An Eco-metric Approach to Growing Natural Capital

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NATURAL ENGLAND

Environmental *Change* Institute

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UNIVERSITY OF OXFORD

Project team

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Outline

- Why is Natural England developing the Eco-metric?
- The Eco-metric concept
- The draft approach developed in Phase 1 (2017/18)
- How could it be used and what are its limitations?
- Phase 2: piloting and refinement (2018/19)

Biodiversity Net Gain – Growing Support

25 Year Environment Plan

*'**expanding the net gain approaches used for biodiversity to include wider natural capital benefits**, such as flood protection, recreation and improved water and air quality'*

*'embed an '**environmental net gain**' principle for development, including housing and infrastructure'*

NPPF

***encouraging biodiversity opportunities** "especially where this can secure measurable **environmental gains**"*

*"Recognising **wider benefits from natural capital**"*

? But what metrics should be used to measure 'net gain' ?

Aims of the Eco-metric

- **Captures the non-monetary value** of wider environmental goods and services from biodiversity net gain
- **Optimises natural capital gains** from investment in biodiversity.
- **Biodiversity-led:** biodiversity net gain is a pre-requisite. Because: *biodiversity underpins the quality of the natural assets that support the long-term delivery of multiple ecosystem services and their benefits*.
- **Simple** and easy to use, using freely available data and/or data gathered as part of Phase 1 or equivalent surveys.
- **As scientifically robust as possible**, using best available evidence.

