A cross-sector guide for implementing the

# Mitigation Hierarchy

Cross Sector Biodiversity Initiative

ICMM IPIECA EQUATOR PRINCIPLES

Prepared by The Biodiversity Consultancy

Cross Sector
Biodiversity Initiative

ICMM International Council on Mining & Metals IPIECA EQUATOR PRINCIPLES

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# A cross-sector guide for implementing the Mitigation Hierarchy


Prepared by The Biodiversity Consultancy

*Lead authors: Jon Ekstrom, Leon Bennun and Robin Mitchell*

The Biodiversity Consultancy Ltd
3E King's Parade, Cambridge, CB2 1SJ, UK
Telephone: +44 1223 366238
Email: enquiries@thebiodiversityconsultancy.com
Website: www.thebiodiversityconsultancy.com
Company Number: 6413116   VAT Number: 941 2882 18



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# Executive summary

The mitigation hierarchy is a tool designed to help users limit, as far as possible, the negative impacts of development projects on biodiversity and ecosystem services (BES).

It involves a sequence of four key actions—'*avoid*', '*minimize*', '*restore*' and '*offset*'—and provides a best-practice approach to aid in the sustainable management of living, natural resources by establishing a mechanism to balance conservation needs with development priorities.

This guidance document is designed to guide users through the practical implementation of the mitigation hierarchy, and offers guidance for understanding each step in the sequence described above, both at the initial design and planning stages of a project and throughout the project's lifespan. It is aimed primarily at environmental professionals, working in, or with, the extractive industries, and who are responsible for managing the potential risks of project impacts on biodiversity and ecosystem services.

The development of this document was, in part, motivated by the International Finance Corporation (IFC) *Performance Standards on Environmental and Social Sustainability*, in particular *Performance Standard 6* (PS6) on *Biodiversity Conservation and Sustainable Management of Living Natural Resources* (IFC, 2012a).

The CSBI recognizes that not every project is governed by IFC PS6, and that the extractive industry, biodiversity science, performance standards and other expectations may evolve and change. This guidance is not, therefore, constrained by IFC PS6 but more broadly reflects the state of the art and good practice of operationalization of the mitigation hierarchy for biodiversity and ecosystem services impact management in the extractive industries.

The structure of the document is described below.

***The Overview***

The *Overview* introduces the mitigation hierarchy as a framework for managing the risks and potential impacts of development projects on biodiversity and ecosystem services. It provides a formal definition of the mitigation hierarchy according to the Cross-Sector Biodiversity Initiative (CSBI), and clarifies the meanings of the terms *avoid*, *minimize*, *restore* and *offset* as used in the context of this guidance document (similar terms may have different legal implications in some jurisdictions).

The *Overview* presents the ecological, economic, regulatory and reputational drivers for applying the mitigation hierarchy, and describes its uses in terms of performance measurement, scheduling, achieving cost-effectiveness in project operations, and as a risk assessment and management tool.

Lastly, the *Overview* emphasizes the importance of engaging financers, and internal and external stakeholders, in the decision making process, and the consequent need for maintaining effective communication and documentation. Examples of key communication materials are provided.

***Section 1: Avoidance***

Section 1 introduces the concept of *avoidance*—the first and most important step in the mitigation hierarchy. The benefits and potential considerations of *avoidance* are summarized, and the different types of *avoidance* are explained, with details provided on how each type of *avoidance* can be undertaken. A number of practical examples are presented to illustrate how *avoidance* has been used by the extractives industry in a range of different circumstances. Guidance on the general practice of *avoidance* is provided, together with a summary of the potential constraints and challenges that may be encountered. This section closes with a summary of how improved ecological information and new technology can combine to give rise to new ideas for *avoidance*, and examples of recent innovative approaches are provided.

***Section 2: Minimization***

Section 2 is dedicated to the second step in the mitigation hierarchy—*minimization*. The principles and types of *minimization* are presented, together with a summary of the advantages and considerations that may need to be borne in mind. Practical examples of *minimization* are provided to demonstrate how this step has been used effectively by the extractives industry in a variety of different circumstances. This section closes with guidance on the general practice of *minimization*, a summary of potential constraints and challenges, and a note on innovative ideas for its application.

***Section 3: Restoration***

*Restoration* is presented in Section 3 of the guidance. The rationale for *restoration* is presented and, as with *avoidance* and *minimization*, the advantages of, and potential considerations for, *restoration* are also summarized. A summary of the key principles and steps for implementing *restoration* are presented, together with giudance on the practice of *restoration*, including realistic goal-setting, effective management of the process, and performance evaluation. A number of examples describing how *restoration* has been successfully employed in practice are also presented.

***Section 4: Offsets***

Section 4 presents the fourth and final step in the mitigation hierarchy—*offsets*. An explanation of the rationale for *offsets* is provided, together with a brief analysis of the business case for BES offsets. The key principles for using biodiversity *offsets* are summarized, as are the different types of *offsets* and the steps involved in the practice of *offsetting*. A practical example is included to demonstrate how *offsetting* has been used to aid habitat recovery for threatened fauna and flora species in a marine environment. The section closes with a summary of significant issues emerging as industry continues to design and implement biodiversity *offsets*.

***References and further information***

A *References* section is provided at the back of the guidance, followed by a list of useful weblinks and a comprehensive selection of relevant titles for further reading. Terminology used within the scope of the guidance is clarified in a *Definitions* section, and a summary of the acronyms used within the guidance is also provided. Finally, the two *Appendices* provide (1) an analysis of future developments and (2) details of knowledge gaps, for both *avoidance* and *minimization*.


# Overview

## About this document

### What is the mitigation hierarchy?

The mitigation hierarchy is a framework for managing risks and potential impacts related to biodiversity and ecosystem services[1] (BES). The mitigation hierarchy is used when planning and implementing development projects, to provide a logical and effective approach to protecting and conserving biodiversity and maintaining important ecosystem services. It is a tool to aid in the sustainable management of living, natural resources, which provides a mechanism for making explicit decisions that balance conservation needs with development priorities.

As defined by the CSBI (CSBI, 2013a), the mitigation hierarchy is: '*the sequence of actions to anticipate and avoid impacts on biodiversity and ecosystem services; and where avoidance is not possible, minimize*[2]*; and, when impacts occur, rehabilitate or restore*[3]*; and where significant residual impacts remain, offset*.

The mitigation hierarchy is not a standard or a goal, but an approach to mitigation planning. It can be used in its own right or as an implementation framework for BES conservation goals such as no net loss (NNL) or net gain/net positive impact (NPI), regulatory requirements and/or internal company standards. It provides a mechanism for measurable conservation outcomes for BES that can be implemented on an appropriate geographic scale (e.g. ecosystem, regional, national, local).

1 See the *Definitions* section on page 79 and, for further explanation, the A-Z of Biodiversity: www.biodiversitya-z.org/content/biodiversity.pdf

2 In the mitigation hierarchy, and in this guidance, '*minimization*' is used in a general sense to mean 'reduce' or 'limit' as far as feasible. It is not used in the legal sense current in some jurisdictions, where the term 'minimize' means 'reduce to zero'. In many instances, it is not possible to reduce a biodiversity-related risk or impact to zero, and if it is possible, the net incremental environmental/social benefit may not justify the significant additional cost.

3 In the mitigation hierarchy, and in this guidance, '*restoration*' is used in a broad and general sense. *Restoration* does not imply an intention to *restore* a degraded ecosystem to the same state and functioning as before it was degraded (which is the meaning in some specific jurisdictions, and may be an impossibly challenging or costly task). *Restoration* may instead involve land reclamation or ecosystem rehabilitation to repair project impacts and return some specific priority functions and biodiversity features to the ecosystems concerned. There are many terms linked to *restoration*, including rehabilitation, reclamation and remediation: these activities only amount to *restoration* when they ensure gains for the specific BES features of concern that are targets for mitigation.

## What is this document for?

This document provides high-level guidance, with pointers to further information, for using the mitigation hierarchy effectively to manage the potential impacts[4] of extractive activities on BES, at a landscape scale, throughout project lifespans. It aims to reflect state-of-the-art good practice of operationalizing the mitigation hierarchy for biodiversity impact management for extractive industries. The guidance is aimed at those working in, or with, industry and financial institutions, who are responsible for overseeing the application of the mitigation hierarchy, and who need a sound grasp of current good practice and its ongoing evolution, as well as a quick and simple way to find additional detailed information when necessary. It draws upon experts in relevant fields and current scientific literature, recognizes gaps and challenges in the implementation of each step of the mitigation hierarchy and leaves room for adaptability to future advances in these areas.

This guidance aims to:

- clearly define the mitigation hierarchy and its application to extractive projects;
- offer practical guidance for understanding and implementing each step of the mitigation hierarchy throughout the lifespan of an extractive project;
- outline how to determine and demonstrate loss or gain of biodiversity and/or ecosystem services as a result of mitigation action or inaction;
- offer practical measures for predicting and verifying conservation outcomes over time;
- allow flexible application, adaptable to site-specific environmental, operational and regulatory circumstances; and
- be systematically applicable across a range of extractive industry projects and natural environments[5].

The guidance is framed to be compatible with other IPIECA and ICMM guidance on biodiversity, ecosystem services and *offsets*, and with the CSBI Timeline Tool and Baseline Biodiversity Data Collection Guidance[6]. It focuses mainly on mitigating impacts on biodiversity, but also addresses ecosystem services (the benefits people receive from ecosystems) when appropriate. The two are closely related, but not in a straightforward way. Conserving biodiversity is likely to maintain existing ecosystem services, but the reverse may not always be so. Application of the mitigation hierarchy to ecosystem services is relatively new. As more experience is gained, this guidance may be updated accordingly.

For both biodiversity and ecosystem services, this guidance assumes a focus on significant (or material) impacts. This means that the impacts are on a BES feature that has substantial intrinsic or ecosystem service value, for example because it is highly threatened, unusual and localized, or of major cultural or economic importance, or in an intact and unmodified state. It also means that the potential impacts are not minor or trivial—for example they would severely reduce a species' viability, or the ability of a habitat to maintain viable populations of its native species. BES performance standards of the Multilateral Financial Institutions, such as the IFC's Performance Standard 6 (IFC, 2012a), provide useful frameworks and guidance for assessing the materiality of impacts. Identifying the BES features of concern is an important first step in applying the mitigation hierarchy. Once these features have been identified, they form the target for application of all the mitigation hierarchy components.

This guidance covers the mitigation of impacts that could be expected to arise from a project's routine activities related to exploration, construction, operation and closure. It does not address the risk of accidents and emergencies. While engineering and planning to prevent, contain and manage emergencies are a crucial part of project design and operation, they are beyond the scope of this document.

## How this document is structured

This document is structured according to the components of the mitigation hierarchy, i.e. *avoidance*, *minimization*, *restoration* and *offsetting*:

- The *Overview* (this section) introduces the mitigation hierarchy and its operationalization as a whole. It covers the primary drivers for implementing the mitigation hierarchy over the lifespan of an asset and touches on topics that are common to all the components of the mitigation hierarchy.

[4] Direct, indirect and cumulative. See the *Definitions* section on page 79.

[5] This guidance does not cover offshore ecosystems, where there is as yet very limited experience of how to apply the mitigation hierarchy.

[6] Full references and weblinks (where available) are given in the *References* section.

- Section 1 focuses on the first, and often the most important, component of the mitigation hierarchy—*avoidance*. This preventive step is intended to *avoid* impacts on the most sensitive BES, through site selection, project design and/or scheduling.
- Section 2 presents the second component of the mitigation hierarchy—*minimization*[7]. This is also a preventive step, and aims to reduce impacts that cannot be *avoided* through physical, operational or abatement controls.
- Section 3 discusses the first remediative component of the mitigation hierarchy—*restoration*[8]. Where damage or degradation to biodiversity values cannot be *avoided* or further *minimized*, there may be scope for remediation via rehabilitation or *restoration* efforts.
- Section 4 covers the last component of the mitigation hierarchy—*offsets*. This step is the last resort to address those significant residual impacts that could not be prevented through *avoidance* and *minimization*, or adequately corrected through *restoration*/rehabilitation. Additional conservation actions are also covered in this section.

Sections 3 and 4 are less detailed than Sections 1 and 2. Extensive information and guidance already exists for *restoration* and *offsets*. This document outlines the key issues for these components and provides signposts to relevant material elsewhere.

## Rationale for use of the mitigation hierarchy

There are ecological, economic, regulatory and reputational drivers for applying the mitigation hierarchy:

**Ecological drivers:** these include protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources, through limiting and/or repairing project impacts on BES. Impacts on biodiversity can adversely affect the delivery of ecosystem services, and this may in turn have negative consequences on human well-being. It may also affect the viability of projects that have significant dependencies on those ecosystem services.

**Regulatory drivers:** the mitigation hierarchy is used by many financial institutions, industries, governments and NGOs. Several financial standards and safeguards (International Finance Corporation Performance Standard 6 (IFC PS6), European Bank for Reconstruction and Development Performance Regulation 6 (EBRD PR6), World Bank Environmental and Social Standard 6 (ESS6), and the Equator Principles) all require application of the mitigation hierarchy for management of impacts on BES. The US Wetland Banking, the European Union Birds and Habitats Directives and Australia's Environment Protection and Biodiversity Conservation Act are examples of regulatory frameworks that also require application of the mitigation hierarchy.

