substantially to 4,800 hectares in 2014/15.

Figure D4.2 Soils Lost to Residential Development (England)



Source: DCLG. Live tables on land use change statistics: Land use change statistics - live tables 2014 to 2015. Note data gap from 2011 to 2013/14.

D4.5.13 In 2010, there was an estimated 68,910 hectares of previously developed land in England, up 11% from 61,920 hectares in 2009.[173] The conversion of previously undeveloped land to developed land decreased from 7,530 hectares in 2000 to 2,180 hectares in 2011, before rising sharply to 21,446 hectares in 2014/15 and reducing to 15,405 in 2015/16. In 2015/16, 7% of the land changing to residential use was in Flood Zone 3. It is not known what proportion of the land was within Flood Zone 3a and what was within Flood Zone 3b.[174]

[173] Defra (2013) *National Land Use Database PDL – Results and Analysis*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/366838/NLUD_2010_Summary_Headline_Report.doc
[174] DCLG 2017) *Live tables on land use change statistics: Land use change statistics - live tables 2015 to* 2016. Available online at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-land-use-change-statistics

D4.5.14 No statistical change in extent was detected in the Coniferous Woodland, Improved Grassland, Bracken, Bog, Fen, Marsh and Swamp and Calcareous Grassland Broad Habitats in England between 1998 and 2007.[175]

D4.5.15 17% of soils in England and Wales show signs of erosion which leads to a reduction in water retention and filtering, and the mobilisation of sediment (which may contain pesticides, nutrients and metals) to watercourses or floodplains.[176]

D4.5.16 In the 2012 Farm Practices Survey for England,[177] 20% of farmers stated that they had experienced soil compaction throughout the soil profile. For the 12 months leading up to August 2012, the Farm Practices Survey 2012 indicated that the most common actions taken to reduce compaction were removing compaction from headlands after harvest, enhancing drainage, using low pressure set-ups and crop rotation.

D4.5.17 Key objectives and targets within the Soil Strategy for England (Safeguarding Our Soils) include:

- to undertake further research in areas including best practices to protect and enhance levels of soil organic matter, contribution of soil management to flood mitigation and best practices to prevent and remediate soil degradation;
- to significantly reduce the rate of loss of stored soil carbon by 2020;
- to halt the decline of soil organic matter caused by agricultural practices in vulnerable soils by 2025; and
- to introduce a reviewed Soil Protection Review to make it a more effective tool for soil management.

D4.5.18 The Natural Environment White Paper (2011) established an ambition that by 2030 all of England's soils will be managed sustainably and degradation threats tackled successfully, in order to improve the quality of soils and to safeguard their ability to provide essential ecosystem services and functions for future generations.

D4.6 Waste Management Effects on Land Use, Geology and Soils

D4.6.1 Waste management practices can have both a direct and an indirect impact on land use, geology and soils; both in construction and operation. The possible impacts of waste management on land use, geology and soils are considered here in a generic manner in anticipation of the assessment of the WMPE and reasonable alternative in **Section 4.7**.

Waste Infrastructure

D4.6.2 Waste infrastructure can have a direct impact upon soil quality. Waste infrastructure includes landfills, recycling and reprocessing facilities and sites for material collection, storage and transfer.

D4.6.3 The localised nature of waste management infrastructure, the site selected and the varied footprint of facilities can lead to direct land take and soil loss. The significance of such effects will depend on the scale of the facility (for example the Urbaser IVC facility at Javelin Park, Gloucestershire with the

[175] Countryside Survey (2007) *England Results from 2007*. Available online at: http://www.countrysidesurvey.org.uk/content/england-results-2007
[176] Environment Agency (2004) *The state of soils in England and Wales*. Available online at: http://www.adlib.ac.uk/resources/000/030/045/stateofsoils_775492.pdf
[177] Defra (2012) *Farm Practices Survey Autumn 2012 - England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/181719/defra-stats-foodfarm-environ-fps-statsrelease-autumn2012edition-130328.pdf

capacity to compost 60,000 tonnes per annum of green waste and food waste has a footprint of 7 ha whereas the Veolia Ockenden landfill site in Essex occupies 230 ha of land and which uses 138.9 ha for landfill), the nature of the site (and so whether greenfield or brownfield), and if classified as greenfield, the soil quality as defined by its agricultural land classification. Sites and facilities located on brownfield are likely to have more limited effects on soil and land use than those on greenfield sites. Construction activity may also lead to soil contamination as a result of accidental spillage, could lead to disturbance of existing contaminated land, and/or cause soil compaction as a result of the use of heavy machinery.

D4.6.4 Once operational (and discounting any loss of land during construction), the operational impacts associated with new waste infrastructure are expected to be negligible, although there may be some adverse impacts on adjacent land uses due to, for example, vehicle movements, dust deposition and emissions.

D4.6.5 Waste infrastructure such as landfills can produce a leachate contaminant that if not contained can percolate into soils, strata and groundwater adjacent to the landfill site. As stated in the 2013 Environmental Report, both inert and non-hazardous landfills can produce leachates that contains ammoniacal nitrogen, heavy metals and organic compounds. Leaching may also carry insoluble liquids (such as oils) and small particles in the form of suspended solids. Landfill leachate is a potentially polluting liquid, which unless managed and/or treated, and eventually returned to the environment in a carefully controlled manner, may cause harmful effects on the soils that surround a landfill site. Improvements in landfill design[178] have introduced the use of non-porous geotextiles and/or geomembranes for lining and capping the cells within landfills. This approach significantly reduces the potential for leachate to percolate into the adjacent soil, strata and groundwater; however, older or closed landfills have not been engineered to the same standard leading to potential contamination.

D4.6.6 The Landfill tax, introduced in 1996, has increasingly taxed landfill users to diminish the appeal of disposal and increase consideration of alternative waste management solutions. The tax has increased ten-fold since its introduction and has instigated a 75% drop in biodegradable waste being sent to landfills. In May 2019 the Committee on Climate Change (CCC) called for the ban of all biodegradable waste from landfills by 2025[179]; this could divert an amount similar to the 7.4Mt of biodegradable waste which was sent to landfill in 2017 into potential recovery in AD plants or composting sites. Whilst the use of landfills is expected to continue to decrease, there is a risk that any such ban may face a delay in implementation due to the constraints upon local authorities to seek alternative recyclate offtakers at a time when foreign contractors are cutting the capacities they are willing to accept.

D4.6.7 Local authorities are facing increasing challenges to source alternative treatment capacity for both recyclate and residual wastes and can be affected by market fluctuations in material prices. The global recycling sector is projected to triple in size between 2017 and 2060[180]. Whilst this is projected at a global level, it is notable that exports of waste from the UK to China, Asia and mainland Europe, will be increasingly constrained as the influx of available material to foreign reprocessors exceed demand. As a result, it is reasonable to anticipate that waste management companies in the UK will see opportunities to increase reprocessing capacity for local authority wastes; leading to investment in new Material Recycling Facilities (MRFs), AD plants and Energy from Waste (EfW) facilities. It is assumed that the proposed EfW infrastructure proposed to 2020 would be sufficient to meet an ambition of no more than 10% Municipal Solid Waste (MSW) to

[178] https://www.gov.uk/government/collections/environmental-permitting-landfill-sector-technical-guidance
[179] Committee on Climate Change (2019) *Net Zero: The UK's Contribution to Stopping Global Warming*. Accessible online at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/
[180] OECD (2019). *Global Material Resources Outlook to 2060. Economic Drivers and Environmental Consequences*. Pg 144. Accessible online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page144

landfill by 2035, if a 65% MSW recycling rate is achieved by that same year[181]. The Environmental Services Association has highlighted a need for infrastructure in England to increase recycling (requiring £1bn of investment) and to treat non-recyclable materials[182] and this is emphasised by the National Infrastructure Commission[183] stating potential solutions such as:

- a universal food waste collection, as proposed in the Government's 2018 Resources and Waste Strategy, could avoid the need to construct between 1 and 3 energy from waste plants by 2050, saving £400M CAPEX and £1.1BN OPEX for local authorities; and
- increased recycling (notably plastics) could avoid the need to build 20 additional incinerators, saving £6.2BN by 2050.

D4.6.8 As such, local authorities may increasingly look to design, construct and operate their own infrastructure; treatment capacity has increased from 10M tonnes in 2000 to almost 80M in 2017[184] and this trend may continue as a result of the narrowing export markets. This will see a continued increase in the provision of waste infrastructure, with associated localised landtake.

D4.6.9 Waste infrastructure is predominantly constructed on brownfield sites in out of town locations, at a safe distance from local receptors. Planning authorities continually seek to develop such sites on previous industrial areas, in which cases the impact upon soils is unlikely to offer any greater risk of contamination than at present. New sites may also be required, for example for bulking sites, counting stations etc., which would affect land use.

D4.6.10 As noted in the 2013 Environmental Report, over 4Mt of soil have been recovered from construction and demolition waste. Site Waste Management Plans, which are no longer a legal requirement, have become embedded as best practice and continue to be used by many businesses.[185,186] The plans outline waste sources, accumulations and management routes whilst promoting the reuse and recycling of materials. It is therefore likely that any displaced soils from new infrastructure projects will be reused or recycled on site as foundations or bunds. The potential extended producer responsibility scheme for certain materials in the construction and demolition sector, as identified in the 2018 Resources and Waste Strategy, could also support reductions in this type of waste.

D4.6.11 Given the relative small scale (at a national level) of the waste management infrastructure likely, it is considered unlikely that the land cover outlined in **Table D 4.2** will be adversely affected by new waste infrastructure. Similarly, the 70% of land used for agricultural purposes[187] is unlikely to be adversely affected given the localised and small scale of infrastructure.

D4.6.12 It is possible that local authorities may opt to utilise remediated contaminated sites for new waste management infrastructure, subject to location, feasibility, planning and costs. As such, it is possible

[181] HM Government (2018). *Our waste, our resources: A strategy for England Evidence Annex*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf
[182] Tolvik Consulting (2017) *UK Residual Waste: 2030 Market Review*. Available online at: http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf
[183] National Infrastructure Commission (2018). *National Infrastructure Assessment*. Accessible at: https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf
[184] Environment Agency (2019). *Waste management in England: 2017 Data Summary*. Accessible at: https://www.gov.uk/government/publications/waste-management-data-for-england
[185] Defra (2013) *Defra Public Consultations: Proposed repeal of construction Site Waste Management Plan Regulations (2008): Summary of responses and Government response.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/237398/site-waste-manage-consult-sum-resp-20130830.pdf
[186] Goodhew, S. (2016) *Sustainable Construction Processes: A Resource Text*, Wiley-Blackwell|.
[187] UNEP (2011) *UK National Ecosystem Assessment, Chapters 10 (Urban) and 17 (England).* Available online at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

that a few of the 511 sites reported as being "contaminated land" could be repurposed to site these facilities[188].

Materials Use

D4.6.13 The material use from waste management operations will have a localised impact upon land use, soils and geology. The use of any new infrastructure will require the displacement of soils and geological materials.

D4.6.14 As noted previously, the recycling sector is projected to triple in size between 2017 and 2060[189]. The sector is expected to grow more rapidly than the mining sector in OECD nations, demonstrating a behavioural shift from demanding virgin material to reusing recyclable products.

D4.6.15 This reduction in demand for virgin metal materials is supplemented through an anticipated increase in recovery of non-ferrous materials from bottom ash. UNEP estimates that extraction of non-ferrous metals from bottom ash in EfW plants could increase three-fold by 2020 (compared to 2006 levels) due to improvements in process technology and the increase of EfW plants needed to manage non-landfilled wastes.[190] European recycling infrastructure is more established than, for example, the Chinese sector which was until recently the most favoured export destination for England's waste. Europe captures 25% more end of life recycled copper with a higher recycling rate (61% against 52% in China).

D4.6.16 Whilst virgin material demand may decrease, it will not be eradicated. The extraction of raw materials to produce goods will have an adverse impact upon landscapes including mines, quarries and forestry's. The UKs latest environmental accounts until 2017 show that total domestic extraction dropped from 691Mt in 1992 to 441Mt in 2017. Imports have increased from 221Mt to 282Mt across the same period, although this is a reduction from the peak of 312Mt in 2013.[191]

D4.6.17 An increase in capacity in waste infrastructure in England will require additional infrastructure. The construction of new infrastructure is not likely to impact significantly upon soils as infrastructure is generally limited to being constructed on brownfield sites and areas already designated for waste management operations. Planning applications demand site investigations that would identify any soils or geological issues of importance and, as such, any risks upon these receptors can be minimised or avoided.

D4.6.18 The operation of new facilities will be associated with vehicle movements and consequential emissions (notably NOx and particulates) which can have effects on soil quality (depending on concentrations, duration and rate of deposition). Any such impacts upon soils will be limited and localised. Emissions and impacts from the construction, and operation, of any new sites are expected to be controlled through permitting, but will remain a critical component in the assessment and monitoring of the infrastructure.

D4.6.19 The operation of new facilities can also produce positive effects e.g. compost produced at composting and AD plants.

[188] Environment Agency (2016) *Dealing with contaminated land in England*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513158/State_of_contaminated_land_report.pdf
[189] OECD (2019). *Global Material Resources Outlook to 2060. Economic Drivers and Environmental Consequences*. Pg 144. Accessible online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page144
[190] UNEP (2013) *Metal Recycling: Opportunities, Limits, Infrastructure, A Report of the Working Group on the Global Metal Flows to the Inter-national Resource Panel.* Available online at: https://www.wrforum.org/wp-content/uploads/2015/03/Metal-Recycling-Opportunities-Limits-Infrastructure-2013Metal_recycling.pdf
[191] Office for National Statistics (2019). *UK Environmental Accounts: 2019*. Accessible online at: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2019

D4.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D4.7.1 **Table D4.4** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D4.4 Assessment of the Draft WMPE and reasonable alternative

Land Use, Geology and Soils		
To conserve and enhance soil and geology and contribute to the sustainable use of land. To preserve the "best & most versatile" agricultural land		
• Will the draft WMPE have an effect on soil quality/function, variety, extent and/or compaction levels? • Will the draft WMPE increase the risk of significant land contamination? • Will the draft WMPE protect and/or enhance Geological Conservation Sites, important geological features and geophysical processes and functions? • Will the draft WMPE change patterns of land use or affect best and most versatile agricultural land?		
	Effect	**Commentary**
WMPE		
Prevention	+	Defra have established a range of targets to reduce wastes including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. Preventing wastes goes beyond simply avoiding landfill or moving materials into the reuse or recycling stages of the hierarchy. The WMPE outlines a commitment to improve waste behaviours through increased awareness initiatives and the adoption of new paradigms in the circular economy; the WMPE will therefore reduce the demand for virgin materials which will help eliminate wastes which reach landfill; therefore supporting the government to achieve national targets. Adopting CE principles could reduce environmental damage by 80% "if more thoughtful decisions were taken at product design" stage (Defra, 2019); showing how CE principles can minimise environmental impacts at later stages of a product lifespan. The circular economy, and improved waste management behaviours such as prevention, may reduce avoidable waste such as single use plastics. However, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal, there may also be a corresponding increase in reuse and recycling. The exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy and demand for new infrastructure – are therefore unknown. It is not expected that waste prevention will affect patterns of land use; instead there is a potential to restore landfill sites to alternative uses if no longer needed due to a prevention of wastes. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+	The 2018 Resources and Waste Strategy and WMPE include commitments to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. The WMPE will support this ambition by seeking to improve the design of materials by promoting the benefits of the circular economy. As such, packaging will be redesigned to be compostable, recyclable or reusable. Any improvements to the design of plastics may open up new opportunities for the material to be reused.

		An increase in reuse of materials could see a reduction in vehicle movements related to waste and recycling collections, if materials are re-used in the home. However, in an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can use the by-products from other businesses. As such these reusers may generate new vehicle movements between reusers; with an impact, albeit negligible, on local soils. As noted in the prevention assessment above, the circular economy, and improved waste management behaviours may reduce avoidable waste however, waste prevention may not lead to an absolute reduction in waste, instead simply moving wastes across the hierarchy. The exact extent of this is, however unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	+	The WMPE includes commitments to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The WMPE will support delivery of these targets by exploring the implementation of service improvements. The government has recently consulted on a range of new services including a separate collection of recycling materials and food wastes. Any barriers to local authorities to such a service will be funded by Defra, demonstrating a commitment to improving recycling services in England. In addition, a DRS has been proposed in England. The WMPE will also explore the opportunities to improve the design of materials to improve recyclability at the end of life. The adoption of circular economy principles, including EPR for certain waste streams and the reformed packaging producer responsibility system, may facilitate the redesign of any problematic materials. The circular economy, and improved waste management behaviours may not reduce waste tonnages overall, but may simply move wastes within the hierarchy; the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy and necessary infrastructure – are therefore unknown. Achievement of the recycling ambitions are subject to adequate sorting technology alongside secure markets for offtakers. As noted by Amey (2018), both domestic processing and reprocessing capacity is needed in England with a potential capacity gap of up to 13Mt. Any new infrastructure may pose risks, albeit minimal and localised to land use and soils. Infrastructure located on brownfield land are likely to have more limited effects on soil and land use than those on greenfield sites. Construction activity may lead to soil contamination as a result of accidental spillage, which could lead to disturbance of existing contaminated land, and/or cause soil compaction as a result of the use of heavy machinery. In addition, in line with the proximity principle, it is expected that any new infrastructure would be developed close to the population centres where wastes are generated. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects would be minimised, reduced or mitigated. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, with limited impacts upon local soils. The anticipated ongoing higher costs associated with rail freight may limit the use of this alternative mode of transport, unless other factors intervene. Where composting is utilised to manage food wastes, the new compost can help contribute to increased soil absorption, and so retention times which can contribute towards limiting localised flood risk. The WMPE outlines plans to introduce a separate food waste collection system. If this service is realised, it is possible it could help restore soil condition.

		It is therefore likely that the WMPE, from a recycling perspective, will have a minor positive effect relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	+	The WMPE does not set or repeat specific targets with regards to recovery of wastes. However, the WMPE does state the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. It is likely that the WMPE and adoption of a circular economy may move material from landfill into recovery facilities. This will offer an improvement to local areas as landfills close; these sites could then be restored to local green spaces. It is assumed that the proposed EfW infrastructure proposed to 2020 would be sufficient to meet an ambition of no more than 10% Municipal Solid Waste (MSW) to landfill by 2035, if a 65% MSW recycling rate is achieved by that same year. Recovery may include the use of AD facilities to manage an increase in food waste from the proposed separate collections. Whilst there are diverging views[192] on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. Analysis by the National Infrastructure Commission identified that the introduction of a food waste collection service could avoid the need to construct between 1 and 3 energy from waste plants by 2050, saving £400M CAPEX and £1.1BN OPEX for local authorities; and the expected increase in recycling could avoid the need to build 20 additional incinerators, saving £6.2BN by 2050. [193] The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise vehicle movements and "exporting" of wastes to other communities. However, Tolvik notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. As such it is possible that the ambitions set out in the WMPE may require increased vehicle movements to additional recovery facilities with capacity. These may be locally located to comply with the proximity principle. If this is not the case, then additional movements may be needed further afield. Any such movements may pose a risk to local soils through emissions. However, this risk and the extent of such a risk, and the impact upon the SEA objectives, is not known at this time. Construction activity may lead to soil contamination as a result of accidental spillage. This could lead to disturbance of existing contaminated land, and/or cause soil compaction as a result of the use of heavy machinery. Overall, the WMPE is likely to divert wastes from landfill into the recovery sector. It can be assumed that the impacts of this may be less than the use of landfill sites. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. This will involve a significant shift from current behaviours to improve the rate of recycling and recovery of materials as noted above. A reduced demand upon landfill sites may improve the land use, geology and soils of communities by reducing the need for excavations of new landfills as well as to target the risks posed by leachate. The restoration

[192] House of Commons Environment, Food and Rural Affairs Committee (2017). *Food Waste in England*. Available online at: https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/42908.htm and Tolvik (2019) *Anaerobic Digestion Market in Great Britain: Does it have the capacity?* Available online at: https://www.tolvik.com/published-reports/view/anaerobic-digestion-market-great-britain/

[193] National Infrastructure Commission (2018). *National Infrastructure Assessment*. Available online at: https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf

		of the landfills can also offer opportunities to restore spent spaces whilst offering renewed greenspaces. The reduction in landfill use is a positive outcome of the WMPE objectives and the plans within. However, the localised impact of landfill and waste management may mean that benefits on land use, geology and soils may be minimum and localised. The WMPE is therefore expected to have a minor positive effect on the SEA objectives. However, landfill is not expected to be fully eradicated and the uncertainty of foreign markets for recycling offtakers for active materials may mean that landfill is a necessary interim measure until new markets are developed. In such a scenario, it is likely that highly stringent obligations may be placed upon any new landfill sites however, due to the increasingly steep landfill taxes, it is reasonable to assume that many waste contractors including local authorities, may seek to recover waste in EfW sites opposed to the option to open new landfill sites. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight may limit the use of this alternative mode of transport, unless other factors intervene. The ongoing use of the road network will pose a minimal but real risk to local soils however the impact cannot be known at this point. In contrast however, the closure of any landfills due to a reduction in demand may provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. Overall, the WMPE is likely to divert significant tonnages of wastes from landfill. Whilst landfill will not be eradicated entirely and may continue in use particularly for inert wastes, it can be assumed that the WMPE may push problematic wastes into the recovery sector due to the restrictive and high costs associated with the landfill tax. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+ +	Overall, the WMPE is likely to divert significant tonnages of wastes from landfill and into other areas of the hierarchy. The services included in the WMPE will divert significant wastes from landfill into the recovery infrastructure. For example, food wastes may be diverted from landfill into AD and other recovery or recycling sites. Plastics may be redesigned to be compostable or recyclable and landfill use will drop to just 10% for municipal wastes. Any necessary new infrastructure will have very localised impacts and are not expected to cause any significant changes to land use, geology or soils. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA. New sites would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop, construct and operate. Through this process, environmental effects, would be minimised, reduced or mitigated. Whilst landfill may not be eradicated entirely and may continue in use particularly for inert wastes, it can be assumed that the WMPE will push problematic wastes into the recovery sector due to the restrictive and high costs associated with the landfill tax. The WMPE is therefore expected to have a significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++	The reasonable alternative aims to deliver the Defra targets, ambitions and the services discussed in the WMPE at a quicker pace than proposed. Preventing wastes goes beyond simply avoiding landfill or moving materials into the reuse or recycling stages of the hierarchy. Preventing wastes includes eliminating waste by

		designing products to have no wastes associated with them at all; such as no packaging/ the removal of unnecessary packaging and where all components can be recovered and reused at the end of life. The WMPE supports this by promoting the idea of the circular economy. A quicker adoption of circular economy principles may reduce demand upon infrastructure up the hierarchy whilst minimising the need for any new infrastructure that could impact upon the SEA objectives. The rapid adoption of the services and achievement of the targets in the reasonable alternative, is expected to have a significant positive effect relative to the current baseline for the issues covered by this SEA objective and guide questions due to the ability to reduce the impact of landfill.
Reuse (increase in reuse of waste streams compared to WMPE)	+ +	Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The reasonable alternative assumes that reuse ambitions will be achieved at a quicker rate than the WMPE has outlined. The reasonable alternative assumes that circular economy principles will be adopted in a quicker timeframe. This means that materials, products and packaging will be redesigned to facilitate the reuse of materials at the end of life. As outlined in the WMPE assessment this means that packaging may be redesigned to be compostable, recyclable or reusable. Any improvements to the design of plastics may open up new opportunities for the material to be reused. This may remove the plastics from landfill; providing localised improvements to geology and soils. The reasonable alternative would deliver these results in a quicker time period. An increase in reuse of materials could see a reduction in vehicle movements related to waste and recycling collections, if materials are re-used in the home. However, in an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can use the by-products from other businesses. As such these reusers may generate new vehicle movements between reusers; with an impact on traffic and transport; it could be expected that the movements of vehicles between businesses may lead to a minor increase in vehicle movements as business-to-business movements may outnumber waste collections that would otherwise have taken the wastes from the business as part of collection routes. Any increase in vehicle movements – or simply a rerouting of movements may cause very localised effects to soil quality from vehicle emission deposition and surface water run off; however, such effects will be transient, localised and difficult to distinguish from collective traffic emissions. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	+ +	Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The reasonable alternative assumes that the ambitions of the WMPE will be delivered in a quicker timeframe and where results exceed stated targets. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities. Following consultation on reforming the packaging producer responsibility system, the Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. In addition, following consultation on introducing a DRS in England, the Government intend to introduce a DRS to start no later than 2023. If the reasonable alternative is implemented, this will provide such services sooner, delivering a segregated range of clean, high value materials. This may improve recycling rates across England whilst reducing wastes as residents seek to recover value in the materials. Recycling is subject to ensuring adequate sorting technology alongside secure markets for offtakers. As noted by Amey (2018), both domestic processing and reprocessing capacity is needed in England with a potential capacity gap of up to 13Mt. Any new infrastructure risks creating a localised impact on soil, land use and geology as a result of land take and

		accidental spillage/dust deposition. Where sites without hardstanding are used – such as during construction and the use of temporary roads - soil compaction may also result of the use of heavy machinery, however this is likely to be very localised and negligible overall. The introduction of a food waste collection service could avoid the need to construct between 1 and 3 energy from waste plants by 2050, saving £400M CAPEX and £1.1BN OPEX for local authorities; and the expected increase in recycling (notably plastics) could avoid the need to build 20 additional incinerators, saving £6.2BN by 2050. The reasonable alternative outlines proposals for a quicker, more successful, separate food waste collection. As noted previously, the use of composting (to manage the new food waste collection system) can help improve soils and reduce localised flood risk by increasing soil water retention (see Chapter D8: Flood Risk and Coastal Change). The reasonable alternative assumes that the measures to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England; to collect food waste separately from all households on a weekly basis; and to arrange for garden waste collection are implemented in a timeframe quicker than that in the WMPE (so considered to be within the medium term (within 1 - 6 years). It is possible that any increase in acceptable recycling materials may generate increased vehicle movements by collection authorities. In addition, the DRS may increase vehicle movements to provide the new service. Combined, any new movements could have an impact upon local soils however the extent of this is not known. In addition, in line with the proximity principle, it is expected that any new infrastructure would be developed close to the population centres where wastes are generated. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permit to develop, construct and operate. Through this process, environmental effects would be minimised, reduced or mitigated. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene again providing minimal adverse effects upon local soils. Overall, the achievement of the targets set out in the reasonable alternative is likely to improve recycling significantly and within a quick time period. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	+ +	The WMPE states the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The reasonable alternative therefore seeks to exceed these objectives. Construction of any new infrastructure may cause a localised impact on soil, land use and geology as a result of land take and accidental spillage/dust deposition. Successful recovery of wastes is subject to ensuring technology for the increasing tonnages of food waste to be managed. Whilst there are diverging views**Error! Bookmark not defined.** on AD capacity, the WMPE ambitions may demand a need for increased sorting technologies within a tighter timeframe than previously expected. However, the impact of such new technologies is likely to pose a negligible and localised impact upon land use, geology and soils. It is likely that the reasonable alternative will see a more ambitious adoption of the circular economy principles. This may reduce the creation of waste overall by moving wastes up the hierarchy and eliminating some wastes entirely through redesign of materials and

		products. This will likely reduce the need for infrastructure which most endangers land use, geology and soils; such as landfills. Overall, the reasonable alternative is likely to provide a positive impact across the full waste hierarchy. The reasonable alternative is therefore expected to have a significant positive effect on the SEA objectives, relative to the baseline.
Disposal (decrease in disposal of waste streams compared to WMPE)	+ +	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The reasonable alternative will seek to exceed these ambitions and at a quicker pace. This may involve a significant shift from current behaviours to improve the rate of recycling and recovery of materials as noted above. A reduced demand upon landfill sites may improve the land use, geology and soils of communities by reducing any land-take required for any new landfills. The restoration of the landfills can also offer opportunities to restore spent spaces whilst offering renewed greenspaces. The reasonable alternative will deliver a move from landfill to other levels of the hierarchy at a quicker pace. Assuming then, that capacity exists in recovery and recycling infrastructure, this may pose a significant benefit to the SEA objectives. However, landfill is not expected to be fully eradicated and the uncertainty of foreign markets for recycling offtakers for active materials may mean that landfill is a necessary interim measure until new markets are developed. In such a scenario, it is likely that highly stringent obligations may be placed upon any new landfill sites however, due to the increasingly steep landfill taxes, it is reasonable to assume that many waste contractors including local authorities, may seek to recover waste in EfW sites opposed to the option to open new landfill sites. Any new landfills are likely to be located in designated areas appointed for waste management activities. The impact of any new sites is likely to pose minimal impacts upon the SEA objectives. Overall, the reasonable alternative is likely to divert significant tonnages of wastes from landfill. Whilst landfill may not be eradicated entirely and may continue in use particularly for inert wastes, it can be assumed that the reasonable alternative will see a reduction in landfill use in a reduced period of time. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+ +	Overall, the reasonable alternative is likely to divert significant tonnages of wastes from landfill and into other areas of the hierarchy. It is set to move materials up he hierarchy to provide benefits including; designing out wastes in products, moving wastes from landfill to recovery/recycling and, as a result, facilitating the development of secure markets for new recyclable materials. Any necessary new infrastructure will have very localised impacts and are not expected to cause any significant changes to land use, geology or soils. Whilst landfill may not be eradicated entirely and may continue in use, particularly for inert wastes, it can be assumed that the WMPE will push problematic wastes into the recovery sector due to the restrictive and high costs associated with the landfill tax. The redesigning of products to eliminate wastes upfront, as well as the potential opportunities to develop new reusable, recyclable and recoverable waste streams suggest that the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.

Score Key:	+ + **Significant** positive effect	+ **Minor** positive effect	0 **Neutral** effect	- **Minor** negative effect	- - **Significant** negative effect	? **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D4.8 Mitigating Measures

D4.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on land use, Geology and Soils, which could be implemented through the planning system:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Investigative excavation works could be undertaken at proposed sites to ensure soils and geological materials are identified, analysed and implications for development proposals understood and that any designated sites of geological importance identified.
- Any excavated material arising from the construction of new infrastructure could be reused in local developments or nearby communities such as local parks or to reinforce flooding defences along rivers, for example.
- Remediation of landfill sites could produce opportunities to improve local soil conditions subject to adequate capping of landfills, extraction of leachates and ongoing monitoring of the site.

D4.9 Uncertainties and Risks

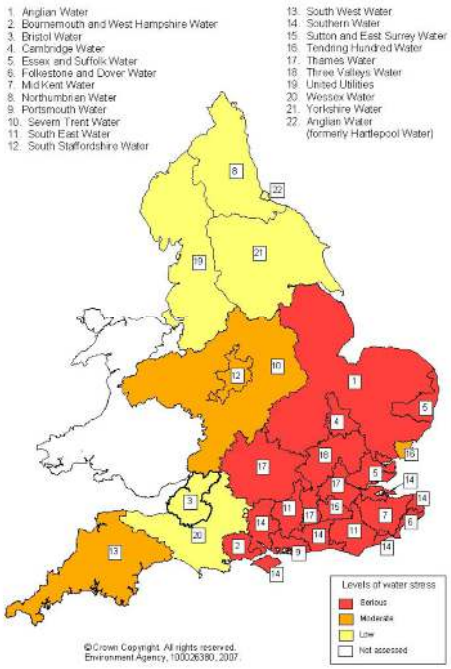
- The localised impact of landfill and waste management will mean that benefits on land use, geology and soils will be difficult to quantify. These will also be very localised.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far-reaching impacts on local, national and international practices.
- The full impact of behaviour changes and any movement of waste tonnages up the hierarchy is not known. It is possible that overall wastes may not decrease but may simply move across the hierarchy.
- The range of materials within new services are not known. The rate of participation and expected increased capture rates – and impacts on receptors such as land use, geology and soils – is also unknown.
- The level of investment and type of infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The locations of new waste management infrastructure are unknown and the effects on local soils are not certain.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.

D5. Water

D5.1 Introduction

D5.1.1 Water is a valuable resource that is increasingly threatened in England through drought. Whilst water is in relative abundance in Scotland and Wales, there is increasing interest in investing in infrastructure to transfer some of this resource across the UK to alleviate critical issues, particularly in the South and East of England. Met Office projections estimate that the UK may endure ten times as many significant droughts (like that experienced in 1976) by 2100 with on average a significant drought every ten years. The Environment Agency has highlighted areas of water stress throughout England. These areas are shown in **Figure D5.1.**[194]

Figure D5.1: Map showing areas of relative water stress



D5.1.2 Waste operations can have a significant impact on water resources – in terms of demand for water to support operations as well as the output from operations into watercourses. Outputs into water courses can include leachate of heavy metals from historic and closed landfills as well as discharge from facilities involved in waste operations.

D5.1.3 It should be noted that for the purposes of this report, water quality and water quantity have been discussed separately. However, the two topics are very closely related and in the majority of cases, issues discussed under one topic could also be discussed under the other. Therefore, to avoid unnecessary duplication, in the majority of instances a given issue is only discussed under the topic to which it is most directly relevant.

[194] Environment Agency (2007) *Areas of water stress: final classification*. Available at: http://publications.environment-agency.gov.uk/PDF/GEHO1207BNOC-E-E.pdf

D5.2 Review of plans and programmes

D5.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D5.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Water. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D5.1 Water Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2000) Water Framework Directive (2000/60/EC) (and subsequent amendments)
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2006) Bathing Waters Directive 2006/7/EC
European Commission (2006) Groundwater Directive (2006/118/EC) (as amended by Directive 2014/80/EU)
National Plans and Programmes
Environment Agency (2013) Managing Water Abstraction (updated 2016)
HM Government (1990) The Environmental Protection Act (as amended)
HM Government (1991) Water Resources Act 1991
HM Government (2010) Flood and Water Management Act 2010
HM Government (2011) Water for Life: White Paper
HM Government (2014) Water Act 2014
HM Government (2015) Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
HM Government (2016) Environmental Permitting (England and Wales) Regulations 2016
MHCLG (2019) National Planning Policy Framework (NPPF)

D5.3 Overview of the Baseline

UK – Water Quality

D5.3.1 The UK has a diversity of inland and coastal waters (such as reservoirs, lakes, rivers, canals, estuaries, transitional waters and coastal waters). Protected water features include: waters designated for human consumption (including those abstracted from groundwater); areas designated for the protection of economically significant aquatic species (e.g. shellfish or freshwater fish); bathing waters (under the Bathing Waters Directive); nutrient-sensitive areas; and areas with waters important to protected habitats or species under the Habitats Directive or the Birds Directive.

D5.3.2 There are 189 protected areas in UK inshore waters with a marine element, which includes 112 Special Protection Areas (SPAs) with marine habitats for birds[195], 99 Special Areas of Conservation (SACs) with marine habitats or species[196], 56 Marine Conservation Zones, 30 Nature Conservation Marine Protected Areas[197] and three Marine Nature Reserves. In total, the area coverage of these sites exceeds 1.5 million hectares, or 1.8% of UK waters.

[195] Joint Nature Conservation Committee (2017). *SPAs with marine components*. Available online at: http://jncc.defra.gov.uk/page-4559
[196] Joint Nature Conservation Committee (2017). *SACs with marine components*. Available online at: http://jncc.defra.gov.uk/page-1445
[197] Joint Nature Conservation Committee (2017) *Contributing to a marine protected area network*. Available online at: http://jncc.defra.gov.uk/page-4549

D5.3.3 The principal aquifers of the UK are located in the lowlands of England. The most important are the Chalk, Permo-Triassic sandstones, the Jurassic limestones and the Lower Greensand.[198]

England - Water Quality

D5.3.4 There are 8 river basin management areas in England:

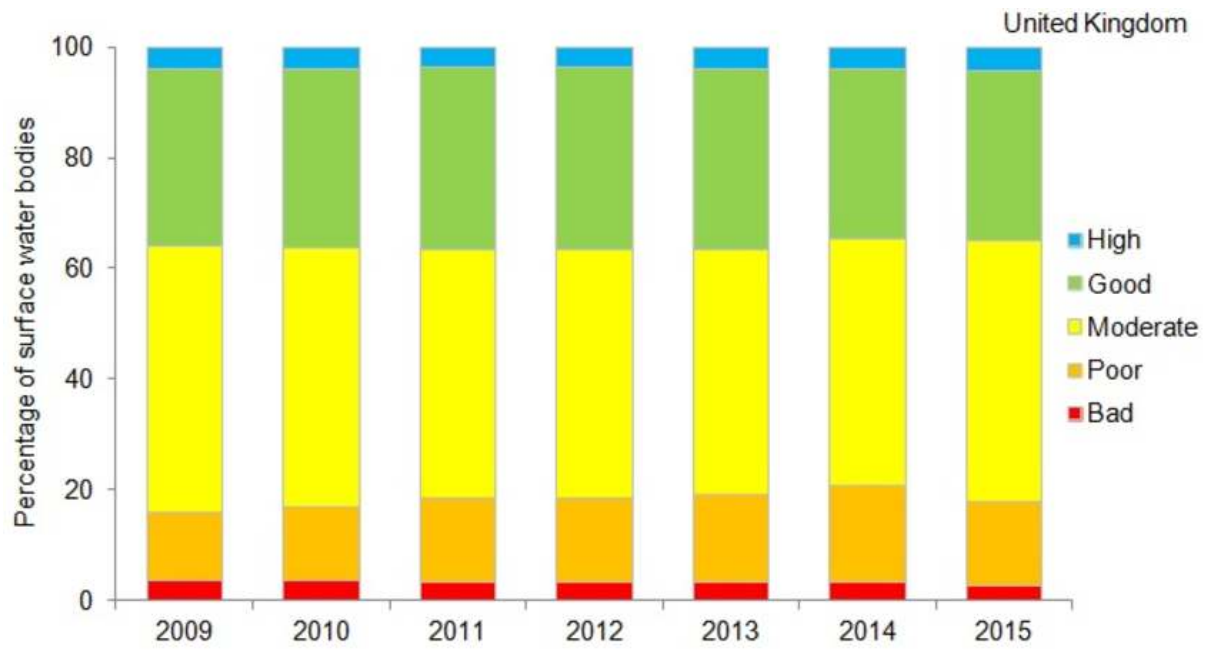
- Anglian river basin;
- Humber river basin;
- Northumbria river basin;
- North West river basin;
- Severn river basin;
- South East river basin;
- South West river basin;
- Thames river basin.

D5.3.5 A river basin district covers an entire river system, including river, lake, groundwater, estuarine and coastal water bodies. The River Basin Management Plans are designed to protect and improve the quality of our water environment. Good quality water is essential for wildlife, agriculture and business to thrive

D5.3.6 **Figure D5.2** shows the status classification of all UK surface water bodies under the Water Framework Directive.

[198] Natural Environment Research Council. *The Aquifers of the UK*. Available online at: http://www.groundwateruk.org/downloads/the_aquifers_of_the_uk.pdf

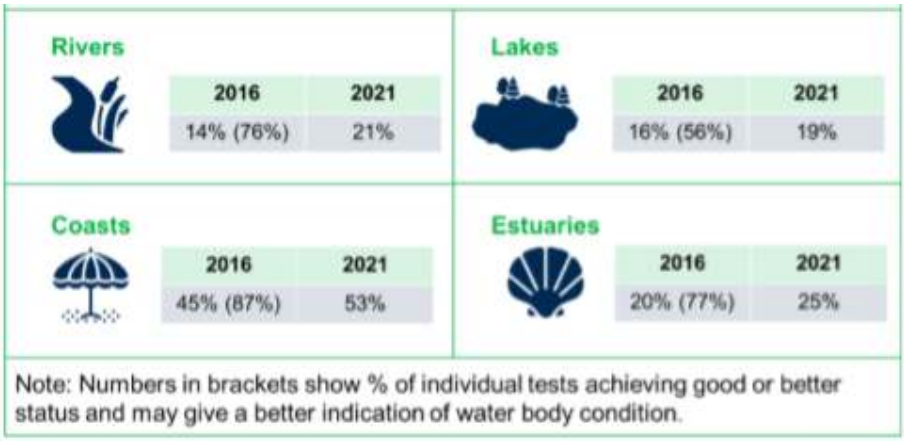
Figure D5.2 Status classification of UK surface water bodies under the Water Framework Directive, 2009 to 2015



Source: Joint Nature Conservancy Council

D5.3.7 **Figure D5.3** provides the percentage of surface water bodies at good or better ecological status in 2016 and the planned improvements to 2021[199].

Figure D5.3 Status classification of UK surface water bodies



D5.3.8 River water quality in England has in general been steadily increasing since 1990. The proportion of rivers at good or high biological quality did not change significantly between 2009 and 2012 but decreased slightly in 2013 and 2014.[200]

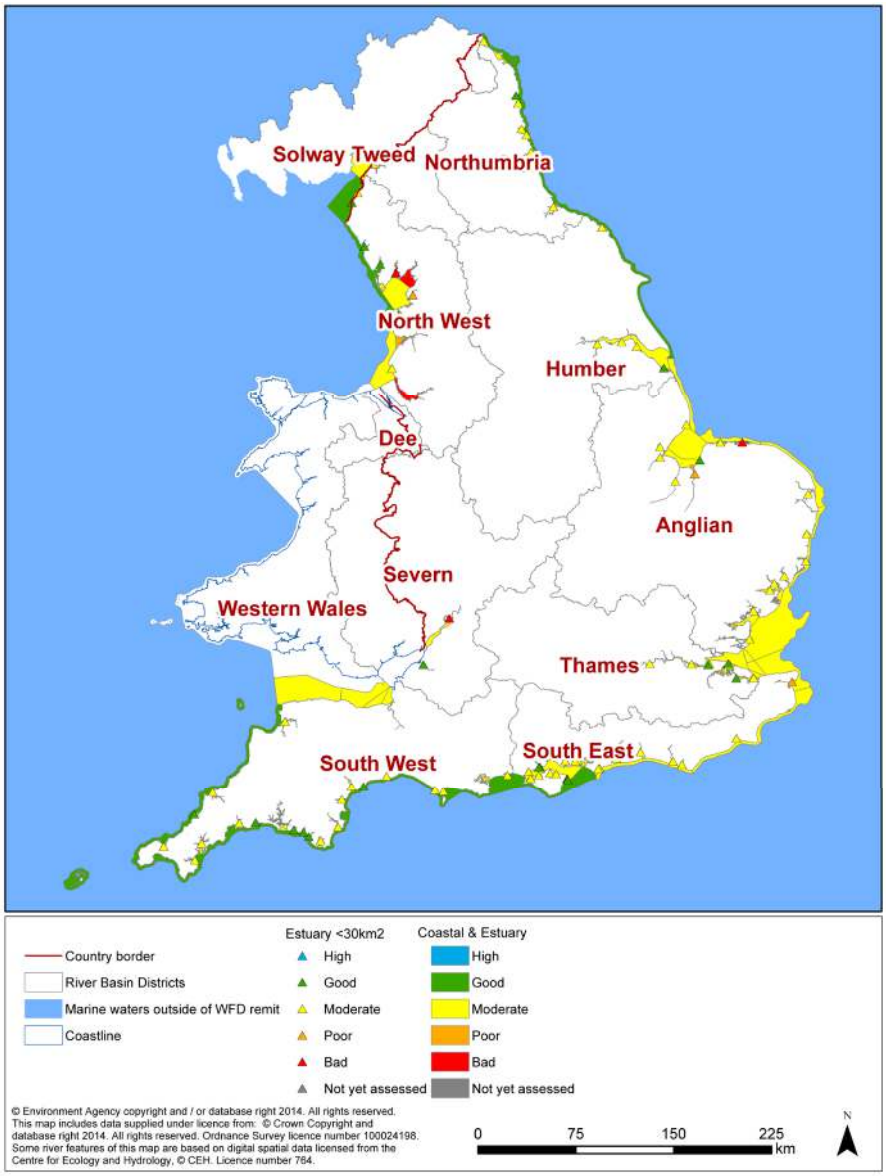
[199] Environment Agency, (2018). The state of the environment: water quality. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/709493/State_of_the_environment_water_quality_report.pdf

[200] Office for National Statistics (2015) *Sustainable Development Indicators*. Available online at: http://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/sustainabledevelopmentindicators/2015-07-13

D5.3.9 Between 2001 and 2016, there has been a downward trend in the number of pollution incidents with a low in 2012 of 250. Agriculture is the sector responsible for more pollution events to water than any other.[199]

D5.3.10 Coastal water quality has improved over the last two decades, however current WFD draft classification results and maps produced by the Environment Agency indicate that there are still a large proportion of coastal waters in England (and Wales) that are classified as being of Moderate Ecological Status (see **Figure D5.4**), i.e. are failing to meet 'Good Ecological Status' (GES) on the basis of a number of physio-chemical and biological standards and are therefore in need of measures to achieve GES.

Figure D5.4 Ecological Status or Potential for Estuaries and Coastal Water Bodies in England and Wales

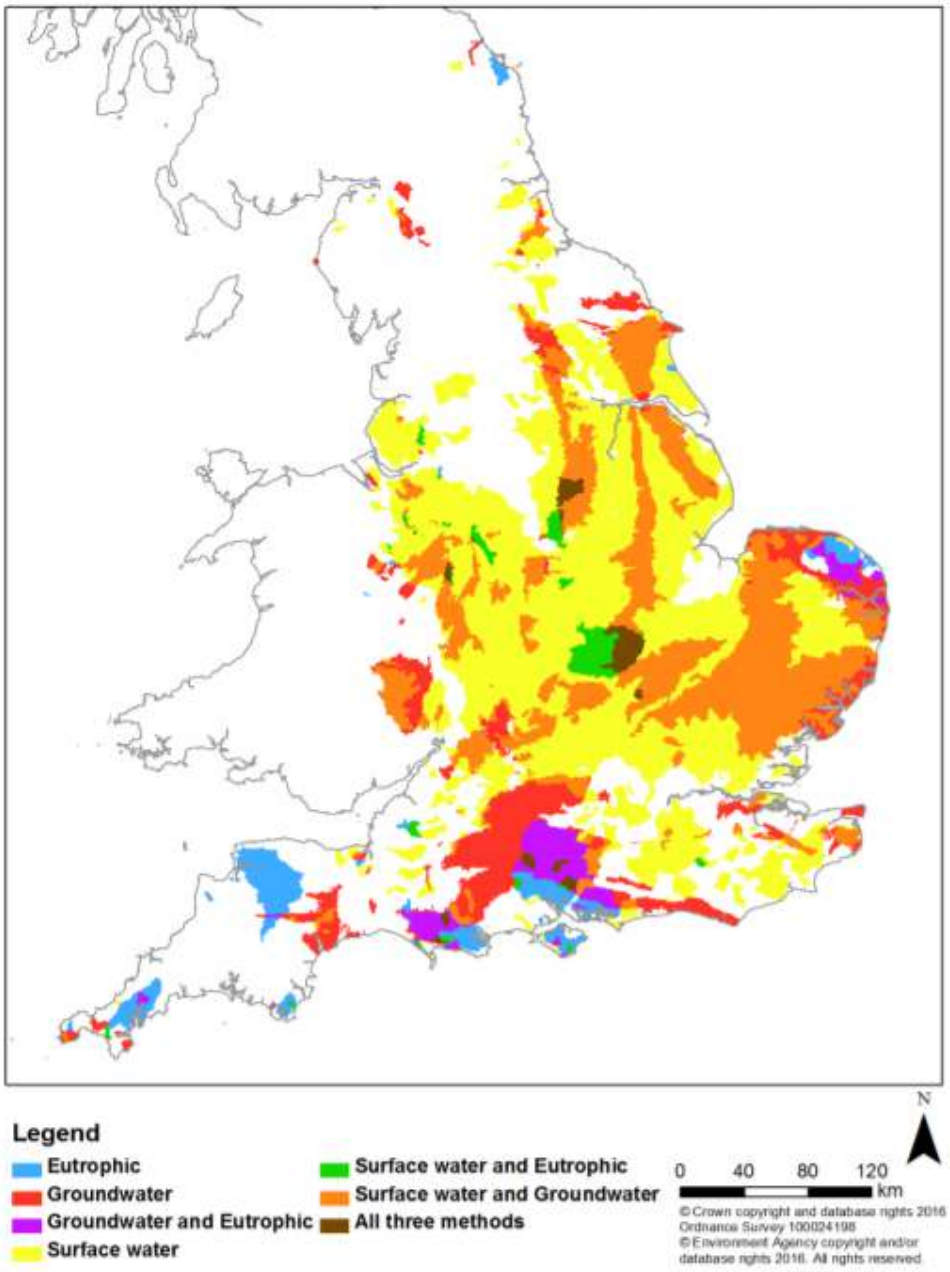


Source: Estuarine and coastal waters national engagement summary. Environment Agency, 2014.

D5.3.11 A Nitrate Vulnerable Zone (NVZ) is an area of land that drains into polluted waters and contributes to the pollution of those waters. Polluted waters are waters that are affected by nitrate pollution or could be if the Regulations are not applied in the area concerned. The Nitrate Pollution Prevention Regulations 2015 require the review of NVZs at least every 4 years. The latest review[201] identifies both existing areas at risk alongside new area and the methods that designate each area as shown in **Figure D5.5**.

