Delivering biodiversity net gain for infrastructure development through stakeholder engagement.

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ACRONYMS

BAP	Biodiversity Action Plan
BBOP	Business and Biodiversity Offsets Programme
BNG	Biodiversity Net Gain
CBD	Convention on Biological Diversity
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
DEFRA	Department for Environment and Rural Affairs
GI	Green Infrastructure
GLA	Greater London Authority
IEMA	Institute of Environmental Management and Assessment
IPBES	Intergovernmental science-policy Platform on Biodiversity and
	Ecosystem Services
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
KII	Key Informant Interview
LA	Local Authority
LPA	Local Planning Authority
LWT	London Wildlife Trust
NG	Net Gain
NGO	Non-Governmental Organisation
NNL	No Net Loss
NR	Network Rail
OECD	Organisation for Economic Co-operation and Development
SME	Small and Medium Enterprises
TOE	Trust for Oxfordshire's Environment

1 ABSTRACT

2

3 Biodiversity net gain (BNG) is a strategy to reverse biodiversity loss from infrastructure 4 development projects, which is gaining traction with industry and governments. However, 5 there is still a gap when it comes to incorporating knowledge and inputs of different 6 stakeholders in an effective way to deliver BNG. I propose closing that gap would enable 7 more effective design and delivery of BNG. In this research, I take the UK as a case study, 8 and show how local government, industry developers and consultants, nationwide and local 9 NGOs, and local interest groups can be brought together with the aim of delivering effective 10 biodiversity net gain, with genuine, long-term and measurable outcomes. I conducted key 11 informant interviews with experts within all these groups, and compiled project-specific case 12 studies. I uncovered five major themes in my research, that show that more effective BNG 13 can be achieved by incorporating previously excluded stakeholders, and having local 14 authorities, record centres and even NGOs and local groups, rather than just industry, take 15 some responsibility for making sure BNG is successful. I show the importance of designing 16 BNG projects with adequate respect to landscape ecology, using qualitative assessments of 17 biodiversity alongside quantitative metrics, and the need for effective monitoring and stewardship of projects to ensure long-term delivery. I show how in all five themes, closing 18 19 the engagement gap can help deliver more effective BNG, although not without some 20 uncertainty. Whilst contentious, I suggest that BNG could be a path forward for all 21 stakeholders to a more biodiverse future.

22 23

Keywords: biodiversity net gain, mitigation hierarchy, biodiversity offsetting, stakeholder
engagement, Lawton principles, landscape ecology, stewardship, offsite, record centres

26 INTRODUCTION

27

28 Biodiversity Net Gain: Background

29

30 The world's biodiversity as a whole is under-threat, as is well reported (CBD, 2014: IPBES, 2018), and this is replicated in the UK, where biodiversity is nationally declining (JNCC, 31 32 2018). This is occurring partly as a result of the increasing rates of development globally, 33 particularly in the energy and infrastructure sectors (OECD, 2012). Such developments are 34 threatening biodiversity not just in rapidly industrialising and particularly biodiverse countries. but here in the UK as well, because present legal and planning systems allow them to go 35 36 ahead with a loss of biodiversity. Despite some efforts, there are no guarantees to preserve 37 biodiversity at present, or historic, levels (Venter et al., 2016).

38

39 In order to preserve or enhance levels of biodiversity, it is necessary in the first instance to 40 mitigate against the impact of development. The 'mitigation hierarchy' (Figure 1) is one such 41 method of achieving this, and is gaining traction with governments and developers 42 internationally (Rainey et al., 2015). The first step of the hierarchy is to avoid affecting 43 biodiversity in the first place, followed by minimising the duration, intensity or extent of these impacts. The third level is to restore or 'remediate', in order to replace the previously existing 44 45 biodiversity or restore ecosystem functionality. The final level is to offset any residual loss 46 incurred after the first three steps have been followed. Offsetting requires measurable 47 restoration or creation of biodiversity to match (No Net Loss, NNL) or exceed (Net Gain, NG) 48 previous levels (Tallis et al., 2015).



Figure 1: The mitigation hierarchy showing the four levels of actions to minimise, or reverse, the impact on biodiversity from development. Offsetting can lead to NNL or NG (equivalent to Net Positive Impact). Source: The Biodiversity Consultancy.

50 Biodiversity offsets are defined as "measurable conservation outcomes resulting from 51 actions designed to compensate for significant residual adverse biodiversity impacts from 52 project development after appropriate prevention and mitigation measures have been taken" 53 (ten Kate & Crowe, 2014) - "actions" offsite or within a development's boundary (onsite). 54 Biodiversity Net Gain (henceforth 'BNG') is a goal for development where the impact on 55 biodiversity caused is outweighed by measures taken by implementing the mitigation 56 hierarchy, which may include offsetting, to the extent that the gain exceeds the loss (BBOP, 57 2018).

58

59 Biodiversity Net Gain in the UK

60

BNG has been picked up by Government and industry in the UK as a potential way forward in reversing the decline in the UK's biodiversity due to development projects. The need for sustainable development is well recognised in the UK, and biodiversity is a vital aspect of the world's potential sustainable future.

65

66 The industry sector in the UK chose to focus on BNG as a general outcome of development 67 (with offsetting as one way to achieve this), by making voluntary pledges to achieve BNG, 68 after offsetting pilots were carried out by HM Government in 2012 (DEFRA, 2013). Many 69 companies choose to measure biodiversity using the DEFRA biodiversity metric, which 70 assigns 'units' based on habitat type, rarity and quality (DEFRA, 2012). As well as metric-71 based calculations, they also adhere to accompanying 'best practice' guidelines: 72 international guidelines (e.g. BBOP, 2012; Pilgrim & Ekstrom, 2014), as well as the UK's 73 good practice principles (CIEEM, CIRIA & IEMA, 2016).

74

75 HM Government is responding to the advances of industry in this area by revisiting the 76 DEFRA metric and previous policy on this issue. The 25 Year Environment Plan (HM 77 Government, 2018a) made reference to BNG and the revised National Planning Policy 78 Framework, which outlines policy around the planning and execution of developments, 79 released in July 2018 references achieving "measurable net gains for biodiversity" under 80 Section 15: Conserving and enhancing the natural environment (HM Government, 2018b). 81 Additionally, a consultation had just closed as how to best update the DEFRA metric for 82 'version 2', which is planned for release in Spring. Finally, a new consultation has been 83 opened by DEFRA investigating the scope for mandatory BNG for development projects.

84

85 86

Challenges Achieving Biodiversity Net Gain

- 87 Literature has identified many challenges associated with the design and implementation of 88 BNG projects that are in need of improvement to increase BNG's efficacy. Throughout this 89 research, I refer to the aim to deliver 'effective' BNG through improving the process of 90 designing and implementing BNG projects. This means a BNG project has to deliver genuine 91 and long-term outcomes, not just outcomes on paper or in theory. This means that BNG 92 must be achieved from the perspective of ecological processes and functions, so that offset 93 projects are not out-of-place, ineffective, short-lived, inequitable in reality or unrealistic 94 (CIEEM, CIRIA & IEMA, 2016). As such, opposition to offsetting has generally been due to a 95 fear that offsetting schemes will not actually deliver biodiversity enhancements (Curran et al., 96 2014), although there have been arguments made academically for both sides (Quétier et 97 al., 2015; lves & Bekessy, 2015).
- 98

99 The collaborative involvement of stakeholders from across sectors is something that has 100 been highlighted as necessary for effective BNG (ICMM & IUCN, 2012; BBOP, 2012). 101 Gaining a consensus from more involvement of a variety of stakeholders is important in 102 order to identify biodiversity conservation goals (Clare et al., 2011; Pilgrim & Ekstrom, 2014). 103 Presently, it is unknown how much or how useful the knowledge held by local groups is, but 104 such engagement when designing offsets is likely to involve "constructive criticism", but that 105 this is critical when framed as positive collaboration (Robinson, 2012), which may assist 106 good decision making, which is key to genuine delivery (von Hase & ten Kate, 2016). There 107 is also uncertainty as to whether criticism from engaging local groups will derail development 108 projects, due to perceived local groups' distrust of industry and their aims (Bull & Brownlie, 109 2015). For the purposes of this research, I define 'local interest groups' as non-110 Governmental self-organised groups of people local to the project site, which partake in 111 monitoring and/or conservation of the local natural environment in an amateur/semi-amateur 112 capacity.

113

From a conservation science perspective, there are major concerns around attempting to put a definitive number on biodiversity (Gamarra et al., 2018; Apostolopoulou & Adams, 2015), or whether present efforts to do so are reliable or accurate (Moreno-Mateos et al., 2015; Panks, 2018) . The Convention of Biological Diversity does not define biodiversity as a quantitative element, and as such attempts to quantitatively measure it will have benefits and limitations (Baker, 2016; Addison, Carbone & McCormick, 2018). Best practice guidelines say how it is vital to use qualitative assessment alongside a main metric, such as DEFRA's in the UK, because a solely metric-based approach will not result in success (Gamarra et al.,2018).

