Business and Biodiversity Offsets Programme (BBOP)

Biodiversity Offset Design Handbook Appendices

BBOP
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Forest Trends, Conservation International and the Wildlife Conservation Society provided the Secretariat for BBOP during the first phase of the programme's work (2004 - 2008).

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About this document

The Principles on Biodiversity Offsets and accompanying supporting materials[1] such as these Appendices[2] to the Biodiversity Offset Design Handbook have been prepared by the Business and Biodiversity Offsets Programme (BBOP) to help developers, conservation groups, communities, governments and financial institutions that wish to consider and develop best practice related to biodiversity offsets. They were developed by members of the BBOP Secretariat and Advisory Committee[3] during the first phase of the programme's work (2004 – 2008), and have benefited from contributions and suggestions from many of the 200 people who registered on the BBOP consultation website and numerous others who have joined us for discussions in meetings.

The Advisory Committee members support the Principles and commend the other working documents to readers as a source of interim guidance on which to draw when considering, designing and implementing biodiversity offsets. Best practice in biodiversity offsets is still in its infancy, and the concepts and methodologies presented here need to be further discussed, developed, tested and refined based on more practical experience and broad debate within society.

All those involved in BBOP are grateful to the companies who volunteered pilot projects in this first phase of our work and for the support of the donors listed overleaf, who have enabled the Secretariat and Advisory Committee to prepare these documents.

BBOP is embarking on the next phase of its work, during which we hope to collaborate with more individuals and organisations around the world, to test and develop these and other approaches to biodiversity offsets more widely geographically and in more industry sectors. BBOP is a collaborative programme, and we welcome your involvement. To learn more about the programme and how to get involved please:

See: **www.forest-trends.org/biodiversityoffsetprogram/**

Contact: **bbop@forest-trends.org**

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1 The BBOP Principles, interim guidance and resource documents, including a glossary, can be found at: **www.forest-trends.org/biodiversityoffsetprogram/guidelines/**. To assist readers, a selection of terms with an entry in the BBOP Glossary has been highlighted thus: BIODIVERSITY OFFSETS. Users of the Web or CD-ROM version of this document can move their cursors over a glossary term to see the definition.

2 This paper was prepared by Susie Brownlie, Jo Treweek and Kerry ten Kate with contributions from Jon Ekstrom, Theo Stephens, Toby Gardner, David Parkes and other individuals cited in the various Appendices.

3 The BBOP Advisory Committee currently comprises representatives from: Anglo American; Biodiversity Neutral Initiative; BirdLife International; Botanical Society of South Africa; Brazilian Biodiversity Fund (FUNBIO); Centre for Research-Information-Action for Development in Africa; City of Bainbridge Island, Washington; Conservation International; Department of Conservation New Zealand; Department of Sustainability & Environment, Government of Victoria, Australia; Ecoagriculture Partners; Fauna and Flora International; Forest Trends; Insight Investment; International Finance Corporation; International Institute of Environment and Development; IUCN, The International Union for the Conservation of Nature; KfW Bankengruppe; Ministry of Ecology, Energy, Sustainable Development, and Spatial Planning, France; Ministry of Housing, Spatial Planning and the Environment, The Netherlands; National Ecology Institute, Mexico; National Environmental Management Authority, Uganda; Newmont Mining Corporation; Private Agencies Collaborating Together (Pact); Rio Tinto; Royal Botanic Gardens, Kew; Shell International; Sherritt International Corporation; Sierra Gorda Biosphere Reserve, Mexico; Solid Energy, New Zealand; South African National Biodiversity Institute; Southern Rift Landowners Association, Kenya; The Nature Conservancy; Tulalip Tribes; United Nations Development Programme (Footprint Neutral Initiative); United States Fish and Wildlife Service; Wildlife Conservation Society; Wildlands, Inc.; WWF; Zoological Society of London; and the following independent consultants: Susie Brownlie; Jonathan Ekstrom; David Richards; Marc Stalmans; and Jo Treweek.

During Phase 1 of BBOP, the BBOP Secretariat was served by Forest Trends, Conservation International and the Wildlife Conservation Society.

We thank those organisations that have provided financial support for BBOP's work[4]: the Alcoa Foundation; Anglo American; City of Bainbridge Island, Washington, USA; Conservation International; Department for International Development, United Kingdom; Department of the Environment, Water, Heritage and the Arts, Australia; Forest Trends; International Finance Corporation; KfW Bankengruppe; Ministry of Housing, Spatial Planning and the Environment, The Netherlands; Newmont Mining Corporation; the Richard and Rhoda Goldman Fund; Rio Tinto; Shell International; Sherritt International Corporation; Solid Energy New Zealand; the Surdna Foundation; the United Nations Development Programme/Global Environment Facility; United States Agency for International Development[5]; and Wildlife Conservation Society.

4 Endorsement of some or all of the BBOP documents is not implied by financial support for BBOP's work.

5 This document is made possible in part by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of Forest Trends, Conservation International and the Wildlife Conservation Society and do not necessarily reflect the views of USAID or the United States Government.

Contents

The BBOP Offset Design Handbook presents information on a range of issues, approaches, methodologies and possible tools from which OFFSET PLANNERS can select the approaches best suited to their individual circumstances when designing a biodiversity offset. It describes a generic process that offset planners could use in designing a biodiversity offset, from initial conception of a development project to the selection of offset sites and activities. This involves describing the project; exploring the policy context; engaging stakeholders; undertaking biodiversity surveys and applying the MITIGATION HIERARCHY; quantifying RESIDUAL IMPACTS; identifying and comparing potential offset sites; calculating CONSERVATION GAINS for preferred offset sites; and deciding upon the final scope, scale, nature and location of offset.

This companion volume of Appendices does not aim to provide comprehensive coverage of offset methodologies, but instead to offer readers a summary of a sample of approaches relevant to biodiversity offsets and some references on them for further reading. Some approaches are required or recommended by government policies; some are the subject of the lending requirements of banks; some are still under development (the approach adapted and tested by BBOP in its pilot projects, REMEDE, the New Zealand Risk Index Method and Averted Risk Formulae) and some other supportive or supplementary methodologies.

The following aspects of each approach or methodology are described where relevant (since some of the approaches or methodologies are not specific to offset design, it is not possible in all cases to provide information on every aspect):

- The ***target or subject*** of biodiversity offsets (e.g. threatened species, wetlands, ECOSYSTEM SERVICES, etc.);
- Offsets in the ***mitigation hierarchy***;
- The upper and lower ***thresholds*** for considering biodiversity offsets (i.e. offsets would not be considered above the 'upper threshold' or below the 'lower threshold');
- The desired or ***required outcome*** of biodiversity offsets;
- ***Options*** that could be considered ***for biodiversity offsets*** (e.g. land, management, restoration, compensatory payment, etc.);
- ***Offset methodology***, including the basis and CURRENCY used to calculate BIODIVERSITY LOSS at the IMPACT SITE and GAIN through offset(s), consideration of landscape level and site selection in planning and locating the offset, and the use of any MULTIPLIERS or ratios to address uncertainty or risk;
- Biodiversity offsets in relation to ***ecosystem services*** (e.g. provisioning, cultural, regulating, supporting services);
- ***Stakeholder*** or interested and affected party ***engagement***;
- ***Implementation***, including timing, duration, management and any checks on effectiveness; and,
- ***Broad comments*** on the level of information, time and expertise that the methodology (i.e. where relevant) would require.

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Appendix A: Approaches and methodologies in use and / or available as drafts, and associated policy requirements

A.1 US wetlands compensatory mitigation (see also Appendix A.3)

The primary law conserving wetlands in the United States is the Clean Water Act (CWA), passed in 1972. Section 404 authorises the Secretary of the Army to "issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into navigable waters at specified disposal sites". These permits, administered principally through the Army Corps of Engineers (the Corps) and known as '404 permits', 'wetland permits', or 'Corps permits', are the cornerstone of federal efforts to encourage protection of wetland resources through market-based means.

This is the most mature of the offset frameworks, having been initiated in the 1970s. The policy objective is to offset unavoidable adverse impacts to wetlands through compensatory mitigation that replaces wetland functions and values. Federal guidance on wetland mitigation banking was issued in 1995, and policy development continues under the auspices of the Federal Interagency Mitigation Workgroup. On March 31, 2008, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (the Corps) announced innovative new regulatory standards that supersede the 1995 guidance. These new standards are designed to promote NO NET LOSS of wetlands by improving wetland restoration and protection policies, increasing the effective use of wetland mitigation banks and strengthening the requirements for the use of *in-lieu* fee mitigation.

Useful references

2008 Compensatory Mitigation Regulations: Department of Defense (Department of the Army, Corps of Engineers 33 CFR Parts 325 and 332) Environmental Protection Authority (40 CFR Part 230 Compensatory Mitigation for Losses of Aquatic Resources); Federal Register 10 April 2008. For more information see: **http://www.epa.gov/wetlandsmitigation/**

See also: Appendix A.3.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	Wetland habitat and function.
Mitigation hierarchy	The hierarchy must be followed, namely (1) avoid filling wetland resources; (2) minimise adverse impacts to those wetlands that cannot reasonably be avoided; and (3) provide compensatory mitigation for those unavoidable adverse impacts that remain after all minimisation measures have been exercised (other wetlands have been restored to compensate for the wetlands destroyed; known as 'compensatory mitigation').
Thresholds for considering biodiversity offsets	Applies to any wetland resource.
Desired or required outcome	National goal of ''no net loss'' of wetland acreage and function.
Offset options	Measures that restore prior wetland areas are favoured most, followed by ENHANCEMENT of low-quality wetlands and creation of new wetlands. Least-favoured of all is the preservation of existing wetlands. Under the new rule these methods of compensation are known as: restoration, establishment (creation), enhancement and preservation. There are three mechanisms for providing this compensation in the Section 404 programme: obtaining credits from a mitigation bank, obtaining credits from an in-lieu fee programme or conducting a permittee-responsible compensation project (i.e. the traditional and still most common form of compensation). Under the new 2008 regulations, use of credits from a mitigation bank is the preferred compensation method because the Corps and EPA view mitigation banks as the least risky form of compensation. Second in the compensation hierarchy is use of credits from an in-lieu fee programme with pursuit of a permittee-responsible compensation project third. Regardless of the mechanism, mitigation should generally take place within the same watershed as the permitted impact and IN-KIND mitigation is preferable to mitigation that uses a substantially different type of wetland.

Broad overview of this approach		
Characteristic	**Description**	
Offset methodology	*Calculating loss-gain: the currency*	Requires measurable and enforceable ecological performance standards for all types of compensation so that project success can be evaluated. The Corps has granted broad discretion to state and local authorities to select currencies. Roughly forty different wetlands assessment methods have been developed, varying in terms of the type of habitats in which the method is used, the basic targets of assessment, and the functional and social values encompassed in the assessment. Over half of the methods go beyond assessment of habitat suitability to encompass some assessment of wetland function, but many of these function-based methods are bounded by limitations on type of habitat for which the method can be used (e.g. coastal wetlands only) and limited in terms of the functions assessed (e.g. limited to avian species functions). That is, most of the methodologies used focus on the area of wetland impacted and a narrow interpretation of functions. The methodologies and approaches differ: • Simple indices are derived from quickly and easily observed characteristics of a wetland, and usually serve as SURROGATE 'INDICATORS' of one or more ecological functions (for example, percent cover of aquatic vegetation, area of wetland). • Narrowly tailored systems attempt to measure directly a limited range of wetland services, such as wildlife habitat, through a detailed procedure focusing on that particular wetland service (for example, percent duck habitat). • Broadly tailored systems examine a range of wetland functions covering a number of observable characteristics.
	Site selection and landscape level planning	The process of selecting a location for compensation sites should be driven by assessments of watershed needs and how specific wetland restoration and protection projects can best address those needs. Siting / landscape – the service area is the watershed, ECOREGION, physiographic province, and / or other geographic area within which the mitigation bank or *in-lieu* fee programme is authorised to provide compensatory mitigation required by DA permits. The service area must be appropriately sized to ensure that the aquatic resources provided will effectively compensate for adverse environmental impacts across the entire service area.
Relation to ecosystem services	Ecosystem services are addressed through maintaining wetland function.	
Stakeholder engagement	No specific references found.	
Implementation	The number of credits available for withdrawal (i.e. debiting) should generally be commensurate with the level of aquatic functions attained at a bank at the time of debiting. Federal regulations thus allows some leeway in the timing requirement, allowing credit withdrawal before equal wetland values are established, if the bank possesses adequate financial assurance and has exhibited a high probability of success. Requires regular monitoring to document that compensation sites achieve ecological performance standards. Real estate instruments that protect the site, financial assurances for near- and long-term site stewardship, monitoring and contingency planning, and identification of parties responsible for project tasks, are required by the regulator.	
Broad comments	There is no one methodology in use, as noted above. The level of resources (time and funds) required could be from low to high, depending on the scope of analysis used to determine the offset.	

A.2 US Fish and Wildlife Services: Habitat Evaluation Procedures

Habitat Evaluation Procedures (HEP) were developed by the United States Fish and Wildlife Service in response to numerous legal mandates in the United States requiring that impact assessments should quantify the extent and status of natural resource components, their susceptibility to loss, and the implications of development alternatives and mitigation measures on those components. The procedure was drawn up for use by regulators and ecologists. In the HEP Handbook (US Fish and Wildlife Service 1980), it is stated that "'Application of Habitat Units (the principal units of comparison in HEP) includes impact assessments, compensation studies and human use analyses. In such analyses, one HU lost for a species must be directly comparable to one HU gained for that species". HEP attempts to quantify habitat value for selected wildlife species based on the assumptions that these species are relative indicators of habitat value. The HEP is also seen as a habitat based approach to the design and implementation of mitigation for key species. It can also be applied as a quantitative approach to designing offsets for individual species, although it was not specifically designed for this purpose.

HEP combines theoretical knowledge of a species' habitat needs with field survey to document the quantity and quality (in terms of carrying capacity) of habitat available and to compare it with 'ideal' or 'optimum' conditions. It can be used to compare the relative value of different areas for a selected wildlife species at a given point in time or to compare the relative value of the same area at different times. HEP addresses habitat availability and carrying capacity for selected evaluation species and do not address changes in species composition of BIOTOPES. It is based on the assumption that certain habitat variables can be measured (e.g. vegetation height) which are strongly correlated with the ability of an area to support a given species. Measurements of these variables are used to derive numerical habitat suitability indices (HSIs) which range from 0.0 to 1.0 and can be multiplied by the area of available habitat to obtain Habitat Units (HUs). The reliability of the method depends strongly on the ability of the practitioner to assign an accurate HSI and to identify clear relationships between carrying capacity and specific environmental variables. HUs do not represent a proven cause-and-effect relationship and are not an actual physical parameter that can be seen in the field, but reflect a hypothesis of species-habitat relationships.

Useful reference

US Fish and Wildlife Service (1980). Habitat Evaluation Procedures (HEP). ESM 102. Division of Ecological Services, Department of the Interior, Washington D.C.

<table>
<tr><th colspan="3">Broad overview of this approach</th></tr>
<tr><th>Characteristic</th><th colspan="2">Description</th></tr>
<tr><td>The target of biodiversity offsets</td><td colspan="2">This approach is focused on species and species PERSISTENCE values, and is used to assess the value of areas of habitat for particular species in terms of their carrying capacity.</td></tr>
<tr><td>Mitigation hierarchy</td><td colspan="2">Not specifically addressed, but HEP is a tool used in conjunction with the application of the mitigation hierarchy in the United States. The product of a specific HEP applied to a project may lead to consideration of additional AVOIDANCE or minimisation measures.</td></tr>
<tr><td>Thresholds for considering biodiversity offsets</td><td colspan="2">HEP identifies residual, unavoidable impacts to species / habitat based on HSIs and can help develop a biodiversity offset to seek no net loss.</td></tr>
<tr><td>Desired or required outcome</td><td colspan="2">No net loss in carrying capacity of habitat for species that are significant for BIODIVERSITY CONSERVATION.</td></tr>
<tr><td>Offset options</td><td colspan="2">In situ ‘LIKE-FOR-LIKE’ or ‘in-kind’ habitat would constitute the only acceptable offset.</td></tr>
<tr><td rowspan="2">Offset methodology</td><td>Calculating loss-gain: the currency</td><td>The approach focuses on priority or significant species and their habitat requirements for persistence. That is, it seeks to replace habitat lost as a residual impact of development through a biodiversity offset, to ensure no net loss of habitat for affected species.

It uses Habitat Units (HUs) and Habitat Suitability Indices (HSIs). HUs are derived by multiplying the HSI of a species by the area of the habitat in question. The HUs consider habitat suitability (including measures of structure and function) for the chosen species (composition). That is, HABITAT STRUCTURE and function are interpreted in terms of the species they support rather than for their own sake. The HUs look at both the quality and quantity of suitable habitat for particular species; these HUs change as a result of negative impacts on biodiversity. The methodology relies on a good understanding of the relationship between species and their habitat, and the carrying capacity of that habitat.

The HSI is effectively a measure of the benchmark optimum habitat for a particular species; an HSI of 1.0 is the benchmark habitat for that species.</td></tr>
<tr><td>Site selection and landscape level planning</td><td>This approach does not consider landscape-level planning or options for conservation in a wider LANDSCAPE CONTEXT.</td></tr>
<tr><td>Relation to ecosystem services</td><td colspan="2">This approach only considers the INTRINSIC VALUES of biodiversity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">Not specifically addressed.</td></tr>
<tr><td>Implementation</td><td colspan="2">It is assumed that the offset would last in PERPETUITY, although this issue is not explicitly addressed.</td></tr>
</table>

Broad overview of this approach	
Characteristic	**Description**
Broad comments	This methodology only looks at species that best represent the biodiversity in area that the impact will occur and their habitat requirements; that is, it does not address wider components of biodiversity that may be impacted. It requires relatively detailed knowledge of the species' habitat requirements to derive a reliable Habitat Suitability Index, and thus determine the number of Habitat Units needed to offset residual impacts. The method could be applied in any country where relationships between carrying capacity for individual species and their habitat are well understood. Detailed work and considerable ecological knowledge are required to develop the HSIs and Hus. More knowledge is needed for developing the HSIs than calculating the HUs based on them); significant ecological research and often some mathematical modelling may be required. The level of resources required could thus be medium to high, depending on the availability of appropriate information.

A.3 US wetland and stream assessment methods in practice

After thirty years of experience with wetland and conservation banking, the United States is home to perhaps the world's most comprehensive set of methods for assessing projects' impacts and offsets' gains on wetlands, streams and listed endangered species. Concerning wetland mitigation, over 40 assessment methodologies are listed in Bartoldus (1999) and a compendium on stream assessment methodologies lists 51. Many of these assessment methodologies involve rigorous and repeatable frameworks for analysis of wetland and stream functionality that involve, and can demonstrate, consistent application not only at impact and offset sites, but across many projects. They allow practitioners in the field to use rapid assessment methods to come to consensus on the BASELINE status of sites and also on projects' impacts and offsets' conservation GAINS using rapid protocols.