[201] Environment Agency (2017) *Review of Nitrate Vulnerable Zone designations for implementation in 2017*. Available online at: http://apps.environment-agency.gov.uk/static/documents/nvz/NVZ2017_Recommendation_Report_Final_HOEV151604_R_1611115.pdf

Figure D5.5 Proposed 2017 NVZs and the methods that designate each area



Source: Environment Agency

D5.3.12 Groundwater provides a third of drinking water in England, and up to 80% in some areas of southern England. The Environment Agency has defined Source Protection Zones (SPZs) for 2,000 groundwater sources. These zones show the risk of contamination from any activities that might cause pollution in the area. The Environment Agency use the zones in conjunction with their Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk and to monitor the activities of potential polluters nearby.

D5.3.13 Groundwater Source Protection Zones are classified as either 'Inner Zone' (Zone 1), 'Outer Zone' (Zone 2), 'Total Catchment/Source Catchment' (Zone 3) or 'Special Interest' (Zone 4). The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and

other environmental factors. A map that shows the contours of these zones for England and Wales can be viewed on the Environment Agency's website.[202]

Bathing Water

D5.3.14 In 2016, 98.5% of bathing waters met the minimum standard of the Bathing Water Directive, with 69.5% reaching the excellent standard. A total of 6 bathing waters, representing 1.5% of the total, did not meet the minimum requirement. Due to a change in recording methodology, bathing water quality statistics can only be compared to statistics from the year 2015 onwards, which at the time of writing provides only two years' worth of comparable datasets. Nonetheless, the data for 2016 showed an improvement on the data from 2015 as a result of recent improvements to infrastructure and more favourable weather conditions.[203]

UK – Water Quantity

D5.3.15 Over the past five years, there has been a downward trend in the amount of water that households are using each day, although fluctuations can be seen throughout the years. However, in 2015- 16, there was a slight increase in the amount of water that individuals use each day, averaging 139.5 litres per person per day. Unmetered households use more water (around 30 litres per person per day more) than metered households. In Scotland, domestic water use accounts for 841.64 Ml/d or 150 litres per person per day (2013-14). A declining trend has been observed since (2008/09). Average water use in Northern Ireland is 145 litres per person per day.[204]

England and Wales

Abstraction

D5.3.16 The abstraction of water from non-tidal surface water and groundwater in England and Wales had fallen steadily from the peak of an estimated 11.6 billion cubic metres in 2001 to 8.2 billion cubic metres in 2011. However, since 2011, total abstraction has increased by 14% to 9.4 billion cubic metres, driven mostly by abstraction for electricity generation, which increased from 1.4 billion cubic metres in 2011 to 2.5 billion cubic metres in 2015. The statistics for 2016 show that abstraction has begun to decrease again due to a large reduction in hydropower abstracted in Wales. The abstractions for public water supply, which makes up 50% of total abstraction, decreased slightly by 1% over the same period to 5.1 billion cubic metres in 2015.[205]

D5.3.17 **Figure D5.6** shows abstraction by type for the years 2000-2015.

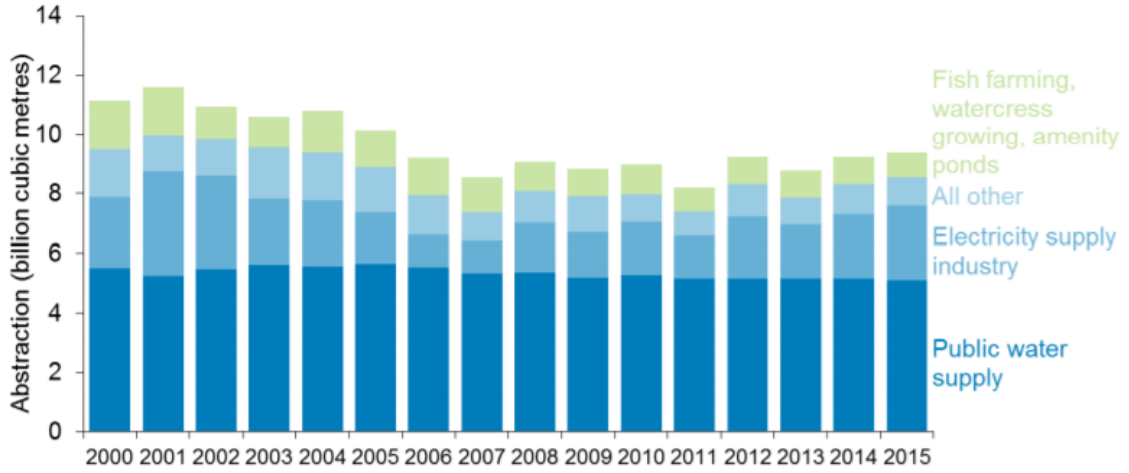
[202] Environment Agency (2019) accessible at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=groundwater

[203] Defra (2016) *Statistics on English coastal and inland bathing waters: a summary of compliance with the 2006 Bathing Water Directive.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/565710/STATS_bathing-water-release-2016v1.pdf

[204] Waterwise (2017) *Water efficiency strategy for the UK*. Available online at: http://www.waterwise.org.uk/data/resources/67/Waterwise-UK-Water-Efficiency-Strategy-full-report.pdf

[205] Defra (2017) *Water abstraction statistics, England 2000-2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/422246/Water_Abstractions_release_V1.pdf

Figure D5.6 Estimated abstractions from non-tidal surface water and groundwater in England, 2000 to 2015.



Source: Environment Agency

Household Water Use

D5.3.18 **Table D5.1** shows the level of water consumption for water companies in England and Wales. As can be seen, the overall industry trend is downwards, with some significant variation between water companies.

Table D5.1 Average water use (litres per person per day)

	2011-12	2012-13	2013-14	2014-15	2015-16	Trend
Industry Average	145.8	140.1	141.5	138.6	139.6	
Water and Sewerage Companies						
Anglian*	144.8	136.2	135.1	133.4	135.4	
Dŵr Cymru	152.1	144.4	144.6	141.5	138.5	
Northumbrian	146.2	140.5	141.2	141.9	144.7	
Severn Trent	125.0	120.9	129.3	126.4	130.4	
South West	134.5	136.7	136.9	134.6	136.6	
Southern	156.7	143.4	140.8	134.8	132.0	
Thames	160.6	154.7	156.2	150.9	149.3	
United Utilities	132.0	128.0	129.1	130.0	130.0	
Wessex	139.8	136.3	138.4	138.8	138.1	
Yorkshire	136.0	133.4	136.2	133.0	133.1	
Water only companies						
Affinity	157.6	148.5	154.7	148.3	152.2	
Bournemouth	146.4	142.4	144.1	138.4	133.6	
Bristol	142.0	141.0	144.0	143.0	141.1	
Cambridge	140.7	133.1	130.1	130.5	132.9	
Dee Valley	138.3	135.5	132.9	130.4	134.9	
Essex & Suffolk	153.0	147.4	151.9	151.0	150.7	
Hartlepool	123.7	123.1	124.7	119.9	127.5	
Portsmouth	160.0	149.0	148.0	145.5	143.3	
South East	167.2	159.4	155.6	148.2	161.2	
South Staffs	135.6	127.6	131.0	129.0	128.9	
Sutton & East Surrey	168.6	161.5	166.5	161.1	157.9	
* Anglian includes Hartlepool						

D5.3.19 Over the past five years, there has been a downward trend in the amount of water that households are using each day, although fluctuations can be seen throughout the years. However, in 2015-16, there was a slight increase in the amount of water that customers use each day. Only four companies have met the UK Government's aspirational target of 130 litres per person, per day.

D5.4 Summary of Existing Problems Relevant to Water

Summary of Existing Problems Relevant to Water

D5.4.1 The following existing problems for water quality have been identified:

- There is considerable pressure on water resources in many parts of the UK, which can in turn affect water quality. The Environment Agency state that increased population is estimated to pose a risk to 2% of river water bodies in England which could result in a deterioration in river quality.[199]
- There is a legacy of groundwater pollution in the UK from historical mining and other industrial activities, although this is progressively being addressed as sites are remediated as part of site redevelopment.[206]
- Many historic landfills were opened - and closed – without being suitably lined or capped to today's standards.[207] This means that there is a risk that leachate will escape from the sites and enter into any underground waterways.
- Direct impacts on water resource and quality from waste management activities can include the abstraction of water for incineration, composting and anaerobic digestion, and potential adverse impacts on water quality associated with poor management of leachate from landfill and other (e.g. composting) facilities.
- Indirect impacts on water resources and quality from waste management activities are often associated with overseas supply chains, related to the avoided requirements to use water in primary production of materials as a result of undertaking waste prevention, reuse and recycling.
- Many waterbodies are subject to pressure from multiple sources including rural diffuse pollution, waste water discharges, acidification and urban diffuse pollution.[208]
- Demand for water is expected to increase from a growing population alongside industrial, agricultural and commercial pressures.[209] Water resources in parts of the UK, particularly the south east and east of England are under growing pressure. Waste management practices should seek to minimise their water demand and water footprint.
- Climate change is expected to have significant impacts on the water environment. Areas where the underlying geology is generally impermeable are expected to be particularly affected as

[206] Department for International Trade (2015) *Land remediation: Bringing brownfield sites back to use.* Available online at: https://www.gov.uk/government/publications/land-remediation-bringing-brownfield-sites-back-to-use/land-remediation-bringing-brownfield-sites-back-to-use
[207] Health Protection Agency (2011) *Impact on Health of Emissions from Landfill Sites*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/334356/RCE-18_for_website_with_security.pdf
[208] Environment Agency (2017) *Plausible future scenarios for water and the water environment to 2030 and 2050.* Available online at: https://www.gov.uk/government/publications/plausible-future-scenarios-for-the-water-environment-to-2030-and-2050
[209] Environment Agency (2013) *The case for change - current and future water availability*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328154328/http://cdn.environment-agency.gov.uk/geho1111bvep-e-e.pdf

river flows would be likely to fall to low levels in drier periods and quickly react to rainfall episodes.[210]

- The risk of prolonged and more severe droughts is increasing, which in turn risks the increasing use of drought restrictions measures and consequent effects (e.g. lower than normal dilution of any consented discharges from waste sites) which can impact the environment, people and the economy.

D5.5 Likely Evolution of Baseline

Likely Evolution of the Baseline – water quality

D5.5.1 The UK Climate Change Risk Assessment[211] identifies that at present, a clear climate-related trend in risk at a national scale cannot be distinguished for freshwater ecosystems and their services. This is due to the dominating role of large year-to-year climate variability and the influence of other factors (notably land use).

D5.5.2 Future projections for an increased incidence of warmer, drier summers are very likely to increase the risk of low flows and reduced water levels with almost ten times as many droughts anticipated in future and with one serious drought every ten years. In combination with higher water temperatures, this increases the risk of ecosystem disruption from reduced oxygen supply, thermal stress to species, reduced dilution of harmful pollutants and increased incidence of algal blooms in water bodies. Climate change would therefore provide further stress for water bodies that do not have good ecological status and may introduce new risks for water bodies that do have good status, depending on the magnitude of change.

D5.5.3 Impacts would be exacerbated during periods of drought, although currently evidence for increased incidence of drought remains limited. The increased likelihood of more frequent periods of heavy rainfall could cause further raw water quality problems due to increased runoff/discharge of pollutants, effluents and sediments into water bodies, including elevated levels of dissolved organic carbon. In addition to environmental impacts, these problems would incur greater treatment costs for drinking water.

D5.5.4 Risks may be further exacerbated in some catchments due to shifts towards more intensive land use, contributing greater pollution loads from diffuse sources. Depending on the rate of sea-level rise, existing freshwater aquifers may be at an increased risk of saline intrusion, with implications for drinking water supplies.

D5.5.5 Ecosystems, particularly wetlands and woodlands, regulate and filter the flow of water through vegetation and soils (interception, evapotranspiration, infiltration, drainage, conductivity). Climate related and human-related changes to ecosystems will therefore modify their role in buffering against extreme high flows (flood risk) and low flows, in addition to their role in water circulation and purification. Increasing evidence is available for these relationships but remains incomplete.[212]

[210] Water UK (2016) *Water resources long term planning framework (2015-2065).* Available online at: http://www.preventionweb.net/publications/view/50354
[211] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment 2017*. Available online at: https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/
[212] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment 2017*. Available online at: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/ccra-chapters/natural-environment-and-natural-assets/

D5.5.6 The Environment Agency has considered five future scenarios for water and the water environment to 2030 and 2050.[213] Taking the reference scenario, which is considered to be the closest representation to the evolution of the baseline without the plan,[214] improvements were anticipated for levels of phosphorus and chemicals and metals. Degradation was predicted in relation to abstraction and flow, physical modification and invasive non-native species.

England

D5.5.7 The objectives of the RBMPs, required by the WFD and referenced earlier in this section, are:

- to prevent deterioration of the status of surface waters and groundwater;
- to achieve objectives and standards for protected areas;
- to aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status;
- to reverse any significant and sustained upward trends in pollutant concentrations in groundwater;
- the cessation of discharges, emissions and loses of priority hazardous substances into surface waters; and
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.

D5.5.8 Since a new assessment framework was introduced in 2009, there has been no real change the in quality of rivers within England; between 2009 and 2012 the percentage of rivers of good biological quality in England dropped from 26% to 25%. Over the same time period the percentage of rivers that passed the chemical status criteria rose from 78% to 80%.

D5.5.9 Defra aims that by 2030, at the latest, England will have improved the quality of our water environment and the ecology which it supports, and continue to provide high levels of drinking water quality from its taps; sustainably manage risks from flooding and coastal erosion, with greater understanding and more effective management of surface water; ensure a sustainable use of water resources, and implement fair, affordable and cost reflective water charges; cut greenhouse gas emissions; and embed continuous adaptation to climate change and other pressures across the water industry and water users.

Likely Evolution of the Baseline – water quantity

D5.5.10 The UK Climate Change Risk Assessment[215] indicates that rainfall patterns will become increasingly seasonal, with lower amounts of flow in the summer. This will lead to lower summer river flows, especially in those catchments with a low groundwater component. This could lead to increased abstraction pressure and increased stress on sensitive hydrological systems. Population pressures are predicted to increase in certain parts of Great Britain, for example in the South East.[216]

[213] Environment Agency (2017) *Plausible future scenarios for water and the water environment to 2030 and 2050.* Available online at: https://www.gov.uk/government/publications/plausible-future-scenarios-for-the-water-environment-to-2030-and-2050

[214] In full, the reference scenario depicts a society that is environmentally conscious, but one where personal interests often dictate behaviour. EU legislation and codes of good practice establish the standards by which the environment is managed, but short political cycles cause most long-term initiatives to fall short of these standards. Goals related to environmental sustainability are reflected in plans for economic growth, but these are often reneged when growth falls below what is expected.

[215] UK Committee on Climate Change (2017) *UK Climate Change Risk Assessment 2017*. Available online at: https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/

[216] ONS (2016) *Subnational Population Projections for Local Authorities in England: Table 2*. Available online at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/localauthoritiesinenglandTable 2

Increased population density will result in an increased pressure on natural resources and could exacerbate current problems or cause new ones. Economic growth could also lead to increased commercial, industrial and agricultural pressure on water resources.[217]

D5.5.11 It is anticipated that climate change will affect river flows, and in turn the availability of water, in the following ways:

- increases in average winter flows;
- reduced summer flows;
- reduced spring flows;
- no clear pattern in autumn flows; and
- increases in the magnitude of flood events.

D5.5.12 These projected changes imply that both high and low flows are likely to be significantly modified throughout the UK. In particular, the reduced summer flows along with an increased demand for water, including water for agriculture, is expected to lead to reduced water availability over the summer months. It is also considered that the UK will experience longer, more acute droughts with areas such as the south and east of England expected to face droughts more severe that those previously experienced.[218]

England and Wales

D5.5.13 In 2013, the Environment Agency[219] modelled four potential future demand scenarios for England and Wales based on differing assumed patterns of behaviour. Under all four scenarios the water exploitation index[220] showed how for all parts of England and Wales, demand for water was expected to increase in all four scenarios. The lowest increase in pressure was in Wales, which ranged from a 2.4% to a 3.6% increase. The highest increase was in the south east and east midlands areas of England, which ranged from a 22.7% to 35.9% increase.

D5.5.14 The level of stress was identified for each water company area as shown in **Table D5.2**.

[217] Anglian Water, United Utilities and Yorkshire Water. *Water 2020 – Long term challenges and uncertainties for the water sector of the future*. Available online at: http://www.anglianwater.co.uk/_assets/media/Water_2020_LT_Challenges_-_Final.pdf
[218] Water UK (2016) *Water resources long term planning framework (2015-2065).* Available online at: http://www.preventionweb.net/publications/view/50354
[219] Environment Agency (2013) *The case for change - current and future water availability*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328154328/http://cdn.environment-agency.gov.uk/geho1111bvep-e-e.pdf
[220] The water exploitation index (WEI) in a country is the mean annual total demand for freshwater divided by the long-term average freshwater resources. It gives an indication of how the total water demand puts pressure on the water resource. It also identifies those countries that have high demand in relation to their resources and therefore are prone to suffer problems of water stress.

Table D5.2 Water company stress classification showing how the current future and future scenarios have been combined.

Water Company Area	2013 Classification					
	Current Stress	Future Scenario 1	Future Scenario 2	Future Scenario 3	Future Scenario 4	Final Stress
Affinity Water (formerly Veolia Water Central)	S	S	S	S	S	Serious
Affinity Water (formerly Veolia Water East)	S	S	S	S	S	Serious
Affinity Water (formerly Veolia Water South East)	S	S	S	S	S	Serious
Anglian Water	S	S	S	S	S	Serious
Bristol Water	M	M	M	M	M	Not Serious
Cambridge Water	M	M	M	M	M	Not Serious
Cholderton & District Water	M	M	M	M	M	Not Serious
Dee Valley Water	M	M	M	M	M	Not Serious
Dwr Cymru Welsh Water	M	M	M	M	M	Not Serious
Essex & Suffolk Water	S	S	S	S	S	Serious
Northumbrian Water	M	M	M	M	M	Not Serious
Portsmouth Water	M	S	M	S	M	Not Serious
Sembcorp Bournemouth Water	L	M	M	M	L	Not Serious
Severn Trent Water	M	M	M	M	M	Not Serious
South East Water	S	S	S	S	S	Serious
South Staffordshire Water	M	M	M	M	M	Not Serious
South West Water	M	M	M	M	M	Not Serious
Southern Water	S	S	S	S	S	Serious
Sutton & East Surrey Water	S	S	S	S	S	Serious
Thames Water	S	S	S	S	S	Serious
United Utilities	M	M	M	M	M	Not Serious
Veolia Water Projects	M	M	M	M	M	Not Serious
Wessex Water	M	M	M	M	M	Not Serious
Yorkshire Water	M	M	M	M	M	Not Serious

Source: Environment Agency

England

D5.5.15 The Environment Agency's Catchment Abstraction Management Strategies (CAMS) have identified a number of catchments in England which are designated as Over-Licensed or Over-Abstracted. Climate change is likely to result in lower summer rainfalls and more frequent/severe winter flood events. Such changes are likely to increase pressure on summer freshwater water availability and increase pollutant run-off into controlled waters during flood events. Unsustainable groundwater and surface water abstraction may contribute to environmental damage of rivers and wetlands at 500 sites in England and Wales, important conservation sites, including sites of national and international conservation importance. However, it should be noted that the Environment Agency's approach to abstraction management and the restrictions placed on abstraction by the Water Framework Directive would both be expected to act in mitigation of these potential trends.

D5.5.16 Defra's Creating a Space for Living[221] identifies that by the 2050s, summer temperatures are likely to increase while summer rainfall decreases, leading to increased risks of short-duration droughts. The population in England is forecast to grow by over 10 million people over the same period, with a large part of this growth occurring in areas where water is already scarce.

[221] Defra (2016) *Creating a great place for living: enabling resistance in the water sector*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/504681/resilience-water-sector.pdf

D5.6 Waste Management Effects on Water

D5.6.1 Waste management operations have both direct and indirect impacts upon water resources. Direct impacts include the demand for water within facilities and their operations, as well as the potential consequences of wastewater discharge. In addition, the potential leachate from landfill into surrounding waterways can pose a significant direct threat to the quality of local ecosystems, soil and water resources. Direct, positive impacts include the benefits associated with the application of compost, derived from food and garden waste, to agricultural land which can improve water retention through improved soil structure, leading to a reduced requirement for irrigation.

D5.6.2 Indirect impacts, as outlined in the 2013 Environmental Report[222] often associated with overseas supply chains, relate to the avoided requirements to use water in primary production of materials as a result of undertaking waste prevention, reuse and recycling.

Waste Infrastructure

Demand for Water Resources

D5.6.3 Waste infrastructure uses water at a range of points as outlined in the example infrastructure of **Table D5.3**

Table D5.3 Uses of water in waste infrastructure

Bulking points (Incl HWRCs)	Material Recycling Facilities	Biomass plants (Incl. AD, IVC, Openrows)	Incineration Plants
Welfare facilities	Welfare facilities	Welfare facilities	Welfare facilities
Washing facilities for vehicles and sites	Washing facilities for vehicles and sites	Washing facilities for vehicles and sites	Washing facilities for vehicles and sites
	Dust dampening systems	Dust dampening systems	Dust dampening systems
	Sprinkler systems	Sprinkler systems	Sprinkler systems
			Gas scrubbing
			Ash discharge

D5.6.4 Data on water demand at each type of facility is limited and would be dependent upon facility design and specific operations. Available data shows that biomass plants in Europe will demand over 22.9Bm^3 by 2050. [223]

D5.6.5 The Environment Agency[224] states that semi dry gas scrubbing typically consumes 250-350kg/tonne of waste incinerated. Most waste incinerators using wet scrubbing consume up to 850kg/tonne of waste incinerated, although this can be reduced by scrubber liquor recirculation. The majority of chemical waste incinerators employ dry scrubbing and therefore consume relatively little water.

D5.6.6 The nature of wastes treated in hazardous waste incinerators, which includes clinical wastes and materials with high chemical compounds, consume higher levels of water consumption (up to 1100kg/tonne of waste) to dampen materials, scrub emissions and ensure emissions to air are controlled.

D5.6.7 As noted in the 2013 Environmental Report, there is little data available for other technologies and configurations of incineration plants. Technologies continue to evolve in the sector and it is therefore reasonable to assume that the above calculations have since been improved.

[222] Eunomia (2013). *Waste management Plan for England*. Environmental Report.
[223] World Energy Council (2010)
[224] Environment Agency (2009) *How to Comply with your Environmental Permit – Additional Guidance for: The Incineration of Waste* (EPR 5.01). Available at: http://publications.environment-agency.gov.uk/PDF/GEHO0209BPIO-E-E.pdf

D5.6.8 Whilst water is a resource under threat in England, it is unlikely that waste infrastructure would impact significantly upon local supplies. As part of the planning process, the water demand for infrastructure would be taken into account and assessed.

Effects on water from leachate

D5.6.9 Waste infrastructure such as landfills and those managing biowastes have the potential to produce leachate contaminant that if not contained can percolate into surface and groundwater adjacent to the landfill site. As stated in the 2013 Environmental Report, both inert and non-hazardous landfills can produce leachates that contains ammoniacal nitrogen, heavy metals and organic compounds. Leaching may also carry insoluble liquids (such as oils) and small particles in the form of suspended solids. Komilis and Ham note, in their review, that varying amounts of leachate have reportedly been produced in MSW and garden waste composting facilities starting from 0 to approximately 490 litres / tonne[225]. The management of leachate is highly controlled and recent improvements in landfill design[226,227] has introduced the use of non-porous geotextiles and/or geomembranes for lining and capping the cells within landfill. This approach significantly reduces the potential for leachate to percolate into the adjacent surface and groundwater. However, should leachate escape from the landfill site, it can have significant localised effects to surface and ground water and water dependent ecosystems. It should also be noted that older or closed landfills have not been designed with the same linings, cappings and leachate collection systems as found in new landfills.

Effects on water from discharges

D5.6.10 **Figure D5.7** (as taken from the Environmental Report (2013)) shows a freshwater eco-toxicity index for differing waste management infrastructure. MBT has a negative eco-toxicity due to the net reduction in pollution due to avoided emissions from material recovery and energy generation whilst landfill and electrical incineration perform less well in regard of eco-toxicity. In particular this assessment reflected:

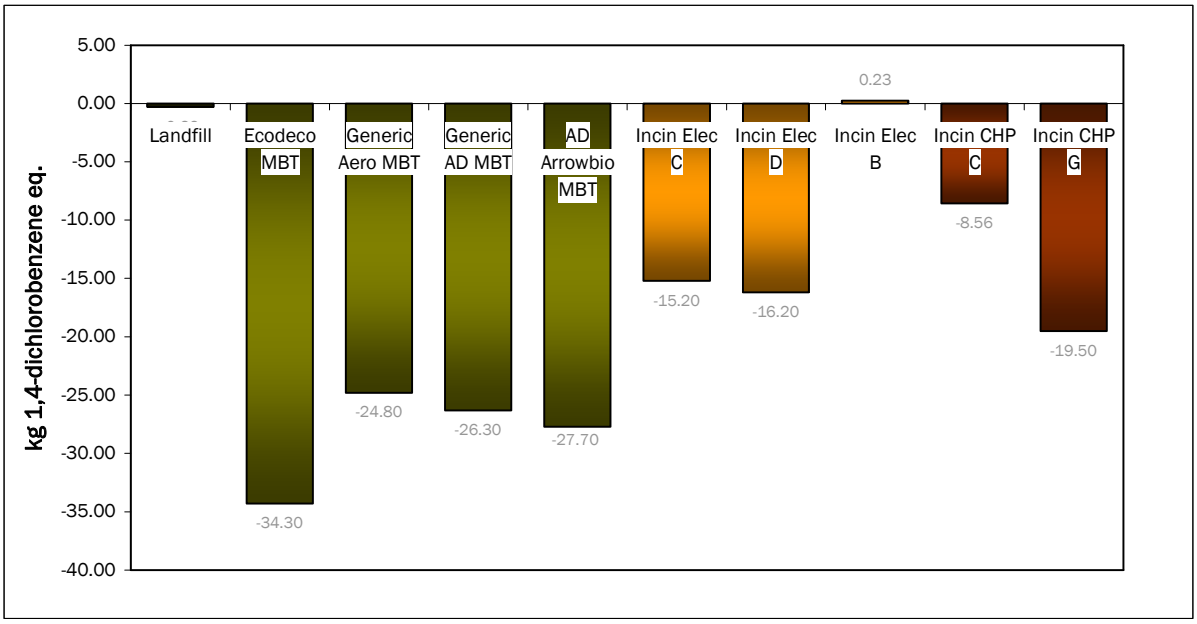
- avoided vanadium emissions to water as a result of recycling ferrous metal; and
- emissions of copper to water from the landfilling of combustion residues.

[225] Dimitris P. Komilis and Robert K. Ham (2004) L*ife-Cycle Inventory of Municipal Solid Waste and Yard Waste Windrow Composting in the United States*, Journal of Environmental Engineering, Vol. 130, No. 11, November 1, 2004, p.1394

[226] https://www.gov.uk/government/collections/environmental-permitting-landfill-sector-technical-guidance

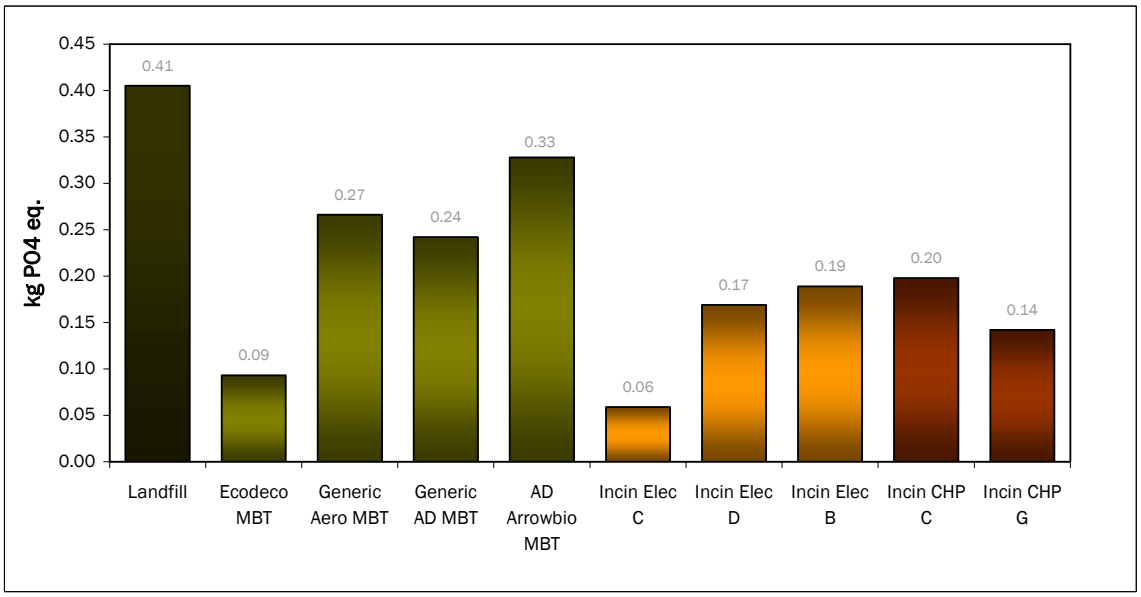
[227] Chartered Institute of Wastes Management (2018) *Guidance for Waste Producers and Landfill Operators* (Draft). Available online at: https://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=2LRf%252bfCsajPqr8XJlBNQsRPWexMfU1INRxWyc2GTb1uukjxzHwhZpZyB7XHouqBSV8WNC4BMR7v0W7hJB9yXBqCjHDbyuQrm4RYZVoftUjgXbRlKOKcLgjp1QzY6z8XXp1zjL1HP39FuAVOsbD76eRnhWsNS%252b5LHLaxwbNXKuZH3F3aoUOo3k4a%252baZTQdwkSEC9bVtJrJOM%253d,

Figure D5.7 Freshwater Aquatic Eco-toxicity



D5.6.11 The 2013 Environmental Report used an eutrophication indicator to measure the potential for pollutants to stimulate plant growth if they were to be released into water bodies. The results in **Figure D5.8** indicates that the majority of MBT facilities (with the exception of the Ecodeco plant) fare less well than the thermal treatments however landfill leachate again remains most potent.

Figure D5.8 Eutrophication



D5.6.12 Groundwater provides up to 80% of drinking water supplies in southern England. Leachate can seep through the base and sides of the landfill into surrounding groundwater and it is recognised

that all lining systems leak to some extent[228] however it is estimated that 4% of total leachate has entered groundwater or land[229].

Materials use

D5.6.13 A study for WRAP illustrated that the total water footprint of clothing used in the UK in any given year amounted to 6,300 Mm3 (million cubic metres) of water, based on annual clothing use of 2.49Mt (comprising 1.14Mt of new clothing, and 1.35Mt of existing clothing).[230]

D5.6.14 On a per tonne basis, the water footprint is 2,534 m3 for every tonne of clothing used in one year.[231] This comprises 2,202 m3/tonne at the raw materials stage, 318 m3/tonne at the processing and manufacturing stage, 0.01m3/tonne for transport and distribution and 15 m3/tonne from the consumer in-use stage. These figures do not include any demand for water use at the disposal stage.

D5.6.15 In the previous 30 years global food production has increased by more than 100%; and 60% more food will be required by 2050. Irrigated food production will increase by 50% by 2050 however water withdrawn for agricultural purposes can only increase by 10%.[232] The agricultural sector accounts for just 1% of water resources in England however, this masks regional differences.[233] In per capita terms this is 243 litres per person per day, approximately one and a half times the daily average household water use in the UK.[234] A reduction in food waste would reduce water demand at all stages of this process In the UK it is estimated that 60% of food waste could be avoided.[235]

D5.6.16 The British Metal Recycling Association states that recycling of steel leads to a 40% reduction in water use, and a 76% reduction in water pollution.[236]. The Bureau of International Recycling states that recycling one tonne of paper avoids the use of 26 m^3 of water and reduces water pollution by 35%.[237] . The recycling of one tonne of aluminium is reported by an industry organisation to save 15,000 litres of cooling water and 860 litres of processing water relative to primary production.[238]

D5.6.17 With the introduction of strict waste targets and the adoption of a circular economy, it is assumed that water use in the sector will diminish. However, it is not yet known what impact the reuse and recycling of these materials may have if new infrastructure and business models are needed.

[228] Environment Agency (2003). *Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water*.
[229] Defra (2004). *Recycling of Home and Garden Pesticide Containers.* Available online at: http://randd.defra.gov.uk/Document.aspx?Document=11564_PS2808Wastestreams.pdf
[230] URS Infrastructure & Environment UK Limited (2012) R*eview of Data on Embodied Water in Clothing: Summary Report, Report for WRAP*, 16 July 2012
[231] This includes the water used by the consumer in washing items of clothing over a year.
[232] Food and Agriculture Organisation of the United Nations (2017). *Water for Sustainable Food and Agriculture: A Report Produced for the G20 Presidency of Germany.*
[233] Defra (2016). Water Usage on Farms: Results from the Farm Business Survey, England 2014/15. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/587269/fbs-wateruse-statsnotice-21jan16.pdf
[234] Chapagain, A. and James, K. (2012) *The Water and Carbon Footprint of Household Food and Drink Waste in the UK,* Report for WRAP, 1 March 2012
[235] House of Commons Environment, Food and Rural Affairs Select Committee (2017). *Food Waste in England. Eigth Report of Session 2016-17.*
[236] https://www.recyclemetals.org/about-metal-recycling.html
[237] http://www.bir.org/industry/paper/
[238] European Aluminium Association and the Organisation of European Aluminium Refiners and Remelters (2005) *Aluminium Recycling: The Road to High Quality products,* 2005. Available at: http://www.oea-alurecycling.org/de/verband/oea_eaa_aluminium_recycling.pdf

D5.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D5.7.1 **Table D5.4** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D5.4 Assessment of the Draft WMPE and reasonable alternative

Water		
To protect and enhance water quality and help achieve the objectives of the Water Framework Directive. To protect and enhance surface and ground water levels and flows and ensure sustainable water resource management.		
• Will the draft WMPE protect and improve surface, ground, estuarine and coastal water quality and quantity? • Will the draft WMPE prevent the deterioration of Water Framework Directive waterbody status (or potential)? • Will the draft WMPE ensure a new activity or new physical modification does not prevent the future achievement of good status for a water body? • Will the draft WMPE pose a significant demand upon any areas of limited or pressured water supplies? • Will the draft WMPE ensure the sustainable and resilient supply of water resources?		
	Effect	**Commentary**
WMPE		
Prevention	+ +	The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which may reduce material use and waste generated. England's water supplies will face increased pressure from a growing demand from agriculture, industry and a growing population. Any actions to reduce water demand in material production and in wastes management may have a positive impact on water quantity and quality in England. Materials such as clothing can demand up to 6.3M m^3 of water and this does not include the water demand at disposal stage. The WMPE outlines ambitions to improve the production of materials through adoption of circular economy principles; it also outlines efforts to improve consumer behaviours by promoting opportunities to prevent wastes. Any reduction in textile production and wastage will have a positive impact on water quantity, accessibility and the objectives of the Water Framework Directive. It is possible that any improvements to material design will minimise water demand; either by reducing demand for virgin material or by developing less water intensive materials. A reduction in food waste would reduce water demand. In the UK, in 2015, 5.0 Mt of edible food was wasted (in addition to 2.1 Mt of inedible parts) in the UK, creating over 6BN cubic metres of water footprint[239]. The proposed collection of food waste separately from all households could generate over 8Mt of food waste to the organics sector, worth up to £280M in renewable energy sales. Food waste is specifically targeted in the WMPE through the potential for a separate collection system. Any reduction in material demand or waste generation may decrease the tonnage of materials that end in landfill. This may reduce the risk of leachate entering local waters. As such, the WMPE is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions

[239] WRAP (2018) *Courtauld Commitment 2025 Food Waste Baseline for 2015*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Courtauld%20Commitment%202025%20-%20baseline%20report%20for%202015.pdf

Reuse	+	Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The WMPE will support this ambition by seeking to improve the design of materials by promoting the benefits of the circular economy. As such, packaging may be redesigned to be reusable. It is possible that any improvements to material design will minimise water demand; either by reducing demand for virgin material or by developing less water intensive materials. However, the extent of these benefits is not known at this point in time. Any improvements to the design of plastics or textiles – or other materials - may open up new opportunities for the material to be reused. This may remove the plastics from, for example, landfill; providing localised improvements to local waterways through a potential reduction in leachate production. However, the extent of these benefits is not known at this point in time. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling	+	Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The WMPE will support delivery of these targets by exploring the implementation of service improvements. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities. Following consultation on reforming the packaging producer responsibility system, the Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. In addition, following consultation on introducing a DRS in England, the Government intend to introduce a DRS to start no later than 2023. The WMPE will also explore the opportunities to improve the design of materials to improve recyclability at the end of life. The adoption of circular economy principles will facilitate the redesign of any problematic materials. The British Metal Recycling Association states that recycling of steel leads to a 40% reduction in water use, and a 76% reduction in water pollution[240]. The Bureau of International Recycling states that recycling one tonne of paper avoids the use of 26 m3 of water and reduces water pollution by 35%.[241] . The recycling of one tonne of aluminium is reported by an industry organisation to save 15,000 litres of cooling water and 860 litres of processing water relative to primary production[242]. The ambitions and policies outlined in the WMPE will support the increase of recycling and, as a result, a reduction in water demand through a reduced need for virgin materials. Recycling is, however, subject to ensuring adequate sorting technology alongside secure markets for offtakers. As noted by Amey (2018), both domestic processing and reprocessing capacity is needed in England with a potential capacity gap of up to 13Mt. The introduction of a food waste collection service could avoid the need to construct between 1 and 3 energy from waste plants by 2050, saving £400M CAPEX and £1.1BN OPEX for local authorities; and the expected increase in recycling (notably plastics) could avoid the need to build 20 additional incinerators, saving £6.2BN by 2050. Data on water demand at each type of facility is limited and would be dependent upon facility design and specific operations. It is highly unlikely that planning permission would be granted for any plant requiring excessive water requirements in areas where water resources are unduly restricted.

[240] https://www.recyclemetals.org/about-metal-recycling.html
[241] http://www.bir.org/industry/paper/
[242] European Aluminium Association and the Organisation of European Aluminium Refiners and Remelters (2005) *Aluminium Recycling: The Road to High Quality products,* 2005. Available at: http://www.oea-alurecycling.org/de/verband/oea_eaa_aluminium_recycling.pdf

		In terms of siting of new waste management infrastructure, the sites themselves would be identified in the waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste). The development itself would require planning permission (and other environmental consents) which then would either seek to minimise or reduce any adverse effects. Given the localised impacts of the WMPE and waste management upon water systems, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery	+	The WMPE specifies an ambition to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a role in these ambitions as wastes are diverted from landfill sites into EfW infrastructure. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. It is likely that the WMPE ambitions will reduce food waste entering the recovery infrastructure as this is progressively diverted to recycling infrastructure such as AD plants. This is discussed further above. For other materials, it is likely that wastes may be diverted from landfills into recovery plants. This may reduce the potential leachate production in landfill sites that could leach into local water systems. Recovery will include the use of AD facilities to manage an increase in food waste from the proposed separate collections. It is estimated that 60% of food waste, and over 6BN cubic metres of water footprint, could be avoided[235] and the proposed separate food waste collection system could reroute food wastes from landfill into recycling processes. Whilst there are diverging views on future AD capacity needs **Error! Bookmark not defined.**, the WMPE ambitions may lead to a need for increased capacity. Data on water demand at each type of facility is limited and would be dependent upon facility design and specific operations. Available data by the World Energy Council (2010) shows that biomass plants in Europe will demand over 22.9Bm^3 by 2050. Whilst pressure upon water is a localised issue, it is unlikely that any waste infrastructure will pose a significant threat to local availability or quality. It is possible that new sorting and reprocessing capacity will be required in England. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The demand for new capacity may require new infrastructure. Data on water demand at each type of facility is limited and would be dependent upon facility design and specific operations. It is assumed that the proposed EfW infrastructure would be sufficient to meet an ambition of no more than 10% Municipal Solid Waste (MSW) to landfill by 2035, if a 65% MSW recycling rate is achieved by that same year[243]. In terms of siting of new waste management infrastructure, the sites themselves would be identified in the waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and whose development would be subject top SEA and HRA. The development itself would require planning permission (and other environmental consents) which then would either seek to minimise or reduce any adverse effects. Furthermore, it is highly unlikely that planning permission would be granted for any plant requiring excessive water requirements in areas where droughts are common and available water resources limited. Construction activity may increase pressure upon local water supplies. In addition, the vehicle movements associated with the construction and operation of the sites may pose a threat to local water systems through extraction, discharge and pollution. The impact of such risks will be localised and heavily monitored by regulatory bodies; it is therefore a low risk with minimum impacts. Overall, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035.

[243] HM Government (2018). *Our waste, our resources: A strategy for England Evidence Annex*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

		The WMPE states the ambitions to adopt the principles of the circular economy; moving material from landfill into recovery facilities. In addition, the potential for new recycling services, food waste collection systems and a DRS, may divert materials from landfill and into high levels of the waste hierarchy. The reduction in landfill use is a positive outcome of the WMPE objectives and the plans within. Waste infrastructure such as landfills and those managing biowastes have the potential to produce leachate contaminant that if not contained can percolate into surface and groundwater adjacent to the landfill site. The management of leachate is highly controlled and improvements in landfill design have introduced the use of non-porous geotextiles and/or geomembranes for lining and capping the cells within landfill. This approach significantly reduces the potential for leachate to percolate into the adjacent surface and groundwater. However, should leachate escape from the landfill site, the material can have significant effects to surface and ground water and water dependent ecosystems. The localised impact of landfill and waste management infrastructure upon water systems may mean that both the risks, and the benefits on water quality and quantities, from the WMPE may be minimum and localised. However, landfill is not expected to be fully eradicated and the uncertainty of foreign markets for recycling offtakers for active materials may mean that landfill is a necessary interim measure until new markets are developed. In such a scenario, it is likely that highly stringent obligations may be placed upon any new landfill sites however, due to the increasingly steep landfill taxes, it is reasonable to assume that many waste contractors including local authorities, may seek to recover waste in EfW sites opposed to the option to open new landfill sites. In terms of siting of new waste management infrastructure, the sites themselves would be identified in the waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste). The development itself would require planning permission (and other environmental consents) which then would either seek to minimise or reduce any adverse effects. Furthermore, it is highly unlikely that planning permission would be granted for any plant requiring excessive water requirements in areas where droughts are common or in close proximity to river basins. Given the localised impacts of the WMPE and waste management upon water systems, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Cumulative	+	Overall, the WMPE is likely to divert wastes from landfill and into other areas of the hierarchy. The WMPE outlines ambitions to improve the production of materials through adoption of circular economy principles; it also outlines efforts to improve consumer behaviours by promoting opportunities to prevent wastes. Any reduction in textile production and wastage will have a positive impact on water quantity, accessibility and the objectives of the Water Framework Directive. As such, packaging may be redesigned to be compostable, recyclable or reusable. It is possible that any improvements to material design will minimise water demand; either by reducing demand for virgin material or by developing less water intensive materials. A reduction in food waste would reduce water demand. In the UK. It is estimated that 60% of food waste could be avoided[235] , creating over 6BN cubic metres of water footprint. The services included in the WMPE will divert wastes from landfill into the recycling infrastructure. For example, food wastes may be diverted from landfill into AD and other recovery or recycling sites. This could have a long-term beneficial effect on the potential to produce leachate contaminant. Any necessary new infrastructure will have very localised impacts and are not expected to cause any significant changes to water systems. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		

Prevention (increase in prevention of waste streams compared to WMPE)	++	The Direction of Travel aims to exceed the Defra targets, ambitions and the services discussed in the WMPE and at a quicker pace. The ambitions to prevent wastes being generated is a positive move. If this is implemented at a quicker pace within the reasonable alternative, this may quickly reduce demand for raw materials as well as the water demand at waste infrastructure. It will also reduce, or nullify, the need for landfill and the potential damage that leachate can pose to local water systems. Preventing wastes includes eliminating waste by designing products to have no wastes associated with them at all; such as no packaging or where all components can be recovered and reused at the end of life. As noted in the WMPE assessment, materials such as textiles and food have a high-water footprint whilst recycled metals can reduce water demand against virgin material production. The efforts to therefore prevent wastes are a positive move and a speedier achievement of these improvements under the reasonable alternative are to be welcomed. As a consequence of the reasonable alternative, water demand may be reduced through a lower demand for virgin materials and local water systems will be under less threat. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Reuse (increase in reuse of waste streams compared to WMPE)	++	The reasonable alternative seeks to exceed the target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The reasonable alternative assumes that reuse ambitions will be achieved at a quicker rate than the WMPE has outlined. The reasonable alternative assumes that circular economy principles will be adopted in a quicker timeframe. Materials and products may be redesigned to be reused; for example, items can be designed to be modular and requiring replacement of set parts which can then be reused then no longer needed. This may facilitate a significant paradigmatic shift in attitudes and behaviours. Any improvements to the design of plastics – or other materials - may open up new opportunities for the material to be reused. This will remove the plastics from, for example, landfill; providing localised improvements to local waterways through a reduction in leachate production. However, the extent of these benefits are not known at this point in time. Overall, the any increase in reuse opportunities; through product redesign or consumer behaviours, is likely to yield a positive impact on water systems, quality and quantity. As such, the reasonable alternative is likely to have an overall significant positive effects, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling (increase in recycling of waste streams compared to WMPE)	++	As stated in the WMPE assessment above, Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being *recyclable*, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The reasonable alternative assumes that the ambitions of the WMPE will be delivered in a quicker timeframe and where results exceed stated targets. If the reasonable alternative is achieved, this will provide such services at a quicker pace. The reasonable alternative assumes that the measures to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England; to collect food waste separately from all households on a weekly basis; to arrange for garden waste collection; and to introduce a DRS in a timeframe quicker than that in the WMPE (so considered to be within the medium term (within 1 - 6 years). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of the consultation on reforming the packaging producer responsibility system which includes incentives to encourage producers to design and use packaging that can be recycled. The ambitions of the reasonable alternative will provide enhanced services whilst facilitating behavioural changes to delivering new, and cleaner, high value materials. This

		would reduce the water demand for virgin materials, as well as the water lost through the (at present) landfilling of any food wastes in landfill. As noted in the WMPE assessment, it is highly unlikely that planning permission would be granted for any plant requiring excessive water requirements in plant requiring significant water requirements in areas where water resources are unduly restricted. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery (increase in recovery of waste streams compared to WMPE)	++	The WMPE states the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The reasonable alternative therefore seeks to exceed these objectives by exceeding the targets within a speedier timescale. It has been shown that England may require increased recovery capacity however the exact location of this, and the water demand of any such sites, are unknown at this time. It is reasonable to assume however that any new sites will be required to comply with strict local planning conditions to prevent risks to local water supplies and water bodies. As noted previously, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. A quicker adoption of the separate food waste collection could eliminate the need for between 1 and 3 energy from waste plants by 2050 and 20 additional incinerators, by 2050. Additional recycling capacity may be required through increased sorting technologies. However, it is not known how the water demand in a recycling plant would compare to the water demand in a recovery plant. Furthermore, it is highly unlikely that planning permission would be granted for any plant requiring excessive water requirements in areas where water resources are unduly restricted. It is likely that the reasonable alternative will see a more ambitious adoption of the circular economy principles. This will reduce the creation of waste overall by moving wastes up the hierarchy and eliminating some wastes entirely through redesign of materials and products. As such, the reasonable alternative is likely to have an overall positive/negative/neutral effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal (decrease in disposal of waste streams compared to WMPE)	++	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The reasonable alternative will seek to exceed these ambitions at a quicker pace. This will involve a significant shift from current behaviours to improve the rate of recycling and recovery of materials as noted above. A reduced demand upon landfill sites may reduce the potential risks to local water bodies from leachate generation, although this will be dependent on site design, engineering and practice. However, landfill is not expected to be fully eradicated and the uncertainty of foreign markets for recycling offtakers for active materials may mean that landfill is a necessary interim measure until new markets are developed. In such a scenario, it is likely that highly stringent obligations will be placed upon any new landfill sites however, due to the increasingly steep landfill taxes, it is reasonable to assume that many waste contractors including local authorities, will seek to recover waste in EfW sites opposed to the option to open new landfill sites. The reduction in landfill use is a positive effect from the reasonable alternative. As noted in the assessment of the WMPE landfills and those managing biowastes have the potential to produce leachate contaminant that can pollute surface and groundwater adjacent to the

		landfill site. Reduction of waste going to landfills and subsequent closure will overtime reduce any effects and risks associated with leachate production. Overall, the reasonable alternative is likely to divert significant tonnages of wastes from landfill. Whilst landfill may not be eradicated entirely and may continue in use particularly for inert wastes, it can be assumed that the reasonable alternative will see a reduction in landfill use in a reduced period of time with localised benefits to water bodies. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Cumulative	++	Overall, the reasonable alternative is likely to divert significant tonnages of wastes from landfill and into other areas of the hierarchy. It is set to move materials up he hierarchy to provide benefits including; designing out wastes in products, moving wastes from landfill to recovery/recycling and, as a result, facilitating the development of secure markets for new recyclable materials. This may significantly reduce consumer demand for virgin material which is shown to be water intensive. The use of recycled materials, through improved collection systems, will provide a substantial volume of clean and segregated material for reprocessors. Where any reprocessing, or recovery, infrastructure is needed, any necessary new infrastructure may have very localised impacts and are not expected to cause any significant changes to water bodies. Whilst landfill may not be eradicated entirely and may continue in use particularly for inert wastes, it can be assumed that the measures that go beyond the WMPE will push problematic wastes into the recovery sector due to the restrictive and high costs associated with the landfill tax. The redesigning of products to eliminate wastes upfront, as well as the potential opportunities to develop new reusable, recyclable and recoverable waste streams suggest that the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.

Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D5.8 Mitigating Measures

D5.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on water:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).

- The full impact of any new infrastructure should be thoroughly assessed. This should include an assessment of the proposed plant's water resource demand, and whether there are any water availability restrictions which need to be identified and resolved.
- Plants should be required to have emergency preparedness plans to provide operational flexibility during periods of low water availability.
- Strong awareness campaigns could be implemented to encourage participation in any collection services to minimise the water footprint of food wastes as well as within the production of new materials.

D5.9 Uncertainties and Risks

- It is possible that any improvements to material design will minimise water demand; either by reducing demand for virgin material or by developing less water intensive materials however the full extent of this is not known.
- The water footprint for the construction and operation of waste infrastructure is not known. This is likely to vary across the design of individual sites and local conditions.
- Advancements in technologies cannot be predicted and this could impact – positively or negatively – on water demand of future waste infrastructure.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far-reaching impacts on local, national and international practices including the need for, and composition of, future waste management infrastructure. It is therefore difficult to assess the impact that the circular economy will have on local or global water quantity and quality.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.
- Future policies may place restrictions on water availability to such infrastructure in areas of water resource constraint; prioritising supplies for public buildings and householders, for example. This could affect operations.

D6. Air Quality

D6.1 Introduction

D6.1.1 Air quality within this context concerns the levels of pollutants emitted into the air and their significance, in terms of the risk of adverse effects on the environment and/or human health. Air pollution remains a serious cause of respiratory conditions and premature deaths. The main air pollutants of concern[244] are as follows (although not all are discussed in the summary text below):

- Sulphur dioxide (SO_2);
- Oxides of Nitrogen;
- Particulate matter (PM);
- Benzene;
- Carbon monoxide (CO);
- Ozone (O_3);
- Lead;
- Other relevant metallic elements - Nickel, Arsenic, Cadmium, Mercury;
- Benzo[a]pyrene (B[a]P).

D6.1.2 Carbon dioxide (CO2) and other greenhouse gas emissions are excluded from the air quality topic and are reported under the climate change topic.

D6.1.3 There are links between the air quality topic and other topics in the SEA including biodiversity and nature conservation, human health, climatic factors and traffic and transport.

D6.2 Review of plans and programmes

D6.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D6.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to air quality. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

[244] Defra (2010) *Air Pollution in the UK 2010*. Available at: http://uk-air.defra.gov.uk/library/annualreport/viewonline?year=2010_issue_2

Box D6.1 Air Quality Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2008) Air Quality Directive (2008/50/EC) and previous directives (96/62/EC; 99/30/EC; 2000/69/EC & 2002/3/EC)
European Commission (2010) Industrial Emissions Directive (2010/75/EU)
National Plans and Programmes
Department for Food and Rural Affairs (Defra) (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland
Defra (2017) Air Quality Plan for Nitrogen Dioxide (NO_2) in UK
Defra (2019) Air Quality: National Air Pollution Programme
Defra (2019) Clean Air Strategy
HM Government (1990) The Environmental Protection Act (as amended)
HM Government (2010) The Air Quality Standards Regulations 2010 (Amended 2016)
HM Government (2016) Environmental Permitting (England and Wales) Regulations 2016
MHCLG (2019) National Planning Policy Framework (NPPF)

D6.3 Overview of the Baseline

UK

D6.3.1 The UK is compliant with its 2010 national emission ceilings for air pollutants. National emissions totals each year for the main pollutants are reported to the European Commission.

D6.3.2 In 1990 UK emissions of Nitrogen Oxide (NOx) (as NO2) were 2.7 Mt. These emissions reduced to 1.1 Mt in 2011 and subsequently the trend has continued.[245] This has largely been due to the implementation of abatement measures for road transport and at coal-fired power stations. Sulphur dioxide (SO2) emissions in the UK have reduced from 3.7 Mt in 1990 to 0.4 Mt in 2007. This is largely due to the decrease in the use of coal and use of increasingly effective abatement.[246]

D6.3.3 Urban background and roadside particulate pollution has shown long-term improvement however small increases in concentration are observed from 2015 to 2016 for roadside sites. There is some year-on-year variability with a long-term downward trend in urban background and roadside particulate pollution. For background sites the concentration of particulate pollution was similar in 2015 and 2016.[247]

D6.3.4 In 2017, 254 Local Authorities in the UK had declared Air Quality Management Areas (AQMAs), a designation made by a Local Authority where an assessment of air quality results in the need to devise an action plan to improve the quality of air.[248] AQMAs are predominantly in urban areas along busy and congested road networks and are generally related to nitrogen dioxide (NO_2) (in

[245] National Atmospheric Emissions Inventory (2017) *About Nitrogen Oxides*. Available online at: http://naei.defra.gov.uk/overview/pollutants?pollutant_id=6
[246] Defra - AQPI Summary Report: Emissions of Air Quality Pollutants – 1970-2011
[247] Defra (2017) *National Statistics Release: Air quality statistics in the UK, 1987 to 2016*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/610927/Air_Quality_National_Statistic_apr17_FINAL.pdf
[248] https://uk-air.defra.gov.uk/aqma/maps

93% of cases), with particulates (PM10) featuring in 6% of cases and SO_2 in 1%. Transport is identified as the main source of pollution for the clear majority of all AQMAs.[249]

D6.3.5 The UK is divided into 43 zones for ambient air quality reporting. This includes 28 agglomeration zones and 15 non-agglomeration zones. In 2015, two zones had locations where the 1-hour limit value for NO2 was exceeded on more than the permitted 18 occasions during 2015. They were the Greater London Urban Area (UK0001) and South Wales (UK0041). The remaining 41 zones and agglomerations complied with the 1-hour mean NO2 limit value.

D6.3.6 Six zones met the annual mean limit value for NO_2 in 2015:

- Brighton/Worthing/Littlehampton (UK0010);
- Blackpool Urban Area (UK0022);
- Preston Urban Area (UK0023);
- Highland (UK0039);
- Scottish Borders (UK0040);
- Northern Ireland (UK0043).

D6.3.7 The remaining 37 zones had locations with measured or modelled annual mean NO_2 concentrations higher than the annual mean limit value (40 µg m-3).

England

D6.3.8 As of 2017 there are 221 local authorities in England with Air Quality Management Areas (AQMAs), 33 of which were within London.[250] As many Local Authorities have multiple AQMAs, there are a total of 626 AQMAs in England. Most AQMAs in England (and the UK as a whole) are in urban areas and result from traffic emissions of nitrogen dioxide or PM10. Emissions from transport (road and other types) are the main source in 97% of the AQMAs declared for NO_2; only a few have been declared as a result of other sources, such as industrial or domestic emissions.

D6.4 Summary of Existing Problems Relevant to Waste and Resources

D6.4.1 The following existing problems for air quality have been identified with regard to the WMPE:

- Poor air quality is generally associated with urban/industrial areas and major road infrastructure. A relatively large number of AQMAs are located in in urban areas, many of which have been designated due to high NO_2 and PM10 levels.
- Logistical movements for waste collections and associated emissions are a source of airborne pollutants.[251] Whilst the duty of care demands that any waste being transported is secured and covered (to prevent dust release), environmental agencies often note that the delivery and disembarking of waste from vehicles can lead to localised air quality concerns.

[249] Defra (2009) *Review of local air quality management*. Available online at: http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/quality/air/airquality/local/documents/laqm-report.pdf
[250] https://uk-air.defra.gov.uk/aqma/maps
[251] Defra (2018) *Our Waste, Our Resources: A Strategy for England*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf

- Emissions to air from processing and operations includes the release of dust from bulking stations and any combustion gases at energy from waste plants, pyrolysis, anaerobic digestion sites or the flaring of methane at landfills.[252] These could be reduced by keeping materials in use for longer.

D6.5 Likely Evolution of Baseline

UK

D6.5.1 **Figure D6.1** identifies the trends in UK sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and particulate matter (PM10, PM2.5) emissions from 1970 to 2017.

D6.5.2 In 2017, total emissions of NOx were 873 kt, and since 1990, emissions have decreased by 72%. In 2017, total emissions of SO2 were 173 kt, and since 1990, emissions have decreased by 97%. In 2017, total emissions of non-methane volatile organic compounds (NMVOCs) had decreased by 66%[253] when compared to 1990 levels.

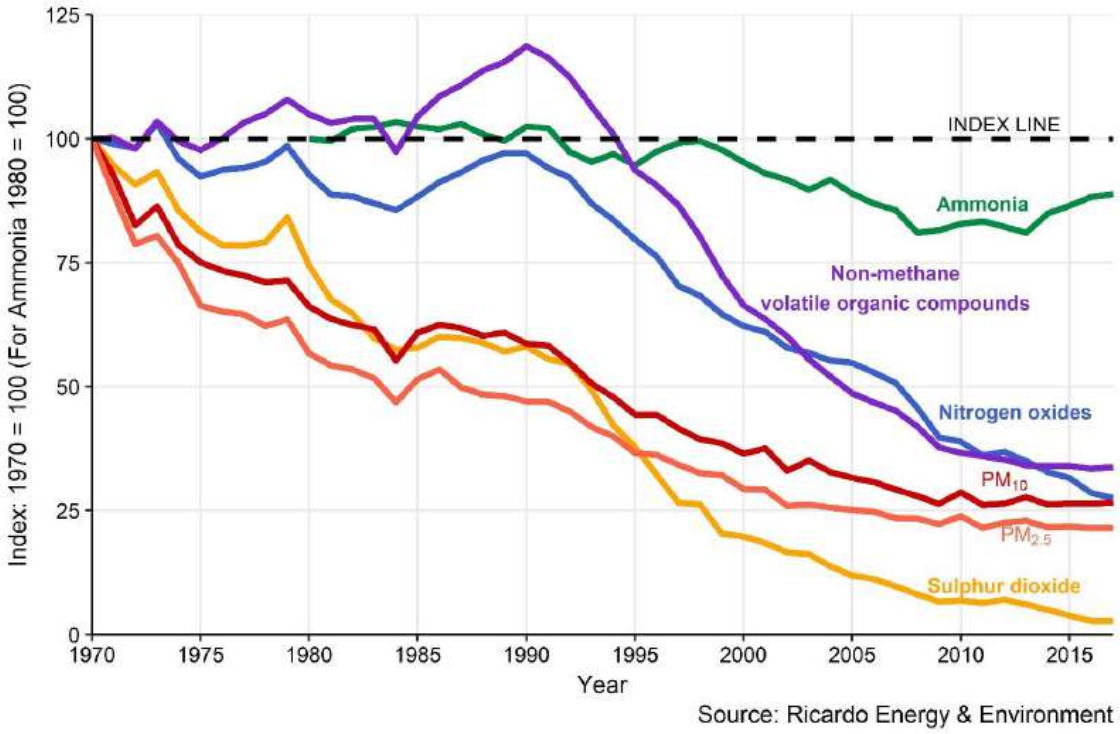
D6.5.3 This is further evidenced by the NOx modelling undertaken for roads directly managed by local authorities and Transport for London. This projected trend did not take into account the effects of the plans itself. The data shows all local authorities achieving the statutory limit for NO2 by 2025, except for Greater London, which would take a further 3 years.[254]

[252] Defra (2013) Waste Management Plan for England: Environmental Report (section 10.3). Available online at: https://consult.defra.gov.uk/waste/https-consult-defra-gov-uk-waste/supporting_documents/Final%20Environmental%20Report_10%206%2013%204.pdf

[253] Defra (2019). Emissions of air pollutants in the UK, 1980 to 2017. Available online at: https://www.gov.uk/government/statistics/emissions-of-air-pollutants

[254] Defra and the DfT (2017) *UK plan for tackling roadside nitrogen dioxide concentrations*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633270/air-quality-plan-detail.pdf

Figure D6.1 UK air quality trend data.



Source: Defra *Emissions of Air Pollutants in the UK, 1970 to 2017.*

D6.5.4 Based on this trend data and in the context of increasingly restrictive legislation with regards to key sources of air pollution, such as from road transport and energy generation, it is reasonable to predict a continued improvement in air quality over time in accordance with the UK Informative Inventory Report (1990 to 2017).[254]

England

D6.5.5 PM_{10} pollution overall has been decreasing in recent years and this is predicted to continue in the future. Concentrations of NO_2 have been declining on average, although London Marylebone Road (the site with the highest NO_2 levels in England) and several other sites are showing increasing concentrations in the most recent years. Long-term trend data combined with increasingly restrictive emissions legislation for road transport would be expected to lead to an improvement in air quality in the long term.

D6.6 Waste Management Effects on Air Quality

Waste Infrastructure

D6.6.1 Air pollution is a major public health risk ranking alongside cancer, heart disease and obesity, and poses the single greatest environmental risk to human health.[255] Air pollution can have detrimental

[255] Defra (2019). Clean Air Strategy 2019. Available online at: https://www.gov.uk/government/publications/clean-air-strategy-2019

effects on habitats and species, as well as acidification of soils and waters, eutrophication and the formation of ground level ozone, all of which can affect ecosystems. Further to this, acidifying emissions to air can cause damage to materials and buildings.[256] The emission of greenhouse gases to air and the associated effects on climate change from waste infrastructure is addressed under Chapter D7 Climatic Factors. Emissions to air occur from waste treatment facilities, depending on the size and type of site and abatement techniques, as well as from waste transport such as collections.

D6.6.2 The National Atmospheric Emissions Inventory (NAEI) provides estimates of the amount of different pollutants that are emitted to air each year from various sectors. Emissions from the waste sector in 2017 are presented in **Table D6.1** below for sulphur dioxide (SO_2), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs), ammonia (NH_3) and particulate matter (PM_{10} and $PM_{2.5}$).[256]

Table D6.1 UK Annual Emissions to Air of SO_2, NOx, NMVOCs, NH_3 and (PM_{10} and $PM_{2.5}$) from the Waste Sector in 2017

	Emissions ('000 tonnes)	% of Total UK Emissions
Sulphur dioxide (SO_2)	0.7	0
Nitrogen oxides (NO_x)	1.5	0
Non-methane volatile organic compounds (NMVOCs)	6.5	1
Ammonia (NH_3)	10.1 [257]	4
Particulate matter (PM_{10})	4.0	2
Particulate matter ($PM_{2.5}$)	3.6	3

D6.6.3 For all of the pollutants, the contribution from the waste sector to the overall UK emissions is low. Ammonia and particulate matter have the greatest contributions to the UK total, although this is still a very low proportion at 4% and below.

D6.6.4 In addition to the above, the UK Informative Inventory Report from the UK National Atmospheric Emissions Inventory (NAEI) Programme identifies that the biological treatment of waste/solid waste disposal on land sector accounted for 9% of the UK emissions for mercury, and the open burning of waste accounted for 8% of the UK's emissions of the dioxins PCDD/PCDF (Polychlorinated dibenzo-p-dioxins/Polychlorinated dibenzofurans). However, the report also confirmed that emissions from the waste sector have a negligible effect on overall UK emissions for most pollutants.[258] Therefore, in the context of national emissions, any effects from emissions to air from waste management are generally expected to have a limited impact, but this may depend on local factors and sensitivities.

D6.6.5 The effects of emissions to air may be greater in locations such as Air Quality Management Areas (AQMAs). 93% of AQMAs relate to nitrogen dioxide, while particulates (PM_{10}) feature in 6% of AQMAs and sulphur dioxide in 1%. Of these, the waste sector makes a non-negligible contribution

[256] Defra (2019) *Emissions of Air Pollutants in the UK, 1970 To 2017: Statistical Release: 15 February 2019.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/778483/Emissions_of_air_pollutants_1990_2017.pdf

[257] This total does not include the ammonia emissions associated with the spreading of digestate.

[258] Ricardo Energy & Environment (2019) *UK Informative Inventory Report (1990 to 2017).* Available online at: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1904121008_GB_IIR_2019_v2.0.pdf

to PM_{10} emissions, around 4.0 kt or 2.3% of UK total in 2017[259], so waste operations in AQMAs designated for PM_{10} could have greater effects on air quality.

D6.6.6 Landfills have the potential for a range of emissions, including acid gases, toxic organic micropollutants, VOCs, particulates and bioaerosols. Landfills can also release odours, and account for 10-25% of odour complaints to local authorities. However, the capping of modern landfills has reduced the likelihood of uncontrolled releases of chemicals, gases and dusts from the landfill site. In addition, abatement technologies such as scrubbers can be used to reduce and control stack emissions consistent with any permitting regulations requirements. Methane emissions from landfill have historically caused concerns, however the decreasing use of landfill, coupled with the robust monitoring of such sites, have lessened this issue.[260]

D6.6.7 Emissions from municipal waste incinerators depend on the composition of the materials incinerated, but may include particulate matter, sulphur dioxide, nitrogen oxides, hydrogen chloride (HCl), carbon monoxide (CO), volatile organic compounds (VOCs), persistent organic pollutants (POPs) including polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals.[261] Public Health England (PHE) has stated that "*modern, well managed incinerators make only a small contribution to local concentrations of air pollutants. It is possible that such small additions could have an impact on health but such effects, if they exist, are likely to be very small and not detectable*".[262] Effects on air quality are therefore expected to be low.

D6.6.8 Emissions to air from composting plants include ammonia, bioaerosols, particulate matter and volatile organic compounds (VOCs).[263] The release of dust, bacteria, fungi and other chemicals such as actinomycetes, endotoxins and 1-3 β glucans can cause respiratory illnesses, however the links between bioaerosols emissions from outdoor composting facilities and local health have been inconclusive. In addition, the spreading of animal manure or compost (particularly compost derived from the treatment of manure in windrows) can release bioaerosols.[264] The 2013 Environmental Report highlights that air pollution impacts are reduced for enclosed composting facilities as abatement equipment such as biofilters and scrubbers can be employed.

D6.6.9 There is the potential for digestate produced as a by-product of the AD process to give off emissions of ammonia and it must be managed, stored and spread according to best practice to minimise emissions. Ammonia reacts with chemicals including transport and industrial emissions to form particulate matter which has a negative impact on human health. When deposited on land, ammonia can acidify soils, natural habitats and freshwaters and overload land and water with nitrogen. These effects reduce biodiversity in sensitive habitats.

D6.6.10 Emissions to air from processing and operations can also include the release of dust from bulking stations, emissions from MBT plant and any combustion gases at energy from waste plants, pyrolysis, anaerobic digestion sites or the flaring of methane at landfills[265]. Abatement equipment

[259] http://cdr.eionet.europa.eu/gb/un/clrtap/inventories/envxguuaa/
[260] Health Protection Agency (2011) *Impact on Health of Emissions from Landfill Sites*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/334356/RCE-18_for_website_with_security.pdf
[261] P. Douglas et al. (2017) *Estimating particulate exposure from modern Municipal Waste Incinerators (MWIs) in Great Britain.* Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6117747/
[262] Public Health England (2014) *Incinerators and public health*. Available online at: https://www.gov.uk/government/publications/incinerators-and-public-health
[263] ERM (2011) *WR 0608 Emissions from Waste Management Facilities*. Available online at: http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15234
[264] L. Giusti (2009) *A review of waste management practices and their impact on human health.* Waste Management 29 (2009) 2227–2239
[265] Defra (2013) *Waste Management Plan for England: Environmental Report* (section 10.3). Available online at: https://consult.defra.gov.uk/waste/https-consult-defra-gov-uk-waste/supporting_documents/Final%20Environmental%20Report_10%206%2013%204.pdf

can be used to reduce emissions.[266] The effects of any remaining emissions to air could be further reduced by keeping materials in use for longer and avoiding disposal.

D6.6.11 Emissions from waste management sites are controlled through environmental permitting regulations. If the waste management activities are specified in either Industrial Emissions Directive 2010/75/EU or Directive 91/271/EEC, any new activities need to be consistent with the best available techniques (BAT) reference document (BREF) on Waste Treatment[267], which details techniques for preventing or minimising emissions and impacts on the environment.

D6.6.12 While well-managed sites are expected to generally have limited emissions to air in line with environmental permitting requirements, pollution incidents to air still occur. In 2015, there were 97 serious pollution incidents affecting air, with 53 these incidents arising from the biowaste treatment, non-hazardous waste treatment and waste treatment (metals recycling) sectors. The majority of these incidents to air were caused by permitted activities. Factors contributing to air pollution incidents at waste sites include poor management, storage, design or maintenance, including treating waste in excess of the site capacity. 43 of the air incidents from the waste sector in 2015 involved the pollutants that can affect amenity, smoke, dust, noise and odour (the latter two accounting for the majority of the amenity incidents).[268]

D6.6.13 Air quality is sensitive to changes in traffic volume and emissions from other sources such as construction plant and machinery. Logistical movements for waste collections and associated emissions are a source of airborne pollutants.[269,270] The waste duty of care code of practice[271] demands that any waste being transported is secured and covered (to prevent dust release), however, this can lead to localised air quality concerns.

D6.6.14 There is also the potential for significant level of dust and other emissions to arise during the construction phase of any new waste management infrastructure, which may have a detrimental effect on air quality. The scale of any effects would depend on the type and location of facility, and any mitigation measures put in place.

Materials Use

D6.6.15 The use of resources requires materials and energy for the extraction of raw materials, transportation and the manufacture of goods. The extraction of primary raw materials and manufacturing activities can have effects on air quality, which extend consideration outside the UK to reflect a lifecycle approach to the effects of waste. Application of the waste hierarchy through

[266] European Commission (2018) *Best Available Techniques (BAT) Reference Document for Waste treatment*. Available online at: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-waste-treatment-industrial-emissions
[267] European Commission (2018) *Best Available Techniques (BAT) Reference Document for Waste treatment*. Available online at: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-waste-treatment-industrial-emissions
[268] Environment Agency (2016) *Pollution incidents: 2015 evidence summary*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/651707/Pollution_incidents_2015_evidence_summary_LIT_10487.pdf
[269] WRAP & CIWM (2009) *Scoping study of potential health effects of fortnightly residual waste collection and related changes to domestic waste systems*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Scoping%20study%20of%20potential%20health%20effects%20of%20fortnightly%20waste%20collection%20Final1.pdf
[270] Defra (2018) *Our Waste, Our Resources: A Strategy for England*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf
[271] Defra (2016). *Waste duty of care code of practice*. Available online at: https://www.gov.uk/government/publications/waste-duty-of-care-code-of-practice

the avoidance of waste generation and the reuse or recycling of materials therefore has the potential for beneficial effects on air quality though avoided manufacture and extraction.

D6.6.16 As identified in the 2013 Environmental Report, these effects may occur outside the UK, reflecting the UK's dependency on imported products from elsewhere. However, food waste was identified as a waste stream with a significant proportion of avoidable waste relating to UK based manufacture, suggesting that food waste prevention activities have the potential for a positive impact on UK air quality from avoided production emissions.[272]

D6.6.17 The prevention of waste, and the reuse of products and recycling (which avoid the need for primary manufacture) also have the potential to save energy and avoid emissions to air associated with energy generation. [273] This may have benefits for air quality depending on the locations involved and the source of energy generation, which may occur outside the UK.

D6.6.18 The primary production of certain metals involves the release of acidifying gases such as SO2 and NOx. These can have a corrosive impact on soil, water, ecosystems and buildings. The OECD highlights that the acidifying emissions to air are typically higher for primary production than secondary (recycled materials). Of the materials investigated in the OECD report, primary production of copper had by far the greatest emissions of acidifying gases to air per kilogram of material. This is substantially reduced for secondary production, but still notably higher than for primary or secondary production of all other metals in the study.

D6.6.19 The 2013 Environmental Report contains data from the WRATE database on the air pollution impacts of the main dry recyclate streams (**Table D6.2**). This identified a relatively large pollution reduction potential associated in particular with the recycling of metals, whilst benefits associated with recycling aggregate were relatively minor. In both cases, benefits were assumed to be largely related to the energy requirements associated with the manufacturing / extraction process.

Table D6.2 Air Pollution Impacts Per tonne of Recyclate

Substance	Units	Quantity of pollutant per tonne of recyclate					
		Paper	Dense plastic	Glass (closed loop)	Ferrous	Non ferrous	Aggregate
NH_3	G	-9.92	6.29	-159.00	-68.00	-145.00	-0.99
VOCs	G	-43.10	-3,540.00	-24.60	-248.00	-2,200.00	-26.60
$PM_{2.5}$	G	-99.90	-401.00	-190.00	-779.00	-4620.00	-0.75
SOx	G	-7.35	7.11	-30.70	-7.35	-7.35	-46.90
NOx	G	-918.00	-5,680.00	-296.00	-2,700.00	-18,000.00	0.00
Cd	mg	4.80	0.88	-6.58	-26.10	269.00	0.00
Cr	g	-0.10	0.07	-0.43	-0.17	-1.12	-0.01
Hg	mg	4.26	-196.00	-7.78	-88.30	1,180.00	-0.82
Ni	g	0.02	0.04	-0.08	-0.43	-3.53	-0.01
Pb	g	0.02	0.02	-0.15	-3.58	39.60	-0.01

[272] WRAP / WWF (2011) *The Water and Carbon Footprint of Household Food and Drink Waste in the UK, Final Report.* Available online at: *https://waterfootprint.org/media/downloads/Water-and-carbon-footprint-food-and-drink-waste-UK-2011_1.pdf*

[273] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Technical Annex*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

Substance	Units	Quantity of pollutant per tonne of recyclate					
		Paper	Dense plastic	Glass (closed loop)	Ferrous	Non ferrous	Aggregate
Dioxin	ng	-0.0004	-0.0003	-0.0003	-0.0004	-0.0004	-0.0001
As	g	-0.02	0.01	-0.03	-0.02	0.67	0.00

Source: WRATE, in 2013 Environmental Report

D6.6.20 As a result, the application of the waste hierarchy to increase recycling, and keeping materials in use for longer or avoiding the need for raw materials, can therefore reduce emissions to air by avoiding the need for extraction of raw materials.[274] However the location of any benefits would be dependent on the location of primary and secondary activities, and the sensitivity of local environments.

D6.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D6.7.1 **Table D6.3** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D6.3 Assessment of the Draft WMPE and reasonable alternative

Air Quality		
To minimise emissions of pollutant gases and particulates and enhance air quality.		
• Will the draft WMPE affect air quality? • Will the draft WMPE create a nuisance for people or wildlife (from dust or odours)? • Will the draft WMPE increase traffic movements and provide a detrimental effect to those living near principal routes?		
	Effect	**Commentary**
WMPE		
Prevention	?	The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery. It is possible that reductions volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. It is possible that the new service will require new fleets to collect and transport separated materials to recycling, composting or recovery sites. This

[274] OECD (2019) *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*. Available online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page1

		presents the opportunity for increases in electric vehicles and hybrid vehicles[275], however the uptake and therefore reduction in emissions cannot be quantified at this stage. The uptake of electric and hybrid vehicles cannot be certain and the effects of redistribution of waste collections cannot be quantified. As such, the WMPE is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+/?	The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material (potentially in the home). An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods, therefore potentially having a significant reduction in emissions such as NO2, PM10 and SO2 which cause air pollution. In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by businesses that can use the byproducts from other processes. As such these reusers will generate new vehicle movements, and therefore emissions, between reusers. These waste vehicle movements would require new fleets. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. As such, the WMPE is likely to have an overall positive effect (with some uncertainty), relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	?	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes (this could be recycled through composting, or AD). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities. Following consultation on reforming the packaging producer responsibility system, the Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. In addition, following consultation on introducing a DRS in England, the Government intend to introduce a DRS to start no later than 2023. If recycling is increased by diverting material from waste collection e.g. as a result of separate food waste collections, it is possible that reductions in residual waste collection fleets would be matched by an increase in additional movements from recycling fleets. It is also possible that the new service will require new fleets to collect and transport separated materials to composting or recovery sites. This presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. The WMPE will support the recycling of such material; however, Tolvik (2017) highlight that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Constructing and operating these sites within AQMAs could have significant impacts on the air quality in the local area. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on air quality, would be minimised, reduced or mitigated.

[275] E.g. https://www.driving.co.uk/news/daf-electric-lorry-delivered/ and https://www.autocar.co.uk/car-news/new-cars/tesla-semi-electric-lorry-launch-pushed-back-2020

		If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. The WMPE reiterates interest in implementing a DRS in England. Whilst this will improve recycling, it is possible that the new service will require new vehicles to collect and transport materials to counting and bulking sites (although to a degree this will reflect how it is implemented). In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements and therefore emissions, as there are few comparable circumstances to its implementation in England; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that such trips would be combined with other journeys, depending on the location of the DRS facilities. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. However, the introduction of new waste infrastructure sites and therefore fleets further presents an opportunity for the introduction of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage.. Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The WMPE will support this ambition by seeking to improve the design of materials by promoting the benefits of the circular economy. As such, packaging will be redesigned to be compostable, recyclable or reusable. Any improvements to the design of plastics will open up new opportunities for the material to be reused. This will remove the plastics from landfill minimising emissions from landfill which affect air quality. Diverting waste from landfill and incineration by increasing recycling will have a positive effect on air quality in general. While there is a potential increase in emissions associated with the deliver and disembarking of waste, it is considered that the reduction in emissions from landfill and incineration would outweigh this. There are uncertainties regarding the location of new recycling facilities required to meet the capacity gap and the potential uptake of electric and hybrid vehicles. As such, the WMPE is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	**?**	The WMPE seeks to improve recovery of materials; both by diverting wastes from landfill into recovery and diverting material from recovery into reuse and recycling. Recovery includes the use of AD technologies as well as EfW incineration.The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. As the plan reiterates key targets - to cut municipal solid waste to landfill to just 10% by 2035. It is likely that landfilled wastes will move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise emissions resulting from localised transport and "exporting" of wastes to other communities. However, Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the air quality impacts. Constructing and operating these sites within AQMAs could have significant impacts on the air quality in the local area. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the

		National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on air quality, would be minimised, reduced or mitigated. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore vehicle emissions, as recovery sites source alternative feedstock (potentially from further afield). For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. A by-product of AD is digestate that can be used as a nutrient-rich fertiliser, however when stored or spread on land releases ammonia, an air pollutant that has negative impacts on human health and the environment. Government has committed, through the Clean Air Strategy to introducing legislation, to require digestate in England to be spread using low-emission spreading equipment by 2025, and digestate stores to be covered by 2027. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, air quality. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; however, this will be dependent on location, design, setting and construction and operational activities. As such the WMPE is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+/?	The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut waste to landfill to just 10% by 2035. The services, ambitions and policy framework within the WMPE will reasonably reduce demand for current and future landfill sites as well as other disposal infrastructure. The exact extent to which disposal demand may drop, or the impact the WMPE may have on future disposal and landfill numbers, is not known at this time. The closure of any landfills due to a reduction in demand could provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. A reduction in the use of landfill and shift towards rese, recycling and set out in the WMPE will allow for emissions and odour from the waste sector as a whole to be reduced (as the emissions from landfill will reduce) resulting in a positive effect on air quality. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; this will be dependent on location, design, setting and construction and operational activities. As such the WMPE is likely to have an overall positive effect (with some uncertainty), relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+/?	Overall, the WMPE brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to

		facilities that are further away than current infrastructure, until new facilities are constructed to address the capacity gaps. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve, and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the air quality impacts. Constructing and operating these sites within AQMAs could have locally significant impacts on the air quality in the local area (e.g. PM10, reflecting the reasons for designating the AQMA), however locating these sites outside AQMAs is likely to have lower impacts. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on air quality, would be minimised, reduced or mitigated. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore emission, as recovery sites source feedstock from further afield. The WMPE requires the movement of wastes from landfill towards other infrastructure. Flaring of methane at landfill sites can have a negative impact on air quality[252]. The movement of wastes up the hierarchy will have a positive impact on air quality by reducing emissions and odours from landfill operation. It is considered that with the measures put in place to meet the requirements of local planning authorities, the shift towards other waste management options and therefore the construction of new sites would have a positive impact on air quality when compared to landfill. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; this will be dependent on location, design, setting and construction and operational activities. As such, the WMPE is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	**?**	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery. It is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. It is possible that the new service will require new fleets to collect and transport separated materials to recycling, composting or recovery sites. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions affecting air quality cannot be quantified at this stage.

		The uptake of electric and hybrid vehicles cannot be certain and the effects of redistribution of waste collections cannot be quantified. As such the reasonable alternative is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	+/?	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material (potentially in the home). An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods, therefore potentially having a reduction in pollutant emissions. In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by businesses that can use the byproducts from other processes. As such these reusers will generate new vehicle movements, and therefore emissions, between reusers. These waste vehicle movements would require new fleets. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. Achieving reuse of materials at a quicker rate would result in a reduction in emissions sooner, however this could be affected by availability of appropriate electric and hybrid vehicles. As such the reasonable alternative is likely to have an overall positive effect (with some uncertainty), relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	?	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE. The 'Direction of Travel' reasonable alternative assumes that the measures to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England; to collect food waste separately from all households on a weekly basis; and to arrange for garden waste collection are implemented in a timeframe quicker than that in the WMPE (so considered to be within the medium term (within 1 - 6 years). As noted in the assessment of the WMPE above, Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system which includes incentives to encourage producers to design and use packaging that can be recycled. For the reasonable alternative it is likely that the same impacts will be encountered with regard to emissions and odour affecting air quality. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the air quality impacts. Constructing and operating these sites within AQMAs would have significant impacts on the air quality in the local area, however locating these sites in less vulnerable areas would have significantly lower impacts. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental affects including effects on air quality would be minimised or reduced as far as is practicable. These new facilities will require new fleets and this presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage.

		Assuming that a DRS in implemented in England and within a short timeframe, the new service could require new fleets to collect and transport materials to counting and bulking sites. In addition, as no DRS has been implemented in a nation with a household recycling service, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements, and therefore emissions; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that these journeys will be combined with other trips (depending on the location of collection points). Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. However, the introduction of new waste infrastructure sites and therefore fleets further presents an opportunity for the introduction of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. It is likely that the Direction of Travel reasonable alternative will see a more ambitious adoption of the circular economy principles. This will reduce the creation of waste overall by moving wastes up the hierarchy and eliminating some wastes entirely through redesign of materials and products. This will likely reduce emissions associated with waste processing, disposal and transportation. Given the timeframes needed to develop and build additional waste infrastructure, it is therefore likely that the Direction of Travel ambitions could have an uncertain effect on the SEA objectives due to uncertainties with the location of new facilities and the potential for use of electric and hybrid vehicles.
Recovery (increase in recovery of waste streams compared to WMPE)	**?**	The 'Direction of Travel' reasonable alternative seeks to improve the rate of recovery. This refers to materials that were previously landfilled and that have now moved up the hierarchy to recovery level. It also considers the removal of material from the recovery stage, to the recycling stage, which is possible in the event of improved recycling services and identification of new offtakers or reprocessors. The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise emissions resulting from localised transport and "exporting" of wastes to other communities. However, Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Constructing and operating these sites within AQMAs could have significant impacts on the air quality in the local area. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on air quality, would be minimised, reduced or mitigated. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore vehicle emissions, as recovery sites source alternative feedstock (potentially from further afield).

		For food waste, any increase in processing above that anticipated by the WMPE could lead to an increase in the digestate by-product of AD which can be used as a nutrient-rich fertiliser, which can be a source of ammonia. However, the Government has committed, through the Clean Air Strategy to introducing legislation, to require digestate in England to be spread using low-emission spreading equipment by 2025, and digestate stores to be covered by 2027. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on, air quality. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; however, this will be dependent on location, design, setting and construction and operational activities. As such the reasonable alternative is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal (decrease in disposal of waste streams compared to WMPE)	+/?	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut municipal solid waste to landfill to just 10% by 2035. These targets will lead to a reduction in need and capacity for disposal. The closure of any landfills due to a reduction in demand will provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. A reduction in the use of landfill and shift towards rese, recycling and recovery in a quicker timeframe than set out in the WMPE will allow for emissions and odour from the waste sector as a whole to be reduced resulting in a positive effect on air quality. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; this will be dependent on location, design, setting and construction and operational activities. As such the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+/?	Overall the 'Direction of Travel' reasonable alternative brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy at a quicker pace than the WMPE proposes. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed to address the capacity gaps. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve, and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. Location of this new infrastructure will be critical in determining the air quality impacts. Constructing and operating these sites within AQMAs could have significant impacts on the air quality in the local area. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects, including effects on air quality, would be minimised, reduced or mitigated. If the waste management infrastructure capacity gap can be met, the decrease in incineration and landfill of waste will have a positive effect of air quality by reducing emissions associated with such waste management facilities. However, there could be increased emissions to air from vehicle movements used in the collection, transfer and storage of waste materials. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This

		may then require increased traffic movements and therefore emission, as recovery sites source feedstock from further afield. The WMPE requires the movement of wastes from landfill towards other infrastructure. This will have a positive impact on air quality by limiting emission and odour from landfill which impact local air quality. The potential for increased waste movements in AQMAs could have a negative impact in these areas which are vulnerable to changes in emissions. It is assumed that the local planning process will ensure that any new waste management sites seek to minimise and eliminate environmental impacts wherever possible limit the impact on air quality. It is considered that with the measures put in place to meet the requirements of local planning authorities, the shift towards other waste management options and therefore the construction of new sites would have a positive impact on air quality when compared to landfill. However, where new infrastructure is required to meet the requirements of the targets, there may be localised effects on air quality, especially if located with an AQMA; this will be dependent on location, design, setting and construction and operational activities. As such, the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions

Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D6.8 Mitigating Measures

D6.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on air quality:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Uptake of use of electric vehicles wherever possible for waste collection and transportation, subject to feasibility, applicability and cost.
- Uptake of renewable energy sources to power waste management sites wherever possible. This could include on-site electricity generation.
- Monitoring of odour and emissions from waste management sites including the delivery and disembarking activities, as appropriate under environmental permitting requirements.

- Avoiding AQMAs wherever possible for collection and waste management sites and ensuring monitoring is in place where no more preferable alternative is possible, as appropriate under environmental permitting requirements.[276]

D6.9 Uncertainties and Risks

- The level and type of product which would be reused cannot be quantified at this stage, and therefore the reduction in manufacturing and waste collections also cannot be quantified.
- The level on investment and infrastructure required to close the waste management gap when diverting waste from landfill is not known at this stage.
- The type of infrastructure which will be built to close this gap is also not knows at this stage, however it is likely to be a combination of recycle and recovery sites.
- The extent that emissions from vehicles will change as a result of schemes e.g. the DRS scheme is not known at this stage.
- The uptake of electric and hybrid vehicles is unknown at this stage.
- It is expected that to achieve the SEA objectives more quickly, the infrastructure construction would significantly intensify, however, this cannot be quantified.
- The locations of new waste management infrastructure are unknown. This results in uncertainties regarding how the site construction will affect air quality and the impact in waste transportation distances.

[276] In this regard, it is noted that one of the criteria in the National Planning Policy for Waste (2014) location criteria states "*Considerations will include the proximity of sensitive receptors, including ecological as well as human receptors, and the extent to which adverse emissions can be controlled through the use of appropriate and well-maintained and managed equipment and vehicles*".

D7. Climatic Factors

D7.1 Introduction

D7.1.1 UK total greenhouse gas (GHG) emissions from waste were 20.3 MtCO2e in 2017[277], representing 4.4% of the UK's total. Methane emissions from the decomposition of biodegradable waste in landfill sites accounted for the majority of these emissions (92%), while the treatment of waste water and the biological treatment, composting and incineration of waste were also key sources of emissions for the sector.[278]

D7.1.2 Climate change within this context is concerned with increasing the likelihood of climate change effects through greenhouse gas emissions, and the ability to adapt to the effects of climate change such as the occurrence of more extreme weather events.

D7.1.3 There are links between climate change and the majority of other topics in the WMPE including biodiversity and nature conservation, land use, geology and soil, water quality and quantity, human health, flood risk, traffic and transport and air quality.

D7.2 Review of plans and programmes

D7.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D7.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to climatic factors. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D7.1 Climatic Factors Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2009) Renewable Energy Directive (2009/28/EC)
European Commission (2011) A Resource- Efficient Europe- Flagship Initiative Under the Europe 2020 Strategy, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (COM 2011/21)
European Commission (2013) Seventh Environmental Action Programme to 2020 'Living well, within the limits of our planet' (Decision No. 1386/2013/EU)
European Commission (2013) Strategy on Adaptation to Climate Change
European Commission (2014) A Policy Framework for Climate and Energy in the Period from 2020 to 2030
United Nations Climate Change Conference (UNCCC) (2011) The Cancun Agreements
UNFCCC (1997) The Kyoto Protocol to the UNFCCC
UNFCCC (2016) The Paris Agreement
National Plans and Programmes
Committee on Climate Change (2017) UK Climate Change Risk Assessment

[277] BEIS (2019) *Final UK greenhouse gas emissions national statistics 1990-2017*. Available online at: https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics
[278] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

Box D7.1 Climatic Factors Plans and Programmes Reviewed for the SEA of the Draft WMPE
Department of Energy and Climate Change (DECC) (2009) The UK Low Carbon Transition Plan: National Strategy for Climate and Energy
DECC (2012) UK Bioenergy Strategy
Defra (2013) The National Adaptation Programme – Making the Country Resilient to a Changing Climate
HM Government (2003) Sustainable Energy Act
HM Government (2008) The Climate Change Act 2008
HM Government (2009) The UK Renewable Energy Strategy
HM Government (2011) Carbon Plan: Delivering our Low Carbon Future
HM Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019
MHCLG (2019) National Planning Policy Framework (NPPF)

D7.3 Overview of the Baseline

International

Climate

D7.3.1 The UNFCCC, Paris Agreement and other international measures to combat climate change are influenced by regular reports from the Intergovernmental Panel on Climate Change (IPCC). The IPCC's Fifth Assessment Report[279] (referred to as AR5) provides the most up to date view of scientific knowledge regarding climate change and in summary concludes that:

- unprecedented atmospheric concentrations of carbon dioxide, methane and nitrous oxide, resulting from industrial activities including fossil fuel combustion, are "extremely likely to have been the dominant cause of the observed warming since the mid-20th century". Total anthropogenic greenhouse gas (GHG) emissions were the highest in human history from 2000 to 2010 and the energy supply sector generated 25% of total GHG emissions in 2010; and
- climate change risks and impacts "can be reduced by limiting the rate and magnitude of climate change". AR5 calls for low carbon energy technologies to generate more than 80% of electricity by 2050 and for unabated fossil fuel generation to be virtually phased out by 2100.

D7.3.2 The report also identifies certain impacts that climate change has already had on freshwater ecosystems, for example, many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change.

UK

Climate

D7.3.3 The UK is presently influenced by predominantly westerly tracking storm systems throughout the year. Variations in temperature, precipitation and wind speeds may be partly accounted for by exposure, latitude and altitude. The surrounding seas also have a significant effect on the national and local weather conditions. The temperatures of air masses reaching the UK have been modified

[279] Intergovernmental Panel on Climate Change (2015) *Synthesis Report - Summary for Policymakers*. Available online at: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

by the ocean such that the UK tends to experience lower summer temperatures than mainland Europe, but milder winters.

D7.3.4 The UK has been getting warmer as a result of a changing climate. Temperature in Central England was around 1°C warmer in the most recent decade (2008-2017) than the pre-industrial period (1850-1900). This is consistent with warming that has been observed at a global scale, of around 1°C since pre-industrial times. Nine of the ten warmest years on record for the UK have also occurred since 2002.[280] Additionally, the UK has been getting wetter, with average annual rainfall increasing in the last few decades, and summers in particular experiencing an increase in rainfall. Changes have been most significant for Scotland.[281]

D7.3.5 Sea levels are rising, and are greater in the south of the UK than the north. Sea level around the UK has risen by about 16cm since the start of the 20th century (when corrected for land movement).280. Globally, sea level is rising at about 3mm per year, and global average temperatures are rising at about 0.15-0.18ºC per decade.[282]

D7.3.6 The number and severity of windstorms have not shown a particular trend over recent decades.

D7.3.7 More specifically, the following observations can be made:[281, 283]

- In the recent past, the UK temperature over the most recent decade (2008-2017) has been on average 0.8°C warmer than 1961-1990.
- There has been an increase in annual average rainfall over the UK, particularly in Scotland for which the most recent decade (2008-2017) has been on average 4% wetter than 1981-2010 average. Summers in the UK have been on average 17% wetter than 1981-2010, however, very long-period natural variations are seen in the longer observational record.
- Mean sea level around the UK has risen by approximately 1.4 mm/year from the start of the 20th century, when corrected for land movement
- Sea-surface temperatures around the UK coast have risen to be on average 0.6°C warmer than 1961–1990.
- The most recent decade (2008–2017) has had 15% fewer days of air frost and 14% fewer days of ground frost compared 1961–1990.

D7.3.8 The second UK Climate Change Risk Assessment (CCRA2) Evidence Report (2017)[284] reviews a range of evidence sources, and concludes that climate change is already affecting both the natural and built environments across the UK.

[280] Met Office (2019) *UKCP18 Headline Findings*. Available online at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-headline-findings.pdf
[281] Royal Meteorological Society (2018) *State of the UK climate 2017.* Available online at: https://rmets.onlinelibrary.wiley.com/doi/10.1002/joc.5798
[282] American Meteorological Society (2018) *State of the Climate in 2017: Special Supplement to the Bulletin of the American Meteorological Society Vol. 99, No. 8, August 2018*. Available online at: https://journals.ametsoc.org/doi/pdf/10.1175/2018BAMSStateoftheClimate.1
[283] Met Office (2019) *UKCP18 Science Overview: Executive Summary*. Available online at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-overview-summary.pdf
[284] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017: CCRA2 Evidence Report*. Available online at: https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/

Energy

D7.3.9 The Digest of UK Energy Statistics 2018[285] provides the latest official statistics regarding energy generation/production capacity and consumption across the UK in 2017. Key statistics of relevance include:

- In 2017 primary energy production rose by 0.4 per cent compared with a year earlier. Growth was driven from wind, solar and hydro, bioenergy and waste.
- Final energy consumption fell by 0.7%, as demand for heating decreased.
- Fossil fuels now account for only 80.1% of total energy supply; a record low. Generation of energy from coal fell by 27% and gas fell 4.6%
- Energy generated from renewables increased by 29.3%

Greenhouse Gas (GHG) Emissions

D7.3.10 The Climate Change Act 2008 prescribes that the UK's GHG inventory covers the six direct greenhouse gases under the Kyoto Protocol, namely:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF_6).

D7.3.11 These gases contribute directly to climate change owing to their positive radiative forcing effect. HFCs, PFCs and SF6 are collectively known as the 'F-gases'. In general terms, the largest contributor to global warming is CO2 which makes it the focus of many climate change initiatives. Methane and nitrous oxide contribute to a smaller proportion, typically <10%, and the contribution of F-gases is even smaller (in spite of their high Global Warming Potentials) at <5% of the total. The Climate Change Act 2008 and amendments require a 100% reduction (compared to 1990 levels) in the UK's 'net carbon account' by 2050, covering all six of the individual greenhouse gases listed above.

D7.3.12 Official statistics regarding greenhouse gas emissions covered under the Climate Change Act 2008 were provided by the Department for Business, Energy & Industrial Strategy for 2015 in the Annual Statement of Emissions.[286] This statistical publication notes that:

- In 2015, UK net carbon account emissions were estimated to be 467.5 million tonnes carbon dioxide equivalent ($MtCO_2e$). This was 9.1 percent lower than the 2014 figure of 514.4 million tonnes and 16.8 percent lower than the 2013 figure of 557.3 million tonnes.
- Between 2013 and 2014, the largest decreases came from the energy supply sector, down 13.6 percent (25.7 $MtCO_2e$) due to a decrease in the use of coal for electricity generation; and the residential sector, down by 17.0 percent (13.1 $MtCO_2e$) due to a reduction in use of natural gas

[285] BEIS (2018) *Digest of UK Energy Statistics 2018*. Available online at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2018-main-report

[286] Department for Business, Energy & Industrial Strategy (2017) Annual Statement of Emissions for 2015. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/604377/Annual_Statement_of_Emissions_for_2015.pdf

for space heating. Demand for heating was lower in 2014 due to the temperature being 1.2 degrees Celsius warmer on average than 2013.