Natural capital and ecosystem services

Cultural services

Aesthetic value

Recreation

Education

Interaction with wildlife

Sense of place

Provisioning services

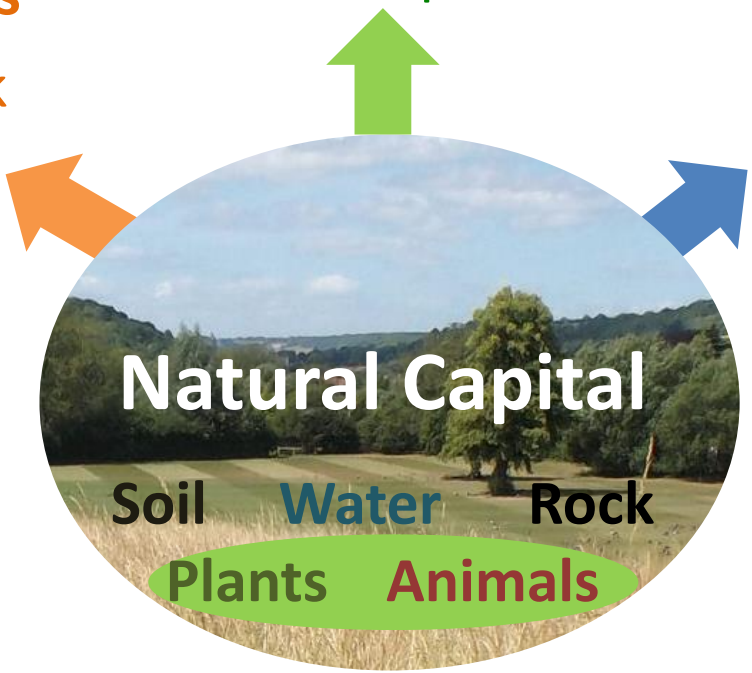
Food crops, livestock

Timber

Biofuels

Fish

Fresh water supply



Regulating services

Flood control

Erosion control

Water quality

Carbon storage

Air quality

Local climate

Noise regulation

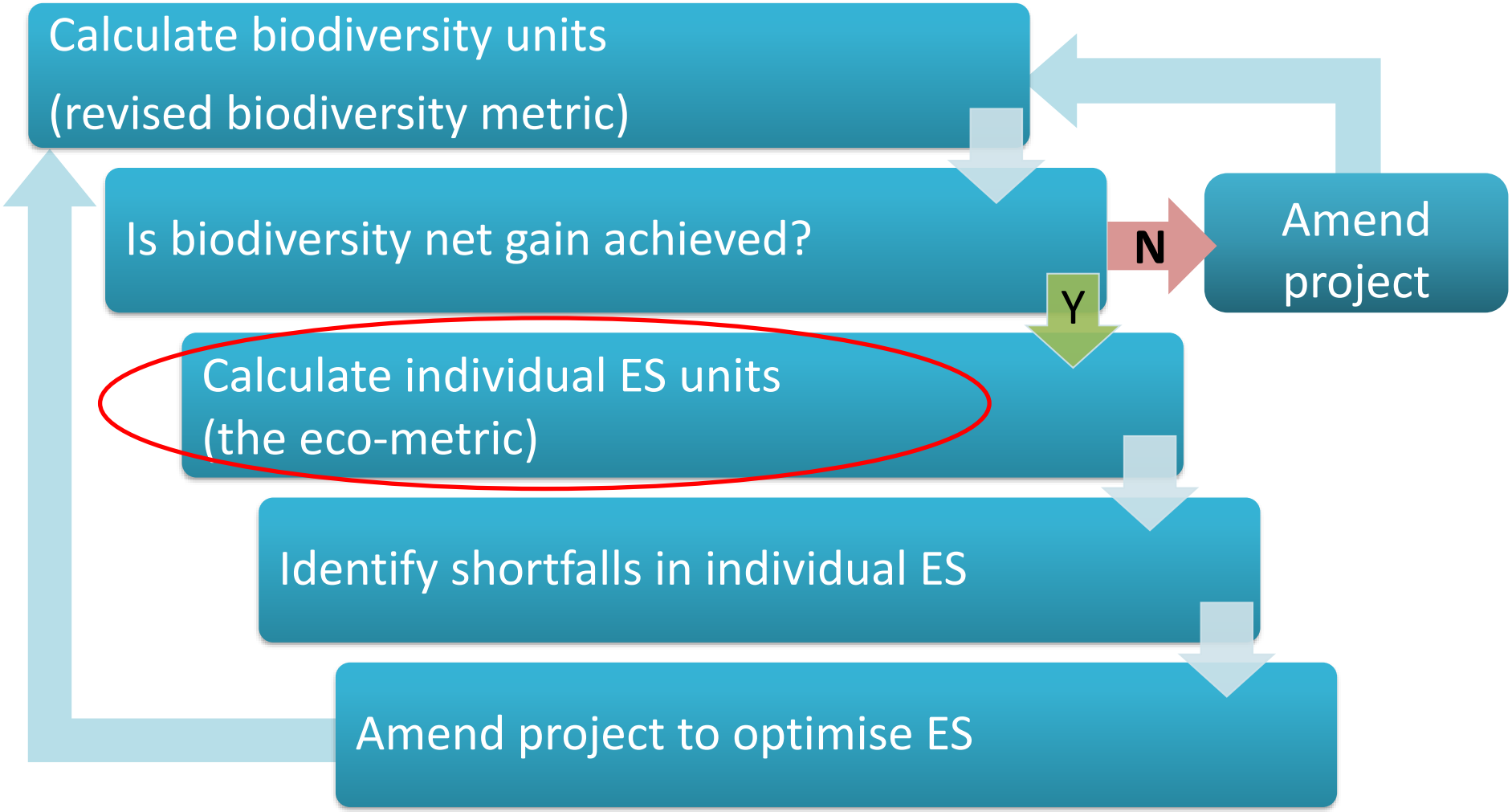
Pollination

Pest control

The basic concept

- An extension of the Defra biodiversity metric
- Uses a simple scoring approach
- Includes factors to account for:
  - ecosystem condition,
  - spatial location
  - time for habitats to reach maturity
- Increases transparency of decision-making
- Clear guidance on limitations

Natural England's eco-metric approach



The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

		Habitat distinctiveness		
		Low (2)	Medium (4)	High (6)
Condition	Good (3)	6	12	18
	Moderate (2)	4	8	12
	Poor (1)	2	4	6

The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

Location parameters	Multiplier
Offset is in a location identified in the offsetting strategy	No multiplier required
Offset is buffering, linking, restoring or expanding a habitat outside an area identified in the offsetting strategy	2
Offset is not making a contribution to the offsetting strategy	3

The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

Figure 7: Multipliers for different time periods using a 3.5% discount rate

Years to target condition	Multiplier
5	1.2
10	1.4
15	1.7
20	2.0
25	2.4
30	2.8
32	3

The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

Difficulty of recreation/restoration	Multiplier
Very High	10
High	3
Medium	1.5
Low	1

Eco-metric calculation

The biodiversity metric

BD = Area x Distinctiveness x Condition x Spatial x Time x Delivery

The eco-metric

ES1 = Area x Score x Condition x Spatial x Time x Delivery
ES2 = Area x Score x Condition x Spatial x Time x Delivery
ES3 = Area x Score x Condition x Spatial x Time x Delivery
ES4 = Area x Score x Condition x Spatial x Time x Delivery
…

Calculating eco-metric units

Habitat map

Assess condition (C), spatial factors (S), time lag (T), delivery risk (D)

Matrix of scores

	ES1	ES2	ES3	…
Hab 1	5	5	3	…
Hab 2	3	2	1	…
…		…	…	…

Calculate units for each land parcel and each ES
Area x Score x C x S x T x D

Total units for each ES

Metrics	**ES1**	**ES2**	**ES3**	…
Before	525	600	300	…
After	550	270	400	…
Difference	+25	-330	+100	…

Sum units for each land parcel and each ES
Before and after development

Designing the eco-metric: ES list

Provisioning	Food production (arable crops, horticulture, livestock, orchards, allotments, urban food)
	Fish production(aquaculture, commercial fishing, recreational fishing)
	Wood production (timber or woody biofuel)
	Water supply
Regulating	Carbon storage / sequestration (combined)
	Air quality regulation
	Water quality regulation
	Erosion protection
	Flood regulation
	Pollination
	Pest control
	Local climate regulation
	Noise regulation
Cultural	Recreation
	Aesthetic value
	Education
	Interaction with wildlife / access to nature
	Sense of place (requires local stakeholder input to scores)