**Economic drivers:** effective application of the mitigation hierarchy can reduce risks, costs and delays for industry and financial institutions during project development. Companies that follow good practice in environmental management, including application of the mitigation hierarchy, may secure easier and less costly access to finance, land and resources[9].

**Reputational drivers:** stakeholders increasingly expect that the mitigation hierarchy should be carefully applied, as good practice towards achieving sustainable development.

[7] In the mitigation hierarchy, and in this guidance, '*minimization*' is used in a general sense to mean 'reduce' or 'limit' as far as feasible. It is not used in the legal sense current in some jurisdictions, where the term 'minimize' means 'reduce to zero'. In many instances, it is not possible to reduce a biodiversity-related risk or impact to zero, and if it is possible, the net incremental environmental/social benefit may not justify the significant additional cost.

[8] In the mitigation hierarchy, and in this guidance, '*restoration*' is used in a broad and general sense. *Restoration* does not imply an intention to *restore* a degraded ecosystem to the same state and functioning as before it was degraded (which is the meaning in some specific jurisdictions, and may be an impossibly challenging or costly task). *Restoration* may instead involve land reclamation or ecosystem rehabilitation to repair project impacts and return some specific priority functions and biodiversity features to the ecosystems concerned. There are many terms linked to *restoration*, including rehabilitation, reclamation and remediation: these activities only amount to *restoration* when they ensure gains for the specific BES features of concern that are targets for mitigation.

[9] e.g. Rainey *et al*. (2014).

## Uses and components of the mitigation hierarchy

The mitigation hierarchy is useful as a framework because it can:

- **Promote performance measurement:** it is the tool by which biodiversity conservation goals (e.g. NNL, net gain/NPI, regulatory or company internal policy goals) can be achieved. Intelligent application of the mitigation hierarchy can reduce the costs of achieving such goals.
- **Reduce scheduling delays and instigate cost-effective approaches:** the mitigation hierarchy is a feedback optimization process to make the most cost-effective investment while effectively managing impacts on biodiversity and ecosystem services. Science, stakeholders, finance and industry schedules all factor into the judicious use of each component of the mitigation hierarchy.
- **Function as a risk assessment and management tool:** the mitigation hierarchy is a risk management tool and an Environmental and Social Impact Assessment (ESIA) planning tool. Appropriate application reduces business costs and scheduling/financing delays. The effective application of the mitigation hierarchy provides the opportunity for early identification of BES risks and mitigation options. This facilitates early business forecasting of potential mitigation requirements and options, schedule and cost estimates, and implications for project feasibility.

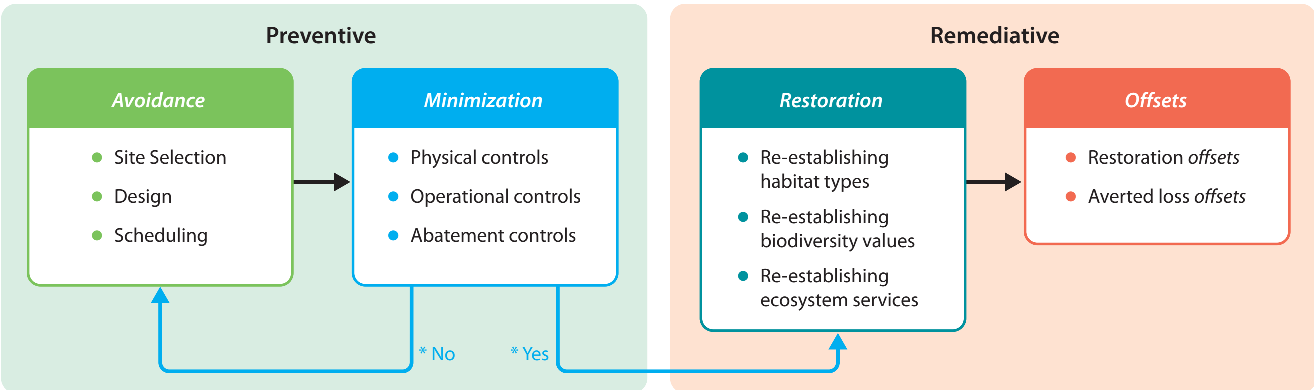
Figure 1 illustrates the iterative process of *avoiding* and *minimizing* until remaining risks and impacts can be managed through the remediative measures of *restoration* and *offsetting*.

The mitigation hierarchy can be viewed as a set of prioritized, sequential components that are applied to reduce the potential negative impacts of project activities on the natural environment. It is not a one-way linear process but usually involves iteration of its steps. It can be applied to both biodiversity and related ecosystem services. There are two preventive components, *avoid* and *minimize*, and two remediative components, *restore* (or rehabilitate) and *offset* (see Figure 1.3). As a rule, preventive measures are always preferable to remediative measures—from ecological, social and financial perspectives.

### Preventive measures

*Avoidance*, the first component of the mitigation hierarchy, is defined by the CSBI[10] as '*Measures taken to anticipate and prevent adverse impacts on biodiversity before actions or decisions are taken that could lead to such impacts.*'

**Figure 1** *Schematic diagram showing the implementation of the mitigation hierarchy*




* Can potential impacts be managed adequately through remediative measures?

[10] Definitions in this section are from CSBI (2013a), *Framework for Guidance on Operationalizing the Biodiversity Mitigation Hierarchy*, December 2013. See also the *Definitions* section on page 79 of this report, for comparison with other definitions that are available.

*Avoidance* is often the most effective way of reducing potential negative impacts. Its proper implementation requires biodiversity and ecosystem services to be considered in the pre-planning stages of a project. When *avoidance* is considered too late, after key project planning decisions have been taken, cost-effective options can easily be missed.[11]

*Minimization*, the second component of the mitigation hierarchy, is defined by the CSBI as '*Measures taken to reduce the duration, intensity, significance and/or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible*'[12]. Well-planned *minimization* can be effective in reducing impacts to below significance thresholds.

## Remediative measures

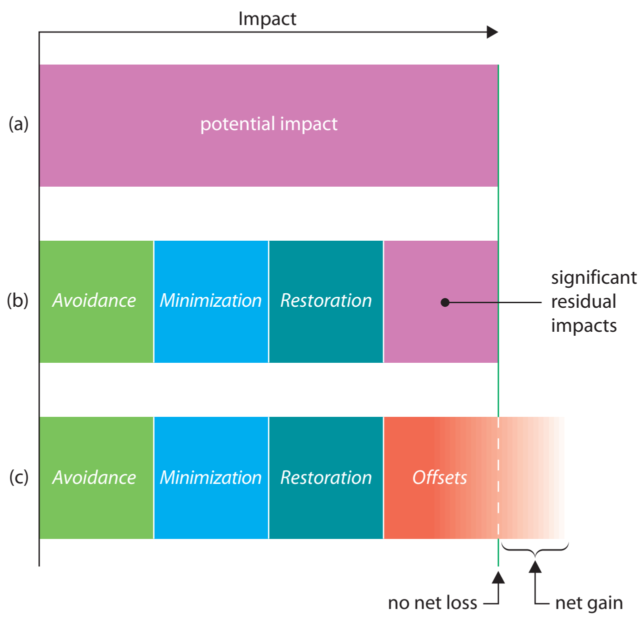
*Restoration* is used to repair BES features of concern that have been degraded by project activity. It involves measures taken to repair degradation or damage to specific BES features of concern—which might include species, ecosystems/habitats or priority ecosystem services—following project impacts that cannot be completely *avoided* and/or *minimized*. In the context of the mitigation hierarchy, *restoration* should focus on the BES features identified as targets for mitigation.[13] *Restoration* is usually carried out on-site and to repair impacts caused (directly or indirectly) by the project. Implementation of *offsets* (see below) may also involve restoration activities carried out off-site to repair impacts not caused by the project. These different kinds of restoration activities should not be confused.

*Offsetting* forms the final component of the mitigation hierarchy. *Offsets* are defined by the CSBI as '*Measurable conservation outcomes, resulting from actions applied to areas not impacted by the project, that compensate for significant, adverse project impacts that cannot be avoided, minimized and/or rehabilitated/restored*'. *Offsets* should have a specific and preferably quantitative goal that relates directly to residual project impacts. Often (but not necessarily) this is to achieve no net loss or a net gain of biodiversity. *Offsetting* is a measure of last resort after all other components of the mitigation hierarchy have been applied.

*Offsets* can be complex, expensive and uncertain in outcome. The need for *offsets* should therefore be reduced as far as possible through considered attention to earlier components in the mitigation hierarchy.

In the example shown in Figure 2, a project's potential impact (a) is reduced by taking measures to *avoid*, *minimize* and *restore* impacts (b) but a significant residual impact remains; this can be remediated via an *offset* (c), which in this case leads to a net gain in biodiversity.

**Figure 2** *Application of the mitigation hierarchy components*




[11] The CSBI Timeline Tool partly aims to address this: www.csbi.org.uk/workstreams/timeline-tool

[12] In the mitigation hierarchy, and in this guidance, '*minimization*' is used in a general sense to mean 'reduce' or 'limit' as far as feasible. It is not used in the legal sense current in some jurisdictions, where the term 'minimize' means 'reduce to zero'. In many instances, it is not possible to reduce a biodiversity-related risk or impact to zero, and if it is possible, the net incremental environmental/social benefit may not justify the significant additional cost.

[13] In the mitigation hierarchy, and in this guidance, '*restoration*' is used in a broad and general sense. *Restoration* does not imply an intention to *restore* a degraded ecosystem to the same state and functioning as before it was degraded (which is the meaning in some specific jurisdictions, and may be an impossibly challenging or costly task). *Restoration* may instead involve land reclamation or ecosystem rehabilitation to repair project impacts and return some specific priority functions and biodiversity features to the ecosystems concerned. There are many terms linked to *restoration*, including rehabilitation, reclamation and remediation: these activities only amount to *restoration* when they ensure gains for the specific BES features of concern that are targets for mitigation.

**Box 1 Differentiated application of the mitigation hierarchy for biodiversity and ecosystem services**

The mitigation hierarchy can be applied to both biodiversity and ecosystem services. However, the approach may need to be differentiated to reflect their distinct characteristics. While biodiversity represents the stock of nature (genes, species and ecosystems), ecosystem services are the benefits to people that flow from this stock when it is combined into integrated and functioning systems.

Where there are significant potential impacts on ecosystem services, the following points should be borne in mind when applying the mitigation hierarchy:

- Identifying the beneficiaries, and the extent of their dependence on the service(s), requires both sociological expertise, and appropriate stakeholder consultation. This information on demand and dependence needs to be brought together with information on how impacts will affect ecosystems and the flow of services. In practical terms, this means bringing together the social and environmental components of impact assessment—which often operate separately.
- Dependencies may extend not only to Affected Communities (defined as a group of stakeholders using an ecosystem service that is affected by the project and reliant on that ecosystem service for their well-being) but to the project itself.
- Understanding the spatial aspect of impacts is crucial. While Affected Communities typically are close to the project site, this is not always the case—for example where there are impacts on water supply or quality which can affect distant communities downstream.
- *Offsets* for ecosystem services should be located so that they deliver to the Affected Communities. This could necessitate a composite *offset* for the project, with separate locations to *offset* residual impacts on biodiversity and on ecosystem services. Ecosystem services that were previously out of reach can sometimes be made accessible by changes in tenure, targeted training, or facilitation of travel. In some situations, compensation for ecosystem services can only feasibly be provided through substitution (e.g. a borehole replacing flowing surface water) and/or monetary compensation. Engineering or monetary compensation is usually less satisfactory than an ecosystem-based approach. It may also not be possible to compensate for some important ecosystem services (e.g. spiritual value) in this way.
- There may often be mitigation trade-offs between different ecosystem services, between services provided to different stakeholder groups, and between biodiversity and ecosystem services. For example, increasing access to, or use of, productive services (such as wood fuel or fisheries) could be incompatible with improved biodiversity conservation, and with some regulating or cultural services. Situations often also arise where the ecosystem services relied upon by Affected Communities involve unlawful activities (e.g. timber or bushmeat harvesting). Where complex trade-offs and dependencies are involved, it is particularly important to obtain a sound understanding of the ecological, social, political and economic contexts, materiality of impacts, and the available options and their consequences. Extensive stakeholder consultations (and probably negotiations), will be necessary.

Many tools are available to guide the identification and prioritization of ecosystem services, such as those from IPIECA/IOGP (2011) or WRI (www.wri.org, e.g. Landsberg *et al.*, 2013). Modelling tools such as InVEST (www.naturalcapitalproject.org/InVEST.html) or ARIES (www.ariesonline.org) may be useful in determining current baselines and trends, and potential project impacts.