- Carbon dioxide (CO_2) is the main greenhouse gas, accounting for 82 percent of total UK greenhouse gas emissions in 2014. In 2014, UK net emissions of carbon dioxide were estimated to be 422.0 million tonnes (Mt). This was around 8.9 percent lower than the 2013 figure of 463.3 Mt. Around half of this decrease was due to 2014 being a warmer year than 2013.
- For the purposes of carbon budgets reporting, UK greenhouse gas emissions in 2014 were 455.6 $MtCO_2e$ which is 100.8 MtCO2e below the average annual emissions required to meet the second carbon budget (2013-2017).

D7.3.13 The Committee on Climate Change's Net Zero report[278] highlights that UK GHG emissions from the waste sector have decreased overall by 70% from 1990 to 2017. This is largely due to a reduction in biodegradable waste going to landfill, investment in methane capture technology and improved management at landfill sites. However, there was a slight increase in 2017 compared to 2016 of 0.3 $MtCO_2e$ (1.5%) due to higher emissions from landfill and waste water treatment.

D7.3.14 Methane emissions from the decomposition of biodegradable waste in landfill sites was the largest contributor to the waste sector's GHG emissions. Methane emissions can be prevented through methane capture and biogas combustion technologies, flaring or through natural oxidisation. It is estimated that 59% of methane was captured across the whole landfill population in the UK in 2017.[278] Methane capture can reach as high as 90% in modern facilities, depending on the nature of the site and its technology.

D7.3.15 Emissions from composting, anaerobic digestion and mechanical biological treatment, which are options for treating biodegradable waste diverted from landfill, were 1.8 $MtCO_2e$ in 2017 (0.4% of waste emissions). Emissions from incineration of municipal solid waste without energy recovery were 0.3 $MtCO_2e$ in 2017, which was highlighted by the Committee on Climate Change as being a low and declining source of emissions.[278]

England

D7.3.16 Greenhouse Gas inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2014 (2017)[287] presents estimates of greenhouse gas (GHG) emissions for the UK Devolved Administrations (DAs): England, Scotland, Wales and Northern Ireland.

D7.3.17 With specific regard to England, it had a 76% share of total net UK GHG emissions in 2015. England has seen a decrease of 41% in greenhouse gas emissions between 1990 and 2015 with a reduction of approximately 5% between 2014 and 2015. This has predominantly driven by a reduction in emissions from the use of coal in the power generation sector and natural gas in the residential sector, with a reduction in emissions from anaerobic managed waste disposal sites also making a substantial contribution. GHG emissions for England in 2015 totalled 368 $MtCO_2e$, with the dominant emission sources being electricity production (21% of total GHG emissions), cars (15%), residential combustion for heating and cooking (14%). Key sectoral trends in England up to 2015 were:

- Emissions from the energy supply sector decreased by 54% between 1990 and 2015, with a 19% decrease in overall emissions between 2014 and 2015. This decrease was mainly due to a reduction in the use of coal in the power generation sector.

[287] Ricardo Energy & Environment for the Department of Energy and Climate Change, The Scottish Government, The Welsh Government and The Northern Ireland Department for Agriculture, Environment and Rural Affairs (2017) *Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2015. 2017.* Available online at: http://naei.defra.gov.uk/reports/reports?report_id=932

- Emissions from the industrial process sector decreased significantly since 1990 by 84% mainly as a result of a declining chemical and fluorocarbon production industry.
- A reduction in biodegradable waste going to landfill, investment in methane capture technology and improved management at landfill sites have led to a significant reduction in emissions since 1990.[278]
- Emissions from the business sector reduced by 24% since 1990 as a result of reduced emissions in manufacturing industries (led by chemicals, non-ferrous metals and other manufacturing) through industrial decline and efficiency improvements. Emissions have recently remained relatively stable, decreasing by 2% between 2014 and 2015.
- Emissions from the residential sector decreased by 15% since 1990 as a result of a switch from less efficient solid and liquid fuels to natural gas for heating, and improvements in energy efficiency.
- Emissions from the agricultural sector reduced by 20% since 1990 mainly due to reductions in fertiliser use and resulting nitrous oxide emissions from soils, and reduced animal numbers resulting in reduced methane from dairy cattle. There was a negligible change in agricultural emissions from 2014 to 2015.
- The Land Use, Land Use Change and Forestry (LULUCF) sector was a source of emissions between the Base Year and 2003 after which the LULUCF sector was a sink. This was as a result of significant decreases in the conversion of land to cropland and settlements, and an increase in grassland carbon storage. This change to a sink was slowed by increased carbon emissions from cropland activities and the harvesting of some of the forest carbon stocks. The net sink increased by 3% between 2014 and 2015 as a result of changes in harvested wood products.
- Emissions from the transport sector decreased by 3% between 1990 and 2015 due to improvements in efficiency of transport vehicles despite growth in transport demand over the period. Emissions between 2014 and 2015 increased by 2% mainly due to increasing emissions from light/heavy lorries and buses.
- Emissions from the public sector reduced by 38% since the Base Year. This is due to increased energy efficiency measures and the switch to gas-fired heating. There was a negligible change in public sector emissions from 2014 to 2015.

D7.3.18 The use of energy from waste (EfW) plants could provide a contribution to local Heat Networks or industrial use of heat. However in England, while all 40 operating incineration facilities are enabled to use heat, less than a quarter do so. This is likely to be due to the fact that it can be costly to build heat distribution networks, and suitable demand for the heat has to be present.[288] However, measures have been included in the 2018 Resources and Waste Strategy to improve heat use from EfW plants and increase efficiencies.

D7.4 Summary of Existing Problems Relevant to Resources and Waste

D7.4.1 The following existing problems for climatic factors have been identified which are relevant to waste and resources:

- Fossil fuel dependency remains high and is likely to remain so for some time.

[288] Defra (2018) *Our Waste, Our Resources: A Strategy for England: Evidence Annex.* Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

- Use of energy from waste plants could provide a contribution to local District Heat Networks or industrial use of heat.
- Legally binding EU and government targets (see: the Climate Change Act 2008 and subsequent revisions: The Climate Change Act 2008 (2020 Target, Credit Limit and Definitions) Order 2009, The Carbon Budgets Order 2009, The Climate Change Act 2008 (2050 Target Amendment) Order 2019) seek to reduce emissions (based on a carbon budget of $MtCO_2$ equivalent) by 100% on 1990 levels by 2050 (known as a 'net zero' target), with an interim target of 34% by 2020.
- It is anticipated that waste related emissions will reduce through increased use of cleaner technologies alongside a reduced demand for landfill sites. However the use of such new technologies must be closely monitored to gauge the emissions on a year to year basis.[289]

D7.5 Likely Evolution of Baseline

UK

Climate

D7.5.1 UKCP18 provides the following predictions on changes to climate within the UK:[280,290,291]

- There is an increased chance of milder, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of extremes.
- By the end of the 21st century, all areas of the UK are projected to be warmer, more so in summer than in winter. Hot summers are expected to be more common. By 2070, in the high emission scenario, this range amounts to 0.7°C to 4.2°C of warming in winter, and 0.9°C to 5.4°C in summer.
- Rainfall patterns across the UK are not uniform and vary on seasonal and regional scales and will continue to vary in the future.
- For London, sea level rise by the end of the century (when compared to 1981-2000) is very likely to be 0.53 m to 1.15 m for a high emission scenario. Sea levels are expected to continue to rise beyond 2100.
- 2080 mean summer temperature: the central estimates of change are projected to be generally between 3 and 4ºC across most of the country, with slightly larger changes in the south and slightly smaller in the north-west of Britain.
- 2080 mean summer precipitation: general south to north gradient, from decreases of 30% in south west England to little change in Scotland.
- Increases in extreme coastal water levels are expected, driven mainly by increases in mean sea level rise. There was no evidence for significant changes in future storm surges, however future changes in storm surges are possible.

[289] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf
[290] Met Office (2018) *UKCP18 Factsheet: Precipitation.* Available online at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-factsheet-precipitation.pdf
[291] Met Office (2018) *UKCP18 Factsheet: Temperature.* Available online at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-temperature.pdf

Greenhouse Gas Emissions

D7.5.2 The Climate Change Act 2008 was passed in November 2008 and created a new approach to managing and responding to climate change in the UK. This included putting in place legally binding targets with the aim of reducing emissions by 2050 and a set of five-year carbon budgets (legally binding limits on the total quantity of greenhouse gas emissions that the country produces over a five-year period) to 2022. Following the 2019 amendment[292], this includes a target of reducing emissions by 100% (compared to 1990 levels) by 2050, known as a 'net zero' target. The UK Government has confirmed its intention within the Fifth Carbon Budget to reduce UK greenhouse gas emissions by 57% by 2030 relative to 1990 levels.

D7.5.3 The Carbon Plan: Delivering our Low Carbon Future (2011)[293] explains that if the UK is to cut emissions by 80% by 2050, there will have to be major changes in how energy is generated and used. In particular:

- energy efficiency will have to increase dramatically across all sectors;
- the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen;
- electricity will need to be decarbonised through renewable and nuclear power, and the use of carbon capture and storage (CCS);
- the electricity grid will be larger and smarter at balancing demand and supply. In the next decade, the UK is expected to complete the installation of proven and cost effective technologies that are worth installing under all future scenarios;
- all cavity walls and lofts in homes, where practicable, are expected to be insulated by 2020;
- the fuel efficiency of internal combustion engine cars will improve dramatically, with CO_2 emissions from new cars set to fall by around a third;
- many of our existing coal-fired power stations will close, replaced primarily by gas and renewable;
- more efficient buildings and cars will cut fuel costs; and
- more diverse sources of electricity will improve energy security and reduce exposure to fossil fuel imports and price spikes.

D7.5.4 As part of this evolution, under the Renewable Energy Directive (2009/28/EC) the UK is committed to delivering 15% of its energy from renewable sources by 2020.

D7.5.5 The Committee on Climate Change recommended a new emissions target for the UK of net zero emissions by 2050,[294] which has been been included in legislation under the Climate Change Act in 2019.292 The accompanying report278 highlights measures needed to reduce the waste sector's emissions to zero through waste prevention, recycling, composting, methane capture at landfill, and alternative waste treatment systems (anaerobic digestion and mechanical biological treatment). Key policy approaches suggested are to divert food, paper and card, wood, textiles and garden waste from landfill, an increase in municipal waste recycling to 70%, and a 20% reduction in

[292] The Climate Change Act 2008 (2050 Target Amendment) Order 2019 (SI 1056)
[293] DECC (2011) *The Carbon Plan: Delivering our low carbon future*. Available online at: https://www.gov.uk/government/publications/the-carbon-plan-reducing-greenhouse-gas-emissions--2
[294] Committee on Climate Change (2019) *Net Zero: Presentation of the report findings from Chris Stark, Chief Executive of the Committee on Climate Change.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Chris-Stark-Presentation.pdf

avoidable food waste by 2025. Measures relating to waste prevention and the treatment of waste water are also suggested.

England

Climate

D7.5.6 UKCP18 provides the following projected changes in climate for England in by the 2070s, based on a high emission scenario, relative to 1981-2000:[295]

- 2070 winter temperature: a change of 0.7°C to 4.2°C warmer;
- 2070 summer temperature: a change of 1.1°C to 5.8°C warmer;
- 2070 winter precipitation: a change of 2% drier to 33% wetter; and
- 2070 summer precipitation: a change of 57% drier to 3% wetter.

D7.5.7 A low emissions scenario for England broadly follows the same pattern, but to a less extreme extent.

D7.6 Waste Management Effects on Climatic Factors

D7.6.1 The approach to waste management and the associated impacts on resource efficiency can result in the emissions of greenhouse gases, which are discussed in this section. As the WMPE does not contain specific location-based policies, the possible impacts of waste management on climatic factors are considered here in a generic manner.

Waste Infrastructure

D7.6.2 Greenhouse gas (GHG) emissions from the waste sector accounts for 4.4% of the UK's total emissions (20.3 $MtCO_2e$ in 2017).[296] This presents a slight increase from 2016 (20.0 $MtCO_2e$), but is a notable reduction across the last five years, from 26.1 $MtCO_2e$. Emissions of methane from landfill accounted for the majority of these emissions, resulting from the decomposition of biodegradable waste. A reduction in biodegradable waste going to landfill, investment in methane capture technology and improved management at landfill sites have led to a significant reduction in emissions since 1990.[297]

D7.6.3 In 2017, landfill accounted for 14.1 $MtCO_2e$ of UK GHG emissions, while waste incineration (without energy recovery), composting, anaerobic digestion and mechanical biological treatment (MBT) together accounted for 2.1 $MtCO_2e$. Incineration without energy recovery is a low and declining source of emissions, while composting, anaerobic digestion and MBT have steadily increased in recent years.[296] A further 4.1 $MtCO_2e$ relate to waste-water handling, which are excluded from the scope of the WMPE. Emissions from municipal solid waste (MSW) incineration plant with energy

[295] Met Office (2018) *UKCP18 Climate Change Over Land.* Available online at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-infographic-headline-findings-land.pdf
[296] BEIS (2019) *Final UK greenhouse gas emissions national statistics 1990-2017: Table 3*. Available online at: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[297] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

recovery are reported in the power sector, with energy from waste (EfW) accounting for 0.8% of UK GHG emissions.[298]

D7.6.4 During construction, energy would be required and greenhouse gases emitted associated with the construction of facilities (including the embodied carbon in the construction materials). In addition, resources would be required for construction materials. During operation, the energy requirements associated with different types of waste management infrastructure will vary, with the scope for the use of renewable energy greater for certain infrastructure types than for others. A report by Eunomia for Zero Waste Europe reviews the carbon dioxide equivalent (CO2e) emissions or avoided emissions per tonne of material for different waste management routes. [299] These have been summarised in the tables in this section.

D7.6.5 There are also GHG emissions associated with the transportation of waste, as a result of waste collections and transport to facilities. Changes to collections and increases in traffic movements have the potential for increased emissions and therefore contribute to the causes of climate change, although SEPA considered that GHG emissions from waste transport were marginal compared to other waste sources when assessing the effects of the Scottish Waste Management Plan.[300]

D7.6.6 The ongoing effects of landfill on climate change are highly dependent on the types of material being sent to landfill, with organic materials such as food waste and paper degrading and emitting GHGs, and plastics and inert materials not directly releasing emissions. This also depends on the management of landfill gases, as this affects the amount of methane captured or vented at the site. Food waste is a major contributor to leachate generation, which affects both effectiveness and costs of landfill gas management, and plastics also affect leachate quality and can prevent efficient breakdown of waste. In addition, how the methane is used, for example flaring or used for electricity generation, can also affect emissions. In 2016, flaring accounted for approximately 4% of methane emissions avoided at landfill sites (down from 10% in previous years).[301] Electricity generated from landfill gas accounted for 1.5% of UK electricity production in 2016.[302]

D7.6.7 The Committee for Climate Change identified that measures to reduce emissions from landfill sites are one of the key ways to reduce the effects on climate change from the waste sector, through waste prevention, waste diversion and methane capture. Of the municipal solid waste sent to landfill in 2011, it has been estimated through composition analysis by Defra that a quarter was recyclable, and just over half of the waste was biodegradable (including 15% food waste and 19% paper and card, which represent the greatest contributors to methane emissions).[302,298]

D7.6.8 Across the whole landfill population of the UK, 59% of methane was captured in 2017. A few modern landfill sites where direct measurement has been taken have been shown to have a capture rates of up to 90% but there is no evidence available to show how typical this is for all modern landfills.[289] The higher the rate of capture, the greater the positive effect for climate change. It is anticipated that waste related emissions could continue to reduce through increased use of methane capture and biogas combustion technologies and flaring alongside a reduced demand for landfill sites.[297] Other methods to reduce methane emissions from landfill include landfill covers

[298] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Technical Annex*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf
[299] Eunomia/Zero Waste Europe (2015) *Carbon Impacts of Waste Management - Technical Appendices*. Available online at: https://zerowasteeurope.eu/downloads/the-potential-contribution-of-waste-management-to-a-low-carbon-economy/
[300] Scottish Government (2009) *Strategic Environmental Assessment: Scottish National Waste Management Plan - Environmental Report*.
[301] Committee on Climate Change (2018) *Reducing UK emissions: 2018 Progress Report to Parliament.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf
[302] Defra (2018) *Digest of Waste and Resource Statistics – 2018 Edition*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710124/Digest_of_Waste_and_Resource_Statistics_2018.pdf

('biocovers'), which enhance the natural process of microbial methane oxidation through improved landfill cover design.[298] Biological oxidation in the soil is estimated to be 10%[303], although this may be improved with redesign of the soil cover.

D7.6.9 As highlighted in the 2013 Environmental Report, incineration of residual waste results in "*the instantaneous release of nearly all of the fossil and organic carbon contained in the combusted waste materials. In contrast to landfill, the vast majority of the carbon is emitted as carbon dioxide*." As for landfill, the effects on climate change are dependent on the carbon content of incinerated material, the amount and type of energy generation, the energy source displaced by generated energy, generating efficiencies, and the extent to which materials are removed for recycling.

D7.6.10 Electricity generated from energy from waste plants accounted for 0.9% of the UK's total electricity generation in 2016.[302] Incineration with energy recovery can have beneficial or detrimental effects on climate change depending on a number of factors, including waste treatment, heat offtake and the source of electricity the energy displaces (as shown below in **Table D7.1)**.[299] There is also increasing use of other potential technologies to derive energy from waste other than incineration, such as transport fuels. Displacement of wind powered energy with electricity generated with waste would result in an overall increase in GHG emissions as wind is a low carbon source of energy, while displacement of electricity generated from coal would result in an overall reduction in GHG emissions, as coal is more carbon intensive. Displacement of electricity generated from gas would result in a small increase in GHG emissions. In addition, efficiencies for generating energy are much higher when heat is generated as well as electricity. Typical net generation efficiencies for European plant are 17% for generating only electricity, 14% electricity with 41% heat for CHP plant, and 70% efficiency for those generating heat only, although efficiencies for modern plant can be higher.[299] Use of energy from waste plants could provide a contribution to local Heat Networks or industrial use of heat. However in England, while all 40 operating incineration facilities are enabled to use heat, less than a quarter do so. This is likely to be due to the fact that it can be costly to build heat distribution networks, and suitable demand for the heat has to be present.[298] However, measures in the 2018 Resources and Waste Strategy to improve heat use from EfW plants would improve efficiencies, with potentially beneficial effects on climate change.

D7.6.11 The application of policies higher up the waste hierarchy could also reduce the throughput of material into energy from waste facilities, which may affect the quality of the feedstock. Higher calorific value material such as paper, cardboard, woods and organic material may be diverted to higher levels of the waste hierarchy, leaving lower calorific value waste streams. This may therefore affect future emissions associated with energy from waste facilities.

D7.6.12 Defra analysis identified that significant additional residual waste energy recovery capacity such as incineration or advanced conversion technologies would not necessarily be needed to meet an ambition of no more than 10% Municipal Solid Waste (MSW) to landfill by 2035, if a 65% MSW recycling rate is achieved by that same year, although there are some uncertainties.[298]

[303] Golder Associates (2014) *Defra: Review of Landfill Methane Emissions Modelling*. Available online at: http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18923

Table D7.1 Summary of Residual Waste Treatment Impacts

Disposal method		**Climate change impacts ($kgCO_2e$ per tonne of residual waste) (excluding biogenic CO_2 emissions)[304]**
Landfill	Gas Capture 20%	506
	Gas Capture 50%	202
	Gas Capture 70%	-6
Incineration (generating only electricity)	Avoided electricity source - coal	-296
	Avoided electricity source - gas	52
	Avoided electricity source - wind	288
MBT	Stabilisation prior to landfilling	-25
	Biodrying (to produce fuel subsequently used in an incinerator)	-24
	AD-based treatment	-30

Source: Eunomia/Zero Waste Europe (2015)

D7.6.13 Mechanical Biological Treatment (MBT) plants process mixed household waste, in addition to commercial and industrial wastes.[305] As described in the 2013 Environmental Report: "*The term Mechanical Biological Treatment (MBT) covers a range of different technologies for treating residual waste. All, however, involve a mechanical and a biological treatment phase. The first involves the recovery of recyclables, typically metals and some dense plastic. The second may be either an aerobic or anaerobic process, the aim of which is either to:*

- *stabilise the waste using a controlled degradation process such that minimal landfill gas is produced when the stabilised product is landfilled;*
- *biologically dry the material so that a fuel with a lower moisture content is produced. The fuel may be sent to an incinerator or in some cases is used in a cement kiln where it avoids the use of coal;*
- *less commonly, the organic fraction may be removed and used as a feedstock for an anaerobic digestion process.*

Treatment systems thus involve the recovery of recyclate, and also, often the recovery energy. Some material may be sent to landfill although this may be a very small proportion of the total input in some systems where there is output to an incinerator. Different aspects of MBT systems therefore function at the recycling, recovery and disposal levels of the waste hierarchy."

D7.6.14 MBT includes separating recyclable materials from the remainder of the waste stream, and aerobic or anaerobic biological treatment to form Refuse Derived Fuel (RDF), compost-like product, or stabilisation to reduce the methane emissions during disposal in landfill. Emissions from the MBT process itself are insignificant, but the overall climate change effects from the process are

[304] For materials of biogenic origin, conventional practice is to assume that the emissions from combustion of these materials should be disregarded, as this represents carbon that was recently part of the short-term carbon cycle (opposed to combustion of fossil fuels, which releases carbon that would otherwise remain contained in geological sources). As energy is generated from combusting these materials, the net contribution to climate change emissions is negative (reflecting the emissions which are avoided from not having to generate energy from other sources).

[305] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

dependent on the operation of the facility and the scale and quality of extracted recyclable materials.[299] Exports of RDF to mainland Europe have increased dramatically between 2010 and 2018, from 9,000 tonnes (from England and Wales) to 2.9 million tonnes (from England).[302,306] This export is to use incinerators with spare capacity in mainland Europe, rather than potentially disposing of waste to landfill in England and Wales. Studies have shown that, while there are uncertainties, the export of RDF is considered unlikely to result in any net increase in carbon dioxide emissions from residual waste treatment. The transport of RDF to the incineration location makes a very minor contribution to the life-cycle emissions, and in some cases uses back-hauling, meaning that transport emissions would be negligible.[307]

Materials use

D7.6.15 The use of resources requires materials and energy for the extraction of raw materials, transportation and the manufacture of goods. The extraction and processing of primary raw materials and manufacture of goods and products result in the emission of greenhouse gases, which extend consideration outside the UK to reflect a lifecycle approach to the effects of waste. The effects could be reduced through the application of the waste hierarchy through waste avoidance, reuse of products and recycling, as this could reduce the need for extraction of primary raw materials, as well as emissions associated with disposal. It is estimated that the GHG emissions resulting from the production of materials which went on to become discarded as waste in the UK were 185 MtCO2e in 2014 (on a life-cycle basis, including global emissions). The treatment of this waste was estimated to avoid emissions of 56 MtCO2e, predominantly through recycling and therefore the avoidance of extraction of raw materials.[302]

D7.6.16 The avoidance of waste generation in accordance with the waste hierarchy, for example through designing packaging to require less materials to be disposed of, reducing food waste, or swapping single use plastic items for reusable alternatives, can reduce the requirement for manufacture of materials and products. This can save energy and reduce GHG emissions.[298] As highlighted in the Eunomia/Zero Waste Europe report, the location of manufacturing activities and source of energy will influence the scale of avoided greenhouse gas emissions, due to the variation in carbon intensity of electricity and heat supplies. **Table D7.2** shows the avoided emissions associated with selected waste streams[299], while **Table D7.3** presents the typical composition for kerbside residual waste in England[308] and so provides an indication of the relative significance of the material within the waste stream taking into account the avoided emissions.

Table D7.2 Data on Waste Prevention Impacts

Material	Avoided Emissions ($kgCO_2e$ per tonne of material)
Paper / card	-893
Plastic	-3,410
Glass	-895
Textiles	-21,148

[306] Environment Agency (2019) *International Waste Shipments -RDF.SRF Exported from England 2018.* Available online at: https://environment.data.gov.uk/dataset/6a9f07b0-d465-11e4-b309-f0def148f590

[307] Eunomia (2015) *RDF Export Analysis of the Legal, Economic and Environmental Rationales: Report for RDF Export Industry Group*. Available online at: https://www.rdfindustrygroup.org.uk/resources/rdf-export-analysis-of-the-legal-economic-and-environmental-rationales/

[308] Defra (2008) WR0119 *Municipal Waste Composition: Review of Municipal Waste Component Analyses: Annex 4 - Analysis of collated studies and updated estimates of national municipal waste composition.* Available online at: http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15133

Material	Avoided Emissions ($kgCO_2e$ per tonne of material)
Steel	-2,937
Aluminium	-12,960
Food waste	-3,800
Discarded machines and equipment (includes WEEE)	-1,754
Others	-1,910
Mineral waste from construction and demolition	-12

Source: Scottish Carbon Metric in Eunomia/Zero Waste Europe (2015)

Table D7.3 Compositional estimates for kerbside residual waste in England

Material	Arising in kerbside residual, %
Food waste	31.72%
Garden waste	6.22%
Other organic	2.70%
Paper	12.86%
Card	5.20%
Glass	4.88%
Metals	3.40%
Plastics	13.52%
Textiles	3.68%
Wood	1.09%
WEEE	1.18%
Hazardous	0.50%
Sanitary	4.71%
Furniture	0.01%
Mattresses	0.00%
Misc combustible	1.41%
Misc non-combustible	2.06%
Soil	0.00%
Other wastes	2.80%
Fines	2.05%

Source: Defra (2008)

D7.6.17 Textiles and aluminium have the greatest avoided GHG emissions per tonne of material, at 21,148 kgCO2e and 12,960 kgCO2e respectively.

D7.6.18 The Carbon Trust states that "Demand for clothing in the UK drives the production of alm*ost three times more emissions outside of the UK than it drives domestically (excluding use phase emissions),*

with China being the most significant source of these international emissions"[309], therefore it is assumed that one reason for the high avoided GHG emissions per tonne of material for textiles is due to avoided transportation from counties such as China to the UK. The Eunomia/Zero Waste Europe report assumed that 70% of the clothing donated is not recycled, but resold with 3% being rejected (landfilled) and a further 27% recycled into rags.[310]

D7.6.19 An estimated £150 million of clothing goes to landfill in the UK each year.[311] WRAP identifies that the average lifetime for a garment of clothing is estimated at 2.2 years, and extending the active life of clothing by nine months can significantly reduce its environmental impact. The 2013 Environmental Report highlights that aluminium accounts for a small percentage of waste arisings. Metals account for only 3.4% of kerbside residual waste.[308] However as highlighted in the Eunomia/Zero Waste Europe report, the extent to which waste prevention avoids product manufacture is uncertain, and would have an effect on the overall carbon savings.

D7.6.20 It is also estimated that food wasted in the UK is worth £20 billion each year.[312] The majority of food wastage is by households.

D7.6.21 In addition, the greenhouse gas emissions associated with the reuse of certain common items has been studied, with the potential for positive effects on climate change. The use of cloth nappies rather than disposable nappies can dramatically cut waste and reduce emissions by up to 40%, depending on the laundering and drying method.[313] Replacing single use carrier bags with long life plastic bags would save 6 kgCO2e per household per year[314], and replacing disposable cups with refillable alternatives would avoid the emission of 58 kgCO2e over the lifetime of the cup.[315]

D7.6.22 The reuse of materials in accordance with the waste hierarchy also reduces the requirement for manufacture of materials and products, saving energy and reducing GHG emissions.[316] The extent to which waste prevention avoids product manufacture can have a significant effect on the carbon savings, for example if the reuse of items is by individuals who may otherwise not have purchased the product. Avoided manufacture may also have reduced benefits where the avoided product would have been derived from recycled sources, as these are typically associated with lower greenhouse gas emissions.[299]

D7.6.23 Research by WRAP has determined the climate change benefits for the reuse of certain electrical items, domestic and office furniture and clothing. The impacts of the reuse of selected items are presented below in **Table D7.4**.

[309] Carbon Trust (2011) *International Carbon Flows Clothing*. Available online at: https://www.carbontrust.com/resources/reports/advice/international-carbon-flows/
[310] Eunomia (2015) *The Potential Contribution of Waste Management to a Low Carbon Economy*. Technical Appendices. Available online at: https://www.eunomia.co.uk/reports-tools/the-potential-contribution-of-waste-management-to-a-low-carbon-economy/
[311] WRAP (2019) *Clothing*. Available online at: http://www.wrap.org.uk/content/clothing-waste-prevention
[312] WRAP (2018) *Food Surplus and Waste in the UK – Key Facts*. Available online at: http://www.wrap.org.uk/sites/files/wrap/Food%20Surplus%20and%20Waste%20in%20the%20UK%20Key%20Facts%2014%205%2019.pdf
[313] Environment Agency (2008) *An Updated Lifecycle Assessment Study for Disposable and Reusable Nappies*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291130/scho0808boir-e-e.pdf
[314] Sustainability Victoria (2007) *Comparison of Existing Life cycle Analysis of Shopping Bag Alternatives*
[315] Refiller (2013) *Lifecycle Assessment: Reusable Mugs vs. Disposable Cups*
[316] HM Government (2018) *Our Waste, Our Resources: A Strategy for England: Technical Annex*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

Table D7.4 Impacts of Selected Re-use Activities

Material	Indicative emissions impact ($kgCO_2e$ per tonne of product) – charity shop	Indicative emissions impact ($kgCO_2e$ per tonne of product) – re-use network
Re-use of washing machine	-500	200
Re-use of television	-8,000	-5,000
Re-use of sofa	-1,450	-1,005
Re-use of dining table	380	760
Re-use of office desk	-400	-200
Re-use of office chairs	-3,000	-2,600
Re-use of t-shirts[317]	-13,000	-11,000
Re-use of woollen jumpers[317]	-9,000	-8,000

Source: WRAP in Eunomia/Zero Waste Europe (2015)

D7.6.24 Reflecting the high carbon footprint associated with textiles, the reuse of clothing had particularly high carbon benefits, with GHG savings of approximately 3 kgCO2e per T-shirt and 4.5 kgCO2e per woollen jumper.[317] The reuse of televisions also has a high GHG benefit, however only 13% of TVs that reach the end of their life are reused.[318] In most cases of reuse, there is a greater climate change benefit through direct reuse via a charity shop, compared to a reuse network which requires collection, sorting, export for sale abroad and recycling of items unsuitable for reuse. The Eunomia/Zero Waste Europe report highlights that office furniture has greater emissions benefits than domestic items, as these are more likely to avoid the purchase of a new item.

D7.6.25 Recycling materials also avoids greenhouse gas emissions due to avoided energy use and greenhouse gas emissions associated with resource extraction, product manufacture, and avoided disposal impacts. Again, any climate change benefits are dependent on the locations of primary and secondary manufacture and the source of avoided energy.

D7.6.26 Estimates from the Eunomia/Zero Waste Europe report of GHG emissions associated with recycling various materials are summarised below in **Table D7.5**. The report highlights that recycling textiles can have one of the greatest avoided emissions per tonne of material, however there is substantial variation depending of the type of textile fibres and the end use of the recovered material. Paper is typically recycled in the greatest quantities, which, along with cardboard, is reprocessed into newsprint or packaging products.[299]

Table D7.5 Impacts on Dry Recycling

Material	Net recycling emissions (excluding biogenic CO_2 impacts) ($kgCO_2e$ per tonne of material)
Paper / card	-315
Plastic	-566

[317] WRAP (2011) *Benefits of Reuse Case Study: Clothing.* Available online at: http://www.wrap.org.uk/sites/files/wrap/Clothing%20reuse_final.pdf
[318] WRAP (2011) *Benefits of Reuse Case Study: Electrical Items.* Available online at: http://www.wrap.org.uk/sites/files/wrap/Electricals%20reuse_final.pdf

Material	Net recycling emissions (excluding biogenic CO_2 impacts) ($kgCO_2e$ per tonne of material)
Glass	-201
Textiles	-5,891
Steel	-1,806
Aluminium	-9,985
Food waste	See Table D7.6
Discarded machines and equipment (includes WEEE)	-181
Mineral waste from construction and demolition	2

Source: Eunomia/Zero Waste Europe (2015)

D7.6.27 In an OECD study into the environmental impacts of certain primary and secondary metals, production of copper and nickel were found to have the greatest cumulative energy demand and emissions of GHGs per kg of metal, followed by aluminium. For these metals the climate change impacts were substantially reduced for production of secondary materials, however for other metals such as zinc, the impacts on energy demand and climate change for recycling were over half those for primary production.[319]

D7.6.28 The previous 2013 Environmental Report highlights that the recycling emissions data "confirms the very low climate change benefit associated the recycling of aggregate such as typically arises in the construction and demolition (C&D) waste stream. It is important to note that opportunities for further reducing climate change impacts through the recycling of C&D waste may be fairly limited, as relatively inert materials (soils and aggregate) typically account for a significant proportion of waste arisings, and most metals in the stream are likely to be already extracted for recycling, although there may be some scope for additional recycling of waste wood and PVC (e.g. in the form of window profiles)." However there is a good reuse market for aggregates derived from C&D waste in roads, drainage and other construction projects. Technology for the separation and recovery of C&D waste is also well established and generally inexpensive.[320] In 2014, C&D waste in the UK accounted for almost 60% of the annual waste arisings.[298]

D7.6.29 With regard to composting and anaerobic digestion (AD), the type and composition of organic waste affects the GHG emissions, as does the type of treatment system, the source of avoided energy (when energy is generated), and the use of soil improving materials. Greenhouse gas emissions arise from the processes themselves, and the resulting products (which include energy, compost and digestate).[299]

D7.6.30 Composting results in emissions of greenhouse gases during the composting process, as well as direct emissions during compost use. Some carbon in compost applied to soil remains sequestered in the soil, however there are uncertainties regarding the extent and timescales.[299]

D7.6.31 AD breaks organic matter such as animal or food down to produce biogas and biofertiliser in the absence of oxygen. This represents the best environmental outcome for food waste that cannot be prevented or redistributed.[305] The number of AD facilities using food waste or farm waste has increased substantially since 2016.

[319] OECD (2019) *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*. Available online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page1

[320] European Commission (2018) *Waste: Construction and Demolition Waste (CDW).* Available online at:

D7.6.32 Biogas produced from AD can be combusted in a gas engine turbine, with electricity exported to the grid. AD electricity generation in 2016 accounted to 0.6% of the UK's total electricity generation.[302] The benefits for climate change depend on the source of electricity that is being replaced, as these have differing levels of carbon emissions (see **Table D7.6**). Heat can also be utilised from this process where suitable systems are in place, avoiding the need for heating (and associated greenhouse gases) from other energy sources. The biogas can also be upgraded, such that the carbon within the gas is removed prior to injection into the gas grid, or upgraded to bio-methane for use a vehicle fuel. When used as fuel, this is particularly for heavy goods vehicles, and replaces diesel.[299]

Table D7.6 Impacts of Source-Segregated Organic Waste Treatment

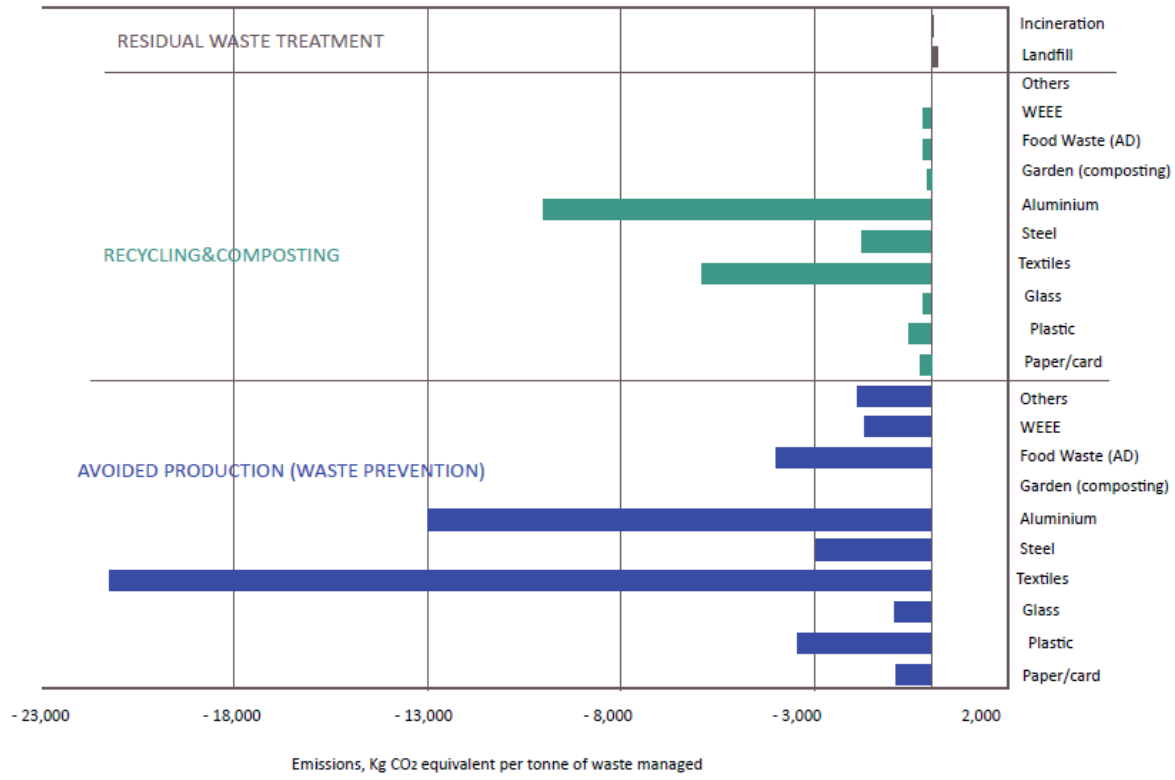
Material	Garden Waste ($kgCO_2e$ per tonne of waste)	Food Waste ($kgCO_2e$ per tonne of waste)
Windrow Composting (open air)	21	29
In-vessel Composting (enclosed)	41	49
AD – electricity only (gas avoided)	-120	-150
AD – electricity only (coal avoided)	-223	-331
AD – electricity only (wind avoided)	-66	-63
AD – CHP	-137	-185
AD – Upgraded biogas used in gas grid	-143	-195
AD – Upgraded biogas fuelling vehicles	-180	-280

Source: Eunomia/Zero Waste Europe (2015)

D7.6.33 The various waste management approaches for various materials included in the tables above are summarised in **Figure D7.1** below[321], which shows the relative effects on climate change. Waste prevention has by far the greatest benefit for climate change per tonne of waste material, particularly for textiles and aluminium.

[321] Eunomia/Zero Waste Europe (2015) *Carbon Impacts of Waste Management – Main Report*. Available online at: https://zerowasteeurope.eu/downloads/the-potential-contribution-of-waste-management-to-a-low-carbon-economy/

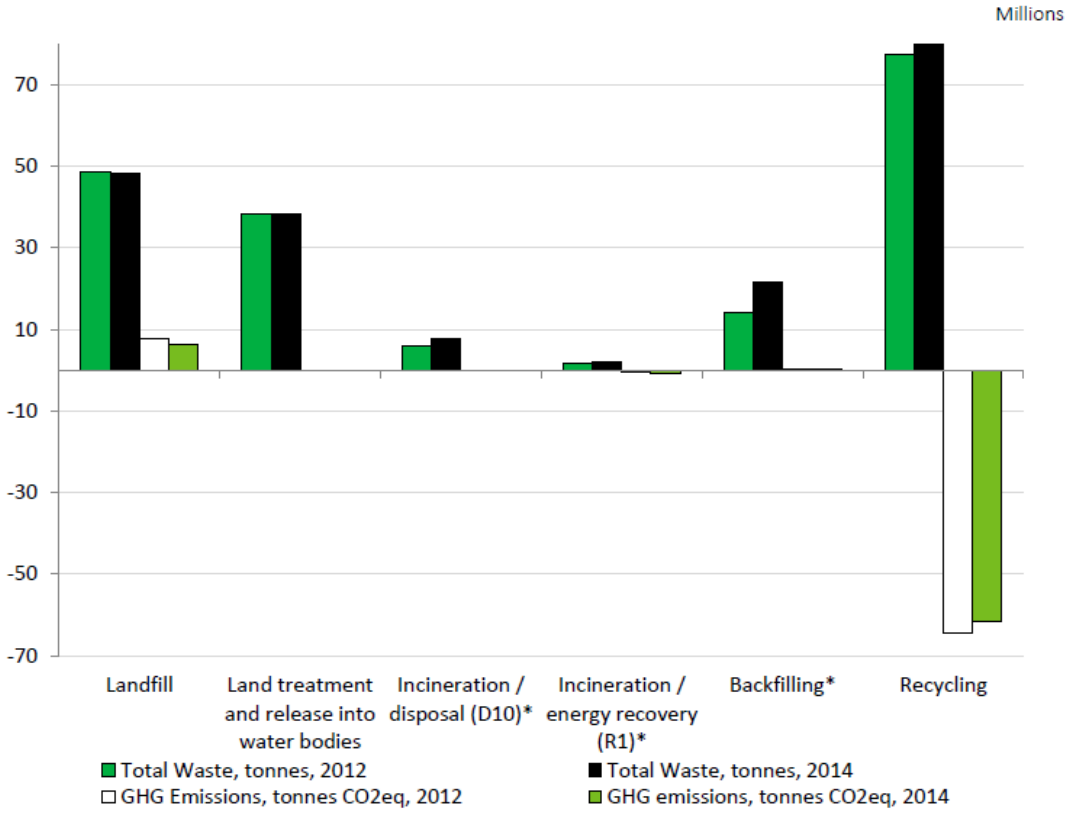
Figure D7.1 Indicative Climate Change Impacts of Key Waste Management Activities per tonne of waste (excl. CO2 from biogenic sources)



Source: Eunomia/Zero Waste Europe (2015)

D7.6.34 **Figure D7.2** below shows the contribution to effects on climate change of the various waste management approaches for 2014 (excluding prevention and reuse).[302] This shows that overall recycling has the greatest effect on climate change, with substantial positive effects. Over half of the emissions avoided by recycling are associated with metal wastes.

Figure D7.2 Waste weight and GHG emissions 2012 and 2014



Source: Defra (2018) *Digest of Waste and Resource Statistics – 2018 Edition.*

Climate Change Adaptation

D7.6.35 Infrastructure, including waste management infrastructure, may be vulnerable to the effects of climate change such as flood risk and coastal change. A study by AEA into the resilience of waste infrastructure identified that extreme weather leading to floods was a particular concern. Extreme weather events and flooding are expected to become more common with a changing climate. The effects on flood risk are addressed under Chapter D8 Flood Risk and Coastal Change.[322]

D7.6.36 Application of the waste hierarchy to develop a circular economy and reuse or recycling of materials can also provide an additional source of materials for businesses, with the potential to increase certainty of supplies and resource availability, and enhance resilience to a changing climate.[323]

[322] AEA (2012) *Increasing the climate resilience of waste infrastructure*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/183933/climate-resilience-full.pdf

[323] Scottish Government (2015) *Making Things Last: Consultation on Creating a More Circular Economy in Scotland: Strategic Environmental Assessment Environmental Report.*

D7.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D7.7.1 **Table D7.7** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D7.7 Assessment of the Draft WMPE and reasonable alternative

Climatic Factors

To minimise greenhouse gas emissions as a contribution to climate change and ensure resilience to any consequences of climate change.

- Will the draft WMPE help to ensure a low carbon design solution to the design and delivery of waste management services including infrastructure?
- Will the draft WMPE lead to an increase in low carbon energy use?
- Will the draft WMPE increase resilience to the effects of climate change?
- Will the draft WMPE promote climate change adaptation (including rising temperatures and more extreme weather events)?
- Will the draft WMPE be responsive to new and evolving legislative changes aiming to reduce carbon emissions to net zero by 2050?

	Effect	Commentary
WMPE		
Prevention	+/?	The Government's commitments include the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. The latter commitment would support the Committee on Climate Change's 'further ambition' measure for achieving net zero emissions from the waste sector by 2050, of a 20% reduction in avoidable food waste by 2025.[289] While 'avoidable' waste includes waste that could have been reused, recycled, composted or when a reusable or recyclable alternative could have been used, it is assumed that waste prevention will also have a role in eliminating this waste (although there is uncertainty regarding the extent). In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. Waste prevention measures are expected to reduce volumes of residual waste being collected for disposal, which has the potential to reduce greenhouse gas (GHG) emissions associated with waste transport. However, this is not certain as there could also be an increase in collection and movement of waste for reuse and recycling as part of the elimination of avoidable waste. In addition, SEPA considered that GHG emissions from waste transport were marginal compared to other waste sources when assessing the effects of the Scottish Waste Management Plan, so any resulting effects on climate change are expected to be small.[300] The avoidance of waste generation in accordance with the waste hierarchy, for example through designing packaging to require less materials to be disposed of or reducing food waste, can reduce the requirement for manufacture of materials and products. This can save energy and reduce GHG emissions.[298] The location of manufacturing activities and source of energy will influence the scale of avoided GHG emissions, due to the variation in carbon intensity of electricity and heat supplies.[299] The extent to which waste prevention avoids product manufacture is uncertain, and would have an effect on the overall carbon savings. In addition, the use of resources requires materials and energy for the extraction of raw materials. The GHG emissions associated with extraction could be reduced through waste avoidance, as this could reduce the need for extraction of primary raw materials. The extraction and processing of primary raw materials and manufacture of goods and

		products result in the emission of greenhouse gases, which extend consideration outside the UK to reflect a lifecycle approach to the effects of waste. As such, the WMPE is likely to have a positive effect with uncertainty regarding the scale of reduction in GHG emissions, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+/?	The commitments in the WMPE for the elimination of avoidable waste will include increases in reuse of products and materials. Reuse is also supported by Defra's target to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. Increased reuse of items in the home may lead to a reduction in waste and recycling collections. However, reuse between businesses or through reuse networks may generate increased transport associated with the distribution of reusable items, so the overall change in GHG emissions from waste transport is uncertain. As highlighted above, effects are expected to be minimal.[300] The reuse of materials in accordance with the waste hierarchy reduces the requirement for extraction of raw materials and manufacture of materials and products, saving energy and reducing GHG emissions, as detailed for waste prevention above. However, the extent of avoided manufacture is uncertain. The extent to which reuse avoids product manufacture can have a significant effect on the carbon savings, for example if the reuse of items is by individuals who may otherwise not have purchased the product. The benefits may be reduced where the avoided product would have been derived from recycled sources, as these are typically associated with lower greenhouse gas emissions.[299] In most cases of reuse, there is a greater climate change benefit through direct reuse via a charity shop, compared to a reuse network which requires collection, sorting, export for sale abroad and recycling of items unsuitable for reuse, however it is not known to what proportion of any increase in reuse would be direct compared to a reuse network. As such, the WMPE is likely to have an overall positive effect with uncertainty regarding the scale of GHG emissions reductions, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	++	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035, and to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025. There are also commitments to reduce avoidable waste, which includes elements of recycling. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as a potential food waste collection system (this could be recycled through composting, or recovered, through AD plants). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. While recycling does consume energy, the climate change impacts are substantially reduced for production of secondary materials compared to primary due to reduced energy requirements and avoided resource extraction. Recycled aluminium and textiles have some of the greatest avoided GHG emissions per tonne of material. Defra data shows that over half of the emissions avoided by recycling in the UK are associated with metal wastes (although this estimate is based on a life cycle perspective and covers the global emissions associated with materials discarded in the UK).[302] Any climate change benefits are dependent on the locations of primary and secondary manufacture and the source of avoided energy. There is a low climate change benefit associated the recycling of aggregate such as typically arises in the construction and demolition (C&D) waste stream, as relatively inert

		materials (soils and aggregate) typically account for a significant proportion of waste arisings, and most metals in the stream are likely to be already extracted for recycling. Composting (which is considered as recycling when the quality protocol has been met) results in emissions of greenhouse gases during the composting process, as well as direct emissions during compost use, although emissions vary with the type and composition of organic waste. Some carbon in compost applied to soil remains sequestered in the soil, however there are uncertainties regarding the extent and timescales.[299] The WMPE supports AD as the most effective way to treat separately collected food waste, so composting of food waste is not expected to substantially increase as a result of the plan. Recycling also has the potential to increase business resilience to a changing climate through the provision of an additional source of materials for businesses, and the potential to increase certainty of supplies and resource availability, however the extent of any effect is uncertain. As more waste material is collected for recycling, there may be a requirement for additional waste infrastructure. Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. During construction, energy would be required and greenhouse gases emitted associated with the construction of facilities (including the embodied carbon in the construction materials). The scale of any future construction and the associated GHG emissions is currently unknown. During operation, the energy requirements associated with different recycling facilities will vary, with the scope for the use of renewable energy greater for certain infrastructure types than for others. The extent of inclusion of renewable energy sources for powering new infrastructure is uncertain. Recycling infrastructure may also be vulnerable to the effects of climate change such as flood risk and extreme weather. The extent of inclusion of adaptation measures to enhance resilience to climate change is not yet certain, and would be determined at later design stages. Increased recycling rates could result in changes to collections and increases in traffic movements. This has the potential for increased GHG emissions, however SEPA considered that GHG emissions from waste transport were marginal compared to other waste sources when assessing the effects of the Scottish Waste Management Plan.[300] Any effects on climate change from transport are therefore expected to be minimal. Defra data[302] identifies that recycling has the greatest effect on climate change compared to recovery and disposal, predominantly due to the avoided GHG emissions compared to providing an equivalent amount of materials from primary sources (and therefore extend beyond the bounds of England). Overall, the WMPE is expected to have a significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	?	The WMPE seeks to improve recovery of materials, including anaerobic digestion (AD) and energy from waste (EfW). The WMPE highlights the Government's support for efficient energy recovery from residual waste as the best management option for waste that cannot be reused or recycled, and for AD as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. The effects of recovery on climate change are dependent on the carbon content of recovered material, the amount and type of energy generation, the energy source displaced by generated energy, generating efficiencies, and the extent to which materials are removed for recycling. Waste incineration (without energy recovery), anaerobic digestion and mechanical biological treatment (MBT) together accounted for 1 $MtCO_2e$ of UK emissions in 2017. Incineration without energy recovery is a low and declining source of emissions, while emissions from anaerobic digestion and MBT have steadily increased in recent years.[296] Emissions from municipal solid waste (MSW) incineration plant with energy recovery are reported in the power sector, with energy from waste (EfW) accounting for

		0.8% of UK GHG emissions.[298] Increases in waste recovery has the potential to increase these emissions, with a greater effect on climate change. However while the extent is uncertain, these are likely to remain a relatively small contribution to England's total emissions. Incineration with energy recovery can have beneficial or detrimental effects on climate change depending on the source of electricity the energy displaces. Displacement of wind powered energy with EfW would result in an overall increase in GHG emissions, while displacement of electricity generated from coal would result in an overall reduction in GHG emissions. Displacement of electricity generated from gas would result in a small increase in GHG emissions.[299] In addition, efficiencies for generating energy are much higher when heat is generated as well as electricity. Use of energy from waste plants could provide a contribution to local Heat Networks or industrial use of heat. While all 40 operating incineration facilities in England are enabled to use heat, less than a quarter currently do so. This is likely to be due to fact that it can be costly to build heat distribution networks, and suitable demand for the heat has to be present.[298] However, measures in the 2018 Resources and Waste Strategy to improve heat use from EfW plants would improve efficiencies, with potentially beneficial effects on climate change. The application of policies higher up the waste hierarchy could also reduce the throughput of material into energy from waste facilities, which may affect the quality of the feedstock. Higher calorific value material such as paper, cardboard, woods and organic material may be diverted to higher levels of the waste hierarchy, leaving lower calorific value waste streams. There is therefore uncertainty regarding the future extent of energy generation and associated emissions. With regard to AD, the type and composition of organic waste affects the GHG emissions, as does the type of treatment system, the source of avoided energy (when energy is generated), and the use of soil improving materials. Biogas produced from AD can be combusted in a gas engine turbine, with electricity exported to the grid, however the extent of avoided GHG emissions depends on the source of avoided electricity. AD electricity generation in 2016 accounted for 0.6% of the UK's total electricity generation,[302] so the overall effect on climate change is expected to be small. Heat can also be utilised from AD where suitable systems are in place, avoiding the need for heating (and associated greenhouse gases) from other energy sources. The biogas can also be upgraded, such that the carbon within the gas is removed prior to injection into the gas grid, or upgraded to bio-methane for use a vehicle fuel. When used as fuel, this is particularly for heavy goods vehicles, and replaces diesel, which has the potential for further reductions in GHGs. [299] The GHG emissions from MBT are dependent on the operation of the facility and the scale and quality of extracted recyclable materials, however emissions and overall effect on climate change from MBT are expected to be negligible.[299] For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. During construction of infrastructure which may be required to meet the commitments of the WMPE, energy would be required and greenhouse gases emitted associated with the construction of facilities (including the embodied carbon in the construction materials). In addition, resources would be required for construction materials. During operation, the energy requirements associated with different types of recovery facilities will vary, with the scope for the use of renewable energy greater for certain infrastructure types than for others. Recovery infrastructure may also be vulnerable to the effects of climate change such as flood risk and extreme weather. The extent of inclusion of adaptation measures to enhance resilience to climate change is not yet certain, and would be determined at later design stages.