However, in the large majority of cases (and the US authorities process some 70,000 to 80,000 decisions on wetland and stream mitigation a year), loss / gain calculations are based on the acres of land impacted, coupled with a simple ratio and sometimes with an approximate estimate of the acres' condition, based on expert review. For instance, an ecologist working for a regulatory agency might verify the assessment of the project developer's consultant, and might categorise the project's residual impact as 'impact on 5 acres of medium quality wetland'. The characterisation of the wetland in question as 'medium quality' would be based on the individual's best professional judgement as an expert, and may be based on an overall impression on a field visit, or on their assessment of the condition of a list of key characteristics of a wetland of that type. The ecologist would likely be familiar with the wetland type concerned along a disturbance gradient from highly disturbed to what is known as the 'reference standard', in optimum condition, and able to make a rapid assessment as to whether the impact or offset site was of high, medium or low quality.

Simple ratios are applied by the regulators to the areas impacted to arrive at the scale of the offset required of the developer, according to the method used and the specific circumstances of the case. For instance, if the offset ('compensatory mitigation' in US parlance) involves 'restoration', and the impact was on 5 acres of wetland, the regulator may require restoration of 8 or 10 acres (typically using ratios between 1:1 and 2:1). While if the offset involves 'preservation', the regulator would only allow partial credit for the offset and might require conservation of 30 acres (typically using ratios up to 10:1).

1. ***Restoration*** means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural / historic functions to a former or degraded aquatic resource. For the purpose of tracking NET GAINS in an aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.
   a. *Re-establishment* means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural / historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.
   b. *Rehabilitation* means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural / historic functions to a degraded aquatic resource. Rehabilitation results in a *gain in aquatic resource function*, but does *not result in a gain in aquatic resource area*.
2. ***Enhancement*** means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

3. ***Establishment*** (creation) means the manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area and functions.
4. ***Preservation*** means the removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

The approach taken and replacement ratios vary around the country. For instance, the states of South Carolina, Georgia and Florida use standard assessment tools that are quantitative or semi-quantitative and go beyond the basic assessment of area of impact and best professional judgement as to quality. And the preservation ratio in Ohio is 2:1, while in Michigan is it 10:1.

Countrywide, it is common for smaller projects to rely on acres as a surrogate for functional level and quality, either because there are no rapid assessment tools available or the impacts are so small that the more detailed approaches are not practicable. Functional assessment tools with more objective and detailed METRICS tend to be used for larger projects and the trend nationwide is towards using them more regularly.

As well as varying geographically and according to the scale of the project, the assessment methods vary according to the nature of the habitat affected. There is panoply of wetland assessment tools tailored to different wetland types in different parts of the country, and a similar range of methodologies has more recently been developed for impacts on streams. The aim for these tools is that they are robust, rapid to apply and usable by a variety of people who are not experts in the ecology of the site in question.

The more rigorous approaches provide better quality results, but take more time, resources and expertise. They tend to be used in two circumstances: (a) where the scope and scale of the likely project impact is large, the agencies are likely to scrutinise the project more closely and ask for better data and (b) consultants working for project proponents know they are likely to be asked to present such detailed information, so they elect to use more quantitative methods.

It is interesting to note that developers sometimes choose to use the more rigorous methods because these may result in a substantially more modest offset investment than if a purely area-based approach was used. For instance, if the project will have an impact on 20,000 acres, but the impact will only be small, it is in the interests of the developer to quantify the impact using a more detailed metric than area alone, since a small offset creating significant conservation gains on (for instance) 5,000 acres may demonstrably offset the small impacts spread across a big area. This will likely be a much more cost effective outcome for the developer than purchasing and conserving 20,000 acres, and it may create more valuable CONSERVATION OUTCOMES, too. Indeed, since 1990 and again in 2008, the regulations have affirmed that an acceptable outcome is for a good functional assessment to demonstrate that NO NET LOSS can be achieved by conserving an area that is smaller than the impact area.

Could the US methods be used by practitioners outside the USA? Some methods could easily be adapted for use around the world in the design of voluntary offsets. However, the challenge is in identifying, among the plethora available, which assessment methodology might be suited to the circumstances of the case. The 2004 EPA review (noted below) could be useful for those interested in identifying methodologies most suited to their circumstances.

Sources

- Pers. comm. Hough, Environmental Scientist, EPA, Oct 2008.
- **http://www.mitigationactionplan.gov/links.html**
- 2004 EPA review of commonly used wetland assessment protocols: **http://www.epa.gov/owow/wetlands/monitor/RapidMethodReview.pdf**
- 2003 Compendium of Stream Assessment Protocols: **http://www.mitigationactionplan.gov/stream%20comp%20page.htm**
- Bartoldus, C.C. 1999. *A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practitioners*. Environmental Concern, Inc., St. Michaels, Maryland.
- King, D.M. and Price, E.W. 2007. *Developing Defensible Wetland Mitigation Ratios: Standard tools for "scoring" wetland creation, restoration, enhancement, and conservation*. University of Maryland Center for Environmental Science, A report prepared for NOAA, Office of Habitat Protection, Silver Spring, MD; February, 2007.
- King, D.M. and Price, E.W. 2004. *Developing Defensible Wetland Mitigation Ratios: A Companion to the Five-Step Wetland Mitigation Ratio Calculator*. University of Maryland, Center for Environmental Science; a report prepared for the NOAA, Habitat Protection Division, September 30, 2004.
- McKenney, B. 2005. *Environmental Offset Policies, Principles, and Methods: A Review of Selected Legislative Frameworks*. Biodiversity Neutral Initiative.
- As examples, Georgia's and South Carolina's Standard Operating Procedures and Florida's Uniform Mitigation Assessment Method, all used to evaluate impact and offset sites, can be found at:

  http://www.sas.usace.army.mil/Compensatory.htm

  http://www.sac.usace.army.mil/?action=permits.forms

  http://www.dep.state.fl.us/water/wetlands/mitigation/umam.htm
- Source for definitions of *restoration* (including *re-establishment* and *rehabilitation*), *enhancement*, *establishment* and *preservation*: 33 CFR 332.2 (Corps Regs) and 40 CFR 230.92 (EPA Regs).

A.4 Birds and Habitats Directives

Special Areas of Conservation (SAC) designated under the Habitats Directive, together with the Special Protection Areas (SPA) designated under the Birds Directive, make up the Natura 2000 network for nature conservation. Each Member State of the European Community is to identify and designate these areas. The policy goal is to maintain the overall (ecological) coherence of the sites.

Useful reference

European Commission, Environment DG. 2002. Assessment of Plans and Projects Significantly affecting Natura 2000 Sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. November 2001. Impacts Assessment Unit, School of Planning, Oxford Brookes University. ISBN 92-828-1818-7. Available at: **http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf**

Broad overview of this approach		
Characteristic	**Description**	
The target of biodiversity offsets	To be acceptable, compensatory measures should address, in comparable proportions, the habitats and species negatively affected.	
Mitigation hierarchy	There must be clear evidence that the mitigation measures have been assessed against the 'mitigation hierarchy' (with the AVOIDANCE of adverse impact on the site being the preferred outcome).	
Thresholds for considering biodiversity offsets	*Upper threshold*	No upper threshold as the Directive covers severe impacts that are proceeding because of imperative reasons of overriding public interest. However, adverse effects on the integrity of sites are, ***by way of exception***, permitted under certain circumstances, but only if 'compensatory measures' are taken: "…the Member state shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected." The compensatory conservation requirement is only triggered for impacts that will cause an adverse effect on the integrity of a site that passes a test of "no ALTERNATIVES"; and where there are "imperative reasons of overriding public interest"…. *Article 6(4) of the Habitats Directive*
	Lower threshold	Sites not listed as part of the Natura 2000 network would fall below this threshold.
Desired or required outcome	The maintenance and enhancement of the overall coherence of Natura 2000 will be the key test on which to assess whether compensatory measures provide functions comparable to those which justified the selection criteria of the original site	
Offset options	Compensatory measures appropriate to adverse effects on Natura 2000 sites consist of: • Restoration: restoring the habitat to ensure the maintenance of its conservation value and compliance with the conservation objectives of the site. • Creation: creating a new habitat on a new site or through the enlargement of the existing site. • Enhancement: improving the remaining habitat proportional to that which is lost due to the project or plan. • Preservation of habitat stock: measures to prevent further erosion of the coherence of the Natura 2000 network.	
Offset methodology	No specific offset methodology is advocated. Compensatory measures should, however, relate to the same biogeographical region in the same Member State and be in as close proximity as possible to the habitat that has been adversely affected by the project or plan.	
Addressing biodiversity offsets in relation to ecosystem services	The area selected for compensation should provide functions comparable to those which had justified the selection criteria of the original site. The area selected for compensation must have – or must be able to develop – the specific features attached to the ecological structure and functions, and required by the habitat and species populations. Consideration must also be given to human health or safety considerations, or important environmental benefits.	
Stakeholder engagement	The competent authority identifies appropriate mitigation measures and these must be assessed in terms of their likely impacts. Proposed mitigation measures must have the support of the relevant nature conservation agencies.	
Implementation	Compensatory measures must have clearly defined implementation and management objectives so that the compensatory measures can achieve the maintenance or enhancement of Natura 2000 coherence. This requires the security of site tenure to be guaranteed, management plans to be drawn up with clear, achievable short-, medium- and long-term objectives, and for long-term monitoring mechanisms to be in place. There must be clear evidence that the mitigation measures can be secured over the short-, medium- and long-term through legal or financial mechanisms.	

A.5 European Liability Directive

The European Union (EU) Environmental Liability Directive (2004/35/E2 21 April 2004) goes beyond existing national and European Commission environmental protection legislation by establishing a framework of environmental liability requiring the prevention and, where that fails, remediation of various categories of environmental damage. The directive refers to damage that has significant adverse effects on achieving or maintaining favourable conservation status of species and NATURAL HABITATS protected under EU legislation. Biodiversity damage is required to be remedied by returning the environment to its baseline condition; in the case of damage to land, the risk to human health must be removed. If the harm to biodiversity cannot be reversed, then 'complementary remediation' by improvement of a similar resource or service may be required to be undertaken to the extent the original resource cannot be fully restored. 'Compensatory remediation' may also be required to compensate society for the loss or enjoyment of the resource or service.

Broad overview of this approach		
Characteristic	**Description**	
The target of biodiversity offsets	Those components of the natural environment damaged, focusing on species and natural habitats protected under EU law.	
Mitigation hierarchy	Prevention is emphasised and remediation is required where prevention fails.	
Thresholds for considering biodiversity offsets	Damage to protected species and natural habitats will only be recoverable if the damage is of such a nature that it has 'significant adverse effects on reaching or maintaining the favourable conservation status' of the habitats and species concerned. The significance of such effects is to be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I of the Directive.	
Desired or required outcome	Returning the natural environment to its baseline condition.	
Offset options	'IN-KIND' OFFSET ACTIVITIES to remediate damage; comprising restoration or rehabilitation. If the harm to biodiversity cannot be reversed, then 'complementary remediation' by improvement of a similar resource or service may be required to be undertaken to the extent the original resource cannot be fully restored.	
Offset methodology	*Calculating loss-gain: the currency*	When determining the scale of complementary and compensatory remedial measures, the use of resource-to-resource or service-to-service equivalence approaches shall be considered first. Under these approaches, actions that provide natural resources and / or services of the same type, quality and quantity as those damaged shall be considered first.
	Site selection and landscape level planning	'Geographical linkage to the damaged site' is one criterion in selecting remedial options.
	Multipliers and ratios	Where it is not possible to provide resource-to-resource or service-to-service equivalence, then alternative natural resources and / or services shall be provided; e.g. a reduction in *quality* could be offset by increasing the *quantity* of remedial measures.
Offsets in relation to ecosystem services	Compensation for loss of enjoyment of the environmental resource or services may be required.	
Stakeholder engagement	Not specifically addressed.	
Implementation	Not specifically addressed.	

A.6 Victoria (Australia): habitat hectares method

This method was first elaborated during the public consultation phase for the Victorian Native Vegetation Management Framework as one of several improvements in identifying priorities and quantifying outcomes for the protection of native vegetation on private land, and was subsequently endorsed by the Victorian Government (Department of Natural Resources and the Environment 2002, in Parkes *et al*. 2003). The approach was drawn up for use by regulators and investors, particularly by agency and consultant ecologists working within these processes.

The Framework represents a landscape approach to planning native vegetation management. Goals for native vegetation management are based on biodiversity, land and catchment protection and are set within the context of bioregions and implemented by Catchment Management Authorities, the State Department and Local Government. The conservation significance of a patch of vegetation (from Very High to Low) is determined according to: the conservation status of vegetation types present; the quality of the vegetation; the conservation status of species present (and the potential habitat value) and other recognised site-based criteria. The Framework provides a strong focus on the protection and net improvement of higher conservation significance vegetation and a flexible but accountable approach for lower conservation significance vegetation to enable landholders to move towards more sustainable land use options. The method has been designed specifically in a *native vegetation management context*; it is recognised that the conservation of many fauna species is influenced by factors other than vegetation as physical habitat (for example, predation by invasive mammals, ABIOTIC habitat features such as rocks and roosting sites) and these additional considerations will need to be taken into account.

Useful references

Parkes, D., Newell, G. and Cheal, D. 2003. Assessing the quality of native vegetation: the ‘habitat hectares’ approach. *Ecological Management and Restoration* Vol 4 Supplement.

Victoria Department of Natural Resources and Environment. 2002. Victoria’s Native Vegetation Management – A Framework for Action. Available from:
http://www.dse.vic.gov.au/CA256F310024B628/0/C2E5826C9464A9ECCA2570B400198B44/$File/Native+Vegetation+Management+-+A+Framework+for+Action.pdf

Broad overview of this approach

Characteristic	Description	
The target of biodiversity offsets (species, habitats, landscapes)	HABITAT STRUCTURE (based on amounts relevant to each HABITAT TYPE) is the principal measured SURROGATE of BIODIVERSITY LOSS or GAIN. Habitat types are usually broad vegetation types but habitat structure ATTRIBUTES can be chosen to represent particular species of value where necessary. Although measurement is based on vegetation characteristics, other biodiversity components such as presence of species and consideration of ecological processes are used as EXCHANGE CRITERIA.	
Mitigation hierarchy	The mitigation hierarchy must be applied: to avoid adverse impacts, particularly through vegetation clearance; to minimise impacts through appropriate consideration in planning processes and expert input to project design or management where impacts cannot be avoided; to identify appropriate offset options to achieve commensurate gains.	
Thresholds for considering biodiversity offsets	*Upper and lower thresholds*	Apart from clearing associated with fire safety and routine infrastructure management, offsets are required on private and public land for all clearing above minimum area thresholds. These thresholds vary according to the conservation significance of the vegetation.
Desired or required outcome	'NET GAIN': this 'whole of landscape' aspirational objective comprises three essential components to ensure an overall increase in the extent and quality of native vegetation in Victoria: a reduction in losses in the extent of existing native vegetation; a reduction in losses in the quality of existing native vegetation due to threatening processes, and the achievement of gains in extent and quality of native vegetation through its rehabilitation and revegetation with indigenous species for BIODIVERSITY CONSERVATION and land and water resource outcomes. Offsetting of clearing is just one part of this policy objective. When applying the Net Gain policy objective to individual acts of clearing, there is a graded required outcome from 'substantial net gain' (i.e. 2x) where the conservation significance is very high to 'net gain' (1.5x) and 'equivalent gain' (1x) for high and medium conservation significance offsets. Also when choosing offset options, similar or more effective land protection function **and** ecological function as impacted by the loss is required for 'very high' conservation significance offsets, similar or more effective land protection function **or** ecological function for 'high' conservation significance offsets, and similar or more effective land protection function for 'medium' and 'low' conservation significance offsets.	
Offset options	Only *in situ* conservation options are allowed, through habitat management to protect, enhance and / or restore native vegetation. There is a graded response to ensuring an appropriate link between the characteristics (e.g. biodiversity value, functionality) of the vegetation or habitat type that is lost through clearing and the subsequent mitigation: from a direct link between loss and offset for higher significance, down to more flexibility for lower significance (at the discretion of the planning authority) leading to opportunities to optimise CONSERVATION OUTCOMES. For example, vegetation proposed as the basis for an offset for impacts on 'very high' conservation significance habitat must be at least 90% of the quality in the area being lost, and the 'revegetation' component of the offset (HABITAT HECTARES) is limited to 10%, whereas for 'medium' conservation significance offsets the quality requirement and revegetation limit is 50%. This avoids exposing 'very high' conservation significance values to the inherent risks of exchanging small areas of high quality habitat with large areas of immature or low quality habitat (offsets must be located in areas of similar site-level functionality).	
Offset methodology	The offset is to be 'LIKE-FOR-LIKE' or 'in-kind', based on the Victoria State native vegetation classification. TRADING UP is specifically allowed and 'rewarded' by affirmative ratios. Use of a benchmark for each vegetation type on their own terms, allows for trading equivalence i.e. if the exchange across types is acceptable, then it is assumed that a loss of 1 habitat ha of type A can be considered to be offset with a gain of 1 habitat hectare of type B.	

Broad overview of this approach		
Characteristic	**Description**	
	Calculating loss-gain: the currency	This approach is based on 'habitat hectares', units of measurement that take into account the *area affected* and *the quality or condition* of the vegetation impacted (determined by the quantities of a number of chosen attributes related to the structure of that habitat). It was originally designed to focus on habitat structure, and thus provide proxies for composition and function. In practice, some aspects of composition and function have been included as attributes and are thus measured directly. The attributes can be chosen to represent particular species of value, if necessary. The approach uses a 'benchmark': the comparison of remnant native vegetation to a reference site having the same vegetation type in a mature and long-undisturbed state. The first step in this process is the identification of the vegetation communities likely to be affected (termed Ecological Vegetation Classes (EVC)). Each EVC has a characteristic assemblage of plant species and structural variation and condition is measured using these characteristics. Where a suitable benchmark cannot be found, benchmark values are devised to represent the presumed long-undisturbed condition of that EVC using historical information and a knowledge of how similar vegetation types have been affected by human disturbance regimes. The final score for a particular unit / BIOTOPE is determined by recording and tallying condition scores for key biodiversity attributes. Multiplying this score by area gives a measure termed a 'habitat hectare'. For example, 10 hectares of mature, fully natural (100% score) wet heathland could be counted as 10 'habitat hectares', whereas 10 hectares of this EVC with a 'habitat score' of 50% would be scored as 5 'habitat hectares'.
	Site selection and landscape level planning	Some of the habitat hectare attributes are LANDSCAPE CONTEXT, such as patch size and neighbourhood. These provide measures of the landscape-level CONNECTIVITY-based value of the impact and offset sites. Other factors such as the strategic conservation importance of particular locations are included as exchange criteria in the broader offsetting process.
	Multipliers and ratios	Victoria State uses a CURRENCY-based multiplier based on the habitat hectares method, as adapted by BBOP in this guidance document. The 'Area x Quality' calculation creates the currency based on a number of individually chosen and case-specific attributes or variables of (mainly) habitat condition which are surrogates for the biodiversity of particular interest or importance in the impacted ecosystem. In addition to the currency-based multiplier inherent in the habitat hectare calculations, the state of Victoria also requires multiples of this quantity to be applied according to the conservation significance of the habitat impacted. This ranges from at least 2x the calculated loss of habitat hectares for very high conservation significance offsets to partially address risk of some level of offset failure (regarded as 'substantial net gain'), a 1.5x multiplier for high conservation significance and a 1x for medium to low conservation significance. TIME DISCOUNTING, in terms of the lower present value of future HABITAT HECTARES, is not specifically dealt with, although only gains estimated at 10 years post-treatment are used in calculations (even though gains will often accrue after this time) so this mitigates this issue to some extent.
Addressing biodiversity offsets in relation to ecosystem services (e.g. provisioning, cultural, regulating, supporting services)	The approach specifically addresses the INTRINSIC VALUES of biodiversity. Land (i.e. soil stability and condition) and catchment (i.e. surface water quality and groundwater flows) protection are also directly relevant in the policy and in practice.	