123

124 Is it well reported that having several implementation options to choose from makes for more 125 successful BNG (ten Kate & Crowe, 2014; Bennett, Gallant & ten Kate, 2017), and once a 126 variety of options are identified then good decision making processes are required to make 127 appropriate choices, in order to ensure effective delivery (von Hase & ten Kate, 2016). There 128 is already some literature on selecting final options using various criteria (Oakley, 2017), but 129 there is a gap on how in practice industry should go about identifying potential options in the 130 first place for maximum efficacy.

131

132 The Lawton Review outlined the need for Britain's "ecological network" to be "more, bigger, 133 better and joined up" (Lawton et al., 2010), but these principles can be echoed globally for 134 better conservation: the need to look at conservation at a landscape-level is now well 135 understood by ecologists (Gonthier et al., 2014) and it is accepted that offsetting should 136 consider connectivity (Quétier & Lavorel, 2011). The original DEFRA metric calculates 137 biodiversity units based on area of particular habitat, not with respect to the wider landscape, 138 e.g. habitat corridors are not given a higher metric value (DEFRA, 2012). Good practice 139 principles however reference enhancing ecological connectivity and contributing towards 140 conservation priorities at regional and national, as well as local, levels (CIEEM, CIRIA & 141 IEMA, 2016).

142

143 BNG projects, especially offsets, often have a significant lag-time to realise the calculated 144 number of metric units (Maron et al., 2010). If BNG outcomes are to be genuine and 145 permanent, which is needed (Gardner et al., 2013; McKenney & Kiesecker, 2010), then long-146 term monitoring of BNG projects and appropriate stewardship, where long-term 147 management of BNG projects is required, are essential to delivery (Bull et al., 2013). There 148 is a potential value of involving local people in monitoring (Clare et al., 2011), and recent research has also highlighted the importance of achieving BNG from a social perspective as 149 150 well, ensuring 'equitability' for people affected as well as ecological enhancements (Griffiths et al., 2018). 151

152

A summary of the current process of designing and implementing biodiversity net gainprojects, within the context of UK infrastructure development, is shown in Figure 2.

9



Figure 2: the current process of designing and implementing a UK infrastructure development project that is aiming for a net gain effect on biodiversity. This is shown from a developer-centric point of view. Note that the option of offsetting brokers has been excluded from this flow diagram.

- 156 Aim of this Research
- 157

The overarching aim of this research is to investigate how the knowledge and inputs of a range of stakeholders can be better incorporated in the design and implementation of BNG projects, in order to produce more effective and long-term outcomes. Engagement of stakeholders in this way is framed according to five major research themes I uncovered, from the challenges identified above.

- 163
- 164 I: Should, and how should, industry collaborate with local interest groups?

What is the potential role that specifically local interest groups may have to play in the BNG design process? I investigate whether industry feels it under-engages with local groups, if they under-engage due to uncertainty as to whether groups will derail projects, and whether they feel further engagement would be beneficial for BNG.

- 169
- 170 II: What sources should we use to measure biodiversity?

171 I investigate what the opinions of stakeholders are concerning the use of single-metrics, and
172 how they think qualitative assessments should be used alongside it. At present, record

- 173 centres hold data collected by local groups, but how useful is this resource, and should174 industry be utilising it more?
- 175
- 176 III: How could industry find offsite locations for BNG projects?

Presently, how is industry finding offsite projects, and what role could other sectors play in
helping with this? I investigate if potential strategies for engagement between different
stakeholder sectors for finding locations could work together.

180

181 IV: How can BNG be designed for landscapes, based on the Lawton Principles?

182 I investigate how well adhered to these principles are, and where there is room for 183 improvement. I investigate who is responsible for advising industry on conservation targets 184 at a landscape level, and what role could local groups have in feeding into landscape 185 conservation strategy?

- 186
- 187 V: How can the long-term delivery of BNG be ensured?

188 Is long-term monitoring, and pre-funded, pre-arranged stewardship programmes important in

189 delivering effective BNG? Is there scope to involve NGOs as partners to carry this out? And

- 190 what is the potential involvement of local groups in these programmes, and what scope there
- 191 is for community engagement to deliver BNG for people as well as nature?

192 **METHODS**

193

194 <u>Literature Review</u>

195

196 My literature review looked at the UK Government's guidelines and policy regarding BNG 197 and offsetting, and the results of previous Government pilot surveys (e.g. DEFRA, 2013; 198 Baker et al., 2014). I reviewed literature regarding best practice guidelines for BNG and 199 offsetting projects already in place here in the UK, e.g. the core papers from the Biodiversity 200 and Offsets Programme (BBOP, 2012) and the good practice principles published by 201 CIEEM, CIRIA and IEMA (2016). This was followed by the British Standard code of practice 202 (BS 42020) and then industry vision documents such as Balfour Beatty's roadmap to BNG 203 (April 2018). This then moved onto leading peer-reviewed scientific literature on offsetting 204 (e.g. Bull et al., 2013).

205

206 Key Informant Interviews

207

In June–September 2018 I conducted key informant interviews with stakeholders from across sectors either currently involved, working towards, or with potential to be engaged in, design or implementation of BNG projects. I conducted sixteen one-to-one interviews and three paired interviews (with two informants contributing), totally twenty-two informants. My external supervisor provided the initial set of contacts, drawn from previous research (Oakley, 2017), which I then expanded.

214

I split the informants into four general categories and developed a set of tailored questionsfor each, so that the interviews were semi-structured:

- a) Industry covering everything from commissioning agencies to consultants and
 offset brokers, this group is defined by commercial operations in this area
- b) Non-governmental organisations this mainly covered charity NGOs that take a
 proactive part in BNG, or institutions specialising in environment management, or
 local interest groups
- c) Record centres a more specialised group containing organisations involved with
 the collation, processing and distribution (a service) of area-specific ecological data
- d) Government this group covers Government agencies involved with BNG, and local
 authorities involved with planning of developments and BNG projects
- 226

For groups A, C and D, I devised a closed-answer questionnaire which was emailed to them, getting six responses for group A. A mixture of multiple choice and Likert scale questions were used. The answers they gave were then discussed in the interview. The remainder of the interview followed the format of semi-structured open-ended question sheets. I drafted the questions, with feedback from my supervisors. Each informant's personal experience with BNG was unique, questions were tailored in-interview to remain relevant. The closed questionnaires and question sheets are shown in Appendices A-F.

234

As part of my interview protocol established with my supervisors, the names and companies of the key informants shall remain anonymous. All informants were circulated a consent form and the protocol (Appendices G and H). For the purposes of this report, the informants are given codes related to their specific sector category as shown in Table 1.

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0.....

Table 1: list of key informants, their sectors within BNG and their coding to preserve anonymity.

Category	Description			Description Co	
Consultants	Senior people with ecology specialisms working for	C1-6			
	consultants that design BNG for UK development. A senior				
	individual in a company that brokers offsets.				
Developers	Environment and sustainability managers working for	D1,			
	commissioning agencies carrying out BNG projects.	D2			
Local interest	A senior person working for a trust that manages BNG	L1			
groups	contributions from local interest groups.				
Ecology &	A senior individual from an organisation that devises and	E1			
industry expert	promotes BNG best practice internationally.				
Wildlife NGOs	Senior individuals working for charity NGOs involved with	N1-5			
	the delivery and management of BNG schemes.				
Record centres	Senior individuals working for record centres in the UK. A	R1-3			
	senior individual working for an association of record				
	centres nationally.				
Government	Senior individuals working for government agencies	G1,			
agency	involved directly with BNG/offsetting policy in the UK.	G2			
Local authorities	Senior individuals working for local authorities as ecologists	LA1,			
	or environment officers, involved with BNG/offsetting locally.	LA2			

I conducted a thematic analysis (Newing, 2011), so I selected information from the interviews that related to the five key research themes. It must be highlighted from the outset that the opinions and beliefs of the informants do not necessarily relate to 'fact', but rather relate to their own subjective experience of BNG in the UK. Also note that following reference to the "developers" (informants D1 and D2) in this case refers to individuals working for commissioning agencies that are steering the strategic vision of development projects.

250

251 Using key informant interviews has well published limitations, which I have mitigated against. 252 Mainly there can be uncertainty as to what is opinion and what is fact (Burgman, 2015) and 253 biases, especially confirmation bias, which refers to heavier weight researchers apply to 254 opinions that match pre-existing beliefs (McBride et al., 2012). This is mitigated against by 255 having a wide pool of informants, and a large sample size for studies of this type, and 256 directly comparing answers. My external supervisor advised on potential biases to be aware 257 of. She also assisted in tailoring my language used in both the questionnaire and the 258 question sheet to avoid ambiguities - in a highly technical area of industry and policy 259 language and vocabulary are very important (Burgman, 2015).