		An increase in vehicle movements associated with avoided disposal (and therefore potential increased movements for collection and transport to recovery sites) could result in increased emissions from waste vehicles, although as for other waste management options, the associated effects on climate change are expected to be minimal. Overall, the effect of the WMPE is uncertain, relative to the current baseline for the issues covered by this SEA objective and guide questions. This is because the GHG emissions and overall effects on climate change are dependent on the scale and nature of recovery, and the source of electricity that is displaced by the energy generated from waste, which is currently unknown. However any change in emissions is expected to be a small contribution to England's total GHG emissions and climate change.
Disposal	++	Disposal options represent the bottom of the waste hierarchy, and are the least desirable waste management options. These include landfill and incineration without energy recovery. The WMPE outlines key targets which aim to reduce the use of landfill. This includes working towards eliminating food waste going to landfill by 2030, as well as a target within the Waste Framework Directive, which seeks to cut waste to landfill to 10% by 2035. The range of commitments outlined in the WMPE will reduce the use of landfill, which include plans to introduce a separate household waste collection system for food wastes which will divert wastes from landfill into recycling or recovery. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. Emissions of methane from the decomposition of biodegradable waste in landfill is the greatest contributor of the UK waste sector to climate change, accounting for over 3% of the UK's total GHG emissions.[296] The elimination of food waste going to landfill is therefore expected to have a significant positive effect on climate change, and would meet part of the 'core' measures identified by the Committee on Climate Change for reducing emissions from waste to net zero by 2050 (however the Committee's report suggests paper, card, wood, textiles and garden waste should also be diverted from landfill by 2025).[289] The diversion of biodegradable materials such as paper from landfill to recycling would also contribute to this effect. The scale of ongoing emissions of GHGs from landfill is dependent on the composition of existing waste at facilities, as well as future deposits. Emissions will also depend on the management of landfill gases, as this affects the amount of methane captured or vented, in addition to how the methane is used, for example flaring or used for electricity generation. Estimates suggest that in 2016, 66% of methane emissions from landfill were avoided (through methane capture, flaring and oxidisation at the landfill site), a reduction from 70% the previous year, predominantly due to a reduction in methane flaring. However the proportion captured for use in energy generation (rather than being emitted) has risen annually, and accounted for 58% of the avoided methane in 2016.[301] Depending on the source of energy avoided, this generated energy has the potential to displace a more carbon intensive alternative, although this is not certain. Biological oxidation in the soil is estimated to be 10%, which can be enhanced through improved landfill cover design.[298] It is estimated that 59% of methane was captured across the whole landfill population in the UK in 2017. A few modern landfill sites where direct measurement has been taken have been shown to have a capture rates of up to 90% but there is no evidence available to show how typical this is for all modern landfills.[289] The higher the rate of capture, the greater the positive effect for climate change. The future rate of capture of landfill gas is not certain, however it is assumed that a move towards more modern methods and increased capture is likely. The WMPE highlights that landfill is expected to continue to be the 'least worst' option of management of certain wastes, particularly for inert waste that cannot be prevented or recycled. Inert wastes are not expected to notably contribute to GHG emissions from landfill. Overall, the WMPE is expected to have a significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	++?	The WMPE brings together a range of aims and targets seeking to improve waste management by moving waste up the hierarchy.

		Overall a substantial reduction in GHG emissions is expected from the implementation of commitments in the WMPE. Increases in waste prevention and reuse have the potential to avoid GHG emissions associated with the extraction of raw materials and avoided manufacturing of materials and products, although the extent of the effect on climate change is uncertain. Recycling and disposal also have the potential for significant reductions in greenhouse gases. For recycling, this is predominantly due to reduced energy requirements and avoided resource extraction meaning that climate change impacts are substantially reduced for the production of secondary materials compared to primary. Landfill is the greatest contributor of the waste sector to climate change, predominantly from emissions of methane from the decomposition of biodegradable waste. Measures to avoid food waste to landfill and diversion of other biodegradable waste to higher levels of the waste hierarchy are expected to significantly reduce GHG emissions in future, although emissions from existing waste in landfill will still require management and capture. Effects relating to waste recovery have a greater level of uncertainty relating to the scale and nature of recovery, and the source of electricity that is displaced by the energy generated from waste. Overall, the WMPE is expected to have a significant positive effect with some uncertainty, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++/?	The 'Direction of Travel' reasonable alternative seeks to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Meeting the commitments for the elimination of avoidable waste in a shorter timeframe would have similar effects as the WMPE due to the prevention of waste. The effect of the prevention of more waste compared to the WMPE on GHG emissions associated with waste transport is uncertain. There will be an expected reduction in volumes of residual waste being collected for disposal, however there may be an increase in collection and movement of waste for reuse and recycling as part of the elimination of avoidable waste. GHG emissions from waste transport are expected to be marginal compared to other waste sources, so any changes are not expected to have a notable effect on climate change. Increased prevention of waste may further reduce the requirements for extracting and processing raw materials, with associated reductions in energy and GHG emissions. The location of manufacturing activities and source of energy will influence the scale of avoided GHG emissions, due to the variation in carbon intensity of electricity and heat supplies.[299] The extent to which waste prevention avoids resource extraction and product manufacture is uncertain, however, benefits have the potential to be significant. As such, the reasonable alternative is likely to have a significant positive effect with some uncertainty, relative to the baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	++/?	The reasonable alternative would involve meeting the commitments for the elimination of avoidable waste in a shorter timeframe, which would include an increase in the reuse of products and materials. Greater increase in the reuse of products is expected to further reduce the requirement for extraction of raw materials and manufacture of materials and products, saving energy and reducing GHG emissions, as detailed for waste prevention above. The extent to which this would avoid product manufacture is uncertain, and benefits may also be reduced where the avoided product would have been derived from recycled sources, which is not known at this stage. However effects have the potential to be significant if the reasonable alternative leads to a substantial avoidance of extraction and manufacturing. The proportion of increased reuse that is direct through charity shops compared to a reuse network is also not certain. Direct reuse presents greater climate change benefits, as reuse

		networks requires collection, sorting, export for sale abroad and recycling of items unsuitable for reuse. A greater increase in the reuse of items in the home may lead to further reductions in waste and recycling collections compared to the WMPE. However, increased reuse between businesses or through reuse networks may increase transport associated with the distribution of reusable items, so the overall change in GHG emissions from waste transport under the reasonable alternative is uncertain. As highlighted above, effects are expected to be minimal.[300] Overall, the reasonable alternative is likely to have an overall significant positive effect due to increased economic benefits, relative to the baseline for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	++/-	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE, or to exceed the WMPE's targets for the proportion of waste recycled. Increasing recycling rates more quickly or achieving higher recycling rates would result in similar effects as the WMPE, but potentially with a greater reduction in GHG emissions. Going beyond the current commitments could also contribute to the Committee on Climate Change's recommendations for achieving net zero emissions from the waste sector by 2050, of an increase in recycling rates of all municipal waste to 70% by 2025.[289] The climate change impacts associated with the production of secondary materials are substantially lower than for primary due to reduced energy requirements and avoided resource extraction. Any climate change benefits are dependent on the locations of primary and secondary manufacture and the source of avoided energy, but effects are assessed as being significant. As the WMPE supports AD as the most effective way to treat separately collected food waste, the composting of food waste and associated GHG emissions are not expected to substantially increase under the reasonable alternative. Should recycling rates increase more quickly or higher recycling rates be achieved, more recycling infrastructure may be required compared to the WMPE, with resulting effects on climate change. Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. During construction, energy would be required and greenhouse gases emitted associated with the construction of facilities (including the embodied carbon in the construction materials). The scale of any future construction and the associated GHG emissions is currently uncertain, but may be greater for the reasonable alternative due to the potential for a greater capacity gap. In addition, resources would be required for construction materials. During operation, the energy requirements associated with different recycling facilities will vary, with the scope for the use of renewable energy greater for certain infrastructure types than for others. The extent of inclusion of renewable energy sources for powering new infrastructure is uncertain. Recycling infrastructure may also be vulnerable to the effects of climate change such as flood risk and extreme weather. The extent of inclusion of adaptation measures to enhance resilience to climate change is not yet certain, and would be determined at later design stages. Increased recycling rates could result in changes to collections and increases in traffic movements, however the contribution to climate change is expected to be minimal. Overall, the reasonable alternative is expected to have a mixed significant positive and minor negative effect, relative to the baseline for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	?	The 'Direction of Travel' reasonable alternative seeks to further improve recovery of materials, for example though AD and EfW. There is currently capacity remaining in AD plants, so while some continued funding is expected as part of the WIDP (including investment in AD and MBT), significant further investment beyond this is not expected although this is not certain.

		There may be an increase in waste recovery under the reasonable alternative, as waste is recovered rather than disposed of. The diversion of waste further up the hierarchy also has the potential to lead to a reduction in the waste sent for recovery, although this is uncertain. The effects of increased waste recovery on climate change are dependent on a number of factors, including the carbon content of recovered material, the amount and type of energy generation, the energy source displaced by generated energy, generating efficiencies, and the extent to which materials are removed for recycling. Increases in waste recovery under the reasonable alternative therefore has the potential to increase these emissions (although this is uncertain), with a greater effect on climate change. As for recycling, the construction of infrastructure which may be required would be required and greenhouse gases emitted associated with the construction of facilities (including the embodied carbon in the construction materials). In addition, resources would be required for construction materials. During operation, the energy requirements associated with different types of recovery facilities will vary, with the scope for the use of renewable energy greater for certain infrastructure types than for others. This is expected to be of a similar extent as for the WMPE. Potential increases in incineration with energy recovery can have beneficial or detrimental effects on climate change depending on the source of electricity the energy displaces, which is currently not known. Generating efficiencies are also much higher when heat is generated as well as electricity, however this option is not fully utilised at the incineration facilities currently operating in England and it is uncertain whether this would occur to a greater extent under the reasonable alternative. The WMPE specifies that AD is preferred as the most effective way to treat separately collected food waste to produce energy and valuable bio-fertiliser. Under the reasonable alternative, AD and associated energy production could further increase compared to the WMPE. Biogas produced from AD can be combusted in a gas engine turbine, with electricity exported to the grid, however the extent of avoided GHG emissions depends on the source of avoided electricity. The biogas can also be upgraded, such that the carbon within the gas is removed prior to injection into the gas grid, or upgraded to bio-methane for use a vehicle fuel, but the extent this may occur and the associated avoided GHG emissions is not certain. Recovery infrastructure may also be vulnerable to the effects of climate change such as flood risk and extreme weather. The extent of inclusion of adaptation measures to enhance resilience to climate change is not yet certain, and would be determined at later design stages. Overall, the effect of the reasonable alternative is uncertain, relative to the baseline for the issues covered by this SEA objective and guide questions.
Disposal (decrease in disposal of waste streams compared to WMPE)	++	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The reasonable alternative will require a quicker adoption of new behaviours and technologies to lessen demand on landfill sites. A long term trend towards reduction in material to landfill is expected to lead to a reduction in need and capacity for disposal. Under the reasonable alternative, landfill sites may close more quickly, however this is uncertain. Achieving the elimination of food waste to landfill more quickly than under the WMPE would have a greater effect on climate change, through a faster reduction in GHG emissions. This could contribute to the 'further ambition' measures set out by the Committee on Climate Change for achieving net zero emissions by 2050 (elimination of biodegradable waste sent to landfill by 2025 or earlier).[289] As emissions of methane from landfill is the greatest contributor of the waste sector to climate change, effects could be significant. Increased capture of future emissions of methane under the reasonable alternative compared to the WMPE is not certain. Overall, the reasonable alternative is expected to have a significant positive effect, relative to the baseline for the issues covered by this SEA objective and guide questions.

Cumulative	++/?	Overall, the reasonable alternative is expected to exceed the commitments in the WMPE, either through implementing improvements at a quicker rate, or to exceed existing targets for recycling and landfill avoidance, or both. Increases in waste avoidance, reuse and recycling at a faster rate than the WMPE is expected to lead to reductions in extraction of raw materials and manufacturing, with associated reductions in GHG emissions and effects on climate change. The extent of any reductions under the reasonable alternative is not certain, but there is the potential for effects to be significant. Measures to avoid food waste to landfill and divert other biodegradable waste to higher levels of the waste hierarchy more quickly than the WMPE are expected to further reduce GHG emissions, although emissions from existing waste in landfill will still require management and capture. As this is the primary source of GHG emissions from the waste sector, effects could be significant. Effects relating to waste recovery for the reasonable alternative have a greater level of uncertainty relating to the scale and nature of recovery, and the source of electricity that is displaced by the energy generated from waste. Overall, the reasonable alternative is expected to have greater benefits for climate change as a result of reduced GHG emissions, and has therefore been determined as having a significant positive effect with some uncertainty, relative to the baseline for the issues covered by this SEA objective and guide questions.

Score Key:	+ + **Significant** positive effect	+ **Minor** positive effect	0 **Neutral** effect	- **Minor** negative effect	- - **Significant** negative effect	? **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D7.8 Mitigating Measures

D7.8.1 To further support the SEA objectives, the following mitigation measures could minimise the impact on climatic factors:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Renewable energy generation could be included at sites of new waste infrastructure.
- Adaptation measures to enhance resilience to climate change could be included for new waste infrastructure.
- Heat from EfW and AD facilities should be used to increase generating efficiencies and avoid the need for heat generated from other sources.

D7.9 Uncertainties and Risks

- The scale, type and location of new infrastructure required when diverting waste from landfill to other stages of the waste hierarchy are not certain at this stage, with resulting uncertainties relating to construction and operational emissions.

- The extent of inclusion of renewable energy sources for powering new infrastructure is uncertain.
- The extent of inclusion of adaptation measures to enhance resilience to climate change is not yet certain.
- The overall change in waste collections and vehicle movements, and the resulting scale of GHG emissions and effects on climate change, are not certain.
- The type and composition of waste managed through disposal, recovery and recycling is uncertain, with associated uncertainties on the scale of GHG emissions.
- The extent to which waste prevention avoids product manufacture is uncertain.
- The extent and location of avoided extraction of primary raw materials are not known.
- The scale, type and source of avoided energy consumption from reduced processing and manufacturing are not certain.
- The source of energy displaced from waste recovery and the resulting effect on GHG emissions is not certain.
- The extent that heat may be used from EfW and AD facilities, avoiding the need for other heat sources, is not yet known.
- The extent to which higher calorific value material such as paper, cardboard, woods and organic material may be diverted from recovery to higher levels of the waste hierarchy is uncertain, leaving lower calorific value waste streams for EfW facilities.
- The future scale and management approach for capturing landfill gas is not certain.
- There are uncertainties regarding the extent and timescales that carbon in compost applied to soil remains sequestered in the soil.
- The scale of increased business resilience due to increased certainty of supplies and availability of recycled materials is not certain.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.

D8. Flood Risk and Coastal Change

D8.1 Introduction

D8.1.1 Flood risk within this context is defined as the risk of coastal, river, surface water, sewer and groundwater flooding. Coastal change in this context has been defined narrowly to include coastal processes coastal erosion.

D8.1.2 There are links between flood risk and coastal change and a number of other WMPE SEA topics, in particular water quality, water quantity and climatic factors.

D8.2 Review of plans and programmes

D8.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D8.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Flood Risk and Coastal Change. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D8.1 Flood Risk and Coastal Change Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2007) Floods Directive 2007/60/EC
National Plans and Programmes
Defra (2013) The National Adaptation Programme – Making the Country Resilient to a Changing Climate
Environment Agency (2011) National Flood and Coastal Erosion Risk Management Strategy for England
HM Government (2010) Flood and Water Management Act 2010
HM Government (2016) Environmental Permitting (England and Wales) Regulations 2016
MHCLG (2019) National Planning Policy Framework (NPPF)

D8.3 Overview of the Baseline

UK

D8.3.1 Flooding is associated with a range of sources: river, coastal, surface water, sewer, groundwater and reservoir.[324]

D8.3.2 Coastal erosion is occurring along 17% of the UK coastline.[325] Sea levels are rising, and are greater in the south of the UK than the north. The global-average sea level rose during the 20th century at an average rate of 1-2 mm/year, with some consensus on the larger value by the research community. The rate was larger (approximately 3mm/year) during the 1990s. UK sea level records

[324] Environment Agency. *Sources of flooding*. Available online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/homeandleisure/floods/31652.aspx
[325] Marine Climate Change Impacts Partnerships. *Impacts of climate change on coastal erosion*. Available online at: http://www.mccip.org.uk/annual-report-card/2013/climate-of-the-marine-environment/coastal-erosion/

are consistent with these values but with smaller trends observed in Scotland (where the land is uplifting) than in the south of the UK.[326]

England

D8.3.3 Approximately 2.4 million properties in England are currently at risk from flooding from rivers and the sea, of which approximately 155,000 residential properties are within high flood risk areas, and around 3 million properties are at risk from surface water flooding, including approximately 215,000 residential properties within high flood risk areas. The total area of agricultural land at risk of flooding is around 12% (1.3 million ha) whilst 122,000 and 290,000 properties are located within areas at risk of groundwater flooding (not including properties also in areas at risk of flooding from rivers and the sea).[327]

D8.3.4 Regionally, Greater London has the highest number of people at risk from flooding, with around 542,000 properties and one million people located in the floodplain. However, although London does have the largest number of people at risk, 84% are in areas with a low chance of flooding. This is mainly due to the major flood defences and flood defence structures in the Thames Estuary, including the Thames Barrier. The City of Kingston-upon-Hull and East Riding in Yorkshire are the two local authorities with the highest number of properties with a chance of flooding. However, other local authorities, such as Boston and North Somerset, have a higher share of properties in areas of significant flood risk. For instance, Boston has about two-thirds of its properties in areas with a significant chance of flooding.[328]

D8.3.5 Coastal erosion is occurring along 30% of England's coastline[329] and current estimates suggest that around 740 properties in England are vulnerable to coastal erosion by around 2030, with a further 1,500 vulnerable by around 2060.[330] Of the regions in England, Yorkshire and Humber has the greatest proportion of coastal length which is eroding at 56% (203km). Coastal erosion is occurring along 30% to 32% of the south east, and south west coastlines whilst 27% and 18% of the north east and north west coastlines respectively are eroding. The East Midlands has the smallest proportion of coastal length which is eroding at 9% or 21km.[331]

D8.4 Summary of Existing Problems Relevant to Waste and Resources

D8.4.1 The following existing problems for flood risk and coastal change have been identified:

[326] Marine Climate Change Impacts Partnerships (2013) *MCCIP Report Card 2013*. Available online at: http://www.mccip.org.uk/media/1301/mccip-arc2013.pdf

[327] Environment Agency (2016) *Adapting to a changing climate: The Environment Agency's second adaptation report under the Climate Change Act*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526000/climate-adrep-environment-agency.pdf and Environment Agency (2015) *Managing flood and coastal erosion risks in England: 1 April 2014 to 31 March 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447646/LIT_10125_FCERM_Annual_Report_2014_to_2015.pdf

[328] Environment Agency (2009) *Flooding in England: A National Assessment of Flood Risk*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292928/geho0609bqds-e-e.pdf

[329] Marine Climate Change Impacts Partnerships (2015) *Coastal erosion and coastal geomorphology*. Available online at: http://www.mccip.org.uk/annual-report-card/2007-2008/marine-environment/coastal-erosion.aspx

[330] Environment Agency (2016) *Adapting to a changing climate: The Environment Agency's second adaptation report under the Climate Change Act.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526000/climate-adrep-environment-agency.pdf

[331] Marine Climate Change Impacts Partnerships (2013) *Impacts of climate change on coastal erosion*. Available online at: http://www.mccip.org.uk/annual-report-card/2013/climate-of-the-marine-environment/coastal-erosion/

- Sea levels are rising, with worst case scenarios of a 1.15m increase in sea level by 2100 (with up to 0.83m more likely). The south and east of England will experience the greatest effective increases, due to the effects of post-glacial rebalancing.
- Flood risk presents a significant planning issue in the development of infrastructure projects, including those for waste management, both in terms of potential direct impacts on the project itself and indirect impacts associated with works (such as increased run-off) which could impact upon current and future waste infrastructure projects.

D8.5 Likely Evolution of Baseline

UK

D8.5.1 Climate change is likely to exacerbate erosion and flooding as a result of sea level rise together with a potential increase in the intensity, severity and frequency of storm events over the next 100 years. The most recent information for the UK from the UK Climate Projections (UKCP18) forecasts a range of relative sea level rise by 2100 (relative to the 1981-2000 average) of between 37 and 83cm in south-east England and 15 and 61cm in Scotland, under a central emissions scenario.

D8.5.2 The scenarios in UKCP18 lead to several predictions relevant to flooding:[283]

- The seasonal distribution of precipitation will change. Winters will become wetter and summers drier. Under the high emissions scenario, winter precipitation in the UK may increase by up to 35%, and decrease by up to 47% in summer.
- The pattern of sea level rise is not uniform across the UK, with sea level rise less in the north than in the south. For London, sea level rise by the end of the century (when compared to 1981-2000), for a high emission scenario is very likely to be 0.53m to 1.15m. For Edinburgh, the range is 0.30m to 0.90m.
- UK coastal flood risk is expected to increase over the 21st century under all emission scenarios considered. An increase in the frequency and magnitude of extreme water levels is expected around the UK coastline.
- The increased future flood risk is expected to be dominated by the effects of sea level rise, rather than changes in atmospheric storminess. There may also be changes in tidal characteristics.
- Projections of average wave height suggest changes of the order 10-20% across the 21st century and a general tendency towards lower wave heights.
- High resolution wave simulations suggest that the changes in wave climate over the 21st century on exposed coasts will be dominated by the large-scale response to climate change. However, more sheltered coastal regions are likely to remain dominated by local weather variability.

D8.5.3 Illustrative projections to 2300 suggest that UK sea levels will continue to rise over the coming centuries under all emission scenarios considered. For London the projections for 2300 are approximately 0.5 - 2.2m and 1.4 - 4.3m for the lowest and highest emission scenarios, respectively. The values for Edinburgh and Belfast are lower.

England

D8.5.4 The UK Climate Change Risk Assessment 2017 includes an assessment of flood risk for England.[332] Assuming no population growth and a continuation of current levels of adaptation, it is considered that by the 2050s the projected number of people at 1:75 or greater risk of flooding rises to around 1.7 million under a 2 degree scenario and 2.2 million for a 4 degree scenario. For the 2080s, the projections suggest 2 million people under a 2 degree scenario and 2.9 million people under a 4 degree scenario. It also projected that the number of residential properties exposed to flooding more frequently than 1:75 years (on average) increases from 860,000 today to between 1.2 million and 1.7 million properties in 2080, depending on the scenario considered. Expected annual damage to residential properties is projected to rise by between 22 – 78% in the 2050s and 47 – 160% in the 2080s depending on climate scenario.

D8.5.5 Sea level rise for London is expected to increase by between 37 – 83cm by 2100 under a central emissions scenario, compared to a 1981-2000 baseline.[283] Additionally, 28% of the combined English and Welsh coast has been found to be experiencing erosion rates greater than 10 cm/year.[332]

D8.5.6 Around 480,000 ha of Best and Most Versatile (BMV) agricultural land is currently at a 1-in-75 or greater annual chance of flooding from rivers, surface water or the sea. This is projected to increase by 15% by the 2050s under a 2 degree centigrade rise in mean global temperatures and 41% under a 4 degree centigrade rise. Over 40,000 ha of agricultural land were inundated during the 2007 floods in England, causing damage estimated at £50 million. The floods and storm surge in 2013/14 caused an estimated £19 million of damage to agriculture.

D8.5.7 Warmer, wetter winters and drier summers in the future could increase rates of soil weathering and increase soil erosion. This could in turn increase peak flows and hence fluvial and groundwater flood risk. This risk will be exacerbated where soils are degraded and compacted due to land management practices (medium magnitude/medium confidence).

D8.5.8 The Environment Agency estimates that over 700 properties could be lost to coastal erosion by around 2040, and over 2,000 could be lost by around 2070. These estimates take into account the interventions set out in shoreline management plans. Without the interventions, this could increase to about 5,000 properties by 2040 and about 28,000 by 2070.[333]

D8.6 Waste Management Effects on Flood Risk and Coastal Change

D8.6.1 The impact of flooding and coastal change will be a localised issue. To date, areas at threat of flooding or coastal erosion are well known and documented.

D8.6.2 As noted previously in **Section 8.3**, 2.4 million properties in England are currently at risk from flooding from rivers and the sea and 3 million properties are at risk from surface water flooding. Regionally, Greater London has the highest number of people at risk from flooding, with around 542,000 properties and one million people located in the floodplain.

D8.6.3 Over 30% of England's coasts are at risk of coastal erosion.[334] Coastal erosion is occurring along 30% to 32% of the south east, and south west coastlines whilst 27% and 18% of the north east and

[332] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for England.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-England-National-Summary-1.pdf

[333] Environment Agency (2018) *Managing flood and coastal erosion risks in England: 1 April 2011 to 31 March 2017*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/694808/1_April_2011_to_31_March_2017_managing_FCERM.pdf

[334] Marine Climate Change Impacts Partnerships (2015) *Coastal erosion and coastal geomorphology*. Available online at: http://www.mccip.org.uk/annual-report-card/2007-2008/marine-environment/coastal-erosion.aspx

north west coastlines respectively are eroding. The East Midlands has the smallest proportion of coastal length which is eroding at 9% or 21km.[335]

D8.6.4 Estimates suggest over 2,200 properties are vulnerable to coastal erosion by 2060.[336] Of the regions in England, Yorkshire and Humber has the greatest proportion of coastal length which is eroding at 56% (203km).

D8.6.5 The changing climate (see Chapter D7) is leading to an increase in sea levels. The UK Climate Change Risk Assessment 2017[337] estimates that, under a 4 degree scenario, 2.2 million people are at 1:75 or greater risk of flooding. At a local level, rising sea levels will increase water heights in London by between 37 – 83cm by 2100 under a central emissions scenario, compared to a 1981-2000 baseline[338]. Additionally, 28% of the combined English and Welsh coast has been found to be experiencing erosion rates greater than 10 cm/year.[332]

Waste Infrastructure

D8.6.6 The location, design and operation of waste infrastructure is addressed through waste local plans. Through the application of planning policies and site specific guidance, inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere. Local plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change - so as to avoid, where possible, flood risk to people and property.

D8.6.7 Coastal sites do not typically host waste infrastructure due to a combination of siting considerations, a desire to avoid coastal flooding and distance to communities to which they relate. However, there are exceptions e.g. a high-temperature incinerator at Ellesmere Port, the Newhaven ERF and the now closed landfill at Mucking Marshes, Essex. Flood defence systems – such as the Thames Barrier – are used to protect communities and assets against the risk of flooding, will depending on location help minimise the flood risks to waste management infrastructure.

D8.6.8 The changing climate could pose a risk to waste infrastructure itself. The waste sector relies heavily upon road networks which, if flooded, can create significant problems for authorities including a lack of storage space (jeopardising legislative compliance) or the risk of insufficient feedstock reaching thermal plants (leading to plant inefficiencies and shutdowns; causing an interruption to heat and energy receivers from local District Heating Networks)[339]. In response to any such floods, waste authorities may then revert to increased use of landfill simply to resolve the immediate crisis.

D8.6.9 Whilst use of current landfills may offer a short-term solution to the disposal of wastes in the event of flooding, landfill sites can also pose a risk as a result of flooding. Increased flooding can increase leachate seepage into underground waterways (if impermeable liners are not present or have failed). In addition, where landfills are poorly capped, it is possible that water can infiltrate the ground cover and risk both subsidence or the lifting of wastes and bursting of existing capping

[335] Marine Climate Change Impacts Partnerships (2013) *Impacts of climate change on coastal erosion*. Available online at: http://www.mccip.org.uk/annual-report-card/2013/climate-of-the-marine-environment/coastal-erosion/
[336] Environment Agency (2016) *Adapting to a changing climate: The Environment Agency's second adaptation report under the Climate Change Act.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526000/climate-adrep-environment-agency.pdf
[337] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for England.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-England-National-Summary-1.pdf
[338] UK CCC ASC (2017) *UK Climate Change Risk Assessment 2017 Evidence Report – Summary for England.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-England-National-Summary-1.pdf
[339] AEA (2012). Increasing the Climate Resilience of Waste Infrastructure.

material. As noted by AEA (2012)[340], modelling demonstrated that by 2100, sea level rises could threaten the security of landfill sites unless sufficient barriers are implemented. Research[341] by the University of Southampton and Queen Mary University of London identified around 2,000 historic landfills in England and Wales located in flood plains or in areas affected by coastal erosion, and highlighted the increasing environmental risks associated with coastal landfill sites in the face of climate change.

D8.6.10 Secondary risks of flooding stem from poor waste management practices. Whilst no research has been done to quantify the frequency or impact of this risk in England litter and fly-tipping have the potential to block local sewers and rivers, leading each to burst their banks and jeopardise local communities.

Materials Use

D8.6.11 Rising sea levels and coastal erosion are a consequence of a changing climate and carbon emissions.

D8.6.12 As noted across this Environmental Report, the use of virgin material requires significantly greater resources in terms of energy use, water demand then secondary materials.

D8.6.13 The increasingly ambitious targets in England that seek to increase recycling and minimise waste tonnages demonstrate a real opportunity to reduce England's demand for virgin materials; with a subsequent reduction in emissions. A Deposit Return Scheme (DRS) offers an opportunity to increase the capture of recyclate for reprocessing and following consultation on introducing a DRS in England, the Government intend to introduce a DRS to start no later than 2023. Following consultation on reforming the packaging producer responsibility system, the Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste.

D8.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D8.7.1 **Table D8.1** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

[340] ibid
[341] https://www.southampton.ac.uk/news/2018/11/coastal-landfill-climate.page

Table D8.1 Assessment of the Draft WMPE and reasonable alternative

Flood Risk and Coastal Change		
To minimise the risks from coastal change and flooding to people, property, communities and habitats and species, taking into account the effects of climate change.		
• Will the draft WMPE help to avoid development in areas of flood risk and, where possible, reduce flood risk? Where development in flood risk areas cannot be avoided, will the WMPE ensure that appropriate mitigation measures are applied to avoid increasing flood risk and, where possible, reduce flood risk? • Will the draft WMPE affect the resilience of infrastructure, places, communities and habitats and species to future flooding? • Will the draft WMPE help to avoid development in areas affected by coastal erosion and not affect coastal processes and/or erosion rates?		
	Effect	**Commentary**
WMPE		
Prevention	**0**	The WMPE collates ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. As noted across this Environmental Report (see Chapter D7 and D9), the use of virgin material requires significantly greater resources in terms of energy use, water demand then secondary materials. The prevention of wastes could reduce the need for waste management infrastructure. The adoption of waste prevention behaviours may therefore reduce the need for new infrastructure, therefore eliminating any (highly unlikely) potential for future such infrastructure to be sited to pose a flood risk (or be at risk of flooding). National and local planning policies and site specific guidance seek to ensure that inappropriate development in areas at risk of flooding are avoided. The circular economy, and improved waste management behaviours such as prevention, may reduce avoidable waste such as single use plastics. However, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling. The exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy – are therefore unknown. The actions within the WMPE seek to reduce wastes, which will in time, reduce the need for waste infrastructure. As such, the WMPE is likely to have an overall neutral effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	**+**	Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, *reusable* or compostable by 2025. The WMPE outlines the commitment to extend product lives through reuse and repair. The WMPE outlines actions to promote product redesign to improve reusability as well as ambitions to continue awareness campaigns to change consumer behaviours. Adopting new behaviours to reuse materials will extend the life of materials; reducing the need for virgin materials and new reprocessing capacity. The reuse of any materials, as promoted by the WMPE, may reduce the potential for littering which can contribute to surface sewer system obstructions and can flood local areas. In addition, the WMPE may also reduce the need for additional waste management infrastructure which could pose a theoretical (and very low) additional flood risk to local communities depending on siting and local factors. However, national and local planning policies and site specific guidance seek to ensure that inappropriate development in areas at risk of flooding are avoided.

		As noted in the prevention assessment above, the circular economy, and improved waste management behaviours may reduce avoidable waste however, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling and the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy – are therefore unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling	+	Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. Where composting is utilised to manage food wastes, the new compost can help improve soil condition and increase soil absorption, and increased retention times can contribute towards limiting localised flood risk. The WMPE includes plans for a separate food waste collection system. Subject to this service being implemented, it is possible any compost produced from the new service could help reduce flood risk, albeit at a very localised level. An increase in recycling, through the proposed collections – as well as a potential DRS – will incentivise consumers to recycle through the potential for financial incentives and use of convenient services. This would then remove litter from waterways which could contribute towards a (minor) cause of local flooding. It is possible that new infrastructure may be required to facilitate the improvements in recycling services. In terms of siting of new waste management infrastructure, the location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. As noted in the assessment above, the circular economy, and improved waste management behaviours may not reduce waste tonnages overall but may simply move wastes within the hierarchy; the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy with consequences upon flood risks – are therefore unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery	+	The WMPE specifies an ambition to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a role in these ambitions as wastes are diverted from landfill sites into EfW infrastructure. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. The WMPE seeks to improve the recovery of wastes by diverting materials from landfill to recovery. The use of AD plants to manage food waste can help to capture the 60% of food waste that is disposed in landfill[235]; this avoids any contribution of organic waste to the generation of leachate, which under flood conditions and which if poorly contained, can contribute to leachate seepage into underground waterways (As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. As noted in the sections above, the WMPE seeks to move wastes away from landfill and up the hierarchy. Landfill sites can also pose a risk as a result of flooding. Increased flooding can increase leachate seepage into underground waterways (if impermeable liners are not present or have failed).

		Whilst the movement of wastes up the hierarchy may require new reprocessing and treatment capacity, the risk posed by waste infrastructure to contribute to flooding or coastal change is minimal. The changing climate could pose a risk to waste collection as well as waste infrastructure itself. The waste sector relies heavily upon road networks which, if flooded, can create significant problems for authorities including inability to collect waste, a lack of access to storage space (jeopardising legislative compliance) or the risk of insufficient feedstock reaching thermal plants (leading to plant inefficiencies and shutdowns; causing an interruption to heat and energy receivers from local District Heating Networks). If waste infrastructure sites themselves flood, this would limit access for waste collection vehicles (also lead to shutdowns causing and interruption to heat and energy receivers from local District Heating Networks). In response to any such floods, waste authorities may then revert to waste sites which can be accessed depending on the location and extent of the flooding. This could result in increased use of landfill simply to resolve the immediate crisis. The plans and actions within the WMPE seek to move wastes up the hierarchy and to prevent wastes. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Cumulative	+	Overall the WMPE seeks to develop, incentivise and support changes in waste management in England. The proposed new services may reduce littering which could otherwise contribute to localised flooding by affecting waterway flows and surface water sewer systems etc. As noted in the sections above, the WMPE seeks to move wastes away from landfill and up the hierarchy. Landfill sites can pose a risk as a result of flooding which can lead to leachate seepage into underground waterways (if impermeable liners are not present or have failed). Whilst the movement of wastes up the hierarchy may require new reprocessing and treatment capacity, the risk posed by waste infrastructure to contribute to flooding or coastal change is minimal. The contribution of the waste sector to flood and coastal change is minimal and localised. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions by further reducing the risks through improved behaviours and new services.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	+	The reasonable alternative aims to exceed the Defra targets, ambitions and the services discussed in the WMPE and at a quicker pace. The prevention of wastes as a result of new behaviours - and the redesign of problematic materials through the circular economy – may reduce the overall tonnages of materials to be managed as wastes. This may reduce the risk of littering which can lead to flooding. As noted in the sections above, the reasonable alternative seeks to move wastes away from landfill and up the hierarchy at a pace faster than the WMPE. Landfill sites can also pose a risk as a result of flooding. Increased flooding can increase leachate seepage into underground waterways (if impermeable liners are not present or have failed). Whilst the movement of wastes up the hierarchy may require new reprocessing and treatment capacity, the risk posed by waste infrastructure to contribute to flooding or coastal change is minimal. The reasonable alternative seeks to implement the proposals of the WMPE at a quicker pace. Delivery of the aims of the WMPE may quickly reduce any risks associated with flooding and coastal change within the waste sector. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Reuse (increase in reuse of waste streams compared to WMPE)	+	The reasonable alternative seeks to exceed the target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The reasonable alternative assumes that reuse ambitions may be achieved at a quicker rate than the WMPE has outlined.

		The reasonable alternative suggests that products can be redesigned to eliminate the notion of wastes whilst increasing opportunities to reuse materials. The reasonable alternative suggests this may happen at a quicker pace than the WMPE. . This may reduce the risk of littering which can lead to flooding. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions in realising behavioural changes, whilst moving material up the hierarchy.
Recycling (increase in recycling of waste streams compared to WMPE)	+	As stated in the WMPE assessment above, Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being *recyclable*, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The reasonable alternative assumes that the ambitions of the WMPE will be delivered in a quicker timeframe and where results exceed stated targets. The reasonable alternative will see the implementation of new recycling services. This will include a potential DRS which will incentivise residents to recycle to recover the financial value in the material. This will reduce the incidence of littering which can lead to flooding. The introduction of the food waste collection service has the potential to generate compost, whose subsequent use can help improve soil condition and increase soil absorption, and increased retention times can contribute towards limiting localised flood risk, albeit at a very localised level. Any new infrastructure is unlikely to be approved in areas susceptible to flooding. Furthermore, the contribution of waste infrastructure to local floods is unknown and likely to be negligible. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery (increase in recovery of waste streams compared to WMPE)	+	The WMPE states the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The reasonable alternative therefore seeks to exceed these objectives by exceeding the targets within a speedier timescale. The use of AD plants to manage food waste can help to capture the 60% of preventable food waste that is currently disposed in landfill[235]; this avoids any contribution of organic waste to the generation of leachate, which under flood conditions and which if poorly contained, can contribute to leachate seepage into underground waterways (The reasonable alternative may divert materials from landfill to recovery; in this scenario it is possible that the capture rates could exceed expectations through high levels of consumer engagement. This may reduce demand for landfill infrastructure in the future and will reduce the risks of leachate leaking from landfills as a result of rising flood waters. As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal (decrease in disposal of waste streams compared to WMPE)	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The reasonable alternative will seek to exceed these ambitions at a quicker pace. As noted in the sections above, the WMPE seeks to move wastes away from landfill and up the hierarchy, reducing the risks of leachate seeping from the sites as well as any wastes escaping from poorly lined sites, or sites where an impermeable barrier is absent. The services proposed in the reasonable alternative may incentivise consumers to reuse, recycle or recover materials; reducing demand for landfills in England. The DRS and the household collection services may divert a range of materials into recycling and recovery levels of the hierarchy, reducing the demand for disposal options. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Cumulative	+	Overall the WMPE seeks to develop, incentivise and support changes in waste management in England. The reasonable alternative will deliver increased results within a tighter timeframe.

		The proposed new collection services will increase the range of materials that can be recycled, whilst incentivising consumers to engage in services that are convenient or that are accessible at home. This may divert materials from landfill into reuse, recycling or recovery facilities. Whilst new facilities may be required, the impact of these upon floods and coastal change are minimal. The use of AD plants or composting sites, to manage food waste, can create high quality compost that can improve the absorption rates of soil, reducing the risks of flooding. The new services may reduce the risk of litter entering local sewer systems and contributing to local flooding. In addition, the reasonable alternative may move wastes up the hierarchy; from landfill into recycling and recovery channels. This may reduce the generation of leachate and the risk of leachate being carried by floodwaters into local ecosystems and waterways. The reasonable alternative seeks to implement effective services within a tighter timeframe. This is likely to divert materials up the hierarchy and reducing the risks of flooding that could be posed by waste infrastructure. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.

Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D8.8 Mitigating Measures

D8.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on flood risk and coastal change:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- A site-specific flood risk assessment should be provided for all waste infrastructure development proposals in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use. For any flood risk assessment undertaken, take into account the impacts of climate change, clearly

stating the development lifetime over which the assessment has been made, and the range of climate scenarios considered.

- For specific waste infrastructure proposals, consider the risk of all forms of flooding arising from the development, in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime.
- Sustainable drainage systems should be used within the design of new facilities unless there is clear evidence that this would be inappropriate.
- Any excavated material arising from the construction of new infrastructure could be reused in nearby communities such as local parks or to reinforce flooding defences along rivers, for example.

D8.9 Uncertainties and Risks

- The threat of rising waters and floods have been mapped however it is possible that these predictions will evolve; future assessments cannot be known at this stage and should be reviewed when considering the location of new infrastructure.
- The locations of new waste management infrastructure are unknown and the effects on local flood risks are not certain.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far reaching impacts on local, national and international practices including the need for, and composition of, future waste management infrastructure as well as any flood risks associated with such new infrastructure.
- The full impact of behaviour changes and any movement of waste tonnages up the hierarchy is not known. It is possible that overall wastes may not decrease, but may simply move across the hierarchy.

D9. Waste and Resources

D9.1 Introduction

D9.1.1 Waste and resources encapsulate a range of stakeholders and operations that combine to manage our refuse and recycling. Waste regulations are taken at a local, national and international level. It is understood that, post Brexit, the UK will continue to emulate EU level environmental legislation.

D9.1.2 The promotion of, design and delivery of municipal waste collections and operations are conducted at a local level; predominantly by local authorities. These authorities are responsible for delivering household and community services whilst contributing to national legislation and targets. Often, these demands are outsourced to the private sector who undertake an element – or all of – the waste obligations upon the local authority. In some cases, local authorities also offer commercial waste collections, otherwise commercial waste is collected by a private waste contractor.

D9.1.3 As the UK moves to adopt the circular economy, a new evolution is beginning to emerge in our psyche and our policies; to design out the notion of waste entirely.

D9.1.4 The circular economy encourages producers to rethink the way products are designed and produced; to ensure assets remain in use as long as possible (via repair, upgrades etc.) whilst being easily disassembled at the end of their lifespan to allow components to be reused elsewhere.

D9.2 Review of plans and programmes

D9.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D9.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Waste and Resources. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D9.1 Waste and Resources Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (1991) Directive on Urban Waste-Water Treatment (1991/271/EEC)
European Commission (1994) Packaging and Packaging Waste Directive (1994/62/EC) (and subsequent amendments)
European Commission (1999) Directive on the Landfill of Waste (1999/31/EC)
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
European Commission (2006) Batteries Directive (2006/66/EC) (and subsequent amendments)
European Commission (2008) Waste Framework Directive (2008/98/EC)
European Commission (2009) Animal By-Products Regulations EC 1069/2009
European Commission (2012) Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) (repealed directive 2002/96/EC)
European Commission (2018) Directive Amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on Batteries and Accumulators, and 2012/19/EU on Waste Electrical and Electronic Equipment (Directive 2018/849)
European Commission (2018) A European Strategy for Plastics in a Circular Economy
National Plans and Programmes
DECC (2012) UK Bioenergy Strategy

Box D9.1 Waste and Resources Plans and Programmes Reviewed for the SEA of the Draft WMPE
Defra (2010) A Strategy for Hazardous Waste Management in England
Defra (2011) Anaerobic Digestion Strategy and Action Plan 2011
Defra (2011) Guidance on Applying the Waste Hierarchy to Hazardous Waste 2011
Defra (2012) UK Plan for Shipments of Waste
Defra (2013) National Policy Statement for Hazardous Waste
Defra (2013) Waste Management Plan for England
Defra (2018) Our Waste, Our Resources, a Strategy for England
HM Government (1990) The Environmental Protection Act (as amended)
HM Government (1996) Finance Act 1996 and Landfill Tax Regulations 1996
HM Government (2003) Waste and Emissions Trading Act 2003
HM Government (2005) The Hazardous Waste (England and Wales) Regulations 2005 (Amended 2009 and 2016)
HM Government (2005) The List of Wastes (England) Regulations 2005
HM Government (2007) The Producer Responsibility Obligations (Packaging Waste) Regulations 2007 (and subsequent amendments)
HM Government (2007) The Transfrontier Shipment of Waste Regulations 2007
HM Government (2008) The Planning Act
HM Government (2009) The Waste Batteries and Accumulators Regulations 2009
HM Government (2011) The Waste (England and Wales) Regulations 2011 (and subsequent amendments)
HM Government (2013) The Waste Electrical and Electronic Equipment (WEEE) Regulations 2013
HM Government (2016) Environmental Permitting (England and Wales) Regulations 2016
HM Government (2018) The Waste Enforcement (England and Wales) Regulations 2018
MHCLG (2014) National Planning Policy for Waste
MHCLG (2015) Planning Practice Guidance (PPG) for Waste
MHCLG (2019) National Planning Policy Framework (NPPF)
Defra (2013) Prevention is better than Cure: The Role of Waste Prevention in Moving to a More Resource Efficient Economy

D9.3 Overview of the Baseline

UK

D9.3.1 The UK generated 222.9 million tonnes of total waste in 2016. Nearly two thirds of this (61%) was generated by construction, demolition and excavation, with commercial and industrial waste accounting for 19% of the total, and households responsible for a further 12%. The UK Statistics on Waste[342] includes the following key points:

- The UK recycling rate for 'waste from households' was 45.7% in 2017 (including incinerator bottom ash metal), showing an overall increase in rates from 40.4% in 2010. There is an EU target for the UK to recycle at least 50% of household waste by 2020.
- UK Biodegradable Municipal Waste (BMW) sent to landfill has continued to fall and in 2017 was 7.4 million tonnes. This represents 21% of the 1995 baseline value. There is an EU target to restrict BMW landfilled to 35% of the 1995 baseline by 2020. The UK comfortably met interim targets for 2010 and 2013.