Broad overview of this approach		
Characteristic	**Description**	
Stakeholder engagement	Stakeholders are principally the land management / development scientific and conservation communities of Victoria State.	
Implementation	*Timing*	A graded response: from formally initiating offsets prior to clearing taking place, to initiating offsets as soon as seasonally practicable after clearing has taken place.
	Duration	The offset should last in PERPETUITY.
Broad comments	A practical approach developed for application in Victoria State and intended to ensure that permitted clearing and associated offsets make an appropriate contribution to the 'whole of landscape' policy objective to arrest / reverse decline in native vegetation classes and habitats. The approach uses habitat quality / condition measures that are not necessarily related to actual occupancy of habitat by species. Provided that significant knowledge and information exists to enable use of habitat structure as a PROXY for biodiversity value, and so long as issues such as invasive species and microhabitats for key species are included in the approach, this methodology may be able to be used reliably elsewhere in the world. The level of resources required could be high to medium, depending on the availability of appropriate and reliable ecological information. The BBOP approach draws on aspects of this methodology.	

A.7 Western Australia: Net Environmental Benefit

This approach was first broadly described in 2006 by Western Australia's Environmental Protection Authority (EPA) in its Position Statement No. 9 on Environmental Offsets. Subsequently in 2008, specific Guidance on Biodiversity Offsets (No. 19) was made available by the EPA.

The EPA focuses on protecting critical (the State's most important) environmental assets and high value assets (see EPA 2006 page 19; and Final Guidance No.19 published in September 2008). Position Statement No. 9 defined a broad list of 'critical' assets. In this context, environmental offsets are defined as environmentally beneficial activities undertaken to counterbalance an adverse environmental impact and achieve a 'net environmental benefit' (EPA 2008).

Useful references

EPA. 2006. Position Statement No. 9. Environmental Offsets. January 2006. Environmental Protection Authority, Western Australia.

EPA. 2008. *Guidance for the Assessment of Environmental Factors (in accordance with Environmental Protection Act 1986). No. 19. Environmental Offsets – Biodiversity.* September 2008. Environmental Protection Authority, Western Australia. Available at:
http://www.epa.wa.gov.au/docs/2783_GS19OffsetsBiodiv18808.pdf

<table>
<tr><th colspan="3">Broad overview of this approach</th></tr>
<tr><th>Characteristic</th><th colspan="2">Description</th></tr>
<tr><td>The target of biodiversity offsets</td><td colspan="2">Offsets focus on environmental values and attributes in relation to an ‘environmental asset’. In the context of biodiversity, an environmental asset may comprise a particular ecosystem, habitat, community or associations of species, species, or biological corridors or linkages.</td></tr>
<tr><td>Mitigation hierarchy</td><td colspan="2">Environmental offsets should only be considered after all reasonable attempts to mitigate adverse impacts have been exhausted.</td></tr>
<tr><td rowspan="2">Thresholds for considering biodiversity offsets</td><td>Upper threshold</td><td>The EPA, in providing its advice to the Minister, will adopt a presumption against recommending approval of proposals or schemes where significant adverse environmental impacts affect ‘critical’ assets.
In some cases, a project likely to significantly impact on a ‘high’ value asset may be found to be environmentally unacceptable whether or not a comprehensive offsets package is proposed.</td></tr>
<tr><td>Lower threshold</td><td>The EPA does not generally undertake EIA in relation to ‘low to medium’ value assets (in less than good to excellent condition as recognised by government agencies and communities). Impacts to this class of assets are usually dealt with by relevant government agency approvals processes.</td></tr>
<tr><td>Desired or required outcome</td><td colspan="2">The successful integration and application of OFFSET ACTIVITIES should aim to produce a ‘net environmental benefit’ outcome.</td></tr>
<tr><td>Offset options</td><td colspan="2">Biodiversity values at the offset site should be similar to those being impacted. That is, offsets should ideally be ‘like-for-like or better’. Biodiversity related offset sites should have similar or better environmental values and attributes in the vicinity of the impacted site or in the same bioregion if a better environmental outcome could be achieved.
Both ‘direct’ (off-site ecosystem restoration, off-site ecosystem rehabilitation, land acquisition for conservation) and ‘contributing’ (materially add to environmental knowledge, research, ongoing management and protection, covenanting) offsets can be included in an offsets package. Priority should be given to formulating a package that will deliver the maximum long-term environmental benefit with a high level of certainty that it can be successfully implemented in the context of ‘like-for-like or better’ (referring to similar or better environmental values and attributes – species compositions, vegetation complex, landscape functions).</td></tr>
<tr><td rowspan="2">Offset methodology</td><td>Calculating loss-gain: the currency</td><td>The approach essentially follows the following steps:
• Identify the key values and attributes associated with assets to be impacted.
• Identify potentially significant residual adverse impacts having applied the mitigation hierarchy / sequence.
• Develop an offsets package (considering both direct and contributing) for significant adverse residual impacts.
No specific methodology is advocated.</td></tr>
<tr><td>Site selection and landscape level planning</td><td>Priority would be given to an offsets package in the same local area or same bioregion (if a better environmental outcome could be achieved) and / or in accordance with regional biodiversity strategies that address regional development and priority areas for protection.</td></tr>
</table>

Broad overview of this approach		
Characteristic	**Description**	
	Multipliers and ratios	POSITIVE OFFSET RATIOS should apply where risk of failure is apparent and / or where there is a reasonable risk that the offset will not fully succeed over the long term. That is, the size of the offset to impact ratio should be larger than 1:1 and be *proportional* to both the importance of the environmental asset being impacted, and the likelihood that the offset is unlikely to achieve a 'net environmental benefit' outcome. Offset ratios should be based on past findings, success rates, current research or other similar projects being undertaken. Risk of failure could be reduced through, for example, putting offsets in more than one location.
Addressing biodiversity offsets in relation to ecosystem services	The emphasis of this approach is on the intrinsic values of biodiversity, although use and CULTURAL VALUES are mentioned. Environmental values are defined as ecological values (e.g. ecosystem health which relates to the protection of the inherent composition, structure and functioning of the natural ecosystem) or beneficial uses (conducive to public benefit, AMENITY, safety, health or aesthetic enjoyment, cultural or spiritual use). Environmental attributes may include types / units in relation to vegetation, landscape etc, ENDEMISM, native vegetation structural integrity, scale, shape and linkages of natural areas relevant to ecological processes, rarity, natural diversity, important fauna habitat, significance related to biophysical or socio-cultural context and other special attributes.	
Stakeholder engagement	Consultation with stakeholders, communities, government agencies and specialists in identifying the key values and attributes to be impacted	
Implementation	*Timing*	Offsets must be clearly defined, publicly registered, transparent, auditable and enforceable. Addition of land to the conservation estate should be in line with conservation strategies and provided with up-front funding to enable its protection and rehabilitation to a state that requires minimum active management over time. An offsets package must be able to produce environmental benefits in an agreed timeframe and be in place (including any bonds or guarantees, where applicable) before development commences.
	Duration	Offsets must be undertaken on the understanding that the activities and outcomes must be long-term. The offset site should be legally protected with covenants or conservation agreements or transferred into the conservation estate to ensure that the positive environmental benefit is long lasting. Legal agreements may be required in some instances to identify responsibilities and to ensure the ongoing management and maintenance of the offset site over an ecologically meaningful timeframe (perhaps decades).
	Management	Offset activities must be monitored over time to check that progress is being made and desired outcomes are achieved both in implementation of the offset and in its ongoing management needs.

A.8 South Australia: Significant Environmental Benefit (SEB) methods

The first edition of the South Australian Strategic Plan (SASP)[6], an overarching State policy document, included a target that all clearance of native vegetation would be offset by a significant biodiversity GAIN. The target was based on the premise that clearance of native vegetation will result in the further loss (even temporary) of habitat, biodiversity and environmental values in a landscape that has been substantially modified by European settlement. The provisions for offsets also support other SASP targets including *no species loss*. The main legislative mechanism to require significant environmental gains in South Australia is the Native Vegetation Act, 1991. This Act requires that a significant environmental benefit is attained *in lieu* of the clearance of native vegetation. The method was developed for use by government ecologists and environmental consultants when assessing the impacts of proposed projects in the agricultural, mining, property / housing development and infrastructure industries.

Amendment to native vegetation legislation will shortly be introduced to State Parliament that will provide, in limited circumstances, that an SEB offset may be achieved outside of the region of impact. The proposed amendments recognise that it may be desirable to undertake restoration or revegetation of habitat that will support threatened species recovery, and that this might be achieved where it is most needed anywhere in the state.

6 See **http://www.stateplan.sa.gov.au/**.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	Native vegetation: ecosystems, communities, habitats, species.
Mitigation hierarchy	The mitigation hierarchy should be applied: e.g. proposed housing development / mining / petroleum / geothermal operations should ensure that there is no practicable ALTERNATIVE that would avoid the clearance of native vegetation, the clearance of less native vegetation or the clearance of less significant native vegetation. Where native vegetation clearance is unavoidable, measures are undertaken to counterbalance the loss of that vegetation to achieve an Significant Environmental Benefit (SEB) either on the site or within the same region.
Thresholds for considering biodiversity offsets	Clearance of native vegetation in South Australia requires the approval of the Native Vegetation Council (NVC) unless the clearance is exempted by the *Native Vegetation Regulations 2003*. In essence, the *Native Vegetation Act 1991* does not permit the clearance of native vegetation that is particularly significant for its biodiversity values (species, habitat or ECOSYSTEM FUNCTION), or its service function in protecting significant soil or water resources. This provision effectively sets the upper threshold for considering biodiversity offsets. A number of exemptions from the Act provided by the Regulations are also conditional on clearance being avoided or minimised, and the proponent achieving an SEB offset (e.g. clearance incidental to mining operations, the provision of infrastructure in the public interest, and the establishment of housing). Where no such conditions apply, offsets would not be considered.
Desired or required outcome	Positive conservation outcomes are encouraged: the desired outcome is SEB through the establishment, regeneration or protection of native vegetation on land specified by the Native Vegetation Council. The clearance of higher value vegetation should be offset by a higher SEB which should support the highest possible biodiversity outcomes in terms of quality, position in the landscape, and ongoing management.
Offset options	An SEB may be achieved through: management of existing remnant native vegetation (e.g. control of pest plants and animals); possibly protection under a Heritage Agreement (conservation covenant); restoring degraded native vegetation to a functioning ecosystem; revegetating cleared areas to recreate a functioning ecosystem. An SEB does not necessarily require 'like-for-like' offsets (however it is encouraged) and does allow 'trading up': the SEB ratio can be adjusted according to the conservation value of the ECOTYPE in question, using state and national data on community / ecotype prioritisation. A landholder may undertake the SEB works, or may seek to make a payment to the Native Vegetation Council (paid into the Native Vegetation Fund), which the Council will use to fund a similar works elsewhere. In addition, a number of other offset activities may be considered, including acquiring land, protecting and funding ongoing management of those areas (may include the donation to organisations for conservation) and / or undertaking revegetation/restoration activities on that land to re-establish habitats; supporting relevant research or removal of threats / management of existing vegetation, fund / undertake projects in Crown estate parks and reserves, and any other approved activities as identified by the proponent that are likely to have an SEB, provided it complies with legislative and policy requirements.
Offset methodology	There are currently a range of methodologies in use in South Australia to determine an appropriate SEB offset, or payment into the Native Vegetation Fund. Separate SEB guidelines, approved by the NVC, have been prepared for the clearance associated with the mining and petroleum industry[7] and the clearance of scattered paddock trees. These guidelines are used by the NVC to determine an appropriate SEB offset for clearance in these industries and for the clearance of scattered trees. Methodologies consistent with these guidelines exist for other circumstances that are not captured by these guidelines.

7 Guidelines for a Native Vegetation Significant Environmental Benefit Policy For the clearance of native vegetation associated with the minerals and petroleum industry, September 2005. Government of South Australia Department of Water, Land and Biodiversity Conservation. **http://www.dwlbc.sa.gov.au/assets/files/nv_mining_guidelines_final_Sept_2005.pdf**.

Broad overview of this approach		
Characteristic	**Description**	
	Calculating loss-gain: the currency	Two pathways are available for determining a SEB offset: • For scattered trees the approach relies on scoring the type, size, relative health, wildlife habitat, landscape and conservation attributes of the tree using a Points Scoring System (PSS). The score generated is multiplied by a factor to determine the SEB offset requirement value. The next step in the process requires an assessment of the SEB value / ha of the proposed offset. The product is fed into a formula that considers the attributes of the SEB offset area such as a Habitat Significance Rating (HSR) and Landscape Context Rating (LCR), which are based on the quality / condition of the SEB site and its relation to other landscape elements. The resultant product obtains the final SEB offset area required. • For the clearance of degraded patches of native vegetation the SEB offset is determined by the relative quality of the vegetation proposed to be cleared, by way of applying a set aside ratio (a sliding scale from 2:1 to 10:1 where 2 equates to low quality and 10 to high quality vegetation with little degradation / weed invasion). • Calculation of the payments to the Native Vegetation Council includes the area cleared, the set-aside ratio (a sliding scale from 2:1 to 10:1), land values for the district (based upon advice provided by the Valuer-General's office) and includes an amount to allow for the future maintenance of these protected areas.
	Site selection and landscape level planning	Offsets may be located within the same region (Natural Resources Management Board) of the State or on the affected site. Consideration is given to landscape-scale issues through the use of a LCR in determining the SEB offset.
	Multipliers and ratios	Risk is covered through the use of innovative Rehabilitation Security Bonds that cover the risk to the government should proponents become insolvent or the rehabilitation is insufficient. In the SEB method, risk of likelihood of conservation outcomes is catered for to some degree by changing the SEB ratio required of the offset. This is done based on a variety of criteria, some of which cover risk, such as the likely conservation value of rehabilitated area. The methodology for calculating SEB requirements associated with mining operations is determined by a function of the area and the condition of the vegetation to be cleared, ranging from an offset of two times the cleared area (2:1) for clearance of poor quality native vegetation through to an offset of ten times the area cleared (10:1) for clearance of intact native vegetation. The proponent may seek to reduce the SEB requirement to take into account restoration of the area after mining if efforts are considered greater than normal site rehabilitation and other efforts to mitigate the impacts. The latter are assessed on a case by case basis. The methodology for calculating SEB requirements for scattered paddock trees also the value of the vegetation (trees) to be cleared multiplied by a factor to achieve a larger SEB for clearance of more significant trees. A score (tree score) is determined for each tree based on its overall wildlife habitat value[8]. The tree score is multiplied by a multiplication factor to determine the SEB offset requirement value. The multiplication factor increases (stepped) as the tree score increases. The SEB offset scores for individual trees are summed to determine the total SEB offset requirement score. The next step in the process requires an assessment of the SEB value / ha of the proposed offset. This is produced by multiplying a HSR for a proposed SEB offset by a LCR. An offset with a good LCR will result in a higher SEB offset point score. A higher SEB value / ha will result in a smaller offset area.

8 Cutten, J.L. and Hodder, M.W. 2002. Scattered tree clearance assessment in South Australia: streamlining, guidelines for assessment and rural industry extension. DWLBC, Adelaide.

Broad overview of this approach	
Characteristic	**Description**
Offsets in relation to ecosystem services	The approach focuses on the intrinsic value of native habitats and species, as well as on landscape values. The focus on native habitats and species will also favour many cultural and economic values of biodiversity in the Australian context.
Stakeholder engagement	No specific reference found in documents.
Implementation	Native vegetation planted as part of the SEB offset is protected under the legislation as though it was naturally occurring native vegetation. The existence of an SEB offset is flagged as an encumbrance against the land title documents for the property to ensure future landowners are aware of the requirement to continue the protection and management of these sites. Although not specifically stated, it is assumed that the offset would persist in perpetuity.
Broad comments	There is no one methodology in use, although the focus on habitat significance and landscape context provides a sensible basis for an offset approach. The application of a ratio to adjust hectares of land required as an offset allows for effective positioning of the offset within a mitigation hierarchy. Although the criteria and ratios are designed for use in South Australia, the principles underpinning this approach would be applicable elsewhere. The method is relatively simple to use, compared with others currently being developed. The scoring system for habitat quality and landscape context is based on known values and ways to measure them. For this reason, the level of resources (time and funds) required could be low to medium, depending on the availability of sufficient relevant information on the impacted habitat and species.

A.9 Western Cape of South Africa's Draft Provincial Guideline

The Western Cape province of South Africa harbours many restricted range threatened ecosystems and species of global significance which require careful policy to protect from cumulative encroachment. In the province's *Provincial Guideline on Biodiversity Offsets*, OFFSET RATIOS have been determined primarily in relation to the proportion of habitat remaining and its THREAT STATUS. The initial CURRENCY is hectares of ECOSYSTEM TYPE adjusted according to ecosystem status (threat level). Offset ratios are intended to prevent significant decline in level of endangerment or threat and to ensure that offsets make a commensurate contribution to meeting conservation targets for the affected ecosystem.