260

261 Case Studies

262

Due to BNG's young age, few UK projects are working towards BNG. Nontheless, I identified
five contrasting case studies into which I conducted further research, and three of which I
visited on-site. These case studies' key information summaries are shown in Table 2.

266

267	Table 2: key information summaries about the five UK-based project case studies referenced
268	in this research.

No.		Key Information			
	Project Name	The Greater West Programme			
	Туре	Linear railway development run by Network Rail that involved			
		electrification, resignalling and upgrade of the Great Western main			
		line.			
1	Location	Main line between London, Bristol and Cardiff.			
	Key Feature	NR have collaborated with the Trust for Oxfordshire's Environment to			
		identify potential locations as suggested by locals, who can apply for			
	funding; applications are assessed by a panel of experts. Successful				
		pilot idea for a large-scale development finding offsetting ideas.			

	Relates to	Theme 1: collaboration with local groups; Theme 3: finding offsite		
		locations.		
	Project Name	Woodberry Down		
	Туре	Housing redevelopment and gentrification run by Berkeley Homes.		
	Location	Hackney, Greater London.		
	Key Feature	Mainly high-quality apartments have been developed adjacent to and		
2		in conjunction with the Woodberry Wetlands, a newly opened reserve		
<u> </u>		that was backed Berkeley. Example of how an NGO, the London		
		Wildlife Trust (LWT) can take stewardship of a site, ensuring long-		
		term gains. The LWT have also started a programme of engagement		
		with the local community.		
	Relates to	Theme 5: delivering long-term BNG.		
	Project Name	Kidbrooke Village		
	Туре	Housing and leisure redevelopment run by Berkeley Homes in		
		partnership with Greenwich Borough Council.		
	Location	Greenwich, Greater London.		
3	Key Feature	New 'village' is being built in phases, and replaces the dilapidated		
-		Ferrier Estate that had become notorious in the area. All biodiversity		
		enhancements are taking place onsite. Case study of landscape-		
		considerate design, and using an NGO (LWT) as a stewardship		
		partner for long-term delivery.		
	Relates to	Theme 5: delivering long-term BNG; Theme 4: landscape BNG.		
	Project Name	The Thameslink Programme		
	Туре	£7bn linear railway upgrade scheme run by Network Rail.		
	Location	Brighton, London, Peterborough main line; London Bridge station.		
4	Key Feature	Lack of and late timing of engagement and misunderstandings with		
		local groups led to conflict over the planting of trees on public amenity		
		land (Streatham Common) and limited the effectiveness of outcomes		
		on this project.		
	Relates to	Theme 1: collaboration with local groups.		
	Project Name	Hinkley Point C		
	Туре	Nuclear powerplant development run by EDF Energy and consultants		
5		Mott MacDonald.		
	Location	Remote Somerset coastline.		
	Key Feature	Isolated development means local group engagement not always		

	possible or helpful. A series of 'landscape enhancements' have been
	designed to boost biodiversity specifically at a landscape level.
Relates to	Theme 4: landscape BNG.

269

270 The case studies were developed by researching publicly available documentation on the

271 projects, visiting sites (for the first three examples listed), and interviewing key informants.

272 They helped inform my core findings with a real-world scenario, and show how lessons can

be learned, either to be replicated or avoided in future, from these developments.

274 **RESULTS**

275

276 <u>I: Should, and how should, industry collaborate with local interest groups?</u>

277

Two-thirds of industry informants felt they worked with local interest groups "not enough" and a third thought that this was "somewhat problematic" (half felt that at present this had a neutral effect). However, from the outset, all consultants and developers outlined that working with local interest groups had inherent trade-offs, rather than being a case of more engagement is always better.

283

Such trade-offs often concerned resources available (i.e. not enough people, time or money to effectively and comprehensively engage with relevant local interest groups) – "we would *like to worker closer with groups, but we lack the manpower*" (D1). The other major trade-off cited was the 'frustrating effect' whereby opening up discussions with local interest groups would lead to such groups using any information or the opportunity to derail developments.

289

A couple of consultants particularly highlighted that for many projects there may not be directly relevant interest groups to consult with, for example if the project site is remote or on privately owned land where no groups have activities.

293

Several developers and consultants, as well as local and national government informants, and several NGO informants outlined a potential role for local interest groups in informing and working with local authorities to inform a landscape-level strategy for BNG, for example it was *"vital for local authority to be guided by our locals"* (LA1).

298

299 C6, the informant involved with brokering offsets, highlighted that local interest groups 300 formed a major part of their business model. They often work directly with local interest 301 groups to identify possible sites for offsetting, which they then broker on behalf of 302 developers. (Note: brokers do not undertake works themselves.) A variant of this model was 303 cited by D2, who identified local interest groups and possible projects to allocate funding to, 304 rather than undertake the project directly. However D2 highlighted this is in conjunction with 305 an NGO delivery partner rather than a commercial broker (see Box 2).

306

307 Several examples were highlighted where earlier engagement would have been beneficial to 308 BNG designs. Of presently used forms of engagement, the most common, listed by twothirds of industry informants, was to consult groups for feedback on already-proposeddesigns for BNG.

311

Box 1: Case Study: The Thameslink Programme.

See Table 2 for key information This £7bn project featured various improvements for the railway line from Bedford in the north down to Brighton in the south, through central London, including the redevelopment of London Bridge station (www.thameslinkprogramme.co.uk). Here, improvements could be made when it comes to engaging local groups to enhance effectiveness. Issues arose as local members of the public caused small-scale damage to offsetting sites on amenity land, as they were unhappy with the work carried out. "Earlier engagement with local groups affected by the proposed offsetting schemes may have helped [increase effectiveness]" (informant N1). This case study shows the potential problems that could arise without early and thorough stakeholder engagement.

To facilitate the London Bridge redevelopment, an area of silver birch woodland near the Selhurst Depot was removed to house trains overnight. This constituted unavoidable biodiversity loss, which it was decided to offset against, with the aim to achieve BNG (Woodley, 2015).

Thameslink worked with the London Wildlife Trust (LWT), who had an ambition to restore the 'Great North Wood', which spanned large areas of south London in the past. As such, potential sites for a woodland planting scheme were identified and selected based on potential biodiversity gain and projected cost. The Thameslink Programme used DEFRA's metric for all calculations and selected Streatham Common as an appropriate site that would deliver the greatest biodiversity benefit. The LWT and Lambeth Borough Council were delivery partners (CIEEM, 2013).

The project was used as a pilot study for DEFRA and there were both positive and cautionary take-aways. Positively, The Thameslink Programme demonstrated a commitment and practical delivery of the BNG concept, from design to implementation, even if it will be several years before the biodiversity potential is realised. Ecologists working for The Thameslink Programme identified key ecological functions that were to be lost at Selhurst and aimed for the offset to replace these at Streatham, marking a pragmatic approach to function-based conservation.

Improvements could have been made with respect to local interest group engagement. Informant N1, who worked on the project, told me they felt one key group, the Friends of Streatham Common could have been engaged earlier. There was local scepticism surrounding the project: N1 reported once planting had taken place some saplings were removed by disgruntled locals. The Friends also voiced concerns that after three years, when stewardship of the trees passed to the Council, there would be insufficient funding to properly maintain the trees (Environment Analyst, 2014). The significance of these concerns will become clearer with time, although lessons learned can be taken forward for future projects.

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3 II: What sources should we use to measure biodiversity?

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All industry informants said Defra's metric was their main metric used when measuring losses and gains in biodiversity, and likewise local authority and record centre informants corroborated that DEFRA's metric is the one most commonly used on BNG projects.

318

All industry and government/local authority informants recognised limitations with any metric for biodiversity, as a single number cannot *"represent the rich complexity of biodiversity"* (C5). However, all also defended its use as a pragmatic way to bring about measurable BNG. Many also highlighted other elements, such as like-for-like offsets (i.e. replacing broadleaf woodland with broadleaf woodland) and as-local-as-possible offsetting, were outlined in best practice guidance (BBOP, 2012) and did not necessarily need to be factored into a metric.

326

However, overall support for the continuation of DEFRA's metric was broad and robust. All industry informants thought it should continue and guide those designing BNG. G1 and E1 said the metric will *"evolve but retain its main form"*. The metric may be simple and *"crude but fit for purpose"* (LA1, also E1), even if developers did not always follow best practice, they said.

332

The majority of industry informants said qualitative assessments should form an important (E1 said *"essential"*), but supplementary, element to BNG design, alongside a metric calculation. They recognised many ecological aspects, especially ecosystem functions and services, are not captured by the metric (Sonter et al., 2018), but should be qualitatively assessed and aimed to be restored, replaced or improved in BNG projects. 339 I investigated the role of local ecological record centres in providing quantitative and 340 gualitative data for BNG designers. All three informants from record centres said their role 341 had great potential to be expanded with the advent of BNG as a service-driven sector 342 demand for data would emerge. Record centres offer data-processing and presentation 343 services as well. All industry consultants said working closely with record centres was very 344 valuable because of the 'cleaning' service they provide – they take data gathered by local 345 interest groups or individuals and are able to sort dubious data from robust data, a vital and 346 time-consuming service found useful by consultants.

