A9 DUALLING
PASS OF BIRNAM TO TAY CROSSING

Natural Capital Assessment

A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-EN-0001
P01
30/05/2025

Jacobs

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

A9 Dualling Programme: Pass of Birnam to Tay Crossing

Document Title:	Natural Capital Assessment
Document No:	A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-EN-0001
Revision:	P01
Document Status:	S4
Date:	23/05/2025
Client Name:	Transport Scotland
Client No:	TS/MTRIPS/SER/2013/03
Project Manager:	EM
Author:	OS
File Name:	A9P02-JAC-ZZZ-Z_ZZZZZ_ZZ-RP-EN-0001

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Contents

1. Introduction

1.1.1 This report comprises the Design Manual for Roads and Bridges (DMRB) Stage 3 Natural Capital Assessment (NCA) for the A9 Dualling Programme: Pass of Birnam to Tay Crossing (hereafter referred to as the proposed scheme).

1.1.2 Historically, Transport Scotland (TS) has explored how best to capture environmental outcomes within decision making and is fully committed to the protection and enhancement of the natural environment for transport projects.

1.1.3 A retrospective natural capital assessment (Transport Scotland, 2022), focussing on the Preferred Route Option as assessed within the Environmental Statement, was previously conducted for the A9 Dualling Programme: Pitlochry to Killiecrankie. The assessment enabled TS to consider the benefits of adopting a natural capital approach in the future and found that NCAs present an opportunity to reframe the way transport schemes interact with their surrounding environment and better identify the value of both the existing environment and proposed mitigation. Following on from this retrospective assessment, TS commissioned a NCA for the proposed scheme as part of DMRB Stage 3 environmental assessment process, building on the learning from the A9 Dualling: Pitlochry to Killiecrankie NCA.

1.1.4 It was identified that the Environmental Impact Assessment (EIA) processes could be supported by additional assessments to:

- Better identify the value of environmental mitigation and enhancement of schemes.
- Shift approaches from the traditional identification of adverse impacts to include scheme benefits and associated value.

1.1.5 A natural capital approach was identified as a potential approach to support the above and capture the true value of TS schemes.

1.2 Key concepts and definitions

1.2.1 The Scottish Natural Capital Accounts (SNCA) (Scottish Government, 2024d) define natural capital as “the stock of natural resources including air, water, minerals and all living things. These natural resources are crucial to the functioning of our society and economy as they underpin and provide a wide range of social, environmental and economic benefits to the people living and working in Scotland.”

1.2.2 Our stocks of natural capital provide flows of ecosystem services over time. These services, often in combination with other forms of capital (human, produced and social) produce a wide range of benefits to people individually and to wider society. These benefits may be direct or indirect and some of these benefits are less obvious than others but still exist and are nonetheless important. For example, ecosystem service benefits can include use values that involve interaction with the resource, and which can have a market value (minerals, timber, freshwater) or non-market value (such as outdoor recreation, or landscape amenity). They also include non-use values, such as the value people place on the existence of particular

habitats or species (HM Treasury, 2024). The various types of ecosystem service benefits (as defined in the SNCA) are explained further below:

- Provisioning services: material outputs such as fish, timber, and fossil fuels.
- Regulating services: the regulation of natural processes that help to maintain the quality of the natural environment we rely upon, such as carbon sequestration (the removal of greenhouse gases from the atmosphere), air pollution removal and noise mitigation.
- Cultural services: non-material benefits such as recreation and aesthetics.

1.2.3 The ability of natural assets to provide goods and services depends on their quality, quantity, and location. These factors can, in turn, be influenced by background pressures or drivers of change, such as climate change and resource extraction (IPBES, n.d.), as well as direct interventions as a result of management practices. Some services may also need extra inputs to actualise benefits, (e.g. manufacturing to produce food from raw agricultural outputs) while in other instances, the benefit arises directly from the service without the need for additional capital or human input (e.g. carbon sequestration). The natural capital logic chain, as detailed in Defra's (the Department of Environment Food and Rural Affairs) ENCA guidance (Defra, 2023), is summarised in Figure 1-1.

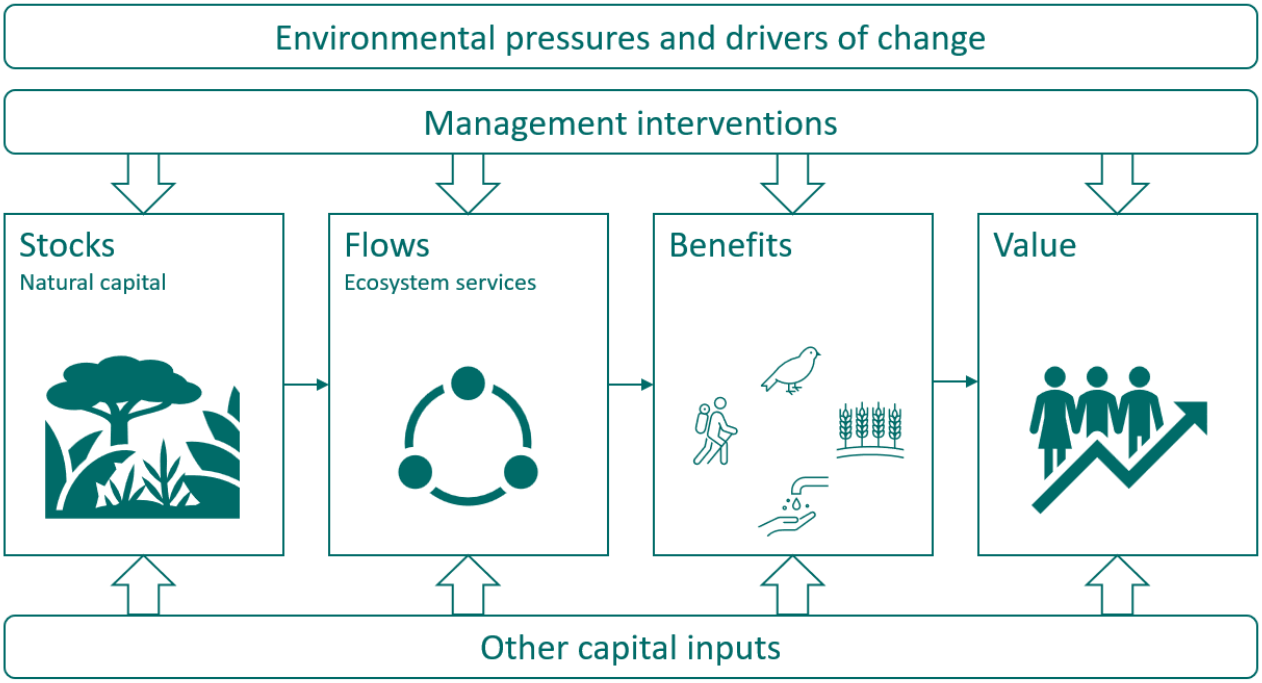

Figure 1-1 Natural capital logic chain, redrawn from Defra's ENCA guidance

1.2.4 The key advantage of the use of natural capital approaches is to ensure that the benefits nature brings are not overlooked and can be protected and enhanced. A NCA aims to understand the baseline stocks of natural capital relevant to (which could be impacted by) a given scheme and the flows of ecosystem service benefits they generate, based on the above the logic chain. The assessment then looks to understand how these services (and associated value) will be impacted as a result of the scheme. As such, the approach provides a framework for improved appraisal of environmental effects alongside externalities (unintended negative environmental effects such as air and water pollution), which are typically the focus of

environmental impact assessment (EIA). Figure 1-2 below (taken from the HM Treasury Green Book (HM Treasury, 2024)) demonstrates this, with the focus of environmental assessment represented by the top row ('environmental externalities') and the focus of NCA represented by the bottom row ('stocks of natural capital' and 'changes in environmental goods and services'). The figure thus depicts how NCA supplements and sits alongside, as opposed to attempting to replace, traditional environmental appraisal for a more comprehensive assessment of environmental and social impacts.

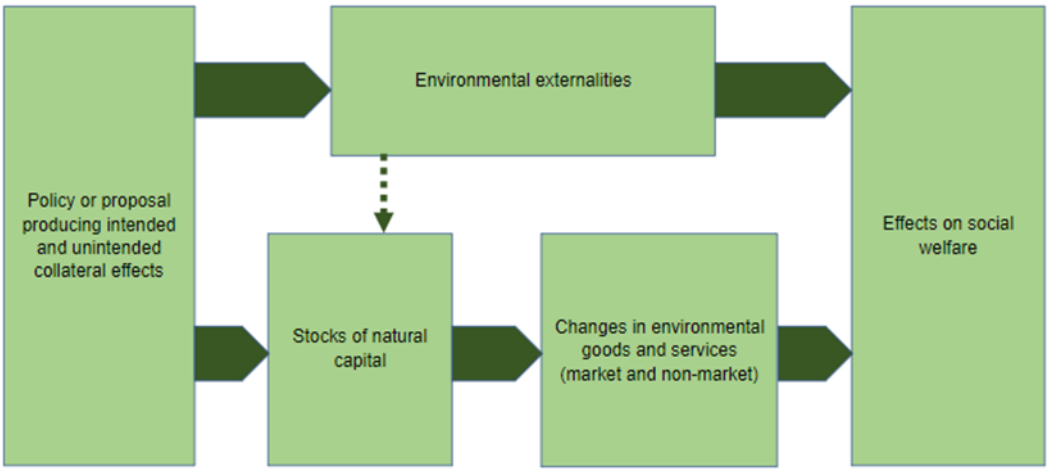

Figure 1-2 The Natural Capital Framework, as part of environmental appraisal

1.2.5 An NCA can add significant value to the appraisal process through a more holistic consideration of impacts, as well as the wider benefits schemes can generate as a function of environmental mitigation efforts and enhancements. It is recognised that in the context of the proposed scheme, there are likely to be both losses and gains of potentially high value habitats (such as woodland). It will thus be critical to understand the impacts to ecosystem services across the project lifespan, as part of the appraisal. The DMRB guidance sets out UK wide guidance on the development of trunk road schemes and provides guidance on environmental assessment, describing the level of assessment required at each of the key stages of development of a trunk road scheme. It should be noted that DMRB LA 108 Biodiversity (National Highways et al., 2020) section 2.1.1, Note 2 specifically promotes the inclusion of NCA within the environmental assessment, stating that "*the reporting of the scale and nature of biodiversity changes can include ecosystem services assessment, natural capital assessment or biodiversity metric evaluation*."

1.2.6 In addition to acting as a standalone output contributing to appraisal and supplementing environmental assessment, NCAs can also add value in demonstrating alignment with key policies around wider benefits and environmental enhancements. In helping to identify opportunities to optimise socio-economic and environmental outcomes and being able to evidence the associated benefits, assessment outcomes can be used to support scheme consenting. In addition to the DMRB recommendation for the inclusion of NCA within trunk road environmental assessment, Section 1.3 below provides a summary of the relevant strategies, guidance and policies from Scottish Government and TS that are relevant to the range of ecosystem services considered as part of this NCA.

1.3 Relevant strategies, guidance and policies

1.3.1 The Scottish Government has recognised the urgent need to consider and address the issues of climate change and biodiversity loss together. The two are inextricably linked, with the changing climate driving the loss of biodiversity. Vice versa, the destruction of ecosystems is affecting the ability of nature to mitigate the impacts of, and our vulnerability to, climate change. Nature plays a critical role in the regulation of greenhouse gases, sequestration of carbon emissions and protection against extreme weather. As a result, as part of The Scottish Biodiversity Strategy to 2045 (Scottish Government, 2024c), the Scottish Government has declared twin, interlinked crises of climate change and biodiversity loss. Scottish Ministers have agreed two key commitments:

- A halting of biodiversity loss by 2030; and
- And to reach Net Zero emissions by 2045, whilst restoring and regenerating biodiversity.

1.3.2 The Biodiversity Strategy, in recognition of the contribution that natural capital makes to underpinning our society and economy, also states that by 2045: natural capital will be embedded in policy making; ecosystems will be diverse, healthy, resilient and deliver a wide range of ecosystem services; and that nature-based solutions will be central to efforts to deliver NetZero and adapt to climate change.

1.3.3 The Edinburgh Declaration (Scottish Government, 2022) recognises the link between climate change and biodiversity and seeks nature-based solutions for transformative change – this established a definitive framework for action to be adopted and embraced by all public sector organisations in Scotland.

1.3.4 The National Planning Framework 4 (NPF4) (Scottish Government, 2023a) states 'to respond to the global biodiversity crisis, nature recovery must be at the heart of future places. We will secure positive effects for biodiversity, create and strengthen nature networks and invest in nature-based solutions to benefit natural capital and contribute to net zero'. Policy 4 states a requirement to "protect, restore and enhance natural assets making the best use of nature-based solutions" to ensure that "natural assets are managed in a sustainable way that maintains and grows their essential benefits and services."

1.3.5 The Scottish Government Draft Planning Guidance (Scottish Government, 2023b) on Biodiversity, which sets out the Scottish Ministers' expectations for implementing NPF4 policies which support the cross-cutting NPF4 outcome 'improving biodiversity,' lays out a number of core principles, one of these being to 'integrate nature to deliver multiple benefits.' The principle states that, "development should consider opportunities to maximise contributions to ecosystem services more generally and deliver multiple benefits for both people and nature."

1.3.6 Scotland's National Strategy for Economic Transformation (Scottish Government, 2022) discusses natural capital in the context of a 'nature-positive economy' citing how 'rebuilding Scotland's natural capital is key to long-term productivity of the many sectors of our economy which rely on the resources and services nature provides'. It also states that Scottish Government is committed to ensuring that local communities are empowered and benefit from investment in natural capital.

1.3.7 The Infrastructure Commission for Scotland recognised the role of infrastructure in supporting environmental as well as social and economic outcomes. Natural infrastructure has since been included within the definition of infrastructure in Scotland's Infrastructure Investment Plan to 2025-26 (Scottish Government, 2021). The plan recognises that natural capital is 'fundamental' to Scotland's 'economy and wellbeing,' and the contribution that investment in natural infrastructure can have toward amenity, wellbeing, economic growth, reducing carbon emissions, climate adaptation and wider benefits.

1.3.8 NatureScot is committed to integrating natural capital into decision-making and investment strategies. This has been reflected in various recent natural capital initiatives, including:

- Scotland's Natural Capital Asset Index (NatureScot, 2023) – NatureScot developed the index to help track the contribution of ecosystems to wellbeing and prosperity at a national scale. The tool is intended to promote the inclusion of nature in policy decisions, where it has been historically overlooked.

- Landscape Scale Natural Capital Tool for Scotland (NatureScot, 2025) – NatureScot is in the process of developing a tool to support land managers in Scotland in using a natural capital approach to recognise the benefits delivered by nature in their decision making.

- NatureScot Natural Capital Account (Nature Scot, 2024)– NatureScot has tested a natural capital approach on land under its ownership/management to understand the benefits currently obtained. This will support them in considering how best to manage their land portfolio sustainably, in the future.

1.3.9 A natural capital approach is embedded within the Tayside Local Biodiversity Action Plan (Tayside Biodiversity Partnership, 2016), which considers the ecosystem services provided by Tayside's natural assets throughout.

1.3.10 The quality and interconnectivity of ecosystems associated with TS's assets are therefore required to be carefully managed to ensure they are in the best condition to mitigate and adapt to climate change and for delivering positive outcomes for biodiversity and society.

1.3.11 Natural capital is also linked to several TS policies such as:

- Fitting Landscapes (Transport Scotland, 2014), which is TS's mandatory Landscape Policy. The key aims within this policy (such as enhancing and protecting natural heritage and building adaptability to change) can be supported by natural capital approaches.

- Landscape and Biodiversity (Transport Scotland, 2025), is TS's published policy and states that wherever possible, any management interventions are designed to protect and enhance roadside biodiversity and respect and integrate with the wider environment, all of which an understanding of the baseline natural capital assets and values can help to achieve.

- The National Transport Strategy (Transport Scotland, 2020), sets out the vision for Scotland's transport system over the next 20 years. There are four interconnected policies underpinning the vision, with 'take climate action' and 'improves our health and wellbeing' being supported by the integration of natural capital approaches. Each year,

delivery plans are developed which set out how TS will deliver against the four policy pillars. Consideration of natural capital can help support the development of these plans and delivery, for example supporting prioritisation of habitat creation to deliver multiple benefits.

1.3.12 Transport Scotland's approach to climate change adaptation and resilience (Transport Scotland, 2023), sets out the vision for a well-adapted transport system in Scotland which is resilient to current and future impacts of climate change. The vision will be delivered through TS's Adaptation and Resilience Framework which is developed to address the 7 climate risks to transport as set out by the Climate Change Committee. An understanding of natural capital assets can help to identify habitats providing carbon sequestration services and support holistic catchment management, delivering benefits across multiple ecosystem services, such as hazard regulation.

1.3.13 In addition to the relevant Scottish Government and Transport Scotland strategies, the community engagement undertaken as part of the project resulted in a series of community objectives being developed (further detail on this can be found in the DMRB Stage 3 Environmental Impact Assessment Report (EIAR) Chapter 7: Consultation and scoping). Some of these are particularly relevant to this NCA, including the following objectives:

- Reduce current levels of noise and pollution in the villages of Dunkeld, Birnam and Inver to protect human health, and well-being of residents and visitors and to enable them to peacefully enjoy their properties and amenity spaces.
- Protect and enhance the scenic beauty and natural heritage of the area and its distinctive character and quality
- Examine and identify opportunities to enhance the levels of wheeling, cycling and walking for transport and leisure, including the improvement of existing footpaths and cycle ways, to promote positive mental health and well-being.
- Preserve and enhance the integrity of the unique and rich historical and cultural features of the Dunkeld, Birnam and Inver communities, thereby supporting well-being and the local economy.

1.4 Aims and objectives

1.4.1 The NCA at DMRB Stage 3 aims to understand the natural capital asset base relevant to, and how this will change as a result of, the proposed scheme and the consequent impacts on ecosystem service benefits. The following objectives have been set out for the delivery of this aim:

- Produce a natural capital asset register for the NCA boundary (see definition in Section 2), quantifying the stocks of natural capital under a baseline and post-development scenario;
- Identify the ecosystem service benefits which could be impacted by the proposed scheme and assess the potential impacts in qualitative, and where possible, quantitative and monetary terms;

- Identify key risks and opportunities related to natural capital to provide recommendations for the ongoing proposed scheme development;
- Assess natural capital impacts in such a manner that they could demonstrate the consideration of relevant legislation and policy identified in Section 1.3 and the business case for the proposed scheme;
- Demonstrate alignment with the DMRB Stage 3 Environment Impact Assessment Report (EIAR), recognising and, where possible, utilising the outcomes from relevant disciplines to inform the assessment of ecosystem service impacts. The NCA will thus supplement the EIAR to provide a more a comprehensive understanding of the impacts of the proposed scheme.

1.5 Approach

1.5.1 The remainder of this report is set out according to five key analytical steps involved with delivering a NCA, following the logic chain set out in Figure 1-3. For each of the steps, the analytical approach (methodology) is explained, followed by the outcomes for that step.

Figure 1-3 NCA steps and report structure

2. Natural capital baseline

2.1.1 This stage involves quantifying the natural capital stocks with the potential to be impacted by proposed scheme. Stocks of natural capital can be conceptualised in different ways; however, the most common and often pragmatic approach is by habitat type. According to the ENCA guidance (Defra, 2023), habitat types most concisely capture the diversity of the UK's ecology, geology and climate in distinct spatial areas. Defining assets by habitat type can also help to identify externalities influenced by the natural environment and ecosystem services supplied by natural capital. As such, a natural capital asset register of habitats relevant to the proposed scheme and their extents was produced. This represents a critical step in informing and interpreting the analysis of ecosystem service benefits, as many of these are directly dependent on habitat extents.

