



ANNEX B3.3.2

Natural Capital and Biodiversity Net Gain

This document has been written in line with the requirements of the RAPID gate two guidance and to comply with the regulatory process pursuant to Severn Trent Water's and Affinity Water's statutory duties. The information presented relates to material or data which is still in the course of completion. Should the solution presented in this document be taken forward, Severn Trent Water and Affinity Water will be subject to the statutory duties pursuant to the necessary consenting process, including environmental assessment and consultation as required. This document should be read with those duties in mind.



Grand Union Canal Strategic Resource Option

Natural Capital and Biodiversity Net Gain
Assessment Report

June 2022

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Grand Union Canal Strategic Resource Option

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1 Introduction

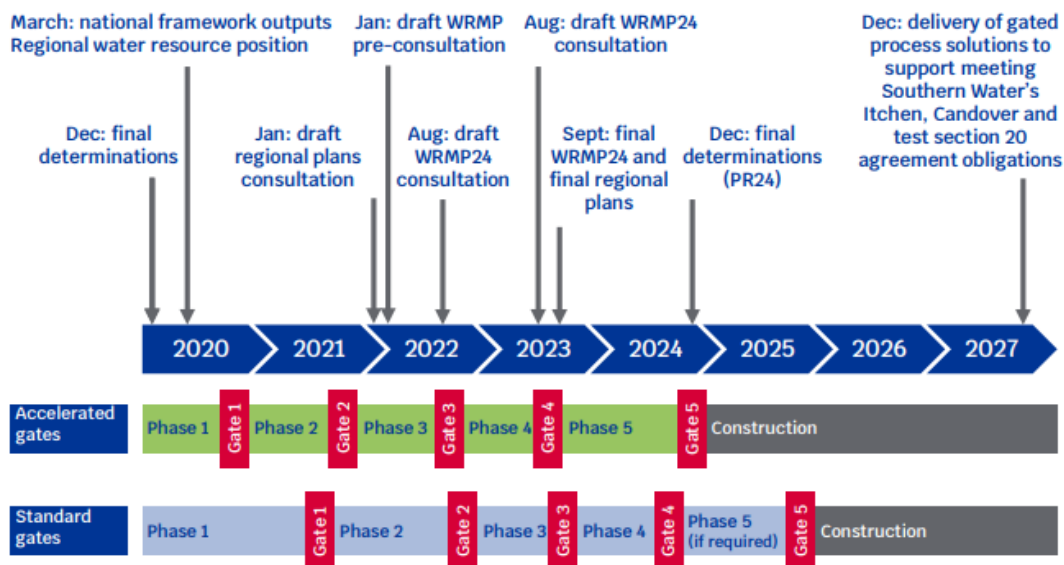
Ofwat, the economic regulator for the water and sewerage sectors in England and Wales, has identified the potential for water companies to jointly deliver strategic water resource schemes to secure long-term water supply resilience while protecting the environment.

To support the progression of these Strategic Resource Options (SROs), the Regulatory Alliance for Progressing Infrastructure Development (RAPID) has been established, comprised of representatives from Ofwat, the Environment Agency and the Drinking Water Inspectorate. RAPID has produced guidance for progressing each SRO which is aligned to a formal gated process to ensure that at each gate:

- Companies are progressing strategic water resource solutions that have been allocated funding at PR19 or have subsequently joined the programme.
- Costs incurred in doing so are efficient.
- Solutions merit continued investigation and development during the period 2020 to 2025.

The timelines for the assessment gates are shown in Figure 1.1 below; the Grand Union Canal (GUC) SRO is on the standard gate timeline and is currently at Gate 2.

Figure 1.1: Gated process for potential strategic regional water resource solutions¹



¹ Source: Regulators' Alliance for Progressing Infrastructure Development, Forward programme 2021-22, March 2021, available online at https://www.ofwat.gov.uk/wp-content/uploads/2021/03/RAPID-Forward-programme-2021_22.pdf, accessed 07/03/2022.

1.1 Grand Union Canal SRO

The GUC SRO has been jointly developed in partnership between Severn Trent Water (STW), Affinity Water (AW) and the Canal and River Trust (the Trust). At the start of Gate 1 a long-list of sub-option routes were derived for the GUC SRO. The discharge options were then shortlisted to three route options by the start of Gate 2 based on the following criteria: environmental and societal impacts; operational flexibility and resilience; operational and embedded carbon; and cost. Of these, Option Route 3 was selected. Optioneering was also undertaken with regards to abstraction locations. A site at Leighton Buzzard was ultimately selected, further details on the optioneering process can be found in the Gate 2 submission.

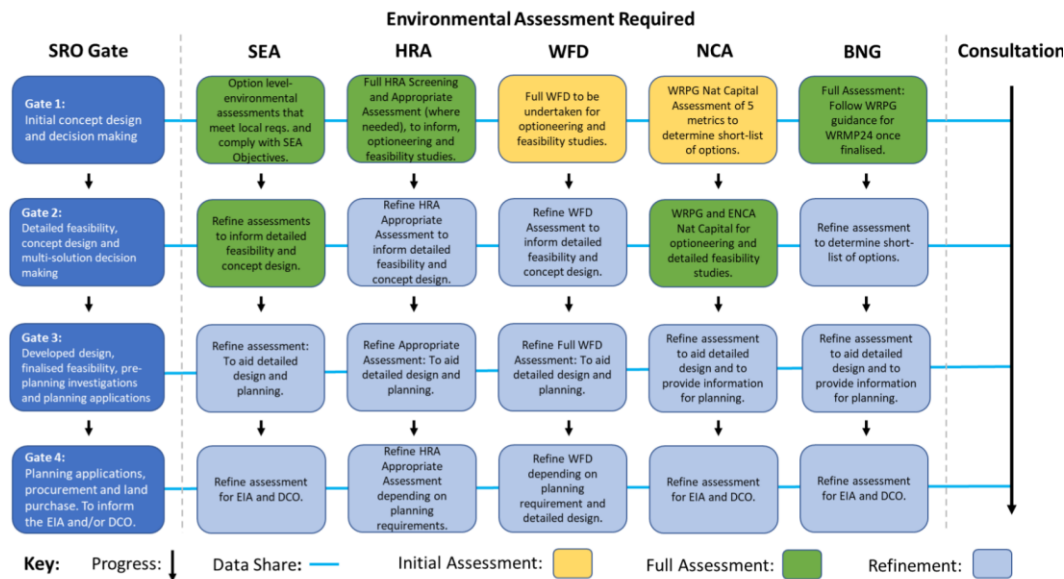
The single solution assessed at Gate 2 includes the pipeline from Minworth to Atherstone (Route 3), the canal transfer to Leighton Buzzard and the abstraction and treatment works at this location (hereafter referred to as 'the scheme') and will be assessed in the following Gate 2 Environmental assessments:

- Natural Capital Assessment (NCA) and Biodiversity Net Gain (BNG) (Annex B3.3.2)
- Environmental Appraisal Report (EAR) (Annex B3.3.5)
- Fish survey report (Annex B3.2.3)
- Habitats and protected species desk study (Annex B3.2.6)
- Habitats Regulations Assessment (HRA) (Annex B3.3.3)
- Invasive and non-native species (INNS) survey report (Annex B3.2.4)
- Sediment report (Annex B3.2.5)
- Strategic Environmental Assessment (SEA) (Annex B3.3.1)
- Waterbody connections report (Annex B3.2.1)
- Water Framework Directive Assessment (WFD) (Annex B3.3.4)

This report forms the Natural Capital and Biodiversity Net Gain Report, which also includes an Ecosystem Services Assessment. Figure 1.2 below shows the integration of the statutory assessment reports (i.e. SEA, HRA, WFD, NCA/BNG) with the RAPID gated process. This schematic is taken from the All Companies Working Group (ACWG) guidance that was released in Gate 1. While this is still largely relevant and followed, it has been somewhat superseded by the RAPID Gate 2 guidance², which the Gate 2 assessments have followed.

² Strategic regional water resource solutions guidance for gate two, Regulators' Alliance for Progressing Infrastructure Development, February 2022, available online at https://www.ofwat.gov.uk/wp-content/uploads/2022/02/Strategic-regional-water-resource-solutions-guidance-for-gate-two_Feb_2022.pdf, accessed 09/02/2022.

Figure 1.2: Environmental Assessment Integration with SRO Gates³



1.2 Scheme Description

The Scheme is shown below in Figure 1.3 and described in detail in Annex A1, Engineering CDR (WSP, 2022). It will comprise a transfer rising main from Minworth Wastewater Treatment Works (WwTW) to the Coventry Canal at the top of Atherstone lock flight. Once outside the Minworth site, and past the M42 and HS2 corridors, the rising main will pass through agricultural land until reaching the outskirts of Atherstone, a small market town within North Warwickshire. The rising main will discharge to the canal side at Coleshill Road, via a new discharge structure sized to avoid deleterious flow velocities and shears.

Transferred water will then progress along the Coventry Canal by gravity into the Oxford Canal at Hawkesbury Lock. Flows will need to bypass the Hawkesbury lock via a low lift pumping station.

The Oxford Canal will then convey the water to the Grand Union Canal at Braunston. The majority of the flow along the Oxford Canal will be by gravity, however a pumping station will be required to bypass the locks at Hillmorton.

At Braunston a bypass pumping station will be required to lift flows from near Braunston Marina to the top lock just before Braunston Tunnel. From Braunston to the abstraction and treatment site at Leighton Buzzard, four additional lock bypass pumping stations will be required south of Milton Keynes at Fenny Stratford, Stoke Hammond, Three Locks and Leighton. The Grand Union Canal section will also require eight gravity bypasses around “downflow” locks at the Wilton Marine Lock Flight, Stoke Bruerne Lock Flight and Cosgrove Lock.

