IGNITION project – Nature-based solutions evidence base evidence review methodology

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The IGNITION nature-based solutions evidence base (available at www.ignitiongm.com) collates a large body of existing research that provides assessment of the benefits of NBS, using a range of quantitative, qualitative and mixed methods.

This document reports on the key stages of the methodology used to review evidence to compile the IGNITION NBS evidence base, including:

1. Determining the review question and scope
2. Establishment of the review team, time and resources constraints
3. Identifying the most appropriate evidence review method
4. Developing a review protocol
5. Structured search for evidence
6. Screening of collected evidence
7. Synthesis and reporting of results
8. Future updates

Stage 1. Determine the review questions and scope

The purpose of the IGNITION NBS evidence base is to provide evidence to help build a positive enabling environment for the development of a pipeline of NBS and accompanying business models.

To address this purpose, the primary question that the evidence review was used to answer was "*what are the quantitative physical flows of ecosystem goods and services delivered by nature-based solutions*".

This question was broken down into a series of sub-questions to reflect the diversity of types of NBS, including:

- Green walls

- Green roofs
- Streets trees and SuDS-enabled street trees
- Sustainable drainage systems (SuDS)
- Urban green spaces, parks and vegetation

Sub-questions were also used to capture the range of possible ecosystem goods and services which could be delivered through each different NBS type, including:

- Air quality
- Water quality and quantity
- Carbon storage and sequestration
- Health and well-being
- Noise
- Biodiversity
- Temperature and energy use
- Land and property prices
- Local economic growth
- Amenity and recreation

In addition, the scope of the reviewed evidence was further limited to the performance of NBS in an urban setting, as this is the primary focus of the IGNITION project.

In setting the scope of the review the collection of quantitative over qualitative evidence was prioritised to fit with the wider intended uses of the evidence base to feed into the identification of business models for NBS and the attraction of investment.

Stage 2. Establishment of the review team, time and resource constraints

The review team was established as two members of the IGNITION project, who were both able to contribute one day a week to the evidence review over a six-month period. The establishment of the review team allowed the time and resource constraints to be established as a two-days-a-week project over a six-month time frame.

Stage 3. Identifying the most appropriate evidence review method

A key challenge in the development of the NBS evidence base was how to best search, review and synthesise the large volume of existing information in a transparent way.

Evidence reviews (ER) represent ways of searching for, reviewing and summarising evidence to help answer specific evidence challenges. However, many different types of ER can be undertaken, including literature reviews, quick scoping reviews, rapid evidence assessment, systematic reviews and reviews of reviews (see Table 1). The choice of review method generally depends on several factors including: time and resources available and level of risk associated with the project (Collins et al 2015).

Literature reviews have traditionally been used to provide an overview of the evidence available on a subject, however, they are relatively limited fact-finding tasks and can be liable to bias and lack transparency. The limitations of literature reviews can be addressed through taking a more systematic approach to assessing evidence. However, full Systematic Reviews are highly comprehensive searches, which involve in-depth critical appraisals of the evidence necessitating significant time and cost to complete. Accordingly, Systematic Reviews are generally considered unsuitable for public bodies. Consequently, in selecting a review methodology for the IGNITION evidence base, both literature reviews and full systematic reviews were considered unsuitable.

The development of the methodology for the IGNITION evidence review, therefore, prioritised the use of either Quick Scoping Reviews (QSR) or Rapid Evidence Assessment (REAS), which can enable greater transparency and address biases inherent in literature reviews without the significant time and resources necessary to complete a systematic review. The use of QSR and REAS can provide an assessment of what is known about the benefits of NBS and an opportunity to use more systematic search methods, but will remain more limited in scope and rigour in order to reduce time and expenses. Both QSR and REAS can also provide an understanding of the volume and characteristic of the evidence available on certain topics and a synthesis of what that evidence indicates in relation to a question, in a format that is

accessible to further scrutiny (Collins et al. 2015; Speirs et al. 2015[1]). However, REAS also aim to provide *'a critical appraisal of that evidence'* (Collins et al. 2015), resulting in additional time and resources costs compared to QSRs.