[342] Defra (2019) *UK Statistics on Waste (March 2019)*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/784263/UK_Statistics_on_Waste_statistical_notice_March_2019_rev_FINAL.pdf

- The recovery rate from non-hazardous construction and demolition waste in the UK in 2016 was 91.0%. There is an EU target for the UK to recover at least 70% of this type of waste by 2020.
- UK generation of commercial and industrial (C&I) waste was 41.1 million tonnes in 2016. This has fallen from 43.7 million tonnes in 2010.
- Of the 222.9 million tonnes of all waste that entered final treatment in the UK in 2016, 48.5% was recovered (including recycling and energy recovery), making this the most common final waste treatment type in the UK. The proportion that went to landfill was 24.4%, which was the second most used waste treatment.
- In 2017, 70.2% of UK packaging waste was either recycled or recovered compared to 72.7% in 2013. The 2014 EU target was for the UK to recycle or recover at least 60% of packaging waste.
- The UK imports around 167 million tonnes of goods and raw materials from abroad each year[343] including almost 1 million tonnes[344] of waste materials. The UK also exports approximately 16.3 million tonnes of materials for recycling per year.

D9.3.2 The Committee on Climate Change highlights that a quarter of food purchased by households and businesses in the UK is wasted, worth around £15 billion per year to households and £5 billion to firms. Additionally, around £150 million worth of clothing goes to landfill each year.[345] Avoiding waste and keeping resources in use for longer could have financial as well as environmental benefits.

D9.3.3 Recycling markets have become constrained in recent years with China, being the predominant offtaker of recycled plastics etc. – increasing the standards of material that they are willing to receive. This has required the UK to diversify the markets to which material is exported; being unable to utilise this at home due to no existing offtakers. The primary offtaker for UK wastes are in the EU; for both recycled material collected and Refuse Derived Fuel (RDF) produced in the UK. Exports of RDF have risen from 961,000 tonnes in 2012 to 3.2 million tonnes in 2017.

D9.3.4 The UK is committed to recovering 70% of non-hazardous construction and demolition waste (by weight) by 2020 in line with its target under the Waste Framework Directive.

England

D9.3.5 Households, commercial, industrial businesses and the construction sector in England produced over 189 million tonnes of waste arisings in 2016.[346]

D9.3.6 In 2017, 22.4 million tonnes of household waste was generated in England with a recycling rate of 45.2%.[347] This represents an increase from 44.9% in 2016, however rates have largely plateaued in recent years. Businesses produced 37.9 million tonnes of waste in 2017; no recycling rate is available.

[343] HMRC (2017) *HMRC trade data, all commodity codes*. Available online at: https://www.uktradeinfo.com/statistics/BuildYourOwnTables/Pages/Home.aspx
[344] HMRC (2017) *HMRC trade data, all waste commodity codes*. Available online at: https://www.uktradeinfo.com/statistics/BuildYourOwnTables/Pages/Home.aspx
[345] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf
[346] Defra (2019) *UK Statistics on Waste (March 2019).* Available online at: https://www.gov.uk/government/statistics/uk-waste-data
[347] Defra (2019) *UK Statistics on Waste (March 2019).* Available online at: https://www.gov.uk/government/statistics/uk-waste-data and https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/778622/UK_Statistics_on_Waste_dataset_Feb_2019_rev_FINAL.xlsx

D9.3.7 Household food waste was reduced by 21% from 2007 to 2012, however this decline has not continued. More recently household food waste has increased from 7 million tonnes in 2012 to 7.3 million tonnes in 2015.[348]

D9.3.8 The construction, demolition and excavation waste sector was the greatest contributor of waste with over 120 million tonnes produced in 2016; accounting for approximately two thirds of total waste generation. England has been exceeding its obligation to recover 70% of non-hazardous construction and demolition wastes, and has recovered in excess of 90% since 2010. The latest data for 2016 indicates a recovery rate of 92.1% for England.

D9.3.9 England also produced 4.8 million tonnes of hazardous waste in 2010 which dropped to 4.3 million tonnes in 2014.[349]

D9.3.10 Approximately 120,000 tonnes of Waste Electrical and Electronic Equipment (WEEE) was collected in Q1 of 2018; a 10% reduction in the previous year[350], however it is most likely that a significantly higher proportion of small WEEE is deposited into householders refuse bins and therefore being disposed within landfill.

D9.3.11 In England, 44.7 million tonnes of waste were set to landfill in 2016, an increase of 8% from 2014 (41.3 million tonnes).[346]

D9.3.12 In 2016, England's waste management sites amounted to:[351]

- 340 landfill sites that accepted waste in 2016 and managed 44.7 million tonnes in 2016;
- 2,340 transfer sites that accepted waste in 2016 and managed 46.7 million tonnes in 2016;
- 2,075 treatment sites that accepted waste in 2016 and managed 72.4 million tonnes in 2016;
- 1,244 metal recovery sites that accepted waste in 2016 and managed 13.8 million tonnes in 2016;
- 81 incineration sites that accepted waste in 2016 and managed 11.6 million tonnes in 2016.

D9.3.13 In 2017/18 the percentage of English Local Authorities collecting selected materials for recycling at the kerbside was:

- beverage cartons – 63%;
- card – 99%;
- glass – 89%;
- metals (cans / tins) – 100%;
- paper – 100%;
- plastic bottles – 99%;
- plastic pots, tubs and trays – 77%;

[348] House of Commons Environment, Food and Rural Affairs Committee (2017) *Food Waste in England - Eighth Report of Session 2016-2017*. Available online at: https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/429.pdf
[349] Defra (2018) *Digest of Waste and Resource Statistics - 2018 Edition*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710124/Digest_of_Waste_and_Resource_Statistics_2018.pdf
[350] HM Government (2018) Our *Waste, Our Resources: A Strategy for England: Evidence Annex*. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf
[351] Ibid

- separate food waste – 35%.

D9.4 Summary of Existing Problems Relevant to Waste and Resources

- The UK generated 222.9 million tonnes of total waste in 2016. Nearly two thirds of this (61%) was generated by construction, demolition and excavation, with commercial and industrial waste accounting for 19% of the total, and households responsible for a further 12%.[352]
- The UK imports around 167 million tonnes of goods and raw materials from abroad each year, including almost 1 million tonnes of waste materials. The UK also exports approximately 16.3 million tonnes of materials for recycling per year.[353,354]
- 'Recycling and other recovery' was the most common final waste treatment type in the UK. The UK recycling rate for 'waste from households' was 45.7% in 2017, showing an overall increase from 40.4% in 2010.[72]
- The majority of UK trend data shows an ongoing improvement in UK waste management practices, both in terms of a reduction in the level of waste generation and a greater use of sustainable alternatives to landfill.[355]
- The consumption of non-renewable sources will deplete overall stocks and may result in a scarcity of resources for future generations.
- A growing market is emerging for second hand products,[356] which could keep items in use for longer and out of waste streams. This may also avoid new products being manufactured.

D9.5 Likely Evolution of Baseline

UK

D9.5.1 The Government's 2018 Resources and Waste Strategy (RWS) sets two ambitious targets on the management of municipal waste:

- a 65% recycling rate for municipal solid waste (MSW) to be achieved by 2035; and
- no more than 10% of total MSW arisings being sent to landfill by 2035.

D9.5.2 As noted above, the UK is also committed to EU targets to:

- recycle at least 50% of household waste by 2020;
- restrict Biodegradable Municipal Waste (BMW) landfilled to 35% of the 1995 baseline by 2020; and

[352] Defra (2019) *UK Statistics on Waste (March 2019).* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/784263/UK_Statistics_on_Waste_statistical_notice_March_2019_rev_FINAL.pdf
[353] HMRC (2017) *HMRC trade data, all commodity codes*. Available online at: https://www.uktradeinfo.com/statistics/BuildYourOwnTables/Pages/Home.aspx
[354] HMRC (2017) *HMRC trade data, all waste commodity codes*. Available online at: https://www.uktradeinfo.com/statistics/BuildYourOwnTables/Pages/Home.aspx
[355] Tolvik Consulting (2017) *UK Residual Waste: 2030 Market Review*. Available online at: http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf
[356] European Commission (2014) *Flash Eurobarometer 388: Attitudes of Europeans towards Waste Management and Resource Efficiency*. Available online at: http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_388_en.pdf

- recover at least 70% of non-hazardous construction and demolition waste by 2020.

D9.5.3 The majority of UK trend data shows an ongoing improvement in UK waste management practices, both in terms of a reduction in the level of waste generation and a greater use of sustainable alternatives to landfill. Depending on future growth and recycling rates, overall waste accumulations (residual waste) are projected to drop to between 21 million tonnes and 27 million tonnes by 2030.[357]

D9.5.4 The Committee on Climate Change recommended a new emissions target for the UK of net zero emissions by 2050, 294 which has been included in legislation under the Climate Change Act in 2019.292 There is therefore a stronger legal driver to cut emissions from waste. Key policy approaches suggested are to divert food, paper and card, wood, textiles and garden waste from landfill, an increase in municipal waste recycling to 70%, and a 20% reduction in avoidable food waste by 2025. Measures relating to waste prevention and the treatment of waste water are also suggested.[278]

D9.5.5 A growing market is emerging for second hand products. In a 2014 Eurobarometer survey on resource efficiency, UK citizens reported a general willingness to buy many items second-hand.[358] A survey for the European Commission found that furniture was common item that would be bought second hand whilst small electricals were least likely. This latter point reiterates the reality that small WEEE predominantly ends up in refuse bins and therefore disposed into landfills; this could perhaps be due to a lack of potential buys to reuse or repair the item, or because owners do not consider that such a market exists to sell items. Both the UK and Scottish governments have stated their interests in building such markets by supporting organisations to keep such items in use for longer – and out of waste streams.

D9.5.6 The UK and devolved governments are continuing to seek new opportunities to reduce waste, for example from carrier bag charges, elimination of single use plastics, extended producer responsibility schemes and deposit return schemes.

England

D9.5.7 Defra has established targets for England which includes a greater focus on waste prevention, seeking to achieve a fall of 50% per person in household waste arising. Recycling and composting of household waste targets have been established - at least 50% by 2020; and recovery of municipal waste - 75% by 2020.

D9.5.8 The 2018 RWS sets more ambitious targets including a 65% recycling rate for municipal solid waste to be achieved by 2035, and a 10% limit on total municipal solid waste being sent to landfill by 2035.

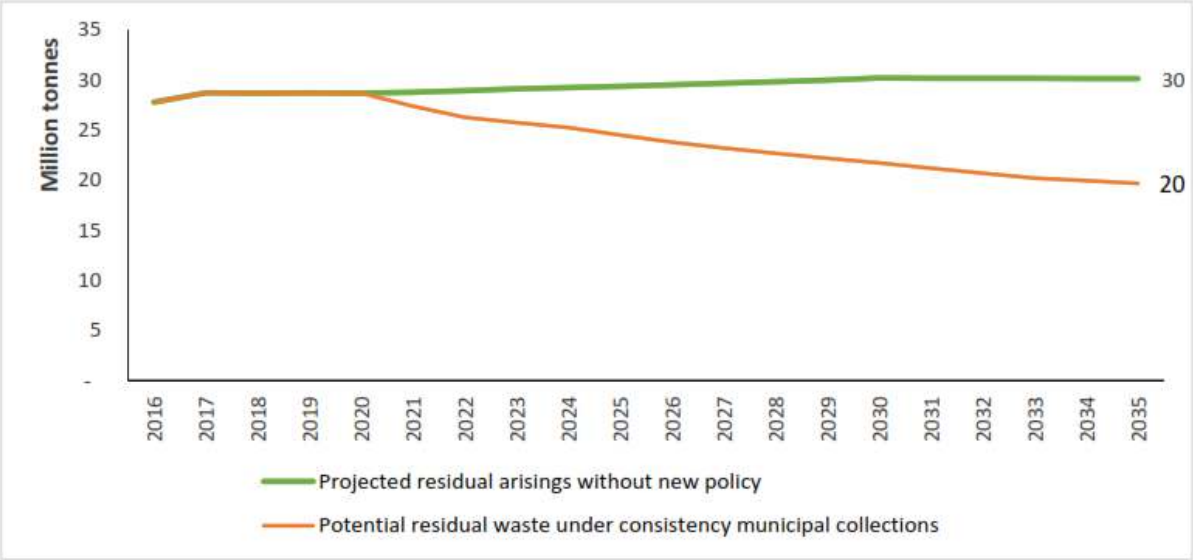
D9.5.9 On the basis of an evaluation of the development of waste streams in the future set out in the 2013 Waste Management Plan for England[359], commercial and industrial waste arisings have been predicted to fall to 43.9 million tonnes by 2020.

[357] Tolvik Consulting (2017) *UK Residual Waste: 2030 Market Review*. Available online at: http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf
[358] European Commission (2014) *Flash Eurobarometer 388: Attitudes of Europeans towards Waste Management and Resource Efficiency.* Available online at: http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_388_en.pdf
[359] Defra (2013) *Waste Management Plan for England.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf

D9.5.10 As noted above, the CCC report[360], if adopted would see the introduction of policies to support carbon reduction targets. It is expected that waste policies – including the WMPE – will be impacted by this and expected to minimise emissions and material demand where possible.

D9.5.11 Projected municipal residual waste arisings, both with and without, new policy is shown in **Figure D9.1**.[361] Without new policy, it is possible that municipal residual waste arisings could reach 30.1 million tonnes in 2035.

Figure D9.1 Projected municipal residual waste arisings with and without new policy



Source: Defra modelling

D9.5.12 In 2017/18 local authorities dealt with almost 998,000 incidents of fly-tipping in England; down 1% from 2016/17.[362]

D9.6 General Waste Management and Resource Effects

D9.6.1 Waste management is a broad sector and encapsulates activities from household collection services, to the engineering, procurement, commissioning and management of waste treatment infrastructure.

D9.6.2 The sector has evolved fundamentally over the previous decade; from a prominent role of managing mixed residual wastes in landfill to the near eradication of waste in general, through the increase in recycling, impending deposit return scheme and adoption of the circular economy.

D9.6.3 Waste is now recognised as a resource for authorities and sectors. When collected, separated, cleaned and reprocessed, it can be a valuable source of income.

[360] Climate Change Committee (2019) *Net Zero – The UK's contribution to stopping global warming.* Available online at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/
[361] HM Government (2018) *Our Waste, Our Resources: A Strategy for England.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf
[362] Defra (2018) *Fly-tipping statistics for England, 2017/18.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/756306/Fly-tipping_201718_Statistical_Release_rev.pdf

D9.6.4 When wastes are recycled this provides an alternative source which can cut demand for virgin production materials.

D9.6.5 When collected and used in recovery facilities, the combustion of the material can be used to generate heat and electricity for local communities.

D9.6.6 The waste hierarchy outlines the preferred approach to waste management; from reducing waste through to disposal. Disposal is seen as the last resort. There are many reasons for this including the loss of resources and the environmental impacts of, for example, landfills.

D9.6.7 Landfill has become an increasingly costly option; with the Landfill Tax (LFT) for standard wastes increasing from £7 per tonne in 1997[363] to £94.15 per tonne in 2020.

D9.6.8 Legislation and targets from governments are seeking to eliminate poor and damaging practices through restrictions upon use of landfills. The Waste Framework Directive sets ambitious targets to reduce the landfilling of municipal waste to landfill to less than 10% by 2035. This will further encourage exploration of more socially and environmentally acceptable solutions. Furthermore, there is a landfill disposal and incineration ban in place for industrial and automotive batteries and a target to reduce landfill of Biodegradable Waste by 65% by 2020 against the 1995 baseline.

D9.6.9 It is recognised that there will continue to be a role for landfill. Whilst landfill is deterred, the use of this method for disposal of inert waste can be acceptable and can provide a valid option to restore quarries and other excavation sites; subject to planning obligations however, as noted in the Resources and Waste Strategy, it is recognised this should only be an option of last resort and all reuse or recycling opportunities should be prioritised.

D9.6.10 It is stated in the 25 year Environment Plan Progress Report (Defra, 2019[364]) that 80% of the damage inflicted upon the environment could be avoided if more thoughtful decisions were taken at product design stage. This demonstrates how the adoption of circular economy principles can help avoid environmental impacts at a later stage.

D9.6.11 This section discusses the current and future changes in waste management, focussing upon the impacts upon waste infrastructure and materials use.

Waste Infrastructure

D9.6.12 Waste infrastructure in England includes a mix of waste management infrastructure including:[365]:

- 340 landfill sites that accepted waste in 2016 and managed 44.7 million tonnes in 2016;
- 2,340 transfer sites that accepted waste in 2016 and managed 46.7 million tonnes in 2016;
- 2,075 treatment sites that accepted waste in 2016 and managed 72.4 million tonnes in 2016;
- 1,244 metal recovery sites that accepted waste in 2016 and managed 13.8 million tonnes in 2016;
- 181 incineration sites that accepted waste in 2016 and managed 11.6 million tonnes in 2016.

[363] Institute for Fiscal Studies. Rates of Landfill Tax. Accessible online at: httpThas://www.ifs.org.uk/uploads/publications/ff/landfill.xls
[364] Defra (2019). *25 Year Environment Plan Progress Report*. Accessible here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/803266/25yep-progress-report-2019-corrected.pdf
[365] Ibid

D9.6.13 In addition to the above, almost 3,000 additional waste treatment sites are permitted in England as of 2017[366]. However, this number will include closed sites as well as those yet to be constructed and commissioned. Based on unpublished research by Wood, it is estimated that approximately 160 additional waste treatment sites (incinerators, biomass plants etc) have been consented or are currently in the planning phase in England as of May 2019.

D9.6.14 In 2017 / 2018 the percentage of English Local Authorities collecting selected materials for recycling at the kerbside was:

- Beverage cartons – 63%;
- Card – 99%;
- Glass – 89%;
- Metals (cans / tins) – 100%;
- Paper – 100%;
- Plastic bottles – 99%;
- Plastic pots, tubs and trays – 77%;
- Separate food waste – 35%.

D9.6.15 Both the WMPE and the Resources and Waste Strategy will contribute to the delivery of five strategic ambitions:

- To work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025;
- To work towards eliminating food waste to landfill by 2030;
- To eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan;
- To double resource productivity by 2050; and
- To eliminate avoidable waste of all kinds by 2050.

D9.6.16 Food waste has been identified as a material for immediate attention. WRAP estimates that over 25Mt of greenhouse gas emissions are generated from food waste per annum, creating over 6BN cubic metres of water footprint. This is estimated to have cost the UK over £20BN in 2015. Following support in the consultations by Defra (2019)[367], the Government will introduce measures for England to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England, and to collect food waste separately from all households on a weekly basis. It has not yet been determined whether the collection of garden waste will be free or subject to charging.[368] This could generate over 8Mt of organic fertiliser for the agri-food sector, and be worth up to £280M in renewable energy sales for AD facility operators[369]. In 2017, the Environment, Food and Rural Affairs Select Committee, when gathering information for the

[366] Environment Agency (2018). *Waste Management in England*: *2017 data*. Accessible online at: https://www.gov.uk/government/publications/waste-management-data-for-england
[367] DEFRA (2019) *Consultation on Consistency in Household and Business Recycling Collections in England*. Accessible online at: https://consult.defra.gov.uk/environmental-quality/consultation-on-consistency-in-household-and-busin/
[368] Defra (2019) *Consultation Outcome: Consistency in Recycling Collections in England: Executive Summary and Government Response: Updated 23 July 2019*. Accessible online at: https://www.gov.uk/government/consultations/waste-and-recycling-making-recycling-collections-consistent-in-england/outcome/consistency-in-recycling-collections-in-england-executive-summary-and-government-response
[369] Defra (2018). *Our Waste, Our Resources: A Strategy for England: Evidence Annex*. Available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

report into 'Food Waste in England', received evidence that AD plants had extensive capacity remaining[370] although views on this are not settled[371], as food and green waste collection practices and volumes continue to change.

D9.6.17 Following the 2019 consultation on consistency in recycling collections, Government will be mandating weekly separate food waste collection, and will give further consideration to providing guidance on frequency of collection for residual waste.[368]

D9.6.18 The Government has consulted on a Deposit Return Scheme (DRS) for single use drinks containers in England and reforming the UK packaging producer responsibility system. The consultations closed in May 2019.[372,373] Following the outcome of the consultations, Government is minded to introduce a DRS for drinks containers (pending further evidence and analysis) from 2023, and plans to introduce an extended producer responsibility system for packaging from 2023.[374,375] If the DRS is adopted in England, new infrastructure will be required. This will include external collection points at supermarkets, counting centres and bulking stations. Whilst local authority buildings and existing buildings could be repurposed for these needs, it is a possibility that new buildings may be required for the new services. The reformations of the packaging producer responsibility system may also stimulate the development of new domestic infrastructure.

D9.6.19 The tonnages of recyclates collected in England may increase as a result of efforts to achieve waste reduction and recycling targets. New services, such as the DRS and the reformed packaging producer responsibility system, will contribute to the achievement of these targets when implemented.

D9.6.20 As more waste material is collected for the purposes of reuse, recycling and reprocessing, there is a concern in the waste industry that there will be a gap in the available waste treatment capacity within the UK; from 0.7Mt estimates in a best case scenario, to a 13Mt capacity gap if trends do not change.[376]

D9.6.21 The circular economy encourages producers to rethink the way products are designed and produced; to eliminate or minimise the creation of waste and to ensure assets remain in use as long as possible (via repair, upgrades etc.) whilst being easily disassembled at the end of their operational life to allow components to be reused elsewhere. It has been estimated that a circular economy has the potential to produce £10BN GVA and 200,000 jobs by 2030[377].

[370] House of Commons Environment, Food and Rural Affairs Committee (2017). *Food Waste in England*. Available online at: https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/42908.htm
[371] Tolvik (2019) *Anaerobic Digestion Market in Great Britain: Does it have the capacity?* Available online at: https://www.tolvik.com/published-reports/view/anaerobic-digestion-market-great-britain/
[372] Defra (2019) *Introducing a Deposit Return Scheme (DRS) in England, Wales and Northern Ireland*. Available online at: https://consult.defra.gov.uk/environment/introducing-a-deposit-return-scheme/
[373] Defra (2019) *Consultation on reforming the UK packaging producer responsibility system*. Available online at: https://consult.defra.gov.uk/environmental-quality/consultation-on-reforming-the-uk-packaging-produce/
[374] Defra (2019) *Consultation Outcome: Introducing a Deposit Return Scheme (DRS) in England, Wales and Northern Ireland: Executive Summary and Next Steps: Updated 23 July 2019*. Available online at: https://www.gov.uk/government/consultations/introducing-a-deposit-return-scheme-drs-for-drinks-containers-bottles-and-cans/outcome/introducing-a-deposit-return-scheme-drs-in-england-wales-and-northern-ireland-executive-summary-and-next-steps#executive-summary
[375] Defra (2019) *Consultation on Reforming the UK Packaging Producer Responsibility System: Summary of Consultation Responses and Next Steps*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819467/epr-consult-sum-resp.pdf
[376] Tolvik (2017). *UK Residual Waste: 2030 Market Review: Final*. The Environmental Services Association. Accessible at: http://www.esauk.org/application/files/6015/3589/6453/UK_Residual_Waste_Capacity_Gap_Analysis.pdf
[377] The Princes Responsible Business Network (2018) R*esource Productivity and the Circular Economy: The Opportunities for the UK Economy*. Accessible online at: https://www.bitc.org.uk/sites/default/files/resource_productivity_and_the_circular_economy_opportunities_for_the_uk_economy-compressed_1.pdf

D9.6.22 As noted by Amey (2018), both domestic processing and reprocessing capacity is needed, alongside domestic treatment and energy recovery infrastructure[378] however the National Infrastructure Commission[379] suggests that increased recycling could have a positive impact on required infrastructure by reducing the need for incinerators:

- a universal food waste collection, as proposed in the Waste Management Plan, could avoid the need to construct between 1 and 3 energy from waste plants by 2050, saving £400M CAPEX and £1.1BN OPEX for local authorities; and
- Increased recycling (notably plastics) could avoid the need to build 20 additional incinerators, saving £6.2BN by 2050.

D9.6.23 The importance of any new infrastructure is exacerbated by the reduced capacity and acceptability of exporting collected materials to a foreign nation. This is discussed in Chapter D12: Landscape and Townscape.

D9.6.24 The operation of new facilities will demand increased vehicle movements with an increase in emissions upon air quality, local soils and land users as discussed across relevant chapters in this Environmental Report. Waste management vehicles account for 0.5% of all vehicle movements.[380] In 2017, waste related products were the third most common commodity transported by HGVs in the UK[381], making up 11% of all goods lifted. Whilst any additional waste management infrastructure proposals could explore alternative transport options such as the use of the rail network, this approach is likely to increase costs when compared to movements of waste via HGVs and LGVs.

D9.6.25 In 2017, 256M tonnes of wastes were transported via the road network[382].

D9.6.26 Increasingly, local authorities are exploring collaborations to increase efficiencies and reduce costs. Collaborations exist through areas such as joint procurement, partnership working and asset sharing. Local authorities are common partners in developing and funding large and expensive infrastructure such as MRFs or EfW plants. In addition, authorities are collaborating on waste collection services. A consolidation of local authority resource management systems is estimated to save between £200M and £450M[383].

Materials Use

D9.6.27 As noted previously, the recycling sector is projected to triple in size between 2017 and 2060[384], demonstrating a behavioural shift from demanding virgin material to reusing recyclable products.

D9.6.28 Whilst demand for virgin material may decrease, it will not be eliminated. The UK's latest environmental accounts until 2017 show that total domestic extraction decreased from 691Mt in

[378] Hevia (2018) *Recycling and Waste World. The UK Needs More Infrastructure to Support a Circular Economy*. Accessible online at: http://www.recyclingwasteworld.co.uk/opinion/the-uk-needs-more-infrastructure-to-support-a-circular-economy/195133/
[379] National Infrastructure Commission (2018). *National Infrastructure Assessment*. Accessible at: https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf
[380] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf
[381] Department for Transport (2017). *Domestic Road Freight Statistics*, United Kingdom 2017.
[382] Department for Transport (2017). *Goods lifted by commodity and type and weight of vehicle: 2017*. Accessible online at: https://www.gov.uk/government/statistical-data-sets/rfs01-goods-lifted-and-distance-hauled#overall-trends-in-domestic-road-freight
[383] ESA (2016). *Resourceful: Delivering a Strong and Competitive UK Resource Economy*. Available at: http://www.esauk.org/application/files/1015/3607/2368/20160801_RESOURCEFUL_Delivering_a_strong_and_competitive_UK_resource_economy.pdf
[384] OECD (2019). *Global Material Resources Outlook to 2060. Economic Drivers and Environmental Consequences*. Pg 144. Accessible online at: https://read.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en#page144

1992 to 441Mt in 2017[385]. The extraction of raw materials to produce virgin goods will have an adverse impact upon landscapes including mines, quarries and forests (See Chapter D4: Landuse, Geology and Soils, as well as Chapter D12: Landscape and Townscape).

D9.6.29 The OECD (2019) state that global environmental impacts through the demand for primary metals are projected to increase by 200% to 400% by 2060.

D9.6.30 Greenhouse gas (GHG) emissions from the waste sector accounts for 4% of the UK's total emissions (20.3 MtCO2e in 2017).[386] This presents a slight increase from 2016 (20.0 $MtCO_2e$), but is a notable reduction across the last five years, from 26.1 $MtCO_2e$. Emissions of methane from landfill accounted for the majority of these emissions, resulting from the decomposition of biodegradable waste. As noted in Chapter D7: Climatic Factors of this Environmental Report, the carbon impact of sourcing secondary materials is significantly less than the climatic impacts of producing virgin material. Aluminium is a resource intensive product requiring one of the highest levels of water input per kg of primary material. Aluminium requires over 1kg of water to generate 1KG of primary material however this drops by two thirds for secondary material. Similarly, the air intensity for virgin material drops from over 10kg per kg to less than 1kg per kg. Resource savings are also evident when comparing virgin plastics to recycled materials[387]. It is therefore evident that the use of supply, and use of secondary materials, is a clear benefit of effective and efficient waste management infrastructure.

D9.6.31 Global plastics production reached 407Mt in 2015 to become the most commonly used material; greater than paper, and aluminium. Plastics have received extensive media coverage due to the impacts upon litter and ecosystems. It is estimated that between 5 and 13Mt of plastic pollution is emitted into the world's ocean basins on an annual basis[388] at a cost of $13BN per year with an overall annual natural capital cost of $75BN.[389] The increase in recycling and the growing public interest[390] to reduce single use plastics more generally, have increased savings to consumer good companies of up to $4BN each year (UNEP 2014).[391]

D9.6.32 As noted in the draft Waste Management Plan, England has banned the sale of plastic microbeads in rinse-off personal care products and are introducing a ban on the supply of plastic drinking straws, stirrers and plastic stemmed cotton buds in October 2020.

D9.6.33 The 25 Year Environment Plan (Defra, 2019) outlines a range of financial incentives to transform the plastics economy including £60M through the Industrial Strategy Challenge Fund, £20M from government to tackle plastics and boost recycling, £10M for plastics research and development, £10M to pioneer innovative approaches to increasing plastics recycling and minimising litter and £20M to the Plastics Innovation Fund to improve plastics research and development[392].

D9.6.34 Following support in the 2019 consultation, a DRS in England could target single use drinks containers such as glass bottles, plastic bottles and cans and could provide a source of high quality

[385] Office for National Statistics (2019). *UK Environmental Accounts: 2019*. Accessible online at: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2019
[386] BEIS (2019) *Final UK greenhouse gas emissions national statistics 1990-2017: Table 3*. Available online at: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2017
[387] Wuppertal Institut (2014). *Material intensity of materials, fuels, transport services, food*. Available online at: https://wupperinst.org/uploads/tx_wupperinst/MIT_2014.pdf
[388] Jambeck et al (2015) *Plastic waste inputs from land into the ocean*
[389] UNEP (2014) *Environment Under Review*. Accessible online at: https://www.unenvironment.org/news-and-stories/press-release/plastic-waste-causes-financial-damage-us13-billion-marine-ecosystems
[390] https://www.earthday.org/plasticban/
[391] UNEP (2014) *Valuing Plastic: The Business Case for Measuring, Managing and Disclosing Plastic Use In The Consumer Goods Industry*. Accessible online at: http://wedocs.unep.org/handle/20.500.11822/9238
[392] Defra (2019). *25 Year Environment Plan Progress Report*. Accessible here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/803266/25yep-progress-report-2019-corrected.pdf

separated materials that could be used by reprocessors and so further decrease the demand for virgin materials. The objective of the planned reform of the packaging producer responsibility system is to reduce unnecessary and hard to recycle packaging, which could also provide a source of high quality secondary materials for use by domestic reprocessors.

D9.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D9.7.1 **Table D9.1** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D9.1 Assessment of the Draft WMPE and reasonable alternative

Waste and Resources		
To nurture a circular economy, minimise waste arisings, promote reuse, recovery and recycling, minimise the impact of wastes on the environment and communities and contribute to the sustainable use of natural and material assets.		
• Will the draft WMPE affect the use of limited natural resources? • Will the draft WMPE require additional infrastructure and resources? • Will the draft WMPE make best use of existing infrastructure and resources? • Will the draft WMPE help achieve government and national targets for minimising, recovering and recycling waste? • Will the draft WMPE affect waste practices and behaviours in residents and businesses? • Will the draft WMPE affect community level or national capabilities to re-use, recycle and recover materials? • Will the draft WMPE support a circular economy?		
	Effect	**Commentary**
WMPE		
Prevention	+	The WMPE collates ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which may reduce material use and waste generated. The prevention of waste may reduce the use of limited resources. As noted earlier in this chapter, the demand for virgin material has significant impacts upon the environment; through both carbon emissions and water demand. The WMPE outlines a commitment to improve waste behaviours through increased awareness initiatives and the adoption of new paradigms in the circular economy; the WMPE will therefore reduce the demand for virgin materials which will help eliminate wastes which reach landfill; therefore supporting the government to achieve national targets. Adopting CE principles could reduce environmental damage by 80% "if more thoughtful decisions were taken at product design" stage (Defra, 2019); showing how CE principles can minimise environmental impacts at later stages of a product lifespan. This may lead to a reduction in the infrastructure that would be necessary to tackle wastes at later stages of the waste hierarchy. The prevention of wastes could eliminate the need to construct more waste management sites including AD plants and EfW plants; this would have a positive effect on local communities by reducing the impacts from transport movements (see chapter D10: Traffic and Transport) as well as to reduce the visual, noise and litter impacts associated with construction or operation of these sites (see chapter D12: Townscape and Landscape).However the precise extent of waste reduction initiatives within the WMPE are likely to be localised and cannot be quantified.

		The circular economy, and improved waste management behaviours such as prevention, may reduce avoidable waste such as single use plastics. However, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling. The exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy – are therefore unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+	Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, *reusable* or compostable by 2025. This will require changes to the behaviour of consumers, manufacturers and reprocessors. This ambition is further supported in the WMPE with the ongoing commitment to extend product lives through reuse and repair. The WMPE outlines a commitment to improve the design of materials by adopting the principles of the circular economy. By improving the design of products, this could extend the lifespan of items by offering reuse opportunities. As noted above, this would positively affect the waste practices and behaviours in residents and businesses, whilst also reducing future demand for virgin materials and natural resources. This will also help the government to achieve waste reduction and diversion targets. The commitment to reusing materials, and moving wastes up the hierarchy, may also reduce the demand for new waste collection sites, reprocessors and recovery infrastructure. This would then reduce the negative impacts from such infrastructure in communities and may offer improvements to issues such as fly-tipping, noise pollution, light pollution and littering (the latter will see improvements in both the terrestrial and marine environments). As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	+	The WMPE reiterate a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The new services outlined in the WMPE include new consistent household waste collection systems, a DRS and a reformed packaging producer responsibility system, which all received support in the 2019 consultations. The new services will ensure a uniform series of materials are collected and, possibly, an increase in materials for some householders, as well as reducing unnecessary and hard to recycle packaging. The new household collection systems may require new infrastructure as is noted in the 2017 Tolvik study that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt; new infrastructure may be required for sorting and reprocessing of wastes. The demand for new capacity may require new infrastructure, causing a negative impact on communities through construction and operational issues such as visual impacts, local landscapes and a potential for light and noise concerns as well as intrusion through construction works. However, it is also possible that existing infrastructure can be repurposed for these needs. Given this uncertainty, and the localised impact of any waste infrastructure, it is impossible to state if the WMPE will have positive or negative effects. In terms of siting of new waste management infrastructure, the location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. This would either seek to minimise or reduce any adverse effects whilst possibly being an opportunity for authorities to promote the reuse or repurposing of vacant infrastructure. As noted in the assessment above, the circular economy, and improved waste management behaviours may not reduce waste tonnages overall but may simply move wastes within the hierarchy; the exact extent of behaviour changes – and the impacts on material tonnages

		across the hierarchy with consequences upon waste tonnages and the response of the waste management sector – are therefore unknown. Overall, the proposals within the WMPE will support the government to achieve waste targets whilst supporting the adoption of a circular economy. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	+	The WMPE highlights the government's ambition to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a role in these ambitions as wastes are diverted from landfill sites into EfW or AD infrastructure until any recycling markets are identified for diverted wastes. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. Whilst it is not known when nor where such new capacity is needed at this stage, if new plants are required, it is possible that infrastructure may pose an impact to local communities, however it is possible that existing infrastructure can be repurposed to meet these needs, or brownfield sites can be brought back to use. As noted previously however new waste management infrastructure would require planning permission (and other environmental consents) which then would either seek to minimise or reduce any adverse effects. The proposals within the WMPE will assist the government to achieve waste targets whilst supporting the adoption of new behaviours and practices among the public and businesses. The plan may help move waste up the hierarchy from disposal, into recovery (and possibly beyond). As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The services, ambitions and policy framework within the WMPE will reasonably reduce demand for current and future landfill sites as well as other disposal infrastructure. The exact extent to which disposal demand may drop, or the impact the WMPE may have on future disposal and landfill numbers, is not known at this time. Overall the WMPE is expected to move wastes up the hierarchy; from disposal into new value creation opportunities such as recycling or recovery options. The WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+	The WMPE outlines a range of targets and ambitions that the government is aspiring to meet. The framework demonstrates a "routemap" to divert wastes up the hierarchy; reducing the need for landfill sites and capturing new value in materials through reuse, recycling and recovery. It also seeks to improve the environmental impact of waste management by reducing demand for virgin material and losing this value through disposal options at the end of life. The demand for new infrastructure could pose risks to local communities where new sorting and reprocessing capacity is needed. Whilst newly built infrastructure could cause a range of effects (see above), it is also possible that any such infrastructure could be housed in existing sites or on brownfield sites; therefore posing little to no impact on local townscapes or landscapes whilst offering significantly improved recycling services to communities. The adoption of circular economy principles can take this one step further by eliminating wastes entirely by redesigning materials to be reusable or recoverable and this is supported in the WMPE. The WMPE will instil a range of behavioural improvements among residents and businesses by seeking to eliminate or capture wastes insofar as possible. The range of services proposed in the WMPE will facilitate this however the extent of these improvements cannot be specifically quantified although should be aligned with the existing targets (e.g.

		increasing recycling from households from current levels to 65% by 2035). As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++	The reasonable alternative aims to exceed the Defra targets, ambitions and the services discussed in the WMPE and at a quicker pace. The WMPE outlines a commitment to support adoption of the circular economy which may help to design out the notion of waste by capturing value at every stage of a products lifecycle. This would instil new behaviours in both consumers and businesses. Such changes to behaviours across society can significantly reduce the demand for virgin and natural materials. The reasonable alternative will aim to improve waste prevention measures significantly; reducing the need for virgin materials and, down the line, recycling and recovery infrastructure. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)		The reasonable alternative seeks to exceed the target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The reasonable alternative assumes that reuse ambitions will be achieved at a quicker rate than the WMPE has outlined. The reasonable alternative would allow consumers (and businesses) to realise the value in maintaining, repairing and reusing materials. This would then allow products to have a longer life; reducing the need for new items. As noted previously, a behavioural shift to adopt reuse as a more normative behaviour, could reduce existing and future demand for waste infrastructure. This could offer benefits to communities through reduced noise and light pollution, intrusion from vehicle movements and a potential reduction in litter or fly-tipping onshore and offshore. Adopting reuse could also see the closure and restoration of landfill sites to offer new community amenities such as greenspaces or wildlife habitats; this would return what was once previously waste management infrastructure, back to community use. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling (increase in recycling of waste streams compared to WMPE)	++	As stated in the WMPE assessments above, Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The reasonable alternative assumes that the ambitions of the WMPE will be delivered in a quicker timeframe and where results exceed stated targets. The reasonable alternative would offer new services, at a quicker pace, to segregate recyclate, including a separate food waste collection service. The services would also include a DRS for drinks containers. This has the potential to capture a high rate of target materials. By developing a clean, segregated material stream, this may help reduce demand on natural resources. The increased recycling services and, most notably, the DRS, may incentivise participation through convenient services which will offer a financial incentive through the DRS. The reformed packaging producer responsibility system will also reduce unnecessary and hard to recycle packaging. Together these may reduce littering across towns and the marine environment; providing a benefit to the visual landscape in communities. As noted previously, any new infrastructure that is considered necessary to increase sorting and reprocessing capacity can be located in existing buildings or on brownfield sites. It is possible therefore that new infrastructure could have a limited impact on communities. Taking this approach could allow for new services to be implemented but with minimal new infrastructure required however the precise capacity and required infrastructure that may be needed for all the new services is not known.

		The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. This would either seek to minimise or reduce any adverse effects whilst possibly being an opportunity for authorities to promote the reuse or repurposing of vacant infrastructure. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery (increase in recovery of waste streams compared to WMPE)	++	The WMPE states the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The reasonable alternative therefore seeks to exceed these objectives by exceeding the targets within a speedier timescale. The reasonable alternative would introduce a separate collection of food waste and assumes a higher participation and material capture rate than the WMPE may deliver. As noted previously, the recovery ambitions within the reasonable alternative may divert food waste from landfill into higher levels of the hierarchy. This change may require additional capacity in infrastructure however this is not known at this time. As noted above, any new infrastructure would have to comply with local planning obligations and it is possible that existing infrastructure can be repurposed to meet these needs, or brownfield sites can be brought back to use. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal (decrease in disposal of waste streams compared to WMPE)	++	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The reasonable alternative will seek to exceed these ambitions at a quicker pace. The reasonable alternative has the potential to divert wastes away from disposal facilities at a quicker pace. This would see a reduction in the demand for new, or even existing, disposal infrastructure such as landfills or visually intrusive EfW plants. The closure, or avoidance, of landfill offers significant advantages to communities by reducing the need for excavation and construction works, as well as the noise, lighting and odour impacts from the operation and movements associated with such disposal methods. Overall the WMPE is expected to move wastes up the hierarchy; from disposal into new value creation opportunities such as recycling or recovery options. The reasonable alternative is expected to exceed these ambitions and is therefore likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	++	The reasonable alternative outlines a range of ambitions and targets that seek to improve waste behaviours across the country over and above those contained in the WMPE. The reasonable alternative suggests that the new services will be introduced at a quicker pace than the WMPE whilst achieving greater results. The reasonable alternative seeks to implement behavioural changes in consumers and businesses to design out wastes and to improve waste behaviours overall. Moving wastes up the hierarchy may reduce demand for virgin and natural materials. To achieve the goals of the reasonable alternative, new infrastructure may be required to manage the increased recyclate that is captured and the material from any DRS and food waste collection service. However, it is possible that any such infrastructure can be housed/located in/on existing sites or on brownfield sites; therefore, reducing any impact to communities. The reasonable alternative suggests that ambitious behaviour changes will be achieved in a short timeframe. The range of services and implementations proposed would facilitate such changes. As such, the reasonable alternative is likely to have an overall significant positive

		effect, relative to the current baseline for the issues covered by this SEA objective and guide questions				
Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect
NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.						

D9.8 Mitigating Measures

D9.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on waste and resources:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Services should be designed to maximise recycling and recovery rates and could take into account the convenience to consumers by, for example, optimising the number and siting of return points for any DRS (and the range of materials collected).
- Strong awareness campaigns could be implemented to encourage participation in any collection services.
- Partnership opportunities could be explored between local authorities or contractors to explore asset-sharing opportunities.
- Any excavated material arising from the construction of new infrastructure could be reused in other local developments, nearby communities such as local parks or to reinforce flooding defences along rivers, for example.
- Restoration of landfill sites could also produce recreational sites for local communities.
- Requirement for responsible construction of waste infrastructure to undertake a full assessment of the impacts on the construction and operation of any new infrastructure.

D9.9 Uncertainties and Risks

- The range of materials within new services are not known. The rate of participation and expected increased capture rates – and impacts on natural material demand – is also unknown.

- An increase in reuse of materials or a reduction in waste tonnages could increase waste imports to recovery sites to maintain calorific requirements.
- The level of investment and type of infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The full impact of behaviour changes and any movement of waste tonnages up the hierarchy is not known. It is possible that overall wastes may not decrease, but may simply move across the hierarchy.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far reaching impacts on local, national and international practices including the need for, and composition of, future waste management infrastructure.

D10. Traffic and Transport

D10.1 Introduction

D10.1.1 Within this context, the definitions of traffic and transport are:

- Traffic - the aggregation of pedestrians or vehicles coming to, or leaving from, a particular locality during a defined period of time.
- Transport - the movement of people and goods from one place to another. Transport is performed by various modes, such as air, rail, road and water.

D10.1.2 There are links between the traffic and transport topic and other topics in this SEA for the WMPE including air quality, noise, health, biodiversity, landscape, climatic factors and population, economics and skills.

D10.2 Review of plans and programmes

D10.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D10.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Traffic and Transport. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D10.1 Traffic and Transport Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
National Plans and Programmes
Department for Transport (DfT) (2012) National Policy Statement for Ports
HM Government (2000) Countryside and Rights of Way Act 2000
MHCLG (2019) National Planning Policy Framework (NPPF)

D10.3 Overview of the Baseline

UK

D10.3.1 The following sub-sections review the current situation on the UK's transport networks.

Road

D10.3.2 Great Britain has a road infrastructure network of 397,000 kilometres in 2017, the majority of which is made up of minor roads (87.1%).[393]

[393] Department for Transport (2018) *Road Lengths in Great Britain 2017 Report*. Available online at: https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2017

D10.3.3 In 2017, total motor vehicle traffic in Great Britain reached a new record level, with 526 billion kilometres (a 1.3% increase from 2016).[394] In Great Britain, overall there has been a steady increase in domestic road freight with 78% of freight goods being moved by road in 2017 (compared to 73% in 2014). Lorry and van traffic continued to grow, rising 1% and 3% respectively from 2016 levels.

D10.3.4 There were 1,770 road deaths in the year ending June 2018. This is a similar level to that seen since 2012.[395] This is some 45 per cent fewer fatalities than a decade earlier (in 2006). There were 26,610 people killed or seriously injured (KSI) reported to the police in the year ending June 2018. This compares to 26,664 in the year ending June 2017.

Rail

D10.3.5 Over the last two decades there has been substantial growth in rail usage, and rail passenger journeys are now at their highest level since the 1920s. An average of 4.7 million journeys per day are made in Great Britain. The majority of growth has been in the London and the South East, and 64% of journeys either start or end in London.

D10.3.6 Around 9% of all freight moved in Great Britain was by rail in 2017. In 2015-16, freight moved by rail was 18 billion net tonne km, down 20% from 2014-15. This decrease was mainly due to a decline in the amount of coal moved, which has fallen substantially (72%) since 2005-06.[396]

Aviation

D10.3.7 There are 58 airports in the UK, with Heathrow being the largest and accounting for twice as many passengers and air transport movements as that next largest airport, Gatwick.[397] Air traffic in the UK has been rising steadily; in 1953 there were 195,000 air traffic movements (ATMs), by 2017 this figure was 2,200,000 (2% more than 2016 but 5% less than the peak in 2007). In this time, both the number of passengers flying (arrivals and departures) and the amount of freight transported has risen dramatically to 284 million passengers and 2.6 million tonnes respectively.[398]

Water

D10.3.8 The UK has 51 Major Ports, defined as ports with cargo volumes of at least 1 million tonnes annually, including Sullom Voe; Forth; Tees and Hartlepool; Hull; Grimsby and Immingham; Felixstowe; Harwich; London; Ramsgate; Dover; Portsmouth; Southampton; Milford Haven; Holyhead; and Liverpool. Overall total freight tonnage declined by 1 per cent in 2015 with 496.7 million tonnes being handled by UK ports in 2015. Whilst tonnage fell marginally, reflecting

[394] Department for Transport (2018) *Transport Statistics Great Britain 2018*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787488/tsgb-2018-report-summaries.pdf
[395] Department for Transport (2018) *Reported road casualties in Great Britain: quarterly provisional estimates year ending June 2018.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/754685/quarterly-estimates-april-to-june-2018.pdf
[396] Department for Transport (2017) *Rail Trends Factsheet*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590561/rail-trends-factsheet-2016-revised.pdf
[397] Department for Transport (2016) *Transport Statistics Great Britain 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/489894/tsgb-2015.pdf
[398] Department for Transport (2018) *Transport Statistics Great Britain 2018*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787488/tsgb-2018-report-summaries.pdf

reduced demand for coal and ores, changes in steel production, and lower dependency on food imports, unitised traffic experienced a third consecutive year of growth.[399,400.]