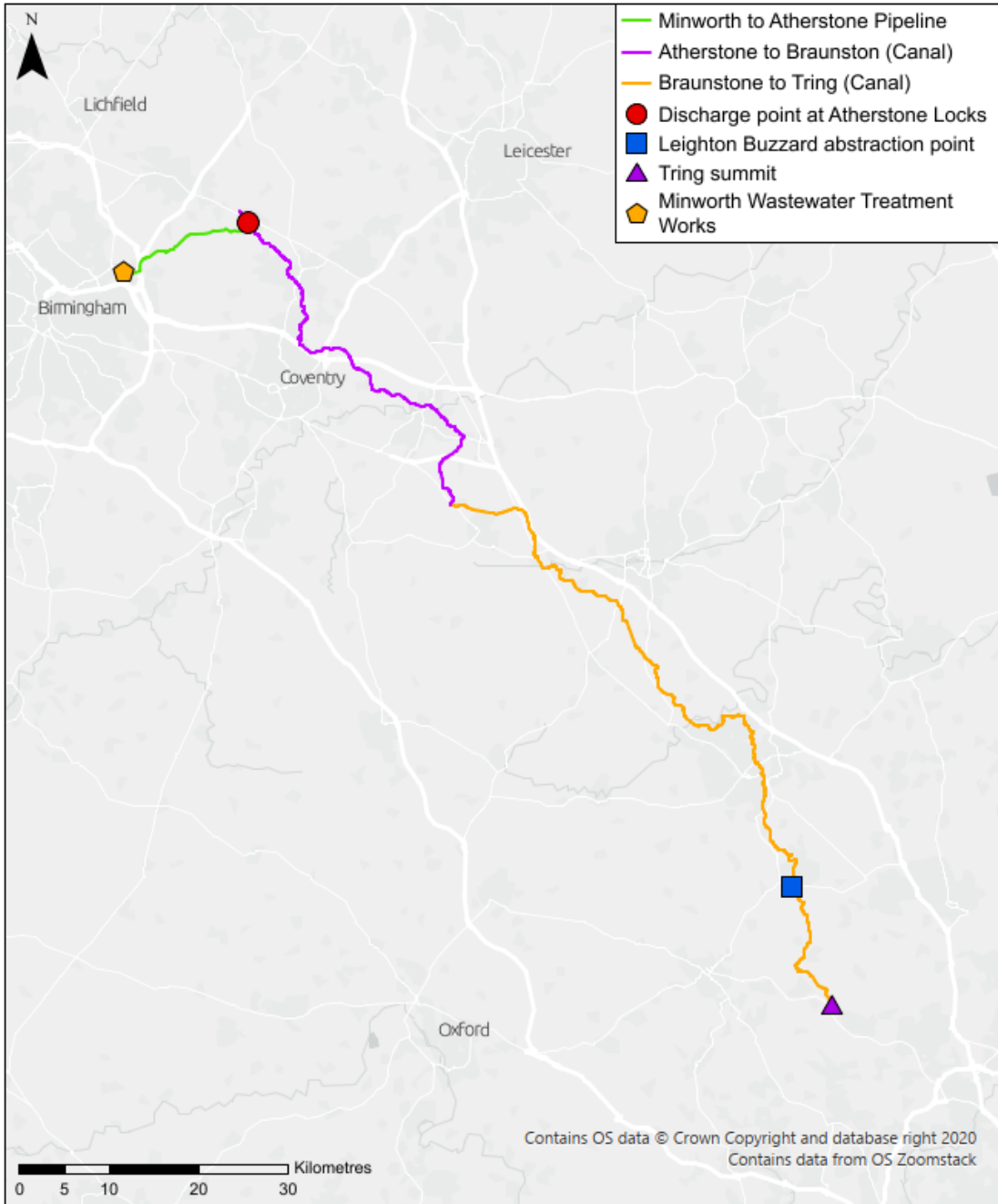
Flow will be abstracted from the Grand Union Canal just south of the A4146 bridge, after the River Ouzel. The site currently proposed at Gate 2 for the treatment works is on relatively flat land slightly raised from the river and canal, although further investigations will be carried out at Gate 2/3 to determine the precise location. Flow will therefore need to cross the River Ouzel within a new, short pipeline and be pumped into an operational raw water storage reservoir before gravitating into the first stage of treatment. Additional interstage pumping in the treatment

³ Source: All Companies Working Group, WRMP environmental assessment guidance and applicability with SROs, Mott MacDonald, October 2020

works will be required with final high lift pumps transferring potable treated water to a new clean water holding tank at the existing Chaul End Water Supply Reservoir (WSR).

During the option selection process, it was determined this option would have the least overall cost, lowest environmental impact and greatest opportunity for net gain and public benefit. The slightly higher operational cost when compared to Route 1, due to longer transfer from Minworth to Atherstone, can be partially offset by energy recovery from the break tank to outfall.

Figure 1.3: The Scheme

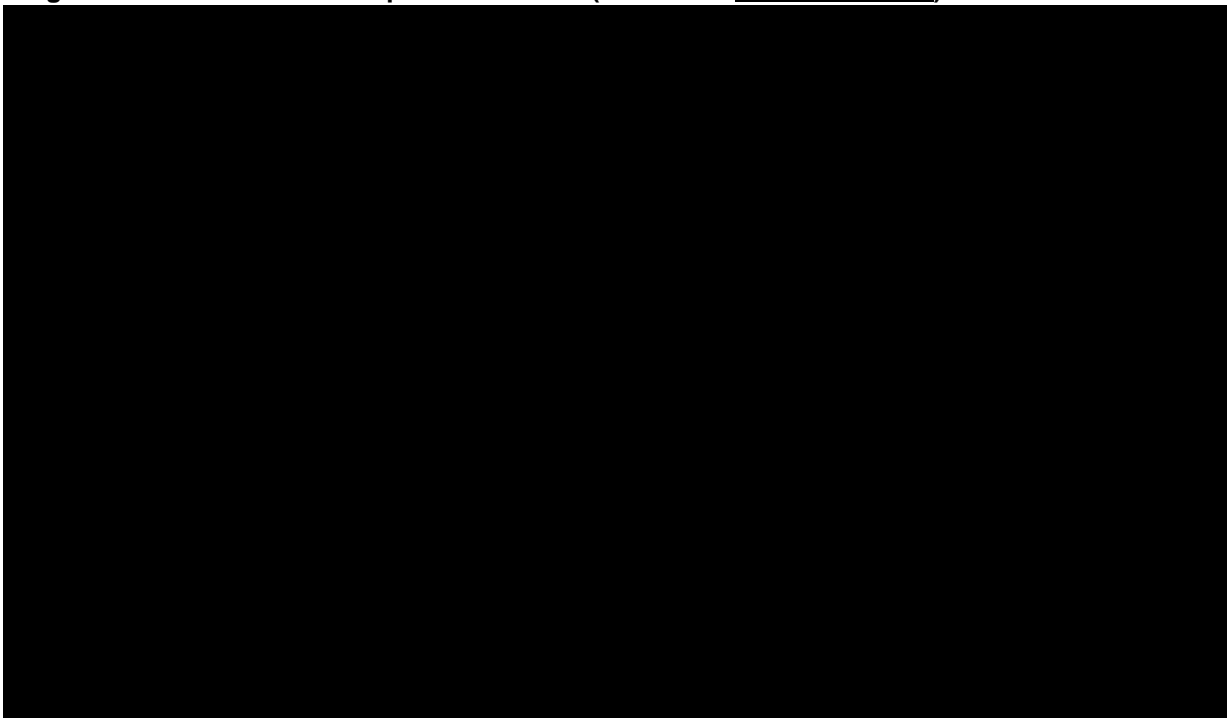


1.3 Assumptions and Limitations

The following assumptions have been used within the assessment:

- The design assumptions stated in the WSP Gate 2 Position Paper - Route Selection technical note⁴ can be applied to the Gate 2 Environmental Assessments, including assumption that >50mm depth change requires towpath raising is valid.
- The assessment is based on a 'worst-case' 100% utilisation of the SRO.
- Tring represents the SE limit of influence of the SRO.
- The volume of water passing NW (after discharging from pipeline) due to the locks opening at Atherstone is deemed to be of minimal change.
- The risk of fish and INNS travelling NW of Atherstone is not increased due to the scheme.
- BNG/NC assessment based on permanent loss of the area shown below in Figure 1.4. This is a worst-case approach that will be updated at Gate 3.

Figure 1.4: Assumed area of permanent loss (centred at [REDACTED])



Grid references for continued monitoring locations redacted

Specific land parcel image redacted

⁴ Gate 2 Position Paper - Route Selection, WSP Technical Note, 25 January 2022

2 Methodology

2.1 Overview

This report accompanies the Gate 2 submission report to RAPID for the GUC SRO. This Annex presents the findings of the NCA, BNG and related opportunities applied to the scheme.

2.1.1 Natural Capital and Ecosystem Services

Natural Capital refers to the elements of the natural world that provide benefits to society and includes aspects such as woodland, grassland, freshwater, marine, urban greenspace and wetland habitats.

The benefits that are provided to humans by the natural environment vary from regulating services such as natural flood management to cultural services such as recreational value.

2.1.2 Biodiversity Net Gain

BNG refers specifically to the combination of habitats present within a site and their ability to support biodiversity. Each habitat is given a distinct score that relates to its area, condition, distinctiveness and connectivity. The change in habitat due to the construction and operation of the SRO options informs the overall BNG score and whether they are likely to contribute to a net gain in biodiversity.

2.2 Scheme elements

For the purposes of this assessment, the scheme has been split into four sections, referred to as 'scheme elements', as shown in Table 2.1.