347

338

Record centre informants agreed record centres need to collect *"as much data from local interest groups as possible"*, including qualitative reports of local sites (rather than just metrics). R1 and 2 outlined their ambition to form closer ties with some larger interest groups to ensure regular and updated data exchange, and to form an active network of such groups. R3 said in the future it may be possible to use such networks to facilitate contact between industry and relevant local interest groups for particular BNG projects, as a potential service, saving industry the legwork of finding interested and cooperative groups themselves.

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6 III: How could industry find offsite locations for BNG projects?

357

358 "Onsite offsetting was always preferable" (D1), following the mitigation hierarchy, and if 359 biodiversity loss can be compensated on the development site, this option is usually "least 360 contentious", quickest plan and execute, and hence potentially more effective, rather than 361 working with multiple third-parties, but it is not always possible.

362

363 C6 (the offset broker) informed me that finding offsite projects is their main business model, 364 working with local interest groups, LAs or landowners to secure potential offsets. Brokers 365 hope they can become the main way of finding and locating potential projects as a 366 commercial service (C6). This view not shared with several industry informants and record 367 centre informants.

368

Some informants expressed their interest to set-up their own schemes for potential BNG projects. Perhaps, the role of appropriate agencies could be to collate information about areas in the country in need of enhancement or regeneration, which can be utilised by developers (G2). Local government, NGO and record centre informants also said this regarding their own organisations, although it is uncertain whether these schemes would be in competition if all realised. They would also likely be in competition at least with brokeringcompanies.

376

There is potential for NGOs to partner closely with record centres to identify potential projects by working with local interest groups (N1). Such local group networks, as mentioned, can be maintained by record centres, and already exist for many NGOs (N1 and 2). There is a potential synergy here when working with industry, as some consultants also referenced this as a potential way of working.

382

Several informants from across sectors agreed that many projects for BNG can be local interest group-led. The main task is finding such groups with good potential projects that perhaps lack funding, refinement of ideas and technical support. NGOs felt there are wellplaced to find and collate these potential groups, although LAs also independently said it should be them that take the lead on this sort of database, lest it be a chargeable service, and hence turn NGOs into *de facto* brokers.

389

Box 2: Case Study: The Greater West Programme

See Table 2 for key information. This programme is the linear upgrade works of the Great Western main line between London, Bristol and Cardiff, including electrification, resignalling and station upgrades, managed by Network Rail Infrastructure Projects. This case study provides an excellent example of how to select offsite projects by working with local interest groups. NR have set up a panel to assess applications for grants for offsetting projects. They are working with the Trust for Oxfordshire's Environment (TOE) to identify potential projects and help groups apply for funding. Because of this, this case study provides an excellent example of how to find and select offsite projects by working with local interest groups, and a model for how a rigorous and robust approach may be applied for large linear developments in the future.

The programme has committed itself to a 'no net loss' approach to biodiversity, and after following the mitigation hierarchy, decided to select offset projects. Biodiversity loss has mainly been incurred due to the loss of tree cover alongside the railway tracks, required mainly for access for construction vehicles and to build and operate new infrastructure required for the electric trains. D2, a senior individual working on the programme, told me that the calculated loss of biodiversity is around 450 biodiversity units (DEFRA's metric).

These units have been split by local area, as it is best practice to have offsetting occur as locally to the damage as possible (BBOP, 2012). Local authority was chosen arbitrarily (after consultation) as a representation of locality. A grant panel was then set up to assess potential offsetting projects brought before it and allocate out funding. The panel is made up not only of individuals working for the Greater West Programme but also TOE, LA representatives and ecologists. Proposals for offset projects are filed by local interest groups, local authorities or individuals.

The Greater West Programme spans the width of the UK, and as such this method for finding offsite offsets would not be practicable for many developers. However, it has had success in robustly and comprehensively finding projects. In Oxfordshire, the programme is working with TOE to allocate funding to suitable projects. L1, a senior individual in the Trust, told me that they are not a delivery body, but work closely with local interest groups in the county to come up with potential projects, and then assist them with Network Rail Infrastructure Project's application procedure. The Trust has the outreach into the local area that the Greater West Programme would struggle to achieve working alone.

Applications submitted are then scrutinised and assessed by individuals within the Greater West Programme, who act as biodiversity consultants. They calculate biodiversity units of the offset applications, and assess whether they meet the criteria for an NNL offset, e.g. like-for-like or like-for-better. The panel specifically assesses the wider biodiversity conservation value of the project, bringing their expertise and local knowledge that the Greater West does not have, which is an effective collaboration.

The first project to get funding approved is run by the private Wormsley Estate (in effect a local interest group), with assistance from the Chiltern Society. They will use the Greater West Programme's grant to plant two hectares of rare box woodland, a highly distinctive habitat, with a high potential biodiversity value (but a long lag-time before that is realised), and 20 hectares of beech and yew woodland enhancement.

The offsetting scheme is a pilot, although the collaboration with TOE has led to promisingly robust project finding and selection; this case study could be a positive example for the future, in order to deliver BNG on large-scale developments such as HS2.

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393 IV: How can BNG be designed for landscapes, based on the Lawton Principles?

394

395 It should be the "responsibility of the local authority" (LA1 & 2) to have a clear plan for their 396 area's landscape-level ecology, which can be referred to as 'green infrastructure' in an urban 397 context (Natural England, 2009). Many LAs have published their own green infrastructure 398 guidance or biodiversity action plans (BAPs) that reference landscape-level ecology, 399 although these can be of "variable quality" (G1 and C3). LA1 said the onus should be on LAs 400 to publish guidance for all developers regarding habitat connectivity and landscape-level 401 ecological processes with explicit reference to the habitats and landscapes of that particular 402 area, perhaps even setting connectivity targets that could be aimed for by developers 403 carrying out BNG projects.

404

It was mentioned several times that realistically a LA could only produce such publications with an in-house ecology team (although C2 said such guidance can be effectively produced by commissioned consultants). But others felt specialist ecologists working for an LA are *"always best placed to advise"* on that area's ecology (LA2, C2, C3), rather than outside consultants. It was often repeated that *"only"* one third of LAs at the moment employ inhouse ecologists; both agency and consultant informants agreed this was suboptimal.

411

412 All industry informants said that working with LAs (who are in charge of planning applications 413 for developments) was an important aspect of a development, and where a LA requires BNG 414 to be achieved as a mandatory aspect of development (e.g. Warwickshire) then working with 415 the in-house ecologists is very helpful to achieve this. LAs have a big role to play in shaping 416 and ensuring BNG was executed effectively (E1). Considering SMEs (small and medium 417 enterprises) are mostly "ignorant" (G1) of BNG and what is good practice to achieve BNG, 418 the guidance of LAs can be especially helpful (although it should be noted I did not interview 419 any representatives from SMEs).

420

421 Finally, several informants across a range of sectors all agreed that it is very important local 422 interest groups and NGOs are engaged by LAs' ecologists when they are creating such 423 landscape-level guidance. Local interest groups hold a large bank of qualitative knowledge, 424 record centre informants said, that can be accessed by LAs to better inform landscape 425 policies for that area. LA1 went further to say it is not the responsibility of industry 426 developers to engage local groups, but the responsibility of LAs to do this on their behalf. 427 and collate and feed back to industry at the planning phase. This was partly accepted by 428 other informants, who agreed with the view that LAs should be engaging local groups to feed 429 into plans that are then utilised by industry at least.

Box 3: Case Study: Hinkley Point C Nuclear Powerplant.

See Table 2 for key information. The new power station, Hinkley Point C will be built on already 'brownfield' land. EDF Energy, the owners, are not explicitly seeking BNG, but consultants Mott MacDonald have designed a series of landscape enhancements to surround the site that they aim to have a greater biodiversity when complete than the 'before works' baseline.

The construction of the power station will bring with it associated medium-term developments such as a construction workers' park and ride facility. These will cause "temporary" biodiversity loss while they are in use over the next decade (before being removed). As such the enhancements aim to offset for this loss, too.

C3 and C4, ecological consultants working on the project, told me that they have not engaged local interest groups because in this example they did not identify any appropriate groups local to the nuclear site. Consultations have however been launched into the enhancement plans with the nearest local residents. Additionally, the enhancements have been designed from a landscape perspective, encompassing meadows, woodland and river basin enhancements and new planting with the aim of creating corridors and a connected landscape.

431

432 V: How can the long-term delivery of BNG be ensured?

433

434 All informants agreed on the vital need for all BNG projects to lay out clear plans for who will 435 look after the offset in the future once construction for the development is complete. 436 Monitoring of BNG sites must take place long-term so industry can learn "what works and 437 what does not" (C5). Monitoring also enables checking as to whether the biodiversity units 438 predicted have been delivered (C6). A couple also agreed monitoring is vital to back-up 439 claims of BNG with measurable evidence - that "outcomes are genuine" (G1). G1 also said 440 that LAs/LPAs should be responsible for making sure that industry developers have these 441 monitoring plans in place and funded in advance of any proposed BNG project, although this 442 is not a legal requirement at present.