Useful reference

Department of Environmental Affairs and Development Planning. 2007. *Provincial Guideline on Biodiversity Offsets*. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town. Available at:
http://www.capegateway.gov.za/Text/2007/3/pgwcoffsetsguidelinedraft_5march_07.pdf

Broad overview of this approach		
Characteristic	**Description**	
The target of biodiversity offsets	Threatened ecosystems and species, special habitats, valued ECOSYSTEM SERVICES and important ecological and evolutionary process areas in a LANDSCAPE CONTEXT.	
Mitigation hierarchy	Biodiversity offsets are seen as a last resort option in the mitigation hierarchy, after a developer has proven that (a) all feasible and reasonable alternatives have been considered in arriving at the proposed development and (b) reasonable and responsible actions have been taken in the location, siting, scale, layout, technology and design of the proposed development to avoid, minimise and repair / restore associated impacts.	
Thresholds for considering biodiversity offsets	*Upper threshold*	Offsets would generally not be considered for impacts on critically endangered ecosystems or species, special habitats, and / or in areas identified by conservation agencies or in bioregional / biodiversity plans as essential to meet conservation targets. Offset in these circumstances could only be considered in exceptional circumstances (e.g. where probability of PERSISTENCE or viability is very low).
	Lower threshold	Impacts on ecosystems or species that were not threatened or identified as important to meet conservation targets (e.g. in an ecological corridor) would not require an offset.
Desired or required outcome	The CUMULATIVE IMPACT of the development authorisation and associated EIA process does not cause any ecosystem to become more threatened than 'endangered'[9] or the conservation status of species and the presence of 'special habitats' to decline; conservation efforts arising from the development application process, and contributing to improved protection of the Western Cape's unique species and ecosystems are focused in areas identified as priorities for BIODIVERSITY CONSERVATION; and, ecosystem services provided by affected biodiversity and on which local or vulnerable human communities – or society as a whole – are dependent for LIVELIHOODS, health and / or safety, are safeguarded.	
Offset options	'LIKE-FOR-LIKE' habitat would generally be required, although 'TRADING UP' could be considered where relevant to the particular circumstances. Although the focus of offsets is on acquiring and securing habitat, monetary compensation may be considered as an interim measure to securing habitat in some cases. Either on-site or off-site offsets would be considered; on-site offsets would be acceptable only if they could make a meaningful contribution to achieving biodiversity conservation targets in the area.	
Offset methodology	*Calculating loss-gain: the currency*	The ecosystem status (threatened status) of the impacted habitat is used to derive a basic offset ratio required to ensure that conservation targets for the impacted ecosystem would be met. Offsets are calculated by multiplying the area lost by the offset ratio which has been pre-assigned to the affected ecosystem according to its conservation status in terms of the National Spatial Biodiversity Assessment. The area determined by this basic offset ratio is then adjusted by a range of context-specific considerations, including: the condition of the affected habitat; the significance of RESIDUAL IMPACTS on threatened species; the significance of residual impacts on special habitats; the significance of residual impacts on important ecological corridors or process areas; and the significance of residual impacts on biodiversity underpinning ecosystem services with socioeconomic value.
	Site selection and landscape level planning	The approach takes into account ecosystem linkages, gradients and CONNECTIVITY aspects in the larger landscape, as well as the location of the impact and offset site(s) in relation to spatial biodiversity plans and conservation priorities. It is intended to support bioregional planning and ensure that development does not

9 South Africa's National Environmental Management Biodiversity Act 2004 makes provision for listing threatened ecosystems and species (critically endangered, endangered and vulnerable).

Broad overview of this approach		
Characteristic	**Description**	
		compromise conservation options or undermine targets. Offsets should be located in the landscape to (in order or priority) to: make the maximum contribution to securing, protecting and / or linking biodiversity priority areas, and consolidating ecological corridors in the landscape identified in biodiversity, bioregional or conservation plans. These areas are broadly grouped as 'key receiving areas' for offsets. Offset sites should provide comparable ecosystem services to those delivered by impacted site, should minimise FRAGMENTATION of habitat and be close to the impacted site.
	Multipliers and ratios	This system calculates multipliers based on ensuring that the persistence of threatened ecosystems in the landscape does not drop below certain thresholds set as a policy target (e.g. '4,000 ha of habitat A'). Following calculation of the residual loss in terms of hectares alone, the multiplier calculation follows two steps: a) Use a basic multiplier linked to the conservation status of affected ecosystems. This involves multiplying the residual loss impact areas by a factor according to the endangerment of the ecosystem: a 30x 'basic ratio' (i.e. for every hectare lost, 30 hectares of offset of that ecosystem would have to be secured) for critically endangered' ecosystems (only in extraordinary circumstances; in most cases these ecosystems are irreplaceable and not 'offsetable'); 20x for 'endangered' ecosystems; 5x for 'vulnerable' ecosystems; no offset for 'least threatened' ecosystems. b) Adjust the revised figure based on the habitat condition, impacts on special habitats, ecological corridors or process areas, and impacts on ecosystem services or the biodiversity underpinning these services. For example, impacts on degraded habitat mean the multiplier can be halved.
Addressing biodiversity offsets in relation to ecosystem services	The initial focus is on the INTRINSIC VALUE of biodiversity (i.e. its conservation significance), but additional considerations relate to important use and cultural values.	
Stakeholder engagement	The consideration of offsets must involve a stakeholder engagement process that takes into account scientific knowledge about the uniqueness of the area impacted as well as the values ascribed to it by local communities. Key stakeholders (conservation agencies, authorities, the proponent, affected parties, non-government organisations, specialists) must be involved in the identification and evaluation of potential offsets, and there should be broad acceptance of the ultimate offset proposed	
Implementation	*Duration*	The offset is intended to be in place in perpetuity, through contribution to the public conservation estate.
	Management	A management (and, where appropriate, a restoration) plan with clear objectives, targets, actions, responsibilities, and timing should be drawn up. Performance auditing and reporting requirements should be spelt out. An adequately resourced ENDOWMENT FUND for the offset would have to be set up, directly related to the costs of managing, monitoring and auditing the offset, as well as obtaining specialist advice where appropriate. A schedule of costs linked to the management plan and associated activities, specialist input, management of offset bond or TRUST FUND should be provided.
	Timing	No specific reference found in documents.
Broad comments	Relatively easy to determine the basic offset ratio required for the impacted ecosystems where there is reliable regional information on their conservation status. The complexity of this methodology would largely depend on the availability of (and need to gather) information on significant species on the affected site and their particular habitat and offset requirements. For significant ecosystems containing special habitats and threatened species, the level of resources (time and funds) required could be high where information is lacking. Conversely, where the impacted area is well-researched, this methodology would be relatively simple and quick to apply.	

Appendix B: Approaches relevant to biodiversity offsets by banks

A number of financing institutions have developed, or are currently in the process of developing, operational or safeguard policies on, amongst others, the environment and its biodiversity. This appendix presents a summary of the policies of three major financing institutions as an indication of the main trends in the requirements of borrowers for dealing with biodiversity.

B.1 World Bank Operational Policy 4.04: Natural Habitats

World Bank projects and activities are governed by Operational Policies[10], which are designed to ensure that they are economically, financially, socially and environmentally sound. The Bank's Safeguard Policies include Environmental Assessments (EA) and policies designed to prevent unintended adverse effects on third parties and the environment. Specific safeguard policies address NATURAL HABITATS (OP 4.04), pest management, cultural property, involuntary resettlement, indigenous peoples, the safety of dams, projects on international waterways, and projects in disputed areas. OP 4.04 addresses mitigation of impacts on biodiversity. There is overlap between the Bank's Operational Policy 4.04 and 4.10 (Indigenous Peoples) with regard to the potential values of impacted biodiversity. These Operational Policies must be seen in relation to the Operational Policy on Environmental Assessment (OP 4.01).

The Team Leader identifies any natural habitat issues, including any significant conversion or degradation that would take place under the project, as well as any other forms of mitigation measures proposed, in the initial Project Information Document (PID) and in the early versions of the Environmental Data Sheet. Updated PIDs reflect changes in the natural habitat issues. The Project Appraisal Document indicates the types and estimated areas (in hectares) of affected natural habitats; the significance of the potential impacts; the project's consistency with national and regional land use and environmental planning initiatives, conservation strategies and legislation; and the mitigation measures planned.

10 See **http://go.worldbank.org/WTA1ODE7T0**.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	The focus of this policy is on important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, and priorities for conservation.
Mitigation hierarchy	If the EA indicates that a project would significantly convert or degrade natural habitats, the project must include mitigation measures acceptable to the Bank. A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project must examine the project's potential negative and positive environmental impacts, compare them with those of feasible ALTERNATIVES (including the 'without project' situation), and recommend measures to prevent, minimise, mitigate, or compensate for adverse impacts and improve environmental performance. A Category B project's potential adverse impacts on environmentally important areas (including wetlands, forests, grasslands, and other natural habitats) are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category A projects. Appropriate mitigation would depend on the characteristics of the given site, but may include full site protection through project redesign; strategic habitat retention; restricted conversion or modification; reintroduction of species; mitigation measures to minimise the ecological damage; post-development restoration works; restoration of degraded habitats; and establishment and maintenance of an ecologically similar protected area of 'suitable size and contiguity'.
Thresholds for considering biodiversity offsets	The Bank does not support projects that, in its opinion, involve the significant conversion (elimination or severe diminution of the integrity of a critical or other natural habitat caused by a major, long-term change in land or water use) or degradation (modification of a critical or other natural habitat that substantially reduces the habitat's ability to maintain viable populations of its native species) of 'critical natural habitats'. These projects would include those within legally protected areas, areas officially proposed for protection, and unprotected areas known to have high conservation value. They would coincide with 'upper thresholds' beyond which offsets would not be considered. 'Critical natural habitats' are defined as: • Existing protected areas and areas officially proposed by governments as protected areas (e.g. reserves that meet the criteria of the IUCN classifications), areas initially recognised as protected by traditional local communities (e.g. sacred groves), and sites that maintain conditions vital for the viability of these protected areas (as determined by the EA process); or • Sites identified on supplementary lists prepared by the Bank or an authoritative source determined by the Regional Environment Sector Unit. Such sites may include areas recognised by traditional local communities; areas with known high suitability for biodiversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species. Listings are based on systematic evaluation of such factors as species richness; the degree of ENDEMISM, rarity and / or VULNERABILITY of component species; representativeness; and, integrity of ECOSYSTEM PROCESSES. For Category A or B projects where there would not be significant conversion or degradation, mitigation – including offsets – would be considered. Category C projects would have minimal or no adverse impact; they would coincide with 'lower thresholds' where offsets would not be required.
Desired or required outcome	The conservation of natural habitats, the maintenance of ecological functions and rehabilitation of degraded natural habitats.
Offset options	Establishing and maintaining an ecologically similar protected area of 'suitable size and contiguity'.

Broad overview of this approach	
Characteristic	**Description**
Offset methodology	No specific methodology is advocated.
Addressing biodiversity offsets in relation to ecosystem services	There is no specific mention of use or cultural values in OP 4.04. However, these aspects are addressed in the OP 4.10 on Indigenous Peoples, where it is noted that "indigenous Peoples are closely tied to land, forests, water, wildlife, and other natural resources, and therefore special considerations apply if the project affects such ties. In this situation, when carrying out the social assessment, the borrower must pay particular attention to (a) the customary rights of the Indigenous Peoples, both individual and collective, pertaining to lands or territories that they traditionally owned, or customarily used or occupied, and where access to natural resources is vital to the sustainability of their cultures and livelihoods; (b) the need to protect such lands and resources against illegal intrusion or encroachment; (c) the cultural and spiritual values that the Indigenous Peoples attribute to such lands and resources; and (d) Indigenous Peoples' natural resources management practices and the long-term sustainability of such practices".
Stakeholder engagement	The Bank expects the borrower to take into account the views, roles, and rights of groups (including local NGOs and local communities) affected by Bank-financed projects involving natural habitats, and to involve such people in planning, designing, implementing, monitoring, and evaluating such projects. Involvement may include identifying appropriate conservation measures, managing protected areas and other natural habitats, and monitoring and evaluating specific projects.
Implementation	In deciding whether or not to support a project with potential adverse impacts on a natural habitat, the Bank takes into account the borrower's ability to implement the appropriate conservation and mitigation measures. If there are potential institutional capacity problems, the project includes components that develop the capacity of national and local institutions for effective environmental planning and management. The mitigation measures specified for the project may be used to enhance the practical field capacity of national and local institutions. The Bank takes into account recurrent funding and capacity-building needs linked to the conservation of natural habitats and maintenance of ecological function.

B.2 International Finance Corporation’s Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management

The International Finance Corporation (IFC) has a number of Performance Standards on Social and Environmental Sustainability. Based on the assessment of risks and impacts and the vulnerability of the biodiversity and the natural resources present, the requirements of Performance Standard 6 (PS6) are applied to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected.

In order to avoid or minimise adverse impacts to biodiversity in the project’s area of influence, the client will assess the significance of project impacts on all levels of biodiversity genetic, species, or ecosystem level, as an integral part of the Social and Environmental Assessment process. The Social and Environmental Impact Assessment (S&EA) process is a way to identify, predict and assess the type and scale of potential biodiversity impacts, and opportunities to benefit conservation, associated with any business activities or projects. Biodiversity assessment should begin as early as possible, as effective assessment of the biodiversity characteristics of an area – and the potential impacts – may require months or even years, to account for seasonal and migration issues. Early attention to biodiversity issues means that potential impacts can be identified and avoided or mitigated in the earliest stages of planning.

There is overlap between the PS6, and Standards 7 (Indigenous Peoples) and 8 (Cultural Heritage) with regard to the potential values of impacted biodiversity. All of these standards must be seen in relation to Performance Standard 1 on Social and Environmental Assessment and Management Systems.

It is useful to note that the IFC and World Bank standards are consistent and fully aligned in terms of their environmental and social objectives, but the IFC's Performance Standards are tailored to the role and responsibilities of the private sector. The IFC Performance Standards, revised in 2006, have been incorporated into revised EQUATOR PRINCIPLES, so as to provide a single, consistent standard for private sector project financing. The Equator Principles were first launched in June 2003 with the goal of ensuring that projects financed by participating financial institutions were developed in a manner that is socially responsible and reflective of sound environmental management practices. The aim of these Principles is to avoid where possible negative impacts on project-affected ecosystems and communities; where impacts are unavoidable, they should be reduced, mitigated, and / or compensated for appropriately. The Principles have been adopted by more than sixty financial institutions (as of April 2009), known as the Equator Principles Financial Institutions (EPFIs).

Useful reference

IFC. 2006. Performance Standards on Social and Environmental Sustainability
(see **www.ifc.org/ifcext/sustainability.nsf/Content/EnvSocStandards**).

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	All levels of biodiversity, from species to ecosystem level, as well as any ecosystem services that might have local, regional or global impacts or implications. The presence of significant biodiversity value covers the range and status of the main species groups that live in the area (e.g. endangered species) and the proximity of the site to protected areas.
Mitigation hierarchy	Mitigation measures should be designed to achieve NO NET LOSS of biodiversity and favour impact AVOIDANCE and prevention over reduction and compensation. Mitigation measures will be designed to achieve no net loss of biodiversity where feasible, and may include a combination of actions, such as: post-operation restoration of habitats with appropriate native species and consistent with local ecological conditions, offsetting biodiversity losses through the creation of ecologically comparable area(s) elsewhere (comparable in size, quality and function) that is managed for biodiversity, and financial or IN-KIND compensation to direct users of biodiversity
Thresholds for considering biodiversity offsets	'Critical habitat' often coincides with the upper threshold for considering biodiversity offsets. 'Critical habitat' is a subset of both natural and MODIFIED HABITAT. It includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for ENDEMIC or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities. Consequently, as PS6 is currently written, impacts on areas of critical habitat would, in the first instance, not be considered by the IFC to be offsetable. This is because, in order for development to proceed in critical habitat, the client must demonstrate compliance with the following requirements, which include 'no measurable adverse impacts': In areas of **critical habitat**, the client will not implement any project activities unless the following requirements are met: • There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species or the functions of the critical habitat described above. • There is no reduction in the population of any recognised critically endangered or endangered species. Any lesser impacts are mitigated as for areas of **natural habitat**, where the client will not significantly convert or degrade such habitat, unless the following condition is met: mitigation measures will be designed to achieve no net loss of biodiversity where feasible, and may include a combination of actions such as (i) post-operation restoration of habitats, (ii) offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity, and (iii) compensation to direct users of biodiversity. In areas of natural habitat, an upper threshold is defined in terms of 'no significant conversion or degradation' unless: there are no technically and financially feasible alternatives; the overall benefits of the project outweigh the costs, including those to the environment and biodiversity; and, any conversion or degradation is appropriately mitigated, as described above. No lower threshold for considering biodiversity offsets is specified.
Desired or required outcome	In broad terms, the objectives are to protect and conserve biodiversity, promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities. For mitigation measures, including offsets, the desired outcome is 'no net loss of biodiversity where feasible'.
Offset options	May include a combination of actions, such as post-operation restoration of habitats, offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity, and / or compensation to direct users of biodiversity.

Broad overview of this approach	
Characteristic	**Description**
Offset methodology	No specific offset methodology is advocated.
Addressing biodiversity offsets in relation to ecosystem services	The Assessment must take into account impacts on ecosystem services or the communities dependent on these goods and services. Forests and aquatic systems are specifically identified as being principal providers of natural resources and thus significant. ECOSYSTEM SERVICES are defined as the benefits that people obtain from ecosystems, and include provisioning services (such as food, fibre, fresh water, fuel wood, biochemicals, genetic resources); regulating services (such as climate regulation, disease regulation, water regulation, water purification, degradation of pollutants, carbon sequestration and storage, nutrient cycling); and cultural services (spiritual and religious aspects, recreation and ECOTOURISM, aesthetics, inspiration, educational values, sense of place, cultural heritage). Performance Standard 1 emphasises the importance of integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects.
Stakeholder engagement	The Assessment must take into account the differing values attached to biodiversity by specific stakeholders, as well as identify impacts on ecosystem services. Consultation with local stakeholders is vital at this stage, and particular attention should be given to vulnerable or disadvantaged communities and to risks to communities from changes to ecosystem services and quality. Key stakeholders include potentially affected communities, public authorities and independent experts.
Implementation	No specific information on the implementation of offsets.

Sources: IFC. 2006. Performance Standards on Social and Environmental Sustainability
(see **www.ifc.org/ifcext/sustainability.nsf/Content/EnvSocStandards**) and personal communication with Peter Neame (IFC) in October 2008.

B.3 European Bank for Reconstruction and Development's Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

In May 2008 the European Bank for Reconstruction and Development (EBRD) adopted a new Environmental and Social Policy to replace its former Environmental Policy. The new policy is accompanied by ten Performance Requirements which outline the social and environmental responsibilities and specific practices that EBRD clients must follow with respect to a range of issues including labour, community health and safety, indigenous peoples, biodiversity, resettlement, protection of natural resources and cultural heritage.

Performance Requirement (PR) 6 addresses BIODIVERSITY CONSERVATION and sustainable natural resource management. The objectives of PR 6 are: to protect and conserve biodiversity; to avoid, minimise and mitigate impacts on biodiversity and offset significant RESIDUAL IMPACTS, where appropriate, with the aim of achieving NO NET LOSS or a NET GAIN of biodiversity; to promote the sustainable management and use of natural resources; to strengthen companies' license to operate, reputation and competitive advantage through BEST PRACTICE management of biodiversity as a business risk and opportunity; and to foster the development of pro-biodiversity business that offers alternative LIVELIHOODS in place of unsustainable exploitation of the natural environment. The EBRD supports a precautionary approach to the conservation, management and sustainable use of natural biodiversity resources (such as wildlife, fisheries and forest products) and will seek to ensure that its operations include measures to safeguard critical habitats and, where feasible, enhance natural habitats and the biodiversity they support. The EBRD highlights the survival of endangered or critically endangered species, endemic or geographically restricted species and sub-species, migratory or congregatory species, assemblages of species associated with key evolutionary processes, and species that are vital to the ecosystem as a whole (keystone species).

There is overlap between PR6, PR1 (Environmental and Social Appraisal) and PR7 (Indigenous Peoples) with regard to the potential values of impacted biodiversity.