Table 2.1: Scheme elements

Element Name
Minworth to Atherstone
Atherstone to Braunston
Braunston to Tring
Leighton Buzzard

2.3 Overview of Gate 1

As part of the Gate 1 Submission to RAPID for the scheme, SEA, BNG, NCA, WFD and HRA assessments took place. An Environmental Assessment Summary Report⁵ was produced (Document Reference 100383187-010 | 383187-MMD-RP-3003 | P02), assessing nine route options via SEA, BNG and NCA.

The Gate 1 NCA, BNG, and Ecosystem Services outputs identified the following:

- NC: All options, except option 2C (Sub-route 6, 50Ml/d), are likely to generate a permanent loss of natural stocks. Option 3C (Sub-route 6, 100Ml/d) has the greatest change in natural capital stocks, notably in loss of pastures.

⁵ Document Reference 100383187-010 | 383187-MMD-RP-3003 | P02)

- BNG: All options are likely to result in a loss of BNG habitat units. Option 3C (Sub-route 6, 100MI/d) has the greatest total net change in terms of hectares lost, whereas option 3A (Sub-route 1) has the lowest.
- Ecosystem services: All the options present opportunities to improve the existing habitats along the pipeline route through post construction remediation and replacement of low value habitats with higher value habitats. Option 3C (Sub-route 6, 100MI/d) had the greatest overall change in value per year, whereas option 3A (Sub-route 1) had the least overall change. When reviewing the assessments outputs, although very similar, Option 3A (Sub-route 1) performed slightly better, and Option 3C (Sub-route 6, 100MI/d) performed slightly worse.

Although the route assessed at Gate 2 was not assessed at Gate 1, it has been formed based on an evolution of these routes, and as such the findings of Gate 1.

2.4 Methodology Overview

2.4.1 Defining the natural capital baseline

2.4.1.1 Zone of influence

The zone of influence was defined as the area of receiving (i.e. a watercourse receiving a discharge) or providing (i.e. an aquifer where abstraction will occur) environment with the potential to be altered or changed as a result of the scheme.

This can include the operational catchment for a surface water abstraction or an aquifer for a groundwater abstraction in addition to the footprint of the scheme.

2.4.1.2 Developing a natural capital baseline

As part of the NCA, a natural capital baseline was developed for the study area. This baseline was developed using open-source data as described in the National Natural Capital Atlas: Mapping Indicators (NECR285)⁶ to generate a Natural Capital account of the stocks within the zone of influence. The list of stocks considered within the accounts and the methodology for mapping them are shown in Appendix A. The methodology used to map natural capital utilises the same breakdown of stocks as the National Natural Capital Atlas where possible. However, the list has been supplemented with additional abiotic stocks and key habitats that are vital such as chalk streams and rivers.

The Natural Capital baseline reported the total quantity of each stock within the study area, and where suitable, an indication of natural capital condition.

2.4.2 Overview assessment methodology: NCA

A natural capital assessment has been undertaken on the scheme in accordance with the Water Resources Planning Guideline⁷ (WRPG) and Enabling a Natural Capital Approach (ENCA) requirements. ENCA is recommended for use by HM Treasury's Green Book: appraisal and evaluation in central government (2020)⁸ and represents supplementary guidance to the Green Book.

⁶ <http://publications.naturalengland.org.uk/publication/4578000601612288>

⁷ 2021, Available online at [Water resources planning guideline - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/Water_resources_planning_guideline_-_GOV.UK.pdf).

⁸ 2020. The Green Book Central Government Guidance On Appraisal And Evaluation. [online] London: HM Treasury. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938046/The_Green_Book_2020.pdf [Accessed 16 March 2022].

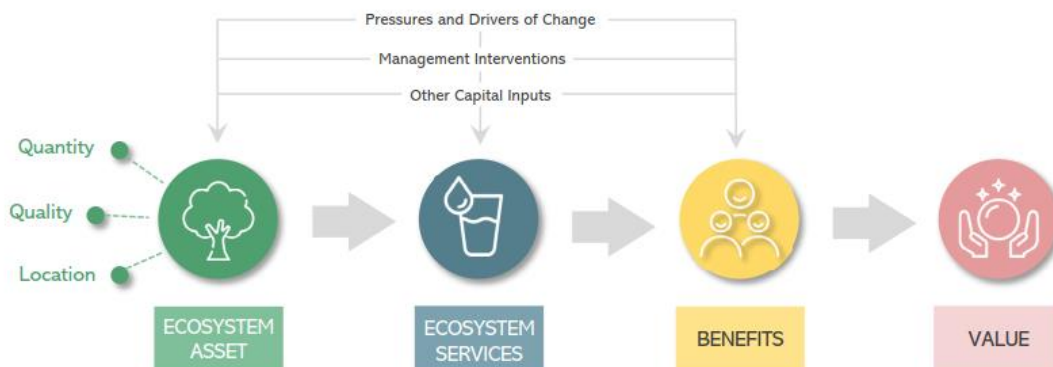
In August 2021, ENCA updated its guidance. Therefore, the NCA were updated in line with the values used to quantify the provision of ecosystem services.

The August 2021 ENCA guidance (GOV.UK, 2021⁹) includes updated values within the Asset Databook and Service Databook. Within the Service Databook, the carbon reduction tab now includes BEIS (2021) carbon values - a set of values produced by the government to be used in policy appraisal and evaluation, reflecting the latest evidence. The climate regulation section of the assessment has been updated in line with this.

The impact of the scheme on the Natural Capital stocks and indicators of condition was reported for each element quantitatively. This impact was reported for during construction and post construction to give an estimation of the impact of the scheme's whole lifecycle. The results of the stock assessment were reported in total losses and gains within each option's zone of influence.

The results of the change in natural capital stocks informed the assessment against the six natural capital metrics (ecosystem services) listed below using the Natural England logic chains (Figure 2.1). The cost / benefit assessment was informed by the option type, option description and any embedded mitigation. The outputs of the NCA were compared to the pre-construction provision of impacted services to assess the impact of the scheme. Five ecosystem services were monetised, and the results of the assessment reported as a discreet monetary figure, water purification was assessed quantitatively.

Figure 2.1: Ecosystem Services valuation logic chain



The metrics used to assess the impact on natural capital include:

- Carbon sequestration (Climate regulation)
- Natural hazard management
- Water purification * Qualitative assessment
- Biodiversity and habitats * BNG assessment
- Air pollutant removal
- Recreation and amenity value
- Food production

⁹ GOV.UK. 2021. Enabling a Natural Capital Approach guidance. [online] Available at: <<https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance/enabling-a-natural-capital-approach-guidance>> [Accessed 16 March 2022].

Both natural capital assessment strategies, as outlined in the Environment Agency’s Water Resource Planning Guidelines (GOV.UK, 2020¹⁰) and the Defra: Enabling a Natural Capital Approach (GOV.UK, 2021⁷), discuss taking a proportionate approach to the assessment. It is therefore important to accommodate this when integrating a natural capital approach within the SRO gated process. A natural capital approach has the potential to inform concept design and aid decision making, by quantifying the relative cost benefits and disbenefits of the scheme to aid the initial assessment of the identified strategic solutions.

2.4.3 Ecosystem Services screening

During the initial phase of the NCA, all of the six ecosystem services listed were reviewed and scoped in or out due to the geographical or socio-economic context of the scheme and its zone of influence. Guidance on the screening process for individual metrics is provided below.

2.4.3.1 Climate regulation

The climate regulation metric focuses on carbon sequestration, which can be defined as the capture and secure storage of carbon that would otherwise be emitted to, or remain, in the atmosphere. The carbon sequestration NCA will be in addition to construction and operational carbon calculations and provides a holistic assessment of carbon emissions for the scheme.

The assessment was determined by land management within the scheme’s footprint which influenced the carbon store for prolonged periods of time and results in a change in net emissions. The estimate of the carbon stocks for the scheme footprint was based on the area of broad land use types according to literature and research. The estimated carbon stocks for broad habitat types are listed below and the sequestration rates are show in Table 2.2.

Table 2.2: Carbon sequestration rates for broad habitat types (JBA Consulting)^{11 12}

Land use type	C Seq rate (t/CO2e/ha/yr)
Woodland - (deciduous)	4.97
Woodland – (coniferous)	12.66
Arable Land	0.107
Pastoral land	0.397
Peatland - Undamaged	4.11
Peatland - Overgrazed	-0.1
Peatland - Rotationally burnt	-3.66
Peatland - Extracted	-4.87
Grassland	0.397
Heathland	0.7
Shrub	0.7
Saltmarsh	5.188
Urban	0
Green Urban	0.397

¹⁰ GOV.UK. 2020. Water resources planning guideline. [online] Available at: <<https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline>> [Accessed 16 March 2022].

¹¹ Alonso, I., Weston, K., Gregg, R. and Morecroft, M. 2012. Carbon storage by habitat - Review of the evidence of the impacts of management decisions and condition on carbon stores and sources. Natural England Research Reports, Number NERR043.

¹² The Environment Agency, (2020) Water resources planning guideline supplementary guidance – Environment and society in decision-making.

The carbon sequestration rates were converted to monetary values using standard methods and the Department for Business, Energy and Industrial Strategy (BEIS) Interim Non-Traded Carbon Values from 2021 (Table 2.3).