2.1.2 The natural capital asset register baseline was informed by the On-site Habitat Baseline from the Statutory Biodiversity Metric Tool (SBMT) (Defra, 2023) calculation for the DMRB Stage 3 EIAR and consequently, the NCA utilises the same SBMT study boundary (which is henceforth referred to as the 'NCA boundary'). The use of the On-site Habitat Baseline represents both the most efficient and most accurate quantification of natural capital stocks available for the NCA boundary, informed by UK Habitat Classification (UKHab) surveys for habitats within the proposed scheme.

2.1.3 Baseline habitat areas were extracted from the SBMT. Neither the SBMT calculation, nor the NCA, accounted for any additional impacts to habitats outside of the NCA boundary and the boundary is assumed to capture construction impacts, including temporary works.

2.1.4 Table 2-1 below presents the sum area of each habitat type within the proposed scheme. The habitat baseline is dominated by the presence of woodland, accounting for >64% of the total area; this is predominantly comprised of coniferous woodland, mixed woodland and lowland mixed deciduous woodland. Second to woodland, grassland dominates with notable areas of other neutral grassland and modified grassland. Small areas of transitional habitat (bracken) are present and there is just under eight hectares of arable land, fairly evenly split between non-cereal crops, temporary grass and clover leys and cereal crops.

Table 2-1 Baseline natural capital asset register for the proposed scheme

Habitat type	Area (ha)
OTHER CONIFEROUS WOODLAND	44.78
OTHER WOODLAND; MIXED	41.02
LOWLAND MIXED DECIDUOUS WOODLAND	24.07
OTHER NEUTRAL GRASSLAND	22.07
OTHER WOODLAND; BROADLEAVED	12.98
DEVELOPED LAND; SEALED SURFACE	12.97
MODIFIED GRASSLAND	9.03
OTHER SCOT'S PINE WOODLAND	7.21

Habitat type	Area (ha)
BRACKEN	6.12
UPLAND HEATHLAND	4.63
WET WOODLAND	4.12
BLANKET BOG	3.43
NON-CEREAL CROPS	2.85
GORSE SCRUB	2.72
TEMPORARY GRASS AND CLOVER LEYS	2.69
CEREAL CROPS	2.08
LOWLAND HEATHLAND	1.87
VEGETATED GARDEN	1.63
OTHER LOWLAND ACID GRASSLAND	1.29
LOWLAND BEECH AND YEW WOODLAND	0.79
OTHER INLAND ROCK AND SCREE	0.70
MIXED SCRUB	0.53
ARTIFICIAL UNVEGETATED, UNSEALED SURFACE	0.46
PURPLE MOOR GRASS AND RUSH PASTURES	0.09
LOWLAND DRY ACID GRASSLAND	0.04
BUILT LINEAR FEATURES	0.04

2.2 Assumptions and limitations

2.2.1 At this stage, linear habitats (hedgerows and watercourses) have not been included within the SBMT for the DMRB Stage 3 Design Fix and are thus not considered as part of the NCA. This is because the methodology is designed for use in English rivers and there is still uncertainty on the suitability and practicality of applying MoRPh assessment methods to assessing river condition in Scotland.

3. Change in natural capital assets

3.1.1 A natural capital asset register was also developed for a post-development scenario for the proposed scheme. As per the baseline, this was taken from the DMRB Stage 3 Design Fix SBMT, compiling the On-Site retained, enhanced and created habitat areas.

3.1.2 The landscape and ecology planting proposals were used to inform the post-development habitats for the proposed scheme within the SBMT. It should be noted that surplus to the landscape and ecology proposals used, additional areas will be required for the compensation of woodland. Additional areas will also be considered for enhancement opportunities. Work has been undertaken and is ongoing to develop said offsite enhancements. A desk study was undertaken to identify local initiatives that could offer a way of delivering enhancements for the proposed scheme. Consultation with Forestry Land Scotland, Atholl Estates and Murthly Estates was also undertaken to identify opportunities for enhancements within land adjacent to the proposed scheme. Further consultation will be undertaken to identify additional off-site areas for enhancement as required.

3.1.3 As offsite enhancements have not been included within the SBMT for the DMRB Stage 3 Design Fix, they are not accounted for within the NCA. As such, the outcomes for the proposed scheme within the NCA are likely to significantly underestimate the potential benefit or, vice versa, overestimate any adverse outcomes for ecosystem services.

3.1.4 Table 3-1 presents the change in area for each habitat type within the proposed scheme. Note that Retained areas represent those which would be retained during construction and, therefore, do not constitute a change. Temporary habitat losses associated with construction have been accounted within SBMT data.

3.1.5 As discussed, the natural capital asset register reflects a post-development scenario where there are some notable losses of woodland, mostly coniferous: deciduous woodland area increases overall by nearly 15ha, whilst there is a loss of almost 28ha of coniferous woodlands (inclusive of Scot's pine). There is a large increase in the coverage of other neutral grassland. Over 65% of bracken habitat is lost along with the majority of arable habitat.

Table 3-1 Post-development natural capital asset register for the proposed scheme

Habitat type	Area (ha)				Percentage change %
	Baseline	Retained	Enhanced/Created	Change	
OTHER CONIFEROUS WOODLAND	44.78	18.35	0.00	-26.43	-59.02
OTHER WOODLAND; MIXED	41.02	24.89	17.78	1.65	+4.01
LOWLAND MIXED DECIDUOUS WOODLAND	24.07	14.72	30.38	21.02	+87.34
OTHER NEUTRAL GRASSLAND	22.07	6.74	25.50	10.18	+46.12
OTHER WOODLAND; BROADLEAVED	12.98	5.24	0.02	-7.73	-59.51
DEVELOPED LAND; SEALED SURFACE	12.97	8.78	19.69	15.50	+119.47
MODIFIED GRASSLAND	9.03	0.70	9.94	1.61	+17.83
OTHER SCOT'S PINE WOODLAND	7.21	5.95	0.00	-1.26	-17.45
BRACKEN	6.12	2.11	0.00	-4.01	-65.48
UPLAND HEATHLAND	4.63	2.37	0.00	-2.25	-48.68
WET WOODLAND	4.12	4.12	0.00	0.00	0.00
BLANKET BOG	3.43	3.43	0.00	0.00	0.00
NON-CEREAL CROPS	2.85	0.00	0.00	-2.85	-100.00
GORSE SCRUB	2.72	1.31	0.00	-1.41	-51.68
TEMPORARY GRASS AND CLOVER LEYS	2.69	0.00	0.00	-2.69	-100.00
CEREAL CROPS	2.08	1.05	0.22	-0.81	-38.87

Habitat type	Area (ha)				Percentage change %
	Baseline	Retained	Enhanced/Created	Change	
LOWLAND HEATHLAND	1.87	1.64	0.00	-0.23	-12.35
VEGETATED GARDEN	1.63	0.10	0.00	-1.53	-93.80
OTHER LOWLAND ACID GRASSLAND	1.29	0.06	0.00	-1.24	-95.74
LOWLAND BEECH AND YEW WOODLAND	0.79	0.79	0.00	0.00	-0.03
OTHER INLAND ROCK AND SCREE	0.70	0.33	0.74	0.37	+52.49
MIXED SCRUB	0.53	0.00	0.65	0.12	+22.64
ARTIFICIAL UNVEGETATED, UNSEALED SURFACE	0.46	0.20	0.00	-0.26	-56.40
PURPLE MOOR GRASS AND RUSH PASTURES	0.09	0.09	0.00	0.00	0.00
LOWLAND DRY ACID GRASSLAND	0.04	0.04	0.00	0.00	0.00
BUILT LINEAR FEATURES	0.04	0.04	0.00	0.00	-0.01
RUDERAL/EPHEMERAL	0.00	0.00	2.24	2.24	NA
RURAL TREE	0.00	0.00	1.62	1.62	NA

3.2 Assumptions and limitations

3.2.1 Ancient woodland has been excluded from the SBMT calculations, and thus the NCA, as it is categorised as an irreplaceable habitat. It is understood that there are some ancient woodland losses associated with the proposed scheme and whilst the significance of the potential impacts on natural capital will be somewhat mitigated by the bespoke compensation required, this is recognised as a limitation of the assessment.

3.2.2 As discussed in Section 3, a number of offsite habitat measures could not be captured within the current NCA. This includes additional (ancient) woodland compensation required, which is considered separately due to ancient woodland being irreplaceable habitat (as above) and planned offsite biodiversity enhancements, which have not been confirmed, and thus insufficient data was available for their inclusion within the SBMT for the DMRB Stage 3 Design Fix. It is assumed that once offsite habitat measures have been confirmed and were these be able to be accounted for within the NCA, the outcomes of the NCA would be notably improved.

4. Identification of ecosystem services

4.1.1 Ecosystem services for inclusion within the NCA were selected from the long list presented within the ENCA Services Databook to provide confidence in a comprehensive consideration of potential natural capital impacts. Services were selected on the basis of the proposed scheme having a tangible impact on the capacity of habitats to deliver them. The selection process was hence an iterative one as the assessment developed and new evidence came to light as to the potential impacts of the scheme; in particular, as relevant chapters of the DMRB Stage 3 EIAR were reviewed to understand potential scheme impacts on natural capital.

4.1.2 The scoping table in Table 4-1 details the ecosystem services considered for inclusion within the NCA and whether they were assessed in qualitative, quantitative or monetary terms. By default, all services scoped in have been considered qualitatively. Where possible, ecosystem services have been quantified and monetised permitting the availability of sufficient data.

Table 4-1 Ecosystem service scoping table

Ecosystem service	Qualitative	Quantitative	Monetary	Justification
Provisioning services				
Food production	✓	x	✓	Within the NCA boundary, there are parcels of both arable habitat and modified grassland, with the proposed scheme resulting in a loss of the former and gain in the latter. This impacts the capacity of land (natural capital) to support food production. Average farmland rents can be used as a proxy to understand the change in this value (more detail on this can be found in section 6.2).
Timber production	✓	✓	✓	Coniferous woodland parcels with active felling licences are present within the DMRB Stage 3 Design Fix boundary for which yield forecasts can be obtained and valued. Assumptions have been made as to how land use change impacting these parcels, as a result of the scheme, will impact upon yields.
Water supply	x	x	x	The DMRB Stage 3 Road Drainage and the Water Environment chapter was reviewed. The assessment identified only one surface water supply abstraction from the River Tay relevant to the proposed scheme, an agricultural abstraction for irrigation. The residual significance of the impact on the abstraction is deemed only to be 'slight' and

Ecosystem service	Qualitative	Quantitative	Monetary	Justification
				the magnitude 'negligible'. Impacts on water supply were thus scoped out of the NCA.
Regulating services				
Air pollutant removal	✓	✓	✓	This service reflects the capacity for habitats to remove atmospheric pollutants and can be quantified and valued using average pollutant removal factors and corresponding unit values for human health benefits. Land use change as a result of the proposed scheme will cause changes in the composition of relevant habitats.
Carbon reduction	✓	✓	✓	Average sequestration and storage factors can be used to quantify the changes in the capacity for habitats to remove carbon from the atmosphere. This can be valued using central government carbon values for policy appraisal (values used can be seen in section 6.5). Land use change as a result of the proposed scheme will cause changes in the composition of relevant habitats.
Flood regulation	✓	✓	✓	Land use changes as a result of the proposed scheme will change the composition of habitats with a role in the storage of flood waters. Average storage rates and corresponding, average damage cost avoided and/or replacement values can be used to quantify and monetise the benefits, respectively.
Noise reduction	X	x	x	An assessment into the capacity for vegetation to provide a buffer for receptors (residential properties) against road noise, and how this changes as result of the changes to habitats associated with the proposed scheme, was undertaken. Details of this assessment are provided in APPENDIX A. The assessment revealed no changes in this service and hence, it is scoped out.
Pollination	✓	✓	x	Land use changes as a result of the proposed scheme will have an impact on the presence of habitats which are important for pollinator species. A bespoke, semi-quantitative (scoring) approach has been developed to understand the scale and direction of these impacts.
Soil erosion protection	✓	x	x	Habitat changes are anticipated which may decrease vegetation cover on slopes with the potential for affecting the risk of geotechnical hazards. These hazards will be considered within the specimen design and subsequent detailed design. In the absence

Ecosystem service	Qualitative	Quantitative	Monetary	Justification
				of detailed soil and stability studies at this stage, quantification of such risks is not possible.
Water purification	X	x	x	This reflects the role of habitats in preventing pollutants from entering watercourses and thus avoiding secondary damages. This service is most relevant to wetland habitats. The wetland habitats within the NCA boundary are wet woodland and blanket bog. Whilst wet woodland likely has a role in the regulation of local water quality, the area of wet woodland is not forecasted to be impacted by the proposed scheme. Furthermore, the blanket bog habitat is not proximal to a watercourse and thus deemed not to provide a service, nor will it change in area as a result of the proposed scheme. Hence this service has been scoped out.
Cultural services				
Education	✓	x	✓	This service reflects the capacity for the natural environment to provide learning opportunities and/or to support learning through its restorative functions. The proposed scheme could present an opportunity to create new geological features of interest through the necessary blasting and thus learning opportunities. The potential benefit is to be quantified for demonstrative purposes of the opportunity only and will not be included within the forecasted impacts of the scheme.
Landscape and amenity	✓	x	x	The proposed scheme has the potential to substantially impact natural assets, in particular woodlands and forests, which play a key role in the area's unique natural beauty and setting. Such cultural impacts are inherently subjective and thus difficult to quantify.
Mental wellbeing	X	x	x	This service reflects the capacity of the natural environment to support the mental wellbeing of relevant populations through its restorative functions. Access to quality greenspace for this purpose is not expected to be significantly affected by the proposed scheme.
Physical health	X	x	x	This service reflects the capacity for the natural environment to provide a setting for outdoor physical activity. Given the rural location, and thus high surrounding availability of quality greenspace, the

Ecosystem service	Qualitative	Quantitative	Monetary	Justification
				proposed scheme is not deemed likely to have a tangible impact on access to space for outdoor activity.
Recreation	✓	x	✓	The proposed scheme is anticipated to have impacts on local, destination greenspaces for outdoor recreation both in terms of access and the quality of recreational experience. The value of recreational experiences can be assessed using average Willingness To Pay (WTP) values applied to baseline visitor data. Baseline values can then be scaled to reflect the anticipated change in recreation values from a combination of changes to visitor numbers and/or recreational experience as a result of the impacts of the proposed scheme. There is insufficient data to accurately quantify the change in visitor numbers alone, however.
Recreation (angling)	x	x	x	The DMRB Stage 3 Biodiversity chapter does not suggest that there will be any residual impacts on aquatic species. It is thus assumed that there are no tangible impacts to angling opportunities and hence this service is scoped out of the NCA.
Volunteering	✓	✓	✓	This service reflects the capacity for the natural environment to provide volunteering opportunities, which have secondary benefits in terms of upskilling, opportunities for social interactions and community cohesion. A wage equivalent for volunteer time can be used as a proxy for the minimum benefit received by participating individuals.

5. Qualitative assessment

5.1.1 Table 5-2 provides a qualitative narrative around the impacts of the proposed scheme on the provision of each ecosystem service relative to the baseline. A narrative is given for the direction of the proposed scheme's impacts on the service and the expected order of magnitude of said impact. An overall score is also assigned for the trajectory and magnitude of change anticipated for each ecosystem service. The scoring system (Table 5-1) used is similar to that used in standard environmental assessment (on a five-point scale from substantial positive to substantial adverse impact). The narrative and scoring have been informed by expert judgement and the quantitative and monetary assessments for the respective services, presented in Section 65.1.2, which are referred to throughout.

Table 5-1. Scoring system for qualitative assessment

Key	
↑↑	Potential substantial positive ecosystem service impact
↑	Potential moderate positive ecosystem service impact
→	Limited ecosystem service impact expected
↓	Potential moderate adverse ecosystem service impact
↓↓	Potential substantial adverse ecosystem service impact

Table 5-2 Qualitative assessment

Ecosystem service	Narrative	Score
Food production	The proposed scheme is likely to result in an overall loss of agricultural land. Notably, there is a loss of almost 6ha of general cropping habitat (non-cereal crop habitat and temporary grass and clover leys), and some loss of cereal crop habitat. The creation of modified grassland goes someway to counter this impact, however there would likely be an overall net loss for this ecosystem service. It is likely that the value of food production varies across the areas of impacted agricultural land more than it was possible to capture within the quantitative assessment. Nonetheless, it is considered that there will be a potentially moderate adverse impact on this ecosystem service.	↓
Timber production	It is anticipated the proposed scheme will likely result in a loss of timber production. This is due to areas currently used for felling potentially being taken out of production to enable mitigation planting. There are two key areas within the scheme boundary that have active felling licences. The Dalpowie plantation is expected to be taken out of timber production prior to construction of the proposed scheme, therefore there is considered to be no impact on this area. Another area to the south of the proposed scheme (Muir of Thorn and Gelly Wood) also has active felling licences, and this area is expected to be used for mitigation planting. It is assumed that in this case, felling will no longer occur, therefore reducing this benefit. There are however uncertainties around how much are this area will be required for planting and therefore it is expected the impacts will be moderately adverse.	↓
Air pollutant removal	The proposed scheme encompasses a significant area of woodland, which plays a vital role in mitigating the impacts of air pollution, particularly in comparison to other habitats such as grassland, agricultural land, and developed areas. However, the construction of the scheme will lead to an overall loss of coniferous woodland which is one of the most effective natural assets for removing atmospheric pollutants. As a result of the habitat changes, this ecosystem service will likely be diminished both during construction and operation of the proposed scheme. Although the proposed scheme creates some woodland and grassland habitat areas, the benefits of this will not be immediately realised, as newly planted areas will require time to establish. Given the rural setting of the project, where background air pollution levels are low and expected to remain low, the overall decline in air pollutant removal services is anticipated to be moderately adverse.	↓
Carbon reduction	The proposed scheme covers a significant area of woodland as well as areas of heathland, grassland and arable land which all have increased carbon stocks when compared with developed, sealed surfaces. Carbon storage (stocks) is expected to decrease overall with the introduction of the proposed scheme due to losses of vegetation carbon as a result of clearance and soil carbon associated with disturbance during construction and land use changes. This is largely due to the initial loss of soil carbon and vegetation carbon during the construction phase and the subsequent time for newly created habitats to replenish soil carbon stocks during the operational phase. There are anticipated to be some benefits to carbon reduction during the operational phase, notably associated with the planting of parcels of compensatory woodland habitat. The average age of existing woodland stands relevant to the proposed scheme is assumed to be approximately 40 years. The Woodland Carbon Code (WCC) states that carbon sequestration in trees typically peaks between years 16 and 25 of a tree's life, after which this tails off with a slowing growth rate. Consequently, the replacement of existing woodland parcels with new planting is expected to provide a net benefit to carbon	↓↓