Useful reference

www.ebrd.com/about/policies/enviro/policy/policy.pdf.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	The focus of this PR is on maintaining ecological integrity and functioning of the ecosystem, and viable populations of native species.
Mitigation hierarchy	The EBRD categorises projects as A, B or C, in terms of the likely significance of their impacts, as described below. Where biodiversity impacts are created by a project, the requirements of PR6 will need to be followed including the implementation of the mitigation hierarchy, and the integration of any necessary biodiversity actions into an Environmental and Social Action Plan (ESAP). The ESAP aims to 'focus on avoidance of impacts, and where this is not possible, mitigation measures to minimise or reduce possible impacts to acceptable levels'. • Category A projects are 'greenfield' or involve major extension or transformation-conversion. They require comprehensive environmental and / or social impact assessment, to identify and assess the potential impacts associated with the proposed project, identify potential improvement opportunities, and recommend any measures needed to avoid, or where avoidance is not possible, minimise and mitigate adverse impacts. • Category B projects may require a variety of due diligence investigations, depending on the project's nature, size and location, as well as the characteristics of the potential impacts and risks. Due diligence should identify and assess any potential future impacts associated with the proposed project, identify potential improvement opportunities, and recommend any measures needed to avoid, or where avoidance is not possible, minimise, and mitigate adverse impacts. • Category C projects, having minimal or no adverse impacts, will not be subject to further environmental or social appraisal. If, after all reasonable options to avoid, minimise or mitigate biodiversity impacts have been exhausted, there are still residual impacts affecting biodiversity, offsets may be required in line with a 'NO NET LOSS' approach.
Thresholds for considering biodiversity offsets	PR6 divides habitats into several categories, with these categories defining the key requirements in that HABITAT TYPE. These categories are 'modified', 'natural' and 'critical' habitats, and 'protected / designated areas'. Irrespective of the category, it is recognised that all habitats support living organisms and therefore due diligence must consider whether or not there would be material biodiversity impacts. Where modified (or newly created habitats) may be impacted, the client should aim to minimise any further degradation or conversion of habitat. That is, where there is merit on conservation grounds and depending upon the nature and scale of the project, the client should identify opportunities to enhance habitats, protect and conserve biodiversity or encourage sustainable harvesting or management of the area in question. In areas of 'natural habitat' (defined as land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions), there must be no significant degradation or conversion of the habitat to the extent that (i) the ecological integrity and functioning of the ecosystem is compromised or (ii) the habitat is depleted to the extent that it could no longer support viable populations of its native species, unless: • There are no technically and economically feasible ALTERNATIVES, and; • The overall benefits of the project outweigh the costs, including those to the environment and biodiversity; and • Appropriate mitigation measures are put in place to ensure no net loss and preferably a net gain of biodiversity value in the habitat concerned, or, where appropriate, a habitat of greater conservation value. 'Critical habitat' is defined by virtue of (i) its high biodiversity value, (ii) its importance to the survival of endangered or critically endangered species, (iii) its importance to endemic or geographically restricted species and sub-species, (iv) its importance to migratory or congregatory species, (v) its role in supporting assemblages of species associated with key evolutionary processes, (vi) its role in supporting biodiversity of significant social, economical or cultural importance to local communities, or (vii) its importance to species that are vital to the ecosystem as a whole (keystone species). Critical habitat must not be converted or degraded. Consequently, in areas of critical habitat, the client will not implement any project activities unless the following conditions are met:

Broad overview of this approach	
Characteristic	**Description**
	• Any due process required under international obligations or domestic law that is a prerequisite to a country granting approval for project activities in or adjacent to a critical habitat has been complied with. • There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its ability to function in the way(s) noted in the preceding paragraph (which defines critical habitat). • Taking a precautionary perspective, the project is not anticipated to lead to a reduction in the population of any endangered or critically endangered species or a loss in area of the habitat concerned such that the PERSISTENCE of a viable and representative host ecosystem be compromised. In all cases where impacts are identified, where attempts have been made to avoid, minimise and mitigate those impacts and where significant residual impacts on biodiversity remain, the client is required to identify actions or projects to offset those impacts. Any such offset project must be structured in agreement with the EBRD. EBRD does not set thresholds for when or where an offset is applicable, but the PR does make a statement that biodiversity offsets are very much viewed as a last resort measure (see Paragraph 8) when all other measures have been taken.
Desired or required outcome	No net loss and preferably a net gain of biodiversity value in the habitat concerned or, where appropriate, a habitat of greater conservation value.
Offset options	An offset in the habitat concerned, or, where appropriate, a habitat of greater conservation value. Any offset projects must be structured and agreed with EBRD.
Offset methodology	No specific methodology is advocated.
Addressing biodiversity offsets in relation to ecosystem services	The EBRD takes into account the use and CULTURAL VALUES of biodiversity by specifically addressing biodiversity of significant social, economical or cultural importance to local communities. The EBRD requires that the client compensate the affected indigenous peoples directly for any loss of livelihood incurred as a result of project related activities and reinstate any land used to its previous status. In addition, if the client proposes to locate the project on, or commercially develop natural resources located within, customary lands under use, and adverse impacts can be expected on the livelihoods, or cultural, ceremonial, or spiritual uses that define the identity and community of the Indigenous Peoples, the client will respect their use and offer culturally appropriate development opportunities; land-based compensation or compensation-in-kind *in lieu* of cash compensation where feasible. FREE, PRIOR AND INFORMED CONSENT is an important component of the EBRD's PR7 and PR10.
Stakeholder engagement	PR 10 covers stakeholder engagement. Clients must identify stakeholders potentially affected by their projects, disclose sufficient information about issues and impacts arising from the projects and consult with stakeholders in a meaningful and culturally appropriate manner. The EBRD may, in some cases, conduct its own public consultation activities for Category A projects.
Implementation	EBRD's environmental and social appraisal includes consideration of three key elements: (i) the environmental and social impacts and issues associated with the proposed project, (ii) the capacity and commitment of the client to address these impacts and issues in accordance with this Policy, and (iii) the role of third parties in achieving compliance with this Policy. Through its technical cooperation activities, EBRD will seek to mobilise support to provide capacity building programmes and other forms of assistance to enhance the projects it finances; for example by building the necessary capacity for consideration and management of environmental and social issues in its countries of operation, or increasing equitable access to the potential benefits of EBRD-funded projects.

Sources: **www.ebrd.com/about/policies/enviro/policy/policy.pdf** and personal communication with Mark Hughes (EBRD) in October 2008.

Appendix C: Methodologies currently being developed

C.1 The approach and methodology adapted and developed by BBOP, and currently being tested at the BBOP pilot sites

This Appendix is structured as follows:

- Context and background for the development of methods and tools for use at the BBOP PILOT PROJECTS.
- A broad overview of the approach.
- Some illustrations of the kind of tools that can be used at various steps in the process, including an approach to calculating LOSS and GAIN.

C.1.1 Context and background for the development of methods and tools for use at the BBOP pilot projects

The approach and methodology described here have been designed for voluntary biodiversity offsets, which are primarily the responsibility of the companies developing them. Parts of the tools are based on methodologies that have been used in countries such as Australia and the USA for many years. Some of the tools (or modified versions) have been applied at the BBOP pilot projects. The tools are designed to be applied in conjunction with stakeholders, who could offer an opinion on whether the offset has successfully applied the BBOP PRINCIPLES ON BIODIVERSITY OFFSETS, and is adequate.

BBOP started its work at the end of 2004, when the Shell Pearl project and Newmont Akyem project were the first pilot projects to join the programme. Early meetings of the BBOP Advisory Committee (Bangkok, November 2004; Washington DC, June 2005; Brazil, March 2006 and South Africa, September 2006) discussed different approaches to offset design which are often used in a regulatory context, particularly in the US and Australia. Participants commented on early prototype drafts of offset methodologies and guidance for the design of voluntary biodiversity offsets that the BBOP Secretariat had prepared with input from Advisory Committee members. Drafts of methods following the basic steps outlined in this Handbook have been developed by the BBOP Secretariat with contributions by many members of the Advisory Committee since 2006 and available to the pilot project partners. However, the draft methodologies have been evolving in parallel with early progress at the pilot projects, based on experience and suggestions from the Advisory Committee. In addition, drafts of potential elements of principles for biodiversity offsets have been discussed since September 2006, but the first draft of the set of principles laid out in Part 1 of this document was only prepared in February 2008, since which time it has been the basis for consultation culminating in final text in December 2008. Consequently, the methodology described here was not available in its entirety to the pilot projects when they started work on the design of their pilot offsets, nor were the underlying principles.

Some of the pilot projects joined BBOP comparatively recently (e.g. Solid Energy New Zealand only joined with its Strongman pilot in October 2007) and, for others, the process of obtaining government consent to initiate the development project concerned has taken years longer than initially anticipated, which has slowed the process of offset design. None of the companies has yet worked through all the steps involved in offset design and described in this Handbook. Finally, Phase 1 of BBOP has involved just five pilot projects with large companies (Shell, Newmont, AngloAmerican, Sherritt, Solid Energy New Zealand), and a sixth involving a small real estate development working with a local authority (Bainbridge). BBOP's seventh pilot, a small, community-led project in Kenya (SORALO), is still outlining the scope of the project and seeking project finance, so has not yet started offset design. With such a small sample size and only partial experience on the part of the pilots in using and testing the draft BBOP tools, the approach in this Appendix is best described as experimental and evolving. Indeed, its guidance on some aspects of voluntary offset design (such as TRADING UP, accounting for changes in the persistence of individual species and the use of MULTIPLIERS) is hesitant and preliminary, since there has not been much public and expert discussion on these topics internationally, and thus little 'BEST PRACTICE' upon which BBOP can draw.

With these caveats, the approach described here offers some optional guidance on which developers planning voluntary biodiversity offsets can draw, alongside the other approaches described in this Handbook. The approach is intended to be pragmatic and flexible and offer one method for offset design, from initial conception to selection of offset locations and activities. (At that point, OFFSET PLANNERS could turn to the OFFSET IMPLEMENTATION HANDBOOK to define the way the offset will be implemented.) The method has been developed to be applicable in all countries and biomes, from desert to tropical and temperate forest to the marine environment. Its suitability will depend upon the availability of adequate data, human and financial resources to apply it meaningfully. A qualified ecologist and local communities' knowledge is needed to complete the offset design, but the approach can be understood by a non-expert.

C.1.2 A broad overview of the approach developed and adapted for use in the design of biodiversity offsets and by the pilot projects

Broadly, the approach follows the steps described in the Biodiversity Offset Design Handbook, namely: describing the project; exploring the policy context; engaging stakeholders; undertaking biodiversity surveys and applying the MITIGATION HIERARCHY; quantifying residual impacts; identifying and comparing potential offset sites; calculating CONSERVATION GAINS for preferred offset sites; and deciding upon the final scope, scale, nature and location of offset.

The premise of the approach is to plan an offset whose aim is to achieve NO NET LOSS of biodiversity as a whole, and to use various methods to be as sure as is reasonably practicable that this will be the outcome, recognising that it is not possible to quantify every last component of biodiversity. The approach involves:

- Using comprehensive BASELINE data on biodiversity, generally prepared as part of the Environmental Impact Assessment (EIA) process, to be familiar with the breadth and significance of the biodiversity in the area of the development project and the project's likely impact upon it. Checking available data for any gaps, and filling these through additional desk- and field-based research.
- Identifying and describing the 'KEY BIODIVERSITY COMPONENTS' in a matrix: all those components of biodiversity at the species, ecological communities and assemblages and ecosystem levels that stand out as conservation priorities for their intrinsic, use and cultural values. (Note: the BIODIVERSITY OFFSET COST-BENEFIT HANDBOOK offers suggestions on identifying these use and cultural values.) Local stakeholders as well as national and international experts contribute to this process, to ensure that their priorities (which are likely to be related to uses for livelihoods and AMENITY and cultural aspects, such as aesthetic and religious values) are embraced. The purpose of the Key Biodiversity Components Matrix is to:
    i) Capture those biodiversity components that are regarded as high priorities for beneficial outcomes through the biodiversity offset. The ability of potential offset sites and activities to deliver conservation gain for each of these components is checked during the site selection process. Since this matrix

covers not only species but the communities / assemblages and ecosystems levels, an offset that delivers benefits for the components prioritised in the matrix should also deliver benefits for other components of biodiversity within the same communities and ecosystems.

ii) Inform the selection of the components of biodiversity to be used to calculate LOSS and GAIN.

- Assessing the residual adverse impact on biodiversity after the 'avoid, minimise and restore' steps in the mitigation hierarchy have been applied, and checking whether the impacts can be offset.
- Quantifying the residual loss of biodiversity using the method described in the table and text below. This is primarily based on an area x quality approach, using a BENCHMARK approach to calculating 'HABITAT HECTARES', supplemented where necessary with a calculation of species population / occupancy for certain species. (This second approach is a recent addition and is still being developed and tested at one of the pilot projects.) Other biodiversity SURROGATES or economic evaluation methods focussed on people's cultural and USE VALUES are also used to establish a package of benefits needed to motivate stakeholders to support the offset, compensating them for residual impacts on their livelihoods and amenity and engaging them in OFFSET IMPLEMENTATION (e.g. through sustainable livelihood activities from which they benefit).
- Determining whether the offset should be IN-KIND or OUT-OF-KIND, based on national and regional biodiversity priorities. 'LIKE-FOR-LIKE' is the first presumption, but the best CONSERVATION OUTCOME is encouraged, so 'trading up' to an out-of-kind offset can be justified, provided there is evidence to support this decision. 'Like-for-like' is defined through a combination of quantitative techniques, expert opinion and checking during the site selection procedure that the Key Biodiversity Components are present at the offset site.
- Selecting and comparing potential offset sites and activities to choose those that are sufficient to offset the losses caused by the project's impacts, taking into account the probability of the offset's being fully implemented, and that the offset will be feasible, accepted by stakeholders, and likely to succeed in the long term. This involves comparing how each Key Biodiversity Component and benchmark ATTRIBUTE is predicted to change under the status quo scenario with how it is predicted to change following the specific offset interventions, to check 'ADDITIONALITY'. The probability of successful change through the OFFSET ACTIVITIES is assessed for each of the attributes that comprise the offset METRICS, so that the scale of the offset is planned to reflect a real likelihood of achieving no net loss.
- Calculating (using the same approaches used to calculate the residual losses at the project site) the amount of biodiversity that could be gained through the offset(s) at the preferred site(s), and considering which (if any) 'multipliers' may be appropriate to use to plan a 'no net loss' offset in the face of risk and uncertainty; considering issues of scale and landscape-level planning to ensure the offset will be viable and fit into broader spatial and conservation plans; integrating the conservation activities with sustainable use projects and COMPENSATION addressing use and cultural values; determining whether a single offset site or a 'composite' offset is preferable and necessary ; and checking acceptance, feasibility and likelihood of success.

Some of the key features of the approach are described in the following table.

<table>
<tr><th colspan="3">Broad overview of the approach used at BBOP pilot sites</th></tr>
<tr><th>Characteristic</th><th colspan="2">Description</th></tr>
<tr><td>Offset target</td><td colspan="2">All: intrinsic, economic and cultural values are covered across all BIOTIC levels and spatial scales of organisation, including to some degree the interactions between these levels.</td></tr>
<tr><td>Mitigation hierarchy</td><td colspan="2">The mitigation hierarchy must be applied. The method reviews steps to avoid and minimise impacts, restore biodiversity after the impacts, and only offset the residual effects.</td></tr>
<tr><td>Thresholds for considering biodiversity offsets</td><td>Upper and lower thresholds</td><td>Lower: According to the BBOP PRINCIPLES, an offset should be considered for ‘significant’ residual adverse impacts on biodiversity, but it is up to developers and their stakeholders to determine what is ‘significant’ on a case by case basis.
Upper: The approach involves an analysis of whether it is possible to offset the project’s impacts on different components of biodiversity, based on a consideration of their IRREPLACEABILITY and VULNERABILITY, as discussed in Step 4 of this Handbook.</td></tr>
<tr><td>Desired or required outcome</td><td colspan="2">The goal of biodiversity offsets is to achieve no net loss or a NET GAIN of biodiversity on the ground with respect to species composition, HABITAT STRUCTURE and ECOSYSTEM FUNCTION, including LIVELIHOOD aspects.</td></tr>
<tr><td>Offset options</td><td colspan="2">To count as part of the offset, activities must involve measurable ‘on the ground’ conservation outcomes (i.e. ‘in situ’ conservation, as defined by the Convention on Biological Diversity). Capacity building, education and research to support this can be extremely valuable but are not regarded as part of the calculation of the core offset, unless they also give rise to measurable on the ground conservation outcomes.</td></tr>
<tr><td rowspan="2">Offset methodology</td><td colspan="2">The offset is designed to deliver ‘no net loss’ or a ‘net gain’ of biodiversity, through a ‘like-for-like or better’ offset that demonstrates additionality. The aim of the approach is to deliver additional conservation outcomes for biodiversity to achieve no net loss overall, but particularly by demonstrating gains for ‘Key Biodiversity Components’ identified early in the offset design process (or higher priority key biodiversity components, if ‘trading up’ can be justified). Offset sites and activities are selected that will:
• Be appropriate to deliver gains of each Key Biodiversity Component through management interventions (positive management, ARRESTED DEGRADATION or AVERTED RISK) at the chosen offset site(s);
• Result in an adequate amount of gain for biodiversity overall, based on the loss / gain calculations described below; and
• Motivate stakeholders to support the offset, by compensating them for RESIDUAL IMPACTS on their use and cultural values associated with biodiversity and engaging them in offset implementation (e.g. through sustainable livelihood activities from which they benefit).</td></tr>
<tr><td>Calculating loss-gain: the currency</td><td>This approach draws on three others:
1. The fundamental basis for the loss / gain calculation is the adapted ‘habitat hectares’ metric that takes into account the area affected and the quality or CONDITION of the biodiversity impacted. This was based on the Victoria, Australia habitat hectares measure, but while the latter focused on vegetation, this covers fauna, too.
2. This can be supplemented, if need be, with a metric based on species population viability.
3. Activities and measures needed to compensate communities affected by the development project and offset and involve them in offset implementation are calculated as part of the offset design. Much of the methodology for this is covered in the Biodiversity Offset Cost-Benefit Handbook, but the results are incorporated into the offset design.</td></tr>
</table>

Broad overview of the approach used at BBOP pilot sites		
Characteristic	**Description**	
	Site selection and landscape level planning	Some of the BENCHMARK attributes can, and should, relate to LANDSCAPE CONTEXT, such as patch size and degree of isolation or FRAGMENTATION. These can also be used to provide measures of the landscape-level CONNECTIVITY required for potential offset sites to adequately offset the losses. In addition, comparative analysis of a range of offset options against the Key Biodiversity Components Matrix enables the offset planner to determine whether one potential offset site or a combination of sites would be needed to deliver conservation gains for all the Key Biodiversity Components, and the loss / gain calculations an appropriate amount of additional conservation
	Multipliers and ratios	The probability of successful change through the offset activities is assessed for each of the attributes that comprise the offset metrics. Site selection helps address correlated risk. In addition, the approach suggests that multipliers can help take into account the risk of failure or partial failure of the offset, though cannot be used to deal with uncertainty about the feasibility or efficacy of conservation measures. Multipliers can also help account for discounting of future biodiversity values to address temporal loss. This area is still in its infancy in terms of application in voluntary offsets, so the guidance given is quite basic.
Relation to ecosystem services	This approach focuses on intrinsic, use and CULTURAL VALUES of biodiversity, which underpin regulating and supporting services. Provisioning and cultural services related to biodiversity (cultural and USE VALUES in the terminology of this Handbook) are considered in the Biodiversity Offsets Cost-Benefit Handbook and then incorporated in the final offset design. However, the approach does not seek to quantify ecosystem services such as soil stability and carbon and water cycling.	
Stakeholder engagement	The stakeholders should be involved in preparing the Key Biodiversity Components Matrix and defining the benchmark attributes that define the CURRENCY.	
Implementation	*Timing*	This approach has been used on a trial basis for individual projects, calculating the impacts mostly before they happen (there is one retrospective pilot project) and aiming to start the offset implementation during the project's operations. It could be used to implement offsets prior to impacts, as in conservation banking.
	Duration	Good practice is for the offset to endure at least as long as the project's impacts, and preferably in PERPETUITY. The Biodiversity Offset Implementation Handbook offers methods that can be used to plan and monitor offsets for implementation over the long term.
Implementation and policy questions		
Target audience	The principal users are likely to be those responsible for environmental performance in companies developing voluntary offsets, and their ecologist staff / consultants. Additional users may include communities, landowners and policy makers. Also regulatory and consenting authorities.	
Resources needed	Depends on availability of existing information. Initial tests suggest that the method can reasonably be implemented within existing procedures and budgets.	