Table 2.3: BEIS updated short-term traded sector carbon values for policy appraisal, £/tCO₂e (real 2018)

Year	Low series	Central series	High series
2020	120	241	361
2021	122	245	367
2022	124	248	373
2023	126	252	378
2024	128	256	384
2025	130	260	390
2026	132	264	396
2027	134	268	402
2028	136	272	408
2029	138	276	414
2030	140	280	420
2031	142	285	427
2032	144	289	433
2033	147	293	440
2034	149	298	447
2035	151	302	453
2036	155	307	460
2037	156	312	467
2038	158	316	474
2039	161	321	482
2040	163	326	489
2041	165	331	496
2042	168	336	504
2043	170	341	511
2044	173	346	519
2045	176	351	527
2046	178	356	535
2047	181	362	543
2048	184	367	551
2049	186	373	559
2050	189	378	568

2.4.3.2 Natural Hazard regulation

Different habitat types have intrinsic flood risk management values by intercepting, storing and slowing water flows. This is known as natural flood management (NFM) and is listed as a policy within the 25-year Environment Plan¹³. The capacity of habitats to achieve this can be quantified, and then a monetary value can be assigned based on the damage-costs avoided

¹³ 25 Year Environment Plan - GOV.UK (www.gov.uk)

from flooding or replacement costs due to their capacity to regulate flood waters. The capacity for a given natural capital asset to provide a flood regulation service will depend on two factors:

- Its capacity to slow overland flows
- Whether the asset is located in an area of flood risk

This ecosystem service also applies in urban areas, where vegetation can reduce surface water flooding from heavy rainfall, with benefits to sewerage capacity. Coastal flood risk, which has been predicted to increase with future climate change, is reduced by coastal margin habitats such as saltmarsh.

The scheme was assessed on their ability to positively or negatively impact flood risk through the comparison of pre and post construction natural capital stocks and the catchment in which it is located. The assessment is restricted to catchment areas which drain to downstream communities impacted by flooding. These communities were identified using the Environment Agency's Indicative Flood Map¹⁴, which overlays areas at risk of fluvial flooding and the National Receptor Database.

Reduced flood damage to downstream or coastal settlements as a result of reduced magnitude / frequency of flood / storm events; and / or lower sewer capacity or water storage costs was valued in line with Broadmeadow et al, 2018¹⁵. This assessment was developed to provide indicative national estimates of water regulation services of woodland to inform natural capital accounts, this is based on modelling to estimate the potential volume of flood water avoided by woodland ecosystems in flood risk catchment. The methodology adopts a replacement-cost (rather than damage cost) approach to valuing the flood regulation service of woodland by applying annualised average capital and operating costs of flood reservoir storage that would be required in the absence of the ecosystem service.

Central estimate of the average annual costs of reservoir floodwater storage is £0.42 / m³. The range is from £0.10 to £1.19 /m³ per year. These "replacement costs" can be considered a lower bound of the benefit if it can be assumed that such expenditure would be deemed value for money by the flooding authorities within flood risk catchments in terms of avoided flood damage costs.

2.4.3.3 Water purification

Based on their ecological functioning, different habitat types, have varying capacities for absorbing pollutants from a given water source. This service is dependent on the location of the natural capital asset and the nature of the surrounding area. If a natural capital asset has a high capacity to remove pollutants but is not close to a water source, the service will not be provided. Due to this, valuation of the static water purification services of different natural capital assets as part of the NCA was not considered appropriate. A common value for different habitat types could not be applied due to extensive variation in local factors which determine the provisioning of this service.

To account for the provision of this service within the NCA the impact of the scheme associated with the provision or removal of woodland and semi-natural grassland was assessed using the modelling results from the NEVO¹⁶ tool. The tool defines the resulting changes for the following water quality variables:

- Dissolved oxygen concentration

¹⁴ <https://flood-map-for-planning.service.gov.uk/>

¹⁵ Broadmeadow, S., Thomas, H., Nisbet, T. and Valatin, G., 2018. Valuing flood regulation services of existing forest cover to inform natural capital accounts. *Forest Research*.

¹⁶ Luizzo, L., (2019) Natural Environment Valuation Online Tool - Chapter 6a: Water Quantity & Quality Model

- Nitrogen concentration (including organic nitrogen, nitrate, nitrogen dioxide, ammonium)
- Phosphorous concentration (including organic and mineral phosphorous)
- Pesticide concentration (for eighteen different pesticide types)

This approach followed the methodology that if an area of woodland were to be lost, the resultant impacts on water quality can be quantified within the schemes zone of influence. Any negative changes to the natural capital in theory, reflects the loss of this service within the schemes zone of influence.

2.4.3.4 Air pollutant removal

Air pollution presents a major risk to human health, resulting in premature deaths and reduced quality of life. By removing air pollution, habitats help to lessen these impacts on health and wellbeing. The provisioning of the service is positively related to several key aspects:

- The surrounding area of the natural capital assets with regards to background pollution, especially particulate pollutant
- The quantity and type of natural capital asset, woodland is the major service provider
- The density of population potentially benefiting from reduced exposure. Because pollutants are transported, beneficiaries may be downwind of the ecosystem

The scheme was screened against the provision of air pollutant removal according to its location. Air pollutant removal was only be considered within built up areas or when the zone of influence includes Air Quality Management Areas. The impact of the scheme was assessed according to changes in natural capital stocks.

The value provided by natural capital assets was taken from the UK government's air quality economic assessment methodology¹⁷. The assessment embeds these values (based on the damage cost approach, i.e. damage to health avoided from reductions in air pollution) and estimates the present value automatically based on the quantitative estimates provided.

Indicative average values for air pollution removal in 2015 for different habitats were calculated from aggregate UK values published in February 2019, as shown in Table 2.4.

The value of each habitat will be combined with the changes expected in natural capital stocks to provide a value for the change in service provision. The final impact will be reported as a single value that will be incorporated within the NCA metric.

Table 2.4: Air pollutant value by habitat type

Habitat group	Value (£ per hectare per year)
Urban Woodland	771
Rural Woodland	245
Urban grassland	149
Enclosed farmland	14
Coastal margins	26

2.4.3.5 Recreation and amenity

The recreational value of green spaces can be significant. This value reflects both the natural setting and the facilities on offer at the site and often has a strong non-market element. It varies with the type and quality of habitat, location, local population density and the availability of substitute recreational opportunities. Recreational values can be beneficially affected by

¹⁷Jones L., Vieno M., Morton Dan et al. (2019) Developing Estimates For The Valuation Of Air Pollution Removal In Ecosystem Accounts. Final Report For Office Of National Statistics - NERC Open Research Archive.

enhancements in green spaces, or adversely affected by new developments or infrastructure. The wider tourism and outdoor leisure sector is also dependent upon nature to varying degrees. This metric depends on the extent to which the natural capital stocks the scheme provides will enhance the opportunity for recreation.

The key parameter needed to estimate in this category is the number of additional or enhanced recreational visits created because of the option. This was estimated using the Outdoor Recreation Valuation Tool (ORVal). ORVal¹⁸ is referenced in HM Treasury Green Book¹⁹. Random utility / travel cost model of recreational demand for all sites in England and Wales and generates probabilistic predictions of visitor numbers for any publicly accessible outdoor recreation park, path or beach. It takes account of scarcity of sites and substitution possibilities, as well as travel distances to sites and their attributes. This is useful for baseline initial assessment, accounting, and multiple sites. This should be seen as an estimation in the absence of site-specific data on visitor numbers.

The change in natural capital stocks and the creation or removal of greenspace was entered into ORVal according to the NCA. The change in visitors and estimated change in value will be reported for using the ORVal online tool.

2.4.3.6 Food production

Food is produced by a range of ecosystems and in some cases, the food for human consumption is effectively the same as the ecosystem service (e.g. wild fruit, fishing). More often the provisioning service is a raw material (e.g. crops) that is harvested and processed by humans and produced capital into added value processed food (e.g. bread). The boundary between what is provided by natural capital and the contribution of other forms of capital is often a grey area, e.g. crops require agricultural management; livestock need grassland ecosystems.

Food production has been calculated using the Natural Environment Valuation Online Tool (NEVO) agricultural model. The NEVO Tool is a web application developed by the Land, Environment, Economics and Policy (LEEP) Institute at the University of Exeter with support from Department for Environment, Food & Rural Affairs (DEFRA) and Natural Environment Research Council (NERC). NEVO's primary purpose is to help explore, quantify and make predictions about the benefits that are derived from existing and altered land use across England and Wales. This is a structural model of agricultural land use and production for Great Britain estimated using Farm Business Survey (2005 – 2011) and June Agricultural Census data. The agricultural land use component in NEVO builds upon the approach developed by Fezzi and Bateman²⁰. NEVO was used to assess the impact of the creation or removal of agricultural land for the scheme. The change in value of food provision for the footprint of the scheme was calculated using this online tool and reported within the NCA.

2.4.4 Overview assessment methodology: BNG

The BNG requirement as outlined in the WRPG stipulates that each SRO should look to maximise BNG. The Gate 1 Environmental Assessment Summary Report published in May 2021 used the most-up-to-date guidance available at the time to undertake the assessment, The Biodiversity 2.0 Metric. In July 2021, Defra and Natural England launched The Biodiversity 3.0 Metric²¹. The 3.0 metric presents significant improvements for measuring and accounting for nature losses and gains. It encourages users to create and enhance habitats where they are

¹⁸ ORVal | Land, Environment, Economics and Policy Institute | University of Exeter

¹⁹ The Green Book: appraisal and evaluation in central government - GOV.UK (www.gov.uk)

²⁰ Fezzi, C., Bateman, I., Hadley, D. & Harwood, A. 2019. Natural Environment Valuation Online Tool - Chapter 1: Agriculture Model

²¹ Archive site for the BNG Metric 2.0 and 3.0
<http://publications.naturalengland.org.uk/publication/5850908674228224>

most needed to help establish or improve ecological networks through rural and urban landscapes. By linking to current and future habitat plans and strategies, including the future Local Nature Recovery Strategies (LNRS), the Metric 3.0 incentivises habitat creation and enhancement where most needed. It also 'rewards' landowners who undertake work early, creating or enhancing habitats in advance, allowing them to generate more biodiversity units from their land. Condition assessment approaches have also been significantly updated and simplified for Metric 3.0 and some key changes made.