Habitat list

- Broad-leaved, mixed and yew semi-natural woodland
- Broad-leaved, mixed and yew plantation
- Parkland / pasture with scattered trees
- Coniferous plantation
- Native pine woods
- Dense scrub
- Traditional orchard
- Hedgerows
- Tall herb and fern
- Bracken
- Semi-natural grassland
  - Acidic grassland
  - Calcareous grassland
  - Neutral grassland
- Improved grassland
- Arable fields
- Arable field margins
- Horticulture
- Woody biofuel crops
- Intensive orchards
- Bog
- Dwarf shrub heath
- Inland rock
- Freshwater
  - Standing open water and canals
  - Running water
- Fen, marsh and swamp
  - Lowland fens
  - Purple moor grass and rush pastures
  - Upland flushes, fens and swamps
  - Aquatic marginal vegetation
  - Reedbeds
  - Other swamps

- Coastal rock
- Coastal saltmarsh
- Vegetated dunes and shingle
- Beach
- Other littoral sediment
- Urban sealed surface and buildings
- Urban permeable paving
- Bare ground
- Garden
  - Vegetated garden
  - Unvegetated garden
- Open mosaic habitats on previously developed land
- Parks and gardens
- Footpath / cycle path - green
- Footpath / cycle path - grey
- Green bridge
- Amenity grassland
- Road island / verge
- Natural sports pitch, recreation ground or playground
- Non-permeable sports pitch, recreation ground or playground
- Cemeteries and churchyards
- Allotments, city farm, community garden
- Green roof
- Green wall
- Brown roof
- Tree
- Bioswale
- Rain garden
- Introduced shrub
- Flower bed

Designing the eco-metric: Scores

- Review of existing approaches
- Biophysical data used where possible e.g. carbon storage
- Natural Capital Accounts used for air quality regulation
- Preliminary scores will be reviewed in Phase 2

	Vegetation, t/ha			Soil, t/ha (top 30 cm)			Total	Standardised score (scale 0-10)			
	Mean	Min	Max	Mean	Min	Max		a) Peat =10	b) BL forest =10	c) Veg only	d) Final
Peat bogs	**7**	1.5	20	**576**	133	1170	**583**	10	21	1	21
Broadleaved forest	**111**	57	208	**162**	70	335	**273**	5	10	10	10
Mixed forest	**78**	47	139	**124**	86	179	**202**	3	7	7	8?
Coniferous forest	**59**	26	95	**107**	82	175	**166**	3	6	5	7?
Marshes	**8**	1	15	**143**	37	235	**151**	3	6	1	6
Natural grassland, pastures	**3**	1	7	**121**	72	204	**124**	2	5	0	2
Moors and heathland	**7**	2	17	**103**	51	196	**110**	2	4	1	4
Shrub; agriculture with significant natural vegetation; orchards	**15**	2	37	**88**	37	120	**103**	2	4	1	5?
Urban greenspace	**8**	2	25	**91**	40	142	**99**	2	4	1	2-4
Bioenergy crops	**3**	1.5	4.5	**75**	70	80	**78**	1	3	0	3
Non-irrigated arable land	**2**	1	5	**64**	27.5	88	**66**	1	2	0	2

Scores based on systematic review by Cantarello et al (2011)