C.1.3 Some illustrations of the kind of tools that can be used at various steps in the process, including an approach to calculating loss and gain

For the first steps of the process (review project scope and activities, review the legal framework and / or policy context for a biodiversity offset, and initiate a stakeholder PARTICIPATION process), please refer to Steps 1 – 3 in the main Biodiversity Offset Design Handbook. The following tables offer an example of some tools that can be used to help with subsequent steps, as described below. As can be seen from the BBOP PILOT PROJECT case studies, some of these have been used at the BBOP pilot sites.

Determine the need for an offset based on residual adverse effects (Step 4 in the main Offset Design Handbook)

The following 'Key Biodiversity Components Matrix' was developed to capture those biodiversity components that are regarded as high priorities for beneficial outcomes through the biodiversity offset. It can help check whether potential offset sites and activities deliver CONSERVATION GAIN for each of these components during site selection and to inform the selection of the components of biodiversity to be used to calculate LOSS and GAIN. More discussion on this step can be found in Step 4 of the main Biodiversity Offset Design Handbook.

BIODIVERSITY COMPONENT	INTRINSIC VALUES						USE VALUES	CULTURAL VALUES
	VULNERABILITY / THREAT			IRREPLACEABILITY				
	Global	National	Local	Site endemic	Localised	Widespread		
Species								
Communities / Assemblages / Habitats								
Whole landscape / Ecosystem*								

* Record in the 'Whole landscape / Ecosystem' row:

- Landscapes / ecosystems that might be affected by the project and are vulnerable and / or irreplaceable;
- Key features of the landscape such as connectivity; and
- Regulating or supporting ecosystem services that are particularly important for maintaining key biodiversity components captured elsewhere in this table.

Table C.1-1 could be useful for identifying and recording key biodiversity components and their values, and how impacts on these values are to be mitigated, during Step 4 of the offset design process. Use of a table such as this can help to check the application of the MITIGATION HIERARCHY and identification of residual adverse effects.

Table C.1-1: A table such as this can be used to consider the application of the mitigation hierarchy to the Key Biodiversity Components and whether the offset for each component should be 'in-kind' (relevant to Steps 4 and 6 in the main Offset Design Handbook)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**Impact Assessment & Mitigation Hierarchy**	**Biodiversity Assessment**								**Impact Assessment**		**Mitigation Hierarchy**					**Justification** *(insert comments here explaining data entered in columns J to P)*
2		**Intrinsic, 'non-use' Values**						**Use and Cultural Values**									
3	Biodiversity Component	Significance			Irreplaceability *(mark only one)*			Socioeconomic Values	Cultural Values	Project Activity	Likely Impact (qualitative based on EIA?)	*(check the principal step)*	Avo	Mitig	Offse / In-kind restriction on offset? (Y/N)	Avoidance or mitigation strategy	
4																	
5		Global	National	Local	Site Endemic	Localized	Widespread										
6																	
7	(e.g.																
8	Bird)																
9																	
1																	
0																	
1																	
2																	
3																	
4	Habitats																
5	To add more																
6	rows…																
3	(e.g. Degraded																
8	Forest)																
9																	
0																	
4																	
44																	
45																	
46																	
67	To add more rows…																
68	Whole Landscapes/Ecosystems																
69	0	0	0	0	0	0	0	0	0								
70																	
71																	
72																	
73																	
74																	
75																	
76																	
77																	
78																	
98	To add more rows…																

Choose methods to calculate loss / gain and quantify residual losses (Step 5 in the main Biodiversity Offset Design Handbook)

This section describes the approach which is being developed and trialled at the BBOP pilot sites to quantify losses and gains of biodiversity (described in Step 5 of the main Offset Design Handbook). The approach to quantifying gains and losses can deal with habitat (type, area occupied and 'quality'); and species' populations (viability / PERSISTENCE). The main steps summarised in Table C.1-2 vary slightly according to whether the HABITAT HECTARES method (which can include consideration of particular species) is being considered alone, or whether species populations are also considered in a supplementary calculation.

Table C.1-2: Summary of steps for calculating loss and gain using the emerging BBOP approach

For biotopes (the basis of the approach)	(If necessary) For species habitat	(If necessary) For species populations
QUANTIFYING RESIDUAL LOSS CAUSED BY THE PROJECT (see also Tables C.1-4 and C.1-5)		
Identify a BENCHMARK. Find 'good' example of community or ecosystem affected (e.g. undisturbed, 'pristine' – or a 'VIRTUAL' (data-based) benchmark if necessary).	Identify a benchmark example, supporting a thriving species population.	Identify a benchmark species population.
Select and weight BENCHMARK ATTRIBUTES and record a reference level at the benchmark site for each attribute.	Select and weight benchmark attributes (area, carrying capacity, habitat suitability, level of disturbance).	Select an appropriate METRIC for each species, assess likelihood of persistence of benchmark population (e.g. population size, viability, etc.)
Quantify pre-project CONDITION of attributes at the project site.	Quantify pre-project condition at the project site.	Assess likelihood of persistence of the project site population (pre-project).
Predict post-project condition for each attribute at the project site.	Predict post-project condition for each attribute at the project site.	Assess implications of proposal for persistence of species population (post-project).
Calculate the losses caused by the proposed project (post-project minus pre-project) relative to the benchmark.	Calculate the losses caused by the proposed project (post-project minus pre-project) relative to the benchmark.	Calculate / estimate change in likelihood of persistence of population
QUANTIFYING POTENTIAL GAIN THAT COULD BE CAUSED BY THE OFFSET		
Repeat this process at potential offset sites, to calculate the possible gain. Record the current score for each attribute prior to the offset intervention. (This will be less than or equal to the reference level at the BENCHMARK site.) Then record the predicted post-offset condition of each attribute – i.e. how each attribute is expected to change with the offset intervention in place. An adjustment should then be made for risk or the likelihood of success of the offset intervention, ATTRIBUTE by attribute. The potential gain is the difference between the pre-offset and the predicted post-offset (risk adjusted) scores, The offset planner can then focus efforts on suitable offset sites that could deliver the necessary gain in 'habitat hectares'.		In the case of populations, potential offset locations would be identified and reviewed to identify which could support a larger or a new viable population. As for impacts, potential gains would be calculated in terms of population persistence with / without offset interventions. An adjustment is then made for risk or the likelihood of success of the offset intervention.

(a) Habitat hectares calculations

For habitat, equivalence of impacts and offsets is calculated on the basis of 'habitat hectares', taking into account area, type and quality of biodiversity as measured on the basis of key ATTRIBUTES. For certain species of conservation significance, detailed assessments of LOSS and GAIN may be required, particularly where these species might experience impacts other than, or in addition to, habitat degradation or conversion, such as intensified hunting pressure, increased disturbance or interruption to migration or disturbance. In such cases, metrics based on habitat proxies may not be particularly informative and it may be necessary also to carry out population assessments. This quantifies losses with respect to key species using estimates of population persistence and predicts how this will change following project implementation. The main steps are broadly similar to the habitat-based approach, but different benchmarks and attributes would be used.

Put simply, losses and gains are calculated as follows:

- ***loss*** = predicted situation for affected area's biodiversity with no project impact minus predicted situation for affected area after impact and restoration.
- ***gain*** = predicted situation for offset area's biodiversity with offset intervention minus predicted situation for offset area with no intervention, **adjusted for risk factors associated with these predictions**.

Both loss and gain are referenced against an independent benchmark and it is the selection of this benchmark that forms the first step in the process of calculating losses / gains. The benchmark comprises a number of weighted 'attributes' that are representative and characteristic of type of biodiversity (the ecosystem, the biodiversity components comprising it – the physical habitat, community structure and composition) that will be affected by the proposed development project. The BIODIVERSITY LOSSES at the IMPACT SITE and gains at the offset sites can be consistently and transparently measured against this benchmark. The benchmark site needs to be in a location where it is possible to carry out some relatively rapid fieldwork to identify, weight and score the attributes defined for it. Benchmark attributes are chosen to reflect the composition, structure and function of each ecosystem or habitat present in the area affected by the development project and its overall 'health' or condition. As well as serving as good SURROGATES or PROXIES for biodiversity overall, they should be readily measurable. They may be to do with structure, composition and function of individual species, features of communities / assemblages, or even characteristics that operate at the landscape scale, such as CONNECTIVITY. Since practical methods for dealing with ECOSYSTEM PROCESSES and ECOSYSTEM SERVICES are still under development, ecosystem function is generally covered by selecting more readily measurable attributes that are good proxies for ecological process and function, for example representation of key functional groups. Some BENCHMARK ATTRIBUTES may be more significant to the overall health of an ecosystem than others, so the different attributes are weighted accordingly. (In total, the weighted attributes of the benchmark will add up to 100%.) Reference levels are recorded for the presence of each benchmark attribute at the benchmark site.

Quantifying the biodiversity loss at the impact site involves assessing it against the benchmark, and predicting the nature and amount of damage that the project will cause. This measurement should be done (wherever possible) before the project goes ahead. The observed pre-impact score and predicted post-impact score for each attribute at the project site are recorded and added, to give the predicted habitat hectares of loss due to the project's residual impact. The calculations to quantify conservation ADDITIONALITY (gains) at offset sites involve quantifying and mapping pre-intervention condition classes at shortlisted sites; assessing the threats currently facing each site; identifying interventions to address these threats and calculating the biodiversity to be gained at each site. This is done in a similar way to that in which loss was calculated at the impact site. Quantifying the biodiversity gain from a potential offset involves assessing the candidate offset site against the benchmark, prior to undertaking the offsetting activities, and predicting the likely improvements in habitat condition that can be accomplished with a specific set of conservation and management activities. Such a calculation is made for each attribute, weighted according to the relative significance of the attribute concerned to the overall health of that HABITAT TYPE, and the probability of success of the offset intervention for each attribute, and the results summed to give the predicted gain in habitat hectares.

Table C.1-3 is an example of a format for describing benchmark attributes and WEIGHTING, and Table C.1-4 is a simplified example of how losses and gains are calculated. In this case there are only 3 ATTRIBUTES, by way of illustration. In reality, there would be more (typically between 10 and 20), the actual number depending on habitat diversity and species richness at the development site, and how comprehensively the biodiversity is characterised. Table C.1-5 similarly sets out how losses and gains can be calculated for species populations. Note that exchange rules can be established for attributes. It may be that some attributes are seen as essential to be catered for through the offset, whereas others are seen as exchangeable.

Use of the BENCHMARK approach can measure losses of individual species where these species are selected as attributes. However, the HABITAT HECTARES approach aggregates scores for all the different benchmark attributes into an overall habitat hectares score, reflecting the overall ecosystem 'health'. This allows for some exchange of loss and gain between attributes while still achieving adequate ‘habitat hectare’ scores. This means that losses with respect to a particular species could be masked by gains with respect to other attributes. Where OFFSET PLANNERS wish to ensure that CONSERVATION OUTCOMES are achieved for these particular species, they can identify and record any ‘NON-TRADABLE’ attributes, for which a specific gain in habitat hectares is required. Other methods to calculate losses and gains with respect to species are described in (b), below.

Table C.1-3: Describing benchmark attributes and weighting

The following table could be useful for recording the (typically, between 10 and 20) ATTRIBUTES selected for the benchmark, recording the score for each found at the benchmark site, defining the weighting of each attribute (total to add to 100%) and deciding whether one or more of the attributes are 'non-tradable'. (This means that a specific score of each non-tradable attribute is needed at the offset site, in addition to an overall score of all the attributes added together.) In selecting attributes, consider: (1) are there enough attributes that are good proxies for the Key Biodiversity Components identified in Table C1-1; (2) are there enough attributes to be confident that the overall health of the ecosystem is measured and (3) are there enough attributes that are good surrogates for ecosystem process and function?

	A	B	C	D	E	F	G
1	**BENCHMARK ASSESSMENT**					**Habitat Type 1:**	**(e.g. Degraded Forest)**
2–4	**Attribute**	**Reference Level at Benchmark Site** (Either units or bands)		**Weight**		**Tradeable or Non-Tradeable Attribute?**	**Rationale, Methods** *(Enter comments explaining the rationale and methods used to choos this attribute and calculate the reference level at benchmark site)*
5		**#**	**Units or Bands**	Total:	0		
6–9	Attribute 1						
10–13	Attribute 2						
14–17	Attribute 3						
18–21	Attribute 4						

Table C.1-4: Simplified example of how to quantify loss at a project impact site using habitat hectares

Total Hectares affected (A) =10	(B)		(C)	(D)	(E)	(F)	(G)	(H)	
Attribute	Benchmark condition / level		Weighting of the attribute	Pre-project condition	Post-project condition	Pre-project habitat hectares, per hectare	Post-project habitat hectares, per hectare	Net loss of habitat hectares, per hectare	Habitat hectares lost
	#	Unit or Bands				(D/B)*C	(E/B)*C	F-G	H*A
Attribute 1: stream veg. density	10	plants / ha	0.4	5	2	0.2	0.08	0.12	1.2
Attribute 2: canopy cover	100%	%	0.3	80%	40%	0.24	0.12	0.12	1.2
Attribute 3: fallen log density	2	logs / ha	0.3	1	0	0.15	0	0.15	1.5
		Total:	1			**Total habitat hectares lost:**			**2.7**

Table C.1-5: Example of how to quantify loss at the project impact site using species-specific measures against a benchmark

Species	Metric	Benchmark	Impact site				
			Pre-project population / viability	Pre-project population / viability (adjusted)	Post-project population / viability	Post-project population (adjusted)	Loss
Code	A	B	C	D (=100*C/B)	E	F (=100*E/B)	G (=D-F)
Species A	e.g. population viability	67%	50%	74.63%	30%	44.78%	29.85%
Species B	Population size	75	50	66.7	15	20	46.7
Species C		etc					

(b) Complementary species calculations

In some cases, it may be appropriate to demonstrate 'NO NET LOSS' for a particularly significant species. This may be especially relevant where residual negative impacts are predicted for species of global conservation concern and / or concern to local stakeholders may be adversely affected.

Where impacts on such species are not linked directly with the structure and composition of habitat (e.g. intensified hunting pressure, increased disturbance or interruption to migration or dispersal, increased mortality due to road kill, decreased reproductive success due to disturbance to breeding animals, or reduced population viability due to barriers to dispersal of sub-populations), then metrics based on habitat proxies may not be particularly informative. In these cases, it is preferable to use metrics specifically tailored to the species concerned.

Table C.1-6 shows how losses and gains can be calculated for species using the BBOP approach. Table C.1-7 is an example of how a species-specific BENCHMARK could be defined. Supporting studies are likely to be necessary to provide the information needed to quantify losses using suitable metrics. Possible metrics include probability of persistence, levels of species occupancy, population size, population density and / or population viability. It may also be possible to obtain populations estimates based on habitat proxies. The methodology used should respond to the particular context and key factors influencing the persistence of species.

An example of an approach being developed to quantify impacts on species is the Risk Index approach being developed in New Zealand. This is described in Appendix C.3.

Table C.1-6: Description of possible steps for calculating SPECIES loss and gain

Step	Description
1. Identify particular species requiring quantification of losses	When quantifying losses with respect to key species, it can be important to evaluate each species separately, rather than use indices that aggregate information on multiple species into a single METRIC. This can help ensure that no species 'fall through the gaps', as can happen with aggregated indices, where a loss with respect to one species can be masked by gains with respect to other species. Also, disaggregated results are more transparent and may be more likely to satisfy stakeholders with different concerns.
2. Select an appropriate metric for each species.	The metrics used to quantify BIODIVERSITY LOSSES with respect to species should relate to likelihood of PERSISTENCE of individual populations. Two alternatives are summarised below: *Population Viability Analysis or PVA:* this is a popular approach among conservation biologists for estimating probability of persistence of species populations. It involves the 'structured, systematic and comprehensive examination of the interacting factors that place a population or species at risk'[11]. Central to PVA is the concept of 'minimum viable population', below which EXTINCTION is considered likely to occur. However, there are a number of limitations to PVA as a tool: data are required on a range of population parameters (e.g. population size, adult survival rates, age of sexual maturity, fecundity, etc.), which are not always readily available or straightforward to measure; PVA models can generate widely differing estimates as a result of differing assumptions or input data, particularly when they are based on small data sets or data sets collected over a small number of years; and models often do not take account of factors affecting probability of extinction, such as Allee effects: the decline in survival and / or breeding success at low population densities. So, there may not be sufficient time and resources to collect the necessary population and life history information for PVA, necessitating other approaches. One alternative to PVA is the use of *Species Occupancy* (SO)[12] measures. These are based on comparing the actual distribution of taxa with the potential distribution in the absence of human induced disturbances. SO measures require fewer population parameters than PVA (only estimates of abundance, recruitment and mortality are required) but are sufficiently robust to be used when only presence-absence data are available. PVA and SO measures can be effective ways of quantifying losses with respect to species, provided that detailed information on population parameters are available, or that sufficient time and resources are available for offset planners to collect them. Where these conditions are not met, an alternative approach may be to use estimates of population size, density or relative abundance as proxies for likelihood of persistence of individual populations, following the rationale that larger (or denser) populations are, all things being equal, less likely to go extinct over a given timescale than smaller (or less dense) populations, provided they remain within the carrying capacity of the ecosystem. There are various methods of measuring the size, density or relative abundance of species populations (e.g. total counts, point counts, transects, quadrats and plot-less techniques). Whichever method is selected for a particular population, the need for repeated sampling (ideally over a period of at least 5 years) should be borne in mind, in order to account for cyclical and STOCHASTIC changes in species populations, which can seriously distort estimates based on single samples. Introductions to species monitoring methods are provided by many standard conservation textbooks and handbooks. Good summaries are included in the following[13]: Sutherland 2000; Hill *et al.* 2005; and Tucker *et al.* 2005. In cases where it is difficult to obtain reliable population data, for example with rare, shy or cryptic species, it may not possible to estimate population size, density or relative abundance directly. In such cases, it may be more appropriate to use habitat extent and / or CONDITION as a PROXY for population size (and, hence, likelihood of persistence). It should be borne in mind, however, that habitat condition may not infer presence, let alone persistence, of species (Bekessy *et al.* in prep.[14]) particularly where impacts that manifest themselves without necessarily adversely impacting a species habitat(s) are in play. Therefore, the use of habitat measures as proxies for individual species may only be appropriate in cases where potential impacts on a species manifest themselves through loss and / or degradation of its habitat.