Ecosystem service	Narrative	Score
	drawdown. However, such gains are not expected to outweigh the initial losses of soil and vegetation carbon during construction and thus a potentially substantial adverse impact on this ecosystem service is anticipated. It should be noted that the carbon fluxes described above are discussed in further detail in Section 6.5.	
Flood regulation	Within the NCA boundary the baseline habitat includes a small area of blanket bog and a substantial area of woodland and grassland. These natural assets are effective at intercepting rainfall and slowing flood waters compared to agricultural and developed land. It is likely that there would be a reduction in this ecosystem service during construction and the period immediately following. This is due to an initial loss of high value habitat (conifer woodland), and whilst an overall increase in other types of woodland and grassland is expected as a result of the proposed scheme, there will be delays until benefits will be realised, due to the time taken to establish newly created habitats. Overall, there is likely to be a reduction in this service as a result of the proposed scheme, mitigated to an extent by the creation of new woodland and grassland areas.	↓
Pollination	The proposed scheme is anticipated to result in both gains and losses of habitat types that are important to support pollinator species. The most significant of these include a loss of coniferous woodland and overall gains in both lowland mixed deciduous woodland and neutral grassland. Both woodland and grassland habitat types are particularly high value for supporting pollinators, whilst the coniferous woodlands scores poorly, meaning there is an overall gain in habitats which are likely to be more beneficial for pollinator species. The overall impacts on this ecosystem service are expected to be a potential moderate positive impact.	↑
Soil erosion protection	Soil erosion protection provided by habitats via vegetation can reduce the risk of landslips and maintain ground stability. Geotechnical hazards have been identified along the proposed scheme, including areas where landslides have occurred historically as well as potential rock slope hazards. Habitat changes are anticipated which will decrease vegetation cover along the proposed scheme; however, replacement habitats are planned (note. the extent of replacement habitats has not been confirmed at the time of writing, therefore has not been considered in this assessment). Earthworks are proposed in areas of existing geotechnical hazards and there is potential for the failure of both natural and engineered slopes if hazards are not mitigated through implementation of good practice measures and design. Geotechnical hazards are to be considered at the proposed scheme specimen design and subsequent detailed design stages. As soil erosion protection will be provided by replacement habitats and geotechnical hazards are to be mitigated through good practice and design, a limited/no ecosystem service impact is expected for the proposed scheme.	→
Education	The Dunkeld area is frequented by universities in Scotland as a field trip site to educate students on structural geology and is recommended as an excursion by Geological Societies. There is potential for the proposed scheme to create new areas of geological interest through exposure of rock for new road cuttings, including areas which could be related to recognised GCR (Geological Conservation Review) Sites. Three areas of cut have been identified as potentially exposing bedrock features of interest which could enhance the existing educational visits already carried out in the Dunkeld area. This is dependent on these areas of road cut being made accessible to the public and the presence of unique rock features. Due to the increase in educational visits, a potentially moderate positive ecosystem service impact is anticipated for the proposed scheme.	↑

Ecosystem service	Narrative	Score
Landscape and amenity	The area of the proposed scheme is currently characterised by the varied landscape of the Tay Valley, with the River Tay meandering through the glen and views of the highlands further north. Extensive areas of woodland and forest cover the surrounding area, and even where managed, form a perception of a natural setting. Landscape designations across the proposed scheme include the River Tay (Dunkeld) National Scenic Area (NSA), Murthly Castle Garden and Designated Landscape (GDL), The Hermitage GDL, Dunkeld House GDL, Tay forest park, Dunkeld Conservation Area, and the Birnam Conservation Area. There is potential for the proposed scheme to result in adverse impacts to the local community, with the consultation process raising concerns arounds loss of woodland (resulting in loss of biodiversity), risk of windthrow for the remaining woodland, loss of screening vegetation, encroachment of the proposed scheme on the footprint of existing gardens, and effects on the River Tay NSA area's beauty and tourism. All of these impacts would likely reduce the quality of the surrounding landscape (although some of it would be temporary due to construction), which could ultimately reduce the benefits to both local communities and people visiting. Key, temporary impacts from construction that are likely to negatively impact landscape include the removal of roadside woodland and scrub, an increase in machinery (excavators and plant) and haulage routes, additional exposed bare earth, structures, earthworks and road surfacing works, temporary soil storage and stockpiles of construction material, and lighting associated with nighttime working and site accommodation. The most significant adverse impacts are expected where major structures and junctions and associated earthworks are being constructed. Key operational impacts that are likely to have more permanent negative impacts on landscape include the operation of the additional carriageways, junctions, and side roads, the addition of associated infrastructure (signage, cameras, barriers, fencing, lighting etc.), a change in the perception of landscape character or landscape/townscape, loss of woodland, alteration of vegetation patterns and field patterns due to tree loss, changes appearance of landform along the road corridor, presence of new bridge structures, and increased visual influence of traffic on the surrounding landscape. In addition, it is anticipated the proposed scheme will have a visual impact, with up to 73 buildings and 35 outdoor locations impacted during construction, and during operation, initially 43 buildings and 35 outdoor locations impacts, reducing to three buildings and five outdoor locations impacts after 15 years (due to the establishment of vegetation planted). All of these impacts influence the natural beauty of the area, which many people in the local community and visitors will benefit from. There are mitigation measures planned as part of the proposed scheme. These include earthworks proposals that minimise the impact of cutting and embankment slopes, the incorporation of Sustainable Urban Drainage Systems (SUDS), returning compensatory flood storage areas to former land cover (where appropriate), use of earth bunding to provide noise barriers, use of natural stone cladding etc. on structures, retaining existing and woodland where possible and planting to replace trees lost, use of native species to enhance biodiversity, and grass and wildflower seeding. All of these measures would minimise the negative impacts on the scheme, and where enhancements to the natural environment are included (e.g., woodland planting, wildflower planting etc.) this would have natural capital benefits for the local community and visitors. In addition, some of these mitigation measures may support additional ecosystem services, for example the planting of native species may support pollinators, and woodland planting may support flood regulation, air pollutant removal, and carbon sequestration and storage. Overall, the landscape and visual assessments concluded there would be some significant (large) impacts to landscape on the year of opening, specifically on the	→

Ecosystem service	Narrative	Score
	Strath Tay: Lower Glen Local Landscape Character Area. This would reduce following establishment of replacement planting; however, this is still considered significant (moderate). In other areas, the initial impacts are likely to be moderate, however following the establishment of planting, these would reduce to not significant. It is therefore concluded that from a natural capital perspective, there is likely to be limited ecosystem service impact. Whilst some of the proposed mitigation measures may have positive impacts to the local community and visitors, there would likely be negative impacts during construction and until any vegetation planted is established.	
Recreation	The proposed scheme is not expected to have any tangible impacts on the amenity of any green spaces dedicated to outdoor recreation. However, there are various path creation and enhancement measures planned as part of the proposed scheme, some of which are anticipated to have a tangible, positive impact on the recreational experience of walkers, wheelers, cyclists, and horse-riders (referred to as WCH) of two 'Outdoor Access Areas' (OAAs) (as defined within the DMRB Stage 3 EIAR Chapter 17 (Population – Accessibility)). The relevant path creation and enhancement measures are shown in APPENDIX B. In summary, the path enhancement and creation measures in Appendices B1 and B2 should improve accessibility to the Hermitage from Dunkeld for WCH and create a new circular route with enhanced accessibility around the River Braan (Inver) OAA. Meanwhile the creation of the new path shown in Appendix B3 should connect up two popular routes for walkers, the Ring Wood area and the Murthly Riverside Path, creating a single, cohesive route along the banks of the Tay. This could potentially notably improve the River Tay Way walking route.	↑↑
Volunteering	Environmental volunteering offers a variety of personal and social benefits, including physical activity, social connections, skill development, and preparation for employment. Additionally, collecting data on volunteer involvement and highlighting the positive impact of volunteer opportunities can be instrumental in securing financial support from donors. The proposed scheme has the potential to support volunteering hours for local environmental groups to increase their outreach. These groups carry out activities such as ecological surveys and tree planting. If this were to be supported, a potential moderate positive ecosystem service impact is anticipated for the proposed scheme.	↑

5.1.2 As per Table 4-1, where sufficient data was available to support assessment, ecosystem service impacts have been quantified (in biophysical terms) and monetised.

6. Quantitative and monetary assessment

6.1.1 The appraisal of the impacts on ecosystem service benefit aligns with the recommendations and principles set out in the HM Treasury Green Book (HM Treasury, 2024). For the appraisal of impacts on natural capital (see Appendix A1. 'Non-market Valuation and Unmonetisable Values' of the Green Book), the Green Book sets out various recommendations but principally points towards Defra's ENCA guidance (Defra, 2023) as supplementary, best practice guidance on this matter. The methods and evidence deployed for the assessment of each ecosystem service, detailed in the subsections below, were hence primarily aligned with those in the ENCA Services Databook.

6.1.2 All ecosystem service benefits were calculated as a 'present value' (PV) over both a 60-year and 100-year appraisal period, which encompass both the construction and operational phases of the proposed scheme. The former appraisal period aligns with that used across the other appraisals for the proposed scheme (for example, the traffic and transport appraisal) to ensure that the values calculated can be integrated into assessment of the wider scheme benefits. The 100-year appraisal period is in alignment with HM Treasury Green Book guidance on the period over which benefits should be calculated concerning interventions anticipated to have long-term effects, particularly when these are significant, environmental effects. Hence, both appraisal periods were used. The calculation of benefits as a present value is also particularly important for ecosystem service benefits given the prevalence of non-linear effects over time. These were accounted for within the calculations where possible and are discussed further below, e.g. Time to Reach Target Condition (TTRTC).

6.1.3 Note that standard HM Treasury Green Book principles for valuation were followed throughout the assessment process. This includes the discounting of benefits using the social (3.5% starting) discount rate and ensuring that all values were uplifted to and presented in 2025 prices using the latest Government GDP deflator (HM Treasury, 2025). It should be noted, however, that air pollutant removal values were discounted using the lower (1.5% starting) discount rate for health and life values, as recommended by the ENCA guidance and the HM Treasury Green Book. This is because the benefits associated with these values are directly derived from improvements to public health. The HM Treasury Green Book states the following: "*The recommended discount rate for risk to health and life values is 1.5%. This is because the 'wealth effect', is excluded. The diminishing marginal utility associated with higher incomes does not apply as the welfare or utility associated with additional years of life will not decline as real incomes rise*".

6.1.4 In addition to the presentation of values as a 100-year present value, benefits are also presented as a series of 'snapshot' values at different points over the proposed scheme lifespan. These are the benefits (in present value terms) obtained at 10, 15, 25, 50, and 100 years from the beginning of the appraisal period, which is the start of construction, assumed as 2029. The snapshot values presented supplement the 100-year present value benefits presented by providing further detail and helping to identify 'tipping points' within the profile

of benefits over time e.g., when benefits turn to disbenefits, or vice versa. Note that, as the snapshot values are also in present value terms, they are also subject to discounting. Hence, it is often the case that snapshot values later in the appraisal period are smaller.

6.1.5 Sensitivity analysis has been undertaken for the quantification and/or valuation of each ecosystem service, presenting calculations using lower-bound (conservative), central and upper-bound (more optimistic) data on the ecosystem service benefits provided by the natural environment to present outcomes for three, corresponding scenarios (where the availability of data/evidence permits). Further detail is provided in the individual methodologies below on the specifics of the sensitivity analysis undertaken, which is based on ranges in either the biophysical or monetary data employed, depending on where the most significant level of uncertainty is perceived to have resulted from.

6.1.6 Consideration was also given to how new habitats would change over the lifetime of the proposed scheme as part of the calculation of ecosystem service benefits. To attempt to account for the inherent uncertainty and risk of failure of habitat creation or enhancement, the difficulty multipliers set out in the SBMT were applied to both 'created' and 'enhanced' habitat parcels. These pre-defined multipliers reflect the difficulty of habitat creation or enhancement and, within the SBMT, reduce biodiversity scores accordingly. The risk multipliers associated with individual habitat parcels (either created or enhanced under the post-development scenario) have been applied to the ecosystem service benefits associated with these parcels to reflect the likelihood of newly created or enhanced habitats failing. For example, the creation of lowland mixed deciduous woodland is of 'high' technical difficulty within the SBMT, which relates to a 0.33 penalty multiplier i.e. an assumed failure of 67%, with benefits reduced accordingly. This is in line with the precautionary principle and what is assumed to be a proportionately conservative approach to the estimation of benefits. Note that of the various habitat types represented in the habitats 'created', only two are subject to a reduction factor: Lowland mixed deciduous woodland (as aforementioned) and other inland rock and scree, subject to a 0.67 risk multiplier. This is because all other habitats created are of 'Low' difficulty to create and thus subject to a risk multiplier of 1 (i.e. no reduction).

6.1.7 In addition to delivery risks, efforts were made to account for how the ability of natural capital assets to provide ecosystem services changes over time. For example, when first planted, newly created woodland habitat will have a lower carbon sequestration rate which quickly increases as the habitat matures. To factor this in, the assessment considered the TTRTC of newly created habitats. This refers to the time for new habitats to mature and thus to reach their full potential to deliver ecosystem services. As per the risk multiplier, for all created and enhanced habitat parcels, the SBMT provides a standard TTRTC. Starting from zero at the year of creation, a linear increase in the ecosystem service benefits delivered from the relevant habitat parcels to the TTRTC was assumed. This is a notable simplification as the relationship is often non-linear, however, in most instances this was deemed a proportionate approach to account for such effects. Where additional analysis was undertaken to account for non-linearity, this is detailed within the individual ecosystem service methodologies.

6.1.8 As well the staggering of benefits to account for TTRTC, it should be noted that zero benefits from enhanced/created habitats were assumed until the end of the construction. The construction phase for individual habitat parcels was aligned with those in the SBMT calculation, supplementary to the biodiversity assessment in the DMRB Stage 3 EIAR Chapter

12 (Biodiversity): it is assumed that there will be a five-year delay in creation for woodland and a four-year delay in creation of other habitats. Benefits from proposed scheme enhancements such as access improvements and corresponding recreation benefits (see Section 6.9 for further details) were also not assumed until the operational phase (starting 2033).

6.1.9 The sections below detail the methods used to assess the individual ecosystem services assessed in quantitative and/or monetary terms, followed by the results.

6.2 Food production

6.2.1 The proposed scheme will result in a loss of approximately 4.7 hectares of agricultural land. Since this provisioning ecosystem service provides significant benefits to society through food production, it is important to capture the impacts of the proposed scheme on this service in the assessment.

6.2.2 Following Scottish Government and the Enabling a Natural Capital Approach (ENCA) guidance (Defra, 2023), the impacts to food production were assessed using the average annual farm rent values. These values represent the average rent values tenant farmers pay for different farm types, and are taken from the Agricultural Survey Results: December 2019 (Scottish Government, 2020). These values are typically used as they are representative of the natural asset's (i.e. the farmland) contribution to the ecosystem service, with other forms of capital input deducted. The results are based on data from larger agricultural holdings together with estimates for smaller farms and indicate the contribution of the land to agricultural output.

6.2.3 The assessment utilizes average annual farmland rents for the 2019/20 period, measured per unit area across various farm types, regions, and classifications such as Less Favoured Areas (LFA) and Non-LFA. The data is presented in terms of median, quartile, and decile rents per hectare, categorized accordingly. Of the habitats present across the study area, cereal cropping, general cropping, and LFA grazing livestock land (cattle and sheep) (note that data from the Scottish Government confirmed that the habitats across the study area are classified as a Less Favored Area) are applicable to the assessment. The central value (£/ha) for each type of agricultural use relevant to the assessment was as follows (presented in 2025 prices):

- Cereal cropping: £159.64/ha
- General cropping: £176.85/ha
- Cattle and Sheep (LFA): £60.66/ha

6.2.4 These values were then mapped to relevant habitat types either retained or created as part of the proposed scheme and multiplied by the respective areas of habitat, also taking into account any losses from the baseline. Cereal cropping values were applied to cereal crop habitat, general cropping to temporary grass and clover leys and non-cereal crops, and cattle and sheep (LFA) to modified grassland.

6.2.5 Sensitivity analysis was applied to the results by using the range of average farm rent values available. Upper and lower bound rent estimates are presented within the agricultural survey for each farm type. This enabled a low, central and high estimate of farm rent to be applied, with the Central estimate calculated using an average of the upper and lower bound rents.

6.2.6 The present value over different appraisal periods (60yr and 100yr) for the low, central, and high estimates are presented in Table 6-1 below. Table 6-2 shows that losses are expected to decrease (become less negative) over the appraisal period. This is likely due to a combination of successfully created habitat reaching target conditions and the effect of discounting.

Table 6-1 PV (£) for food production

Estimate	60yr	100yr
Central	- 29,354	- 34,276
Lower	- 20,817	- 24,497
Upper	- 35,777	- 41,485

Table 6-2 Snapshot monetary values (£) for food production at different years

Estimate	10	15	25	50	100
Central	- 716	- 603	- 428	- 230	- 86
Lower	- 536	- 451	- 320	- 172	- 64
Upper	- 831	- 700	- 496	- 267	- 99

6.3 Timber production

6.3.1 To calculate the value of timber production, it was first necessary to explore the Scottish Forestry Felling Permissions and Licences (Scottish Forestry, 2025) to identify any areas with active licences within the DMRB Stage 3 Design Fix boundary. Two areas were identified within the boundary. Two areas were identified as having active felling licences. These areas provide an ecosystem service value which the proposed scheme will potentially have an impact on, if timber production were to be stopped.

6.3.2 The first area within the DMRB Stage 3 Design Fix boundary is the Dalpowie plantation, located between chainages 400 and 1200. It is understood that in this area, the estate managing the timber plantation will have felled all relevant areas prior to the proposed scheme being constructed, and any future restocking will not be used for timber production. It is therefore assumed that this area would have been taken out for forestry production prior to the proposed scheme and therefore any impacts on this area have not been take into consideration in the assessment.

6.3.3 A second area with an active felling licence is located to the south of the proposed scheme (Muir of Thorn and Gelly Wood) and is currently identified as an area for mitigation planting as part of the proposed scheme. Given this area would be planted as mitigation, an assumption has been made that this would no longer be felled for timber, therefore the benefits would be reduced/lost. Due to current uncertainties around how much of this area will be require for mitigation, a low, central, and high estimate has been calculated, to account for the fact some felling may still occur once the proposed scheme is completed. The low estimate assumes 50% of the current volume felled would be lost, the central estimate assumes 75% of the current volume felled would be lost, and the high estimate assumes all woodland in this area would be required for mitigation and the total area will no longer be

felled. It should be noted that the licence in this area is currently in place from 2023-2025, and there are also uncertainties around whether felling would continue at this site. The results presented below should therefore be used with caution, noting the various uncertainties.

6.3.4 Using the Scottish Forestry Felling Permissions and Licences data, it was possible to obtain the felling volume (m^3) for the active licences in the area to the south of the scheme. One of the licence areas included an area of woodland that does not sit within the DMRB Stage 3 Design Fix boundary, and it was therefore necessary to calculate a revised felling volume estimate. Based on the areas of woodland, 25% of the volume listed was included in the calculation. Additionally, it was assumed that the volumes presented in the felling permissions and licences are for the duration of the licence. Given the licence for this area is listed as being active from 2023-25 (2 years), the volume was halved, to represent a yearly volume.

6.3.5 To calculate the value of timber production, the Coniferous Standing Sales Price (Scottish Forestry, 2025) was used. A 5-year average (2020-2024) was taken to allow for fluctuations over each year (£37.83/m^3 when adjusted to 2025 prices). Using the volume of timber as taken from the active licences, and the standing sales price, the present value for timber production has been estimated. It was assumed that the timber production service is not lost until the end of the construction period, so for the first five years, the volume of timber production is recorded as zero. This is because the value of any timber production is not as a result of the proposed scheme, therefore the benefit of this cannot be claimed.