### The first components of the mitigation hierarchy are often the most useful and effective

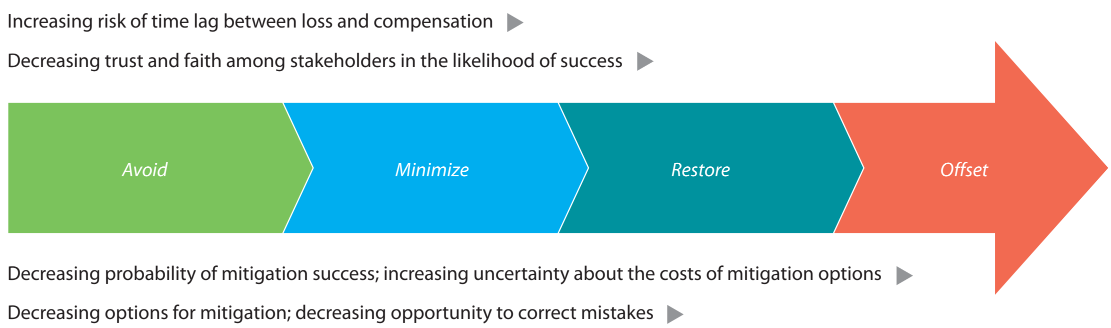
The mitigation hierarchy is a hierarchy in terms of priorities. As a general rule, this means that the earlier components need special emphasis. While all components of the mitigation hierarchy are important, rigorous efforts to *avoid* and *minimize* as far as feasible are likely to achieve significant reductions in potential impacts (Figure 2). Careful implementation of the early components of the mitigation hierarchy will reduce the project's liability for *restoration* and *offsets* measures. This is important as these later mitigation components may often—but not always—encounter the following (see also Figure 3):

1. Increasing technical, social and political risks (e.g. technical failure of restoration, or political failure of a biodiversity *offset*).
2. Increasing uncertainty of costs, and risk of cost escalation.
3. Increasing costs per unit of BES.
4. Increasing requirements for external stakeholder engagement and specialist expertise.
5. Decreasing opportunity to correct mistakes.
6. Decreasing confidence and trust among key stakeholders.

However, the opportunity costs of *avoidance* and *minimization* may often be larger for the project site (because it contains valuable mineral, oil or gas resources) than for other ecologically similar areas. There may thus be a strong economic rationale for *restoration* and (especially) *offsets* to be favoured over *avoidance* and *minimization* in addressing potential impacts. In practice, therefore, trade-offs between environmental and economic effectiveness may need to be considered and resolved. There is no simple formula for doing this, and different risks and considerations will need to be weighed carefully in the context of societal preferences and stakeholder concerns.

There are often fewer options and higher risks further along the mitigation hierarchy. Where it is feasible, *avoidance* tends to have fixed, known costs and in many cases a higher probability of success than later components. Beyond *avoidance*, mitigation options usually diminish, and challenges related to cost, schedule and stakeholders often become more significant. Exceptions occur however (e.g. *restoration* may in some cases be riskier and more expensive than *offsetting*) and projects will need to be considered on a case-by-case basis.

**Figure 3** *Avoid, minimize, restore, offset*



# The mitigation hierarchy and the project lifespan

The CSBI Timeline Tool[14] illustrates how options for the preventive components (*avoidance* and *minimization*) occur primarily, but not exclusively, early in the project planning cycle, and options for the remediative components (*restoration* and *offsets*) occur later and throughout operations.

Figure 4 illustrates the application of the mitigation hierarchy across the project lifespan and highlights the components most likely to be of importance during each broad stage.

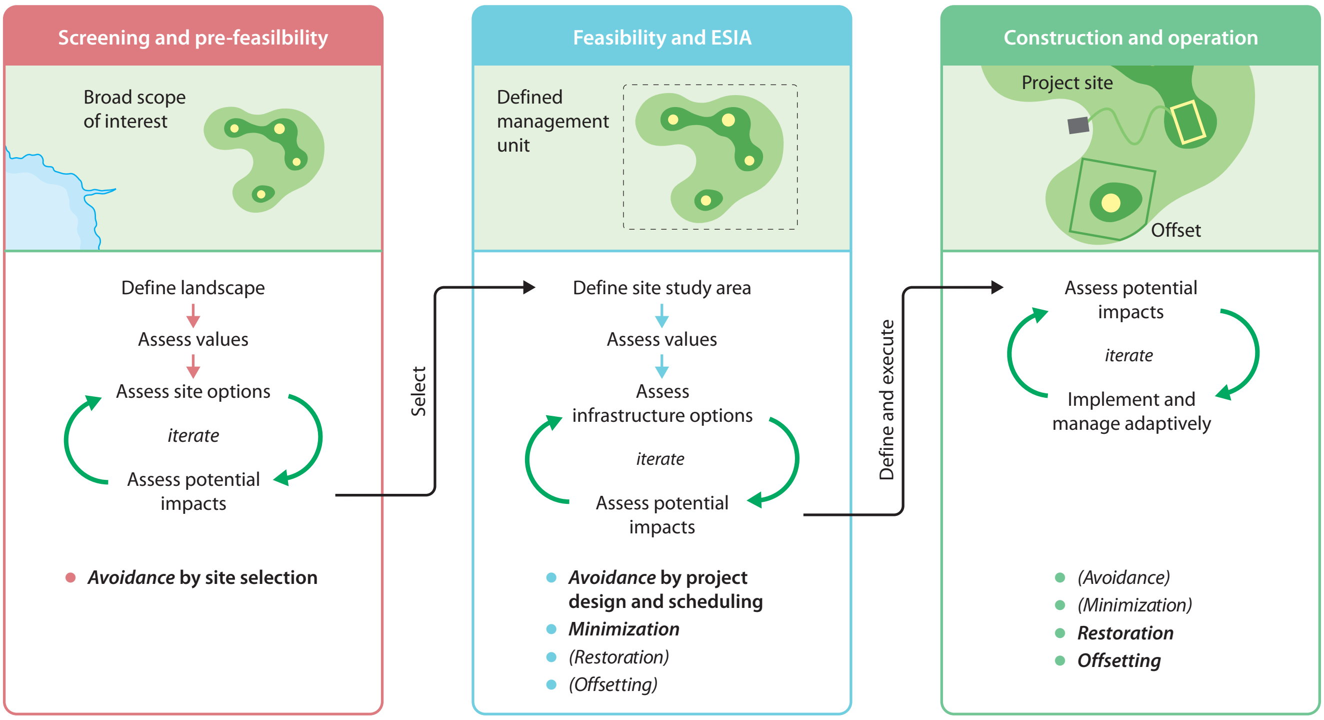
Selection of project sites through ecosystem-level BES screening occurs at the pre-feasibility assessment stage. Once a site has been chosen, further *avoidance* and *minimization* occurs within the project site. During construction and operation, implementation of the mitigation hierarchy involves adaptive management. Work undertaken during each stage includes defining study areas, assessing BES values and impacts, and choosing and implementing mitigation options. Iterative decision making (shown by the green arrows in Figure 4) is desirable at each stage.

## Using the mitigation hierarchy before, during and after the ESIA

The mitigation hierarchy has traditionally been used during the ESIA and, more recently, the *offset* design process. However, it is proving valuable in current good practice to also use the approach before and after the ESIA.

Before the ESIA, the mitigation hierarchy functions as a risk assessment framework to assess the magnitude of BES risks, for example to consider whether it is feasible to mitigate impacts at the site, whether the site can be *restored*, and whether an NNL can be achieved. Questions to ask include: Is there a risk of irreversible or non-*offsettable* impacts? Are there less-damaging alternatives that are feasible? And, with respect to ecosystem services: Is the proposed development likely to be sustainable in this location, given its natural resource dependencies?

**Figure 4** *Applying the mitigation hierarchy across three broad stages of the project timeline*




[14] CSBI Timeline Tool www.csbi.org.uk/workstreams/timeline-tool

**Table 1** *Financial institutions and industry use the mitigation hierarchy for different purposes at different stages of the project lifespan*

| Project stage | Industry use of the mitigation hierarchy | Financial institution use of the mitigation hierarchy | Key mitigation hierarchy components implemented |
|---|---|---|---|
| Pre-ESIA | • Risk assessment: first screening for potential *offset* locations | • Risk Assessment | • *Avoidance* by site location<br>• (*Offsets*) |
| ESIA | • Mitigation design<br>• Feedback optimization approach to mitigation investment<br>• Residual impact assessment<br>• *Offset* design | • Conceptual framework<br>• Guidance for clients | • *Avoidance* by project design and scheduling<br>• *Minimization*<br>• (*Restoration*)<br>• (*Offsets*) |
| Post-ESIA | • Performance tracking<br>• Adaptive management | • Performance tracking for loan and/or financing agreement actions[15] (ESAPs, EPAPs[16])<br>• Performance audits | • (*Avoidance*)<br>• *Minimization*<br>• *Restoration*<br>• *Offsets* |

During ESIA, the mitigation hierarchy can function as the principal ESIA organizing framework for BES. It guides planning and communication. Half way through the ESIA process, it is good practice to use the mitigation hierarchy as a feedback optimization tool (see below). This involves checking to determine whether impacts remaining after *avoidance* and *minimization* can be remediated (with *restoration* and *offsets*). If remediation would incur unacceptably high costs or risks, it may be necessary to go back and reassess the earlier components of the mitigation hierarchy.

After the ESIA, during the construction and operations phase, the mitigation hierarchy functions as an adaptive management framework for practitioners, as an audit tool for regulators and financial institutions, and as an NNL tool in *offset* design.

Both industry and financial institutions apply the mitigation hierarchy across the different stages of the project cycle, but for slightly different purposes. For industry, the mitigation hierarchy is mainly a tool for planning and adaptive management; for financial institutions it provides a framework to guide clients, and a means to audit performance (Table 1).

## How to move to the next component of the mitigation hierarchy and use feedback to optimize investments

The mitigation hierarchy is not a one-way linear process, and entails both feedback and adaptive management to optimize investments (see Figure 5 on page 17).

***The principle***

The question, 'How much *avoidance* is enough?' depends on the mitigation options remaining for the biodiversity features of concern, after this component has been applied. Iteration may therefore be necessary (Figure 5).

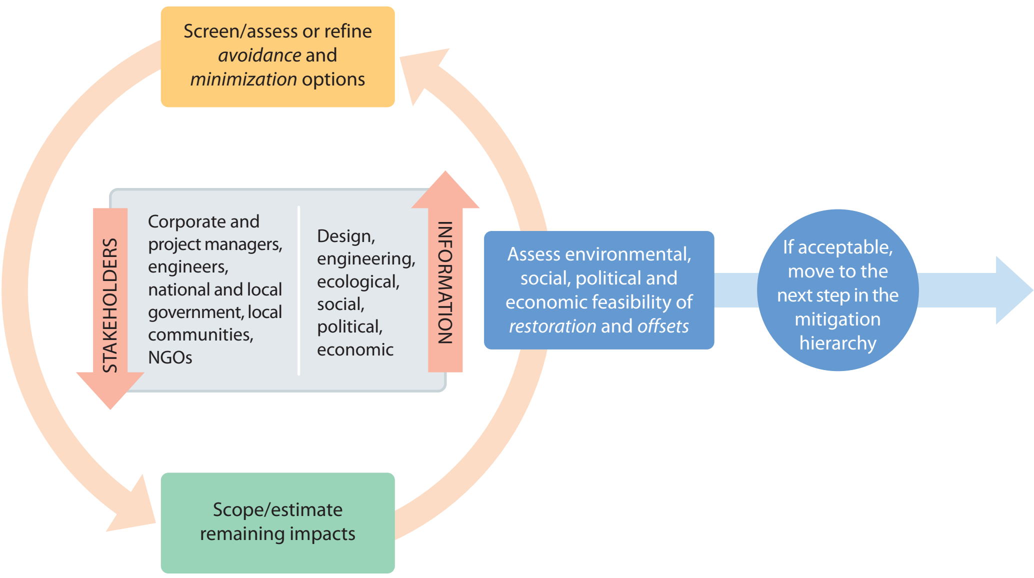
***The method***

1. Apply *avoidance* and *minimization* measures to potential BES impacts using a risk-based approach.
2. Characterize and estimate the magnitude of the potential remaining impacts to be addressed by *restoration* and, if necessary, *offsetting*.
3. Assess the environmental, social, political and economic feasibility of *restoring* or *offsetting* this type and magnitude of impact on BES values.

15 Equator Principles (2014). *Guidance for EPFIs* [Equator Principles Financial Institutions] *on incorporating environmental and social consideration into loan documentation.* www.equator-principles.com/resources/ep_guidance_for_epfis_on_loan_documentation_march_2014.pdf

16 Environmental and Social Action Plans (mainly multilateral finance institutions (MFIs)), and Equator Principle Action Plans (Equator Institutions). For an example see: www.pgi-uk.com/Doc/pdf/EIAReports/Equator-Principles-Action-Plan-for-Pungwe-B.pdf

**Figure 5** *The iterative stages in the assessment of options and impacts, to optimize investment in components of the mitigation hierarchy*



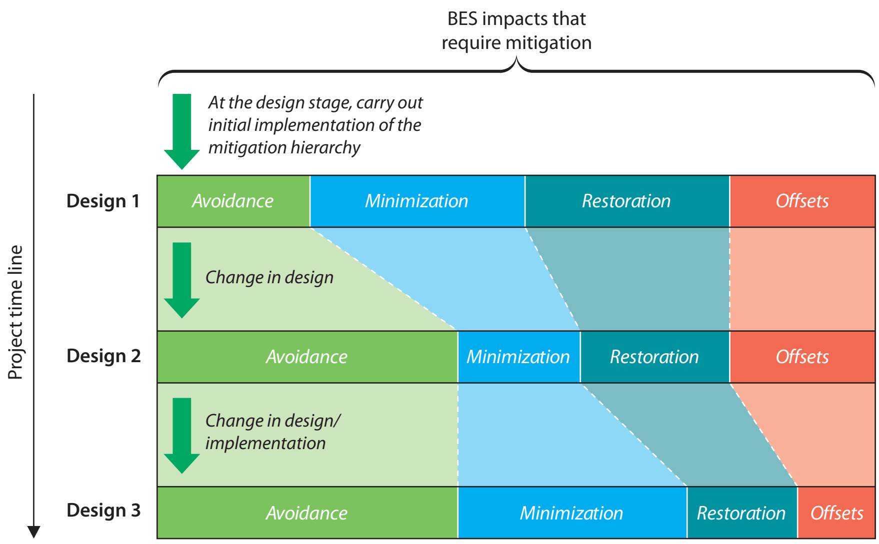

4. If risks and/or costs are too high, return to *avoidance* and *minimization* and repeat the evaluation process
5. Throughout the process, communicate the options with planners, engineers and decision makers.