For the IGNITION evidence base, REAS were selected as the evidence review methodology in order to enable as systematic approach to be taken to evidence collation as possible. However, it was not possible to also complete a '*critical appraisal of that evidence'* within the time and resource constraints of the evidence base review team.

Evidence Review type	Key characteristics	Time and resources
Literature Review	A non-systematic but quick collation and analysis of evidence	1 week to 2 months
Quick Scoping Reviews	A non-systematic overview of existing research on a constrained topic	1 week to 2 months
Rapid Evidence Assessments	A short but systematic assessment on a constrained topic plus critical review	2 – 6 months
Systematic Reviews	A broad systematic review of existing research on a topic	8 – 12 months
Review of Reviews	A full systematic review of existing review studies	6 months +

Table 1. Overview of Evidence Review types (Government Social Research Service 2013[2])

[1] Speirs et al (2015) Developing a rapid evidence assessment (REA) methodology – A UKERC TPA technical document, UK Energy Research Centre

[2] GSR. (2013). "Rapid evidence assessment toolkit." Civil Service, Civil service resources and guidance website

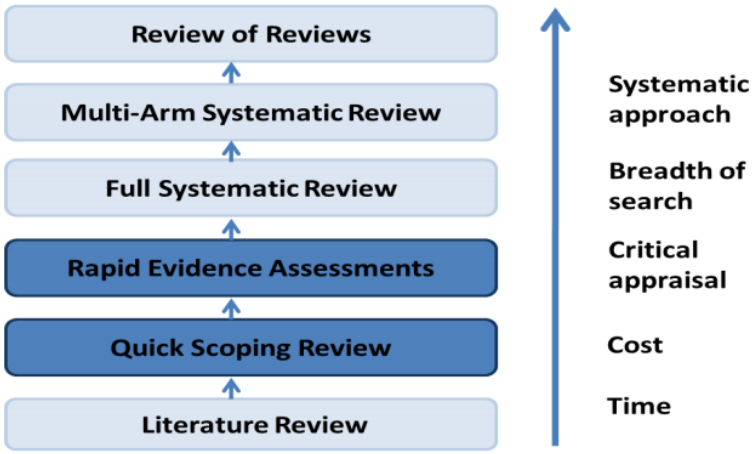

Figure 2. Civil service guidance on Rapid Evidence Assessments in relation to the family of evidence reviews

Stage 4. Development of the review protocol

Completing a Rapid Evidence Assessment requires the development of a systematic approach to reviewing evidence using a review protocol. A review protocol template was developed for the review team, outlining how the evidence should be collated, recorded and synthesised through the review period.

Review Protocol: IGNITION NBS Evidence Review

Aim	To quantify the physical flows of ecosystem service from a range of common NBS in an urban setting.
Scope	The scope of the review should prioritise where possible the collation of evidence from (i) the UK or Europe, (ii) evidence on temperate climate conditions, (iii) published since 2000s, (iv) published in English, (v) quantitative evidence over qualitative, and (vi) evidence from an urban setting. The scope of the evidence review is limited to the target types of NBS, including: • Green walls • Green roofs • Urban green spaces, parks and vegetation • Street trees and SuDs-enabled street trees • Sustainable drainage systems (SuDS) Target ecosystem services, including: • Air quality • Water quantity and quality • Carbon storage and sequestration • Temperature • Energy use • Noise • Land, property and rent prices • Health and well-being • Recreation and amenity • Local economic growth
Conceptual Model	The conceptual model for the review is the ecosystem services cascade produced by Haines-Young and Potschin (2010[3]).

[3] Haines-Young, R., & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. Ecosystem Ecology: a new synthesis, 110-139.