6.3.6 The values presented in Table 6-3 below show there is likely to be a significant loss in the value of timber production as a result of the proposed scheme. This is due to areas currently with active felling licences expected to be taken out of production to enable mitigation planting for the scheme to take place. The losses decrease over time; however, this is likely a result of the discounting applied, as it not assumed any new woodland created would have any timber production benefits.

Table 6-3 PV (£) for Timber production

Estimate	60yr	100yr
Central	- 1,418,387	- 1,733,871
Lower	- 945,591	- 1,155,914
Upper	- 1,891,182	- 2,311,828

Table 6-4 Snapshot monetary values (£) for timber production at different years

Estimate	10	15	25	50	100
Central	- 45,922	- 38,665	- 27,410	- 14,776	- 5,483
Lower	- 30,615	- 25,777	- 18,274	- 9,851	- 3,655
Upper	- 61,229	- 51,553	- 36,547	- 19,702	- 7,311

6.4 Air pollutant removal

6.4.1 Various habitats provide air quality regulation benefits by removing air pollutants. To quantify the change in air pollutant removal, the method set out in ENCA's Services Databook has been followed. The change in the stocks of natural capital providing air quality regulation benefits within the proposed scheme has been quantified. Additionally, the amounts of air pollutants removed by different types of vegetation were calculated as average physical flows (tonnes) of ammonia, nitrogen dioxide, ozone, sulphur dioxide and inhalable particulate matter (PM10) over a 10-year period (2013-2023).

6.4.2 When valuing air pollutant removal, it is important to consider the wider context and demand for the ecosystem service, such as baseline air quality. It can generally be considered that baseline air quality is likely to be poorer in urban areas than rural areas. The entire proposed scheme is located within a rural area as classified by the Scottish Government Urban Rural Classification 2022 (Scottish Government , 2024a).

6.4.3 To monetise impacts associated with this service, the Office for National Statistics (ONS) UK Natural Capital Accounts: 2024 (Office for National Statistics, 2024) annual values for air pollution removal per unit area for different habitat types in Scotland were applied to relevant habitats within the proposed scheme. Values were mapped to the habitats present on a best-fit basis. Supplementary data to inform the valuation of benefits provided by coniferous and broadleaf woodland was sourced from Scotland's Environment (Scotland's Environment, 2014).

6.4.4 Values not defined by the ONS for "mixed woodland" habitats were calculated by taking an average of broadleaf and coniferous woodland values and for "scrub" habitats an average value was generated using broadleaf woodland, coniferous woodland and semi-natural grassland was used. Other limitations include the use of broad habitat values to define distinct habitats which could both over and underestimate the capacity of the habitat to remove air pollutants. The values used for the assessment are presented in Table 6-5 below (all in 2025 prices).

Table 6-5. Unit values for each habitat type to assess air pollutant removal

Habitat	Low (£/ha)	Central (£/ha)	High (£/ha)
BROADLEAF WOODLAND	£13.23	£14.04	£14.84
CONIFEROUS WOODLAND	£46.72	£49.57	£52.41
MIXED WOODLAND	£29.98	£31.80	£33.63
ENCLOSED FARMLAND	£7.25	£7.69	£8.13
FRESHWATER, WETLANDS, AND FLOODPLAINS	£1.73	£1.84	£1.94
MOUNTAINS, MOORLAND, AND HEATH	£2.21	£2.35	£2.48

Habitat	Low (£/ha)	Central (£/ha)	High (£/ha)
SEMI-NATURAL GRASSLAND	£2.80	£2.97	£3.14
SCRUB	£20.92	£22.19	£23.46
URBAN GRASSLAND	£26.91	£28.55	£30.19
URBAN TREES	£1,164.61	£1,235.52	£1,306.43
COASTAL MARGINS	£0.53	£0.57	£0.60

6.4.5 The ability for vegetation to reduce pollutants is expected to decline over time due to long-term trends in background pollution. The ONS previously stated that the value of air pollution removal over time is projected to fall by 2030, reflecting baseline declines in background pollution. In the original Jones et al (2017) study (Jones, et al., 2017), values for 2030 were around 50% lower than 2015 estimates. However, upon review by the ONS of the ratio of asset value to 2020 values, the decline in unit values over time is much more muted than anticipated.

6.4.6 Accordingly, sensitivity analysis was undertaken by comparing the ONS 2013 to 2023 10-year average of all air pollutant removal flows in tonnes per hectare for Perth and Kinross Council (where the proposed scheme is located) against values for the rest of Scotland. The results showed that per hectare, habitats within Perth and Kinross Council removed 6% less air pollutants when compared with the rest of Scotland. This is likely due to the council area covering a primarily rural setting, thus providing less of an air pollutant removal benefit due to low existing background air pollution levels. The sensitivity analysis was derived as follows:

- Lower: 6% reduction in benefit over the appraisal periods.
- Central: No reduction in benefit over the appraisal periods.

6.4.7 Upper: 6% gain in benefit over the appraisal periods. Table 6-6 shows that the air pollutant removal ecosystem service is expected to decrease as a result of the proposed scheme, representing a disbenefit. This conclusion is consistent across the Central, Low and High sensitivity analysis estimates. Sensitivity estimates are based on different benefit reduction factors employed reflecting different scenarios of background pollution levels.

Table 6-6 PV (£) for air pollutant removal

Estimate	60yr	100yr
Central	- 68,654	- 93,003
Lower	- 64,714	- 87,665
Upper	- 72,594	- 98,341

6.4.8 The disbenefit observed is mostly due to the loss of baseline woodland habitat anticipated with the construction of the proposed scheme. The rural location of the scheme has lessened the impact of the loss as the levels of background air pollution are lower than more urban areas.

6.4.9 The change in air pollutant removal values over time across Central, Low and High sensitivity analysis estimates are presented in Table 6-7, showing that disbenefits are expected to decrease (become less negative) over the appraisal period. This decrease over time is likely due to successfully created habitat reaching target conditions, especially the created woodland and grassland habitats. However, though the value of air pollutant removal services improves over time with the maturation of newly planted woodland and grassland habitat, it is not enough to offset the expected losses in baseline woodland habitat, thus the values remain negative. The decrease in disbenefits over time is also partly attributable to the air pollution reduction effect declining due to long term trends in background pollution, coupled with the effect of applying an economic discount rate.

Table 6-7 Snapshot monetary values (£) for air pollutant removal at different years

Estimate	10	15	25	50	100
Central	- 1,419	- 1,219	- 1,048	- 801	- 522
Lower	- 1,337	- 1,149	- 988	- 755	- 492
Upper	- 1,500	- 1,289	- 1,108	- 847	- 552

6.4.10 Biophysical values have been calculated for this ecosystem service as discussed. It was deemed not proportionate to break down the air pollutant removal flows for each pollutant due to the rural setting of the proposed scheme, hence the flows are presented for all pollutants combined. The values highlight that the proposed scheme will have a long-term negative impact on air pollutant removal in the area due to habitat changes.

Table 6-8 Cumulative air pollutant removal flows - All pollutants (based on 10 year average 2013-2023) (tonnes)

Estimate	60yr	100yr
Central	-158	-250
Lower	-149	-235
Upper	-168	-265

Table 6-9 Air pollutant removal flows - All pollutants (based on 10 year average 2013-2023) (tonnes) at different years

Estimate	10	15	25	50	100
Central	-3	-2	-2	-2	-2
Lower	-3	-2	-2	-2	-2
Upper	-3	-2	-2	-2	-2

6.5 Carbon reduction

6.5.1 The quantitative and valuation approaches for carbon storage have been based on the land use changes associated with the proposed scheme. This approach aligns with the approach taken to calculate the change in carbon stocks within Chapter 20 (Climate) of the DMRB Stage 3 EIAR. However, as the assessment also includes the impacts on carbon stocks, the assessment within the NCA should not be considered additional to that within the Climate chapter, i.e., carbon stocks are double-counted between the two assessments. As such, when considering the Whole Life Carbon (WLC) impacts of the scheme, figures from both assessments should not be included.

6.5.2 Carbon storage factors (tC/ha) have been identified for habitat types based on the habitats relevant to land use changes associated with the proposed scheme as detailed in Chapter 10 (Landscape) of the DMRB Stage 3 EIAR. The carbon storage factors used were based on the database compiled by Natural England (Gregg, et al., 2021) as this is the most recent database of carbon storage factors and is recommended by ENCA guidance (Defra, 2023). Each land use type was assigned a vegetation and soil carbon density value. Proposed seeding areas were assigned carbon stocks values for neutral grassland for proposed areas of grassland and carbon stocks values for arable/cultivated land were used for proposed areas agricultural land. Proposed planting and woodland areas used the woodland stocks carbon value, specifically 100-year mixed native broadleaved woodland on mineral soil (to 1m).

6.5.3 Risk multipliers derived from the Statutory Biodiversity Metric (Defra, 2023) were assigned to the proposed seeding areas, planting areas and woodland areas to reflect the likelihood of newly created or enhanced habitats failing.

6.5.4 Land use change calculations took into consideration the greenhouse gas emissions produced from vegetation loss and soil disturbance during the construction phase and potential changes in soil carbon during the operational phase. Carbon stored in tonnes was converted to tonnes

of CO_2e using a greenhouse gas equivalencies calculator. This was to align with Central Government carbon values (see below), which are provided on a £ per tCO_2e basis.

6.5.5 Within the construction area, it was assumed that 100% of vegetation carbon would be lost due to clearance and 25% of the soil carbon would be lost due to disturbance. For the operational phase emissions, the remaining soil carbon for each land use type was calculated as 75% remaining after construction.

6.5.6 The difference was calculated between the baseline land use soil carbon remaining after construction and the soil carbon of the proposed (post-development) land use for each parcel. If the proposed land use had a lower soil carbon density than the baseline land use after accounting for construction effects, it was assumed that this change in soil carbon would be lost. This process occurs quickly so it was assumed 100% of the change in soil carbon was lost during the first year of the operational phase across both appraisal periods.

6.5.7 If the proposed land use had a greater soil carbon density than the baseline land use after accounting for construction effects, the change in soil carbon between the land uses would gradually be replenished during the operational phase. As per the methodology in Chapter 20 (Climate) of the DMRB Stage 3 EIAR, 50% of this change in soil carbon was allowed for during the operational phase over the 60-year appraisal period. For the 100-year appraisal period, which also assessed as part of this NCA, an 83% replenishment of soil carbon was allowed for during the operational phase to align with the assumptions made in Chapter 20 (Climate) of the DMRB Stage 3 EIAR. This assumes this process is time-intensive and thus the potential benefits are scaled to account for this.

6.5.8 Monetary values for application to the tonnes of carbon (CO_2e) emitted and/or sequestered across the appraisal period were drawn from the Government's most recent carbon values for use in policy appraisal and evaluation (Department for Energy Security and Net Zero (DESNZ) and Department for Business Energy & Industrial Strategy (BEIS), 2021). This approach aligns with the methods set out in the Green Book and supplementary guidance (HM Treasury, 2024). The lower and upper carbon values were considered alongside central values for the purpose of sensitivity analysis.

6.5.9 As discussed, the above methodology aligns with the approach taken to the calculation of carbon stocks within Chapter 20 (Climate) of the DMRB Stage 3 EIAR. A limitation of this approach is recognised in that there is likely a minor inflation of the carbon losses. This is because soil carbon losses during construction (25% due to disturbance) are assumed also to apply to parcels of woodland which are being retained, within the model. Whilst a fraction of this carbon is restored during the operational phase (50% or 83%, as above, depending on the length of the appraisal period), there is some loss associated with these parcels, which are potentially undisturbed in reality.

6.5.10 The approach to the calculation of carbon reduction benefits across the operational phase associated with parcels moving from a land use with a lower soil carbon density to a higher soil carbon density under the post-development scenario is relatively simplistic. To account for the fact that this flux (draw down) of carbon occurs over time when a land use change results in a habitat change, a reduction factor is applied (50% or 83%, as above). The limitations of this approach are explained further below:

- Firstly, this represents a simplification of the temporal changes in the carbon sequestration potential of newly created habitats. Further work is required to understand how well this would represent the cumulative volume of carbon sequestered by a given habitat over time. There is a possibility that this approach could underestimate the carbon benefits of these parcels. For example, the Woodland Carbon Code (WCC) (Woodland Carbon Code, 2025) states that carbon sequestration in trees typically peaks between years 16 and 25 of a tree's life. Thus, to only claim 50% of the difference in carbon stocks over a 60 year period could represent a significant underestimate.

- Secondly, sequestration (as opposed to emission) fluxes are only accounted for via the difference in the soil carbon stocks from baseline to the post-development (proposed land use) scenario, excluding vegetation. This again could represent a significant underestimate of the sequestration potential of any proposed land use, particularly for parcels moving to a land use with considerable biomass, such as woodland. However, further work would be required to confirm this.

- Finally, to monetise the carbon benefits, it was necessary to map this over time. The 50% and 83% reduction factors for gains in carbon stocks, however, were applied to align with the DMRB Stage 3 EIAR assessment of carbon stocks, to account for the fact that these gains are accrued over time. As a result of the application of economic discounting during the monetisation of benefits, it is possible that the monetary benefits are underestimated due to the potential, conceptual overlap between these negative multipliers (the reduction factors and discounting) and thus the potential 'doubling up' of temporal penalties.

6.5.11 Whilst the further work would be required to understand exactly how the above limitations have affected the total carbon reduction benefits, it is assumed that the results of this method may overestimate the potential adverse effect and underestimate the potential beneficial effect, providing a conservative outcome. This, however, is in line with a precautionary approach.

6.5.12 As show in Table 6-10, an overall loss is anticipated for carbon stocks due to the assumed total vegetation clearance at the construction phase, the initial decrease in woodland habitat and the time taken for replacement habitat to recover carbon stocks losses. Initial clearance of vegetation carbon and soil carbon disturbance during the construction phase accounts for the greatest loss.

Table 6-10 PV (£) for carbon stocks

Estimate	60yr	100yr
Central	- 10,593,603	- 10,404,425
Lower	- 5,296,802	- 5,202,212
Upper	- 15,890,405	- 15,606,637

6.5.13 As shown in Table 6-11, after the initial losses of carbon stocks during the construction and operational phases, the carbon stocks show a benefit and a year-on-year increase as snapshot monetary values. This is because the losses of carbon stocks are accounted for as initial,

blanket losses during construction year one (2029) as a result of vegetation clearance and soil carbon disturbance, and in operational year one (2033) when the soil carbon changes associated with land use changes are considered. As discussed above, carbon stocks are not assumed to remain static over time as carbon sequestration rates vary over a habitat's lifecycle. These gains in carbon stocks throughout the remainder of the appraisal period are not great enough to recuperate the overall losses at the start of the construction and operational phases.

Table 6-11 Snapshot monetary values (£) for carbon stocks at different years

Estimate	10	15	25	50	100
Central	9,740	8,839	7,272	5,688	4,443
Lower	4,870	4,419	3,636	2,844	2,222
Upper	14,610	13,258	10,908	8,532	6,665

6.5.14 The biophysical flows for carbon stocks are presented in tCO_2e and show an overall loss of carbon stocks over the appraisal period, illustrated in Table 6-12, and Figure 6-1. The initial construction phase loss in 2029 is assumed to be static until the initial operational phase loss in 2033 associated with land use changes. During the remainder of the appraisal period the soil carbon stocks gradually recover as habitats mature, as discussed, these gains are not great enough to account for the overall losses at the start of the construction and operational phases.

Table 6-12 Cumulative carbon stock flux (tCO_2e)

Estimate	60yr	100yr
Central	-32,071	-30,609

Table 6-13 Net carbon stock flux (tCO_2e) at different years

Estimate	10	15	25	50	100
Central	-33,897	-33,715	-33,349	-32,436	-30,609

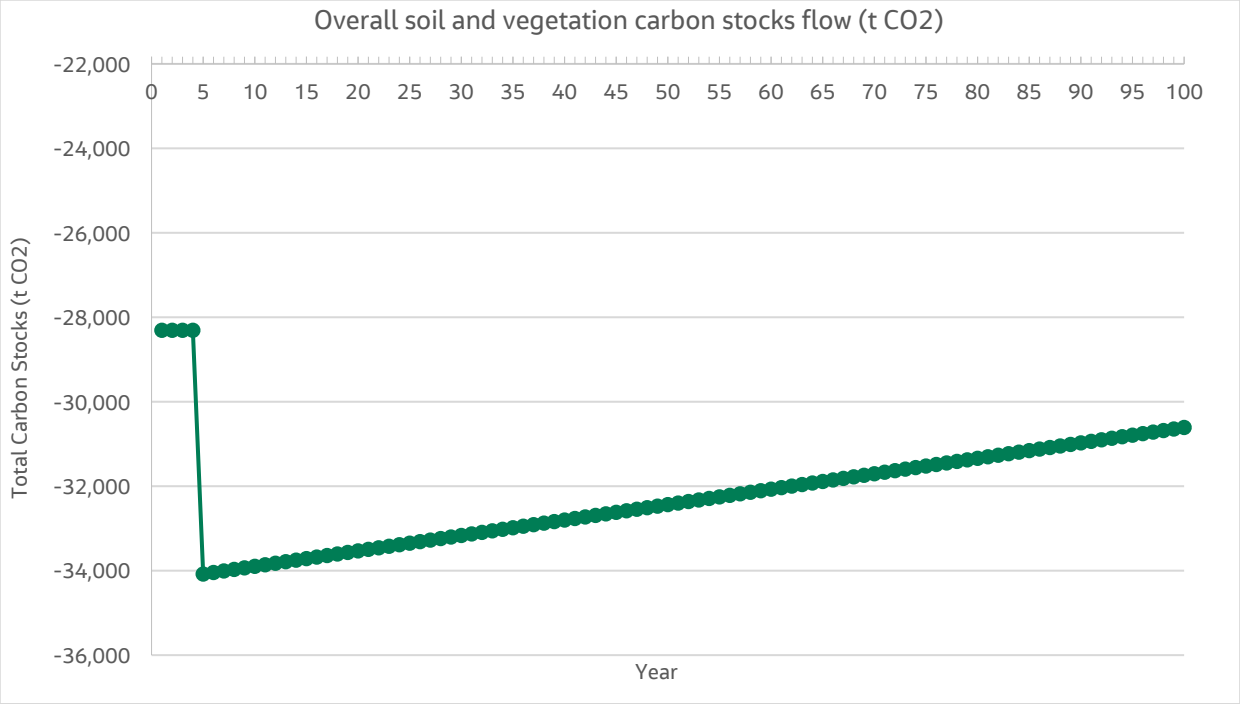

Figure 6-1: Graph showing the overall flow of carbon stocks (soil and vegetation carbon) over the 100-year appraisal period. The initial construction phase loss in 2029 is assumed to be static until the initial operational phase loss in 2033 associated with land use changes. Post-2033, the soil carbon stocks gradually recover as habitats mature during the remainder of the appraisal period.

6.6 Flood regulation

6.6.1 Flood regulation refers to the capacity of habitats to store flood waters, thus providing a societal benefit in reducing flood risk. Given that the River Tay is within close proximity to the scheme, local habitats may have a role in regulating flow pathways and flood risk.

6.6.2 Flood regulation has been quantified based on a value transfer approach for the change of stocks which support the storage of flood waters within the boundary of the proposed scheme. This method is based on the Joint UK Land Environmental Simulator (JULES) model approach developed by Forest Research in 2018 (Broadmeadow, S., Thomas, H., Nisbet, T.,Valatin, G., 2018) and built upon by further work, carried out by Broadmeadow (Broadmeadow, et al., 2023) and Fitch et al. (Jones, Fletcher, Fitch, & Morton, 2022). This approach is not based on the Flood Hazard Research Centre's Multi-coloured Manual and is an approximation based on habitat type only.