Part of draft scoring matrix – under review

	Food production	Wood production	Fish production	Water supply	Flood regulation	Erosion protection	Water quality regulation	Carbon storage	Air quality regulation	Local climate	Noise regulation	Pollination	Pest control	Recreation	Aesthetic value	Education	Interaction with wildlife	Sense of place
Broad-leaved, mixed and yew semi-natural woodland	1	6	0	3	10	10	10	10	6	10	8	8	8	10	10	10	10	10
Broad-leaved, mixed and yew plantation	0	8	0	2	9	8	8	9	6	10	8	6	6	8	10	6	7	8
Parkland / pasture with scattered trees	5	2	0	7	6	8	6	5	3	6	6	8	8	10	10	6	6	10
Coniferous plantation	0	10	0	1	10	6	5	7	10	10	10	2	6	8	6	6	4	6
Native pine woods	0	0	0	2	10	8	6	8	8	10	10	6	8	10	10	10	10	10
Dense scrub	2	2	0	4	6	8	5	5	7	6	6	8	10	8	8	6	8	6
Traditional orchard	5	1	0	7	8	8	5	5	4	8	6	8	8	8	10	8	7	10
Hedgerows	1	1	0	4	6	8	5	5	8	6	6	8	10	8	10	8	10	10
Tall herb and fern	1	0	0	8	5	6	5	4	1	2	1	8	10	8	10	6	8	4
Bracken	1	0	0	8	5	8	5	4	1	2	1	6	8	8	6	4	6	2
Semi-natural grassland	6	0	0	9	4	8	4	2	1	2	1	8	8	10	10	10	10	10
Acidic grassland	6	0	0	9	4	8	4	3	1	2	1	6	8	10	10	10	10	10
Calcareous grassland	6	0	0	9	4	8	4	2	1	2	1	10	8	10	10	10	10	10
Neutral grassland	6	0	0	9	4	8	4	2	1	2	1	8	8	10	10	8	10	10
Improved grassland	10	0	0	7	3	4	1	3	1	2	1	2	3	4	4	2	2	4
Arable fields	10	0	0	7	2	0	0	2	1	2	1	2	2	2	2	2	1	2
Arable field margins	0	0	0	8	4	6	5	2	1	2	1	8	8	4	8	6	6	4
Horticulture	10	0	0	7	2	0	0	1	1	2	1	2	2	2	2	2	1	2
Woody biofuel crops	0	10	0	3	4	2	1	3	1	2	1	2	4	2	2	2	1	2
Intensive orchards	10	0	0	3	8	6	1	5	4	8	6	6	4	2	8	2	1	2
Bog	2	0	0	10	5	8	7	10	1	4	1	6	3	8	8	8	10	10
Dwarf shrub heath	2	0	0	8	5	8	5	4	1	2	1	10	9	10	10	8	10	10
Inland rock	0	0	0	0	0	0	0	0	0	0	0	0	0	8	10	8	2	10

Part of draft scoring matrix – under review

	Food production	Wood production	Fish production	Water supply	Flood regulation	Erosion protection	Water quality regulation	Carbon storage	Air quality regulation	Local climate	Noise regulation	Pollination	Pest control	Recreation	Aesthetic value	Education	Interaction with wildlife	Sense of place
Urban sealed surface and buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban permeable paving	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare ground	0	0	0	4	1	0	1	1	0	1	0	1	3	2	2	6	6	2
Garden	0	0	0	3	3	2	1	1	1	1	1	2	2	2	2	2	2	2
Vegetated garden	1	0	0	7	3	5	2	2	2	2	2	4	4	4	6	4	4	4
Unvegetated garden	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Open mosaic habitats on previously developed land	0	0	0	5	2	4	1	2	1	2	1	6	6	8	6	8	6	4
Parks and gardens	0	0	0	7	3	5	2	4	3	4	2	6	8	10	8	6	6	6
Footpath / cycle path - green	0	0	0	5	2	3	1	2	1	2	1	4	4	10	6	2	4	6
Footpath / cycle path - grey	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	2
Green bridge	0	0	0	2	2	0	1	1	1	2	1	2	2	10	6	6	8	8
Amenity grassland	0	0	0	7	3	4	2	2	1	2	1	2	2	10	5	2	2	2
Road island / verge	0	0	0	5	3	4	2	2	1	2	1	2	2	2	5	2	2	2
Natural sports pitch, recreation ground, outdoor gym or	0	0	0	7	3	3	2	2	1	2	1	2	2	10	2	2	2	4
Non-permeable sports pitch, outdoor gym or playgroun	0	0	0	0	0	0	0	0	0	0	0	0	2	10	1	2	0	2
Cemeteries and churchyards	0	0	0	7	3	4	2	4	1	2	1	6	4	2	6	2	4	8
Allotments, city farm, community garden	7	0	0	7	2	0	1	2	2	2	2	6	4	10	5	6	4	10
Green roof	0	0	0	0	3	1	1	1	1	6	1	6	4	2	5	4	2	6
Green wall	0	0	0	0	1	0	1	1	4	6	2	6	4	2	6	4	2	6
Brown roof	0	0	0	0	1	0	1	1	1	2	1	6	8	2	4	4	4	6
Tree	0	0	0	1	6	6	2	7	6	8	6	6	8	2	10	8	8	10
Bioswale	0	0	0	2	5	2	2	2	1	4	1	4	4	2	8	4	6	4
Rain garden	0	0	0	10	5	2	7	2	1	4	1	6	6	2	10	6	8	6

Condition factors for ES


James Petts, Flickr


Steve, Flickr

Example condition factors for ES

Food crops	Agricultural Land Class
Fish production	WFD ecological and chemical status
	Barriers to fish passage
	Quality of substrate; presence of meanders etc
Water supply	Soil permeability (LANDIS), soil compaction (survey)
	Tree size (diameter); canopy cover
Flood protection	Soil permeability (LANDIS), soil compaction (survey)
	Tree size (diameter); canopy cover
Water quality/erosion	Ground cover, vegetation roughness, sward height
Air quality regulation	Leaf area index
	High biogenic VOC emitting species (Y/N)?
Carbon storage	Tree size (diameter)
	Soil carbon, soil depth
	Peat (active formation; degraded)