### *The outcome*

Figure 6 (below) shows an example of how changes in emphasis across the mitigation hierarchy may result during the design phases as new information becomes available and further consultation takes place.

Several rounds of application (iterations) of the mitigation hierarchy are likely through a project's planning and operational phases. When using a no net loss/net gain framework, scenarios need to be informed by quantitative assessment of losses and gains. In the hypothetical example presented in Figure 6, the iterative application of the mitigation hierarchy at the design stage leads to increased use of *avoidance* and *minimization*, ultimately reducing the scale of *restoration* and *offsets* needed for remediation.

**Figure 6** *Increasing the use of avoidance and minimization in project design through iterative application of the mitigation hierarchy*




*In this hypothetical example, assessment leads to modification of Design 1, which would have left unacceptable potential impacts remaining after* ***avoidance*** *and* ***minimization****. In the next iteration, Design 2 achieves further* ***avoidance****, but it would still not be unfeasible to* ***restore*** *or* ***offset*** *the potential impacts. Design 3 further* ***minimizes*** *potential impacts, reducing the scale of* ***restoration*** *and* ***offsets*** *needed for remediation*

**Box 2 Biodiversity and ecosystem services—risks, impacts and dependencies**

Risks associated with BES take two forms: the risk that development projects pose to BES, and the risk that impacts on BES (if not adequately addressed through the mitigation hierarchy) can pose to development projects.

**Intrinsic risk**

This is the risk of significantly damaging important and sensitive biodiversity features or ecosystem services. This may also pose a direct risk to a project that is dependent on specific ecosystem services.

**Compliance risk**

This is the risk of failure to comply (or being perceived not to comply) with government regulation or finance safeguards. This could result in fines, delays and increased costs, as well as slower and more troublesome approvals for future projects and reduced access to finance, natural capital and land.

**Reputational risk**

This is the risk that shareholders, stakeholders and wider society may perceive that good practice has not been followed in relation to BES. This could result in weakened relationships with stakeholders, and reduced trust (with an increased chance of protests or political obstacles causing delays and costs), a diminished 'social licence to operate' locally, nationally and/or internationally, diminished investor confidence and loyalty, and lower staff morale. As with compliance risk, it could also result in reduced access to finance, land and natural resources.

*Avoidance* and *minimization* help to prevent potential impacts, and the intrinsic, compliance or reputational risks that these would pose. *Restoration* and *offsets* help to remediate impacts that have already happened. Failure to remediate adequately may also pose intrinsic, compliance or reputational risk.

For a more detailed discussion of risks and impacts see IPIECA-IOGP (2011).

## Application of the mitigation hierarchy including *offsets* to achieve BES targets

No net loss (NNL) can be defined as the point at which project-related impacts on biodiversity are balanced by measures taken through application of the mitigation hierarchy, so that no loss remains. Where the gains are greater than the losses, net gain results.

NNL and net gain are therefore targets which can be used to drive performance in the application of the mitigation hierarchy. NNL or net gain may be required for specific biodiversity values by some regulatory frameworks or financing conditions. Where feasible, IFC PS6 requires NNL for impacts on Natural Habitat and net gain for impacts on Critical Habitat[17], and this approach is increasingly regarded as best practice. Projects may take many years to achieve NNL, and many milestones will be set along this journey.

However, the mitigation hierarchy may be applied without having NNL or net gain as a goal. Setting clear targets for the biodiversity features of concern and taking a quantitative approach are still desirable to ensure effective delivery.

Currencies and metrics to demonstrate BES losses and gains exist but are still being refined and tested.[18]

## BES target feasibility assessments

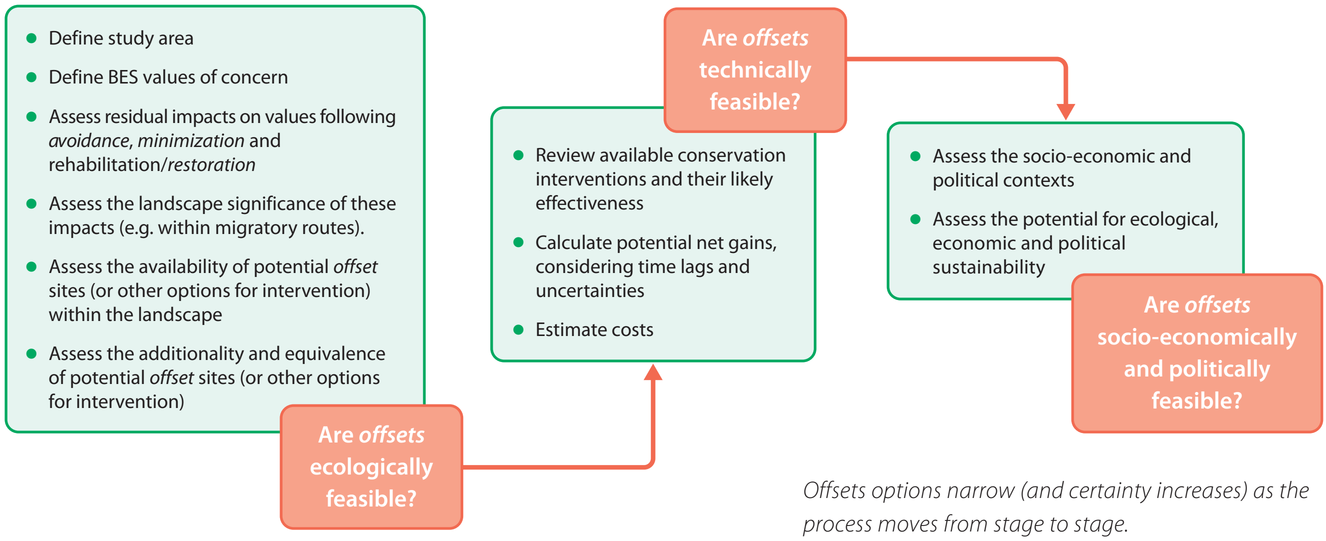
BES target feasibility assessments evaluate the likelihood that a project will achieve specific targets, such as NNL or net gain. Some financial institutions look for such predictions—qualitative feasibility and quantitative forecasts—in loan-supporting documents[19] to provide a greater degree of certainty of BES targets being met.

[17] For projects financed by the IFC or financial institutions adopting PS6. Definitions of Natural Habitat and Critical Habitat can be found in IFC Performance Standard 6 (www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES) and the accompanying Guidance Note 6 (www.ifc.org/wps/wcm/connect/a359a380498007e9a1b7f3336b93d75f/Updated_GN6-2012.pdf?MOD=AJPERES).

[18] An example framework for measurement is outlined in ICMM-IUCN (2013) Independent report on biodiversity *offsets*. Available at www.icmm.com/biodiversity-offsets

[19] Project examples include Oyu Tolgoi (Mongolia, http://ot.mn/en) and several others not yet at financial close.

**Figure 7** *Steps in assessing the technical and political/business feasibility of a biodiversity conservation target (e.g. no net loss)*




*Offsets options narrow (and certainty increases) as the process moves from stage to stage.*

Feasibility assessments consider technical, social, political and economic issues. To answer the question, 'Is it possible to achieve a target?' (such as NNL), the burden of proof goes through the stages of theoretical feasibility, technical feasibility (including cost considerations) and socio-political feasibility (including sustainability considerations) (Figure 7). As greater certainty is achieved, the project mitigation and *offset* options are narrowed down, as in any project design process.

At a coarse scale, such assessments can initially be completed as a desktop exercise, before a field assessment is undertaken. Financial institutions will also be interested in the track record or capacity of clients to undertake such work.

## Measuring the contribution of mitigation hierarchy components towards a BES target

A BES target forecast (such as for NNL) can be done by assessing losses versus gains predicted from the application of each step of the mitigation hierarchy through the project life span.[20]

Once appropriate metrics for BES features (or surrogate measures, if appropriate) have been chosen, a precautionary approach, with specialist input, can be used to predict the gains expected from *avoidance*, *minimization*, *restoration* and *offsets*. For averted loss *offsets*, the determination of net gain can be achieved through estimates of change predicted in the absence of the *offset* (the 'counterfactual' scenario).

## Applying the mitigation hierarchy retroactively

The mitigation hierarchy is ideally applied from the earliest stages of a new project, or an existing project's expansion. It is more challenging to apply the mitigation hierarchy retrospectively to a project that is already operational. In this case, the potential for *avoidance* and *minimization* is likely to be limited, but opportunities could become apparent when, for example, site layout and timetabling of activities are reviewed. However, an ongoing project may still provide significant opportunities for *restoration* and, especially, *offsetting*. One challenge is that, frequently, baseline (pre-project) data

[20] For examples, see the gains forecast for the QIT Madagascar Minerals project (Temple *et al.*, 2012—www.thebiodiversityconsultancy.com/wp-content/uploads/2013/06/Forecasting-towards-NPI.pdf) and the loss/gain table of habitats and species for Bardon Hill Quarry, UK (Temple *et al.*, 2010—www.thebiodiversityconsultancy.com/wp-content/uploads/2013/06/Biodiversity-Offset-Case-Study-Bardon.pdf)

for priority BES features are limited, making it hard to assess project impacts quantitatively (or even qualitatively). This may require 'back-casting', inferences based on current status in relation to land-use and other changes since the project started.

## Communication and documentation

The reputational benefits of, and indeed recognition for, selecting certain design options can be recognized if financiers[21], and internal and external stakeholders, have been consulted and engaged in the process of decision making. Therefore, the communication of the design options, key choices to be made, the technical, economic and political constraints, and the refined business case can be beneficial to a project. Communication materials could include the following:

- maps and available quantitative data on loss, potential gains, costs and social issues, to better demonstrate options on constraints and opportunities;
- an estimate of residual impacts after the mitigation hierarchy has been applied;
- figures in terms of simple metrics, such as 'quality hectares'[22] of habitat, which can help stakeholders to understand and comment on the significance of impacts, predicted gains and the proposed/adopted *avoidance* and/or other mitigation measures (some design options may need to remain confidential for commercial or other sensitive reasons); and
- a Biodiversity Action Plan (BAP) or environmental management plan, which follows the mitigation hierarchy.

[21] Lenders often require a biodiversity management plan, a biodiversity monitoring plan, and in some cases a biodiversity *offset* plan or demonstration of approach to no net loss. All these documents can be effectively based on the application of the mitigation hierarchy.

[22] 'Quality hectares': a biodiversity metric that weights habitat area by its quality (often assessed on a scale of 0–1, or 0–100%) in terms of intactness or suitability for specific biodiversity features of interest. See Temple *et al.* (2012) for an example at www.thebiodiversityconsultancy.com/wp-content/uploads/2013/06/Forecasting-towards-NPI.pdf

Section 1

# Avoidance

## Definitions

The CSBI defines *avoidance* as '*Measures taken to anticipate and prevent adverse impacts on biodiversity before actions or decisions are taken that could lead to such impacts*'. Other similar definitions exist[23].

*Avoidance* involves changes in early project planning to 'design out' impacts or risks. Measures taken to *avoid* impacts can therefore take place at different scales and in both time and space.

## Rationale

*Avoidance* is the first and most important step of the mitigation hierarchy. It offers many benefits, some of which are outlined in Table 2 (page 22) together with potential downsides and aspects to consider.

## Key principles

The key principle in *avoidance* is to start its consideration as early as possible in the project planning process, at a point where adjustments to project site and infrastructure location may still be feasible.

Other important principles, which also apply to *minimization* (see Section 2) and indeed to all elements in the mitigation hierarchy include:

- access to, and use of, the most relevant datasets and expertise;
- use of maps and spatial information[24];
- monitoring basic performance of staff and contractors; and
- monitoring the implementation of environmental management plans and the results of adaptive management.

[23] Business and Biodiversity Offsets Programme (http://bbop.forest-trends.org/pages/mitigation_hierarchy); and the UNEP-WCMC Biodiversity A-Z (www.biodiversitya-z.org).

[24] Preferably on a single GIS platform at landscape scale and study area scale (such as habitat maps, nesting sites, watercourses, infrastructure plans, immigration predictions).