6.6.3 The hydraulic modelling carried out for infrastructure schemes is typically focused on the impacts of the engineered works and most often excludes the impacts on the flood water storage capacity of habitats, which are thus considered within this NCA. A higher-level approach has been taken in the assessment, estimating the flood regulation benefits based on average storage capacities per unit habitat area derived from national scale datasets. The equivalent monetary value is determined based on the replacement-cost approach, applying annualised average capital and operating costs of equivalent flood reservoir storage that would be required in the absence of the ecosystem service. It is recognised that a key

limitation of this approach is that it does not account for the spatial aspect of flood risk i.e., whether any 'at risk' receptors do, in reality, benefit from this storage capacity via a reduced risk. However, the applied 'average' flood storage benefits are designed to account for this limitation and are therefore conservatively estimated.

6.6.4 The annual flood regulation values per unit area for different habitat types from the aforementioned references were assigned to relevant habitats within the NCA boundary. This was done on a best-fit basis. These values were multiplied by the area of the relevant habitats to calculate the annual benefit. Upper and lower replacement costs were considered alongside central values for sensitivity analysis.

6.6.5 Values for grass, shrubland and other woodland habitats (broadleaf and conifer) were taken from Fitch et al. (2022), however the value for trees outside woodland was taken from Broadmeadow et al. (2023). This research presents low, central and upper replacement cost values for the habitat. The differences between these values were converted to multipliers and used to extrapolate lower and upper-bound replacement cost estimates for the other habitats that contribute to flood regulation. Replacement costs in this case represent the average capital and operation costs of flood storage that would be required in the absence of the ecosystem service. The unit values used for each habitat type are as follows (all in 2025 prices):

- Inland wetland: £888.44/ha/yr
- Broadleaved woodland: £312.64/ha/yr
- Coniferous woodland: £382.68/ha/yr
- Mixed woodland: £347.66/ha/yr
- Grass: £149.59/ha/yr
- Shrubland (heather): £149.25/ha/yr

6.6.6 This approach was necessary due to the absence of Central, Low, or High estimates for sensitivity analysis in the studies; Economic Assessment of Freshwater, Wetland and Floodplain Ecosystem Service (Morris, J. and Camino, M, 2011) and Fitch et al. (Jones, Fletcher, Fitch, & Morton, 2022)

6.6.7 The discussed method uses the latest estimates of flood storage volumes by habitat to evaluate the value of this service. The sources of these values are indicated within the ENCA guidance (Defra, 2023).

6.6.8 Table 6-14 presents the present values over different appraisal periods and shows that flood regulation services provided by habitats are expected decrease as a result of the proposed scheme, representing a disbenefit. The loss in coniferous woodland habitats is a key factor in the results, as these habitats generate an annual flood regulation benefit per unit area over double that of grasslands (£382.68/ha/yr compared to £149.59/ha/yr, 2025 prices). This conclusion is consistent across the low, central and high sensitivity analysis estimates over 60yr and 100yr appraisal periods.

6.6.9 The change in flood regulation values over time for all three scenarios (low, central, and high) are presented in Table 6-15 showing that disbenefits are expected to decrease (become less negative) over the appraisal period. This is likely due to a combination of successfully created habitat reaching target conditions and the effect of discounting.

Table 6-14 PV (£) for flood regulation

Estimate	60yr	100yr
Central	- 394,120	- 449,862
Lower	- 78,284	- 88,880
Upper	- 934,300	- 1,058,044

Table 6-15 Snapshot monetary values (£) for flood regulation at different years

Estimate	10	15	25	50	100
Central	- 10,159.96	- 6,831.64	- 4,843.08	- 2,610.77	- 968.82
Lower	- 1,983.88	- 1,268.39	- 901.44	- 489.51	- 186.52
Upper	- 23,721.33	- 15,135.52	- 10,732.11	- 5,788.96	- 2,153.07

6.6.10 Biophysical values have also been calculated for this ecosystem service, calculating the change in flood water storage capacity associated with habitats as a result of the proposed scheme. The majority of the values have been calculated by taking the 10-year average flood storage volume for various woodland types relative to bare soil. The habitat 'mixed woodland' was determined by averaging the values of broadleaf and coniferous woodland. The results, shown in Table 6-16, highlight that the proposed scheme could adversely affect the capacity of the natural environment to support in flood water storage and the slowing of flows in the local area, due to losses in canopy interception and soil storage capacity. However, it is important to note that this assessment is based on average habitat values, and this has not taken into account the location of specific habitats.

Table 6-16 Cubic meters of flood water stored per hectare at different years

Estimate	10	15	25	50	100
Biophysical Values (m^3)	-25,609	-20,452	-20,452	-20,452	-20,452

6.7 Pollination

6.7.1 The habitats present around the road network can be of huge importance in supporting pollinator species, which play a vital role in supporting healthy ecosystems. Despite this importance, it is not possible to monetise pollination as an ecosystem service; instead, this has been quantified in the form of identifying the areas of different habitat which have the potential to support pollinators. A comparison has been made between the baseline and post-development scenarios for the proposed scheme.

6.7.2 The approach to assessing pollination utilises both an existing tool and is supplemented with citizen science data. To first understand broadly which habitat types are important to pollinators, the NATURE tool (v1.2) was used. This is a publicly available, excel spreadsheet-based tool that allows users to assess the impacts of land-use and management change on natural capital assets and ecosystem service provision. Built into this tool are a series of base scores that indicate which ecosystem services different habitat types typically provide, as well as an inbuilt metric defining relative provision of ecosystem services in comparison to other habitat types. Pollination is one of the ecosystem services considered in this tool and allows habitat types to be scored based on their potential to support pollinator species. The base scores from this tool were used as an indicator to demonstrate how well each habitat type provided this ecosystem service.

6.7.3 In addition to the NATURE tool scores and to further refine the assessment, data on pollinator host species and pollinating invertebrate species was obtained through the GBIF (Global Biodiversity Information Facility, 2025), which is a mixture of citizen science data uploaded by the public and specialists who have carried out detailed site surveys. The point data for each host species and pollinator species was filtered by only including records between 2013 and 2024. The host species and pollinator species used as indicators were informed by an ecology specialist. The selection of the host plant species was taken from the Centre of Ecology and Hydrology Flower Insect Time (FIT) count methodology, using 14 target flower species which are easily identifiable, and a standardised methodology for citizen science. The invertebrate pollinator species were selected following a literature review of the relative pollination services provided by different genus. The species are listed in Table 6-18.

6.7.4 There are several limitations to using citizen science data, including the accuracy and availability of the data. In the case of the proposed scheme, there were very few records of host species or pollinator species found within the scheme boundary. This therefore means the assessment is primarily based on the scores from the NATURE tool.

6.7.5 To combine the NATURE tool scores and the citizen science data, a methodology has been developed to score the host species and pollinator species. To avoid artificially displaying any areas where there is no host species or pollinator species data as being of low value to pollinators, the base scores were first multiplied by 10, extending the range of the scores. Scores were then assigned to each of the host and pollinator species, based on their relative importance at demonstrating high value habitat for pollinators. These scores are listed in Table 6-17 and Table 6-18. Where host or pollinator species were preset, the score was then added to the base score. A diagram of the methodology is also presented in Figure 6-2. The final scores were assigned a category from very low to very high value for pollinators.

Table 6-17.Pollinator host species scores

Host species	Score
Runnunculus	5
Lamium	5
Cratauegus	5
Rubus	2
Taraxacum	2

Host species	Score
Lavandula angustifolia	6
Heacleum sphondylium	5
Centaurea	5
Trifolium	4
Senecio	2
Calluna	6
Cirisium carduus	4
Buddleja	2
Hedera	2

Table 6-18. Pollinator species scores

Pollinator species	Score
Apis mellifera (honey bee)	10
Bombus sp (bumblebee species)	8
Solitary sp (solitary bee species)	7
Diptera (fly species)	6
Lepidoptera (butterfly and moth species)	5
Pollen coleoptera (pollen beetle species)	4
Vespidae sp (wasp species)	3

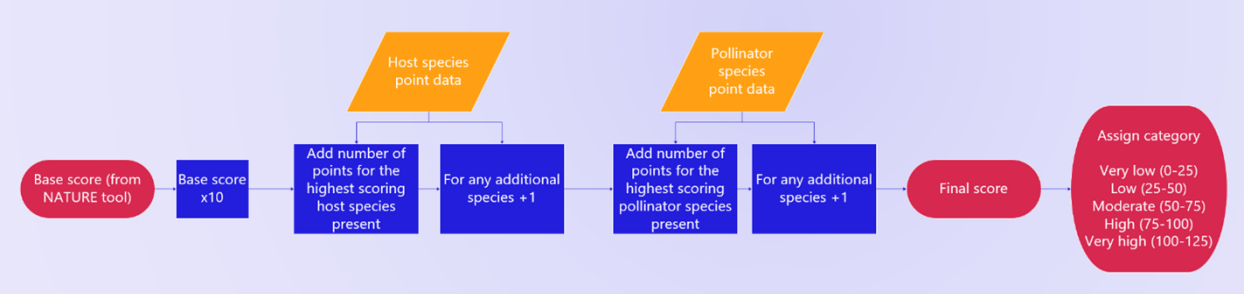

Figure 6-2 Pollination methodology

Table 6-19 below presents a summary of the areas of habitat that score very low to very high across the NCA boundary for both the baseline and post-development scenarios. These results show a generally positive change as a result of the proposed scheme, with a decrease in areas seen as very low and low, whilst there is an increase in moderate areas. This suggests several areas of habitat are becoming a higher category for pollinators. This is likely due to the increase in higher value habitats, such as mixed deciduous woodland and grassland, whilst there is a loss of habitats such as coniferous woodland, which scores low for supporting pollinators. There is a very small loss of some high scoring habitat, all of which is made up of

lowland and upland heathland. However the change is minimal, so there is likely to be limited impact to pollinators.

Table 6-19 Summary of habitat areas suitable to support pollinators

Category (potential to support pollinators)	Baseline area (ha)	Post-development area (ha)	Change
Very low	81.74	65.72	-16.01
Low	5.34	4.51	-0.84
Moderate	116.92	136.00	19.08
High	210.50	210.24	-0.26
Very high	0.00	0.00	0.00

6.8 Education

6.8.1 As an ecosystem service, education refers to the capacity for the natural environment to support learning and development, either through presenting new learning opportunities or through facilitating learning via nature's restorative effects.

6.8.2 Currently, the proposed scheme is not anticipated to have any tangible impact on education benefits provided by the natural environment. However, a specific opportunity has been identified, which if capitalised upon, the scheme may be able to claim some notable education benefit.

6.8.3 The area surrounding Dunkeld is currently frequently visited by geology enthusiasts, geology societies and universities in Scotland as a field trip destination to observe unique structural geology. There are dedicated excursions to Dunkeld and Little Glen Shee run by the Edinburgh Geological Society (Brown & Gillen, 2015), the British Geological Survey (British Geological Society, 2019) and the Geological Society of Glasgow (Geological Society of Glasgow, 2017). The area is visited for its various localities where bedrock is exposed, and geological structures and formations of note can be observed.

6.8.4 As a result of the necessary rock blasting for the construction of the proposed scheme, some of the new cuttings may expose bedrock and, in turn, create new geological features comparable to those visited in the excursions cited above. Three cutting sites have been identified with this potential and are described in Table 6-20, which has been informed by Chapter 13 (Geology, Soils Groundwater and Land Contamination) of the DMRB Stage 3 EIAR.

Table 6-20. Opportunities for proposed scheme cuttings to create geological features of interest

Cutting	Opportunity
C13	The proposed cutting C13, located between chainages 6100 and 6500, is expected to intercept bedrock at a relatively shallow depth (0.3m) and has the potential to expose a similar significant geological feature to the one recognised at the Craig a' Barns Geological Conservation Review (GCR), exposing similar bedrock. The Craig a' Barns GCR is a significant geological feature as an exposed hinge zone of the Highland Border Downbend with associated deformation features

Cutting	Opportunity
	(Brown & Gillen, 2015). Craig a' Barns is an outcrop at which important structural features are exposed. C13 lies on the same high of the Highland Border Downbend underlain by the same bedrock geology (Dunkeld Grits). C13 could thus become a comparable feature to that of Craig a' Barns GCR should comparable levels of accessibility be provided. This should be relatively achievable given that Path 45 (PKC Core Path DUNK/65), running from the Hermitage, passes directly behind the proposed cut face.
W13	The proposed cutting W13, located between chainages 8000 and 8400, has the potential to expose a significant geological feature as the cutting is situated between two GCRs: Craig a' Barns and Rotmell Farm, which have been recognised for the significant structural features present in the bedrock. There is a possibility that further features of interest could be exposed as the cutting lies upon the same Dunkeld Grits formation. W13 hence could also become a comparable feature to those discussed should access be provided. Access should be relatively achievable to this roadside cutting by means of a layby or similar.
CS7B/CS8	The proposed cutting CS7B/CS8, located between chainages 2000 and 2300, is expected to expose bedrock of The Birnam Slate and Grit Formation. The cutting is located next to the disused Birnam Quarry which is not a GCR site but is still a locality of interest for structural features related to the formation of the Tay Nappe (Brown & Gillen, 2015). The cutting could thus create a new site of geological interest, albeit a potentially smaller opportunity relative to the potential features which could be exposed at CS7B/CS8. Providing access could be challenging as the cutting is primarily an underpass so access may not be feasible on foot. However, there is a chance bedrock could be exposed at the surface.

6.8.5 To secure an educational benefit from the proposed scheme, would require additional measures would be required to make sure the cutting sites are accessible. Furthermore, it is not guaranteed that the cuttings will expose comparable geological features to those already within the area. The potential educational benefit has been quantified below as a demonstrative exercise of the potential opportunity for the proposed scheme. However, the benefits calculated will not be included in the NCA summary tables (presented in Section 6.11) as the benefits will not be realised with the current proposed scheme design.

6.8.6 For the purpose of demonstrating the potential benefits, the Dunkeld and Little Glen Shee area is presumed to receive between 120 and 480 visits (central estimate of 300 visits) annually as part of geological excursions. This is a relatively conservative estimate assuming that given the relatively academic nature of the excursions identified, these would be limited to tertiary level education and above. The lower-bound estimate assumes one excursion of 20 members (the number of spaces available for the Geological Society of Glasgow excursion) every two months. The upper-estimateupper estimate assumes two trips per month. A value of £30.73 per visit (uplifted to 2025 prices) is applied to estimate the baseline education benefit. This is a value from the Economic Analysis of Cultural Services: UK NEA Economic Analysis Report (Mourato, et al., 2010) and represents the indicative average cost of nature-based educational trip as a proxy minimum value received by the individual in terms of an investment in their knowledge.

6.8.7 To estimate the net benefit from proposed scheme, uplifts to the baseline were assumed based on the potential value added by the new cuttings. The new cuttings could create three new localities within the Dunkeld and Little Glen Shee excursion area. Hence, the following uplifts were applied:

- Upper-bound: +60%, based on the fact there are currently five localities within the Dunkeld and Little Glen Shee excursion. A direct relationship between value and the number of localities would thus assume an uplift of +60% from three further localities.
- Central: +40%
- Lower-bound: +20%

6.8.8 Table 6-21 shows that the potential education benefit over 100 years could range from £20k - £244k and from £17k - £201k over 60 years, assuming that new geological features are created from the cutting and that access to these is provided as part of the proposed scheme. With the exception of assuming no access until the operational period, the benefits are assumed to remain constant over time; hence, the changes in the snapshot monetary values shown in Table 6-22 reflect the impact of discounting.

Table 6-21 PV (£) of the potential education benefit from cutting opportunities

Estimate	60yr	100yr
Central	83,850	101,810
Lower	16,770	20,362
Upper	201,241	244,344

Table 6-22 Snapshot monetary values (£) of the potential education benefit from cutting opportunities

Estimate	10	15	25	50	100
Central	2,614	2,201	1,560	841	312
Lower	523	440	312	168	62
Upper	6,274	5,283	3,745	2,019	749

6.9 Recreation

6.9.1 Greenspaces can provide significant recreational value, which is reflected in the welfare benefits gained by individuals visiting such spaces. These benefits are proportional to the nature, accessibility, and quality of the space.

6.9.2 Changes in the benefits provided by local, recreational greenspaces has been assessed using data and insights from Chapter 17 (Population – Accessibility) of the DMRB Stage 3 EIAR. This bespoke approach was developed to best capture the impacts of the proposed scheme on recreational spaces, which are highly specific; for example, there are no substantial, direct land use impacts on such spaces. The Accessibility chapter provides a comprehensive assessment of the proposed scheme's impacts on routes for WCH. This includes impacts on core paths, rights of way, National Cycle Routes, horse riding routes and local paths within 500m of the proposed scheme, with a total of 60 paths identified.

6.9.3 As part of the Accessibility assessment, the impacts upon OAAs are distinguished. OAAs are defined as, *"local open space and green space that are used by the public for recreational*

purposes" (Ministry for Housing, 2014). Given their definition, it was deemed appropriate to focus the assessment of recreation benefits, as part of the NCA, on the impact on the identified OAAs.

6.9.4 The Accessibility chapter identified adverse impacts on OAAs as a function of the impacts to paths associated with these spaces. Impacts to paths were considered in two terms: the impacts to journey length as a result of severance and the impacts to amenity. The impacts to journey length were not considered as part of the assessment of recreation benefits in the NCA as changes to journey length could be seen as negative or positive from a recreation perspective. Adverse effects on the amenity of paths identified in the chapter were a summation of visual, air quality and noise impacts on the paths. The amenity impacts (including impacts with reference to the three, individual components) to all paths relevant to the proposed scheme are summarised in Appendix A17.1 (Impact Assessment for WCH Routes and Access to Outdoor Areas) of the DMRB Stage 3 EIAR in Table A17.1-2. Table A17.1-2 was reviewed to identify any effects to paths associated with OAAs identified as 'Moderate' or above. Note, that only residual effects (with mitigation) were considered, i.e. lasting impacts to OAAs, in keeping with a proportionate approach. Moderate impacts (or above) were assumed to represent an appropriate threshold for effects of significance, which could have a tangible impact on the recreational experience offered by OAAs.

6.9.5 Whilst the Accessibility chapter focused on the potential, adverse effects on the OAAs and their associated paths (due to the mitigation lens of the EIAR), the NCA looks to capture both the proposed scheme's adverse and positive impacts (enhancements) on recreation. A review was thus undertaken, with the support of the Accessibility and Design Teams, to identify all new path creation and enhancement measures currently planned as part of the DMRB Stage 3 proposed scheme alignment. These measures were then reviewed as to whether they could have a tangible impact on the recreational experience offered by the OAAs identified, in terms of significant improvements in accessibility.

6.9.6 For each of the OAAs identified in the Accessibility chapter, Table 6-23 summarises the estimated baseline visitor numbers. The adverse and positive impacts to amenity of associated paths are also identified. Note that paths are referred to using the numbering system from Chapter 17 (Population – Accessibility) of the DMRB Stage 3 EIAR; Figure 17.1 of the DRMB Stage 3 EIAR provides a map of all paths relevant to the proposed scheme and their reference numbers. Several of the OAAs are scoped out of the assessment based on negligible visitor numbers (thus it was deemed they would not be proportionate for inclusion in the quantification of benefits) or overlap with other OAAs in terms of a shared path network, with the potential for double-counting of recreation benefits. Ultimately, based on the adverse and positive amenity impacts identified, conclusions were drawn as to how the baseline recreation benefits associated with each OAA could be scaled to reflect these impacts and calculate the net benefit associated with the proposed scheme. Note that in the case of positive impacts, reference is made to Appendix B, which contains schematics for the path creation and enhancement measures associated with the proposed scheme which were deemed to have the potential for a tangible impact on the recreational experience offered by the OAAs.