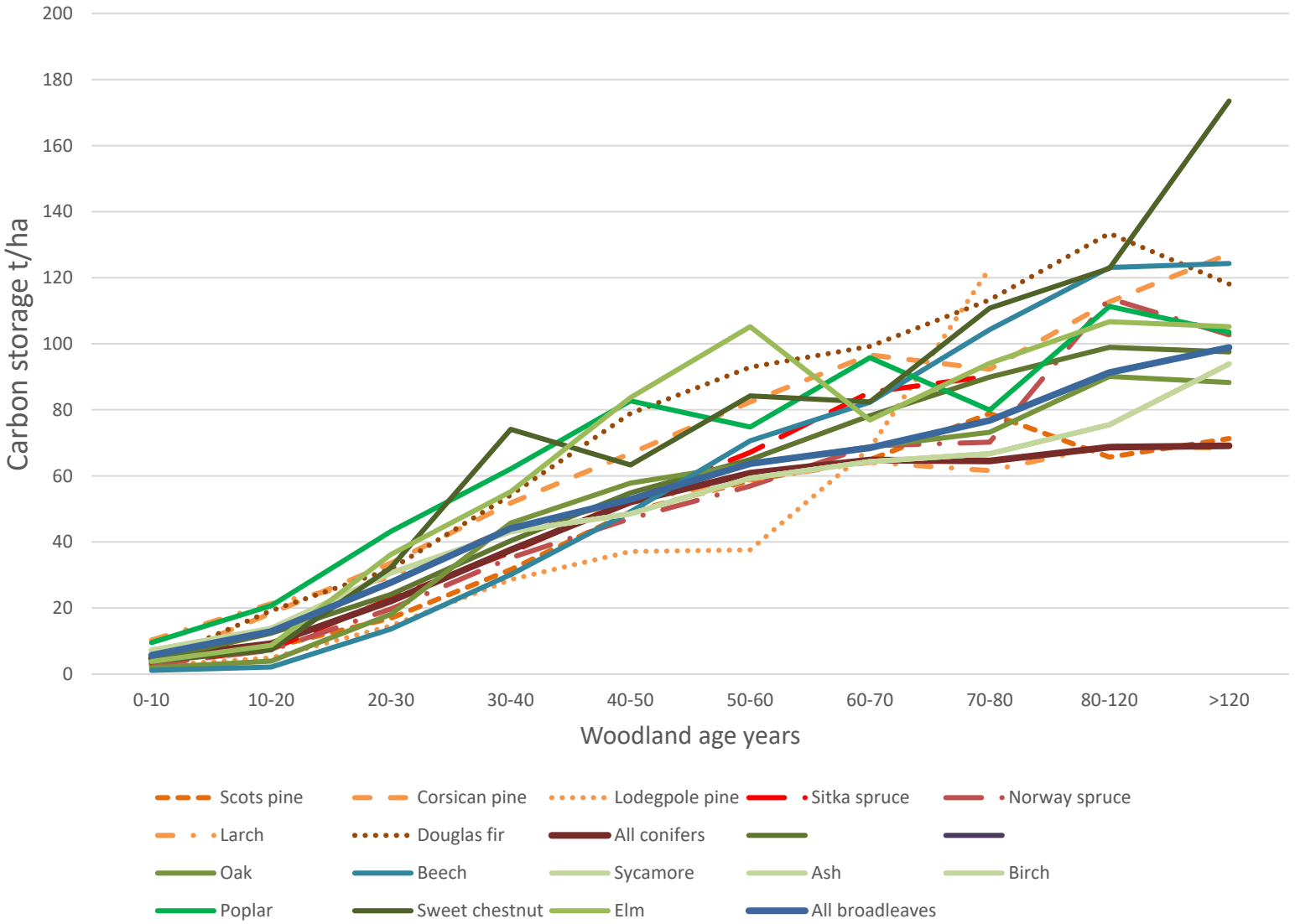
Select, set multipliers and test in Phase 2

Example condition factors for ES

Pollination	Flower forage abundance
	Flower forage diversity
Pest control	Structural diversity
	Dead wood abundance
Recreation	Public access (Y/N)?
Aesthetic value	Landscape diversity
Education	Priority habitat (Y/N)?
	Ancient habitat (Y/N)?
Interaction with wildlife	Priority habitat (Y/N)?
	Public access (Y/N)?
	Ancient habitat (Y/N)?
Sense of place	Landscape Character Area habitat, species or feature?
	Locally determined indicators / places
	Priority habitat (Y/N)?
	Historic features
	Ancient habitat (Y/N)?