**Table 2** *Advantages of, and considerations for, avoidance*

| Advantages | Considerations |
|---|---|
| • Most effective ecologically: most likely to deliver a no-net-loss outcome. Lowest risk step. Can be the most cost-effective step. | Most effective with:<br>• early review and relatively reliable information about ecological risks and alternatives, including at landscape and location-specific scales, i.e. benefits from front-loading certain BES-related efforts; and<br>• early planning and action before all financial factors are known. |
| • Large gains are possible. | • Can entail significant up-front costs or changes to initial plans. |
| • Higher certainty of success. | |
| • Tangible and evident to stakeholders: manages reputational risk. *Avoidance* of impacts on high-value BES can be highly significant for a company's local licence to operate and also for its national and global image. | • Can be 'forgotten' by stakeholders during the project lifetime (efforts not recognized).<br>• Some corporate organizations and industry associations have stated 'no go' commitments requiring *avoidance* of World Heritage Sites (including ICMM and Shell in 2003, and Soco and Total in 2014).<br>• *Avoidance* decisions are sometimes commercially/politically confidential and therefore cannot be communicated effectively to all stakeholders. |
| • Immediate: does not require the long time frames to achieve outcomes that would be necessary for *minimization*, *restoration* or *offset* options. | |
| • Costs can be integrated into project design. | |
| • Costs are one-off, not ongoing. | |
| • Often more cost-effective (for achieving a particular result) than later steps in the mitigation hierarchy. | |
| • Can greatly reduce the risk of significant delays and costs in permitting and scheduling. | |
| • Justifications for *avoidance* will normally be multiple, e.g. social and political, facilitating the business case. | • Can be difficult to negotiate when actual project feasibility and schedule are critical/in question. |
| • Clear scientific basis. | • A coarse 'one size fits all' approach.<br>Not all BES sensitivities will be covered. |
| • May be easier to measure loss vs. gain in *avoidance* decisions. | |
| • Spatially- and temporally-specific BES sensitivities can be specifically *avoided* (e.g. a nesting site, a 10-day migration period). | |
| • *Avoidance* may be the only option for certain 'irreplaceable' BES values (e.g. some old growth forest, some locally endemic species). | *continued …* |

Table 2 (continued) *Advantages of, and considerations for, avoidance*

| Advantages | Considerations |
|---|---|
| • *Avoidance* through carefully structured stakeholder consultation can develop support for, or reduce opposition to, a project (e.g. siting of hydropower dams). | |
| • *Avoiding* impacts in the first place removes the need for scientific justification or expert consensus on the acceptability of later stages of the mitigation hierarchy. | |
| • Legal or financial requirements may call for *avoidance*, e.g. for specific sites (such as Protected Areas), species, ecosystems and/or ecosystem processes. Specific definitions and guidance exist in some countries for *avoidance* and *minimization*[25]. Many lenders have specific requirements, such as the IFC PS6 stipulations[26] to *avoid* impacts on biodiversity and ecosystem services[27]. | |

[25] For example, see Galveston District (2013): *Galveston District Stream Condition Assessment: Evaluating Avoidance, Minimization, Stream Restoration Projects and Compensatory Mitigation Plans* www.swg.usace.army.mil/Portals/26/docs/regulatory/Streams/Evaluating Stream Plans June 2013.pdf

[26] For activities/projects financed by the IFC, an Equator Principles Financial Institution, or a lending institution that subscribes to the IFC Performance standards.

[27] IFC (2012a): Performance Standard 6, *Requirements* paragraph 7: '*As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services*'; and paragraph 25: '*With respect to priority ecosystem services … adverse impacts should be avoided*'. www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES

## Key steps in *avoidance*

These steps are not strictly sequential but may take place alongside each other:

- engage project planners and engineers with ecologists/environmental professionals;
- ensure that there is effective communication between the environmental and social elements of the project;
- make mitigation requirements explicit in contractor agreements;
- plan and conduct appropriate stakeholder consultation, with results feeding back into planning;
- ensure an iterative process: before mitigation design is complete, assess whether *restoration* and *offsets* measures can compensate for remaining impacts (see Figure 1). Strengthen planned *avoidance* and *minimization* measures if necessary; and
- integrate *avoidance* into environmental management plans.

## Key types of *avoidance*

In general, the different approaches to *avoidance* can be categorized into three major types, i.e. *avoidance* through:

- site selection;
- project design; and
- scheduling.

Many approaches may encompass all three types of *avoidance*.

### *Avoidance* through site selection

*Avoidance* through site selection involves the relocation of the project site or components away from an area recognized for its high BES value.

This type of *avoidance* involves screening for BES values very early in the planning process, followed by an analysis of alternative project locations. Spatial information is needed at a landscape level (i.e. at a scale that shows potential project locations in their wider geographical context) for relocation of an entire project site, or at a local level for relocation of project components.

***What does it involve?***

*Avoidance* through site selection involves spatially placing whole projects so as to *avoid* areas of high value for biodiversity or ecosystem-services. Spatial *avoidance* can take many forms, for example:

- focusing exploration away from high biodiversity value areas;
- preferential siting of infrastructure outside an important site, such as a Key Biodiversity Area; and
- re-routing of a road or pipeline to *avoid* a wetland or a migratory corridor.

***When is it done?***

- Upon entering a new geographical area of operation: through identifying and *avoiding* regions or locations with higher BES value.
- During exploration: through designing on-ground activities to *avoid* identified biodiversity and related ecosystem services risks.
- Before the sites or corridors for the main project or ancillary infrastructure have been chosen.

***How can it be undertaken?***

Spatial *avoidance* is best accomplished initially (early in a project lifespan) through landscape (or seascape) screening of biodiversity risk (see Appendices 1 and 2). This is essentially a mapping exercise, conducted by corporate or project planning teams. Financial institutions are not usually involved at this stage.

The steps to be taken are mapped in Appendix 1 and 2, and briefly summarized here:

- Obtain data layers through desktop and/or fieldwork means.
- Assess biodiversity risks at proposed project sites through a simple mapping overlay, e.g. in geographic information systems (GIS): what are the biodiversity values at the proposed project site? How many hectares of each priority ecosystem or species habitat could be impacted?
- Communicate site risks to project planning teams, in terms of scheduling delays or the potential magnitude of mitigation costs.
- For biodiversity, recognized global and national datasets[28] can support such screening via GIS.
- Ecosystem service maps generally do not yet reliably demonstrate risks at the appropriate spatial scale, though they may give an indication of where additional data collection is needed. To *avoid* risks to ecosystem services, some further field data collection/stakeholder engagement may be needed (both social and technical).

## *Avoidance* through project design

*Avoidance* through project design takes place when selecting the type of infrastructure, and its and placing and mode of operation on the project site.

Impacts may be *avoided* through careful placement of infrastructure, and through the careful choice of construction and operational methods. This provides an opportunity to consider any potential 'downstream' effects of the project design, outside the project site.

***What does it involve?***

*Avoidance* through project design involves changing the layout and type of infrastructure used at the project site. The two major approaches are:

- selection of the types of infrastructure, construction and operational processes (e.g. directional drilling, methods for mine pit construction, the choice of pipelines vs. railways or roads); and
- selection of the layout of project infrastructure, such as micrositing and rerouting of pipelines.

***When is it done?***

- *Avoidance* through project design occurs after site selection.
- Engagement in the early design process before decisions begin to be made is critical.
- *Avoidance* through project design is most effective when considered during conceptual design, feasibility study and front-end engineering design.
- The selection of infrastructure layout happens at the same time as, or just after, selection of the construction and operational processes.
- If a financial institution is involved at this stage, *avoidance* through project design considerations can be included as part of environmental and social due diligence.

[28] For example: IBAT (www.ibatforbusiness.org); IUCN Red List (www.iucnredlist.org); GBIF (www.gbif.org); GlobCover (www.esa-landcover-cci.org/?q=node/158); Landsat (http://landsat.usgs.gov/Landsat_Search_and_Download.php)

**Table 3** *Examples of how to undertake avoidance through project design*

| Organization of project site and fixed infrastructure | Routing of linear infrastructure* | Choice of infrastructure type |
|---|---|---|
| • Clustering project facilities on a single site to reduce the overall footprint.<br>• Reducing the width of corridors during construction and operations.<br>• Maximizing the use of multiple well-drilling sites.<br>• Using existing infrastructure wherever possible to *avoid* or reduce road construction and/or vegetation clearing.<br>• Reducing the size of camps and facilities, which might be sequentially used.<br>• Identifying and protecting undisturbed set-asides within project areas, for example to conserve patches or corridors of valuable habitat, or migration routes.<br>• Locating drill pads to *avoid* nesting sites; modifying footprint design or size to *avoid* a threatened or sensitive vegetation type or species.<br>• Modifying the location of fixed infrastructure and facilities—such as drilling sites, gas processing facilities, oil treatment centres, waste rock dumps, tailing dams, oil treatment centres. | • Micro-routing linear infrastructure around habitat features and/or areas of importance to BES.<br>• Burying transmission lines to prevent collisions with birds, or pipelines to *avoid* blocking animal movements.<br>• Locating support roads in already disturbed habitats to *avoid* direct damage and risks from increased access.<br>• Aligning new linear infrastructure alongside existing structures (e.g. existing roads, or rail corridors) and on disturbed habitats. | • Using horizontal wells and extended-reach drilling (ERD) in sensitive areas where feasible.<br>• Using a pipeline rather than a road to *avoid* indirect impacts from increased access (e.g. impacts on trade in bushmeat).<br>• Using aerial conveyor belts to reduce habitat fragmentation.<br>• Using air coolers instead of water coolers in power generation facilities, to *avoid* thermal discharge to aquatic systems.<br>• Using helicopters rather than roads.<br>• Modifying drainage systems, e.g. routing of sediment-laden storm-water run-off and other effluents away from high biodiversity aquatic habitats.<br>• Using new technologies to *minimize* lateral drawdown of groundwater through mine de-watering.<br>• Expanding underground mine with robotic operation. |

* Including onshore and offshore pipelines, transmission lines, railway corridors, support roads

### *How can it be undertaken?*

- Early communication is essential between project planners, engineers and geoscientists, and project (or external) ecologists/environmental professionals.
- *Avoidance* through project design is a major component of an ESIA. Field data collection and stakeholder engagement on biodiversity and ecosystem services will probably be necessary, informed by the risk screening results.
- Before and during ESIA, continuous communication between ecologists/environmental professionals and planning, engineering and construction teams can facilitate decision making and implementation. Engineering and procurement contractors may also need to be involved in this decision making process, and this can be included as a requirement in their contracts.
- *Avoidance* through project design is applicable during detailed project design such as micrositing of infrastructure and roads, using ground disturbance permits or other methods.
- Overlaying project site BES maps with infrastructure and activities (e.g. road use), preferably in GIS, will help to facilitate workshops to discuss impacts and options. See Example 7 on page 29.

## *Avoidance* through scheduling

*Avoidance* through scheduling is achieved through changes in the timing of project activities. Impacts may be *avoided* by understanding and taking into account seasonal and diurnal patterns of species behaviour (e.g. breeding, migration, roosting) and ecosystem functioning (e.g. river flow, tree fruiting patterns, vegetation growth cycle/pattern) as well as the use of natural resources by local communities (e.g. fishing and hunting seasons and locations).

**Box 3 Examples of how to undertake *avoidance* through scheduling**

- Restricting exploration, construction or operational activities to outside bird or marine mammal breeding or migration seasons.
- Moratoria on road or rail transport at night, to facilitate freedom of movement for wildlife.
- Seasonal timetabling of activities for minimal impacts.
- Leaving short 'windows' of disturbance-free time (on a seasonal or daily basis) to *avoid* the most sensitive periods for BES (e.g. when mass fruiting of a tree species attracts primates, or when a medicinal plant flowers and is collected by local people).
- Sequencing of events: constructing a project or extracting resources across a landscape in a manner that permits species migrations in advance of the project activity moving to their habitat, preserving corridors at all times, and/or supporting *restoration* objectives by leaving undisturbed areas adjacent to those undergoing *restoration*.

### *What does it involve?*

*Avoidance* through scheduling involves changes in the timing of construction and operational activities.

### *When is it done?*

Temporal *avoidance* is implemented after *avoidance* through site selection, and concurrent with *avoidance* through project design. It continues into the operational life of the project, in decision making on all activities.

### *How can it be undertaken?*

*Avoidance* through scheduling calls for a good ecological understanding of the seasonal or diurnal (day/night) patterns of species behaviour and ecosystem functioning in and around the project area. This feeds into a close collaboration between project planners, engineers and ecologists/environmental professionals, and results in the management of activities around periods when potential impacts on BES are lowest.

# Examples of avoidance in practice[29]

## AVOIDANCE — EXAMPLE 1

### *Avoiding* high biodiversity values in liquid natural gas (LNG) site selection, Tanzania

BG Group and Statoil completed a rigorous site selection process marrying technical, environmental and social disciplines to identify a preferred option for the installation of an LNG facility from a shortlist of several sites on the Tanzanian coastline. Information on the occurrence and distribution of biodiversity was used to inform the selection process, ensuring that *avoidance* of high biodiversity values was a key consideration in the final choice of site.

## AVOIDANCE — EXAMPLE 2

### Identifying and preserving high-quality habitat during oil and natural gas development in Colorado

In Colorado, BP worked with a team from the Nature Conservancy to evaluate the potential impacts of an oil and natural gas development on the San Juan basin landscape. The area contains valuable natural habitats for mule deer, elk, bald and golden eagles and other species, some protected under federal law and others important economically as game species.

The analysis, including computer modelling, identified areas where BP should *minimize* or *avoid* future development and where wildlife and habitat impact mitigation efforts were likely to bring the most benefits. For example, the modelling effort determined that the maintenance of existing sage brush communities would have a positive impact on deer and elk herds during the winter. The sage brush habitat provides critical forage during winter months when snow depths can limit foraging opportunities.

With this information, BP and the state regulators developed the San Juan Wildlife Mitigation Plan. This Plan aims both to preserve existing high-quality habitat and to *offset* any loss of habitat by taking steps to *restore* or enhance habitat conditions nearby.