443

444 'Stewardship' in this case refers to who will look after the BNG site when the primary work is 445 completed by developers and the site must be looked after to realise its potential

430

446 biodiversity, rather than explicitly about monitoring (although the two often will come hand-in-447 hand). All industry and NGO informants agreed on the potential for NGOs to take a more 448 active role in stewardship of BNG projects, pairing with developers as 'delivery partners' (at 449 least referring to delivery in a long-term sense). Such a policy would be very specific to 450 NGOs, and only the largest of NGOs may choose to take on such a responsibility (N2). 451 Funding was seen as less of an issue because it was assumed at least in the medium-term 452 the developers would financially contribute to stewardship of sites, as part of their 453 commitment to delivering BNG.

454

455 Stewardship projects would *"greatly benefit"* from the involvement of local interest groups as 456 key stakeholders (N1 and R1). Engaging them at the design phase also may help them to 457 get involved in the stewardship phase. Local groups are unlikely to be given full stewardship 458 responsibility, unless a small project, but may partner with larger NGOs on bigger projects.

459

Box 4: Case Study: Woodberry Down Housing Development.

See Table 2 for key information. Woodberry Down is a new housing development, primarily consisting of high-quality apartments, in Hackney, London. The site has been developed next to and in conjunction with the Woodberry Wetlands, a newly opened reserve that was backed by developers Berkeley Homes. This case study is a good example of how an NGO, the London Wildlife Trust (LWT) can take stewardship of a site, ensuring long-term gains. The LWT have also started a programme of engagement with the local community, which ensures the delivery of BNG for people, as well as ecological enhancements.

In conjunction with the Hackney Borough Council, developer Berkeley Homes is in the process of gentrifying a previously run-down council estate, providing new homes for previous occupants and creating thousands more new accommodation, mainly of a premium finish and price. The development lies adjacent to two reservoirs previously owned by Thames Water. In the 1990s it was proposed that the reservoirs were filled in, but a local residents' campaign saved them. One was sold to the Borough Council as a leisure facility (which remains today), and the other stayed out-of-bounds (access was only granted for Thames Water maintenance). In 2005 a community garden was established in the far corner of the site, but access to the reservoir was still barred.

The LWT helped write a proposal to open the reservoir up and turn it into a wetlands

centre. This was then successfully backed and promoted by Berkeley Homes, who also provided some funding for the venture, as well as support and assistance. Works were carried out by a range of groups, including volunteers and Berkeley, and the wetlands centre opened in 2016 – this included the planting of reed beds and the creation of islands, as well as a visitor centre/café and LWT outreach hub – the LWT have worked closely with locals to engage them in the project to foster a sense of responsibility for the local natural landscape.

N3 (an individual working onsite at Woodberry Wetlands for LWT) told me that the community is a vital part of the project. The original members of the community garden input into the designs, and the groundwork, for the new wetlands. LWT work with the new residents' association to get together volunteers for monitoring, maintenance and enhancement of the site, ensuring the residents of the new development are engaged with this project. Additionally, LWT emphasise bringing different societies together, ranging from the original occupants of the previous council estate to the new residents of the premium apartments. The outreach hub also runs a "Tiny Tadpoles" pre-school group to foster a natural world interest in the youngest city residents. There is still work to do with respect to the water quality and aquatic life, but the wetlands have been successful in raising measurably at least the avifauna locally. See Figure 3 (Results) for photographs of the Woodberry site.

This project has not been used as an example of biodiversity offsetting, but may demonstrate how such BNG projects could be approached in the future. There is the potential to identify sites such as the previous reservoir, that are adjacent or nearby to a planned development, and for which there could be an enhancement programme to deliver higher levels of biodiversity. The level of local engagement seen here also delivers BNG for people, as well as nature, echoing recent research (Griffiths et al., 2018).

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Box 5: Case Study: Kidbrooke Village Housing Development.

See Table 2 for key information. Kidbrooke Village is an urban regeneration scheme led by Berkeley Homes in partnership with Greenwich Borough Council. The new 'village' is being built in phases, and replaces the dilapidated Ferrier Estate that had become notorious in the area. All biodiversity enhancements are taking place onsite, with the vision to create a 35ha 'tongue' of green open space, made up of chalk streams, heathland and wetland, running through the entire development, down towards the preexisting Cator Park in the south, to be called Kidbrooke Park. This is a good case study of landscape-considerate design, and using an NGO, here the LWT, as a stewardship partner for long-term delivery.

Ecologists at Berkeley Homes have developed in their masterplan the "nine concepts" around 'making space for nature and beauty', which include green infrastructure, connectivity, species diversity and management. They have partnered with the LWT as stewardship and delivery partners. I interviewed and was shown around the site by N4 and N5, individuals working on the project for LWT. They said no local interest groups were involved with the design of the masterplan, as it was assessed that none were really present on the Ferrier Estate, there are robust plans in place to form a volunteer corps at the visitor centre that will be built by Berkeley, and managed by LWT. This project is not explicitly aiming to achieve BNG, although the masterplan vision laid out by Berkeley, LWT, GLA and Greenwich aims to generate greater biodiversity than the low baseline of the previous Ferrier Estate.

Full completion is aimed for around 2030. However, presently this represents an example of involving NGOs in a biodiversity strategy considering a whole landscape, working onsite, and delivery community engagement to result in effective and genuine outcomes. See Figure 4 (Results) for photographs of the current site and a model of the future masterplan.

461

Figure 3: Photographs of the Woodberry Wetlands. Clockwise from top left: a view from the café terrace overlooking reedbeds and the newly surfaced walkway, showing the use of the new site by the community. A view from the far side of the wetland looking back towards Woodberry Down – older council housing to be replaced can be seen on the far right. A view of the new boardwalk towards the main entrance next to the new residential high-rises, showing the proximity of developments. All photographs © Henry Grub 2018.



Figure 4: Photographs of the under-development Kidbrooke Village. Clockwise from top left: 'chalk stream' recreation at a completed part of Kidbrooke, showing a variety of planting used. New trees planted along new walkways around the site of the prospective Kidbrooke Park, show the use of the park for ecological and amenity purposes. A model of the masterplan of the whole complex and park running through the middle (Source: Berkeley Homes), shows how the plan to have a tongue of land running through the Borough. All photographs © Henry Grub 2018.



475 **DISCUSSION**

476

477 BNG and the mitigation hierarchy has the potential to be applied much more widely than for 478 just industry development, in fact the hierarchy may become a global tool for conservation 479 (Arlidge et al., 2018). Thus, it is important that outcomes are genuine, effective and long-480 lived. The collaborative involvement of stakeholders is necessary for effective BNG (ICMM & 481 IUCN, 2012; BBOP, 2012), yet my research shows that at present those designing BNG 482 projects are under-engaging with local interest groups, which supports Pilgrim & Ekstrom's 483 (2014) previous statements that more involvement is needed for better consensus. For 484 example, higher levels of engagement may have been able to forge a better consensus in 485 the Thameslink Programme. At present, it appears that the visions for BNG projects are 486 made mainly by industry, with local groups being mainly engaged after designs are complete 487 for a consultation. It could be suggested that were relevant, local groups should have more 488 input designing projects in the first place, such as in The Greater West Programme, which 489 forges consensus by allowing local group-led project designs. However, examples like 490 Hinkley Point C perhaps suggest that whilst collaborative engagement is necessary, the 491 typical pool of stakeholders will not always be relevant, and will be different project-to-492 project. It would appear that Bull & Brownlie's (2015) concern that local groups distrust will 493 derail projects weighs significantly on the minds of industry, which was concerned about 494 local groups confounding development, rather than helping achieve BNG. Robinson (2012) 495 says that whist criticism as a result of engagement with local groups is to be expected, 496 criticism can be a constructive element to building consensus, and from for example the 497 Thameslink Programme, industry may do well to work off this basis going forward.

498

With that said, industry's trade-offs with stakeholder engagement should be recognised, as various constraints such as time and resources limits industry's ability to identify all relevant stakeholders and proactively engage with them. As such, whilst a lot of onus is put on industry as responsible for core engagement (BBOP, 2012), perhaps the role of local governments and record centres should be considered in assisting with this – and in general further research will be needed as to how much responsibility for genuine BNG should be shouldered on sectors other than industry.