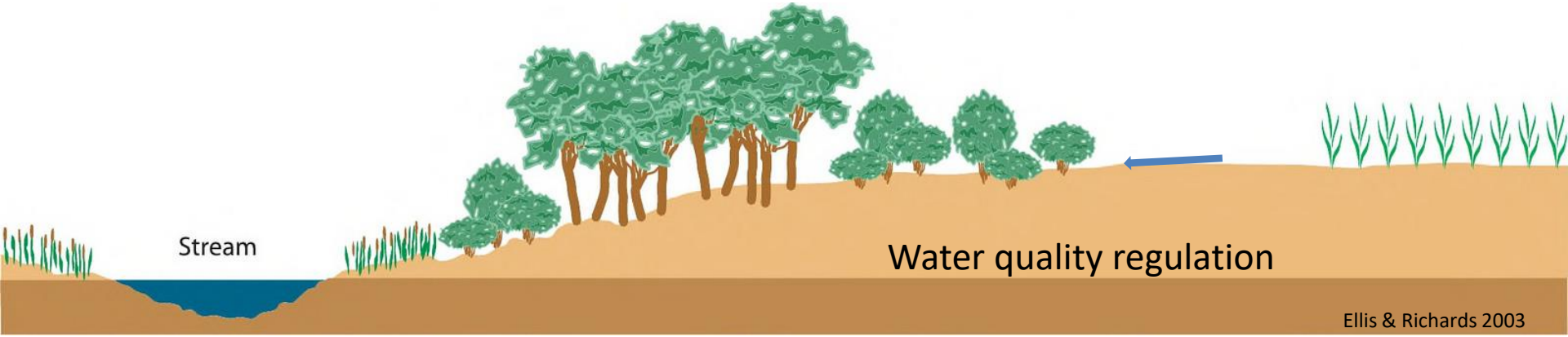
Select, set multipliers and test in Phase 2