*The San Juan Basin contains valuable habitat for Mule Deer and Elk, among other species*

## AVOIDANCE — EXAMPLE 3

### *Avoiding* disruption to caribou migration in Canada

AREVA's Kiggavik uranium mine project in Nunavut, Canada, is being designed to *avoid* impacts on migratory caribou. The mine site was selected to *avoid* known caribou water crossings where traditional knowledge indicated that caribou may be more sensitive to changes in direction while migrating. *Avoidance* through scheduling will also be implemented. Only a winter road, operating in seasons of low sensitivity for caribou, will be used to supply the mine, while road activity will be halted or managed (e.g. by grouping of trucks to reduce frequency of potential disturbance) during caribou movements or migration. Road design and construction (material and embankment height) will incorporate wildlife-friendly features to facilitate caribou movement across the landscape.

*Caribou migration in Nunavut, Canada*

[29] Place names and other details have been removed for some examples

**AVOIDANCE — EXAMPLE 4**

### Gas pipeline design changed to *avoid* mammal migration route in Central Asia

A project in central Asia required a gas pipeline to pass through a biological corridor used as a migratory route by an endangered mammal species. The linear infrastructure risked blocking the autumn migration. Two *avoidance* options existed:

- rerouting the pipeline to pass outside of the known migratory route (*avoidance* through site selection); and
- burying the pipeline to remove a barrier to movement during operation (*avoidance* through project design).

The rerouting option was chosen because it ensured the least amount of disturbance and was of lower cost than a burying option. This option was only possible due to the early planning stage at which BES issues were considered. After *avoidance* had been undertaken, options to *minimize* impacts (see Section 2) were to construct overpasses and/or underpasses at regular intervals, which allow the mammals to cross, and hence *minimize* the barrier effect.

**AVOIDANCE — EXAMPLE 5**

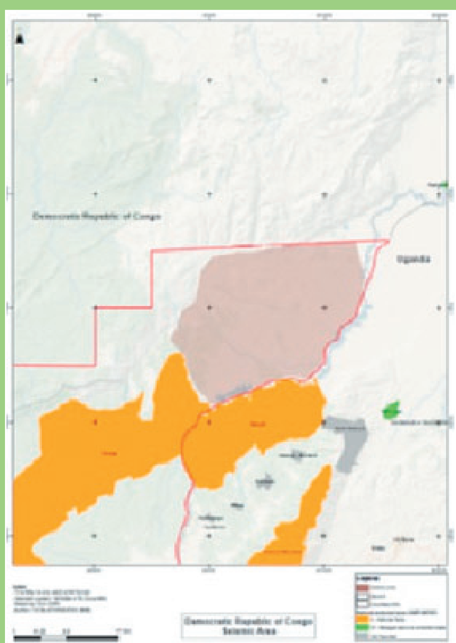
### Micro-routing mine access roads in Chile to *avoid* sensitive habitats

On the Chilean side of Barrick Gold's Pascua-Lama project, the main access road was rerouted to *avoid*, as far as possible, wetlands (vegas) and the nesting sites of an endemic and regionally-protected sub-species of burrowing parrot (*Cyanoliseus patagonus bloxami*). The transmission line, as well as temporary buildings set up to support the construction of the road, were also relocated based on the proximity to these sensitive habitats.

**AVOIDANCE — EXAMPLE 6**

### *Avoiding* impacts at a World Heritage site in the Democratic Republic of Congo

The Virunga National Park in Democratic Republic of Congo (DRC) is listed as a UNESCO natural World Heritage (WH) site due to its universally recognized biodiversity value. The park is situated within Total E&P's Block III Albertine Graben Project and makes up around 30% of the Block. Early in the project inception phase Total's internal biodiversity risk assessment identified the UNESCO WH site and also recognized its legal status as a Protected Area under DRC environmental law. Total will *avoid* any impacts on the WH site by ensuring that no exploration or work is carried out in the Virunga National Park area's 2012 boundaries. This commitment was reiterated during Total's Shareholders' Meeting in May 2013. Total has further undertaken to refrain from prospecting or exploiting oil and gas in any natural sites inscribed on the World Heritage List as at 4 June 2013.

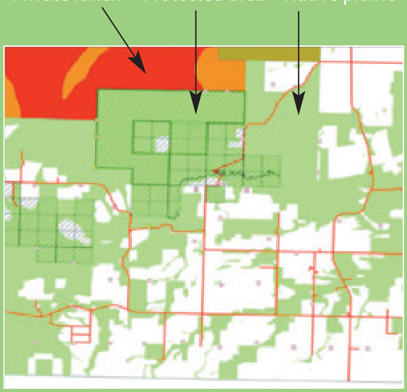


*Seismic acquisition in Total E&P's Block III Albertine Graben Project will be restricted to the north-east sector of the block, outside the Virunga National Park (a UNESCO World Heritage natural site)*

## AVOIDANCE — EXAMPLE 7

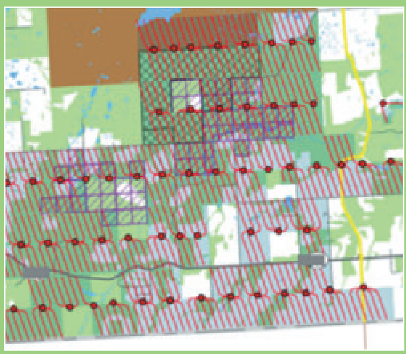
### Infrastructure design for unconventional oil and gas *avoids* biodiversity impacts in North American grassland

In this case significant impacts on biodiversity were *avoided* through the project infrastructure design process. The aim of the design study was to maximize resource extraction while *minimizing* impacts on environmental and social values. In this unconventional gas field, it was clear that the greatest and most cost-efficient biodiversity gains available in the mitigation hierarchy were in *avoidance* through project design. A study was undertaken to assess how much of the resource could be extracted while *minimizing* well pad placement on high-biodiversity land and through the use of horizontal directional drilling (HDD).



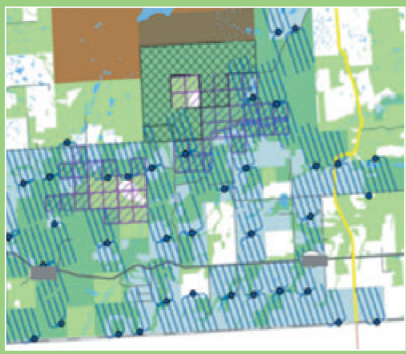

*Biodiversity values and other constraints were mapped across the gas field. These included private land, protected areas, native grassland (recognized as Critical Habitat) and watercourses. This process is a type of spatial biodiversity constraints mapping.*

Well pad placement and HDD visualization: maximal resource access with no constraints



*Well pad placement was first designed to maximize resource extraction, using known HDD engineering options. These infrastructure placements would have resulted in significant and unacceptable impacts on biodiversity, principally rare and threatened plants, birds and grassland ecosystems. Legal and stakeholder drivers influenced decision making.*

Well pad placement using four constraints: native prairie; protected areas; watercourses; and residences



*Ecologists and engineers discussed and mapped options for mitigation. Constraints were agreed upon so that the project aimed to 'maximize resource extraction while minimizing impacts on Critical Habitat' and other features such as residences. This resulted in a design with fewer well pads and longer directional drilling. GIS spatial overlay design allowed every pad to be placed outside of native grassland Critical Habitat. As a result the residual impact caused by well pads was reduced from many hectares down to zero. This design meant that (a) some parts of the concession could not be accessed, leading to a loss of resource exploited and potential revenue, and (b) avoidance of many biodiversity impacts and a reduction in mitigation costs was possible.*

## AVOIDANCE — EXAMPLE 8

### Innovative jetty design and construction *avoids* biodiversity impacts for LNG project

The Papua New Guinea Liquefied Natural Gas Project (PNG LNG) operated by Esso Highlands (a subsidiary of ExxonMobil) recognized that their jetty design originally approved for the PNG LNG plant site and pipeline landfall would have required significant dredging, trenching, backfilling and construction of a causeway. The project sought to *avoid* damage to biodiversity through the innovative design and construction of the jetty. A state-of-the-art cantilever bridge system was used to construct the jetty. The self-propelled pile-driving unit built jetty segments incrementally away from the shore and out to the berth. This type of construction method *minimized* the impact of bridge construction in the mangroves and marine environment. In addition, an alternative pre-existing marine offloading facility was selected, which eliminated the need for any further dredging or causeway construction.

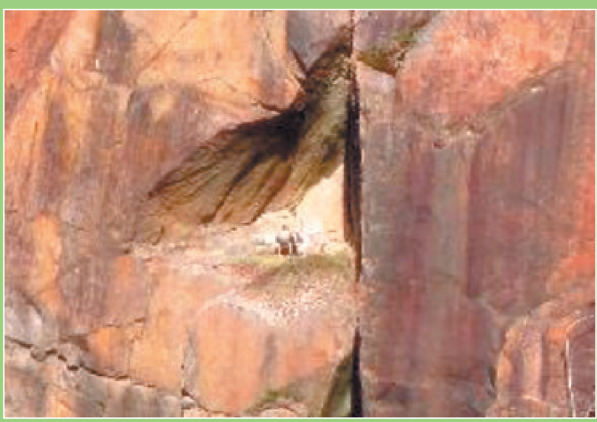

*Plan view of the PNG LNG Project*

These changes led to a 75% reduction of the area to be disturbed, and reduced sedimentation and impacts on marine ecology. They eliminated the need for long-term operational maintenance dredging due to sedimentation accumulation in dredged channels, and the consequent *minimization* and monitoring required for such impacts.

## AVOIDANCE — EXAMPLE 9

### Scheduling to *avoid* impacts at a closed mine in France

At a closed mine in Bellezane, France, AREVA plans to build a storage facility for radioactively contaminated sediments in the rehabilitated (partially backfilled and revegetated) open pit. Construction will be halted from January to June to *avoid* the reproductive period of a sensitive species, the peregrine falcon. Similarly, stripping of soil and clearing of vegetation will be carried out only in winter, so as not to interfere with the nesting season of species such as the woodlark.



*The peregrine falcon, a sensitive nesting species at the Bellezane mine in France*

*Soil stripping and vegetation clearance being undertaken in winter, outside the bird nesting season*

## AVOIDANCE — EXAMPLE 10

### Research investments inform early *avoidance* of impacts on fauna in Peru

*Avoidance* and *minimization* are key components of Repsol Peru's biodiversity management programme. During 3D seismic surveys, the project developed a method for studying impacts on biologically sensitive areas (BSAs). BSAs are areas where animals mate, nest, eat, drink, bathe, move or use specific clay licks. If a BSA was found, the planned seismic survey location had to *avoid* it. For measuring effectiveness, the ocelot (*Leopardus pardalis*) was chosen as a key species indicator. This approach also led to improved knowledge of the area for future projects, local awareness of the project and better relationships with external stakeholders and regulatory agencies.

## AVOIDANCE — EXAMPLE 11

### Risk screening informs pipeline redesign in Azerbaijan

Following environmental and social screenings as part of the South Caucasus Pipeline Expansion project in Azerbaijan and Georgia, BP redesigned the pipeline configuration to *avoid* affecting a cultural heritage site. The planned route for the pipeline and a facility site included part of the Gobustan Cultural Reserve, a UNESCO World Heritage site. The screening process identified several heritage sites including potential burial mounds, traces of medieval road and a potential medieval settlement. BP established a buffer zone around the sites and *avoided* these areas.

## AVOIDANCE — EXAMPLE 12

### *Avoiding* impacts on provisioning services through adaptive mine-path planning in Madagascar

QIT Madagascar Minerals (QMM) altered the timing of the dredging path for its ilmenite mine in response to information about the location of provisioning services for two local communities obtained from mahampy (a reed) and ravenala (a palm). The QMM Environment and Communities teams work closely together, and because of this they recognized the importance of these resources for the local communities. Changing the mine path was critical to the company's local social licence to operate. As a result, any hectares of mahampy and ravenala have been clear of the mine path for several years, allowing time for alternative resources to be located and negotiations to take place.

*The timing of the mine-path taken by the floating dredge was altered to reduce impacts on local ecosystem services: forest products used by local communities.*

**AVOIDANCE — EXAMPLE 13**

***Avoiding* coral reef encroachment during LNG development, Yemen**

Total's LNG project site in Yemen is located among the marine habitats of Balhaf, which include sensitive areas of coral reef with high biodiversity. As a first step, Total undertook intensive coral sensitivity mapping and monitoring. The marine construction work, as initially planned, would have encroached on several areas of coral reef. A complete redesign of some parts of the plant was therefore undertaken during the initial site preparation phase. For example, the route for the outfall pipeline was relocated and finally laid on a sandy bottom sufficiently far away from the reefs to *avoid* impact, while the footprint of the shoreline protection wall was reduced. The result was that almost no corals were encroached upon.

**AVOIDANCE — EXAMPLE 14**

**Pipeline rerouting to *avoid* impacts on an endemic lichen in Namibia**

The lichen *Teloschistes capensis* is only found in Namibia and South Africa. It thrives near AREVA's Trekkopje uranium mine in Namibia because of the coastal fogs characteristic of the region. In this fragile ecosystem, lichens play an important role, as support to other vegetation and food for animals. Initial plans were to pipe seawater purified by reverse osmosis across a field of lichen. Once the importance of the lichen field was recognized, a 10 km detour in the pipeline was designed to *avoid* it. Steps were also taken to protect the lichen field from the impacts of people and vehicles.

# The practice of *avoidance*

Extensive experience exists regarding the implementation of *avoidance* measures for extractive industry sector projects. Requirements and opportunities are changing with the appearance of new policies and regulations, better biological data and innovative technologies.