506

507 There has been plenty of criticism and scepticism over, in the UK specifically DEFRA's 508 metric technique (Moreno-Mateos et al., 2015; Panks, 2018), and globally over using metric-509 based calculations to measure biodiversity (Gamarra et al., 2018; Apostolopoulou & Adams, 510 2015). However, my research has shown a broad-standing support for the methodology

511 when trying to achieve BNG, and being able to set targets when designing projects. That 512 said, my research has found the approach to be a double-edged sword, echoing much of the 513 literature on this topic, which cautions about the limitations of guantifying biodiversity in a 514 metric (Baker, 2016; Addison, Carbone & McCormick, 2018). In this research it has become 515 obvious the value that all stakeholder sectors put on qualitative assessments of biodiversity 516 and ecosystem functions alongside these metrics, which is in line with best practice (BBOP, 517 2012). Such qualitative features are essential to contextualise metric-based approaches, but 518 I have to conclude BNG will not move on without these single-metrics as they prove too 519 useful a tool for bridging the gap between ecology and business. With that said, at present 520 BNG projects are going through an iterative learning process, and further research as to the 521 most accurate ways of assessing biodiversity baselines metrically and using gualitative 522 assessments will be vital.

523

This research has shown that NGOs and record centres may also have the ability to collect qualitative data sources and act as liaisons for local interest groups, on behalf of developers. Consultants highly value the work of record centres in vetting sources and content, and this may prove to be an excellent way to tap into local groups' knowledge. Record centres and some NGOs aim to build networks of local groups that can contribute in this area and this may well prove useful for industry to engage with, although more research here is needed as to the global applicability of this possibility.

531

532 I discovered that there is appetite from record centres and local government levels to create 533 databases of potential offsetting projects and plans, and their locations, in order to readily 534 collate prospective options for future BNG projects. When choosing from offsetting options it 535 is important to get the decision-making process right (von Hase & ten Kate, 2016), but I 536 suggest there needs to be much further research as to how options are identified and 537 collated in the first instance. The Greater West Programme gives an excellent example of 538 how collaboration can identify projects for scrutiny, but this framework is time-consuming and if offsetting is to be realised globally on a much larger scale, the effort required to 539 540 identify potential offsets will need to be reduced. The role of local governments, record 541 centres, NGOs or offsetting brokers in reducing effort, whilst maintaining quality and 542 robustness of decisions made has perhaps come out of this research as a key area for 543 future work to deliver global levels of BNG.

544

545 My investigation into landscape-level considerations for BNG design identified that not 546 enough consideration is given to good practice guidance (CIEEM, CIRIA & IEMA, 2016) or 547 literature (Quétier & Lavorel, 2011; Lawton et al., 2010) by industry. Better guidance is

548 required from planning authorities as to what these locality-specific landscape considerations 549 should be, for industry to take into account. Subsequently, I found such guidance should be 550 informed by a variety of stakeholders, including local groups, which would underline the 551 importance of locals and stakeholders identifying their own biodiversity goals, even at a 552 landscape level (Pilgrim & Ekstrom, 2014, Clare et al., 2011). If stakeholders are to inform 553 landscape-level strategies, as they should (Clare et al., 2011), then they need to be engaged 554 by those responsible for coordinating such policies, such as local government. However, this 555 comes with significant resource restrictions. Local government must also be equipped to 556 discuss ecological issues with industries designing BNG generally, otherwise you lose an 557 informed stakeholder in the decision-making process.

558

559 The requirement of permanence for BNG outcomes is well recognised (Gardner et al., 2013; 560 McKenney & Kiesecker, 2010), but this can only be achieved through long-term monitoring and appropriate stewardship of projects (Bull et al., 2013). This was the most well-561 562 recognised factor from my research too. Clare et al. (2011) suggested the use of local 563 people in monitoring of BNG projects, and this is something I discovered to be well-received 564 among stakeholders, and examples such as Woodberry and Kidbrooke show how this might 565 be done in the future. Enlisting conservation-focused NGOs as delivery partners not only 566 allows for more direct community engagement in projects, which is implemented at the 567 design phase may help to forge consensus, but at the long-term delivery phase will 568 safeguard the permanence of outcomes, when pre-funded and clearly pre-arranged. 569 Community engagement in this way may also go further to deliver further BNG for people as 570 well as ecology, which has recently been highlighted (Griffiths et al., 2018), and the example 571 of setting up an outreach centre at the Woodberry Wetlands, which proactively engages new 572 locals to the adjacent housing development shows how this might be practically achieved.

573

A summary of the key findings of this research is shown in Figure 5, which shows the repeat of the current process of BNG from Figure 2, but adds current, and future potential stakeholder inputs. Green potential inputs are synergies revealed in this research. Projects wishing to achieve BNG in the future can combine these novel inputs as appropriate to secure long-term and genuine outcomes.



Figure 5: the process of designing and implementing BNG (Figure 2) with inputs added. Inputs in red (solid arrows) indicate inputs that already exist. Inputs in green (dashed arrows) indicate inputs that could be used in the future, from this research. Note inputs from consultants have been ignored, as consultants are taken in this case to be part of 'industry'.

580 Overall, this research has shown the need and potential for enhanced incorporation of 581 stakeholder knowledge and input, from across a range of sectors, in order to achieve BNG 582 that is genuine and long-term. This research has suggested on several fronts the 583 engagement and input of local interest groups in particular can advance the efforts and 584 outcomes of BNG. If BNG strategies can prove to have genuine and long-term outcomes, 585 then BNG will be brought to the fore of global conservation efforts.

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589

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APPENDIX A

Closed Questionnaire for Industry Informants (Group A)

1. How much does your organisation use qualitative (i.e. non-arithmetic/metric) assessments when estimating or assessing the biodiversity baseline of a project's site before works (i.e. the 'amount' of biodiversity to be offset)?

Never	Infrequently	About half of the	Frequently	Every time
		time		

2. How often do you use DEFRA's biodiversity metric as your main way to calculate no net loss or net gain?

Never	Infrequently	About half of the	Frequently	Every time
		time		

3. When calculating whether no net loss or net gain has been achieved, how many other distinct metrics or methods does your organisation typically use (other than DEFRA's metric)?

Zero	One	Two	Three	Four or more
------	-----	-----	-------	--------------

- 4. If one or more, what are these metrics or methods?
- 5. Does your organisation typically make use of data stored in local environmental record centres in any way?
- Yes always
- □ Sometimes
- □ No: never or highly unusual
- 6. Does your organisation send out public requests for biodiversity net gain proposals?
- Yes always
- □ Sometimes
- □ No: never or highly unusual
- 7. Does your organisation actively approach specific local interest groups asking for biodiversity net gain proposals?
- Yes always
- □ Sometimes
- □ No: never or highly unusual
- 8. When in the process of biodiversity net gain design or implementation are local interest groups engaged typically by your organisation (excluding use of record centres)?

At the start	Early on	Halfway	Later on	After designs	Never
				complete	

- 9. If contacted, typically what input do local interest groups have with respect to net gain design? Mark all that apply:
- Groups contribute previously collected data
- Groups contribute opinions and feedback on proposals
- Groups conduct data collection your organisation or client commissions
- Groups are consulted during impact assessments
- Groups propose net gain designs
- Others:
- 10. If applicable, when conducting impact assessments how useful are the data and/or input of local interest groups?

Not gathered	Irrelevant	Slightly useful	Quite useful	Vital
11 Ovorall	to you think your	organization or v	our aliante work v	with local interact

11. Overall, do you think your organisation or your clients work with local interest groups...

Nowhere	near	Not enough	About right	More	than	Too much
enough				necessary		

12. When designing biodiversity net gain, what is the consequence of your answer to Q11?

Very	Somewhat	Neutral	Somewhat	Very helpful
problematic	problematic		helpful	

- 13. Out of all stakeholders, whose input (if used) is most important when conducting impact assessments?
- □ Local interest groups
- □ Local government/planning authorities
- Local residents
- □ Consultants
- 14. For proposed biodiversity net gain offset project sites, does your organisation conduct feasibility assessments?
- Yes always
- □ Sometimes
- □ No: never or highly unusual
- 15. If yes, or sometimes, from Q14, which of the below elements are typically included in such assessments? Mark all that apply:
- Likelihood of project to realise future aims, including complexity of attempted habitat
- Likelihood project can be executed as planned

- □ Counterfactuals: any assessments of consequences if the project is not executed
- □ Logistical difficulty or ease of carrying out project
- □ Lag time for project to realise aims
- Others:_____

APPENDIX B

Closed Questionnaire for Government Informants (Group D)

1. How much do you see qualitative (i.e. non-arithmetic/metric) assessments used by industry contractors or consultants when estimating or assessing the biodiversity baseline of a project's site before works (i.e. the 'amount' of biodiversity to be offset)?

Never	Infrequently	About	half	of	Frequently	Every time
		the time	Э			

2. How often do you see DEFRA's biodiversity metric used as industry's main way to calculate no net loss or net gain?

Never	Infrequently	About	half	of	Frequently	Every time
		the time	Э			

3. When calculating whether no net loss or net gain has been achieved, how many other distinct metrics or methods does your organisation typically accept from industry (other than DEFRA's metric)?

Zero	One	Two	Three	Four or more

- 4. If one or more, what are these metrics or methods?
- 5. Where a local interest group has data of use to the local record centre, how often would you encourage that group to contribute it (where they do not already)?
 - □ Always
 - □ Sometimes
 - □ Never or highly unusual
- 6. How useful is it for a local authority to have a dedicated ecologist working with industry to design biodiversity net gain for a project?