Table 6-23 Summary table of Outdoor Access Areas, estimated visitor numbers and assumptions related to changes to the recreational benefit from these sites based on amenity impacts identified

OAA	Relevant paths	Estimated annual visitor numbers	Source of visitor data	Adverse amenity impacts	Positive amenity impacts	Conclusions for scaling of benefits
The Hermitage and River Braan	35, 36, 39, 41, 42, 44	359,937	Annual visitor numbers sourced from Association of Leading Visitor Attractions (ALVA, 2025). Note that in the Accessibility chapter The River Braan is identified as a separate OAA. However, sources (Walkhighlands, 2025) indicate that there is a significant overlap in the path network between these OAAs. Hence, in the NCA, these areas are treated as a single OAA to avoid the potential double-counting of recreational visitors.	Path 39: Due to the closer proximity of the path to the proposed route options and subsequent visual impact from earthworks, there is expected to be a decrease in the amenity value for WCH using this path. Moderate, visual impact anticipated and a Major impact in terms of noise.	The path enhancements in APPENDIX BB should collectively have a positive impact on access to the Hermitage from Dunkeld. This is particularly given that the main footbridge over the River Braan was washed away in a storm in recent years and there has since been a diversion in place using Paths 36 and 41, which is an elongated route (see the Population – Accessibility chapter for further details). The enhancements pictured would create a new crossing using the main A9 bridge across the River Braan to the Hermitage from Dunkeld. The enhancements in Appendix B2 represent a significant improvement to the path network around the popular River Braan area (the Strava Global Heatmap (Strava, n.d.) suggests footfall is almost as heavy as the main Hermitage site). A new path is being added to turn Path 35 into a circular route and Paths 35 and 39, which are currently unbound (dirt) tracks, are to be upgraded.	The adverse impacts on Path 39 should have a relatively negligible impact on the recreational benefits associated with the wider Hermitage and River Braan OAAs, given that this is only a small section of path within the much wider, associated network. The overall improvements in accessibility and new circular route around the River Braan OAA could have a tangible impact on visitor numbers and the recreational experience. For the sake of a conservative estimate, an **uplift of 5 - 10%** of the recreational benefit from this OAA was assumed based reflecting the potential change in visitor numbers and/or improvement in recreational experience.
Tay Forest Park – Craigvinean Plantation	45, 46, 47, 52	NA	Visitor numbers estimated for the Hermitage were assumed to account for visits to this OAA and hence it was **scoped out** of the assessment. According to the	NA	NA	NA

			Land Management Plan for Craigvinean (Forestry and Land Scotland, 2020): "*The forest receives high visitor numbers each year. Approximately 200,000 people visit the National Trust (NTS) site at the Hermitage with a significant proportion of these visitors also taking in wider walks through the forest block*".			
Inver Wood	45, 46, 47	NA	The Strava Global Heatmap suggests negligible user numbers compared to other visitor sites. There is also a large overlap in the path network between this OAA and the Craigvinean Plantation OAA and, by extension, with the Hermitage and River Braan OAA, with potential for double-counting of visitor numbers. This OAA was hence **scoped out** the assessment.	NA	NA	NA
River Tay	35, 38 (NCR77), 48 (NCR77), 53	89,984	The path network comprising Paths 35, 38 and 48/NCR77 looks to receive approximately 25% of the footfall received by the Hermitage, according to the Strava Global Heatmap. Other paths within the area appear to receive relatively negligible footfall.	Path 35: Due to the closer proximity of the path to the proposed route options and subsequent visual impact from earthworks, there is expected to be a decrease in the amenity value for WCH using this path. Moderate, visual impact anticipated and a Moderate impact in terms of noise.	In its current state, there are concerns for the safety of WCH using the NCR77 when crossing the Jubilee Bridge, as the path is not clearly segregated from northbound carriageway. To address this, the path will be moved to the southbound carriageway-side on the Jubilee Bridge. To accommodate this and to continue to provide access from the east, when coming from the east the NCR has been diverted to the south, crossing under the A9 under the new Dalguise Junction to access the southbound-side, where the new path continues up to (utilising the Dalguise Access Track) and across the Jubilee Bridge. At the northern extent, a new path will be created, to again avoid crossing the A9, to connect to the existing NCR77 route on the eastern bank of the River Tay, heading back down to Dunkeld. The	As a result of the adverse impacts on the amenity associated with Path 35, there will be some adverse effects on the recreational experience of users of this path. On the other hand, users of NCR77/Path 48 should have an improved recreational experience from the new route which is segregated from the main A9 carriageway. It is likely that these improvements outweigh the adverse effects encountered by users of Path 35 but not to an extent where it would be appropriate to assume an overall benefit proportionate for quantification. Hence, no change to the recreational benefit associated with this OAA was assumed.

					enhancements described should improve the safety of cycle users of NCR77, providing a truly segregated route across the Jubilee Bridge and crossing under the A9 to access the NCR77 route heading east (south of the Jubilee Bridge).	
Birnam Hill	18, 20, 23, 28/NCR77, 30	89,984	Based on the apparent footfall of the Birnam Hill walking route (Walkhighlands, 2025) on the Strava Global Heatmap, compared to that received for the Hermitage, estimated to receive 25% of the visitor numbers to the Hermitage.	None	Path 23: Overall an increase in amenity value is expected for WCH using this path due to the improved safety of the grade separated crossing.	Benefits for amenity (from improvements to Path 23) relate to safety and are not anticipated to have a tangible impact on the overall recreational experience offered by the Birnam Hill OAA to extent where quantification would be proportionate. Hence, no change to the recreational benefit associated with this OAA was assumed.
Ring Wood	15, 19, 21, 22/NCR77, 24	118,779	Based on the apparent footfall compared to that received for the Hermitage on the Strava Global Heatmap, assumed to receive approximately 1/3 of the visitor numbers received by the Hermitage.	None	The path identified in APPENDIX BB represents a new path connecting the established route around Ring Wood (back to Dunkeld) to the Dalpowie plantation. Currently, there is no formal route connecting Ring Wood to Dalpowie, with the dramatic drop off in footfall between Ring Wood and the Dalpowie area on the Strava Global Heatmap reflecting this. The Dalpowie Plantation sits between Ring Wood and another high footfall walking route, the Murthly Riverside Path (Path 4, following the southern bank of the River Tay around the Murthly Castle grounds, down to the Roman Bridge feature). The new path should connect Ring Wood to the more established, local paths within the Dalpowie Plantation (Path 15), which link up with the Murthly Riverside Path via the Roman Bridge (via Paths 21a and 7). This should hence lead to a more cohesive, single riverside route between Ring Wood	The enhancements, by means of a connection between two existing and popular riverside walks, could create a new, extended route along the Tay as part of the River Tay Way, which could have benefits both in terms of new visitors and improved recreational experience. For the sake of a conservative estimate of the potential benefit, an **uplift of 10 - 20%** is applied to the baseline benefit obtained from Ring Wood, reflecting the potential change in visitor numbers and/or improvement in recreational experience.

					and the Murthly area. The Strava Global Heatmap data indicates demand for such a route, with some footfall evident between Ring Wood and the Dalpowie Plantation (across to Murthly Estate), despite there being no obvious footpath currently. Additionally, the Roman Bridge/Murthly Riverside Path Route comprises a section of the River Tay Way (Perth and Kinross Countryside Trust, n.d.), which does connect to Dunkeld but does so by diverting south of the A9, presumably due to an absence of formal path via the Dalpowie site. This should hence provide a more direct and scenic route for the River Tay Way (remaining on the banks of the Tay) to Dunkeld.	
Rohallion Loch	9	NA	Strava Global Heatmap suggests negligible user numbers compared to other OAAs. This OAA was hence **scoped out** the assessment.	NA	NA	NA

6.9.7 For those OAAs where a scaling of the associated benefits was deemed appropriate to reflect tangible changes as a result of the proposed scheme, the baseline benefits were calculated by applying a value per visit of £4.11 (uplifted to 2025 prices) to estimated annual visits. This value is the average value per visit to woodland and farmland greenspace sites based on aggregate site selection of the relevant land covers in the Outdoor Recreation and Valuation tool (ORVal) (Day & Smith, 2018). Baseline benefits were then scaled according to the conclusions drawn in Table 6-23 to estimate the net benefits associated with the proposed scheme.

Table 6-24 PV (£) for recreation

Estimate	60yr	100yr
Central	4,189,059	5,086,308
Lower	2,792,706	3,390,872
Upper	5,585,412	6,781,744

Table 6-25 Snapshot monetary values (£) for recreation at different years

Estimate	10	15	25	50	100
Central	130,603	109,965	77,956	42,024	15,594
Lower	87,069	73,310	51,971	28,016	10,396
Upper	174,138	146,619	103,941	56,032	20,793

6.9.8 Table 6-24 shows a net benefit to recreation associated with the proposed scheme ranging from approximately £2.79m - £5.59m over a 60yr period to £3.39m - £6.78m over a 100yr period. These benefits are associated with the WCH path creation and improvement efforts which were considered to have a tangible impact on the recreational experience and/or access to two of the OAAs – the Hermitage and River Braan and Ring Wood. Whilst some adverse impacts to the amenity of paths associated with OAAs were identified, these were judged not to be of sufficient scale to have a tangible impact on recreational experience and/or access. The benefits calculated are not assumed to change across the appraisal period (bar the delay over the construction period) and hence the decrease in values over time presented in Table 6-25 simply reflects the effect of discounting.

6.10 Volunteering

6.10.1 Engaging in environmental volunteering provides numerous personal and social advantages, such as promoting physical activity, fostering social connections, enhancing skills, and preparing individuals for future employment. Gathering data on volunteer participation and showcasing the positive outcomes of such opportunities can also play a crucial role in attracting financial support from donors.

6.10.2 The proposed scheme has the potential to support volunteering hours for local environmental groups to increase their outreach and positive impact. These groups carry out activities such as ecological surveys and tree planting around the Dunkeld and Birnam area. If these groups

were to be supported further, a potential substantial positive ecosystem service impact is anticipated for the proposed scheme.

6.10.3 To quantify the potential value of volunteering benefits, the method set out in ENCA's Services Databook has been followed. ENCA recommends applying a monetary value per volunteer hour based on the calculated replacement cost of an average formal volunteer hour (for frequent volunteers i.e. at least once a month).

6.10.4 The valuation is based on a methodology to value unpaid voluntary activity in the Household Satellite Accounts (Office for National Statistics, 2017) which is an estimate of what the same activity would cost if it was being provided by a paid person in the market and the value is then uprated by the Average Weekly (regular) Earnings Index. This approach effectively captures the benefit of volunteering to the organisation by quantifying the labour the organisation is receiving "for free" but doesn't capture the benefit to the individual. This valuation does capture additional benefits associated with volunteering such as greater social connections and increased mental well-being which is a limitation of the methodology. Ideally, the replacement costs would also reflect the level of skill of the voluntary activity. The value used in this assessment is £16.70 (uplifted to 2025 prices) per volunteer hour.

6.10.5 For the purpose of sensitivity analysis, the number of volunteer hours per week was estimated to be eight per volunteer across two potential environmental volunteer organisations (one ecological surveying group and one tree planting group) providing an environmental benefit. Sensitivity analysis was carried out as follows:

- Lower estimate: Two volunteers sponsored for eight hours per week each across two volunteer organisations
- Central estimate: Four volunteers sponsored for eight hours per week each across two volunteer organisations
- Upper estimate: Six volunteers sponsored for eight hours per week each across multiple environmental groups

6.10.6 Even with the delay in access until 2033 to facilitate the proposed scheme construction, the overall volunteering benefit would likely be positive. This is the case for Central, Low and High sensitivity analysis scenarios and is presented in Table 6-26. This assumes that the proposed scheme would support volunteering opportunities throughout the appraisal period.

Table 6-26 PV (£) for volunteering

Estimate	60yr	100yr
Central	631,978	767,341
Lower	315,989	383,670
Upper	947,967	1,151,011

6.10.7 Note that the decrease in values over time following the operational phase, shown in Table 6-27, is due to the effect of discounting. Volunteer hours are assumed to remain constant throughout the appraisal period.

Table 6-27 Snapshot monetary values (£) for volunteering at different years

Estimate	10	15	25	50	100
Central	19,703	16,590	11,761	6,340	2,353
Lower	9,852	8,295	5,880	3,170	1,176
Upper	29,555	24,885	17,641	9,510	3,529

6.11 Summary results

6.11.1 Table 6-28 presents the summary 100-year present value results for each ecosystem service and the sum, total Net Present Value (NPV), across each of the sensitivity scenarios (central, lower- and upper-bound). Note that, as discussed within the respective sub-sections in Section 6, the values associated with education and volunteering have not been included within the summary results. This is because the benefits associated with these services were calculated for demonstrative purposes of additional opportunities only and are not forecasted to be gained as part of the proposed scheme, currently.

6.11.2 The upper- and lower-bound scenarios represent a scenario where the baseline capacity for natural assets to provide ecosystem services is at its greatest. This means that for those services where there is a loss in the service due to the proposed scheme, the loss is actually greatest under the upper-bound scenario (and vice versa, losses are smallest under the lower-bound scenario). For this reason, Table 6-29 presents the summary values translated into a new set of 'optimism' scenarios. Under the 'least optimistic' scenario, for each ecosystem service, the lowest benefit (or greatest loss) calculated from across the three sensitivity scenarios is assumed. Under the 'most optimistic' scenario, the highest benefit (or smallest loss) calculated from across the three sensitivity scenarios is assumed. Theoretically, this demonstrates the maximum range in the change in ecosystem service benefits which is forecast to occur as a result of the proposed scheme.

6.11.3 On the basis of the optimism scenarios presented in Table 6-29, the 100-year NPV for the proposed scheme ranges from approximately -£15.73m to (+)£222.58k. The breakdown of the 100-year NPV is visualised in Figure 6-3. The most significant losses are associated with carbon reduction, followed by timber production. Only under the most optimistic scenario, where the losses are the smallest (and gains greatest), do the benefits from recreation outweigh these losses. Carbon reduction and recreation clearly have the greatest influence on the total 100-year NPV across the optimism scenarios. It should be noted that, as discussed in Section 6.5, the values associated with carbon reduction are assumed to be conservative and the losses, in reality, could be less than those forecasted. This could have a notable impact on the overall profile of the impact of the proposed scheme on natural capital values.

Table 6-28 Summary 100yr present value benefits for sensitivity scenarios

Ecosystem service	Central	Lower	Upper
Food production	- 34,276	- 24,497	- 41,485
Timber production	- 1,733,871	- 1,155,914	- 2,311,828
Air pollutant removal	- 93,003	- 87,665	- 98,341

Ecosystem service	Central	Lower	Upper
Carbon reduction	- 10,404,425	- 5,202,212	- 15,606,637
Flood regulation	- 449,862	- 88,880	- 1,058,044
Recreation	5,086,308	3,390,872	6,781,744
Total	**- 7,629,129**	**- 3,168,297**	**- 12,334,592**

Table 6-29 Summary 100yr present value benefits for optimism scenarios

Ecosystem service	Central	Least optimistic	Most optimistic
Food production	- 34,276	- 41,485	- 24,497
Timber production	- 1,733,871	- 2,311,828	- 1,155,914
Air pollutant removal	- 93,003	- 98,341	- 87,665
Carbon reduction	- 10,404,425	- 15,606,637	- 5,202,212
Flood regulation	- 449,862	- 1,058,044	- 88,880
Recreation	5,086,308	3,390,872	6,781,744
Total	**- 7,629,129**	**- 15,725,464**	**222,575**

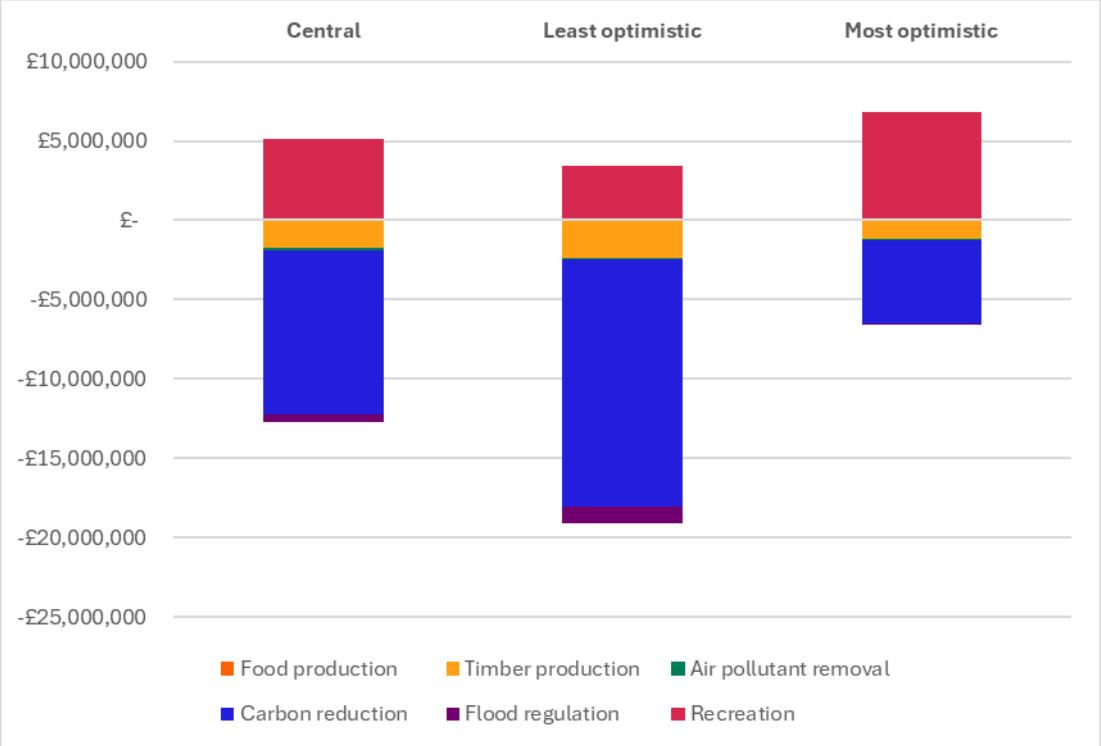

Figure 6-3 Summary 100yr present value benefits for optimism scenarios

6.11.4 Table 6-30, Table 6-31 and Figure 6-4**Error! Reference source not found.** represent the equivalent summary tables/figures to Table 6-28, Table 6-29 and Figure 6-3, respectively, over the 60 year appraisal period. On the basis of the optimism scenarios presented in Table 6-31, the 60-year NPV for the proposed scheme ranges from approximately -£16.03m to -£820.8k. Similarly to the 100-year appraisal period, as depicted in Figure 6-4, the losses associated with

carbon reduction and the gains associated with recreation have the greatest influence on the total 60-year NPV. Over the 60-year appraisal period, the losses are greater under the least optimistic scenario due to the greater carbon losses, primarily. As is explained in Section 6.5, most the of the carbon reduction losses occur at the start of the appraisal period whilst the gains associated with habitat creation efforts are accrued more steadily over time. Consequently, across the 60-year appraisal period, the gains have had less opportunity to outweigh the early losses.