Methods	1. Evidence should be searched for each NBS subtype and category of ecosystem services following the search strategy (see stage 5). 2. The evidence items identified through the search strategy should be extracted and saved in the evidence database (see stage 5). 3. For each item of evidence included in the database, the following components should also be recorded: (i) type of NBS (ii) specific dimension of the NBS (iii) benefit pathway (iv) source, (v) hyperlink, (vi) date produced, (vii) type of evidence, (vii) any conditions and limitations of the study (e.g. number of people surveyed or number of parks surveyed), (ix) geographical location of the study (see stage 5). 4. Either quantitative evidence for a physical flow of ecosystem service or a qualitative evidence statement should be recorded for each item of evidence included in the database. 5. Evidence included in the database should be refined through the screening criteria (see stage 6).
Synthesis	6. Synthesis of evidence should report on the characteristics of the evidence base for each subtype of NBS, including (i) the quantity of evidence found, (ii) the geographic distribution of that evidence (e.g. does it relate to Europe or the US), and (iii) an indication of the main types of studies generating evidence (e.g. modelling studies or experimental studies) (see stage 7). 7. The synthesis of the quantitative findings should ideally include the average or range for each physical flow of ecosystem services and, where appropriate, the mid-point of this range.
Timeline	The timeframe for the review is October 2019 to March 2020, providing a six-month review period.

Table 2. Evidence review protocol

Stage 5. Structured search for papers

To identify evidence items, a key component of the review was a structured search for evidence from science and practice, and the collection of additional evidence where possible from experts and NBS suppliers. It is important that the search strategy covered a range of types of evidence in order to minimise public bias.

The main locations of search for each type of evidence are outlined in Table 3. In using academic search engines (e.g. Google Scholar) it is acknowledged that these sign-post to citations of academic research identified by 'crawling' the internet for information. Whilst these have the advantage of enabling a broader search they use unknown algorithms, which may change, preventing transparency and reproducibility.

Evidence type	Locations of search
Peer reviewed academic evidence	Databases of scientific peer reviewed evidence (e.g Google Scholar)
Grey literature (produced by government bodies, agencies, think tanks or consultancies)	Targeted searches of Reviews of Reviews and existing review of the benefits of green infrastructure published by key UK environmental organisations e.g Defra, the Forestry Commission, Natural Environment. Grey literature was also captured through Google Scholar.
Unpublished evidence (produced by experts or NBS suppliers)	Experts were identified through the IGNITION project team partners and an IGNITION event with NBS suppliers (Dec 2019)

Table 3. Locations of search

In order to search for evidence in a systematic and transparent manner, a series of keywords related to the review question were used to structure the search (see Table 4). Boolean operators (AND, OR, NOT) were then used to create search strings e.g. "green wall" AND "performance" AND "air quality", using combinations of the key search terms outlined in Table 4.

Intervention	Outcome
“green walls”; “green facades”; “living walls”; “green screens”; “vertical greening systems”; “hedges”	“performance”; “outcomes” “ecosystem services”, “health”; “well-being”; “air quality”; “pollution”; “water quantity”; “runoff reduction”; “runoff coefficient”; “infiltration rate”; “temperature”; “energy use”; “thermal insulation”; “peak flow”; “water quality”; “carbon storage”; “carbon flux”; “carbon sequestration”; “land price” “property price”; “rent price”; “noise attenuation”; “biodiversity”; “amenity”
“green space”; “green infrastructure”; “urban vegetation”; “urban park”	
“street trees”; “urban trees”; “suds-enabled street trees”; “roadside trees”; “verges”	
“Sustainable drainage systems”; “SuDS”; “swales”; “bioswales”; “rain gardens”; “ponds”; “filter strips”; “bioretention”; “infiltration trench”; “detention ponds”	
“green roofs”; “intensive green roofs”; “green envelopes”; “extensive green roofs”	

Table 4. Search terms used in the Evidence Review

Search results were then recorded in a database, including details of each individual piece of evidence. For each item of evidence included the database captured: the NBS type and specification, the benefit pathway, publication name and hyperlinked location, as well as recording the evidence (see Table 5).