Example: carbon stored in woodlands vs age



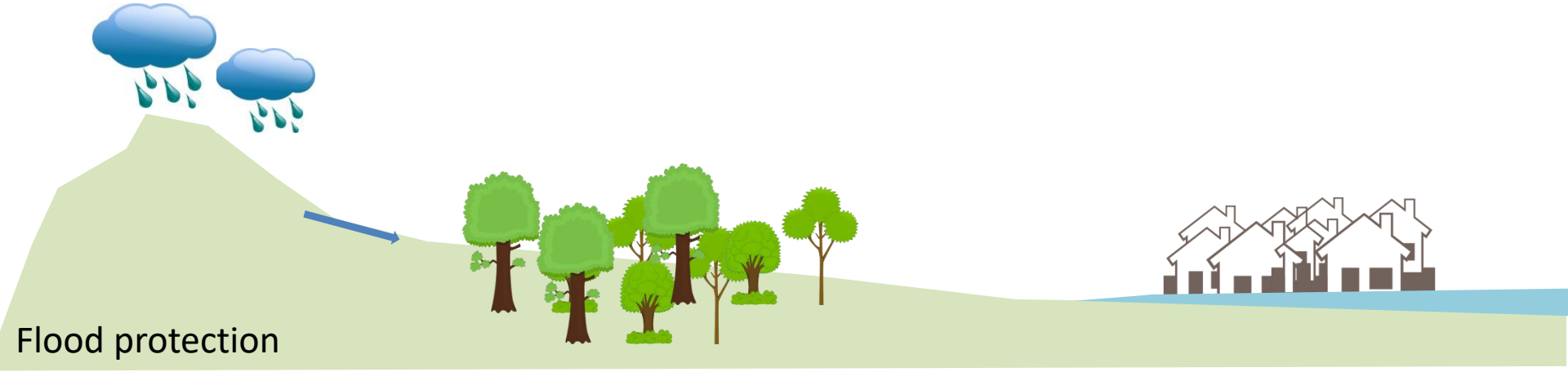
Milne and Brown 1997

Spatial factors for ES



Water quality regulation

Ellis & Richards 2003



Flood protection

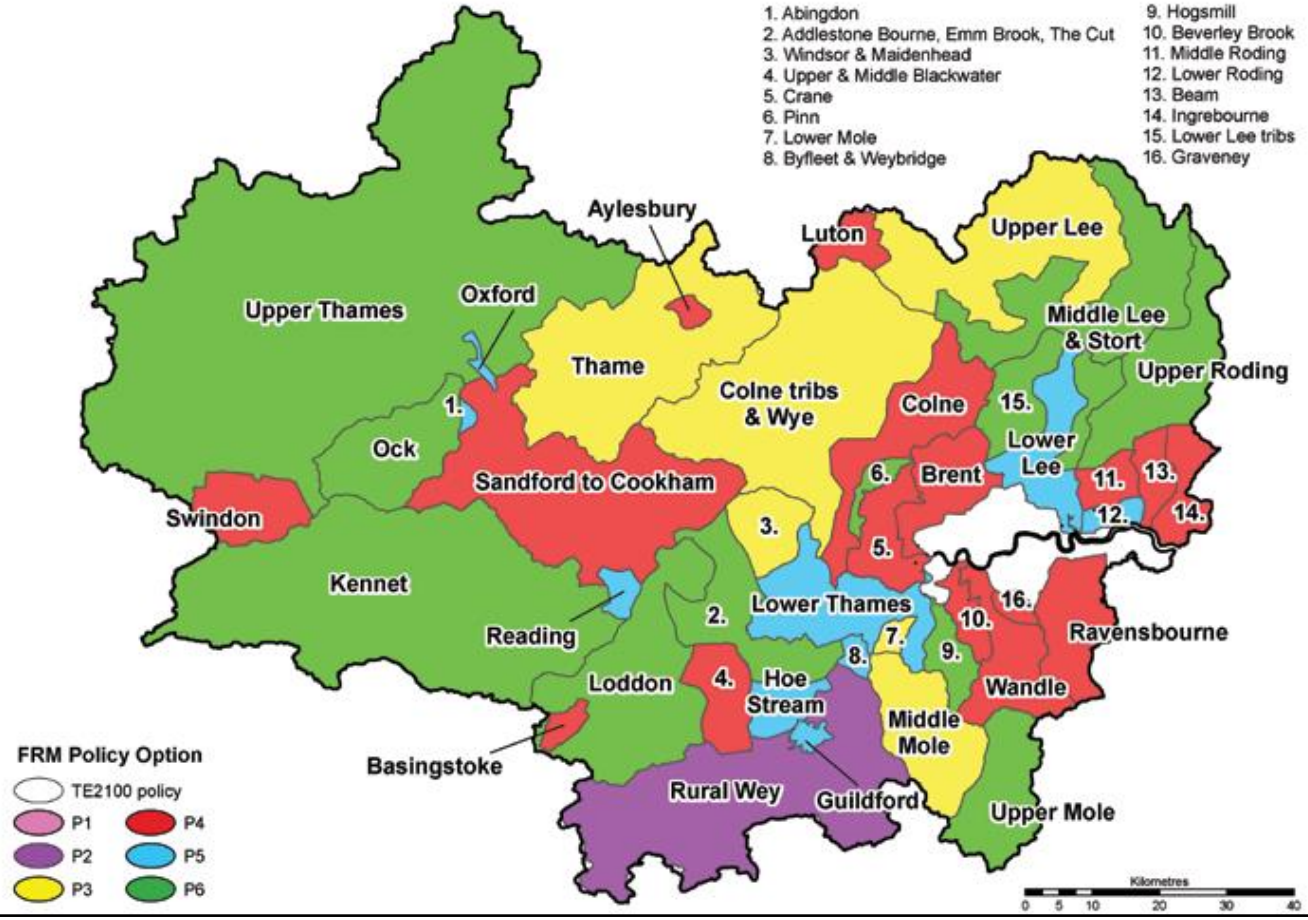
Air quality and noise regulation

Examples of spatial indicators for ES

Water supply	Catchment abstraction management policy (indicates water scarcity and ability to improve supply)
Flood regulation	Catchment flood management policy (indicates number of properties at risk of flooding, severity of risk and ability to mitigate)
Soil erosion	Slope; soil erodability
Water quality	Is habitat on flow path between pollution source and receptor (stream, aquifer, coast) (Y/N)? In a surface and groundwater vulnerable zone (Y/N)?
Local climate regulation	Distance of habitat from buildings; aspect Max summer temperatures
Pollination / pest control	Proximity to (pollinator-dependent) crops Connectivity and patch size of semi-natural habitat
Recreation	Population within certain distance
Aesthetic value	Access and visibility from public places