## Start early, but don't stop: *avoidance* through the project lifespan

Considering *avoidance* at the very start of project planning, before site selection and project design has started, increases the opportunities to maximize ecological and economic effectiveness. Early *avoidance* options can be assessed a long time before ESIA, during a country or landscape screening process.

Once major project decisions have been made, *avoidance* options inevitably become fewer. Nevertheless, as the CSBI Timeline Tool[30] demonstrates, the mitigation hierarchy is relevant across the entire project lifespan (see Figure 4 on page 15). *Avoidance* is an important component of adaptive management throughout operations, and even during closure.

## Think big: understanding the project site within the wider landscape

Many institutions (financial institutions, NGOs and governments) support a landscape approach with regard to managing land use and BES-related challenges. An initial landscape-scale study is initially essential to inform all three types of *avoidance*. This should begin to answer the questions, 'How is biodiversity distributed in the landscape?' and 'What impacts on biodiversity and ecosystem services might the chosen project site have?'

*Avoidance* through site selection is almost impossible without landscape level maps and information: the objective is to select a project site to *avoid* the most sensitive areas in terms of biodiversity and the ecosystem services it provides.

For *avoidance* through project design and *avoidance* through scheduling, a study area larger than the project site can be useful. This is because:

[30] www.csbi.org.uk/workstreams/timeline-tool

- impacts are better understood when considered in relation to the surrounding area (the project site will be part of a larger suite of habitats, with ecological interconnections);
- the spatial scope of impacts (direct or indirect) may extend beyond the study area; and
- it is more cost-effective to make initial baseline surveys[31] over a wider area than to return to undertake a whole new set of surveys outside the project site later on—as may be needed if a landscape-scale approach is not taken at the start.

The relative significance of impacts at the site should be assessed in the context of the landscape:

- What values and sensitivities exist at the site and in its surrounds?
- How is the site ecologically linked to the landscape—for example, upstream or downstream effects, habitat fragmentation and connectivity, linear features (rivers and riparian vegetation, reefs, hills)?
- How do any migratory species use and move across the landscape?
- What is the wider range and distribution of specific BES values at the project site?

Considering these questions can help a project to better understand the significance of losses and gains at the project site.

The ecological function of habitats impacted must be considered, not just their area. For example, 100 ha of forest or seagrass impacted at the site may have greater significance if it forms part of a narrow corridor for the migration of black bears, or constitutes periodic foraging grounds for manatees, from a much larger area. Likewise, if a project site is in a wetland area, downstream effects outside of the project boundary may be the most important to assess. The key issue is how impacts on the site may have wider impacts on BES outside it.

## Synthesize, map, discuss: assessing BES values and sensitivities

The next step is to assess the types, amounts, distribution (in space and time), ecological and social significance, and sensitivity to disturbance of the BES values within the study area (see Example 7 on page 29).

### *Desktop screening*

In many cases, a great deal of useful information can be acquired from existing datasets, via a desktop screening process. This is a task for specialists with the skills to assess ecological and social risks related to BES. Appropriate use of datasets such as those found in the Integrated Biodiversity Assessment Tool (IBAT), the IUCN Red List, and other national or regional sources helps identify BES-related risks, reduce environmental, social and health impact assessment (ESHIA) costs, and better define ESHIA Terms of Reference (ToRs). Desktop screening can also help to inform an 'NNL Feasibility Assessment', i.e. a first assessment of whether significant residual impacts could potentially be *offset*. Such NNL Feasibility Assessments have been used by some financial institutions as part of project finance documentation[32] (see Box 4).

**Box 4 Using 'no-net-loss' (NNL) forecasting to optimize investment in *avoidance* and calculate *offset* liability**

The Oyu Tolgoi Copper Mining Project[32], Mongolia, used NNL forecasting to inform the design of *avoidance* and *minimization* measures. Initially, the size of the impacts remaining after these preventive measures were so great that *restoration* and *offsets* were not technically and financially feasible. Therefore, using the feedback optimization illustrated in Figure 5 on page 17, new *avoidance* and *minimization* measures were designed to reduce the residual impacts.

The NNL feasibility assessment determines the approximate magnitude of the project footprint, and therefore provides an estimate of the likely residual impacts. It is usually possible to undertake an NNL feasibility assessment for a project to determine the options for reaching NNL. Both desktop and field data are usually necessary, but it can be completed in approximate terms using desktop data (e.g. prior to financing or early concession decisions). Such assessments therefore 'set the scope' for the whole mitigation hierarchy, and in particular the requirements for *avoidance* and *minimization*.

31 See CSBI (2015) for guidance on baseline surveys. www.csbi.org.uk/workstreams/biodiversity-data-collection

32 For an example see the Net Positive Impact Forecast for the Oyu Tolgoi Project http://ot.mn/sites/default/files/documents/ESIA_BA5_Net_Positive_Impact_Forecast_for_the_Oyu_Tolgoi_Project.pdf

***Early engagement with stakeholders***

Early engagement of appropriate external stakeholders (e.g. at the pre-feasibility planning stage) to understand their perspectives on BES values, sensitivities and risks (e.g. which values stakeholders are particularly concerned about) is crucial. Stakeholder views may be divergent. Seeking these views and taking them into account is important, and will be beneficial.

***Early acquisition of field data***

Desktop screening will usually identify knowledge gaps. The importance of these gap can be assessed using information from stakeholder engagement and through consultation with available expertise (including local knowledge-holders). This will help to guide a cost-effective and targeted programme of data acquisition, if needed. Focused studies to establish primary data sets on BES values are best undertaken in collaboration with community members or researchers specializing in those components of BES. Consider remote sensing for landscape-scale screening to identify gaps in knowledge. Use field surveys, based on good habitat maps, to reveal data on priority species groups identified during risks screening. Reduce costs by eliminating surveys on groups very unlikely to represent risks.

Where location-specific data are poor, specialists may still be able to reconstruct baselines and interpolate existing data for the study site. Conservation planning software can prioritize *avoidance* actions, given due consideration to uncertainties. Using remotely-sensed datasets[33] combined with existing knowledge, the distribution of BES values can be predicted based on bio-physical parameters. Although there will be errors of 'commission' and 'omission' until fieldwork is carried out, desktop work is useful and almost always has a role to play. Using desktop studies to the full is likely to reduce ESHIA costs in the longer term.

***Making spatial BES maps available to decision makers***

It is useful to synthesize data from desktop and field studies and to convert them into formats that are understandable and attractive to project planners and engineers. Spatial (preferably GIS) maps of BES values and sensitivities—sometimes called 'constraints maps' (see Example 7 on page 29)—can be converted into simpler spatial maps that can be understood by project decision makers and management, and utilized alongside other maps used for project planning, e.g. with respect to hydrology, geology, socio-economics and infrastructure. Ideally, there should be a single integrated GIS platform for the whole project.

# Constraints and challenges

## Cost considerations: is expensive *avoidance* worth it?

*Avoidance* costs can be significant, but (where *avoidance* is feasible) are often lower than the costs of long-term *minimization*, *restoration* or *offsets*.

Typically, many *avoidance* options will be fairly straightforward to identify, justify and incorporate within the decision-making process. Direct costs associated with *avoidance* are generally incurred up-front, and are normally a single event. As such, they are typically integrated into project development costs rather than being shown as a dedicated BES budgetary line item. However, *avoidance* costs may sometimes include large opportunity costs (e.g. foregoing mineral extraction to *avoid* impacts), hidden costs (e.g. additional infrastructure costs from choosing alternative project layouts, etc.) and net present value costs (e.g. through necessitating changes in project scheduling).

Where potential *avoidance* options involve significant costs, it may be hard to judge trade-offs between *avoiding* BES impacts and incurring significant costs. Under such circumstances it is advisable to carry out some form of cost-effectiveness analysis (CEA[34]) or cost-benefit analysis (CBA[35]). These approaches can help to determine whether the costs are justifiable or not, or whether another step in the mitigation hierarchy may deliver a more cost-effective and acceptable solution.

[33] GlobCover (www.esa-landcover-cci.org/?q=node/158), LandSat (http://landsat.usgs.gov/Landsat_Search_and_Download.php), Quickbird (http://glcf.umd.edu/data/quickbird), etc.

[34] For guidance on cost-effectiveness analysis, see: http://betterevaluation.org/evaluation-options/CostEffectivenessAnalysis; and WHO (2003): www.who.int/choice/publications/p_2003_generalised_cea.pdf

[35] For an example of a cost-benefit analysis toolkit, see Manchester Metropolitan University (2015): http://www2.mmu.ac.uk/bit/project-management-toolkits; and European Commission (2014): http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

Where biodiversity features are particularly vulnerable and/or irreplaceable, outright *avoidance* may be the only feasible option, if the risks involved in relying on other mitigation components are too high. In practice, this means that a planned project would not go ahead, or would proceed only where potential impacts could be *avoided*.

## An emerging challenge: *avoidance* of indirect and cumulative impacts

The creation of a new extractive industry site, perhaps in a remote area or in an area with low population density, can result in an influx of workers and other settlers[36]. An increased population and new or expanded settlements may put increased pressure on local natural resources and BES values. Several developments may be planned in the same area, creating cumulative impacts. One possible approach to managing such indirect and cumulative impacts would be for industry, along with others such as a government agency lead, to work together in selecting appropriate *avoidance* measures. A Strategic Environmental Assessment[37] at the appropriate scale can provide a framework for this.

## Keeping track: monitoring and evaluation for *avoidance* actions

Like other mitigation activities, *avoidance* needs monitoring. An effective monitoring framework covers both actions and outputs/outcomes. Questions include:

- Are actions being implemented by contractors or staff?
- What outcomes are resulting? For example, is a night-driving ban being enforced, and if so, what impact is this having on the number of mammals killed on roads?

Structuring by pressure, state and response indicators[38] may often be helpful. Regular monitoring is best but need not always be frequent. The ideal is to aim for the least burdensome system that is consistent with producing robust and meaningful results, which can inform adaptive management if necessary.

A problem with monitoring *avoidance* is that activities subsequent to the decision to *avoid* may be outside the company's control. For example, another company may choose to site its project in a location that had initially been *avoided*. Working closely with stakeholders, including government, from an early stage, and having a transparent process for generating and sharing information and decisions, can help to avoid this.

**Box 5 Managing indirect impacts by linking together social and environmental management plans**

A mining company in East Africa has successfully managed the potential negative indirect impacts on biodiversity caused by the immigration of prospective workers and families. Risks included increased illegal hunting of endangered mammals and reduced access (for local residents) to ecosystem services such as forest plantations crops and timber. There was a risk that this would lead to significant issues with the resident community concerning the company's social licence to operate, as well as cause significant biodiversity impacts. Joint workshops and good working relations between the social and environmental teams from the beginning facilitated an understanding of the likely scale of immigration, the potential risks this posed and the possible mitigation measures available. There was senior level support for these mitigation measures because the risks were multiple: health, safety, social licence to operate, biodiversity and natural resource management. Fortunately, single mitigation measures could meet multiple social and environmental risks. The project found solutions with the government and its financial partner. These included limiting immigration and managing the locations for settlement growth. This, in turn, reduced impacts on natural resources and biodiversity around the project site.

[36] IFC (2009): the IFC has produced extensive guidance on this topic in their *Handbook for addressing project-induced in-migration*. www.ifc.org/hb-inmigration

[37] See Box 6 (page 36), the *Definitions* section (page 82) and www.sea-info.net

[38] OECD Framework for Environmental Indicators: www.ibama.gov.br/category/59?download=2919

**Box 6 Cumulative impacts and Strategic Environmental Assessment**

When other development projects already exist, are planned or can be anticipated to take place in a landscape or seascape (an 'eco-scape'), cumulative impacts should be considered. The impacts of individual projects on BES features of concern may be assessed as being of minor significance, but could add up and/or interact so as to be highly material. For example, the fragmentation effect of building one new road to a mine, or one new pipeline to an oil and gas field, might not be considered significant; but the combined impact of ten new roads (or pipelines) crossing the landscape would be.

Cumulative impact assessment considers 'the incremental changes caused by other past, present or reasonably foreseeable actions together with the project' (European Commission, 1999). As with other impact assessments, it is applied for specific BES features of concern because of their sensitivity or importance for stakeholders. Essentially, cumulative impact assessment reframes the materiality of potential project impacts. When project impacts make a significant contribution to cumulative impacts, and cumulative impacts are material, project impacts should be regarded as material too, and appropriate mitigation measures (starting with *avoidance*) should be applied.

The IFC (2012c) provides detailed guidance on assessing and mitigating cumulative impacts. When an initial cumulative impact assessment shows significant potential impacts, it will often be in the developer's best interest to encourage (working with other project proponents where relevant) a government-led process that can develop a more strategic, large-scale approach to cumulative impact management. This will guard against a project's mitigation measures being undermined by other developments in future (e.g. new projects being sited in areas that had previously been *avoided*). It therefore also serves to reduce business risks owing to perceived impacts, or impacts on ecosystem services on which the project depends.

Cumulative impacts would ideally be addressed via a Strategic Environmental Assessment (SEA—see the *Definitions* section on page 79) that considers and balances economic, social and environmental priorities and forms the basis for an integrated land- or sea-use plan at a large spatial scale (an eco-scape, a region or an entire country). SEAs can be challenging to undertake, but are increasingly seen as important by governments, development agencies and development banks.