Table 6-30 Summary 60yr present value benefits for sensitivity scenarios

Ecosystem service	Central	Lower	Upper
Food production	- 29,354	- 20,817	- 35,777
Timber production	- 1,418,387	- 945,591	- 1,891,182
Air pollutant removal	- 68,654	- 64,714	- 72,594
Carbon reduction	- 10,593,603	- 5,296,802	- 15,890,405
Flood regulation	- 394,120	- 78,284	- 934,300
Recreation	4,189,059	2,792,706	5,585,412
Total	**- 8,315,059**	**- 3,613,502**	**- 13,238,847**

Table 6-31 Summary 60yr present value benefits for optimism scenarios

Ecosystem service	Central	Least optimistic	Most optimistic
Food production	- 29,354	- 35,777	- 20,817
Timber production	- 1,418,387	- 1,891,182	- 945,591
Air pollutant removal	- 68,654	- 72,594	- 64,714
Carbon reduction	- 10,593,603	- 15,890,405	- 5,296,802
Flood regulation	- 394,120	- 934,300	- 78,284
Recreation	4,189,059	2,792,706	5,585,412
Total	**- 8,315,059**	**- 16,031,553**	**- 820,796**

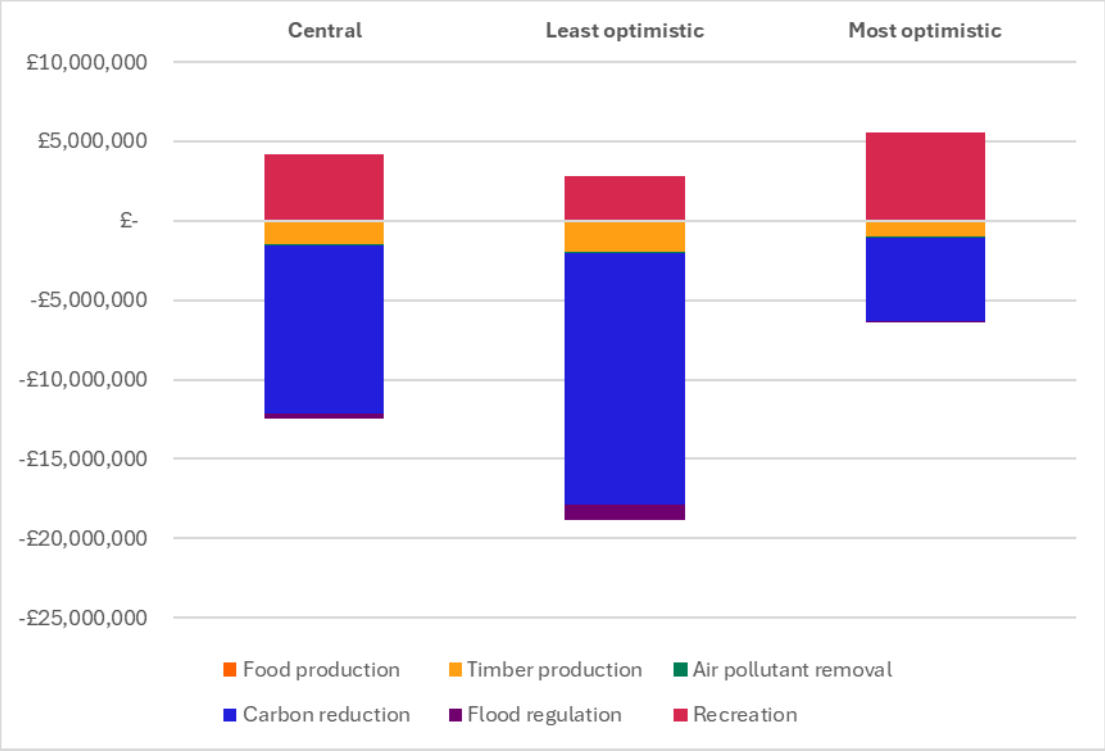

Figure 6-4 Summary 60yr present value benefits for optimism scenarios

6.11.5 It should be noted that the education and volunteering opportunities, if realised, could have a notable effect on the overall natural capital value of the proposed scheme. Over 100 years, the NPV would range from -£15.32m to (+)£1.62m if the benefits forecasted are included. Over 60 years, the NPV would range from -£15.7m to (+)£328.41k.

7. Conclusions

7.1.1 The A9 P2 NCA explored the effects of the proposed scheme on ecosystem service benefits as a result of its impacts on natural assets (habitats) within the NCA boundary.

7.1.2 The key changes to natural capital assets as a result of the proposed scheme are the losses of woodland habitat totalling to 12.7ha within the NCA boundary. Whilst there is a gain of 14.9ha of deciduous woodland types, there is a loss of 27.7ha of coniferous woodlands, resulting in an overall deficit within the NCA boundary. In contrast, there a notable increase in the area of other neutral grassland. Other notable impacts were a loss of 65% of bracken habitat and the majority of arable habitat within the NCA boundary.

7.1.3 The impact on eleven ecosystem service benefits was assessed in qualitative terms. Adverse impacts are assumed for food production, timber production, air pollutant removal, carbon reduction and flood regulation. Carbon reduction impacts are deemed to be the most substantial, primarily due the loss of soil and vegetation carbon stocks associated with woodland clearance. Pollination and recreation benefits are forecast to increase from the proposed scheme. Recreation benefits are deemed to be substantial, associated with new footpath creation and enhancement measures which are assumed to improve access, to and recreational experience from the use of, multiple greenspace sites. There could also be notable benefits from education and volunteering; however these are identified as opportunities which could be realised through additional scheme enhancements.

7.1.4 Six ecosystem service benefits (excluding education and volunteering opportunities) were assessed in monetary terms (and a number of these presented with supporting quantitative [biophysical] evidence). In alignment with the qualitative assessment, the impacts on carbon reduction and recreation had the most notable effects on total NPV for the proposed scheme. Over 100 years the NPV (for the optimism scenario) is forecast to range from -£15.73m to (+)£222.58k . Over 60 years, the NPV is between -£16.03m to -£820.8k. Over 100 years, the overall benefits are greater due to the fact that the bulk of losses associated with carbon reduction occur early in the proposed scheme lifecycle and thus over time, some of these losses are offset by the recreation benefits.

7.1.5 If volunteering and education opportunities are delivered upon, the 100-year NPV for proposed scheme would range from -£15.32m to (+)£1.62m. Over 60 years, the NPV would range from -£15.7m to (+)£328.41k.

7.1.6 It is also important to note that the impacts to ecosystem services presented in this NCA are potentially underestimated in the case of benefits or overestimated in the case of disbenefits. This is due to the fact that offsite enhancements and woodland compensation measures (which have not yet been confirmed) have not currently been included within the SBMT, the outputs from which underpin this assessment. It would be recommended that this NCA is updated once this information is available.

7.1.7 The NCA has identified a number of risks and opportunities for the proposed scheme with regards to ecosystem service benefits. These have been summarised in Table 7-1.

7.2 Risks and opportunities

Table 7-1 Natural capital risks and opportunities

Ecosystem service	Risks	Opportunities
Food production	The proposed scheme is anticipated to result in the loss of some agricultural areas, most notably around 6ha of arable land with a corresponding reduction in to agricultural output anticipated.	NA – small loss of agricultural land associated with the proposed scheme. Limited, tangible opportunities identified.
Timber production	The proposed scheme is anticipated to negatively impact timber production, due to an expected loss of a site currently with an active felling licence. However, the extent of this impact is currently uncertain, as it is not currently confirmed how much of this area will be required for mitigation planting.	If the whole area currently planned for mitigation planting is not required, there may be opportunities for timber production to continue. However, the scheme is unlikely to present any opportunities to positively impact timber production directly.
Air pollutant removal	The proposed scheme is expected to lead to initial habitat loss, impacting air pollutant removal. While the proposed scheme will create woodland and grassland habitat, the benefits will take time to materialise, as newly planted areas must mature before reaching optimal conditions.	Strategic implementation of compensatory woodland planting and new habitat creation as part of biodiversity enhancement efforts could maximise air pollutant removal effectiveness. Albeit, potential benefits are limited by limited background air pollution.
Carbon reduction	The loss of woodland habitat due to scheme land take presents a clear risk in terms of the loss of future nature-based carbon removals. Failure to consider the carbon implications of mitigation and/or compensation efforts could result in additional carbon losses. For example, the enhancement of existing woodland parcels over and above new woodland creation could mean significantly less carbon offsetting potential.	Compensatory planting of new woodland parcels presents the opportunity to offset a degree of the forecasted carbon losses as a result the overall habitat losses due to the proposed scheme land take. The composition and structure of woodland planting proposals could be considered to optimise the potential carbon offsetting opportunities.
Flood regulation	The proposed scheme is anticipated to result in a loss of woodland habitat which could play a role in slowing overland flows and floodwater storage, particularly important given the steep topography of the surrounding area and the fact that notable areas of Inver, Little Dunkeld and Birnam are subject to regular flooding from the River Tay and River Braan.	Compensatory woodland planting and new habitat creation as part of biodiversity enhancement efforts could be carried out strategically to integrate and/or deliver Nature-Based Solutions (NBS) to reduce downstream flood risk.
Pollination	There was very limited citizen science data on pollinator/host species available across the study area. This may have a resulted in the high value of some habitat areas being under-represented (i.e., showing as only moderate value to pollinators, rather than high). Despite this, impacts of the proposed	Undertake pollinator surveys or more detailed assessments of pollination to determine the impacts of the scheme. There is an opportunity for the proposed scheme to include measures to further support pollinators through the re-planting of vegetation.

Ecosystem service	Risks	Opportunities
	scheme are still anticipated to be represented by this methodology. There is a risk the construction of the proposed scheme will disrupt pollinator species. However, overall, there is likely to be a generally positive impact as a result of the mitigation planting.	
Soil erosion protection	The proposed scheme is expected to have an overall minimal impact on soil erosion protection; however, this is primarily due to the mitigation measures to be put in place such as replacement habitat creation alongside good design and practice measures.	Geotechnical risks arising from soil erosion are being considered and mitigated against. Options could be reviewed strategically to integrate and/or deliver NBS to reduce the negative effects of soil erosion.
Education	NA – no risk identified to education benefits, provided by the natural environment, associated with the proposed scheme.	This assessment has identified a number of cuttings which could expose geological features comparable to those localities which make Dunkeld and Little Glen Shee a destination excursion for universities, geological societies and geology enthusiasts. Only relatively small enhancements would be required to make any exposed features accessible, adding to the geological heritage in the area enjoyed by these communities.
Landscape and amenity	The proposed scheme is expected to have an overall minimal impact to landscape; however, this is primarily due to the mitigation measures to be put in place. If these were not to be delivered, these is likely to be more negative impacts to the surrounding landscape.	The mitigation planting required for the scheme is likely to have positive impacts for the surrounding landscape and perception of landscape.
Recreation	The assessment of recreation benefits considered only residual (post mitigation) impacts. Without the mitigation detailed in the DMRB Stage 3 Population – Accessibility chapter which supports mitigation of impacts on the amenity of footpaths, and enhancements to existing footpaths, the results could be less favourable.	The proposed path connecting River Wood and Path 15 within the Dalpowie Plantation presents substantial potential for recreation benefit by creating a cohesive and accessible riverside route for WCH users by connecting the Ring Wood Area to the Murthly Riverside Path via Dalpowie. If a formal connection is created, this could greatly improve the River Tay Way route, negating the need for its diversion south of the A9 (away from the riverside) to reach Dunkeld from the Murthly Estate. The River Braan OAA (Inver) area has a high footfall and the new, circular route and planned footpath enhancements could add significant value. Currently, Path 35 is an informal, narrow and unbound track with relatively poor accessibility. Improving

Ecosystem service	Risks	Opportunities
		accessibility for a wider array of users could add substantial benefit.
Volunteering	NA – no risk identified to volunteering opportunities, presented by the natural environment, associated with the proposed scheme.	The proposed scheme could enhance volunteering opportunities for local environmental groups, expanding their outreach and positive impact. Such initiatives offer numerous personal and social benefits, such as physical activity, social engagement and skill development while also providing valuable insights into the local ecology.

7.3 Recommendations

7.3.1 This NCA has been authored to align with the DMRB Stage 3 EIAR and should be considered supplementary to the EIAR findings. The findings herein should hence be considered in the decision-making processes relevant to the EIAR. Additionally, there is an opportunity to include the benefits quantified, particularly the monetary ecosystem service outcomes, within the business case for the proposed scheme. It is worth noting that the outcomes of the NCA were based on proposed scheme design for the DMRB Stage 3 Design Fix, at which stage opportunities for further voluntary habitat enhancements within land adjacent to the proposed scheme were still being discussed. Further consultation will be undertaken to identify additional off-site areas for enhancement as required. It is recommended that the NCA outcomes are revised should opportunities for voluntary enhancements be identified and progressed as these should significantly impact upon the natural capital outcomes.

7.3.2 Based on the risks and opportunities set out Table 7-1, the following recommendations for the proposed scheme design are made:

- Compensatory woodland planting and enhancement measures are considered in a strategic manner to realise multiple benefits. These could include optimisation for air pollutant removal, carbon reduction, soil erosion protection and implementation as part of a NBS to address downstream flood risk. Additionally, the impact on local landscape character should be carefully considered.

- The removal of woodland habitats as part of the proposed scheme, particularly on valley slopes, should be carefully considered in terms of the potential impact on flood risk and soil stability. Further investigation should be considered.

- There are opportunities to support pollinators through proposed scheme planting. Pollinator surveys could help to evidence and optimise the potential benefits.

- Provisioning of access to cuttings which result in the creation of new geological features, a possibility identified for the proposed scheme, could generate significant education benefit and enhance the already important geological heritage of the Dunkeld and Little Glen Shee area.

- Supporting local volunteering initiatives such as environmental groups which carry out ecological surveys and tree-planting could deliver benefits to the community whilst promoting Positive Effects for Biodiversity in alignment with the NPF4 requirement.

- The recreation benefits are highly important in the overall NPV for natural capital associated with the proposed scheme. These benefits rely on the following assumptions: that the new path proposed connecting Ring Wood to the Dalpowie plantation links with accessible, existing paths through Dalpowie which eventually connect to the Murthly River Path; and that the enhancements to the River Braan OAA/Inver area create a new circular route and significantly improve the accessibility of Path 35 for more WCH. Designs should ensure that these assumptions are realised to truly benefit local recreation.

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APPENDIX A Noise reduction assessment

A.1.1 Noise reduction is an important ecosystem service provided by vegetation, and one of particular importance in the context of road schemes where vegetation can act in a crucial role to buffer communities against additional noise pollution.

A.1.2 Identifying vegetation that is providing noise reduction benefits is dependent on several factors including the height, density, width, and area. It is also important to establish the location of any vegetation in relation to the noise source and receptors (e.g., dwellings) benefiting from noise regulation. The approach to the assessment was thus to review the threshold parameters in relation to the characteristics of vegetation to provide a noise reduction benefit, use these to identify areas of vegetation providing a benefit (considering the location relative to noise receptors), and to see if the proposed scheme would impact any potential benefits as a result of changes to vegetation.

A.1.3 Table 8-1 presents the outcomes of a literature review carried out to understand the required, physical characteristics of vegetation to provide a noise reduction benefit.

Table 8-1 Outcomes of literature review into threshold vegetation characteristics for provisioning of noise reduction benefits

Reference	Notes	Figures on threshold vegetation height	Figures on threshold vegetation depth
Peng et al., 2014	The aim of this study was to review available literature as well as to obtain specific experimental data to provide a better understanding of noise transmission when significant vegetation is present. The excess attenuation of traffic noise through 10 to 20m of trees (tree spacing <0.5m) was found to be typically 2 to 3dB, relative to Calculation of Road Traffic Noise (CoRTN) standardised calculation procedures predictions.	Only trees were referred to in the capacity to mitigate against traffic noise.	10-20m depth
Van Renterghem et al., 2012	Tree belts could be effective in reducing road traffic noise, on condition that planting schemes are optimised and tree density is sufficiently high. Calculations showed that a 15m deep and 2.5m stem height tree belt planted at 1m average spacing with 0.11m diameter tree trunks was found to have a performance equivalent to a standard 1.5m high noise barrier.	2.5m height trees	15m depth tree belt
Ow & Ghosh, 2017	This study was carried out to determine the effect of roadside vegetation on the reduction of road traffic noise under varying planting intensities. Roadside vegetation ranging from minimal planting through to moderate and dense plantings were used. The results showed that the traffic noise was reduced by 50% when vegetation was	Vegetation belts referred to are trees in the vast majority of instances	Moderate vegetation density required; 10m depth tree belt

Reference	Notes	Figures on threshold vegetation height	Figures on threshold vegetation depth
	enhanced from a minimal to moderate planting intensity, and no enhancement in noise reduction was observed as vegetation was further increased to a dense intensity. A 5 m depth of vegetation barrier was found to be an ideal depth for traffic noise reduction. This report also investigated the effectiveness associated with setbacks where it was found that the greater the setback distance, the higher the level of noise amelioration and a 10 m depth was identified as the threshold for an effective tree belt. On further investigation, the evidence in the paper suggests that while a 5m depth of general vegetation can provide some noise mitigation, a 10m depth for a tree belt is needed to achieve the best results.		
Waters et al., 2023	Tree belts and forestry can provide sound reductions of up to 6 dBA for a 15m depth, where performance depends on the spacing between trees, trunk diameter and leaf size and density. Generally, the larger the leaf side, the greater level of sound reduction provided. To achieve similar results to a dedicated noise barrier, vegetation belts need to be 15m thick with a shrub layer and care must also be given to the plant placements.	Other vegetation types do have a noise buffering impact, but only trees are referred to with regards to a capacity to abate noise in a comparable manner to a noise barrier	Tree belt of 15m depth
Forest Research, 2025	Planting “noise buffers” composed of trees and shrubs can reduce noise by five to ten decibels for every 30 m width of woodland, especially sharp tones, and this reduces noise to the human ear by approximately 50%. It is recommended to ‘plant tall trees where possible' to maximise the effectiveness of the capacity for vegetation to act as a noise barrier.	Noise buffers should comprise 'trees and shrubs' (i.e. trees with an understorey)	30m depth
GreenBlue Urban, 2015	With regards to tree size, it has been proven that noise reduction tends to increase with tree height up to 10-12m, after which it tends to decrease. This is a result of lower branches dying and allowing sound to travel more easily. Published results on the effectiveness of trees as sound barriers vary enormously, however, a study by Huddurt in 1990 shows that in some instances noise can he reduced by 6 dB over a distance of 30 meters where planting is particularly dense. Leonard and Parr (1970) and Reethof (1973) found that a dense belt of trees and shrubs between 15-30 m wide could reduce sound levels by as much as 6-8 dB. Cook and Van Haverheke (1972) found reductions in noise level of 5-10dB for belts of trees between 15-30m wide. Research also suggests that wide plantings (around 30 meters) of tall dense trees combined with soft ground surfaces can reduce apparent loudness by at least 50%.	10 - 12m is optimum height	15 - 30m depth vegetation appears to have notable noise reduction benefit

8.1.1 On the basis of the findings from the literature review, the conclusions in Table 8-2 were drawn regarding the threshold physical characteristics for vegetation to provide a noise reduction benefit.