Select, set multipliers and test in Phase 2

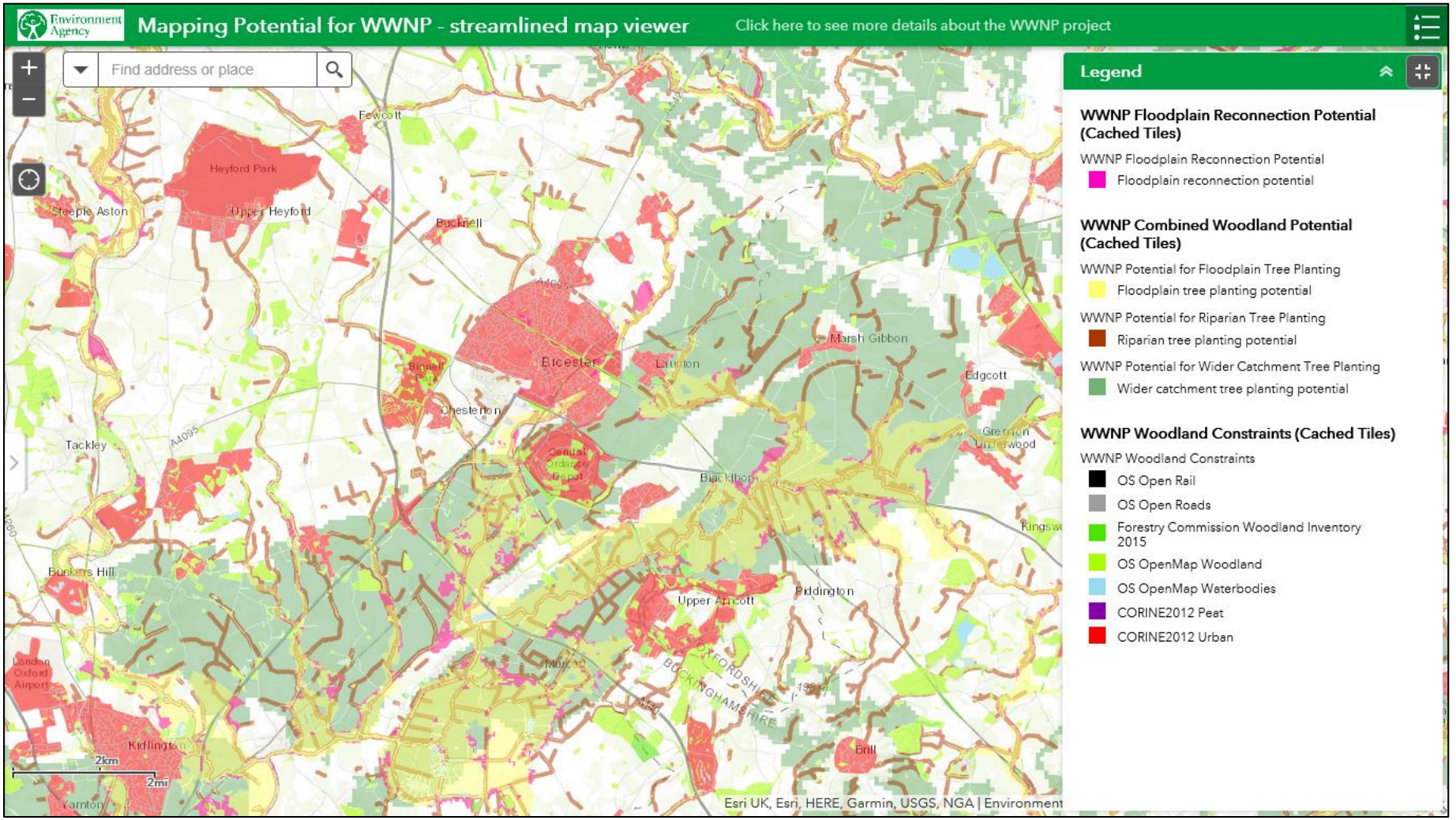
Use catchment flood management plans?



P1	Little or no flood risk
P2	Low to moderate flood risk – management can be reduced
P3	Low to moderate flood risk – doing OK
P4	Low, moderate or high flood risk – doing OK but more action needed to keep pace with climate change
P5	Moderate to high flood risk – further action needed
P6	Low to moderate flood risk – can store water or manage run-off to provide overall flood risk reduction

Working with natural processes: woodland opportunity maps

Slowly permeable soils = better opportunity for woodland to improve infiltration
Floodplain woodland = slows the flow
Riparian woodland – 50m buffer from rivers



How can the eco-metric be used?

- **Land use change** from development or management, from feasibility, scoping and impact assessment, to design, construction, maintenance and monitoring.
- Designed to **help planners and developers**
  - optimise the full range of natural capital benefits from biodiversity net gain
  - make the business case for biodiversity investments
  - increase transparency in decision-making
- **Informs decision making**, alongside other planning information.

Examples

- Comparing alternative options for site design (habitats, spatial configuration)
- Assessing the impact of management (e.g. changes to habitat condition)
- Deciding on best location for site allocations

Limitations

- **Informs decision making**, alongside other planning information.
- It **does not replace expert assessment** such as for flood risk, or existing planning or statutory requirements such as environmental assessment.
- It is a **simple** way of capturing the broad range of environmental goods and services provided by biodiversity net gain.
- It will not replace more detailed ecosystem service assessments.

Guidance and principles

- **Biodiversity net gain is a pre-requisite.** The eco-metric can be used to optimise delivery of ecosystem services once biodiversity net gain is achieved.
- **Use within the mitigation hierarchy** (avoid - minimise - restore - compensate)
- **Be aware of limitations.** Scores and multipliers are largely based on expert judgement.
- The eco-metric is a **decision support tool** to be used alongside detailed impact assessments.
- **Individual ES scores cannot be added together.** They are not comparable, and this will mask gains and losses in different ES.

Phase 2: 2018-19

- Multipliers for condition and spatial factors
- Multipliers for time lag
- Expert review of scores and multipliers
- Spreadsheet template and guidance
- Testing in a range of real-life situations: over 20 pilot projects

  scale – plot, place, plan

  sector and location: urban/rural; housing / minerals / transport / community; north / south

  practitioner developer/planner/others
- Evaluation including cross-checking against other tools
- Stakeholder workshop and webinar, March / April 2019
- Refinement of approach
- If proven a final eco-metric approach will be published 2019

Ecosystems Knowledge Network

THANK YOU