The DEFRA 3.0 metric is the recommended approach to net gain assessments. The government anticipates the 3.0 metric to become the industry standard for biodiversity assessments for on-land and intertidal development types in England. As proposed in the Environment Act 2021²² in November 2021, biodiversity net gain must be measured using a recognised biodiversity metric. The Metric essentially underpins the Environment Bill's provisions for mandatory biodiversity net gain in England, subject to any necessary adjustments for application to major infrastructure projects. The Act further specifies the requirement of biodiversity reports to include specified quantitative data relating to biodiversity, and as such any tool which evaluation is predominantly qualitative is not recommended.

As such, the Gate 2 approach has updated all assessments undertaken at Gate 1 to the 3.0 Metric. Any new scheme elements brought into the gated process at this stage have also been assessed by the 3.0 metric, in line with current guidance. These are to be further refined throughout the gated process to inform planning requirements.

A biodiversity baseline has been developed from spatial data sets of habitats inventories to calculate BNG change through land use. The Priority Habitat Inventory and sites with Site of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Area (SPA) and Ramsar designations were used to identify areas with high biodiversity importance. Units have been assigned to the pre-construction land use according to the habitats present in the scheme boundary. Post construction land use, including any mitigation described in the scheme description, has been used to calculate the post construction score. As this assessment will be carried out using only open-source data a precautionary approach is applied, presuming that where not specifically known, habitats will be assigned the moderate habitat score.

2.4.5 Opportunities

The potential opportunities for the scheme to enhance NC and BNG were considered following the NCA and BNG assessments, utilising the data and results to inform on the most appropriate potential opportunities for enhancement of the scheme and wider benefits.

Structure of this Report

This document presents the BNG, NCA and opportunities relating to the scheme. There are two parts to this report.

- 1. The Gate 2 NC and BNG Assessment Findings.** The BNG, NCA and opportunities have been undertaken in line with the methodology found in the *WRSE Regional Plan Environmental Assessment Methodology Guidance* (Mott MacDonald, 2020²³). The outputs of these assessment are described in Section 3
- 2. Opportunities.** The potential opportunities to achieve a 10% net gain in BNG as well as improve the overall provision of ecosystem services provided by natural capital.

²² [Environment Act 2021 \(legislation.gov.uk\)](https://www.legislation.gov.uk)

²³ Mott MacDonald. 2020. *WRSE Regional Plan Environmental Assessment Methodology Guidance*. Norwich: Mott MacDonald.

- 3. Gate 3 Requirements and Next Steps.** Developed design, finalised feasibility, pre-planning investigations and planning investigations.

3 Gate 2 assessment

The Gate 2 NCA and BNG outputs for the scheme are summarised in Table 3.1, Table 3.2, Table 3.3 and Table 3.4. Mitigation has only been considered when outlined in the scheme description, or where standard mitigation must be applied.

A summary of what is included within each table is as follows:

- Table 3.1 shows the predicted impacts on natural capital during and post construction.
Note: Only those stocks with predicted impacts are listed.
- Table 3.2 summarises the predicted impacts to the provision of ecosystem services screened in for detailed assessment.
- Table 3.3 summarises the predicted impacts to the provision of water purification for the scheme, where screened in for qualitative assessment.
- Table 3.4 shows the unmitigated BNG outputs for the scheme which have been informed using the predicted impacts on natural capital in Table 3.1.
Note: At this stage the BNG only takes account reinstatement, not re-provision or additional habitat creation unless outlined in the scheme description.

For RAPID Gate 3 the BNG assessment can be revisited, and mitigation or enhancement opportunities developed further to achieve the 10% BNG required within the scheme.

Additionally, where possible, the scheme could aim to not only reinstate lost habitat, but also provide a greater or more diverse habitat than is lost, to achieve overall Biodiversity Net Gain in line with regulatory requirements for BNG (at the time of the project consenting) as stated as a mandatory requirement within the Environment Act 2021²⁴. The latter could be achieved during the RAPID Gate 3 assessments by identifying local sites of ecological interest and proposing measures which enhance these features.

Table 3.1: Predicted impacts on natural capital stocks

Natural capital stock	Area within scheme boundary pre-construction (Ha)	Stocks present during construction (Ha)	Stocks present post construction (Ha)	Change (Ha)
Minworth to Atherstone				
Coastal floodplain grazing marsh	0.44	0.00	0.44	0.00
Arable	16.79	0.00	16.79	0.00
Pastures	5.21	0.00	5.21	0.00
Broadleaved, mixed and yew woodland	0.62	0.00	0.62	0.00
Woodland priority habitat	1.70	0.00	1.70	0.00
Coniferous woodland	0.06	0.00	0.06	0.00
Ancient woodland	0.64	0.00	0.00	-0.64
Greenspace	0.98	0.00	0.98	0.00
Urban woodland	0.04	0.00	0.04	0.00

²⁴ [Environment Act 2021 \(legislation.gov.uk\)](https://legislation.gov.uk)

Natural capital stock	Area within scheme boundary pre-construction (Ha)	Stocks present during construction (Ha)	Stocks present post construction (Ha)	Change (Ha)
Atherstone to Braunston				
Arable	13.93	0.00	13.93	0.00
Pastures	13.79	0.00	13.79	0.00
Other semi-natural grassland	0.07	0.00	0.07	0.00
Broadleaved, mixed and yew woodland	5.17	0.00	5.17	0.00
Woodland priority habitat	7.99	0.00	7.99	0.00
Coniferous woodland	0.09	0.00	0.09	0.00
Greenspace	1.79	0.00	1.79	0.00
Urban semi-natural habitat	0.004	0.00	0.004	0.00
Braunston to Tring				
Coastal floodplain grazing marsh	0.15	0.00	0.15	0.00
Arable	20.80	0.00	20.80	0.00
Pastures	16.83	0.00	16.83	0.00
Orchards and top fruit	0.07	0.00	0.00	-0.07
Hay meadows	0.02	0.00	0.02	0.00
Other semi-natural grassland	0.004	0.00	0.004	0.00
Broadleaved, mixed and yew woodland	7.99	0.00	7.99	0.00
Woodland priority habitat	11.78	0.00	11.78	0.00
Coniferous woodland	2.17	0.00	2.17	0.00
Greenspace	1.26	0.00	3.32	0.00
Urban semi-natural habitat	0.01	0.00	0.01	0.00
Urban woodland	0.60	0.00	0.60	0.00
Leighton Buzzard				
Arable	22.90	0.00	0.00	-22.90
Pastures	3.57	0.00	0.00	-3.57
Woodland priority habitat	0.13	0.00	0.00	-0.13
Active flood plain	0.38	0.00	0.00	-0.38

Table 3.2: Quantitative detailed assessment of the unmitigated predicted impacts on the provision of ecosystem services

Ecosystem services	Baseline value (£/year)	Estimated value post construction (£/year)	Temporary impact from construction (£/year)	Total future value (£/year)	Overall change in value (£/year)
Minworth to Atherstone					
Carbon storage	£8,264.78	£0.00	-8,264.78	£5,951.58	-£2,313.20

Ecosystem services	Baseline value (£/year)	Estimated value post construction (£/year)	Temporary impact from construction (£/year)	Total future value (£/year)	Overall change in value (£/year)
Natural hazard management	£271.12	£0.00	£-271.12	£160.81	£-110.31
Air Pollutant Removal	£1,005.80	£0.00	£-1,500.80	£695.52	£-310.29
Recreation and Amenity Value ²⁵	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Food production ²⁶	Scoped out	Scoped	Scoped out	Scoped out	Scoped out
Total	£9,541.69	£0.00	£-9,541.69	£6,807.90	£-2,733.79
Atherstone to Braunston					
Carbon storage	£31,457.40	£0.00	£-31,457.40	£24,959.78	£-6,497.62
Natural hazard management	£1,250.15	£0.00	£-1,250.15	£937.61	£-312.54
Air Pollutant Removal	£4,104.93	£0.00	£-4,104.93	£3,127.60	£-977.33
Recreation and Amenity Value	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Food production	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Total	£36,812.47	£0.00	£-36,812.47	£29,024.98	£-7,787.49
Braunston to Tring					
Carbon storage	£54,050.03	£0.00	£-54,050.03	£42,240.79	£-11,809.24
Natural hazard management	£1,997.04	£0.00	£-1,997.04	£1,497.78	£-499.26
Air Pollutant Removal	£6,130.59	£0.00	£-6,130.59	£4,671.12	£-1,459.48
Recreation and Amenity Value	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Food production	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Total	£62,177.67	£0.00	£-62,177.67	£48,409.69	£-13,767.98
Leighton Buzzard					
Carbon storage	£2,407.26	£0.00	£-2,407.26	£0.00	£-2,407.26
Natural hazard management	£11.52	£0.00	£-11.52	£0.00	£-11.52
Air Pollutant Removal ²⁷	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Recreation and Amenity Value	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Food production	Scoped out	Scoped out	Scoped out	Scoped out	Scoped out
Total	£2,418.78	£0.00	£-2,418.78	£0.00	£-2,418.78

²⁵ Scoped out when the option does not cause the permanent loss of greenspace.

²⁶ Scoped out when the option does not cause the permanent loss of arable and pastoral land.

²⁷ Scoped out when the option does not cause the temporary and/or permanent loss of associated stocks within an AQMA or urban area.