Very unhelpful	Somewhat	Neutral	Somewhat	Very useful
	unhelpful		useful	

7. When in the process of biodiversity net gain design or implementation are local interest groups typically engaged by industry contractors and/or consultants (excluding use of record centres)?

At the start	Early on	Halfway	Later on	After	designs	Never
				comp	lete	

- 8. If contacted, typically what input do local interest groups have with respect to net gain design? Mark all that apply:
 - □ Groups contribute previously collected data
 - Groups contribute opinions and feedback on proposals

- Groups conduct data collection your organisation or client commissions
- Groups are consulted during impact assessments
- Groups propose net gain designs
- Others:
- 9. Following from Q7, when would you recommend to industry contractors/consultants that they engage local interest groups?

At the start	Early on	Halfway	Later on	After designs	Never
				complete	

- 10. Does your organisation send out public requests for biodiversity net gain proposals on behalf of industry for a specific project?
 - Yes always
 - □ Sometimes
 - □ No: never or highly unusual
- 11. Does your organisation actively approach specific local interest groups asking for biodiversity net gain proposals on behalf of industry for a specific project?
 - Yes always
 - □ Sometimes
 - □ No: never or highly unusual
- 12. When industry conduct impact assessments, how useful would you say the data and/or input of local interest groups is?

Probably	not	Irrelevant	Slightly useful	Quite useful	Vital
gathered					

13. Do you think industry works with local interest groups...

Nowhere	near	Not enough	About right	More	than	Too much		
enough				necessary				

14. When designing biodiversity net gain, is your answer to Q13...

Very	Somewhat	Neutral	Somewhat	Very helpful
problematic	problematic		helpful	

15. Out of all stakeholders, whose input (if used) is most important when conducting impact assessments, from the point of view of your organisation?

- □ Local interest groups
- □ Local government/planning authorities
- □ Local residents
- Consultants
- Others:

APPENDIX C

Closed Questionnaire for Record Centre Informants (Group C)

1. How much do you see qualitative (i.e. non-arithmetic/metric) assessments used by industry contractors or consultants when estimating or assessing the biodiversity baseline of a project's site before works (i.e. the 'amount' of biodiversity to be offset)?

Never	Infrequently	About	half	of	Frequently	Every time
		the time	Э			

2. How often do you see DEFRA's biodiversity metric used as industry's main way to calculate no net loss or net gain?

Never	Infrequently	About	half	of	Frequently	Every time
		the time	e			

- 3. Where a local interest group has data of use to the local record centre, how often would you encourage that group to contribute it (where they do not already)?
 - Always
 - □ Sometimes
 - □ Never or highly unusual
- 4. How useful is it for a local authority to have a dedicated ecologist working with industry to design biodiversity net gain for a project?

Very unhelpful	Somewhat	Neutral	Somewhat	Very useful
	unhelpful		useful	

5. When in the process of biodiversity net gain design or implementation are local record centres typically engaged by industry contractors/consultants?

At the start	Early on	Halfway	Later on	After	designs	Never
				comp	ete	

6. When in the process of biodiversity net gain design or implementation are local interest groups typically engaged by industry contractors and/or consultants (now excluding use of record centres)?

At the start	Early on	Halfway	Later on	After designs	Never
				complete	

- 7. If contacted, typically what input do local interest groups have with respect to net gain design? Mark all that apply:
 - Groups contribute previously collected data
 - Groups contribute opinions and feedback on proposals

- Groups conduct data collection your organisation or client commissions
- Groups are consulted during impact assessments
- □ Groups propose net gain designs
- Others:
- 8. Following from Q5&6, when would you recommend to industry contractors/consultants that they engage local interest groups or the record centre?

At the start	Early on	Halfway	Later on	After	designs	Never
				compl	ete	

9. When industry conduct impact assessments, how useful would you say the data and/or input of local interest groups is (accessed from a local record centre or not)?

Probably	not	Irrelevant	Slightly useful	Quite useful	Vital
gathered					

10. Do you think industry works with local interest groups...

Nowhere	near	Not enough	About right	More	than	Too much
enough				necessary		

11. When designing biodiversity net gain, is your answer to Q10...

Very	Somewhat	Neutral	Somewhat	Very helpful
problematic	problematic		helpful	

12. How much (how often) contact do you have with local interest groups that contribute towards record centres?

- □ Only when they contact us
- □ We are in regular electronic contact with some groups
- □ We are in regular electronic contact with a variety of groups
- □ We hold face-to-face meetings with specific groups regularly
- □ We hold open face-to-face meetings with many groups regularly
- □ Contact with groups is not of any typical pattern
- 13. How often are you in contact with local interest groups that collect data but have never contributed towards record centres?

None	Irregular	Regular	but	Quite frequent	Day-to-day
		infrequent			

14. Do you have a database of local interest groups and their specialities?

- Yes
- □ No
- □ Partially complete
- 15. Do the contacts from this data base (if yes or partial) get shared with industry contractors/consultants?

- □ Yes only if they ask for relevant contacts
- □ Yes always when they request data whether they ask for contacts or not
- □ Not standard practice
- □ No, never

APPENDIX D

Question Sheet for Industry Informants (Group A)

- A. Introductory questions:
 - 1. What is your role within [organisation name]?
 - 2. What previous experience have you had with biodiversity net gain projects?
 - 3. How long have you been working on biodiversity offsetting and net gain?
 - 4. How recently, if at all, has your organisation or have your clients been targeting net gain generally instead of no net loss?

Note that for these further questions I am investigating net gain projects.

B. Open questions & discussion:

First, have a look through the questionnaire and discuss the reasons given for particularly Q15&16.

- 16. What quantitative (i.e. non-arithmetic/metric) data is your organisation typically using in impact assessments (from any source)?
- 17. What are the key types of data that are a) essential and b) desirable for impact assessments?
- 18. What 'evidence' (meaning quantitative data and qualitative assessments) do local interest groups directly contribute to your organisation for a) impact assessments and b) net gain project designs?
- 19. In your opinion, what of the above evidence, if any, is of particular use for a) assessments and b) designs?
- 20. What types of data do local interest groups collect that is unusable for your organisation?
- 21. Are you sceptical about involving local interest groups or using their data? If so, why?
- 22. Overall, how can local interest groups inform or provide data for processes of assessing baseline biodiversity, in a way that would be the most useful for your organisation or clients?
- 23. Is there a protocol you follow to set the objectives (aimed for outcomes) for a biodiversity net gain project? Is this protocol written by your organisation or given by a different authority? Do you have objectives outside just to achieve biodiversity net gain (where this is the case)?

- 24. If you set the objectives, what quantitative metric data feeds into this process?
- 25. When setting the priorities for a project (important aspects of proposed BNG projects), do you use qualitative assessments and if so to what degree?
- 26. How informative has your organisation found qualitative assessments when designing net gain projects in the past?
- 27. For the answers given to Q19, what would the typical sources of the marked elements be?
- C. Closing & summary questions:
 - 28. To close, overall is the process for assessing/evaluating biodiversity at sites for development (the impacted site) adequate/fit for purpose at the moment in your opinion?
 - 29. Regardless, where are the design process' key strengths and weaknesses overall?
 - 30. Overall what practical challenges can you identify that arise in the implementation of these projects?
 - 31. Do you have any further points you'd like to make?
 - 32. Do you have any recommendations for further people I should speak to?
 - 33. Would it be ok for me to contact you about the possibility of a follow-up interview further down the line of my research?
 - 34. Do you have any remaining questions you'd like to ask me?

APPENDIX E

Question Sheet for Government Informants (Group D)

- A. Introductory questions:
 - 1. What is your role within [organisation name]?
 - 2. What previous experience have you had with biodiversity net gain projects?
 - 3. How long have you been working on biodiversity offsetting and net gain with industry?
 - 4. How recently, if at all, has industry been targeting net gain generally instead of no net loss?

Note that for these further questions I am investigating net gain projects.

- B. Open questions & further discussion:
 - 5. How typically does your organisation engage with local interest groups a) outside of specifically BNG designs and b) specifically on the topic of BNG designs?
 - 6. How do you weight local resident's concerns and values in informing project priorities?
 - 7. What are the most important aspects for industry to adhere to for BNG projects in this area, and how were those aspects set originally?
 - 8. Following on from Q22, how important is it for industry to consult and design around a local biodiversity action plan (or equivalent)?
 - 9. What is the value of DEFRA's biodiversity metric, and briefly where are its strengths and weaknesses?
 - 10. Do you feel industry is well informed enough when assessing biodiversity and designing BNG or could they be more well informed specifically from engaging more with LIGs?
 - 11. What role could your organisation play in bringing together LIGs and industry contractors and consultants, to maximum benefit for the BNG design process?
 - 12. What role does your organisation play in assessing feasibility of proposed NG offsets?
 - 13. From which sector is there too little input into the BNG design process, in your opinion? i.e. are any sectors underrepresented?
 - 14. How much advice does industry take from your organisation? i.e. how much consultancy does local government conduct for industry designing BNG projects?