England

Road

D10.3.9 England has a road infrastructure network of approximately 304,000 km (as at 2017), of which 12% comprises major roads.[401] The average speed on local 'A' roads in England during the weekday morning peak in the year ending December 2015 was 23.4 mph. This is a 0.7% decrease on the year ending September 2015.[402]

D10.3.10 Over the last two decades the rate of car traffic growth has slowed. For an average person, car use fell throughout the 2000s, but this was partially offset by an increase in population using the roads. Van traffic has grown faster than car traffic on all types of road in recent years. HGV vehicles are travelling less distance, but carrying more goods since the 1990s, owing to a shift away from using smaller HGV vehicles towards larger vehicles or vans. HGV traffic has not yet returned to pre-recession levels. Recent trends show a resumption of traffic growth after the recession. Growth has been strongest on the SRN and for van traffic across all roads.[403]

D10.3.11 Mileage travelled by heavy goods vehicles involved in household waste management activities is estimated to account for 0.5% of all vehicle movements.[404] Factors that affect the volume of vehicle movements include the number of properties served, the volume and characteristics of the waste collected, the frequency of collection, the collection routes used and the distance between generation of waste and the location of appropriate management facilities. Changes to collections may alter vehicle movements; if this resulted in an increase in vehicles, this could add pressure to the road networks in congested areas.

Rail[405]

D10.3.12 In 2014/15, 70% of Great Britain rail journeys were made with London and South East operators.

Aviation[406]

D10.3.13 The 5 London airports (Heathrow, Gatwick, Luton, Stansted, London City) accounted for 60% of passengers, 50% of ATMs and 78% of freight in 2017.Heathrow is the busiest airport in the UK,

[399] Department for Transport (2016) *UK Port Freight Statistics: 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/555338/port-freight-statistics-2015.pdf
[400] Department for Transport (2015) *Domestic Waterborne Freight, 2014*. Available online at: https://www.gov.uk/government/statistics/domestic-waterborne-freight-2014
[401] Department for Transport (2018) *Road Lengths in Great Britain 2017 Report*. Available online at: https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2017
402 Department for Transport (2016) *Congestion on local 'A' roads, England: October to December 2015 Report.* Available online at: https://www.gov.uk/government/statistics/congestion-on-local-a-roads-england-october-to-december-2015
[403] Department for Transport (2016) Road use statistics Great Britain. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/514912/road-use-statistics.pdf
[404] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf
[405] Department for Transport (2016) *Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2015.* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541587/rail-passengers-crowding-2015.pdf
[406] Department for Transport (2016) *Air traffic at UK airports*. Available online at https://www.gov.uk/government/statistical-data-sets/avi01-traffic-passenger-numbers-mode-of-travel-to-airport

followed by Gatwick and Manchester, with approximately 75 million passengers in 2015.[407] The other major airports in London are Gatwick, Luton, Stansted and London City, and other major airports in England include Birmingham, Bristol, Newcastle, East Midlands International and Liverpool (John Lennon).

Water

D10.3.14 Grimsby and Immingham remained England and the UK's busiest port in terms of tonnage, handling 12 per cent of the UK market in 2015 with 59.1 million tonnes of goods. Grimsby and Immingham overtook London as the busiest port in 2000. It also accounted for the largest share of the UK's dry bulk traffic at 18 per cent (19.1 million tonnes). However, dry bulk tonnage at this port has decreased by 10 per cent compared to the previous year.[408]

D10.3.15 In 2017, goods moved by domestic water transport accounted for 13% of total domestic freight transport in the UK.

Modes of Transport

D10.3.16 The 2011 Census highlighted that the majority people in England travelled to work by car. The breakdown of methods of travel to work is as follows:[409]

- working mainly at or from home – 3.5 % (1,349,568 persons);
- underground, metro, light rail, tram – 2.6% (1,027,625 persons);
- train – 3.5% (1,343,684 persons);
- bus, minibus or coach – 4.9% (1,886,539 persons);
- taxi – 0.3% (131.465 persons);
- motorcycle, scooter or moped – 0.5% (206,550 persons);
- driving a car or van – 36.9% (14,345,882 persons);
- passenger in a car or van -3.3% (1,264,553 persons);
- bicycle – 1.9% (742,675 persons);
- walking – 6.9% (2,701,453 persons);
- other method of travel to work – 0.4% (162,727 persons); and
- not in employment 35.3% (13,718,653 persons).

D10.3.17 UK Census data also indicates that the average distance travelled to work in England and Wales increased from 13.4km in 2011 to 15.0km in 2011.[410]

[407] CAA (2016). *Summary of Activity at Reporting Airports 2015.* Available online at http://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Datasets/Airport_stats/Airport_data_2015/Table02_2_Summary_Of_Activity_at_UK_Airports_2015.pdf

[408] Department for Transport (2016) *UK Port Freight Statistics: 2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/555338/port-freight-statistics-2015.pdf

[409] ONS (2011) *Method of Travel to Work in England and Wales – 2011.* Available online at: http://www.ons.gov.uk/ons/rel/census/2011-census-analysis/method-of-travel-to-work-in-england-and-wales/sty-method-of-travel-to-work.html

[410] ONS(2014) *2011 Census Analysis - Distance Travelled to Work.* Available online at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171776_357812.pdf

D10.4 Summary of Existing Problems Relevant to Waste and Resources

D10.4.1 The following existing problems for traffic and transport have been identified:

- Traffic on parts of the UK's transport network exceed capacity at peak times.[411]
- Increasing levels of congestion are on the UK's strategic road network, with road traffic forecast to increase.[412]
- There is a need for investment in transportation infrastructure to meet future demand and support economic growth.
- There is a need to reduce the need to travel and facilitate a shift towards more sustainable modes of transport. [413]
- Changes to collections may alter vehicle movements; if this resulted in an increase in vehicles, this could add pressure to the road networks in congested areas.

D10.5 Likely Evolution of Baseline

UK

Road

D10.5.1 England's road traffic is expected to increase by between 19 - 55% above 2010 levels by 2040. Whilst new technologies will provide some relief through better use of network capacity, more highly automated vehicles may also be part of the problem by stimulating demand.[414]

Rail

D10.5.2 The National Policy Statement for National Networks (Department for Transport, 2014)[415] highlights that passenger demand is predicted to continue to grow significantly, by 50.1% by 2033 with long distance rail passenger travel increasing by 63.8%. Total rail freight, meanwhile, is forecast to grow by 3% annually to 2043.

D10.5.3 The All-Party Parliamentary Group for High-Speed Rail's Report of the Inquiry into Britain's Rail Capacity highlights that if the current growth rate of demand continued for a sustained period, current infrastructure would be inadequate and incremental upgrades such as those suggested by Rail Package 2 (RP2) and 51m's 'Optimised Alternative' would be insufficient to accommodate the demand.

[411] Department for Transport (2018) *Transport Statistics Great Britain 2018*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787488/tsgb-2018-report-summaries.pdf
[412] Department for Transport (2015) *Road Traffic Forecasts 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf
[413] Committee on Climate Change (2019) *Net Zero – Technical Report.* Available online at: https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf
[414] Reese Jeffrys (2016) *A major road network for England*. Available online at: http://www.futureroadsengland.org/
[415] Department for Transport (2014) *National Policy Statement for National Networks*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

D10.5.4 In this context, the UK Government has identified a need for development of the national rail network at the strategic level including the development of strategic rail freight interchanges and new high-speed lines.

Aviation

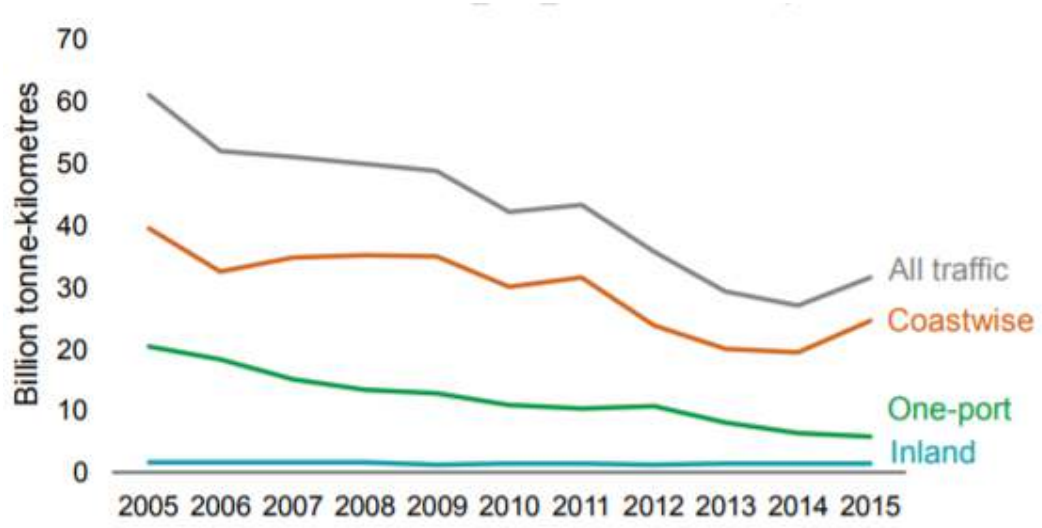
D10.5.5 Demand for air travel is forecast to increase within the range of 1% - 3% a year up to 2050, compared to historical growth rates of 5% a year over the last 40 years. The slowdown in growth rates in the future reflects the anticipation of market maturity across different passenger markets and a projected end to the long-term decline in average fares seen in the last two decades.[416]

D10.5.6 The central forecast from the 2013 analysis, taking into account the impact of capacity constraints, is for passenger numbers at UK airports to increase from 219 million passengers in 2011 to 315 million in 2030 and 445 million by 2050. This is an increase of 225 million passengers over the next 40 years compared to an increase of 185 million since 1970. The major south east airports are forecast to be full by 2030. However, there is a range around this projection and they could be full as soon as 2025 or as late as 2040. Heathrow remains full across all the demand cases considered by the DfT.

Water

D10.5.7 **Figure D10.1** shows the trend data for domestic water transport. There is an overall downward trend for coastwise (traffic carried around the coast from one UK port to another) and one-port (traffic to and from offshore locations, such as oil rigs and sea dredging) freight good moved, noting the increase in coastwise transport in 2015. Freight goods movements via inland waterways has remained largely static since 2015.

Figure D10.1 Domestic waterborne freight goods moved, 2005-2015



Source: Department for Transport

[416] Department for Transport (2013) *UK Aviation Forecasts.* Available online at: https://www.gov.uk/government/publications/uk-aviation-forecasts-2013

England

D10.5.8 Forecasts undertaken by the DfT indicate that compared to a 2010 baseline (and under a central scenario), road traffic will be between 19% and 55% higher by 2040. Cars are the dominant mode of road transport and are forecast to remain so in spite of a slight reduction in the proportion of total traffic they make. Cars made up 80% of traffic miles in 2010 and are forecast to make up between 73% and 80% of traffic miles in 2040, whereas light goods vehicles (LGVs) made up 14% in 2010 and this is forecast to be in the range 15% to 20% in 2040. HGVs comprise 6% of total traffic in 2010 and this is forecast to be in the range of 4% to 6% in 2040.[417]

D10.6 Waste Management Effects on Traffic and Transport

D10.6.1 Waste management is a contributor to road traffic. The logistics involved include collecting and bulking materials from local communities, before these are then taken to reprocessors or disposal sites.

D10.6.2 Waste management logistics remain a sensitive issue among local communities with existing or proposed waste infrastructure.

D10.6.3 Waste is predominantly transported using the road system. In very rare cases rail transport has been explored or adopted due to costs involved.

D10.6.4 Traffic and transport include use of the road network, rail system, aviation and, ports or shipping.

D10.6.5 Waste movements generate both emissions and dusts. These pose a risk to local communities through negative impacts upon biodiversity (see Chapter D1), human health (see Chapter D3), air quality (see Chapter D6), climate change (see Chapter D7) and local buildings (see Chapter D11). The potential risk of litter, from poorly secured wastes can also impact upon many of these receptors.

Waste Infrastructure

D10.6.6 Waste hauliers are a significant user of England's 300,000km of roads. Vehicle movements contribute to the congestion on the UKs transport network.

D10.6.7 Waste management vehicles account for 0.5% of all vehicle movements.[418] In 2017, waste related products were the third most common commodity transported by HGVs in the UK[419], making up 11% of all goods lifted.

D10.6.8 In 2017, 256M tonnes of wastes were transported via the road network. **Table D10.1** provides a summary of tonnages transported against each vehicle type[420].

[417] Department for Transport (2015) *Road Traffic Forecasts 2015.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf
[418] Defra (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69391/pb9052a-health-report-040325.pdf
[419] Department for Transport (2017). *Domestic Road Freight Statistics*, United Kingdom 2017.
[420] Department for Transport (2017). *Goods lifted by commodity and type and weight of vehicle: 2017*. Accessible online at: https://www.gov.uk/government/statistical-data-sets/rfs01-goods-lifted-and-distance-hauled#overall-trends-in-domestic-road-freight

Table D10.1 Waste movements by vehicle type

Rigid vehicles					Articulated vehicles		
Over 3.5t to 7.5t	Over 7.5t to 17t	Over 17t to 25t	Over 25t	All Rigids	Over 33t	All Artics	All vehicles
3M tonnes	4M tonnes	17M tonnes	80M tonnes	103M tonnes	50M tonnes	50M tonnes	153M tonnes

D10.6.9 In 2017, the number of foreign registered freight vehicles increased from 0.6M in 1997 to 2.1M in 2017, whilst UK registered goods vehicles decreased by 37% in the same time period however it is not known how many of these vehicles are specifically for the movements of wastes.[421]

D10.6.10 With traffic on England's roads anticipated to increase by up to 55% by 2040, the number of vehicles on the roads are set to increase significantly. Across a range of scenario modelling LGV traffic is anticipated to increase from between 23% and 108% by 2050 with "a significant impact on total traffic growth".[422] In contrast, HGV traffic is forecast to grow by just 5% to 12% across the same scenarios. As a consequence, LGVs will account for 19% of all traffic; increasing congestion from 7% to 16% however no explicit contribution from waste movements is known.[423]

D10.6.11 Waste collection vehicles operate in local communities throughout the day, and, on occasion, are routed out of the main area if bulking site are located in the suburbs. Bulkers and hauliers then take bulked waste to reprocessing sites. Bulkers and hauliers predominantly operate outside of rush hours to minimise congestion.

D10.6.12 Any changes to waste collection services, including development of new infrastructure, routing or fleet selection, will create a change on community roads and traffic impacts. It is reasonable to assume that the proposed Deposit Return Scheme (DRS) for England will increase vehicle movements. Whilst the exact design is not yet known, there will be an increase of vehicles from collection sites to counting centres, and onwards to bulking sites or reprocessors. The DRS is likely to generate significant vehicle movements that, subject to operating hours, will increase traffic on roads across England.

D10.6.13 Total waste shipments out of the UK decreased from 210Mt in 2008 to 178Mt in 2017 however a clear breakdown of the contribution of wastes cannot be confirmed.[424]

D10.6.14 In 2016 91% of hazardous waste exports were shipped from the UK to other EFTA member states.[425] Shipments of hazardous wastes from the UK to EFTA countries has increased significantly from 36,000t in 2001 to 383,000t in 2016[426]. It is reasonable to expect a continued increase in shipments from the UK to EFTA nations until additional capacity is developed in the UK.

[421] Department for Transport (2018). *Transport Statistics Great Britain 2018, Moving Britain Ahead*. Accessible online at: https://www.gov.uk/government/statistics/transport-statistics-great-britain-2018
[422] Department for Transport (2018). *Road Traffic Forecasts*. Accessible at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740399/road-traffic-forecasts-2018.pdf
[423] Department for Transport (2018). *Road Traffic Forecasts*. Accessible at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740399/road-traffic-forecasts-2018.pdf
[424] Eurostat Statistics (2018). *Gross Weight of Goods Transported from UK Main Ports*. Accessible here: https://ec.europa.eu/eurostat/web/transport/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_yjUOJMEUlFPI&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=1
[425] Eurostat Statistics (2016). *Waste Shipment Statistics*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_shipment_statistics#Shipments_of_hazardous_waste_within_and_out_of_the_EU
[426] Eurostat Statistics (2016). *Waste Shipment Statistics*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_shipment_statistics#Shipments_of_hazardous_waste_within_and_out_of_the_EU

D10.6.15 Data from the EU suggests that no waste was transported by rail in England between 2008 and 2018[427] however data from the Department for Transport (2019) shows that waste accounted for 3% of commodities moved by rail in 2017, equating to 0.5Bn tonne-kms[428] In total 365,000 freight train movements took place in 2006/07, dropping to 224,000 in 2016/17[429]; an equivalent drop from 9.4M road vehicle journeys to 8.2M in 2016/17.

Materials Use

D10.6.16 Waste movements demand high quantities of fuel. Between 1970 and 2016, HGV fuel demand has increased from 3.63Mt of fuel to 6.41Mt of fuel. For LGVs, fuel demand increased from 2.085Mt in 1970 to 6.12Mt in 2017. However, the proportion related to waste movements is not known[430].

D10.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D10.7.1 **Table D10.2** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D10.2 Assessment of the Draft WMPE and reasonable alternative

Traffic and Transport		
To minimise the volume of traffic and promote more sustainable transport choices.		
• Will the draft WMPE help to minimise traffic volumes? • Will the draft WMPE affect congestion? • Will the draft WMPE help to minimise the direct effects of transport such as noise and vibration, air pollution and carbon emissions, severance of communities and wildlife habitats and safety concerns? • Will the draft WMPE encourage alternative and sustainable means of transporting freight, waste and minerals, where possible?		
	Effect	**Commentary**
WMPE		
Prevention	+	The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. It is likely that the reduction of wastes overall may reduce the need for vehicle movements as wastes will no longer require collection, storage and transfer to recyclers, reprocessors or disposal sites. The circular economy, and improved waste management behaviours such as prevention, may reduce avoidable waste such as single use plastics. However, it is possible that waste

[427] Eurostat Statistics (2019). *Goods transported by Group of Goods – from 2008 Onwards*. Accessible at: https://ec.europa.eu/eurostat/web/transport/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_yjUOJMEUlFPI&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=1

[428] Department for Transport (2017). *Domestic Freight moved by commodity. 2017*. Accessible at: https://www.gov.uk/government/statistical-data-sets/rai04-rail-freight

[429] Department for Transport (2017). Nu*mber of Freight Train Movements, Impact on Road Haulage and Freight Performance Measure: Annual From 2006/07*. Accessible at: https://www.gov.uk/government/statistical-data-sets/rai04-rail-freight

[430] Department for Business, Energy and Industrial Strategy (2018). *Energy Consumption in the UK (ECUK) 2018*. Accessible online at: https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

		prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling. The exact extent of behaviour changes – and the impacts on movement of material tonnages across infrastructure at each level of the hierarchy – are therefore unknown. As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions. .
Reuse	?	The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material as the WMPE supports the adoption of the circular economy principle including the redesign of materials that could improve the reusability of plastics. An increase in reuse of materials could see a reduction in vehicle movements related to waste and recycling collections, if materials are re-used in the home. However, in an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can use the by-products from other businesses. As such these reusers may generate new vehicle movements between reusers; with an impact on traffic and transport; it could be expected that the movements of vehicles between businesses may lead to a minor increase in vehicle movements as business-to-business movements outnumber waste collections that would otherwise have taken the wastes from the business as part of collection routes. As noted in the prevention assessment above, the circular economy, and improved waste management behaviours may reduce avoidable waste however, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling and the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy – are therefore unknown. As such it is possible that the ambitions set out in the WMPE may require increased vehicle movements to additional sites. However, it is also possible that there could be a reduction in the frequency of household collections. At this stage, the outcomes and the effects on the evolution of the current baseline are uncertain.
Recycling	-/?	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as a potential food waste collection system (this could be recycled through composting, or AD). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. If recycling is increased by diverting material from waste collection e.g. as a result of separate food waste collections, it is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements may be matched by an increase in additional movements from recycling fleets. It is possible that the new service will require new fleets to collect and transport separated materials to composting or recovery sites. The WMPE will support the recycling of such material however Tolvik (2017) highlight that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps may evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants and may require additional vehicle movements to take material to sites with capacity.

		The WMPE reiterates interest in implementing a DRS in England. Whilst this will improve recycling, it is likely that the new service may require new vehicle fleets to collect and transport materials to counting and bulking sites (although to a degree this may reflect how it is implemented). In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements, as there are few comparable circumstances to its implementation in England; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that such trips would be combined with other journeys, depending on the location of the DRS facilities. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight may limit the use of this alternative mode of transport, unless other factors intervene. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. As noted in the assessment above, the circular economy, and improved waste management behaviours may not reduce waste tonnages overall but may simply move wastes within the hierarchy; the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy with consequences upon traffic movements – are therefore unknown. It is therefore likely that the WMPE, from a recycling perspective, will have a minor negative effect on the current baseline (with some uncertainty) for the issues covered by this SEA objective and guide questions.
Recovery	**-/?**	The WMPE seeks to improve recovery of materials; both by moving wastes from landfill into recovery and moving material from recovery into reuse and recycling. Recovery includes the use of AD technologies as well as EfW incineration. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. As the plan reiterates key targets - to cut municipal solid waste to landfill to just 10% by 2035 – it is likely that landfilled wastes may move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise vehicle movements and "exporting" of wastes to other communities. However, Tolvik notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. As such it is possible that the ambitions set out in the WMPE may require increased vehicle movements to additional recovery facilities with capacity. These may be locally located to comply with the proximity principle. If this is not the case, then additional movements may be needed further afield. However, this risk and the extent of such a risk, and the impact upon the SEA objectives, is not known at this time. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA. New sites would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop, construct and operate. It is also possible that any increase in recycling may divert materials from recovery facilities to reprocessors. It is highly likely such movements will be via the road network as the movement of wastes by rail is known to be costly and problematic (regarding location of infrastructure compared to local rail networks). Whilst the increase in recycling is a positive impact, it may have a detrimental effect on the calorific value and operational efficiencies

		of recovery plants. This may then require increased traffic movements, as recovery sites source feedstock from further afield. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. Given the timeframes needed to develop and build additional waste infrastructure, it is therefore likely that the WMPE is likely to have an overall negative effect (with some uncertainty), relative to the current baseline for the issues covered by this SEA objective and guide questions related to waste. This reflects the anticipated increase in vehicle movements to manage the waste that can no longer be disposed of, and which will require transfer to, and from, recovery sites.
Disposal	+	The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut waste to landfill to just 10% by 2035. The range of commitments outlined in the WMPE will reduce the use of landfill (leading to a reduction in traffic related to any associated facilities). The effects on traffic from plans for household waste collection system for food wastes which may divert wastes from landfill into recycling of recovery are described above. The WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	?	Overall, the WMPE brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed. This could therefore have both positive and negative impact on traffic and transport (depending on the scale of change in vehicle movements to different waste facilities). The development of new services such as food waste collection services and a DRS will require new vehicle movements. It is not known however if these services will lead to a reduction in other vehicle movements (e.g. household waste collection services) to balance out the new movements. It is also possible that a DRS could generate increase personal journeys as the public travel to collection point to redeem their deposits., although it is also possible that these journeys will be combined with other trips (depending on the location of collection points). It is unknown what impact the reduction in waste accumulations will have on waste movements and whether any improvements in waste management will reduce movements given the range of new commitments that are expected to be implemented. As such, the WMPE is likely to have an overall unknown effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	+ +	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. Should the reduction in wastes materialise in a reduced timeframe this will mean that the demand for waste treatment may drop, across both reprocessors and disposal sites. A reduction of this magnitude would have a significantly positive impact upon traffic and transport movement and is reflected in the assessment against the SEA objective.
Reuse (increase in reuse of waste streams compared to WMPE)	?	An increase in reuse of materials could see a reduction in vehicle movements if materials are reused in a domestic context. However, in an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can valorise

		the by-products of other businesses. As such these reusers could generate new vehicle movements; with an impact on traffic and transport. An increase in reuse of materials could see a reduction in vehicle movements related to waste and recycling collections, if materials are re-used in the home. However in an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can use the by-products from other businesses. As such these reusers may generate new vehicle movements between reusers; with an impact on traffic and transport; it could be expected that the movements of vehicles between businesses may lead to a minor increase in vehicle movements as business-to-business movements outnumber waste collections that would otherwise have taken the wastes from the business as part of collection routes. As such it is possible that the ambitions set out in the reasonable alternative may require increased vehicle movements to additional sites. However, it is also possible that there could be a reduction in the frequency of household collections. It is unclear however, if reuse opportunities require business-to-business movements; it is possible that the ambitions set out in the reasonable alternative may require increased vehicle movements which exceed current traffic movements to recycling plants however this risk and the extent of such a risk, is not known at this time. At this stage, the outcomes and the effects on the evolution of the current baseline are uncertain.
Recycling (increase in recycling of waste streams compared to WMPE)	**-/?**	The reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE. The reasonable alternative assumes that the measures to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England; to collect food waste separately from all households on a weekly basis; and to arrange for garden waste collection are implemented in a timeframe quicker than that in the WMPE (so considered to be within the medium term (within 1 - 6 years). As noted in the assessment of the WMPE above Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the reform of the packaging producer responsibility system which includes incentives to encourage producers to design and use packaging that can be recycled.. In the Reasonable Alternative it is likely that the same impacts may be encountered with regard to traffic and transport. If recycling is increased by diverting material from refuse bins, it is likely that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched, if not exceeded, by an increase in additional movements from recycling fleets. It is likely that the new service may require new fleets to collect and transport materials to composting or recovery sites. Assuming that a DRS in implemented in England and within a short timeframe, the new service will require new fleets to collect and transport materials to counting and bulking sites. In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements, as there are few comparable circumstances to its implementation in England; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that these journeys will be combined with other trips (depending on the location of collection points). Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. It is therefore likely that the reasonable alternative will have a minor negative effect (with some uncertainty) on the SEA objective.

Recovery (increase in recovery of waste streams compared to WMPE)	-/?	The reasonable alternative seeks to improve the rate of recovery. This refers to materials that were previously landfilled and that have now moved up the hierarchy to recovery level. It also considers the removal of material from the recovery stage, to the recycling stage, which is possible in the event of improved recycling services and identification of new offtakers or reprocessors. It is possible that any increase in recycling, through this reasonable alternative will divert materials from recovery facilities to reprocessors. Whilst this is a positive impact in terms of the waste management hierarchy, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements as recovery sites source feedstock from further afield. The proposed food waste collection service may divert food wastes into AD recovery (or composting recycling). Whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. The WMPE reiterates the importance of the proximity principle; stating that waste management sites must be carefully located to minimise vehicle movements and "exporting" of wastes to other communities. However, as stated previously, Tolvik notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. As such it is possible that the ambitions may require new infrastructure. It is not known whether this infrastructure would be locally located (with little impact on vehicle movements) or if it would be further afield, thus requiring increased vehicle movements to additional facilities counterproductive to the proximity principle. The precise extent of such a risk against the SEA objectives, is not known at this time. As the plan reiterates key targets - to eliminate avoidable plastics over the 25 year Environment Plan and to eliminate avoidable wastes of all kinds by 2050 – it is likely that landfilled wastes will move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. Any movements of wastes will continue to rely on the road network; the higher costs, and locations of infrastructure and rail networks, will reduce the appeal of rail freight. We can therefore safely assume waste may continue to be transported by the road network. Given the timeframes needed to develop and build additional waste infrastructure, it is therefore likely that this reasonable alternative will have a negative effect on the SEA objectives (with some uncertainty) as vehicle movements to manage a reduction in landfill (in the medium term of <6years) will lead to increased vehicle movements to, and from, recovery sites.
Disposal (decrease in disposal of waste streams compared to WMPE)	+/?	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut municipal solid waste to landfill to just 10% by 2035. These targets may lead to a reduction in need and capacity for disposal. The reasonable alternative will require a quicker adoption of new behaviours and technologies to lessen demand on landfill sites. It is possible that traffic movements to landfills will drop significantly, although this is uncertain at this stage. The reasonable alternative ambitions will have a positive effect on the SEA objectives as vehicle movements to/from disposal options will decrease (noting that the effects on other waste management options higher up the waste management hierarchy will be adversely affected).
Cumulative	?	Overall the reasonable alternative brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy at a quicker pace than the WMPE proposes.

		Collectively, the plans and policies within the WMPE will either require the avoidance of the generation of the waste completely e.g. the removal of single use plastic bags or will require the movement of wastes from landfill toward other waste management infrastructure. The plans will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed. This will therefore have a negative impact on traffic and transport. The development of new services such as food waste collection services and a DRS will require new vehicle movements. It is not known however if these services will deliver a reduction in other vehicle movements (e.g. household waste collection services) to balance out the new movements however this is unlikely; in addition the introduction of a DRS is likely to generate increase personal journeys as the public travel to collection point to redeem their deposits, although it is also possible that these journeys will be combined with other trips (depending on the location of collection points). It is unknown what impact the reduction in waste accumulations will have on waste movements and whether any improvements in waste management will reduce movements given the range of new services that are expected to be implemented. The cumulative impact of the reasonable alternative on the SEA objective for waste and resources is uncertain.

Score Key:	**+ +** **Significant** positive effect	**+** **Minor** positive effect	**0** **Neutral** effect	**-** **Minor** negative effect	**- -** **Significant** negative effect	**?** **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D10.8 Mitigating Measures

D10.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on traffic and transport:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Any new waste infrastructure could include a Transport Assessment to determine the impacts of, and any remedial efforts, around traffic movements. In undertaking a Transport Assessment, consideration should be given to consult with Highways England, highway authorities, the railway network operator(s), Network Rail, the Maritime and Coastguard Agency, relevant navigation authorities and Associated British Ports, as appropriate. Discussions should include any proposed mitigation measures. The assessment should distinguish between the construction and operation stages if appropriate.

- Any new infrastructure could be sustainable located to minimise vehicle movements. Where HGV traffic will be affected, consideration should be given to the number, frequency, scheduling and route selections when seeking to understand the effects on the existing road network and those communities living close to the proposed waste management site and/or route.
- Alternative modes of transport could be explored in the design, and delivery, of future infrastructure or services – such as rail freight.
- Uptake of use of electric vehicles wherever possible for waste collection and transportation, subject to feasibility, applicability and cost.
- Backhauling opportunities could be explored within, and between, local authorities and waste management contractors to minimise vehicle movements.
- Traffic movements could be monitored throughout construction and operation to ensure compliance with operating permits and planning approvals.

D10.9 Uncertainties and Risks

- An increase in reuse of materials or a reduction in waste tonnages could increase waste imports to recovery sites to maintain calorific requirements; the impact of this on traffic and transport is unknown.
- The full impact of behaviour changes and any movement of waste tonnages up the hierarchy is not known. It is possible that overall wastes may not decrease, but may simply move across the hierarchy.
- The level of investment and type of infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The locations of new waste management infrastructure are unknown and the effects on traffic movements are not certain.
- The costs and security of fuel supplies is unknown and could lead to potential disruptions in waste collection services in future.
- Future policies may place restrictions on road movements or require changes to vehicle emissions limits.
- Future policies may also seek to improve the commercial competitiveness of rail freight.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far reaching impacts on local, national and international practices including the need for, and composition of, future waste management infrastructure. The impact of the circular economy, upon traffic and transport, is unknown.

D11. Cultural Heritage

D11.1 Introduction

D11.1.1 Cultural heritage, including architectural and archaeological heritage, within this context is defined as all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.

D11.1.2 There are links between the cultural heritage topic and other topics in this SEA for the WMPE, specifically landscape and townscape and land use, geology and soils.

D11.2 Review of plans and programmes

D11.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D11.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to cultural heritage. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D11.1 Cultural Heritage Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
Council of Europe (1992) European Convention on the Protection of Archaeological Heritage (Valetta Convention)
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
UNESCO Convention Concerning the Protection of World Cultural and Natural Heritage (1972)
National Plans and Programmes
Department for Culture, Media & Sport (DCMS) (2013) Scheduled Monuments & Nationally Important but Non-Scheduled Monuments
DCMS (2017) Heritage Statement
HM Government (1979) Ancient Monuments and Archaeological Areas Act
HM Government (1990) Planning (Listed Building and Conservation Areas) Act
HM Government (2010) The Government's Statement on the Historic Environment for England
Historic England (2015) Historic Environment Good Practice Advice in Planning Notes 1 to 3
Historic England (Various) Advice Notes
Historic England (Various) Conservation Areas Site Specific Assessment and Guidance
MHCLG (2019) National Planning Policy Framework (NPPF)

D11.3 Overview of the Baseline

UK

D11.3.1 The UK has over 459,000 listed buildings, approximately 33,720 scheduled monuments, 2,416 historic parks and gardens, in excess of 10,259 conservation areas and 28 World Heritage Sites.

England

D11.3.2 In England, there are approximately 378,360 listed building entries, 19,858 scheduled monuments, 1,664 registered historic parks and gardens, approximately 9,866 conservation areas, 47 registered historic battlefields, 53 designated wrecks and 19 World Heritage Sites.[431]

D11.3.3 Historic England's Heritage at Risk Register (2018)[432] identifies sites most at risk of being lost as a result of neglect, decay or inappropriate development. There are fewer entries on the 2017 register (5,254) than the 2016 Register (5,341) and in turn the 2015 Register (5,478). Historic England's Heritage Indicators 2018 report[431] states that there was a further reduction in the number of entries on the register in 2018, the figure dropped to 5,160[431]. Historic England report the following findings in the Heritage Indicators 2018 report[431]:

- 2,067 (0.6%) of England's listed buildings are on the Register;
- 502 conservation areas in England are on the list;
- 2,484 (12.5%) of England's 19,858 scheduled monuments are on the Register;
- 99 (6.0%) of England's 1,664 registered parks and gardens are on the Register;
- Of the 47 registered battlefields in England, 4 (8.5%) are on the Register;
- 4 (7.5%) of the 53 protected wreck sites around England's coast are on the Register.

D11.4 Summary of Existing Problems Relevant to Waste and Resources

D11.4.1 The following existing problems for cultural heritage have been identified:

- The settings of some heritage assets are at risk from new development.
- Scheduled monuments in rural areas are at risk from agricultural practices, land disturbance and unrestricted plant, scrub or tree growth.
- Challenging economic conditions are reducing the funds available to conserve and manage heritage assets.
- Wetlands are fragile and vulnerable to subtle changes arising from development that can affect paleoenvironmental deposits and archaeological assets.[433] Other aspects of the wider historic environment that could be affected include disruption to historically important water sources, the flooding or drying of deep archaeological sites and assets such as mills and bridges which can be affected by local water levels.
- The impact of climate change on wetland heritage is currently poorly understood. Measures introduced to protect and enhance natural environmental qualities (water quality or biodiversity) may also inadvertently threaten wetland heritage if not handled sensitively.

[431] Historic England (2018) *Heritage Indicators 2018*. Available online at: https://historicengland.org.uk/content/heritage-counts/pub/2018/hc2018-heritage-indicators/
[432] Historic England (2017) *Heritage at Risk Register 2018*. Available online at: https://historicengland.org.uk/whats-new/news/heritage-at-risk-2018
[433] Historic England (2019) *Wetland Heritage.* Available online at: https://historicengland.org.uk/research/current/discover-and-understand/landscapes/wetland-heritage/

D11.5 Likely Evolution of Baseline

D11.5.1 Key findings from the latest Buildings at Risk and Heritage at Risk registers are reported in the section above. Whilst these do not provide projections regarding the future state of the historic environment, they do indicate the level of known heritage assets which require ongoing conservation, protection and care.

D11.5.2 Climate change poses an unknown risk to wetland archaeological remains, which may be exacerbated by future climate scenarios.

D11.6 Waste Management Effects on Cultural Heritage

D11.6.1 The impacts of Waste infrastructure on cultural and historic sites are site specific. The potential impacts of waste infrastructure on such sites will include dust, noise, climatic emissions and vehicle movements (including vibrations).

D11.6.2 As noted in the 2013 Eunomia Environmental Report, these are not impacts that can be meaningfully quantified in either a national or local context in relation to the Waste Management Plan for England.

D11.6.3 The potential impacts from waste infrastructure upon cultural heritage will highly repeat those outlined in both the Climatic Factors and Landscape and Townscape chapters (see chapters D7 and D12 respectively).

D11.6.4 Cultural heritage in this section refers to buildings of importance, monuments, archaeology and historical sites.

Waste Infrastructure

D11.6.5 The main impact of waste infrastructure on cultural heritage is the potential harm to buildings from emissions and vibrations.

D11.6.6 The Governments Statement on the Historic Environment for England (2010) reiterate the importance of cultural heritage to local economies whilst noting that waste management practices (through repair, refurbishment or demolition) can contribute to, and overlap, with other policy objectives such as sustainability goals.[434]

D11.6.7 Damage to buildings and sites of cultural heritage can lead to a loss of amenity. As noted in the 2013 report, loss of amenity is not a market good and, as such, no known studies quantify the impact of lost amenity from building damage.[435] Furthermore it is not possible to identify he precise impact of pollutants from the waste sector upon cultural heritage receptors.

D11.6.8 Acidic pollutants have a corrosive effect upon buildings and stonework. Both SO2 and NOx emissions pose a detrimental effect to buildings and are common pollutants from vehicle movements. In areas where these pollutants are present, deterioration rates of building materials have been found to be 10 to 100 times higher than in areas without these contaminants.[436]

[434] Department of Culture, Media and Sport (2010). The Governments Statement on the Historic Environment for England. Available online at: https://www.gov.uk/government/publications/the-governments-statement-on-the-historic-environment-for-england
[435] Watkiss, P et al (2000) *Impacts of Air Pollution on Building Materials*, September 2000. Available at: http://arirabl.org/Publications_files/Buildings-PollAtmos.pdf
[436] Watkiss, P et al (2000) *Impacts of Air Pollution on Building Materials*, September 2000. Available at: http://arirabl.org/Publications_files/Buildings-PollAtmos.pdf

D11.6.9 As outlined in the 2013 Environmental Report, and adapted from Watkiss et al (2000), the sensitivity of building materials to air pollution – and the Stock at Risk in England – are shown below in **Table D11.1**.

Table D11.1 Sensitivity of building materials to SO2

Material	Sensitivity to Air Pollution	Stock-at-Risk
Brick	Very low	Very large
Mortar	Moderate to high	Very large
Concrete	Low	Very large
Natural Stone (sandstone, limestone, marble)	High (severely affected by SO_2)	Large (particularly objects of cultural value)
Unalloyed Steel	High (severely affected by SO_2)	Very small
Stainless Steel	Very low	Medium
Nickel and Nickel-plated Steel	High (especially in SO_2-polluted environment)	Very low
Zinc and Galvanised Steel	High (especially in SO_2-polluted environment)	Medium
Aluminium	Very low	Medium
Copper	Low	Low
Lead	Very Low	Low

Source: Adapted from Watkiss, P et al (2000) Impacts of Air Pollution on Building Materials, September 2000

D11.6.10 This shows that natural stone – such as sandstone, limestone etc – which are used predominantly across historical monuments and buildings, are most susceptible to decay. This suggests that waste management infrastructure involving incineration poses the greatest potential risk to cultural heritage sites if located near to townscapes or where emission plumes could be carried by the wind to local townscapes.

D11.6.11 Traffic is known to generate vibrations in properties, or structures, near to roads and railways. When vehicles encounter irregularities in the road surface, the dynamic loads generate stress waves which travel through surfaces to building foundations. A range of issues can affect the specific intensity of vibrations such as vehicle type, weight, soil compaction, distance between building and road etc. Vibrations can cause cracks in walls, and ceilings, damage to masonry and problems in foundations. As noted by the Institute for Research in Construction, it is difficult to establish a vibration level that may cause building damage and, therefore, controversy continues to surround the issue.[437]

D11.6.12 Planning Officers in local authorities will assess the anticipated impact of proposed waste infrastructure upon local cultural heritage receptors. Any proposed waste infrastructure developments will likely be subject to Environmental Impact Assessments and other local assessments to ensure minimum to no impact upon cultural heritage sites.

[437] Institute for Research in Construction (2000). Construction Technology Update No. 39. Accessible online at https://pdfs.semanticscholar.org/7e44/ef248dada3a2ed234228d04c7197c3ed8735.pdf

Materials Use

D11.6.13 An increase in recycling would limit the requirement to use incineration or landfill facilities. As shown in the Environmental Report and taken from WRATE, the pollutants associated with recyclate are a reduction against the development of virgin material; moreso with regards to non-ferrous metals and dense plastics. **Table D11.2** summarises the quantity of pollutants associated with recycled materials.

Table D11.2 Air Pollutants Associated with Recycled Materials

	Units	Quantity of pollutant per tonne of recyclate					
		Paper	Dense plastic	Glass (closed loop)	Ferrous	Non ferrous	Aggregate
NH_3	g	-9.92	6.29	-159	-68	-145	-0.99
VOCs	g	-43.1	-3,540.00	-24.6	-248	-2,200.00	-26.6
$PM_{2.5}$	g	-99.9	-401	-190	-779	-4620	-0.75
SOx	g	-7.35	7.11	-30.7	-7.35	-7.35	-46.9
NOx	g	-918	-5,680.00	-296	-2,700.00	-18,000.00	0
Cd	mg	4.8	0.88	-6.58	-26.1	269	0
Cr	g	-0.1	0.07	-0.43	-0.17	-1.12	-0.01
Hg	mg	4.26	-196	-7.78	-88.3	1,180.00	-0.82
Ni	g	0.02	0.04	-0.08	-0.43	-3.53	-0.01
Pb	g	0.02	0.02	-0.15	-3.58	39.6	-0.01
Dioxin	ng	-4E-04	-0.0003	-3E-04	-0.0004	-0.0004	-0.0001
As	g	-0.02	0.01	-0.03	-0.02	0.67	0

D11.6.14 The full extent of pollutants would be subject to the location of sites, technologies used, waste composition and significant other aspects however it is clear that the recycling of materials can eliminate emissions which are damaging to cultural heritage buildings.

D11.6.15 The implementation of a DRS as well as any additional recycling infrastructure is intended to increase recycling or minimise waste sent to incinerators and landfill. This will also provide a high quality of material for remanufacturers, reducing the demand for virgin materials to produce new plastics and steels. It is anticipated that a DRS can capture up to 90% of target materials and this has been evidenced in European nations. Following consultation on reforming the packaging producer responsibility system, the Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste.

D11.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D11.7.1 **Table D11.3** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the

reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D11.3 Assessment of the Draft WMPE and reasonable alternative

Cultural Heritage (including architectural and archaeological heritage)		
To conserve and enhance the historic environment including designated and non-designated heritage assets and their settings.		
• Will the draft WMPE affect the significance of internationally and nationally designated heritage assets and their settings? • Will the draft WMPE affect non-designated heritage assets and their settings? • Will the draft WMPE conserve and enhance the historic environment including landscapes, townscapes, buildings, structures and archaeological remains? • Will the draft WMPE affect the fabric and setting of historic buildings, places or spaces that contribute to local distinctiveness, character and appearances?		
	Effect	**Commentary**
WMPE		
Prevention	+	The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The WMPE reiterates a series of interventions that will seek to prevent wastes being landfilled. This includes improved recycling services, a separate food waste collection services and a Deposit Return Scheme. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery. It is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. Emissions from vehicles are known to release acidic pollutants which damage cultural heritage assets e.g. limestone buildings. It is possible that the new service will require new fleets to collect and transport separated materials to recycling, composting or recovery sites. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+/?	The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material (potentially in the home). An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods, therefore potentially having a significant reduction in emissions such as NOx, SOx and particulates which can affect the fabric of buildings and structures, notably those constructed using limestone. A reduction in vehicle movements also reduces noise, vibration and disturbance along the collection route which could be damaging to vulnerable foundations of cultural heritage assets. In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by businesses that can use the by-products from other processes. As such these reusers would generate new vehicle movements, and therefore increase emissions and disturbance along shipment routes, between reusers. These waste vehicle movements would require new fleets. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage.