Table 3.3: Qualitative assessment of the unmitigated predicted impacts on the provision of water purification

Likely baseline provision	Construction impacts	Likely future provision	Overall change in provision
Minworth to Atherstone			
The stock likely provides a high provision of the ecosystem service due to the natural capital assets high capacity to store and absorb pollutants and the proximity of the asset to a water source.	The provision of services will be lost during construction.	The future provision of the ecosystem service provided by the stock will likely be reduced.	The provision of water purification provided by the stock will likely be reduced due to the scheme.
Atherstone to Braunston			
The stock likely provides a high provision of the ecosystem service due to the natural capital assets high capacity to store and absorb pollutants and the proximity of the asset to a water source.	The provision of services will be lost during construction.	The future provision of the ecosystem service provided by the stock will likely be reduced.	The provision of water purification provided by the stock will likely be reduced due to the scheme.
Braunston to Tring			
The stock likely provides a high provision of the ecosystem service due to the natural capital assets high capacity to store and absorb pollutants and the proximity of the asset to a water source.	The provision of services will be lost during construction.	The future provision of the ecosystem service provided by the stock will likely be reduced.	The provision of water purification provided by the stock will likely be reduced due to the scheme.
Leighton Buzzard			
The stock likely provides a high provision of the ecosystem service due to the natural capital assets high capacity to store and absorb pollutants and the proximity of the asset to a water source.	The provision of services will be lost during construction.	The future provision of the ecosystem service provided by the stock will likely be lost.	The provision of water purification provided by the stock will likely be lost.

Table 3.4: Summary of the unmitigated BNG Metric outputs

Scheme element	On-site Baseline (Ha)	On-Site Post Intervention (Ha)	Total Net Unit change (Ha)	Total Percentage Change
Minworth to Atherstone	90.58	62.40	-28.18	-31.11%
Atherstone to Braunston	605.44	492.42	-113.02	-18.67%
Braunston to Tring	1240.45	1066.94	-173.51	-13.99%
Leighton Buzzard	61.64	0	-61.64	-100.00%

The unmitigated BNG outputs have been informed using the predicted impacts on natural capital stocks listed in Table 3.1.

3.1.1 Summary of NCA and BNG assessments

3.1.1.1 Minworth to Atherstone

NCA

The scheme element will likely cause the temporary and permanent loss of stocks during construction. However, best practice mitigation (such as directional drilling) and reinstatement/compensation of habitat means that most Natural Capital stocks post construction will little change. However, when habitat is lost during construction or implementation and then replaced it is unlikely to retain the same natural capital value. Priority habitats should be avoided whenever possible as certain features within them are irreplaceable once lost. The scheme element will likely cause the permanent loss of ancient woodland. Ancient woodland is a high value natural capital stock that cannot be replaced or replicated once lost, therefore, future

provision of stock presumed permanently lost. The Gate 2 NCA and BNG assessments undertaken are considered the worst case-scenario of the impact the scheme will likely have on the environment. The elements of the scheme at this stage are concept designs and through Gate 3 and further investigative work, the route could be diverted to minimise the impact upon this priority habitat and to avoid irreplaceable habitats such as ancient woodland. Therefore, ancient woodland will likely be avoided as the pipeline will be routed around this habitat.

Ecosystem Services

The scheme element is likely to generate the loss of natural capital stocks during construction. However, habitat expected to be reinstated/compensated to pre-construction conditions following best practice technique will likely have no permanent impact to the provision of ecosystem services. Broadleaved, mixed and yew, priority, coniferous and urban woodland have a significant maturity time with a delay of 30 years. Therefore, this delay is considered within potential future provision of this stock through the ecosystem services assessment. This can be accounted to the tree mortality rate presumed after woodland areas are replanted.

Construction impacts include the release of CO₂ due to habitat clearance, loss of natural hazard management, loss of removal of air pollutants and a reduction in water purification. However, it is not expected to affect the future value as stocks are expected to be reinstated. However, ancient woodland is irreplaceable and once lost cannot be replaced. Therefore, the future provision of ecosystem services provided by ancient woodland, namely carbon sequestration, natural hazard management, water purification and air pollutant removal will be permanently lost.

The scheme element presents an opportunity to improve the existing habitats through post construction remediation and replacement of low value habitats with higher value habitats. The scheme element crosses several priority habitats Network Enhancement Zones and is therefore suitable for the planting of new high value habitats.

BNG

Applying the methodology, the scheme element will result in the loss of BNG habitat units due to the temporary removal of habitats during construction.

3.1.1.2 Atherstone to Braunston

NCA

The scheme element will likely cause the temporary loss of stocks during construction. However, best practice mitigation (such as directional drilling) and reinstatement/compensation of habitat means that most Natural Capital stocks post construction will have little change. However, when habitat is lost during construction or implementation and then replaced it is unlikely to retain the same natural capital value. Priority habitats should be avoided whenever possible, as certain features within them are irreplaceable once lost.

Ecosystem Services

The scheme element is likely to generate the loss of natural capital stocks during construction. However, habitat expected to be reinstated/compensated to pre-construction conditions following best practice technique will likely have no permanent impact to the provision of ecosystem services. Broadleaved/mixed/yew/priority/coniferous/urban woodland have a significant maturity time with a delay of 30 years. Therefore, this delay is considered within potential future provision of this stock through the ecosystem services assessment. This can be accounted to the tree mortality rate presumed after woodland areas are replanted.

Construction impacts include the release of CO₂ due to habitat clearance, loss of natural hazard management, loss of removal of air pollutants and a reduction in water purification. However, it is not expected to affect the future value as stocks are expected to be reinstated.

The scheme element presents an opportunity to improve the existing habitats through post construction remediation and replacement of low value habitats with higher value habitats. The scheme element crosses several Priority Habitats and Network Enhancement Zones and is therefore suitable for the planting of new high value habitats.

BNG

Applying the methodology, the scheme element will result in the loss of BNG habitat units due to the temporary removal of habitats during construction.

3.1.1.3 Braunston to Tring

NCA

The scheme element will likely cause the temporary loss of stocks during construction. However, best practice mitigation (such as directional drilling) and reinstatement/compensation of habitat means that most Natural Capital stocks post construction will have little change. However, when habitat is lost during construction or implementation and then replaced it is unlikely to retain the same natural capital value. Priority habitats should be avoided whenever possible as certain features within them are irreplaceable once lost. The scheme element will likely cause the permanent loss of traditional orchards.

Ecosystem Services

The scheme element is likely to generate the loss of natural capital stocks during construction. However, habitat expected to be reinstated/compensated to pre-construction conditions following best practice technique will likely have no permanent impact to the provision of ecosystem services. Broadleaved/mixed/yew/priority/coniferous/urban woodland have a significant maturity time with a delay of 30 years. Therefore, this delay is considered within potential future provision of this stock through the ecosystem services assessment. This can be accounted to the tree mortality rate presumed after woodland areas are replanted.

Construction impacts include the release of CO₂ due to habitat clearance, loss of natural hazard management, loss of removal of air pollutants and a reduction in water purification. However, it is not expected to affect the future value as stocks are expected to be reinstated.

The scheme element presents an opportunity to improve the existing habitats through post construction remediation and replacement of low value habitats with higher value habitats. The scheme element crosses several Priority Habitats, Network Enhancement Zones and is therefore suitable for the planting of new high value habitats.

BNG

Applying the methodology, the scheme element will result in the loss of BNG habitat units due to the temporary removal of habitats during construction.

3.1.1.4 Leighton Buzzard

As shown in Figure 1.4, the Leighton Buzzard Gate 2 NCA and BNG assessments have taken a high-level assumption as to the area of construction and have assumed, at this stage, that any stocks lost are permanent. The assessments will be revised during Gate 3, once the design has been finalised.

NCA

The scheme element will likely cause the permanent loss of stock. This assessment has taken the worst-case scenario and the assessment should be updated during Gate 3 and Gate 4.

Ecosystem Services

The scheme element is likely to generate the loss permanent loss of natural capital stocks during construction and post-construction, as a worst-case assessment.

The scheme element presents an opportunity to improve the existing habitats through post construction remediation and replacement of low value habitats with higher value habitats. The scheme element crosses several Priority Habitats, Network Enhancement Zones and is therefore suitable for the planting of new high value habitats.

BNG

Applying the methodology and worst-case assumption, the scheme element will result in the permanent loss of all BNG habitat units due to the removal of habitats during construction.

4 Opportunities

Following the BNG and NCA, opportunities should be considered to ensure that the natural environment is left in a better condition than pre-construction conditions. This should be achieved by one or both of the following:

- Mitigation: Opportunities to offset the net loss of biodiversity asset(s) and/or Natural Capital stock(s) (ecosystem service).
- Enhancements: Opportunities that, once introduced and established, would result in a net gain to a biodiversity asset and/or Natural Capital stock(s) (ecosystem service).

As a core principle, where possible, the scheme should aim to not only reinstate lost habitat, but also provide a greater or more diverse habitat than is lost, to achieve overall BNG. The latter could be achieved by identifying local sites of ecological interest and proposing measures. Any habitats that are created or enhanced to achieve BNG are required to be secured for 30 years, through management, maintenance and monitoring. The natural capital map which is based on the methodology described in the NECR285 (see Section 2) should be utilised, where possible, to assist in identifying opportunities to improve natural capital.

A summary of the potential NCA, BNG mitigation and enhancement measures for each sub-component type are outlined in Table 4.1. Further explanation into the potential enhancement measures is provided within the sections below.