11 Schaffer, M.L. 1981. Minimum population sizes for species conservation. *Bioscience* 31: 131-4; Schaffer, M.L. 1987. Minimum viable populations: coping with uncertainty. Pp 69-86 in Soulé, M. ed. *Viable populations for conservation*. Cambridge, UK: Cambridge University Press; Schaffer, M.L. 1990. Population Viability Analysis. *Conservation Biology* 4(1), 39; Gilpin,M. and Soulé, M. 1986. Minimum viable populations: processes of species extinction. Pp 19-34 in Soulé, M. ed. *Conservation Biology*. Sunderland: Sinauer.

Step	Description
3. Identify a benchmark population for each species	Once an appropriate metric has been selected for each key species at the IMPACT SITE, biodiversity losses with respect to this species are quantified using a similar (albeit simplified) approach to that used for key habitats. For each species, a suitable benchmark population is identified. This is to provide a point of reference against which the impact site population can be assessed. As far as possible, the benchmark population should meet two criteria. First, it should be at a site with similar ecological characteristics to the impact site (i.e. total area, area and condition of different BIOTOPES, connectivity to neighbouring sites, etc). Second, it should be at a site that has been exposed to minimal or no human induced disturbances for a very long period (at least decades, ideally centuries). Where these conditions are not met, it may be necessary to create a 'SYNTHETIC' BENCHMARK population, either by reference to historical data on species population sizes, densities or relative abundance, or through consultation with experts on the species.
4. Assess likelihood of persistence of the benchmark population	Once a benchmark population has been identified, the selected metric is applied. Whichever metric is selected, it should be measured repeatedly (ideally over a period of at least five years), and seasonal fluctuations should be accounted for (either by repeat sampling throughout the year or sampling at a fixed time each year). Measures of population viability, for instance, can be referenced to a benchmark, just as for habitats.
5. Assess likelihood of persistence of the impact site population (pre-project)	The next step is to use the same metric for the impact site population (before the project's impact takes place) as was used for the benchmark population. Once again, repeated sampling should be used to account for cyclical and stochastic variability within and between years. It is important that the impact site population is measured prior to the project commencing, in order that a BASELINE can be established against which losses can be measured. In cases where short project timelines do not allow for several years of data collection prior to the start of the project, it may be possible to use the results of past studies of the species at the impact site, provided that these use a comparable methodology to the one that will be used to measure the population metric. The metric for the pre-project population should then be calibrated on a scale of 0 to 100, against the benchmark population. If, for any reason, the metric for the pre-project population is higher than that for the benchmark population, the adjusted metric should still be set at 100 (the maximum). This reflects the fact that, for most species, there is a point above which increased population size, density or relative abundance does not translate into increased likelihood of persistence (indeed, the reverse could even be true, if the carrying capacity of the ecosystem for the species was exceeded).
6. Calculate losses with respect to the species at the impact site	Step 5 is then repeated for the predicted post-project population at the impact site (i.e. the predicted population after the impacts). Finally, losses with respect to the species are calculated by subtracting the adjusted metric for the post-project population from the adjusted metric from the pre-project population. The final figure can very roughly be thought of in terms of reduction in likelihood of persistence of the population.

12 Dr. Theo Stephens of New Zealand's Department of Conservation is presently developing applications for a set of measures called Species Occupancy (SO) measures to quantify the amount of biodiversity remaining, to measure conservation performance, development impacts, to compare different offset options and to determine whether no net loss will be achieved by a specified offset package.

13 Sutherland, W.J. 2000. *The conservation handbook: research, management and policy*. Oxford: Blackwell; Hill, D., Fasham, M. Tucker, G., Shewry, M.C. and Shaw, P. eds. 2005. *Handbook of biodiversity methods: survey, evaluation, and monitoring*. Cambridge, UK: Cambridge University Press; Tucker, G., Bubb, P., de Heer, M., Miles, L., Lawrence, A., van Rijsoort, J., Bajracharya, S.B., Nepal, R.C., Sherchan, R. and Chapagain, N. 2005. *Guidelines for biodiversity assessment and monitoring for protected areas*. Kathmandu, Nepal, and Cambridge, UK: King Mahendra Trust for Nature Conservation and UNEP-World Conservation Monitoring Centre.

14 Bekessy, S.A., Wintle, B.A., Lindenmayer, D.B., McCarthy, M.A., Colyvan, M. and Possingham, H. P. In prep. The biodiversity bank cannot be a lending bank.

Table C.1-7: Example of a completed species-specific loss quantification matrix

Species	Metric	Benchmark population	Impact site				
			Pre-project population	Pre-project population (adjusted)	Post-project population	Post-project population (adjusted)	Loss
Code	**A**	**B**	**C**	**D (=100*C/B)**	**E**	**F (=100*E/B)**	**G (=D-F)**
Species X	Probability of persistence in 100 years (PVA)	90	75	83	60	67	16
Species Y	Population density (mature individuals / km^2)	200	150	75	50	25	50
Species Z	Relative abundance (individuals / transect)	40	20	50	5	13	37

Finally, potential gains are calculated for potential offset sites. Tables C.1-8 and C.1-9 are examples of spreadsheets that can be used to summarise results of comparative review so that a final selection can be made.

Review potential offset locations and activities and assess the biodiversity gains which could be achieved at each (Step 7 in the main Biodiversity Offset Design Handbook – see www.forest-trends.org/biodiversityoffsetprogram/guidelines/odh.pdf)

Table C.1-8: A table or spreadsheet such as this could be used to record and compare whether potential offset sites could deliver conservation gains for Key Biodiversity Components during site selection (see Step 7 of the main Biodiversity Offset Design Handbook)

	A	B	C	D	E	F	G	H
1	**Offset Components Evaluation**							
2	Biodiversity Component	**Offset Type**		**Site Selection******				**Rationale** *(Insert comments here explaining data entered in columns D to G)*
4		In-Kind Necessary	Out of Kind is an Option	Site 1	Site 2	Site 3	Site 4	
5				***[Insert Name]***	***[Insert Name]***	***[Insert Name]***	***[Insert Name]***	
6	**Species (TO EDIT CONTENTS OF GREY CELLS, GO TO WORKSHEETS "(1) Biodiversity Assessment" and "(2) Impact Ass & Mit Hierarchy")**							
7	(e.g. Bird)							
8								
9								
10								
11								
12								
13								
14								
15								
36	To add more rows…							
37	**Habitats**							
38	(e.g. Degraded Forest)							
39								
40								
41								
42								
43								
44								
45								
46								
67	To add more rows…							
68	**Whole Landscapes/Ecosystems**							
69								
70								
71								
72								
73								
74								
75								
76								
77								
78								
98	To add more rows…							
		**** Add qualitative assessment of likely gain						

Calculate offset gains and select appropriate offset locations and activities (Step 7 in the main Biodiversity Offset Design Handbook)

Table C.1-9: A table or spreadsheet such as this could be used to record and compare the conservation gains that could be generated at potential offset sites during site selection (see Step 7 of the main Biodiversity Offset Design Handbook)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Calculation of Habitat Hectares to be gained for Habitat type 1 at Proposed Offset Site 1**															
2		**Benchmarking**				**Offset Site Assessment**										
3–4	Proposed Offset Site 1	Habitat type	Attribute	Bench-mark Ref. Level	Weight	No. of ha of habitat type	Pre-offset (current) condition	Threats at site and proposed conservation intervention to address them	Predicted change without project (%change * % probability)	Pre-intervention (current condition minus predicted change without project) (G*I+G)	Predicted Gain with project (% change * % probability)	Post-offset Condition	Total Predicted Gain (L-J)	Pre-offset habitat hectares (J/D*E)*F	Post-offset habitat hectares (L/D*E)*F	Habitat Hectares Gained (O-N)
5		1	Habitat type 1, attribute 1 (e.g. plants/ha):	15	0.5	50	5	Habitat conversion. Increased patrolling by local community rangers.	8%	5	50%	7.5	2	8.96	12.5	3.54
6			Habitat type 1, attribute 2:	10	0.3		6		5%	6	38%	8.25	2	9.45	12.38	2.93
7			Habitat type 1, attribute 3:	12	0.2		8		5%	8	38%	11	3	7.00	9.17	2.17
			[Add as many rows as needed for remaining attributes]													
8			TOTAL							0				Habitat hectares gained:		9

In this scenario, there are three attributes. The reference level (ie score for each of these attributes at the pristine benchmark site) is entered here.	The weight of each attribute is entered here. In total, the weightings for all the attributes for this habitat type should add up to 1.	This is the score the offset planner counts in the field for each attribute at the offset site. It will be less than or equal to the reference level at the benchmark site.	The offset planner believes the offset activities will achieve a 10% improvement in attribute 1 with a 75% probability of success. Multiplied together, that makes 8%, which is entered here.

For the final steps of the process (deciding upon the final OFFSET ACTIVITIES and sites, recording the offset design and entering the OFFSET IMPLEMENTATION process) please refer to Steps 7 – 8 in the main Biodiversity Offset Design Handbook.

C.2 REMEDE Toolkit – Resource Equivalency Method

The REMEDE project (**R**esource **E**quivalency **M**ethods for Assessing **E**nvironmental **D**amage in the **E**U) is developing a toolkit (not yet published) to provide users with an overview of resource equivalency methods in the context of the Environmental Liability Directive (ELD), the Habitats and Wild Birds Directives and the Environmental Impact Assessment (EIA) Directive. The Toolkit outlines analytical steps that can be used to assess and remediate different types of environmental damages and incidents covered by these Directives. It will assist the reader in answering two fundamental questions: how are losses of, or damages to, natural resources or services assessed and quantified? And, how much complementary and compensatory remediation is needed to make the public whole for those losses or damages?

The methods described in the Toolkit can be applied in three different types of damage scenarios: (a) where there is expected damage, as in the context of the Habitats, Wild Birds and EIA Directives; (b) where there is significant imminent threat of damage in the context of the ELD; or (c) after damage has occurred and has been deemed significant in the context of the ELD. The Toolkit consists of four parts:

- **Part I** provides an overview of the central concepts relevant to Resource Equivalency methods.
- **Part II** describes in detail the five steps of a resource equivalency analysis.
- **Part III** focuses on a select number of issues discussed in Part II for which some readers may require a more detailed explanation (e.g. discounting, economic theory of environmental compensation, and environmental quality standards in the EU). It also contains the full text of relevant Directives.
- **Part IV** provides case study examples and summaries developed as part of the REMEDE project.

'Equivalency analyses' are methods and approaches that are used to determine the type and amount of resources and services that are lost over time as a result of an environmental damage, and the type and amount of actions needed to offset the loss. Equivalency analyses take into account the chemical, physical, biological and, sometimes, social and economic, nature of an environmental impact and remediation options.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	Habitats and ecosystems, primarily, but the method is flexible enough to include some species. The method can address individual animal evaluation (growth, reproductive success, etc.), changes in population using habitat proxies, species density and diversity, species occupation and population variables (size, density, diversity, habitat availability). The model incorporates consideration of the function of individuals or species in generic ecological processes.
Mitigation hierarchy	No specific reference found in documents.
Thresholds for considering biodiversity offsets	This approach does not have any thresholds for considering biodiversity offsets
Desired or required outcome	The desired outcomes are offsets of a similar type and quantity as those lost due to development or contamination. The method focuses on determining the quantity of offsets necessary based on adjustments for time of implementation of offsets, and relative quality of the offset when compared to the resources lost.
Offset options	Only *in situ* conservation outcomes are allowed. This approach is not inflexible, however, in requiring 'LIKE-FOR-LIKE' or 'IN-KIND' offsets it allows for out-of-kind adjustments through the use of habitat / species measures to adjust remediation required between different habitats or species.
Offset methodology	There are several types of equivalency analyses. Of particular relevance to offsets is Habitat Equivalency Analysis (HEA), in which losses are expressed in terms of habitat and are offset by remediation of similar habitat, and Resource Equivalency Analysis (REA), in which losses are expressed in terms of resource units (such as numbers of fish or birds). Generally, a HEA or REA includes estimation of the loss in terms of a quantity of resource or service over time (the 'debit'), estimation of the quantity of resource or service gain produced by a remediation project (the 'credit'), and 'scaling' of complementary and compensatory remediation projects (but not primary remediation) to ensure that the total anticipated gain is approximately equal to the calculated loss. The type of environmental damage and opportunities for remediation influence the choice of a specific equivalency approach and measure of loss (debit) and gain (credit). • The loss or debit is often multi-dimensional, since an environmental damage can have adverse impacts on many species, habitats, ECOSYSTEM FUNCTIONS, and human use and NON-USE VALUES. In addition, the damage can vary over space and time. Typically in a HEA or REA, one or more measures are defined to serve as indices of key resources or services that were damaged. It is assumed that remediation that addresses these chosen measures will also benefit aspects of the debit that were not specifically treated in the equivalency analysis. • The gain or credit in an equivalency analysis is the amount of resource or service benefit that will be gained through complementary and compensatory remediation. The number, type and size of projects are scaled so that the expected amount of benefit generated approximately equals the debit, quantified in terms of the same METRIC used to quantify the debit. REA can incorporate the benefits of conservation in a regional LANDSCAPE CONTEXT in this analysis. Simply stated, ensuring equivalency between the losses and gains involves the following: • Quantifying the losses caused by the damage; • Determining the amount of benefit expected per unit of gains or remediation; and • Dividing the losses by the per-unit gains to yield the total amount of remediation needed. A biodiversity values analysis is used to devise which currencies would be most appropriate to cover the most important values likely to be affected. Use can be made of benchmarks, reference sites, baseline data or modelling to determine the degree of change at the IMPACT SITE.

Broad overview of this approach	
Characteristic	**Description**
Offsets in relation to ecosystem services	The intrinsic, economic and cultural values of biodiversity are covered across all biotic levels and spatial scales of organisation.
Stakeholder engagement	Consultation with competent authorities, technical experts and stakeholders is an important part of determining the key values to be impacted, and to fine-tune the approach in each case.
Implementation	The benefits of the offset increase with increasing duration.
Broad comments	Significant ecological knowledge would be required to use resource equivalency methods as a proxy for biodiversity value. The method relies on prior ecological knowledge that can link the relative changes in the biodiversity with the anticipated offsets. Quantifying the debit and credit typically requires expertise and professional judgment on the part of the equivalency analysis team. A range of expertise is often required with specialist knowledge directly relevant to the type of resources and services damaged. The level of resources required would depend on the availability of relevant information. With extensive available information, time and costs would be fairly low; with limited information, resource requirements could be high.

C.3 New Zealand Risk Index Method

This method uses a risk index to calculate BIODIVERSITY LOSSES and GAINS and is intended to inform the design of biodiversity offsets to ensure no regional scale biodiversity loss as a result of a development project. It is still under development.

Biodiversity offsets aim fully to compensate risk to biodiversity PERSISTENCE caused by development impacts. Relevant achievement measures reflect effects on biodiversity persistence of both impacts and offsets. Biodiversity persistence is eroded by two processes: loss of habitable area and depletion of populations within habitable areas. These processes are described using the survival-area and survival-abundance relationships. These are combined to estimate the rate of persistence probability change and compare impacts and offsets. A proxy persistence measure, Susceptibility to Biodiversity Loss, or SBL, provides the CURRENCY of exchange to compare loss at the impacted site with gain at offset sites. Input data can be supplied at any level of sophistication, from local expert opinion to detailed systematic regional scale inventory.

The spreadsheet includes options for accounting for cost effectiveness assessment intended to help with fine-tuning design of both offset and impact AVOIDANCE at the project site. However, important exchange equity issues such as recognising fair exchanges of loss now for future gain, certain loss for uncertain gain, or loss in one place for gain somewhere else, have not been addressed.

Broad overview of this approach		
Characteristic	**Description**	
The target of biodiversity offsets	Ecosystem (or biotope), communities, species and their habitats.	
Mitigation hierarchy	It is intended that the mitigation sequence would be addressed for each and every value attached to biodiversity (e.g. intrinsic, different use values, cultural).	
Thresholds for considering biodiversity offsets	*Upper threshold*	Offsets would not be considered when it would not be technically possible to offset damage within a few (<10) years. Examples would be for destruction of mid-late seral stage communities; damage to species populations for which the 'how to' of compensation is unknown (e.g. hydro power schemes on migratory fish).
	Lower threshold	An offset would be required when the area occupied or abundance of a biodiversity component would be reduced by a proposed development activity.
Desired or required outcome	No regional scale biodiversity loss as a result of a development project.	
Offset options	This approach does not require a 'like-for-like' or 'in-kind' offset. Rather, it requires assurance that there would be no negative change in probability of persistence of biodiversity. However, rules to constrain the solution to like-for-like offsets (or any other goal) could be added. The offset design must ensure a net improvement in security for impacted components. *In situ* offsets are required; capacity building would not qualify as an offset.	
Offset methodology	*Calculating loss-gain: the currency*	This approach is based on an index of 'persistence probability'. A proxy persistence measure (Susceptibility to Biodiversity Loss, or SBL) provides the currency of exchange to compare loss at the impacted site with gain at offset sites. An Excel spreadsheet provides a template for the calculation, enabling the user to identify what spatial extent and intensity of conservation management is required to offset biodiversity loss caused by the development project. To use this methodology, information about the project is required, namely: the impact 'footprint' of the project; an inventory of species and BIOTOPES; and the status and area currently occupied by each species and biotope. Although benchmark sites do help to specify outcome targets, they are not critical to the approach. In addition, information related to the 'bigger landscape' is required, namely: the current status and area occupied by each species and biotope; and the potential (historic) area occupied by each species and biotope. For each potential offset site, it is necessary to know the target area to be occupied by each species and biotope; and the status for each species and biotope within that target area. There is a strong social component to this approach which influences offset design; the consideration of the values – and their relative priorities – attached to biodiversity plays an important role.
	Site selection and landscape level planning	The impact and offset are viewed in the wider landscape context, as described above.
	Multipliers and ratios	No multipliers or discounting are currently used, although their use would be an option should it be appropriate.

Broad overview of this approach	
Characteristic	**Description**
Addressing biodiversity offsets in relation to ecosystem services	The approach is intended to identify all relevant values associated with the affected biodiversity: intrinsic, use (including economic, commercial and social cohesion), and cultural values. The goal of the envisaged participatory process is to establish the likely RESIDUAL IMPACTS on particular values associated with biodiversity, and then to decide on any 'bottom lines' and the general approach for dealing with each. (Offsets are seen as the penultimate option, with 'ignore / accept' the damage being the last option.)
Stakeholder engagement	The identification of values attached to impacted biodiversity, deciding on the relative WEIGHTINGS or importance of the different biodiversity value streams, and developing acceptable 'rules' for combining or prioritising them in determining an appropriate offset(s), would involve stakeholder engagement; relevant stakeholders would have to be identified in each case (e.g. authorities, communities, specialists, NGOs). It is important in this approach to recognise that for different cases in different contexts, the values attached to biodiversity could vary widely (e.g. the use versus INTRINSIC VALUES). It is intended that a committee of NGO representatives and ecologists would publicly advise the developer and consenting agency on whether or not a fair and feasible biodiversity offset has been proposed.
Implementation	The offset should last in PERPETUITY, or at least until the biotope is fully restored.
Broad comments	The level of resources (time and funds) required could be from low to high, depending on the availability of sufficient relevant information on biotopes and species.