		It is considered that there could be a reduction in the frequency of household collections and therefore emissions and vibrations, however the level of reduction and impacts are dependent on specific collection routes and locations. As such the WMPE is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	+/?	The WMPE repeats ambitious targets for England including a target to increase household recycling to 50% by 2020 and 65% by 2035. The government completed consultation in spring 2019 on a range of new services including a separate collection of recycling materials and food wastes. Measures will be introduced to increase household recycling to ensure consistency in acceptable materials as well as mandatory separate food waste collection system (this could be recycled through composting, or AD). The WMPE states that Defra will provide funding to address the net costs of any new commitments placed on waste authorities, this is further supported by the outcome of consultation on reforming the packaging producer responsibility system. The Government is seeking to introduce the powers to extend the producer responsibility systems via the Environment Bill, with further consultation expected in 2021. This includes incentives to encourage producers to design and use packaging that can be recycled, and packaging producers funding the cost of managing packaging when it becomes waste. If recycling is increased by diverting material from waste collection e.g. as a result of separate food waste collections, it is possible that reductions in residual waste collection fleets could be matched by an increase in additional movements from recycling fleets. It is also possible that the new service will require new fleets to collect and transport separated materials to composting or recovery sites. There is therebefore potential for increase in emissions such as NOx and SOx which cause damage to cultural heritage assets, including limestone buildings. An increase in vehicle movements also increases noise, vibration and disturbance along the collection route which could be damaging to vulnerable foundations of cultural heritage assets. The need for new fleets presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. The WMPE will support the recycling of such material; however, Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental affects including effects on air quality would be minimised, reduced or mitigated. The WMPE reiterates interest in implementing a DRS in England. Whilst this will improve recycling, it is likely that the new service will require new vehicle fleets to collect and transport materials to counting and bulking sites (although to a degree this will reflect how it is implemented). In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements and therefore emissions; it is possible personal car movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that such trips would be combined with other journeys, depending on the location of the DRS facilities. Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. The need for new fleets presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection

		vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on cultural heritage. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on local cultural heritage assets, however, this will be dependent on location, design, setting and construction and operational activities. The opportunity to use electric and hybrid vehicles cannot be quantified at this stage, however it is clear that the use of these vehicles would have a positive impact by reducing acidic pollutants which can damage cultural heritage assets e.g. limestone buildings. As such the WMPE is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	+/?	The WMPE seeks to improve recovery of materials; both by moving wastes from landfill into recovery and moving material from recovery into reuse and recycling. Recovery includes the use of AD technologies as well as EfW incineration. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. As the plan reiterates key targets - to cut municipal solid waste to landfill to just 10% by 2035. It is likely that landfilled wastes will move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. While recovery options may result in more emissions of certain pollutants being released to the atmosphere (e.g. CO2) when compared to landfill which primarily emits CH4, the added benefit of electricity generation diversifying the UK supply and reducing reliance on fossil fuels for energy will have a positive overall effect on the UK energy generation profile. The WMPE will support the recycling of such material; however, Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental affects including effects on air quality would be minimised, reduced or mitigated. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore vehicle emissions, as recovery sites source alternative feedstock (potentially from further afield). For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on cultural heritage. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on local cultural heritage assets, however, this will be dependent on location, design, setting and construction and operational activities. The opportunity to use electric and hybrid vehicles cannot be quantified at this stage, however it is clear that the use of these vehicles would have a positive impact by reducing acidic pollutants which can damage cultural heritage assets e.g. limestone buildings. As such the WMPE is likely to have an overall

		positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut waste to landfill to just 10% by 2035. The range of commitments outlined in the WMPE will reduce the use of landfill. These include plans to introduce a separate household waste collection system for food wastes which will divert wastes from landfill into recycling of recovery. The reduction in waste to landfill will have positive effects on cultural heritage assets by reducing vehicle movements which can affect assets. The closure of any landfills due to a reduction in demand will provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. This may contribute to improving the setting and amenity of areas adjacent to cultural heritage assets. As such the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+	Overall, the WMPE brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed. Construction of this new infrastructure would affect cultural heritage assets dependent on location, dependent on location, design, setting and construction and operational activities. Tolvik (2017) notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental affects including effects would be minimised, reduced or mitigated. Whilst construction activities have the potential to negatively affect cultural heritage assets, there are a number of benefits of constructing new facilities in order to divert waste (e.g. reduced emisions from incinerators, reduced emissions from waste disposal traffic). As such, the WMPE is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	+ +	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The WMPE repeats ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which will reduce material use and waste generated. The elimination of avoidable plastics and avoidance of waste will reduce the amount of waste collected for disposal but may increase the amount of waste collected for recycling and recovery. As a result of waste avoidance and elimination, the emissions associated with waste disposal will be minimised, however there may be an increase in emissions associated with recycling and recovery. It is possible that reductions in volumes of residual waste collected for disposal and its effects on vehicle movements will be matched by an increase in additional movements from recycling and recovery fleets. Emissions from vehicles are known to release acidic pollutants which damage cultural heritage assets e.g. those with limestone on the external faces of the structure. It is possible that the new

		service will require new fleets to collect and transport separated materials to recycling, composting or recovery sites. This presents the opportunity for increases in electric vehicles and hybrid vehicles, however the uptake and therefore reduction in emissions cannot be quantified at this stage. Should the reduction in wastes materialise in a reduced timeframe this will mean that the demand for waste treatment will drop, across both reprocessors and disposal sites. A reduction of this magnitude would have a significant positive effect on cultural heritage assets by avoiding the need for any new infrastructure, reducing vehicle emissions from the collection and transfer of wastes and minimising the disturbance from noise and vibration to the setting of assets. This is reflected in the assessment against the current baseline for the issues covered by this SEA objective and guide questions.
Reuse (increase in reuse of waste streams compared to WMPE)	**?**	The 'Direction of Travel' reasonable alternative seeks to implement improvements at a quicker rate. The WMPE notes that Defra has set a target for all plastic packaging to be recyclable, reusable or compostable by 2025. The WMPE will support the reuse of such material. An increase in the reuse of materials could see a reduction in material for waste and recycling with a consequential effect on waste and recycling collections. A decrease in vehicle movements would also be associated with a decrease in emissions and could lead to a reduction in noise, vibration and disturbance along the collection route. This could also reduce the frequency of household collections of residual waste and recycling, and reduce manufacturing of certain goods. Achieving this target before 2025 would increase the potential for positive effects. In an industrial setting, and with the increase in the circular economy, materials are likely to be reused by other businesses that can use the by-products from other businesses. As such these reusers will generate new vehicle movements, and therefore increase emissions and disturbance along shipment routes, between reusers. It is considered that there could be a reduction in the frequency of household collections and therefore emissions and vibrations, however the level of reduction and impacts are dependent on specific collection routes and locations. As such the reasonable alternative is likely to have an overall uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling (increase in recycling of waste streams compared to WMPE)	**+/?**	The 'Direction of Travel' reasonable alternative seeks to achieve the range of recycling targets at a quicker pace than the WMPE. The 'Direction of Travel' reasonable alternative assumes that the measures to increase household recycling by having all local authorities collect a consistent set of dry materials from households in England; to collect food waste separately from all households on a weekly basis; and to arrange for garden waste collection are implemented in a timeframe quicker than that in the WMPE (so considered to be within the medium term (within 1 - 6 years). As noted in the assessment of the WMPE above Defra has committed to provide funding to address the net costs of any new commitments placed on waste authorities. For the reasonable alternative it is likely that the same impacts will be encountered with regard to emissions affecting cultural heritage assets. Construction of any new infrastructure could affect cultural heritage assets dependent on location, design, setting and activities. If located on a greenfield site, there is the potential to disturb undiscovered archaeological sites. It is likely that the new service will require new fleets to collect and transport materials to composting or recovery sites. The need for new fleets presents an opportunity for the development and use of electric and hybrid vehicles; however, the take up (in terms of the availability of equivalent collection vehicles and the replacement of the existing vehicle fleet) and therefore reduction in emissions cannot be quantified at this stage. Assuming that a DRS in implemented in England and within a short timeframe, the new service will require new fleets to collect and transport materials to counting and bulking sites. In addition, it cannot be assumed that a DRS would lead to a reduction in waste collection vehicle movements, and therefore emissions; it is possible personal car

		movements may increase as residents drive to collection points to redeem their deposits, although it is also possible that these journeys will be combined with other trips (depending on the location of collection points). Given the location of waste infrastructure – which are not commonly located next to transport hubs – it is very likely that such movements would rely on the road networks, meaning that options to move to alternative transport arrangements, therefore reducing emissions, are unlikely to be available to have a significant national effect although may be available at a local level. The anticipated ongoing higher costs associated with rail freight will limit the use of this alternative mode of transport, unless other factors intervene. It is likely that the Direction of Travel reasonable alternative will see a more ambitious adoption of the circular economy principles. This will reduce the creation of waste overall by moving wastes up the hierarchy and eliminating some wastes entirely through redesign of materials and products. This will likely reduce emissions associated with waste processing, disposal and transportation. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall positive or negative effects on cultural heritage. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on local cultural heritage assets, however, this will be dependent on location, design, setting and construction and operational activities. The opportunity to use electric and hybrid vehicles cannot be quantified at this stage, however it is clear that the use of these vehicles would have a positive impact by reducing acidic pollutants which can damage cultural heritage assets e.g. limestone buildings. As such, the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery (increase in recovery of waste streams compared to WMPE)	+/?	The 'Direction of Travel' reasonable alternative seeks to improve the rate of recovery. This refers to materials that were previously landfilled and that have now moved up the hierarchy to recovery level. It also considers the removal of material from the recovery stage, to the recycling stage, which is possible in the event of improved recycling services and identification of new offtakers or reprocessors. As the plan reiterates key targets - to cut municipal solid waste to landfill to just 10% by 2035. It is likely that landfilled wastes will move up the hierarchy to recovery opportunities; until such a time as reprocessors are secured for materials. The WMPE will support the recycling of such material; however, Tolvik (2017) highlights that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental affects would be minimised, reduced or mitigated. It is also possible that any increase in recycling will divert materials from recovery facilities to reprocessors. Whilst the increase in recycling is a positive impact, it will have a detrimental effect on the calorific value and operational efficiencies of recovery plants. This may then require increased traffic movements and therefore emission, as recovery sites source feedstock from further afield. For food waste, whilst there are diverging views**Error! Bookmark not defined.** on future AD capacity needs and capacity estimates will need to be reviewed in advance of the introduction of a separate food waste collection, it is possible that the WMPE ambitions may well lead to a need for increased capacity. The government support stated in the plan for AD gives confidence that AD plants will continue to be in operation and contribute to waste processing in the medium term. Given the uncertainty regarding whether waste will be diverted from landfill to recovery facilities or recycling facilities, it is difficult to determine whether there will be overall

		positive or negative effects on emissions, air quality and the consequences for heritage assets (although such effects may be locally significant). Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on heritage assets; however, this will be dependent on location, design, setting and construction and operational activities. The opportunity to use electric and hybrid vehicles cannot be quantified at this stage, however it is clear that the use of these vehicles would have a positive impact by reducing acidic pollutants which can damage cultural heritage assets e.g. limestone buildings. As such the reasonable alternative is likely to have an overall positive/uncertain effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal (decrease in disposal of waste streams compared to WMPE)	+	The 'Direction of Travel' reasonable alternative seeks to divert wastes from landfill at a quicker pace than the WMPE. The WMPE outlines key targets which aims to reduce the use of landfill including the aims to eliminate food waste going to landfill by 2030, as well as a target, within the Waste Framework Directive, which seeks to cut municipal solid waste to landfill to just 10% by 2035. These targets will lead to a reduction in need and capacity for disposal. In contrast however, the closure of any landfills due to a reduction in demand will provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. The closure of any landfills due to a reduction in demand will provide opportunities for such sites to be remediated and restored to use as greenspaces or as sites for construction. As such the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+/?	Overall the 'Direction of Travel' reasonable alternative brings together a range of aims and targets seeking to improve waste management by moving wastes up the hierarchy at a quicker pace than the WMPE proposes. Collectively, the plans and policies within the WMPE will require the movement of wastes from landfill towards other infrastructure. These will require possible diversion of wastes to facilities that are further away than current infrastructure, until new facilities are constructed. Construction of this new infrastructure would affect cultural heritage assets dependent on location, dependent on location, design, setting and construction and operational activities. The location of these capacity gaps will evolve and change based upon population changes, behavioural changes and the lifespan of technologies in reprocessing plants. The location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate. Through this process, environmental effects would be minimised, reduced or mitigated. Whilst construction activities have the potential to negatively affect cultural heritage assets, there are a number of benefits of constructing new facilities in order to divert waste (e.g. reduced emisions from incinerators, reduced emissions from waste disposal traffic) and achieving the SEA objectives in a shorter timeframe will lessen the likelihood of such adverse effects occurring as a result of the waste sector. Where new infrastructure is required to meet the requirements of the targets, there may be localised effects on heritage assets; however, this will be dependent on location, design, setting and construction and operational activities. The opportunity to use electric and hybrid vehicles cannot be quantified at this stage, however it is clear that the use of these vehicles would have a positive impact by reducing acidic pollutants which can damage cultural heritage assets e.g. limestone buildings. As such the reasonable alternative is likely to have an overall positive/unknown effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.

Score Key:	+ + **Significant** positive effect	+ **Minor** positive effect	0 **Neutral** effect	- **Minor** negative effect	- - **Significant** negative effect	? **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D11.8 Mitigating Measures

D11.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on cultural heritage assets:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Requirement for responsible construction of waste infrastructure to ensure early identification of undiscovered archaeological sites and protocols for relocating the infrastructure should the site be deemed non developable.
- Requirement to monitor and control vibrations where it is identified that a cultural heritage asset may be at risk.
- Uptake of use of electric vehicles wherever possible for waste collection and transportation.
- Uptake of renewable energy sources to power waste management sites wherever possible. This could include on site generation.
- Offsetting of emissions to limit the effect of cultural heritage assets on a global scale.

D11.9 Uncertainties and Risks

- The level and type of product which would be reused cannot be quantified at this stage, and therefore the reduction in manufacturing and waste collections also cannot be quantified.
- The level to which construction would potentially damage an undiscovered archaeological site cannot be stated here. This will depend on a number of factors and if good practises are in place, there could be no effect on the asset.
- The level on investment and infrastructure required to close the waste management gap when diverting waste from landfill is not known at this stage.
- The type of infrastructure which will be built to close this gap is also not knows at this stage, however it is likely to be a combination of recycle and recovery sites.
- The extent that emissions from vehicles will change as a result of schemes e.g. the DRS scheme is not known at this stage.

- It is expected that to achieve the SEA objectives more quickly, the infrastructure construction would significantly intensify, however, this cannot be quantified.
- The locations of new waste management infrastructure are unknown. This results in uncertainties regarding how the site construction will affect cultural heritage assets and the impact in waste transportation distances.

D12. Landscape and Townscape

D12.1 Introduction

D12.1.1 Landscape in this context is defined by The European Landscape Convention as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors". This definition is stated as covering natural, rural, urban and peri-urban (i.e. the urban-rural fringe) and includes land, inland water and marine areas. For the purposes of this assessment though, landscape is taken to apply to rural areas and townscapes in urban areas. Visual effects are those effects that influence how people see a landscape or townscape, such as the erection of a building.

D12.1.2 There are links between the landscape and townscape topic and other topics in the SEA of the WMPE, including in particular biodiversity and nature conservation and cultural heritage.

D12.2 Review of plans and programmes

D12.2.1 The completed review of plans and programmes has been used to provide the policy context for the assessment. **Box D12.1** summarises those plans and programmes reviewed as part of the completion of this SEA that are relevant to Landscape and Townscape. A description of each plan and programme, any proposed objectives or targets and the relevance to the assessment of the draft WMPE is presented in **Appendix C**.

Box D12.1 Landscape and Townscape Plans and Programmes Reviewed for the SEA of the Draft WMPE
International/ European Plans and Programmes:
Council of Europe (2000) European Landscape Convention (Florence Convention) (became binding March 2007)
European Commission (2001) Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment (SEA Directive) (2001/42/EC)
National Plans and Programmes
MHCLG (2019) National Planning Policy Framework (NPPF)
Natural England (2014) National Character Area (NCA) Profiles

D12.3 Overview of the Baseline

UK

D12.3.1 Statutory sites designated (wholly or partially) for their landscape value include National Parks, Areas of Outstanding Natural Beauty (AONBs) (in England and Wales), Country Parks, Historic Gardens and Designed Landscapes, National Scenic Areas (NSAs) and Regional Parks (in Scotland) and World Heritage Sites. Other important (non-statutory) sites include Areas of Great Landscape Value (AGLV) in Scotland; Heritage Coasts (in England and Wales); and National Trust/National Trust for Scotland properties.

D12.3.2 The UK has 15 National Parks and (excluding Scotland) 46 AONBs. Each National Park is administered by its own National Park Authority whose duty it is to conserve and enhance natural beauty, wildlife and cultural heritage; and to promote opportunities for the understanding and enjoyment of the special qualities of National Parks by the public. The Broads Authority in England

has a third purpose to protect the interests of navigation. The primary purpose of AONB is to conserve and enhance the natural beauty of the landscape.

England

D12.3.3 There are ten National Parks in England; the most recently designated National Park being the South Downs National Park (designated on 31 March 2010). Together, National Parks cover 9.3% of the land area in England and include 453 conservation areas.[438]

D12.3.4 There are 34 AONBs in England, one of which straddles England and Wales (the Wye Valley AONB). AONBs cover 18% of England and Wales.[439] The East Hampshire and Sussex Downs AONB designations were revoked on the 31 March 2010 when the South Downs National Park Designation Order came into effect.

D12.3.5 England has been divided into areas with similar landscape character, which are called National Character Areas (NCAs). A total of 159 NCAs have been identified in England.[440] The boundaries of the NCAs are not precise and many should be considered as broad zones of transition. Natural England have rewritten and redesigned all of England's 159 NCA profiles and published the revised profiles in September 2014. The NCAs are defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity.

D12.3.6 Heritage Coasts are areas defined (they are not statutorily designated) for the beauty and undeveloped nature of the coastline. They represent 1,057km of England's coastline and are managed to conserve their natural beauty and, where appropriate, to improve accessibility for visitors. Most Heritage Coasts are within the boundaries of National Parks or AONBs, although some including Lundy, the Durham Coast, and Flamborough Head stand alone.[441]

D12.3.7 There are 18 World Heritage Sites in England including Saltaire a complete and well preserved industrial village of the second half of the 19th century, located on the river Aire.[442]

D12.4 Summary of Existing Problems Relevant to Waste and Resources

D12.4.1 The following existing problems for landscape have been identified:

- Over the last century, the following landscape character trends have been experienced in the UK:[443]
  - a decline in some traditional agricultural landscape features such as farm ponds and hedgerows, and a loss of archaeological sites and traditional buildings;
  - increased urbanisation, often accompanied by poor design standards and a decline in the variety of building materials, and the importation of urban and suburban building styles into rural areas; and

[438] National Parks (2016)) *National park facts and figures.* Available online at: http://www.nationalparks.gov.uk/learningabout/whatisanationalpark/factsandfigures
[439] National Association of AONBs (2017) *Areas of Outstanding Natural Beauty*. Available online at: http://www.landscapesforlife.org.uk/
[440] Natural England (2014) *National Character Area profiles: data for local decision making*. Available online at: http://www.naturalengland.org.uk/ourwork/landscape/englands/character/areas/default.aspx
[441] Natural England (2006) *Review and evaluation of heritage coasts in England*. Available online at: http://publications.naturalengland.org.uk/publication/4594438590431232?category=56001
[442] UNESCO (2017) *Properties inscribed on the World Heritage List for Great Britain and Northern Ireland*. Available online at: http://whc.unesco.org/en/statesparties/gb
[443] Natural England (2008) *State of the Natural Environment 2008*. Available online at: http://publications.naturalengland.org.uk/publication/31043

  - a loss of remoteness and reduced tranquillity because of built development and traffic growth.

- Light pollution appears to have increased considerably over the last 30-40 years over much of the UK. The growth of urban areas, road networks and industrial areas are all major contributors to increased light levels.
- The UK landscape is vulnerable to a variety of pressures. Key threats and opportunities to landscape character include the development of new infrastructure, agriculture, the loss and expansion of woodland and natural processes.
- The visual impact of waste infrastructure remains an issue of strong opposition among residents. The impact of Energy from Waste plants, anaerobic digestion sites and other infrastructure with a large footprint, can have substantial local effects on communities.
- Use of Landscape Character Assessment and similar local documents should be thoroughly included within the design and planning processes for any new infrastructure.
- However, the increase in recycling and recovery of wastes has led to a reduction in the demand for landfills in the UK. Whilst historic landfills may cause concern if these are not capped properly and require repair, the slowing demand for new landfills will reduce any further threat of new landfills being opened close to communities.

D12.5 Likely Evolution of Baseline

England

D12.5.1 There are a number of pressures and risks outlined in the Natural England State of the Natural Environment 2008 Report that may affect the quality of landscapes in England. These include:

- Sea-level rise: Over the next few decades it is anticipated that there will be major sea incursions inland during storms, particularly on the south and east coasts of England. If measures such as managed retreat are not adopted in low-lying areas, there may be widespread losses of intertidal and coastal habitats. In the coastal zone, sea-level rise may also result in the direct loss of freshwater habitats such as reedbeds and wet grasslands.
- Fire: More droughts in the future will make the countryside increasingly vulnerable to wildfire, with potential for heathland, grassland, broadleaved woodlands and bogs to undergo major change in their structure.
- Grazing management: More summer droughts may mean that grazing is no longer possible in some open habitats such as fens, grasslands and heathlands due to die-back of vegetation and a lack of drinking water for animals. The spread of diseases (e.g. bluetongue) related to climate change may also reduce livestock numbers and restrict movement, altering grazing patterns and landscapes.
- Energy production: The production of biofuels in the countryside may result in changes to landscapes. Solar and wind energy developments are likely to be more common.
- Development pressure: Within rural England, the area of developed land has increased by about 4% since 1990. It is expected that the pace of development within England will increase in the future to make up for the current shortfall in housing provision. The effect of this increase pressure for development is likely to be felt most acutely in central and southern England where demand for housing is greatest.

D12.5.2 Natural England report that in 2008, existing landscape character was being maintained in 51% of England's landscapes, whilst in a further 10%, existing character was being enhanced. However, 20% of landscapes were showing signs of neglect, while in the remaining 19% new landscape characteristics are emerging.

D12.5.3 Data from 1990 to 2003 indicates that in England, the number of Character Areas with patterns of change that either maintain or enhance character has increased from 36% to 61%. The number of Character Areas with evidence of neglect or erosion of character has decreased. This evidence suggests that the character of the majority of English landscapes, at Character Area scale, is being sustained.

D12.5.4 The protected nature of National Park and AONB landscapes make it less likely that these landscapes will be affected by some of the risks outlined above (e.g. development pressure) although those protected landscapes nearest to existing urban areas are more likely to be at risk.

D12.6 Waste Management Effects on Landscape and Townscape

D12.6.1 The impact of waste infrastructure upon landscapes and townscapes is dependent upon the specifics of the proposed site and the design of the infrastructure itself. This includes aspects such as:

- height and scale of the infrastructure;
- obstruction upon views from receptor points (eg nearby homes, hills etc);
- proximity to local buildings (schools, homes etc);
- proximity to local parks;
- potential increase in vehicle movements;
- presence, or absence, of foliage and other boundary screening opportunities.

D12.6.2 As noted by both the 2013 Environmental Report[444] and the Defra (2004)[445] report, there is very little literature to determine the landscape impact of waste infrastructure on a local or national scale.

D12.6.3 This section will focus upon the known data regarding waste infrastructure. Discussion is included on litter and further detail on this aspect is included in Biodiversity and Nature Conservation (see Chapter D1).

Waste Infrastructure

D12.6.4 Waste infrastructure is a familiar sight in communities as well as the outskirts of large population centres. In England, 330 landfills accepted waste in 2017 with a further 87 incineration sites. In total there was 6,390 waste management sites that accepted waste in 2017 – including treatment sites, transfer stations etc.[446]

[444] Eunomia (2013) *Waste Management Plan for England Strategic Environmental Assessment: Environmental Report* Final Report for Defra

[445] Defra (2004*) Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*, March 2004. Available at: http://archive.defra.gov.uk/environment/waste/statistics/documents/health-report.pdf

[446] Environment Agency (2018). *Waste Management in England: 2017 data*. Accessible here: https://www.gov.uk/government/publications/waste-management-data-for-england

D12.6.5 Landfill inputs dropped continuously from 80M tonnes in 2000 to just over 40M in 2014 however the number has risen steadily since then[447] and remaining landfill capacity has fallen to 422Mm^3.

D12.6.6 Waste infrastructure varies significantly to suit local capabilities of both the market and site conditions. The footprint of any infrastructure can vary significantly. As shown in **Figure D12.1** the characteristics of waste infrastructure can vary from just 0.15hectares up to 50 hectares. Recent examples demonstrate the growth of infrastructure to manage increasing waste tonnages; the Veolia Ockenden landfill in Essex has an overall footprint of 230 ha of land[448].

Figure D12.1 Typical characteristics of Key Waste Management Facilities[449]

Facility	Waste Treated (pa)	Typical Site Area (Hectares)	Building Footprint (Metres)	Building Height (Metres)	Expected Lifetime of Facility (Years)
Landfill	250,000	5-50	25 x 25 (gas treatment)	10 (gas treatment)	5 – 20
Thermal Treatment (small scale)	50,000	<1 – 2	80 x 40	15 – 25, stack 30 – 70	20 – 25
Thermal Treatment (large scale)	250,000	2 – 5	120 x 60	25 – 30, stack 60 – 80	20 – 25
MBT	50,000	1 – 2	100 x 30	10 – 20	20 – 25
Pyrolysis and Gasification	50,000	1 – 2	60 x 60	15 – 25, stack 30 – 70	20 – 25
Anaerobic Digestion (small scale)	5,000	0.15	30 x 15, plus 4 circular tanks at 6 – 10 diameter	7 (tanks 10)	25
Anaerobic Digestion (large scale)	40,000	0.6	40 x 25, plus 2 circular tanks at 15 diameter	7 (tanks 6)	25
In-vessel Composting	25,000	1 – 2	25 x 30	4 – 5	10 – 25
Open Air Windrow	25,000	2 – 3	None necessary	3 – 4 (if any)	20 – 25
Waste Transfer Station	120,000	0.7	70 x 30	12	20
Recyclables Processing Facility	50,000	1 – 2	70 x 40	12	20

Source: Adapted from ODPM (2004) Planning for Waste Management Facilities: A Research Study, August 2004 and Enviros (2009) Catalogue of Waste Treatment Facilities, May 2009

D12.6.7 It is understood that, as of May 2019, over 155 additional waste treatment sites (incinerators, biomass plants etc) are consented or in planning phase in England.

D12.6.8 To minimise the landscape impact of waste infrastructure local authorities and their planning officers' seek to locate waste sites in areas outside of the main communities, in industrial areas or sites already designated for waste management activities. The National Planning Policy for Waste

[447] Environment Agency (2018). *Waste Management in England: 2017 data*. Accessible here: https://www.gov.uk/government/publications/waste-management-data-for-england
[448] Veolia (2019) https://www.veolia.co.uk/essex/veolia-essex/landfill-sites
[449] Eunomia (2013) *Waste Management Plan for England Strategic Environmental Assessment: Environmental Report* Final Report for Defra

(2014)[450] requires that waste planning authorities strenuously assess applications and their impacts to mitigate against adverse impacts by adhering to the proximity principles and "give priority to reuse of previously developed land, sites identified for employment uses and redundant agricultural and forestry buildings and their curtilages".

D12.6.9 Developers of waste infrastructure facilities can seek to minimise the visual impact by investing in screening, cladding and other design features to allow the plant to be considered compatible with the surrounding environment. However, some facilities can include a stack of up to 80m, in which case visual intrusion can be obviated to some extent by stack diameter, material selection and colour.

D12.6.10 Waste infrastructure such as fleet yards, sorting facilities, energy from waste plants and bulking sites etc can operate 24-7. As such, they generate of noise from vehicle movements and operations – as well as light pollution. Operations can include machinery (inside and outside of the plant), as well as alarm systems for security, vermin control and staff management. Waste infrastructure can impact negatively upon local townscapes through such disturbance.

D12.6.11 Deposit Return Schemes (DRS) could increase the need for collections and bulking infrastructure closer to population centres however any DRS infrastructure is likely to be contained within warehouse-style buildings, possibly within industrial estates, and so minimising the visual impact upon communities.

D12.6.12 It is notable however that waste infrastructure *can* be developed within areas of natural beauty such as national parks, as shown by Przydatek (2019)[451] showing that landfill sites exist in the North York Moors National Park. Developers of new waste faciltiies will be expected to comply with local planning policies to prevent or minimise any adverse impact to the character and quality of local areas.

Litter and fly-tipping

D12.6.13 As noted in the 2013 Environmental Report, litter is a visible consequence of waste management infrastructure. Ineffective household waste collections, or those services that incur a charge (e.g. bulky uplifts) are likely to encourage littering.

D12.6.14 The current proposals on reforming the UK packaging producer responsibility system[452] propose a producer fee to cover the cost to local authorities related to dealing with littered and fly-tipped packaging waste. The upcoming potential for a Deposit Return Scheme is expected to divert additional material from street litter. In Scotland, it is estimated that DRS affected materials make up approximately one fifth of the Scottish litter composition:

- Plastic bottles: 9%
- Metal cans: 4%
- Packaging glass: 9%

[450] Department for Communities and Local Government (2014). National Planning Policy for Waste. Accessible online at: https://www.gov.uk/government/publications/national-planning-policy-for-waste
[451] Przydatek (2019). *Waste Management in Selected National Parks: A Review* in Journal of Ecological Engineering: Accessible online at: http://www.jeeng.net/Waste-Management-in-Selected-National-Parks-A-Review,102609,0,2.html
[452] DEFRA, (2019). *Reforming the packaging producer responsibility system*. Accessible online at: https://consult.defra.gov.uk/environment/introducing-a-deposit-return-scheme/

D12.6.15 DRSs have been found to reduce littering. A study by the European Commission[453] reviewed the the Dansk Returscheme[454] (the Danish DRS), the Norsk Resirk (the Norwegian DRS renamed Infinutum[455]) and a pilot DRS project in the Catalan[456]. The study concluded that whilst the inherent complexity of identifying a direct correlation between the operation of a DRS and littering makes quantifying the effect difficult, those countries operating a DRS show low littering rates of drink packaging. The benefits of a DRS are most apparent in those countries with comparatively low levels of recycling prior to implementation of the DRS. These findings are supported by a number of other studies. Following on from the Catalan pilot DRS, a further study has estimated a reduction in the littering of drink containers from 1,280 tonnes to 173 tonnes per year if the scheme were to be fully implemented, a reduction of 86%[457]. In the USA eight states legislated for the implementation of a DRS in the 1970/80s, with rates of litter reduction ranging from 30-64%, with the variation in part a reflection of the different methodology employed in studying the effectiveness of the various DRS[458]. A study by Ghent University[459] that reviewed the effects of DRS in the Netherlands, Germany and Israel concluded that a DRS could be expected to reduce littering by 40%. A study by the European Commission also concluded that a DRS would be beneficial in reducing marine litter. The Marine Conservation Society identified a deposit return scheme as a positive move towards reducing the effects of litter on marine environments.[460]

D12.6.16 Since the 2013 Environmental Report, further research has outlined the extent of the problem caused through marine litter. Marine litter is rapidly becoming a growing concern for governments through high profile campaigns and media coverage that draw attention to the extent, and impacts, of marine litter. Ostle et al (2019)[461] identified a "significant increase" in macroplastics between 1957 and 2016. It was found that macroplastics had a global footprint and have peaked in Arctic waters between 2002 and 2014.

D12.6.17 Public attention and opposition to marine litter has grown. Over 95% have reported seeing litter on local beaches[462]. Data from the Marine Conservation Society identifies a long-term trend of increasing levels of marine litter deposited on beaches, with an increase of 4% over 4 years[463].

[453] European Commission (2013) *Marine Litter study to support the establishment of an initial quantitative headline reduction target.* Available at: http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/final_report.pdf
[454] The Dansk Retursystem continues to operate. Further details are available at: https://www.danskretursystem.dk/en/
[455] Infinitum continues to operate. Further details are available at: https://infinitum.no/english/contact
[456] The Catalan Zero Waste Pilot operated in 2013. Further details are available at: https://zerowasteeurope.eu/2013/04/catalan-zero-waste-network-launches-pilot-bottle-deposit-project-in-cadaques/
[457] Eunomia (2017) *Plan for Deposit Return Scheme Launched in Catalonia.* Available at: http://www.eunomia.co.uk/plan-for-deposit-return-scheme-launched-in-catalonia/
[458] Container Recycling Institute (2016) *Bottle Bill Resource Guide*. Available at: http://www.bottlebill.org/about/benefits/litter/bbstates.htm
[459] Ghent University (2016) *Deposit-refund schemes for one-way drink packaging*. Available at: https://lib.ugent.be/fulltxt/RUG01/002/304/845/RUG01-002304845_2016_0001_AC.pdf
[460] Zero Waste Scotland (2015) *Summary of Responses to the Call for Additional Evidence for a Deposit Return Scheme for Scotland 2015.* Available at: https://www.zerowastescotland.org.uk/sites/default/files/ZWS%20Report%20DRS%20Call%20for%20Evidence%20Dec%202015.pdf
[461] Ostle et al (2019), *The Rise in Ocean Plastics Evidence from a 60 Year Time Series*. Nature Communications. Accessible at: https://www.nature.com/articles/s41467-019-09506-1
[462] Hartley et al (2018) Marine Pollution Bulletin, Volume 133: *Exploring public views on marine litter in Europe: Perceived causes, consequences and pathways to change.* Available online at: https://www.sciencedirect.com/science/article/pii/S0025326X18303904
[463] https://www.mcsuk.org/clean-seas/drs

D12.6.18 The United Nations has acknowledged DRS as an effective approach to reducing plastic pollution in its *Draft Resolutions on Marine litter and microplastics* (2017)[464], and *Management of Marine Debris* (2014)[465] and this is supported by the Marine Conservation Society[466].

Materials Use

D12.6.19 The increased recycling targets, and the move toward a circular economy, are both intended to prolong the lifetime of materials and reduce the need for additional virgin materials. WRAP found that the adoption of a circular economy in the UK could lead to 30M tonnes of fewer material inputs into the economy, whilst producing 20% less waste and providing 20M tonnes of increased recycling[467].

D12.6.20 There is approximately £20Bn worth of food is waste in the UK each year. Whilst efforts are ongoing to educate citizens to reduce this waste, it is possible that the material can be captured and composted for use in local greenspaces. In 2018, the Government announced that every home in England would receive a weekly food collection and consultation opened in February 2019[468]. The consultation concluded in May 2019 with Government publishing a summary of submission and a response stating that given the support for separate food waste collection in that consultation, Government will legislate to ensure that every local authority provides householders with a separate food waste collection. Given the strong support for having businesses separate food waste for collection, Government will seek to amend legislation to require this. However, given the range of views on how this provision should be applied, options will be discussed further with the sector and with businesses and more detailed proposals prepared for consideration early next year.

D12.6.21 This could generate over 8Mt of food waste to the organics sector, worth up to £280M in renewable energy sales[469]. In 2017, the Environment, Food and Rural Affairs Select Committee, when gathering information for the report into 'Food Waste in England', received evidence that AD plants had extensive capacity remaining[470] although views on this are not settled[471], as food and green waste collection practices and volumes continue to change.

D12.6.22 In addition, the UK Plastics Pact has set out key targets by 2025 including:

- 100% of plastic packaging to be reusable, recyclable or compostable;
- 70% of plastic packaging to be effectively recycled or composted;
- elimination of single use packaging;
- 30% recycled content within all plastic packaging.[472]

[464] The United Nations Environment Programme (December 5, 2017) *Draft resolution on marine litter and microplastics* [online] Available at: https://papersmart.unon.org/resolution/uploads/k1709154.docx

[465] The United Nations Environment Programme (November 7, 2014) *Draft resolution on Management of Marine Debris* [online] Available at: http://www.cms.int/sites/default/files/document/cop11_crp14_dr_management_marine_debris_0.pdf

[466] ibid

[467] http://www.wrap.org.uk/content/wraps-vision-uk-circular-economy-2020

[468] Defra (2018). Our Waste, Our Resources: A Strategy for England. Available online at: https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england

[469] Defra (2018). Our Waste, Our Resources: A Strategy for England: Evidence Annex. Available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765915/rws-evidence-annex.pdf

[470] House of Commons Environment, Food and Rural Affairs Committee (2017). *Food Waste in England*. Available online at: https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/42908.htm

[471] Tolvik (2019) *Anaerobic Digestion Market in Great Britain: Does it have the capacity?* Available online at: https://www.tolvik.com/published-reports/view/anaerobic-digestion-market-great-britain/

[472] WRAP (2018). A Roadmap to 2025 – The UK Plastics Pact. Available online at: http://www.wrap.org.uk/content/the-uk-plastics-pact-roadmap-2025

D12.6.23 Sufficient waste infrastructure would be essential to meet these ambitions. Waste services may need to adapt to manage a changing material flow at the kerbside. It is also possible that such a significant change may jeopardise the operational efficiency of disposal sites such as incinerators which require minimum calorific feed flows and which are contractually mandated between contractors and local authorities. As such, it is possible that, if the UK successfully achieves the ambitions above, then local authorities may incur expensive contractual changes or look to import materials from the UK to make up any calorific shortfall.

D12.6.24 The potential movement of any material – from any DRS or imported materials – poses a risk of litter to communities en-route to processing sites. This could lead to increased roadside littering if Duty of Care obligations are not robustly ensured to protect materials when in transit.

D12.6.25 Increasingly, local authorities are exploring collaborations to maximise effective and efficient use of resources. Collaborations exist through areas such as joint procurement, partnership working and asset sharing; as promoted through the National Planning Policy for Waste (2014)[473]. A consolidation of local authority resource management systems could save between £200M and £450M[474]. Local authorities are common partners in developing and funding large and expensive infrastructure such as Material Recycling Facilities or Energy from Waste plants. In addition, authorities are collaborating on waste collection services. An increase in collaboration efforts could change the face of waste management in England if authorities amalgamate services and infrastructure. This could mean either a reduction in sites, or the creation of new sites.

D12.7 Likely Significant Effects of the Draft WMPE and Reasonable Alternative

D12.7.1 **Table D12.1** presents the findings of the assessment of the Draft WMPE and reasonable alternative. The SEA objective and guide questions are restated, and then for both the WMPE and the reasonable alternative, the effects of each are considered against each element of the waste management hierarchy (prevention, reuse, recycling, recovery and disposal).

Table D12.1 Assessment of the Draft WMPE and reasonable alternative

Landscape and Townscape.
To protect and enhance landscape and townscape quality and visual amenity.
• Will the draft WMPE lead to detrimental visual impacts? • Will the draft WMPE affect the purposes and/or special qualities of protected/designated/culturally important landscapes and their setting? • Will the draft WMPE provide opportunities to enhance nationally and locally designated landscapes, townscapes and seascapes and their settings? • Will the draft WMPE affect the intrinsic character or setting of local landscapes, townscapes and seascapes? • Will the draft WMPE help to minimise light pollution from construction and operational activities on residential amenity and on sensitive locations and receptors? • Will the WMPE help reduce the likelihood of littering and fly-tipping and other waste crime (through blight and environmental degradation)? • Will the draft WMPE affect public benefits and/or services provided by landscape? • Will the draft WMPE affect tranquillity?

[473] Department for Communities and Local Government (2014). National Planning Policy for Waste. Accessible online at: https://www.gov.uk/government/publications/national-planning-policy-for-waste

[474] ESA (2016). *Resourceful: Delivering a Strong and Competitive UK Resource Economy*. Available at: http://www.esauk.org/application/files/1015/3607/2368/20160801_RESOURCEFUL_Delivering_a_strong_and_competitive_UK_resource_economy.pdf

	Effect	Commentary
WMPE		
Prevention	+	The WMPE collates ambitious targets for England including the aim to eliminate avoidable plastic waste over the lifetime of the 25 Year Environment Plan, to eliminate avoidable waste by 2050 and to work towards no food waste entering landfill by 2030. In addition, the WMPE supports the principles of the circular economy which may reduce material use and waste generated. Any movement of waste up the hierarchy may lead to a reduction in the infrastructure that would be necessary to tackle wastes. The prevention of wastes could eliminate the need to construct more waste management sites including AD plants and EfW plants; this would have a positive effect on local communities by reducing the visual impact on local receptors and townscapes as well as secondary impacts such as light pollution, noise and littering from wastes that escape during transport and processing. Changing consumer behaviours to reduce wastes, through awareness campaigns and a redesign of materials to eliminate waste overall, would likely help reduce fly-tipping, littering and waste crime in communities. However, the extent of this is likely to be localised and the impact as a result of the WMPE cannot be quantified. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Reuse	+	Defra has established a target to ensure that all plastic packaging placed on the market is recyclable, *reusable* or compostable by 2025. The WMPE outlines the commitment to extend product lives through reuse and repair. The WMPE outlines a commitment to improve the design of materials by adopting the principles of the circular economy. By improving the design of products this could extend the lifespan of items by offering reuse opportunities. As noted above, this could then reduce the future demand for waste collection sites, reprocessors and recovery infrastructure. This would then reduce the visual footprint of waste infrastructure in communities and may offer improvements to issues such as fly-tipping, noise pollution, light pollution and littering. As noted in the prevention assessment above, the circular economy, and improved waste management behaviours may reduce avoidable waste however, it is possible that waste prevention may not lead to an absolute reduction in waste and resources collected, merely a reduction in waste collected for disposal. Whilst there may be a reduction in volumes of residual waste collected for disposal and its effects on vehicle movements, there may also be a corresponding increase in reuse and recycling and the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy – are therefore unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recycling	+	Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being recyclable, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The new services outlined in the WMPE include new household waste collection systems and a DRS and reforms to the packaging producer responsibility system. The new household collection systems may require new infrastructure as the 2017 Tolvik study notes that there may be a capacity gap in waste management infrastructure of between -3.8Mt and 8.5Mt. The demand for new capacity may require new infrastructure. It is possible that this new infrastructure could pose detrimental visual impacts, be a potential for light and noise concerns as well as intrusion through construction works, which collectively will affect local landscapes. However, it is also possible that existing infrastructure can be repurposed for these needs. Given this uncertainty, and the localised impact of any waste infrastructure, it is impossible to state if the WMPE may pose a positive or negative impact on landscape and townscape.

		In terms of siting of new waste management infrastructure, the location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the National Planning Policy Framework and National Planning Policy for Waste) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents/permits to develop, construct and operate which then would either seek to minimise or reduce any adverse effects. It is assumed that any increase in material capture will include an element of material that would otherwise have been littered. This will further benefit the environment in removing physical hazards and sources of contaminants to terrestrial and marine environments; a position supported a range of studies have identified beneficial effects on the reduction in littering from the introduction of a DRS and by the Marine Conservation Society who support the introduction of a DRS to tackle marine litter[475]. As noted under "reuse", any reduction in the demand for landfill may avoid the associated detrimental effects on local communities whilst allowing an opportunity to restore such sites to greenspaces; providing improvements to the visual character of local communities and offering new public benefits. The circular economy, and improved waste management behaviours may not reduce waste tonnages overall but may simply move wastes within the hierarchy; the exact extent of behaviour changes – and the impacts on material tonnages across the hierarchy and necessary infrastructure – are therefore unknown. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Recovery	+	The WMPE specifies an ambition to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a role in these ambitions as wastes are diverted from landfill sites into EfW infrastructure. The WMPE and RWS also support greater efficiency of EfW plants, including through utilisation of the heat generated. It is not known if new capacity will be needed for the new collection service. If so, it is possible that such infrastructure may pose a detrimental impact on local communities as previously outlined and recovery infrastructure frequently includes greater visual impacts through the need for emission stacks, however it is also possible that existing infrastructure can be repurposed to meet these needs, or brownfield sites can be brought back to use. As noted previously however new waste management infrastructure would require planning permission (and other environmental consents) which then would either seek to minimise or reduce any adverse effects. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Disposal	+	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The WMPE is favourable toward reducing the demand for current and future landfill sites. The WMPE will therefore support moves to reduce demand for disposal of wastes; this may provide improvements by reducing odours and vehicle movements which affect the landscape and townscape of communities. The restored landfill sites can then be used as recreational greenspaces; providing communities with new public amenities. The exact extent to which landfill demand will drop, or the impact the WMPE may have on future landfill numbers, is not known however at this time. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Cumulative	+	The WMPE provides a range of ambitions that can provide improvement to the local landscape and townscape of communities. The framework demonstrates a "routemap" to divert wastes up the hierarchy; reducing the need for landfill sites. This will provide benefits to communities by reducing the need for new landfill sites and allowing for the closure and restoration of others.

[475] https://www.mcsuk.org/clean-seas/drs

		The demand for new infrastructure could pose risks through visual impacts as well as increased noise, light pollution and intrusion from the construction and operation of new facilities. However, it is also possible that any such infrastructure can be housed in existing sites or on brownfield sites; therefore posing little to no impact on local townscapes or landscapes. The movements of wastes through the hierarchy, and the introduction of new services can offer reductions in littering (both marine and terrestrial) and landfilling by incentivising better waste management. The adoption of circular economy principles can take this one step further by eliminating wastes entirely by redesigning materials to be reusable or recoverable and this is supported in the WMPE. The exact impact of future waste infrastructure upon landscape cannot be calculated however until the design and success of such services and behavioural changes are in place. As such, the WMPE is likely to have an overall minor positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions.
Direction of Travel Reasonable Alternative		
Prevention (increase in prevention of waste streams compared to WMPE)	++	The reasonable alternative aims to exceed the Defra targets, ambitions and the services discussed in the WMPE and at a quicker pace. The reasonable alternative may seek to prevent wastes at a more ambitious pace. This will require behavioural changes in consumers and operational changes in manufacturers to design out wastes. Any improvements to consumer or manufacturing behaviours will eliminate wastes and instil a new paradigm across society. This would reduce the demand for future waste management infrastructure and may also see the closure of reprocessing plants or recovery sites if waste volumes are not sufficient; this could offer significant improvements to the landscape and townscape of local communities. Preventing wastes at the pace within the reasonable alternative could also see the closure and restoration of landfill sites to offer new community amenities such as greenspaces or wildlife habitats. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Reuse (increase in reuse of waste streams compared to WMPE)	+	The reasonable alternative seeks to exceed the target to ensure that all plastic packaging placed on the market is recyclable, reusable or compostable by 2025. The reasonable alternative assumes that reuse ambitions will be achieved at a quicker rate than the WMPE has outlined. The reasonable alternative would see consumers and manufacturers changing their behaviours significantly; as outlined above. The reasonable alternative would see products being designed for reuse. The reasonable alternative would also see consumers reusing products significantly more than at usual. Businesses may also reuse materials by sharing via business-to-business platforms or making better use of the third sector. As noted previously, a behavioural shift to adopt reuse as a more normative behaviour, could reduce existing and future demand for waste infrastructure. This could offer benefits to communities through reduced noise and light pollution, intrusion from vehicle movements and a potential reduction in litter or fly-tipping. Adopting reuse could also see the closure and restoration of landfill sites to offer new community amenities such as greenspaces or wildlife habitats. As such, the reasonable alternative is likely to have an overall positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recycling (increase in recycling of waste streams compared to WMPE)	++	As stated in the WMPE assessment above, Defra has established a target to increase household recycling and composting to 50% by 2020, to work towards all plastic packaging placed on the market being *recyclable*, reusable or compostable by 2025 and to achieve a 65% recycling rate for municipal solid waste by 2035. The reasonable alternative assumes that the ambitions of the WMPE will be delivered in a quicker timeframe and where results exceed stated targets.

		The reasonable alternative would offer new services, at a quicker pace, to segregate recyclate, including a separate food waste collection service. The services would also include a DRS for drinks containers. This is likely to reduce littering across towns; providing a benefit to the visual landscape in communities. As stated, it is assumed that any increase in material capture will include an element of material that would otherwise have been littered. This will further benefit the environment in removing physical hazards and sources of contaminants to terrestrial and marine environments; a position supported by the Marine Conservation Society who support the introduction of a DRS to tackle marine litter[476]. In addition, any new infrastructure that is considered necessary to increase sorting and reprocessing capacity can be located in existing buildings or on brownfield sites. It is possible therefore that new infrastructure could have a limited impact on communities. Taking this approach could reduce the visual impact and noise pollution associated with the construction and operation of new sites. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Recovery (increase in recovery of waste streams compared to WMPE)	++	The WMPE states the ambitions to eliminate wastes of all kinds by 2050 and to eliminate food waste to landfill by 2030. Recovery is likely to play a significant role in these ambitions. The reasonable alternative therefore seeks to exceed these objectives by exceeding the targets within a speedier timescale. The reasonable alternative would introduce a separate collection of food waste and assumes a higher participation and material capture rate than the WMPE may deliver. As noted previously, this will divert food waste from landfill into the recovery or recycling level of the hierarchy which could require additional capacity in infrastructure. It is not known if new treatment capacity may be needed for the new collection service in time, however to avoid the impacts of new infrastructure – as noted previously - existing infrastructure can be repurposed to meet these needs, or brownfield sites can be brought back to use. As noted previously, the movement of wastes up the hierarchy could see a reduction in the demand for landfill. This may allow an opportunity to restore landfill sites to greenspaces; providing improvements to the visual character of local communities and beaches and offering new public benefits. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Disposal (decrease in disposal of waste streams compared to WMPE)	++	The WMPE reiterates targets to eliminate food waste to landfill by 2030 and to reduce municipal wastes to landfill to a maximum of 10% by 2035. The reasonable alternative will seek to exceed these ambitions at a quicker pace. The reasonable alternative has the potential to divert wastes away from disposal facilities at a quicker pace. This would see a reduction in the demand for new, or even existing, disposal infrastructure such as landfills or visually intrusive EfW plants. The closure, or avoidance, of landfill offers significant advantages to communities from a landscape and townscape perspective by reducing the need for excavation and construction works, as well as the noise, lighting and odour impacts from the operation and movements associated with the disposal methods. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions
Cumulative	++	The WMPE provides a range of ambitions that can provide improvement to the local landscape and townscape of communities. The WMPE outlines a "routemap" to divert wastes up the hierarchy; increasing the prevention of wastes, reuse and recycling. It also seeks to limit the recovery and disposal of wastes unless necessary.

[476] https://www.mcsuk.org/clean-seas/drs

		The reasonable alternative suggests that the new services will be introduced at a quicker pace than the WMPE. The development of new waste management infrastructure could have visual impacts as well as increased noise, light pollution and intrusion from the construction and operation of new facilities, and be viewed as collectively intrusive in the landscape. However, it is also possible that any such infrastructure can be housed in existing sites or within existing industrial landscapes therefore, presenting little to no impact on local townscapes or landscapes. The exact impact of future waste infrastructure upon landscape cannot be calculated however until the design and success of such services and behavioural changes are in place. It is, however, reasonable to conclude that the ambitions within the reasonable alternative will provide real improvements to communities by tackling litter, fly-tipping and potentially reducing demand on landfill sites. As such, the reasonable alternative is likely to have an overall significant positive effect, relative to the current baseline for the issues covered by this SEA objective and guide questions

Score Key:	+ + **Significant** positive effect	+ **Minor** positive effect	0 **Neutral** effect	- **Minor** negative effect	- - **Significant** negative effect	? **Uncertain** effect

NB: where more than one symbol is presented in a Box Dit indicates that the SEA has found more than one score for the category. Where a Box Dis coloured but also contains a '?', this indicates uncertainty over whether the effect could be a minor or significant effect although a professional judgement is expressed in the colour used. A conclusion of uncertainty arises where there is insufficient evidence for expert judgement to conclude an effect.

D12.8 Mitigating Measures

D12.8.1 Many of the identified effects relate to siting and implementation of waste faciliaties, their operation and any new services needed. The likelihood of adverse effects occurring, their magnitude and their duration will be dependent on the type, scale and location of infrastructure to be developed, the proximity of sensitive receptors and the nature of the associated waste collection services to be implemented. It should also be noted that location of new sites would be identified in the relevant waste local plan (which would themselves be consistent with the policies of the NPPF and NPPW) and which are subject to SEA and HRA, and would require relevant planning permissions (which could include EIA and HRA) and environmental consents to develop and construct. The operation of waste management facilities is also subject to environmental permitting. However, to further support the SEA objectives, the following mitigation measures could minimise the impact on landscape and townscape:

- Any new infrastructure proposed should be considered against the policies and requirements of the relevant waste local plan, or National Policy Statement (if applicable).
- Any new infrastructure should seek to be compatible with the surrounding landscape and land uses, and consistent with the requirements of the NPPF, seek to protect and enhance landscape quality. Consideration should be given where appropriate to make such sites interesting and innovative in design through form, function and materials.
- Any excavated material arising from the construction of new infrastructure csould be reused on site or in uses as local as possible, such as local parks or to reinforce flooding defences along rivers, for example.
- Strong awareness campaigns could be implemented to encourage participation in any collection services to minimise any needs for landfill.

- Restoration of landfill sites could produce recreational site for local populations.
- Longitudinal litter audits could be undertaken regularly to track the impact of new services upon litter and fly-tipping on both terrestrial and marine environments.

D12.9 Uncertainties and Risks

- The locations of new waste management infrastructure are unknown and the effects on local townscapes and landscapes are not certain.
- The full environmental and economic impact of adopting a circular economy is not known, given the scope of the circular economy and the far reaching impacts on local, national and international practices including the need for, and composition of, future waste management infrastructure.
- The type of infrastructure required when diverting waste from landfill to other stages of the waste hierarchy is not certain at this stage.
- The full impact of behaviour changes and any movement of waste tonnages up the hierarchy is not known. It is possible that overall wastes may not decrease, but may simply move across the hierarchy.
- The extent and timescales of moving up the waste hierarchy for the reasonable alternative, and the associated scale of effects, are not certain.
- It is not known what impact a DRS may offer to increase recycling, or to reduce terrestrial and marine litter as no DRS has been implemented in a country that already hosts household recycling collections.

wood.