Table 4.1: Summary of potential net gain mitigation and enhancement opportunities

Scheme element	Mitigation opportunity	Enhancement opportunity
All scheme elements	Scheme layouts to be amended to avoid the permanent loss of high value natural capital assets that once lost, cannot be easily reinstated. Assets include ancient woodland and traditional orchards.	Creation of higher value habitat within grassland, arable and pasture natural capital assets onsite to achieve an increase in Biodiversity Units (BU) and work towards a 10% uplift in BNG.
	<p>Schemes to identify area for the creation and/or reinstatement of high value natural capital assets, including:</p> <ul style="list-style-type: none"> ● Coastal and floodplain grazing marsh ● Lowland fens ● Lowland raised bog ● Reedbeds ● Blanket bog ● Hay meadows ● Dwarf shrub heath ● Broadleaved, mixed and yew woodland ● Coniferous woodland <p>Bluespace</p>	<p>Habitat creation work within the adjacent priority habitats. Scheme falls within or are in the vicinity of habitat network zones²⁸:</p> <ul style="list-style-type: none"> ● Habitat restoration-creation ● Restorable habitat ● Fragmentation action zone ● Network enhancement zones 1 and 2 ● Expansion zone <p>These areas identify specific locations for a range of actions to help improve the ecological resilience for each of the habitats/habitat networks. The scheme should look to identify habitat network zones and priority habitats within the near vicinity and look to improve/create/restore habitats which would help to work towards increasing BU and work towards a 10% uplift in BNG.</p>

²⁸ Edwards J, Knight M, Taylor S & Crosher I. E (May 2020) 'Habitat Networks Maps, User Guidance v.2', Natural England

Scheme element	Mitigation opportunity	Enhancement opportunity
	Greenspace	
	Construction practices to be considered to reduce the amount of clearance required for, especially in areas that include high value natural capital assets (see above for list).	Increase the quality/quantity of freshwater assets, including lakes, ponds located in designated SSSIs, pending detailed assessment of local conditions and available space.
	Directional drilling to be used where possible to avoid loss of high value natural capital assets (see above for list).	Scheme to identify suitable areas offsite for the creation, enhancement and/or restoration in order to develop off-site net gains, working towards achieving a 10% uplift in BNG.
		Identify areas of local peatland restoration
Scheme elements located along the canals		Possibly create man-made floating wetland islands, enabling plants and microbes to form and attract wildlife both above and below the water's surface and create biochemical and physical processes to improve things such as water quality.
Wastewater treatment works, abstraction and treatment works, and other scheme elements that contain above ground infrastructure		Seeding of grassland within footprints of the above ground infrastructure, where possible.

4.1.1 BNG Unit Purchase

BNG can be achieved via a new statutory biodiversity credits scheme. Credits can be bought by developers as a last resort when onsite and local offsite provision of habitat cannot deliver the BNG required. The price of biodiversity credits will be set higher than prices for equivalent biodiversity gain on the market and are expected to be purchased through a national register for net gain delivery sites. Natural England is in the process of running pilot schemes to provide a practical insight into the implications of the scheme, which is expected to go live spring 2023. The number of credits required to be purchased to obtain a 10% increase in BNG for each scheme element has been calculated and presented in Table 4.2 (i.e. how many BNG units are required to offset the loss plus achieve a 10% net gain).

Habitat creation possibilities to achieve a 10% BNG gain include:

- On-site: Improve the existing habitats on-site through post construction remediation and replacement of low BNG value habitats with higher BNG value habitats
- Off-site: Purchase suitable areas of off-site land within the local area and/or at a regional scale to offset BNG decrease by improving the existing habitats within the off-site land and/or by replacing existing habitats with higher BNG value habitats.
- On-site and off-site: Improve existing habitats and/or replacement of low BNG value habitats with higher BNG value habitats as part of the catchment management options.

It is important that, where possible, the scheme starts to consider reaching out to local Non-government organisation and planning authorities who may potentially be able to carry out BNG both onsite and offsite before Gate 3. Early engagement may help to get the best ideas of local opportunities for enhancement, how this can be achieved, local priorities and limiting factors which can all help to inform the NCA and BNG assessments during Gate 3.

Table 4.2: BNG habitat units required to be purchased to achieve 10% net gain

Scheme element	BNG habitat unit purchase
Atherstone to Braunston	94.47
Braunston to Tring	139.82
Minworth to Atherstone	106.16
Leighton Buzzard	47.13
Total	387.58

4.1.2 Network Recovery Networks

The Government's 25 Year Environment Plan²⁹ includes provision for a Nature Recovery Network (NRN) and states that it will deliver on the recommendations of the Lawton Report³⁰ and that recovering wildlife will require more habitat; in better condition; in bigger patches that are more closely connected. As well as helping wildlife thrive, the NRN could be designed to bring a wide range of additional benefits: greater public enjoyment; pollination; carbon capture; water quality improvements and flood management.

Natural England have produced a series of habitat network maps³¹ to help address the challenges outlined in the Lawton report and believe they should provide a useful baseline for the development of a NRN as required within the 25 Year Environment Plan and Local Nature Recovery Strategies as proposed within the Environment Bill. The maps have been created to provide a national overview of the distribution of habitat networks with suggestions for future action to enhance biodiversity, to help stimulate local engagement with partners and to agree local priorities and identify where action might help build more ecologically resilient ecosystems across landscapes.

- **Habitat Creation/Restoration:** Areas where work is underway to either create or restore the primary habitat.
- **Restorable Habitat:** Areas of land, predominantly composed of existing semi-natural habitat where the primary habitat is present in a degraded or fragmented form and which are likely to be suitable for restoration.
- **Network Enhancement Zone 1:** Land connecting existing patches of primary and associated habitats which is likely to be suitable for creation of the primary habitat. Factors affecting suitability include proximity to primary habitat, land use (urban/rural), soil type, slope and proximity to coast. Action in this zone to expand and join up existing habitat patches and improve the connections between them can be targeted here.
- **Network Enhancement Zone 2:** Land connecting existing patches of primary and associated habitats which is less likely to be suitable for creation of the primary habitat. Action in this zone that improves the biodiversity value through land management changes and/or green infrastructure provision can be targeted here.
- **Fragmentation Action Zone:** Land within Enhancement Zone 1 that connects existing patches of primary and associated habitats which are currently highly fragmented and where fragmentation could be reduced by habitat creation. Action in this zone to address the most fragmented areas of habitat can be targeted here.

²⁹ 25 Year Environment Plan - GOV.UK (www.gov.uk)

³⁰ Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., & Wynne, G.R. (2010) Making Space for Nature: a review of England's wildlife sites and ecological network. Report to Defra.

³¹ Edwards J, Knight M, Taylor S & Crosher I. E (May 2020) 'Habitat Networks Maps, User Guidance v.2', Natural England

- **Network Expansion Zone:** Land beyond the Network Enhancement Zones with potential for expanding, linking/joining networks across the landscape i.e., conditions such as soils are potentially suitable for habitat creation for the specific habitat in addition to Enhancement Zone 1. Action in this zone to improve connections between existing habitat networks can be targeted here.

There are opportunities for the scheme to support the NRN, for example, where pipelines are to be constructed within one of the identified habitat zones, reinstatement of land following construction could be linked to the priorities of that area such as habitat creation, restoration or improvement.

It is recommended that these opportunities be further explored at Gate 3. Wider partnership working with landowners, conservation groups and other organisations should be explored to help deliver opportunities for biodiversity enhancement.

4.1.3 Potential wider benefits

Blue infrastructure systems and riparian areas provide a wide range of ecosystem services to human populations, notably because they are a key component in many biogeochemical cycles and global biodiversity and these services are seen to hold an important economic value. Some of the wider ecosystem services that these natural capital stocks can provide that are not already considered as part of the Gate 2 assessments are listed in Table 4.3.

Table 4.3: Potential wider ecosystem services and possible restoration/improvement practices

Ecosystem service	Wider benefit	Examples of possible restoration/improvement practices
Recreation and tourism	The association of water is positively appreciated for several activities such as fishing, canoeing or aesthetic enjoyment.	Dedicate some areas to such activities to channel the public into appropriated zones, where possible.
Education values	Blue infrastructure and riparian areas provide sites for formal and informal education and heritage learning.	Create some information points or paths for the public in well-equipped zones, where possible.
Sense of place	Build community ownership and enhance the local populations spirit and sense of place. This may encourage enjoyment and understanding of the natural, historic and cultural heritage.	Improve and create the blue infrastructure and provide arts-based creative community interpretation to enhance and celebrate culture and heritage assets, where possible. This may reconnect the local population with their canal heritage and cultural assets.
Mental and physical health and wellbeing	The 'Canal and River Trust' conducted research showing that spending time by the water promotes better mental and physical wellbeing ³²	Improve and create habitats around blue infrastructure. Allow greater access to people through creating paths/parking etc.

Wider benefit case studies along the scheme are being prepared as part of a separate workstream, which will consider wider benefits the scheme can provide to people, including habitat creation, which may potentially improve the provision of ecosystem services, BNG and provide wider benefits such as those listed in Table 4.3. However, these case studies are conceptual and are yet to be finalised. These wider benefit case studies should be further considered within the Gate 3 NCA and BNG.

³² [Assessing the wellbeing impacts of waterways usage in England and Wales \(canalrivertrust.org.uk\)](https://www.canalrivertrust.org.uk)

5 Conclusions and Next Steps

5.1 Gate 3: Developed design, finalised feasibility, pre-planning investigations and planning investigations

Refer to Figure 1.2 for the Gate 3 process for the environmental assessments.

At Gate 3, the natural capital assessment would be refined further to work alongside the environmental impact assessment / DCO process to provide a natural capital input into the EIA. The assessment would be further updated, as required, in lieu of developed design. During Gate 3, the BNG assessment would be further updated, if required, in lieu of developed design and/or mitigation.

The NCA, BNG and ecosystem services outputs identified the following:

- **NC:** The scheme will mostly cause the temporary loss of natural capital stocks. The scheme is likely to cause the permanent loss of ancient woodland and traditional orchards, that once lost cannot be replaced, and therefore, during Gate 3 the design could look towards re-iterating the design to avoid impacting these areas.
- **BNG:** The scheme is likely to result in a loss of BNG habitat units due to the temporary loss of natural capital assets during construction. Mitigation and enhancement opportunities for the scheme have been suggested within Section 4, which can work in tandem to reducing the loss of BNG and introducing net gain. These will be developed further during Gate 3.
- **Ecosystem services:** The scheme presents opportunities to improve the existing habitats along the route through post construction remediation and replacement of low value habitats with higher value habitats. The potential permanent loss of ancient woodland could result in the permanent loss of several ecosystem services that the stock provides in synergy, including carbon sequestration, natural hazard management and air pollutant removal.