Table 8-2 Threshold physical vegetation parameters identified for providing noise reduction benefits

Parameter	Threshold value	Logic
Minimum vegetation depth	15m	Median average depth threshold for a noise abatement benefit identified in the literature review
Minimum vegetation area	200m^2	Vegetation below this threshold area is assumed to provide 'little or no noise mitigation service' according to the ONS urban natural capital accounts (Office for National Statistics, 2019)
Minimum vegetation height	2.5m (and trees only)	Most evidence regarding vegetation height in the literature review pointed to the fact that only trees have tangible noise reduction benefit, hence only tree containing habitats should be considered. One study identified a stem height specifically of 2.5m.

8.1.2 To identify parcels of qualifying vegetation (which meet the above physical criteria) within the proposed scheme, Normalised Difference Vegetation Index (NDVI) imagery was used. This is a geospatial analysis that makes use of multispectral aerial imagery to assess how much light at certain wavelengths is being reflected by the surface at a given location. Healthy vegetation reflects more Near-Infrared (NIR) and green light compared to other surfaces, conversely it absorbs more light from red and blue wavelengths. Therefore, a calculation can be run on the NIR and red wavelength values for a given area to produce an NDVI value with a range of –1 to 1, indicating the presence of vegetation. A value closer to 1 indicates a higher vegetation density whilst a value closer to -1 indicates an absence of vegetation (e.g. hardstanding).

8.1.3 The other important element to understanding noise reduction is the number and type of receptors receiving this benefit. The available data on valuing noise mitigation benefits pertains to residential properties only; therefore, the OS Mastermap Buildings dataset was used, and buildings with a footprint greater than 15m^2 were removed as these are not likely to be residential. Research undertaken by Eftec (Defra, 2018) to develop the methodology for the UK NCA recommends that noise reduction benefits are valued only for buildings that sit within noise bands of 60dBA and above to avoid overestimating the benefits. Scotland's Noise Map (Scottish Government and Transport Scotland, 2024b) was used to overlay noise bands with the receptor data to identify those buildings subject to noise above this threshold with a qualifying vegetation parcel (in the line of sight) between the building and the respective noise source.

8.1.4 A value of £120 per annum (2023 prices) from the ONS urban natural capital accounts (Office for National Statistics, 2019) was applied to qualifying buildings to calculate the baseline noise reduction benefit from vegetation. This value represents the lower-bound value of the health benefits to individuals living in UK buildings (within noise bands above 60 dBA) benefiting from road noise mitigation of at least 1 decibel by vegetation.

8.1.5 To understand any changes to baseline noise reduction benefits resulting from the proposed scheme, the impacts to any qualifying vegetation parcels were reviewed in terms of potential

habitat loss. The post-development habitat map was overlayed to understand whether the proposed scheme would cause any qualifying vegetation parcels to drop under the threshold area (200m2) or depth (15m); in which case, the capacity for the parcel to provide a noise reduction benefit would be assumed to be lost. Vice versa, the post-development habitat map was also reviewed for any new vegetation (woodland – assuming only woodland would be of sufficient height) parcels which would meet the depth and area criteria and could be assumed to provide a noise reduction benefit based on their location relative to a noise receptor and source, as above.

8.1.6 The assessment revealed a single, qualifying building within the proposed scheme under the baseline. Furthermore, the post-development habitat map suggested that whilst the relevant vegetation parcel was to be somewhat reduced in size as a result of the proposed scheme, the changes would not cause it to drop below any of the threshold physical characteristics for providing a noise reduction benefit. The qualifying building and the respective vegetation parcel shown under the baseline and post-development habitat maps are presented in Figure 8-1. Additionally, no new qualifying vegetation parcels and buildings were identified as a result of the proposed scheme habitat creation. As such, the proposed scheme is not anticipated to have a tangible impact on noise reduction benefits and thus noise reduction was scoped out of the NCA.

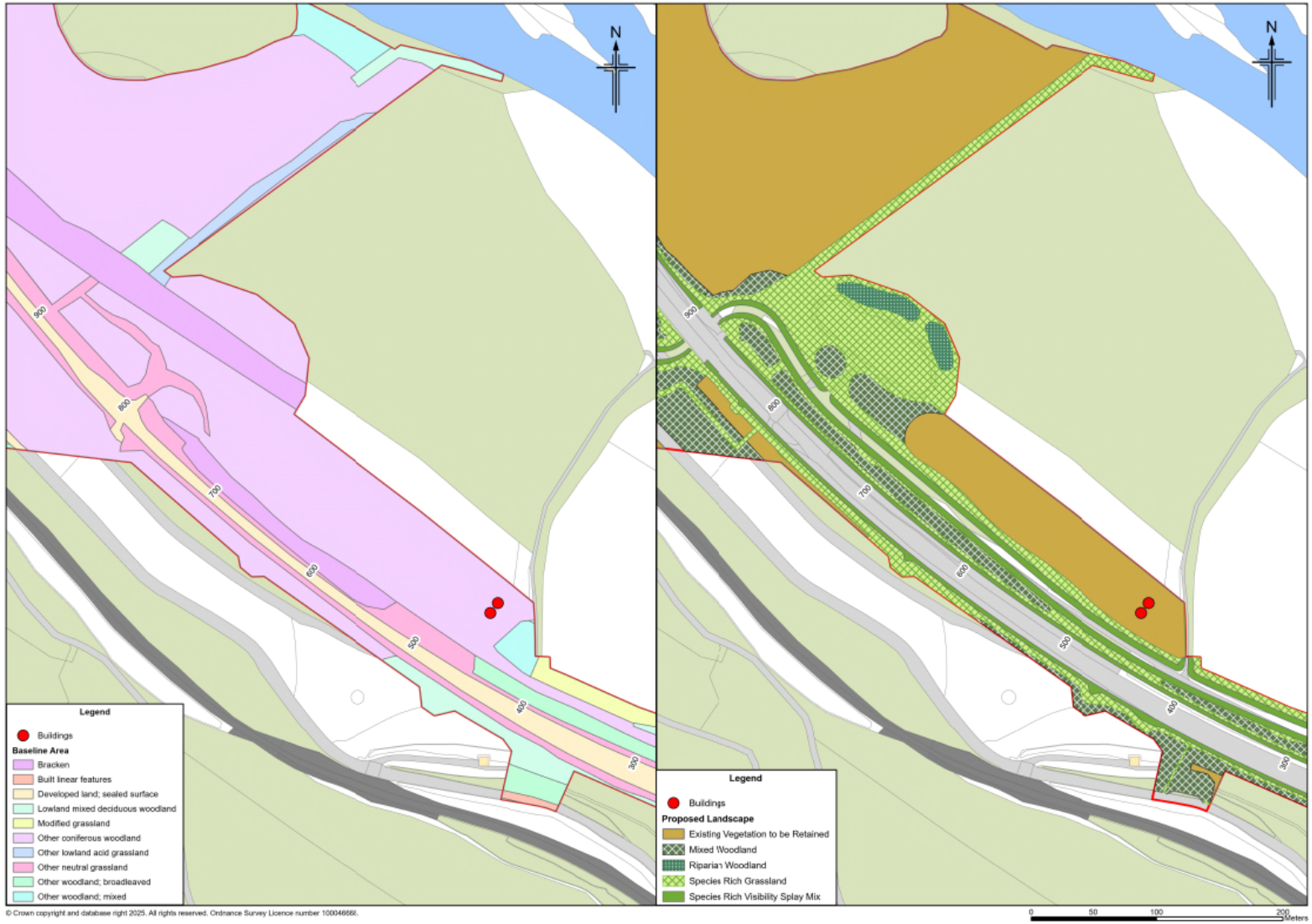

Figure 8-1 Building benefiting from noise buffering by vegetation and changes to qualifying vegetation parcel as a result of the proposed scheme

APPENDIX B Footpath enhancements

B.1 Connectivity improvements between Dunkeld and the Inver and River Braan areas

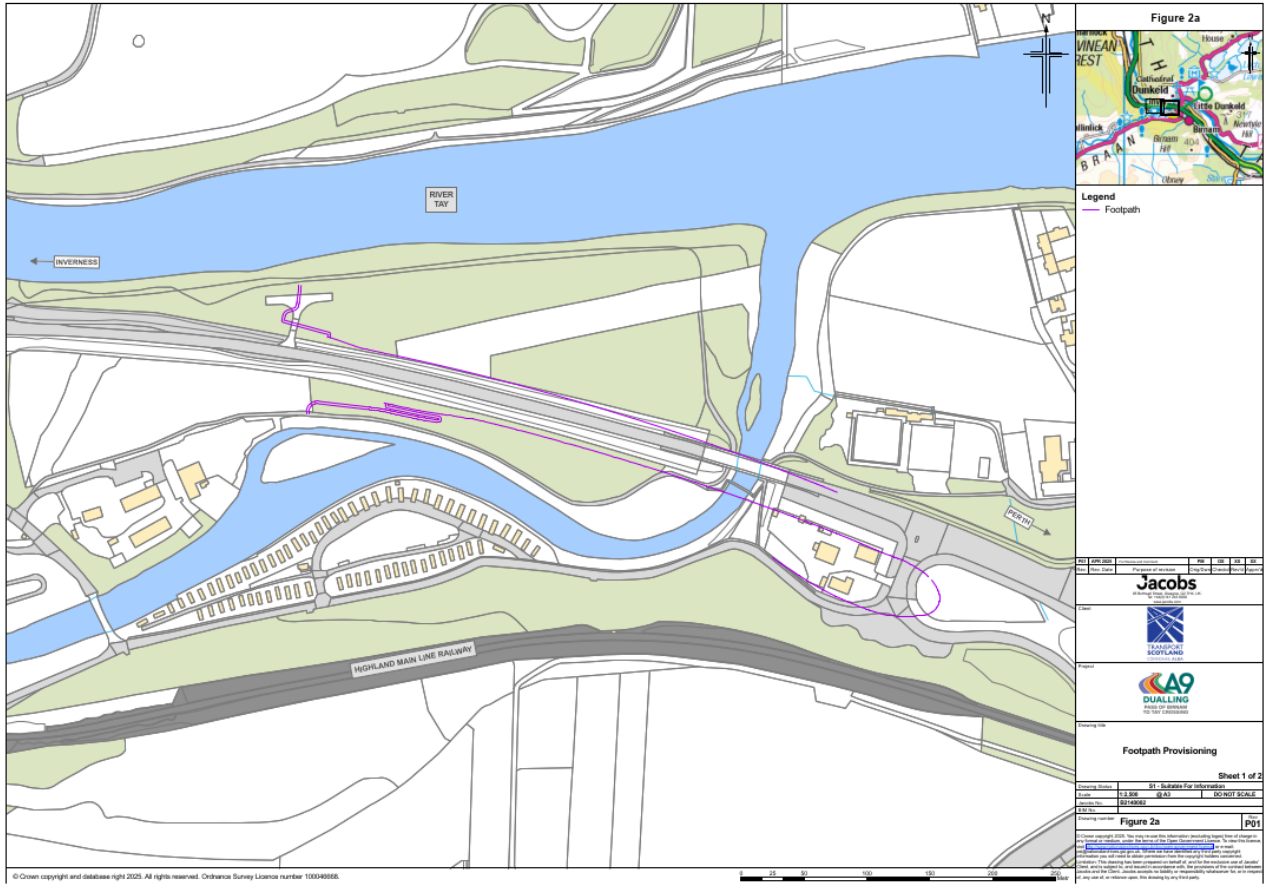

Figure 8-2 Proposed footpaths crossing the River Braan as part of the new main carriageway alignment

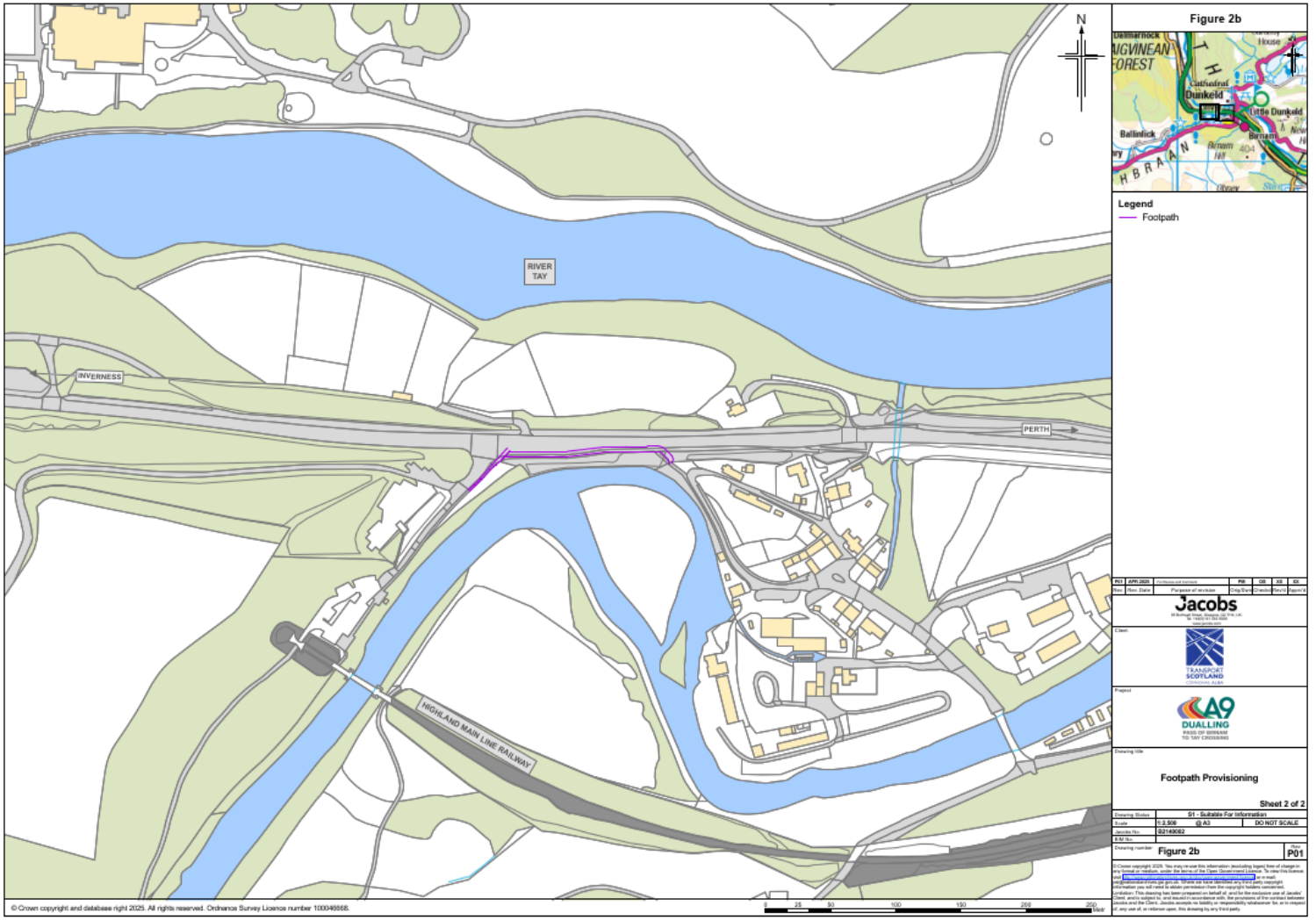

Figure 8-3 Upgrade to core path DUNK/64 (Path 41) which is often used to access the Hermitage

B.2 River Braan area footpath creation and enhancement

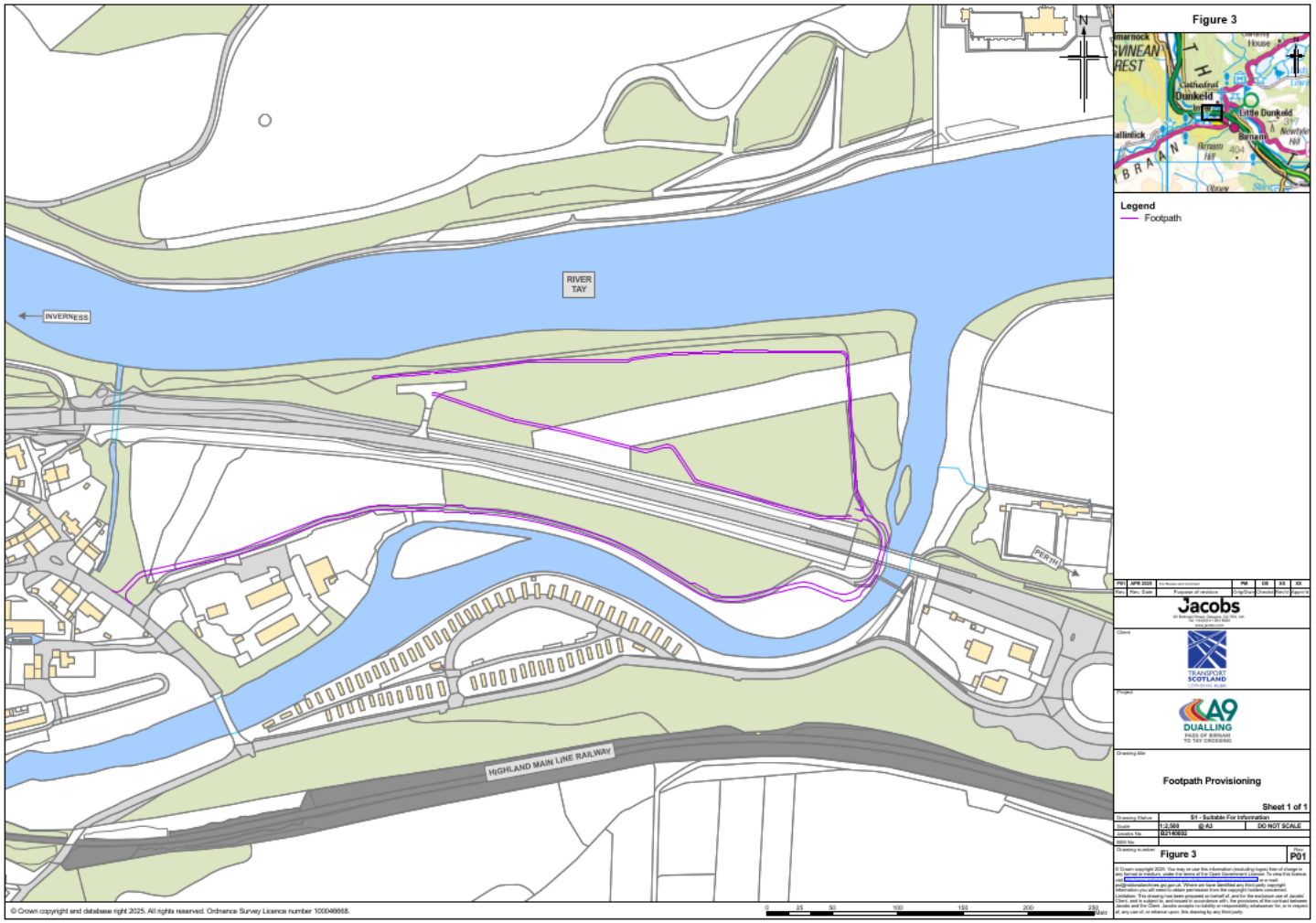

Figure 8-4 Enhancement of Path 35 and creation of new footpath for a new and improved circular route around the River Braan area

B.3 Ring Wood and Dalpowie connectivity improvements

Figure 8-5 New footpath connecting Path 21 (Ring Wood) to Path 15 (Dalpowie Plantation)


A9
DUALLING
PASS OF BIRNAM
TO TAY CROSSING

Jacobs


A9
DUALLING
PASS OF BIRNAM
TO TAY CROSSING


TRANSPORT
SCOTLAND
CÒMHDHAIL ALBA