C.4 New Zealand: Averted Risk Formulae

These formulae are being developed in New Zealand[15] to calculate the size of offset required to achieve 'NO NET LOSS' of biodiversity through protecting priority areas for biodiversity from conversion. These so-called 'AVERTED RISK OFFSETS' are appropriate where the background rate of loss is high, there is ample opportunity to protect relatively large intact areas from clearance, and there is no desire to actively manage these areas beyond enforcing their protected status. The formulae take into account the background or historic rate of loss of biodiversity, and incorporate DISCOUNT RATES as deemed most appropriate to the particular context. They either assume that unsustainable use of resources in these protected areas would be prevented and thus that the rate of loss within these areas would be zero, or they can incorporate some anticipated rate of biodiversity loss within the protected area compared with the loss rate outside that area in calculating the required size of the offset. This formula does not take into account enhanced management or restoration of the protected areas, i.e. it assumes 'benign neglect'.

The basic formula is as follows:

$$A_x = \frac{A_i\,(L_p + r)}{(L_u - L_p)}$$

Where:

A_x is the area for a 'no net loss' averted risk offset.

A_i is the area impacted by the project.

r is the discount rate. The base rate should be 5% to 10% with uncertainty risk premium (2% to 10%) added.

L_p is the clearance loss rate of legally protected areas (ideally, this is zero).

L_u is the loss rate of unprotected areas. Loss rate is calculated thus: if 80% of an unprotected habitat remains after 5 years, then Lu = -(LN(0.8))/5 = 0.045, where LN is the natural logarithm.

15 Dr. Theo Stephens (Department of Conservation, New Zealand) and Jake Overton of LandCare Research, New Zealand (in preparation).

<table>
<tr><th colspan="3">Broad overview of this approach</th></tr>
<tr><th>Characteristic</th><th colspan="2">Description</th></tr>
<tr><td>The target of biodiversity offsets</td><td colspan="2">Biotopes.</td></tr>
<tr><td rowspan="3">Offset methodology</td><td>Calculating loss-gain: the currency</td><td>The methodology calculates the area of offset required to compensate fully for the area lost as a result of proposed development, taking into account background rates of loss of the impacted biotope and relevant discount rates.</td></tr>
<tr><td>Site selection and landscape level planning</td><td>The methodology is developed to deal with offsets at landscape-level. It could be informed by systematic conservation planning (Zonation, Marxan, as described in Appendix D).</td></tr>
<tr><td>Multipliers and ratios</td><td>The formulae can take into account anticipated rates of biodiversity loss within a protected area compared with those outside a protected area, using relevant discount rates. That is, there is effectively a ‘built in’ multiplier.</td></tr>
<tr><td>Addressing biodiversity offsets in relation to ecosystem services</td><td colspan="2">The approach could be applied to any biotope of value.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">Engagement with local experts and / or communities regarding rates of loss of NATURAL HABITAT, and with conservation stakeholders regarding priority areas for BIODIVERSITY CONSERVATION, is implicit.</td></tr>
<tr><td>Implementation</td><td colspan="2">No specific reference found in documents.</td></tr>
<tr><td>Broad comments</td><td colspan="2">This methodology does not require detailed biodiversity information and is relatively simple to apply. It requires spatial information on land tenure and known priority areas for biodiversity conservation (if available). Also, it requires either land cover or historic data, local community and / or expert input on background rates of clearance of natural habitat. The level of resources is likely to be low to medium, depending on the ready availability of such information.</td></tr>
</table>

Appendix D: Supportive or supplementary approaches and methodologies

D.1 Zonation

Zonation is a reserve selection framework for spatial conservation planning. It identifies areas important for retaining habitat quality and CONNECTIVITY for multiple species, indirectly aiming at species' long-term PERSISTENCE. Zonation can be used for various purposes such as spatial conservation prioritisation, conservation assessment, reserve selection and reserve network design. That is, it is not a tool designed specifically for offsets, but it can help to locate offsets in the most appropriate places in the landscape in order for them to make the best possible contribution to biodiversity conservation in the long term.

Zonation is most appropriate for data-based regional-scale planning of offsets where compensation can occur elsewhere from where the loss takes place, and where compensation may come from other biodiversity values than from those that are being lost ('TRADING UP', e.g. balancing the loss of populations of a more common species by siting an offset in an area that includes rare or threatened species). It therefore potentially deals with trade offs at the landscape scale and can be used to rank prospective compensation areas. The Zonation leaflet[16] is a useful two page summary of the method.

16 See **www.helsinki.fi/bioscience/consplan**.

Broad overview of this approach	
Characteristic	**Description**
The target of biodiversity offsets	The framework focuses on species, species composition per unit of area, and habitats.
Offset methodology	The approach was not developed specifically to determine offsets; rather, it is a broad, landscape-scale tool for conservation planning that can be used to this end. It draws on methods of determining connectivity between ecosystems and habitats, analysing uncertainty, species prioritisation (weighting), species interactions and tradeoffs between species. Species information can be input as point occurrence data. The tool does not make use of a benchmark. The most straightforward way of using Zonation for offsetting is to use it to identify areas that would be good for conservation and could be protected to compensate for areas that would be lost (i.e. averted risk type offsets). Only areas that are not already intended for retention or conservation would be acceptable as an offset (thereby satisfying the criterion of 'ADDITIONALITY'). In simple terms, analysis would proceed as follows: • Determine the area to be lost e.g. 10 units of habitat (e.g. forest type); • Carry out Zonation analysis at a resolution of one unit or less; • Identify top locations that have no current or planned protection; • Review levels of threat to the persistence of biodiversity in these locations; and, • Calculate the potential biodiversity 'dividend' that would be secured from investing in an offset in alternative locations. Assume that by protecting these areas retention would increase to from 60% to 85%, meaning a 25% retention gain in the long term. Assuming similar conservation values for impact and offset areas, and the offset would be implemented exactly according to plan, the area needed to compensate for loss would be (1/0.25)*10 = 40 area units of the 'top locations' of land with no current or planned protection. One could further speculate on the transferability of threat; if the 25% gain comes from stoppable threat, then the 40 units would hold. If however, the threat is only partially stoppable (e.g. 80% of threat would transfer elsewhere – often termed 'LEAKAGE'), then the NET GAIN would only be 20% of the above, implying a further multiplication by (1/(1-0.8)) ending at 200 area units needed for fair compensation.
Addressing biodiversity offsets in relation to ecosystem services	The methodology focuses on the intrinsic values of biodiversity, looking at IRREPLACEABILITY and threat.
Stakeholder engagement, implementation	No specific reference found in documents; not a specific offset methodology.
Broad comments	The level of resources (time and funds) required could be high to medium, depending on the availability of sufficient relevant information on habitats and species.

D.2 Marxan and Marzone

Similar to Zonation, Marxan is a software tool to determine reserve selection framework for spatial conservation planning. It is target-based and best used in a proactive manner to help identify conservation priorities within the landscape. Once identified, these priorities can inform and direct spatial development to avoid or minimise negative impacts on biodiversity, and to highlight what could be considered as 'offset receiving areas'. That is, although Marxan was not designed for selecting offsets, it can help to locate offsets in the most appropriate places in the landscape in order for them to make the best possible contribution to biodiversity conservation in the long term.

Marxan is arranged around defined planning units, for which information on species and environmental features (e.g. vegetation types), existing reserve or protection status, land-price (etc.) must be supplied. Species information is entered together with the specific area or habitat targets needed to conserve different species (e.g. how many hectares containing this species or habitat are required to be protected in a reserve). These models, in addition to generating options for reserve selection, can also help to identify the most cost effective and efficient spatial location of protected land parcels to meet conservation objectives and targets.

Different from Zonation, Marxan allows the incorporation of land prices and conservation management costs which can help guide an offset strategy to identify those areas that will allow targets to be achieved for the least cost. By helping users evaluate how well each option meets both conservation and socioeconomic objectives, the program can facilitate the exploration of tradeoffs amongst different candidate sites for an offset. Both tools can be used as part of a wider spatial planning exercise and involve stakeholder engagement to focus on key biodiversity issues and help to prioritise conservation options in the landscape[17]. Like all reserve planning software, Marxan, like Zonation, is not designed to act as a stand-alone reserve design solution. Its effectiveness is dependent upon the involvement of people, the adoption of sound ecological principles, the establishment of scientifically defensible conservation goals and targets, and the construction of spatial datasets.

As with Zonation, the level of resources (time and funds) required could be high to medium, depending on the availability of sufficient relevant information on habitats, species and other variables. In addition, the effectiveness of these models relies on conservation targets for particular BIOTOPES, habitats and species; the exercise in determining these targets may require time and funds.

It should be re-emphasised that these software programs were not designed for biodiversity offsets. Their specific limitation is that they focus on capturing the best 'biodiversity return' based on existing species distributions in a landscape. However, offsets are dynamic and the end-goal is the enhanced retention of biodiversity in the long-term. Frequently this can be achieved through interventions other than reserve creation – e.g. offsets that are based on changes in land-management practices, eradication of invasive species etc. Conventional reserve planning software like Marxan is not designed to solve this larger set of optimisation problems.

Marzone is a new program based on Marxan, that does allow consideration of multiple land (or sea) management zones (e.g. including multiple use areas or extractive reserves that confer some biodiversity benefits but also allow certain human activities), such that conservation objectives can be achieved through a wider suite of management options than reservation alone. Given this feature, it applies more readily to 'real world' situations and may offer advantages over earlier models to BIODIVERSITY OFFSET PLANNERS.

17 e.g. Driver, A., Cowling, R.M. and Maze, K. 2003. Planning for Living Landscapes: Perspectives and Lessons from South Africa. Botanical Society of South Africa.

D.3 Biological Territorial Capacity

This method adopts a landscape, energetic approach to understanding the ecological state of ecosystems, in order to improve their management and regulate their use. The method is based on Biological Territorial Capacity (BTC). BTC is a synthetic function referred to a vegetation ‘ecocoenotope’ (habitat unit), based on the concept of resistance stability, the principal types of ecosystems of the ecosphere, and their metabolic capacity (biomass, gross primary production, respiration). In essence, BTC represents the state of an ecological system and it is proportional to the meta-stability of the vegetated biotope units. This approach was not specifically developed for use in designing offsets, but the CURRENCY can be applied to loss-gain calculations.

Useful reference

Ingegnoli, V. 2002. *Landscape Ecology: A Widening Foundation.* Springer Verlag, Berlin, New York.

Broad overview of this approach		
Characteristic	**Description**	
The target of biodiversity offsets	Species, communities and ecosystems, focusing on biotope parameters and quality / condition.	
Offset methodology	*Calculating loss-gain: the currency*	The methodology calculates cover, structure and age of habitat; plant biomass; dominant species, species richness, key and threatened species presence; and, the functional role of landscape units, levels of disturbance, and contiguity of similar habitats. The method is used in order to model the impacts resulting from a project. The difference between the actual state and the future impacted state is modelled using comparable cases. The model enables a quantitative assessment of impacts and provides a measure of the offset needed. The impacted site is compared with 'normal' or benchmark values for the affected biotope. Biological Territorial Capacity (BTC) is used as an INDICATOR of vegetation state and productivity, measuring the change resulting from RESIDUAL IMPACTS. Offsets aim to deliver the same quantum of BTC gains, to compensate or offset residual loss. Loss in BTC in one area is thus made up for by gain elsewhere. The currency of exchange is Mcal/m^2/year, drawing on respiration, gross productivity and biomass variables.
	Site selection and landscape level planning	The methodology is specifically developed to deal with landscape-level units and associated biodiversity. It thus takes into account such things as contiguity of similar habitats, and landscape level ecological processes.
	Multipliers and ratios	A precautionary approach is taken to calculating the offset; a relatively large offset is indicated where there is uncertainty about the success of the offset and / or about the assumptions made in the methodology.
Offsets in relation to ecosystem services	The approach could be applied to any biotope of value, either in terms of intrinsic, use or CULTURAL VALUE.	
Stakeholder engagement	No specific reference found in documents.	
Implementation	No specific reference found in documents.	
Broad comments	This methodology is fairly complex and requires relatively detailed information on habitats and species, as well as on 'normal' values for biotopes. (The method of BTC calculation is based on a check-list depending largely on the vegetation type. Analysis can be expedited using simplified tables, but practical experience is required in order to simplify the methodology.) The level of resources is thus likely to be medium to high, depending on the availability of such information.	

D.4 Emerging ecosystem services assessment tools and their corporate applicability

This appendix gives an introduction to some tools explored in Business for Social Responsibility's comparative assessment of emerging environmental services tools.

The aim of the Millennium Ecosystem Assessment[18], released in 2005, was to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being. The Assessment was conducted by over 1,300 scientists from 95 countries and was designed to meet some of the assessment needs of the Convention on Biological Diversity (CBD), the Convention to Combat Desertification (CCD), the Ramsar Convention on Wetlands and the Convention on Conservation of Migratory Species of Wild Animals (CMS), and other users including the private sector, civil society, and indigenous peoples.

In response, efforts are underway to create environmental service assessment and measurement tools. Since 2007, a number of tools have emerged or are currently being developed to assess multiple ECOSYSTEM SERVICES, and several of these were reviewed by Sissel Waage, Emma Stewart and Kit Armstrong on behalf of Business for Social Responsibility in November 2008[19]. Ecosystem services covered in these models typically include services such as purification of air and water, regulation of water flow, detoxification and decomposition of wastes, generation and renewal of soil and soil fertility, pollination of crops and natural vegetation, control of agricultural pests, dispersal of seeds and translocation of nutrients, maintenance of biodiversity, partial climatic stabilisation, moderation of temperature extremes, wind breaks, support for diverse human cultures, and aesthetic beauty and landscape enrichment.

The emergent tools for conducting integrated ecosystem assessments analysed in the Synthesis Report are:

- ARIES (Assessment and Research Infrastructure for Ecosystem Services)[20], which is under development by the University of Vermont's Ecoinformatics Collaboratory (within the Gund Institute for Ecological Economics), Conservation International and Earth Economics as well as with collaboration from experts at Wageningen University. This is a computer model and decision-support infrastructure to assist decision-makers and researchers by estimating and forecasting ecosystem services provision and their correspondent range of economic values in a specific area. Features of the tool are that it is a probabilistic, non-deterministic model designed for continual updating; transparent, so users know information sources; has a user-friendly interface despite complexity of the model; and it builds on University of Vermont's Ecosystem Services Database that contains spatially-explicit, peer-reviewed valuation data as well as methods of analysis, publications and project models. It will be pilot tested with Conservation International and Earth Economics.
- ESR (Corporate Ecosystem Services Review)[21], which was launched in March 2008 by the World Resources Institute (WRI), the Meridian Institute, and the World Business Council on Sustainable Development (WBCSD). This is a decision-support tool that provides a sequence of questions that helps managers develop strategies to manage risks and opportunities arising from their company's dependence

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18 See **http://www.millenniumassessment.org/**.

19 Waage, S., Stewart, E. & K. Armstrong (2008) A Comparative Assessment of Emerging Ecosystem Services Tools & their Corporate Applicability, BSR Environmental Services, Tools and Market Working Group **http://www.bsr.org/membership/working-groups/environmental-markets.cfm**.

20 See **http://esd.uvm.edu/**.

21 See **http://www.wri.org/project/ecosystem-services-review**.

on ecosystems. Features of the tool are that it offers a methodical, logical sequence of guiding questions; is the most advanced in terms of 'road-testing' with companies; and there are plans to provide guidance on integration into existing ENVIRONMENTAL MANAGEMENT SYSTEMS as well as valuation techniques.

- InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs)[22], which is in development by The Natural Capital Project – a joint venture among Stanford University's Woods Institute for the Environment, The Nature Conservancy, and World Wildlife Fund – with the goal of issuing a manual in the Summer / Fall 2008 and software in Fall / Winter 2008. It is a decision-making aid to assess how distinct scenarios might lead to different ecosystem service and human well-being related outcomes in particular geographic areas. Features of the tools are that it enables users to input their own site-specific data; allows for expert opinion as data to address data gaps; enables consideration of present and future trade offs from alternative resource management; is user-friendly with few data requirements; and identifies where ecosystem service benefits originate.
- MIMES (Multiscale Integrated Models of Ecosystem Services)[23], which is currently available in an early version ('beta plus') from the University of Vermont's Gund Institute for Ecological Economics. This is a multi-scale, integrated suite of models that assess the true value of ecosystem services, their linkages to human welfare, and how their function and value might change under various management scenarios. Features of the tool are that value can denominated in dollars, land area, or other such parameters; it is already populated with reliable, publicly available data; it can be scaled for additional data input; and the model is open source and has run successfully.
- NVI (Natural Value Initiative) assessment approach[24], which is being created by Fauna & Flora International, Brazilian business school FGV, and the United Nations Environmental Programme's Finance Initiative as a financial service sector focused tool for assessing biodiversity and ecosystem service risks. The tool is an evaluation benchmark methodology for assessing biodiversity and ecosystem-services related risks and opportunities in companies. NVI's work is initially within the food the food, beverage and tobacco sectors, and it builds on past FFI – Insight Investment work on a similar benchmarking methodology that was piloted for oil and gas, mining and metals and utilities sectors. Features of the tool are that it: promotes greater awareness within the finance sector of the links between biodiversity, ecosystem services and investment value, including the risks associated with mismanagement; and creates a company risk profile and offers case studies based on both publicly available information and direct corporate engagement.

In addition to these tools focused on multiple ecosystem services, BSR notes that a number of other biodiversity related tools that are also relevant given (a) the role of biodiversity in ecosystem structure and function and (b) the broad range of environmental parameters being considered, which include elements of ecosystem services. Two other relevant assessment approaches – which are in various stages of development – include:

- BBOP (Business and Biodiversity Offsets Programme) Toolkit[25]: a toolkit for assessing whether or not biodiversity offsets are appropriate and providing guidance on their design and implementation (the subject of this document and other Handbooks – see **www.forest-trends.org/biodiversityoffsetprogram/guidelines**); and

22 See **http://www.naturalcapitalproject.org/InVEST.html**.

23 See **http://www.uvm.edu/giee/mimes/**.

24 See **http://www.fauna-flora.org/newsnvi2.php**.

25 See **http://www.forest-trends.org/biodiversityoffsetprogram/index.php**.

- IBAT (Integrated Biodiversity Assessment Tool)[26], which is in development by Conservation International, following on their 'Initial Biodiversity Assessment & Planning' (IBAP)[27] approach that draws on Rapid Ecological Assessment methodologies for use within a corporate development context. This is a screening tool to help companies incorporate biodiversity into their risk analysis, decision-making and planning processes. Features of the tool are that it builds on locally collected scientific knowledge and data; delivers a cost effective product in a timely manner; and is limited to biodiversity high biodiversity value areas and protected areas.

BSR's Synthesis Report focuses on all of these tools. For further information and the full report, please see **http://www.bsr.org/membership/working-groups/environmental-markets.cfm.**

26 See **http://www.biodiversityinfo.org/ibat/**.

27 See **http://www.celb.org/ImageCache/CELB/content/energy_2dmining/ibap_2epdf/v1/ibap.pdf**.

To learn more about the BBOP principles, guidelines and optional methodologies, go to:

www.forest-trends.org/biodiversityoffsetprogram/guidelines