The opportunities identified in the BNG/NC assessment have the potential to contribute to government ambitions for environmental net gain. This could take the form of habitat compensation, creation and/or species relocation schemes. Any schemes would need to be taken forward based on a comprehensive understanding on the interaction between natural systems and between natural systems and social uses of land.

For Gate 3, the scheme should look to develop the design of the Leighton Buzzard abstraction site to enable a more reliable and in-depth NC and BNG assessment to be undertaken. For Gate 3, the scheme should consider some opportunities to create and improvement habitat on-site and off-site through local schemes, NRNs and wildlife corridors in order to achieve a 10% net gain in BNG units and increase the provision of ecosystem services, therefore aiding in developing more resilient options for the future provision of water for GUC.

A. Natural capital stocks and mapping methodology

Broad Natural Group	Subgroup	Mapping Methodology
Freshwater	Active flood plain	Areas at high or medium risks within the Environment Agency (EA)'s Risk of Flooding from Rivers and Sea dataset.
	Blanket Bog	Area of blanket bog mapped using Natural England's Priority Habitat Inventory.
	Chalk Rivers*	Mapped using the EA chalk rivers dataset and mapping intersections with OS watercourse polygons
	Coastal and floodplain grazing marsh	Area of coastal floodplain and grazing marsh mapped using Natural England's Priority Habitat Inventory
	Lakes and standing waters	Area of lakes and reservoirs mapped using the Centre for Ecology and Hydrology (CEH)'s UK Lakes Portal dataset.
	Lowland Fens	Area of lowland fens mapped using Natural England's Priority Habitat Inventory.
	Lowland raised bog	Area of lowland raised bog mapped using Natural England's Priority Habitat Inventory
	Modified waters e.g. reservoirs	Area of reservoirs mapped by selecting Ordnance Survey (OS) surface water polygons (VectorMap District) that coincide with CEH's Inventory of UK reservoirs (points).
	Other semi-natural habitats	Area of other semi-natural habitat mapped using Natural England's Priority Habitat Inventory (including upland and lowland grasslands, heathland and saltmarsh).
	Ponds and ditches	Mapped by selecting surface waterbodies (from OS VectorMap District) that do not intersect rivers, are smaller than 2ha in size.
Mountain, Moor and Heath	Reedbeds	Area of reedbed habitat mapped using NE's Priority Habitat Inventory
	Rivers	Length of rivers mapped using EA's Water Framework Directive (WFD) river waterbodies dataset (cycle 1, to include coastal streams
	Blanket bog	Area of blanket bog mapped using Natural England's Priority Habitat Inventory.
	Dwarf shrub heath	Mapped using Natural England's Priority Habitat Inventory ('fragmented heath', 'lowland heathland' and 'upland heathland')
	Inland rock, scree and pavement (AML*)	Area of inland rock and limestone pavement above the moorland line, mapped using CEH's LCM2015 ('inland rock'), Natural England's Priority Habitats Inventory ('limestone pavement') and the Rural Payment Agency (RPA)'s Moorland Line dataset.
	Lakes and Reservoirs	Area of lakes and reservoirs above the moorland line, mapped using CEH's UK Lakes dataset, CEH's Inventory of UK reservoirs dataset and RPA's Moorland Line dataset.
	Mountain heath and willow scrub	Area of mountain heath and willow scrub mapped using Natural England's Priority Habitat Inventory.
	Rivers (AML)	Length of rivers mapped using EA's WFD river waterbodies dataset and RPA's Moorland Line dataset.
	Semi-natural grassland (AML*)	Area of semi-natural grassland above the moorland line, mapped using Natural England's Priority Habitat Inventory and RPA's moorland line dataset.
	Upland flushes fens and swamps	Area of upland flushes, fens and swamps, mapped using Natural England's Priority Habitat Inventory.

Broad Natural Group	Subgroup	Mapping Methodology
	Wood pasture (AML*)	Area of wood pasture above the moorland line, mapped using Natural England's provisional Wood-Pasture and Parkland BAP Priority Habitat Inventory and RPA's Moorland line dataset.
	Woodland (AML*)	Area of woodland above the moorland line, mapped using FC's National Forest Inventory and RPA's moorland line dataset.
Urban	Blue space	Mapped by intersecting OS VectorMap District Surface Water with the Office for National Statistic (ONS)'s Built-Up areas dataset.
	Green space - not semi-natural	Area of urban green space (not semi-natural), mapped using the OS Open Greenspace Layer.
	Open mosaic habitats	Area of open mosaic habitats on previously developed land, mapped using Natural England's draft Open Mosaic Habitat dataset
	Woodland, scrub and hedge	While urban scrub and hedge are difficult to map at a national scale, the area of urban woodland is mapped here by intersecting FC's National Forest Inventory with ONS Built-Up Areas.
	Semi-natural habitats	Mapped by intersecting Natural England's Priority Habitat Inventory habitats (excluding woodland, good quality semi-improved grassland and traditional orchards) with ONS Built-Up Areas
Farmland	Arable and rotational leys	Area of arable and rotational leys, and horticulture individually, this map shows the area of arable and horticulture combined. Mapped using UK Land Cover 2018 Sub Classes.
	Horticulture	Area of arable and rotational leys, and horticulture individually, this map shows the area of arable and horticulture combined. Mapped using CEH's Land Cover Map 2015 (LCM2015).
	Improved grassland	Area of improved grassland mapped using CEH's LCM2015.
	Orchards and top fruit	Area of orchards and top fruit mapped using Natural England's Priority Habitat Inventory ('traditional orchards')
Woodland	Ancient Woodland	Mapped using Natural England's Ancient Woodland dataset.
	Broadleaved, mixed and yew woodland	Mapped using FC's National Forest Inventory.
	Coniferous woodland	Area of coniferous woodland mapped using FC's National Forest Inventory
	Woodland priority habitats	Mapped using Natural England's Priority Habitat Inventory ('deciduous woodland').
Grasslands	Hay meadows	Area of hay meadow mapped using Natural England's Priority Habitat Inventory ('upland meadow' and 'lowland meadow').
	Other semi-natural grasslands	Area of other semi-natural grassland, mapped using Natural England's Priority Habitat Inventory ('upland calcareous', 'lowland calcareous', 'lowland dry acid', 'good quality semi-improved', 'grass moorland' and 'purple moor grass and rush pasture').
Coastal	Beach	Area of beach mapped using OS VectorMap District ('foreshore'). Note that this dataset includes areas of intertidal sediment as well as beaches.
	Coastal lagoons	Area of coastal lagoons mapped using Natural England's Priority Habitat Inventory ('saline lagoons').
	Mudflats	Area of intertidal mudflats mapped using the EMODnet (Natural England) Intertidal Mudflats dataset.

Broad Natural Group	Subgroup	Mapping Methodology
Marine	Salt marsh	Area of saltmarsh mapped using EA's Saltmarsh Extent dataset.
	Sand dunes	Area of sand dunes mapped using Natural England's Priority Habitat Inventory ('coastal dunes')
	Sea Cliff	Area of sea cliff habitat mapped using Natural England's Priority Habitat Inventory ('maritime cliff and slopes').
	Shingle	Area of shingle mapped using Natural England's Priority Habitat Inventory ('coastal vegetated shingle').
	Intertidal rock	Area of intertidal rock mapped using Natural England's Open Marine Evidence Base (EUNIS code A1).
	Maerl beds	Area of maerl beds mapped using Natural England's Open Marine Evidence Base (EUNIS code A5.51).
	Reefs	Area of potential reefs mapped using JNCC's Potential Annex 1 Reefs
	Sea grass beds	Area of seagrass beds mapped using Natural England's Open Marine Evidence Base (EUNIS code A2.61)
	Shallow subtidal sediment	Area of shallow subtidal sediment mapped using JNCC's UKSea Map 2018 (biozone = shallow ircularittoral or infralittoral and substrate = sediment, sand or mud).
	Shelf subtidal sediment	Area of shelf subtidal sediment mapped using JNCC's UKSea Map 2018 (biozone = deep circularittoral and substrate = sediment, sand or mud).
Soils	Subtidal rock	Area of subtidal rock mapped using JNCC's UKSea Map 2018 (substrate = rock).
	Nutrient Status of Soil	Mean estimates of total nitrogen concentration in topsoil (0-15cm depth) - % dry weight of soil, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project (2016).
	Soil Carbon/Organic Matter	Mean estimates of carbon density in topsoil (0-15cm depth) – tonnes per hectare, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project (2016)
Indicators of condition	Soil Biota	Mean estimates of total abundance of invertebrates in topsoil (0-8 cm depth), mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project (2016)
	Natural Aquifer Function	Area of groundwater catchment with 'good' quantitative status for WFD 2016, mapped using EA's WFD data and groundwater catchment boundaries (C2).
	Naturalness of Flow Regime	The WFD hydrological regime classification describe the naturalness of river flows. This map shows the length of river with 'high' WFD hydrological status in 2016, mapped using EA's WFD data and river water bodies (C2)
	Lack of Physical Modifications of Water Bodies	Lack of physical modification of rivers, mapped using EA's Reasons for Not Achieving Good Status data (SWMI = 'physical modification'), 2013-2016.
	Presence and Frequency of Pollinator Food Plants	Mean estimates of number of nectar plant species for bees per 2x2m plot, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project (2016)
	Chemical status of water bodies	River chemical status for WFD 2016, mapped using EA's WFD data and river water bodies (C2)

* The list of natural capital stocks as described in NERC285 have been supplemented with additional abiotic stocks and key habitats that are vital to the GUC region.