Heading	Description
Type	Type of NBS to which the evidence relates.
Specification	Specification of the NBS which the evidence was generated from; this could be, say, seven urban parks across a city or an individual roof. For certain NBS types, key characteristics, such as depth or area, should also be recorded here.
Benefit pathway	A simplified representation and example of the relationship between the NBS type and outcomes in the benefit category that can be assessed e.g. shading by trees cooling surface.

Heading	Description
Evidence source	Full reference (+hyperlink), Name of organisation, author or contact (date produced/contacted), title of report/article/other, name of publisher, place of publication.
Date of publication	Year evidence produced.
Evidence type	Evidence, that is the work that underpins the report: T - Tool; R - Report; AS - Academic Study; LR – Literature Review, DP – Demonstration Project, SU – Survey, C – Conference report.
Physical flow of ecosystem services	Performance recorded.
Units	The units for the flow of ecosystem services (e.g. reduction in surface temperature would be ^{o}C per m^2, carbon sequestration would be Carbon kg m^2 yr)
Potential benefits for monetisation	Any aspect of the physical flow monetarised by the evidence sources.
Monetary value	The monetary value reported by the evidence sources.
Units	The units monetary value e.g. currency used.
Conditions or limitations	A description of the conditions of the study (e.g. modelling, experimental or survey study) can be recorded here. Any specifics which may allude to the context the evidence was generated through.
Location of the study	The geographical location of where the evidence was produced. For systematic studies and meta-analysis, 'international' is used or an indication is given of the geographical location of the majority of the studies included in the systematic review

Table 5. Structure of the evidence database

Stage 6. Screening the evidence

The review team then screened the results of the structured search to ensure that the database provided the most relevant evidence for the synthesis stage.

The screening process was done in a systematic manner with a predefined set of prioritisation criteria (outlined in Table 6). These criteria ensured that only the most relevant findings were taken to the evidence synthesis stage and led to the inclusion of 1,008 evidence items in the databases, from 562 evidence sources. Items which did not meet the prioritisation criteria were still recorded but were removed from the main database.

Screening criteria	
Geographical reference	Prioritisation of UK and European Studies, where available. If no, or limited, evidence available for UK or Europe then international studies were included.
Climatic conditions	Prioritisation of temperate climate conditions for benefits focused on temperature and energy. If no, or limited, evidence available for temperate climates then other climates were included.
Date	Studies published after 2000. If no evidence available for after 2000 then earlier were included.
Language restrictions	Only evidence published in English.
Outcome restrictions	Prioritisation of quantitative evidence where available. Additional qualitative evidence was also recorded where relevant but was not prioritised.
Urban	Prioritisation of urban evidence where available.
Type of study	Conceptual studies removed.

Table 6. Screening criteria for the NBS evidence base

Stage 7. Synthesis of evidence items

The screened evidence 6 month review produced 1,008 evidence items across the benefit categories. The evidence base was not intended to be a static finished production but designed to be a live repository of knowledge and evidence which will continue to be added to throughout the IGNITION

project. The process of synthesis was, therefore, performed relatively simply with a review to future updates.

For each NBS type and evidence category, the following aspects were reported on to give a sense of the characteristics of the evidence base: (i) the quantity of evidence items and sources available, (ii) the types of studies (e.g. modelling or experimental), (iii) the geographical origins of the evidence. For each of the benefit types a quantitative summary of the findings where provided where appropriate, e.g. the average, range and midpoints. Where insufficient quantitative data was found a brief qualitative summary was given where possible.
When reporting on quantitative figures, the screening criteria outlined in Table 6 were used to refine the evidence reported, where possible. For quantitative evidence the range, maximum and minimum figures were reported, where appropriate, and the midpoint of this range. Where evidence was excluded the reasons for this were stated.

Stage 8. Future updates

The database is designed not to be a static document but as a live repository of evidence on nature-based solutions. The simple format used in the database is designed to enable the continued addition of evidence by project partners, stakeholders and NBS suppliers over the course of the IGNITION project and beyond.