- 15. What 'evidence' (meaning quantitative data and qualitative assessments) do local interest groups directly contribute to industry?
- 16. What types of data do local interest groups collect that is unusable for industry?
- 17. Are you skeptical about involving local interest groups or using their data? If so, why?
- 18. Overall, how can local interest groups inform or provide data for processes of assessing baseline biodiversity, in a way that would be the most useful for achieving biodiversity net gain?
- C. Closing & summary questions:
 - 19. To close, overall is the process for assessing/evaluating biodiversity at sites for development (the impacted site) adequate/fit for purpose at the moment in your opinion?
 - 20. Regardless, where are the design process' key strengths and weaknesses overall?
 - 21. Overall what practical challenges can you identify that arise in the implementation of these projects?
 - 22. Do you have any further points you'd like to make?
 - 23. Do you have any recommendations for further people I should speak to?
 - 24. Would it be ok for me to contact you about the possibility of a follow-up interview further down the line of my research?
 - 25. Do you have any remaining questions you'd like to ask me?

APPENDIX F

Question Sheet for Record Centre Informants (Group C)

- A. Introductory questions:
 - 1. What is your role within [organisation name]?
 - 2. What previous experience have you had with biodiversity net gain projects?
 - 3. How long have you been working on biodiversity offsetting and net gain with industry?
 - 4. How recently, if at all, has industry been targeting net gain generally instead of no net loss?

Note that for these further questions I am investigating net gain projects.

- B. Open questions & further discussion:
 - 5. What types of data are particularly extensive in the records? i.e. species counts etc.
 - 6. What sources of data are particularly high contributors to your record centre (types of sources rather than specific sources)?
 - 7. Generally speaking, how important is it for industry to consult and design around a local biodiversity action plan (or equivalent)?
 - How extensive are records for your catchment with respect to spatial resolution? That is to ask:
 - i. For any given site [in London], how likely is there to be relevant and up-to-date records for consultants to access?
 - ii. For any given site, how far would the available data be able to go with regard to assessing the biodiversity of such a site? How variable is this between sites?
 - 9. What is the value of DEFRA's biodiversity metric, and briefly where are its strengths and weaknesses?
 - 10. Do you feel industry is well informed enough when assessing biodiversity and designing BNG or could they be more well informed specifically from engaging more with local interest groups, or even record centres?
 - 11. What role could your organisation play in bringing together LIGs and industry contractors and consultants, to maximum benefit for the BNG design process?
 - 12. Or do you feel record centres should be the first point-of-contact for industry when accessing groups' data?

- 13. From which sector is there too little input into the BNG design process, in your opinion? i.e. are any sectors underrepresented?
- 14. Do you provide industry with a consultancy role do you point them in the direction of good or robustly collected data?
- 15. Could you and do you provide a data commissioning service for industry (i.e. asking local groups to collect data pertinent to an industry project)?
- 16. What kinds of records do local interest groups collect that is unusable for industry?
- 17. What causes for scepticism are there when using locally collected data?
- 18. Overall, how far do you feel your resource is utilised by consultants when designing BNG projects?
- 19. Overall, how can local interest groups inform or provide data for processes of assessing baseline biodiversity, in a way that would be the most useful for achieving biodiversity net gain?
- C. Closing & summary questions:
 - 20. To close, overall is the process for assessing/evaluating biodiversity at sites for development (the impacted site) adequate/fit for purpose at the moment in your opinion?
 - 21. Regardless, where are the design process' key strengths and weaknesses overall?
 - 22. Overall what practical challenges can you identify that arise in the implementation of these projects?
 - 23. Do you have any further points you'd like to make?
 - 24. Do you have any recommendations for further people I should speak to?
 - 25. Would it be ok for me to contact you about the possibility of a follow-up interview further down the line of my research?
 - 26. Do you have any remaining questions you'd like to ask me?

APPENDIX G

Interview Protocol Circulated to Informants Partaking in KIIs

Key Informant Interviews: Information Sheet

Synopsis:

I (Henry Grub) am a second-year undergraduate student reading for a BA in Biological Sciences here at the University of Oxford. When it comes to delivering biodiversity net gain for infrastructure projects, it is important to be able to make accurate assessments of the biodiversity and needs of an area, from the evidence that can be or already has been collected. There are a range of sources of biodiversity evidence for particular areas, including from industry and local interest groups. Combining these sources of data and knowledge as robustly as possible would enable industry to more effectively design and deliver biodiversity net gain. I am defining local interest groups as non-Governmental self-organised groups of people local to the project site, which partake in monitoring and/or conservation of the local natural environment typically in an amateur/semi-amateur capacity. In this project, I propose to investigate the various sources and types of data and qualitative evidence that is held by local interest groups and in other sources such as local record centres and the scientific literature, and develop a model to combine these types of information with ecological impact assessments, for use in better designing and informing biodiversity net gain.

Timeline in brief: the main body of research will be completed by the end of August 2018, with most writing occurring over October and November. My final thesis will be submitted in January 2019, for release later next year (by June 2019).

My contact details: Email: <u>henry.grub@merton.ox.ac.uk</u> Tel: +44 7496259175

Why have I been invited to take part?

Your experience, knowledge and position in your organisation means that your input would be very valuable to my project.

Do I have to take part?

Participation in my project is voluntary and you do not have to take part if you don't want to. Most importantly, you personally are **not the subject** of research, but rather speaking on behalf of your organisation in your official capacity to provide information about biodiversity net gain projects.

Your responses will be anonymous and confidential, so that readers of my report will not be able to identify you. I may wish to name you and your organisation in order to quote you 'on the record' in my work. In that case I will get your explicit written permission beforehand and ask for quotes to be approved; in the absence of that permission I will not use this information.

You may choose to withdraw yourself and the data that you provide at any time, without penalty. No reason is necessary and you can withdraw by notifying me in writing. Do not hesitate to contact me should you have any questions about the work and nature of the meeting before deciding to participate.

What will happen in the study?

If you decide to take part in my study, you will be asked to participate in at least one Key Informant Interview. The interview will take the format of a one-on-one semi-structured meeting. It will be held at a location of your choosing, or if that is not possible, over the telephone. The meeting will last for no longer than one hour. No preparatory work is required for the meeting.

You will then also have the option to be contacted regarding further research questions, with the potential for a second follow-up meeting if you agree.

What happens to the research data provided?

All responses will be assigned to your job role within your sector (e.g. environmental consultant) and these descriptors will be used for the research rather than your name and organisation. All responses used in the research project and the thesis will be given under these descriptors. You will never be named (unless explicitly requested).

Only I (and no one else) will have information about your name and organisation and what you said to me. After I have submitted my research project, I will delete all identifiable information and retain only the anonymised descriptors, unless I have explicitly been given permission in writing to retain a quote or cite you or your organisation.

Will the research be published?

The University of Oxford is committed to the dissemination of its research for the benefit of society and the economy and, in support of this commitment, has established an online archive of research materials.

If you agree to participate in this project, the research will be written up as a thesis. On successful submission of the thesis, it will be deposited both in print and online in the University archives, to facilitate its use in future research. The thesis will be placed online in an open access repository, meaning it will be available to every internet user. The research may also be written up in the form of academic papers and/or industry briefing notes which will be published in international peer reviewed journals.

Who has reviewed this project?

This research project and its protocol have been reviewed by my supervisors: Professor E.J. Milner-Gulland (University of Oxford) and Dr Julia Baker (Balfour Beatty).

Who do I contact if I have a concern about the study?

If you have a concern about any aspect of this project, please speak to the researcher, Henry Grub (<u>henry.grub@merton.ox.ac.uk</u>) or his Oxford supervisor, Professor E.J. Milner-Gulland (<u>ej.milner-gulland@zoo.ox.ac.uk</u>), who will do their best to answer your query. The researcher will acknowledge your concern within 10 working days and give you an indication of how he intends to deal with it.

APPENDIX H

Consent Form for Informants Partaking in KIIs

Key Informant Interviews: Consent Form

Professor E.J. Milner-Gulland Email: <u>ej.milner-gulland@zoo.ox.ac.uk</u> Henry Grub Email: <u>henry.grub@merton.ox.ac.uk</u>

> Please initial

each box:

- 1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
 - 2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or academic penalty.
 - 3. I understand that research data collected during the study may be looked at by designated individuals from the University of Oxford where it is relevant to my taking part in this study. I give permission for these individuals to access my data.
 - 5. I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.
 - 6. I understand how this research will be written up and published.
 - 7. I understand how to raise a concern.
 - 8. I consent to being audio recorded.
 - 9. I consent to being photographed.
 - 10. I give permission to be quoted directly in the research publication, subject to quotation approval from me.
 - 11. I agree to take part in the above study.







Consenting Participant's Name

Date

Signature