## Creative thinking: innovative ideas for *avoidance*

Improved ecological information and new technology can combine to give rise to innovative ideas for *avoidance*. These are very specific to the sector, biome and BES value. Bringing together those who know the area and its biodiversity, and those who know the project and its infrastructure—including the engineers and ecologists working on-site—may spark innovative ideas for dealing with specific issues. New and untested mitigation approaches could have potential unintended consequences; consideration should be given to assessing and monitoring such consequences.

Some examples of recent innovative approaches are given below:

- Use of high-frequency noise, outside the range of human hearing, to keep animals away from infrastructure).
- Use of green lights on offshore oil/gas production platforms, to *avoid* impacts on nocturnally migrating birds[39];
- Zoning and control of access to concessions, to reduce direct and indirect impacts pre-emptively; if indirect impacts are predicted to be widespread, this can constitute an effective *avoidance* option (e.g. Pic de Fon Management Plan[40]); and
- Use of security controls on roads and on permit area boundaries to reduce the harvest and disturbance of natural resources; the most effective *avoidance* of a variety of impacts on oil and gas and mining concessions has been achieved at sites such as those operated by Shell in Gabon and the ExxonMobil Chad Export Project,[41] where safety restrictions have reduced illegal impacts on forests in and around concessions.

[39] Poot, H. *et al.* (2008). Green light for nocturnally migrating birds. In *Ecology and Society*, Vol. 13, Issue 47.

[40] Rio Tinto, Simandou

[41] Moynihan, K. J. *et al.* (2004). *Chad Export Project: Environmental Protection Measures*. Society of Petroleum Engineers, Publication No. SPE 86683. www.esso.com/Chad-English/PA/Files/SPE_Paper_86683_EnvProtMeasures.pdf

Section 2

# Minimization

## Definitions[42]

The CSBI has defined *minimization* as '*measures taken to reduce the duration, intensity, significance and/or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible*'. Other similar definitions exist[43].

Risk and impact *minimization* is key to industrial environmental mitigation and management. If *avoidance* is not possible, and once the preferred alternatives have been chosen, it is appropriate to consider *minimization*. Measures vary according to the project's BES values, proposed infrastructure and activities. Measures to *minimize* impacts can be applied throughout the project lifespan, from design through construction, operations and end-of-life activities.

*Minimization* and *avoidance* are closely related. Whether a measure is categorized as one or the other may depend on circumstances and scale. For example, rerouting a road to completely *avoid* an amphibian migration route counts as *avoidance* through project design. Controlling the movement of vehicles during migration season, so as to reduce amphibian mortality, would be termed *minimization*.

## Rationale

The rationale for undertaking *minimization* is similar to that for *avoidance*. *Minimization*, however, does not offer the same ecological certainty (that actions will have the intended effect) that *avoidance* does. Some advantages of, and considerations for, *minimization*, are shown in Table 4 on page 38.

42 In some jurisdictions, the term 'minimization' (and the related word 'minimize') is legally defined as 'reduce to zero'. Therefore, some companies have chosen to avoid using the words 'minimize'/'minimization' and instead use words like 'limit'/'limitation' and 'reduce'/'reduction'.

43 For example: Business and Biodiversity Offsets Programme (http://bbop.forest-trends.org/pages/mitigation_hierarchy); Biodiversity A-Z, UNEP-WCMC (www.biodiversitya-z.org/content/minimisation); and *Evaluating Avoidance, Minimization, Stream Restoration Projects and Compensatory Mitigation Plans* (http://www.swg.usace.army.mil/Portals/26/docs/regulatory/Streams/Evaluating Stream Plans June 2013.pdf)

## Key principles

- *Minimization* is a core part of ESIA. Effective engagement with ESIA specialists is fundamental to the design of *minimization* methods.
- Engage relevant specialists and stakeholders to predict impacts that cannot feasibly be *avoided* and to help design *minimization* measures.
- Provide information in a form appropriate for others (e.g. construction engineers) to use.
- Hold workshops to facilitate communication between ecologists/environmental professionals, planners, engineers and finance and permitting managers.
- Encourage innovation; however, be prepared to revert to a conservative approach if costs for unproven *minimization* measures begin to escalate.
- Be realistic about what *minimization* can and cannot achieve, and be cautious about the effectiveness of untested methods; *minimization* measures that look good on paper do not always work in practice.

## Key steps in *minimization*

*Minimization* starts in project conception and can continue until closure, using adaptive management (Box 7).

- Predict risks and impacts remaining after *avoidance*. What significant impacts on priority BES features are unavoidable, or are there potential impacts for which *avoidance* would not be technically feasible and/or cost-effective?
- Design *minimization* methods to reduce impacts. Write the ToRs for ESIA consultants or other specialists, which are specific to the priority BES or infrastructure risk in question, e.g. 'Design wildlife corridors for the road for species x, y and z.'
- Explore additional *minimization* opportunities throughout the project lifespan. Use adaptive management to assess opportunities during construction and throughout operations (e.g. lay down areas and timing of each activity).

**Table 4** *Advantages of, and considerations for, minimization*

| Advantages | Considerations |
|---|---|
| • *Minimization* efforts may seem more visible and 'real' than *avoidance* measures to some stakeholders.<br>• Planning and implementation of *minimization* measures can occur adaptively throughout the project lifespan in response to performance monitoring.<br>• An adaptive approach allows adoption of new technologies or practices that become available over the project lifetime and allow BES risks to be handled more effectively.<br>• Impacts can be *minimized* by addressing both the source magnitude and the exposure or BES sensitivity to the impact (such as habituation to noise). | • *Minimization*, by definition, usually results in only the partial mitigation of impacts—i.e. some impacts will be incurred, however they will be less severe than if no mitigation had been implemented.<br>• It can be challenging to assess and monitor the success of *minimization* measures in some cases, especially if the technique is unproven and/or baselines are unreliable.<br>• *Minimization* is often less certain in its effectiveness than *avoidance*.<br>• The active interventions involved in *minimization* could have unexpected or unintended consequences (e.g. road crossings could become traps by concentrating animals where they are easily hunted or depredated).<br>• Some *minimization* approaches could generate open-ended costs.<br>• Practicalities (e.g. the time needed to develop the information base, methods and/or local capacity) could cause delays in *minimization* measures and a time-lag in reducing impacts. |

**Box 7 Adaptive management and continuous improvement happens through the repeat assessment of *minimization* options throughout the project lifespan**

Continuous improvement is a well-accepted corporate concept, particularly in health and safety management. It can also be effectively applied to BES-related impact mitigation. A commitment to continuous improvement for managing BES-related impacts/challenges manages both risk and reputation. Some *minimization* options will become obvious only after construction is complete or operations are under way. The stakeholder and scientific consensus concerning the project may change over time, requiring continuous adaptation and improvement based on new conditions, data, priorities, regulatory requirements and perceptions. For example, the *minimization* targets and monitoring efforts of QIT Madagascar Minerals have changed over the years as new data have been acquired on the global distribution of the rare or threatened species identified in baseline surveys. With the discovery of new sites for some species, and their decreasing global threat status, fewer and fewer remain on the company register as priorities for *minimization*. Duty of care and corporate responsibility to stewardship remain, nevertheless (Rabenantoandro *in litt*., 2012).

# Types of *minimization*

*Minimization* actions can be conveniently divided into three major categories (see Table 5 on pages 40–41 for examples):

- **Physical controls:** adapting the physical design of project infrastructure to reduce potential impacts, such as installing culverts on roads, or bird flight diverters on transmission lines.
- **Operational controls:** managing and regulating the actions of people associated with the project—including staff, contractors or (where feasible) project affected people and migrants. Operational controls can manage both direct impacts (e.g. soil spill *minimization* from drill pad construction) and indirect impacts (e.g. measures to reduce illegal hunting).
- **Abatement controls:** taking steps to reduce levels of pollutants (e.g. emissions of dust, light, noise, gases or liquids) that could have negative impacts on BES. Engineering for *minimization* may distinguish between designs that abate at source (e.g. reduce the amount of noise created) and abate at receptor (e.g. put barriers in place to reduce noise transmission).

These categories may at times overlap. Many different examples of *minimization* are available, and new practices emerge every year. While innovation can reap rewards, care must be taken in experimenting with untested methods with unknown costs.

**Box 8 *Minimizing* habitat fragmentation and degradation**

Habitat fragmentation is the process by which a single contiguous habitat block, such as a 100-ha forest, becomes dissected into several small blocks (e.g. 30 ha each). Gaps between habitat blocks can be barriers to species movement or other necessary ecological connectivity. Habitat degradation is the process by which the quality or condition of the habitat becomes compromised, e.g. by reef damage from boats, or progressive low-intensity burning and cutting within a forest. Poor condition habitat may not support high-value species nor provide ecosystem services.

Negative impacts can be *minimized* through careful spatial design of project infrastructure, and by taking steps to ensure that linear infrastructure (such as roads, railways or pipelines) does not create barriers (e.g. by building wildlife bridges or corridors, or controlling and limiting vehicle movements). Linear infrastructure may also provide an enhanced pathway for the movement of predators, poachers and/or invasive species. Measures, such as checkpoints and movement controls, can be put in place to *avoid* this. Translocation of protected species could be considered if the action is expected to yield a measurable conservation benefit and all risks have been weighed[44]. Translocation attempts may cause new impacts, and do more harm than good if not carefully assessed and planned. Research may be needed to design effective *minimization* for some BES values and types of impacts.

[44] The reason translocation often fails is because the new site/ecosystem usually 'has its niches full', meaning that there is no food, shelter or space for the translocated animals. The IUCN guidelines on translocating threatened species are a useful resource: https://portals.iucn.org/library/sites/library/files/documents/2013-009.pdf

**Table 5** *Examples of physical, operational and abatement controls for minimization*

| Physical controls | Operational controls | Abatement controls |
|---|---|---|
| • Design vegetation clearance for exploration activities such as seismic surveys to *minimize* direct losses, *minimize* fragmentation of habitat, and maximize potential for regrowth along lines. | • Manage access to project sites and sensitive sites, and control immigration and induced access to natural resources. | • Design and install drainage and water treatment systems for control of pollutant discharges (such as total suspended solids or oil and grease). |
| • Protect watercourses from sources of contamination and siltation. | • Manage the pattern and timing of vegetation clearance (e.g. to reduce fragmentation, and promote regeneration). | • Implement appropriate pollution abatement treatments (for example, abatement of nitrogen oxide emissions from power generation facilities to *minimize* impacts on ecosystem and vegetation growth) |
| • Shade light sources and/or direct them onto site areas. | • Prohibit the burning of vegetative waste following forest clearance to *avoid* air emissions and reduce the risk of forest fires. | • Take measures to reduce the quantity/rate of introductions of invasive alien species onto project sites |
| • Use fencing to limit incidental damage to existing biodiversity: for instance, to wetlands adjacent to construction areas, trees adjacent to road alignments, or mobile wildlife. Fencing must be used carefully so as not to introduce new impacts by restricting animal movements. | • Manage indirect impacts such as migration, induced access and increased purchasing power of local inhabitants, which can lead to agricultural expansion and increased take of wildlife. | • Implement solid waste management practices, such as properly managed rubbish sites, to reduce the spread of feral predators such as foxes, cats and dogs. |
| • Substitute low-impact technologies or practices for higher-impact ones, e.g. limited vegetative/soil removal for clearing to promote recovery and inhibit the spread of non-native/invasive species. | • Establish institutional controls on, and provide alternatives to, unsustainable natural resource use (e.g. fuelwood, bushmeat, and fishing). | • Use designs or technologies that reduce or limit pollution, e.g. low-intensity lighting, noise silencers, dust-control devices. |
| • *Minimize* unnecessary noise sources and use, and maintain appropriate noise attenuation devices on engines and other pieces of equipment. | • Implement procedures to safeguard or retain plant species and materials (seeds, rootstock and medicines) used by local communities, during implementation of vegetation clearance programmes. | • Basic smoke and dust abatement can be significant in reducing impacts on rare, threatened and endangered species such as lizards (their eggs) and plants (smothering). |
| • Provide base material compatible with local ground conditions; bitumen should be laid on a geotextile membrane. Avoid the widespread use of concrete at sites—use only at those areas that absolutely require it. | • Implement operational controls on contractors to *minimize* disturbance around drill pads and at the edge of pits (in case of mining). | |

*continued …*

Table 5 (continued) *Examples of physical, operational and abatement controls for minimization*

| Physical controls | Operational controls | Abatement controls |
| --- | --- | --- |
| • Stabilize disturbed slopes, revegetating them preferentially with native species to reduce/*avoid* erosion. | • During operations, implement procedures that *minimize* impacts at the reinstated locations and therefore do not disrupt natural revegetation by indigenous flora and re-colonization by local fauna. | |
| • Design operations or facilities to reduce the number of access points or opportunities for off-road tracking. | • Keep the workforce within defined boundaries (e.g. camps at night) and to the agreed access routes. | |
| • Employ careful methods of road construction (e.g. to reduce dust and noise) or river crossings (e.g. selection of the most appropriate open-cut method for a river crossing). | • Educate the workforce about environmental performance expectations and requirements, including those related to BES. | |
| • Limiting the footprint of supporting infrastructure components of a project to *minimize* habitat loss (e.g. narrowing the width of an access road). Large-scale versions of this may be regarded as *avoidance* through project design. | • Keep traffic to the minimum requirements for operations. | |
| • Consider species-specific controls, such as wildlife crossings or bird flight diverters. | • Impose and enforce speed limits and instruct vehicle operators regarding driving expectations and requirements. | |
| | • Allow access to site(s) transportation only by authorized employees | |

# Examples of *minimization* in practice

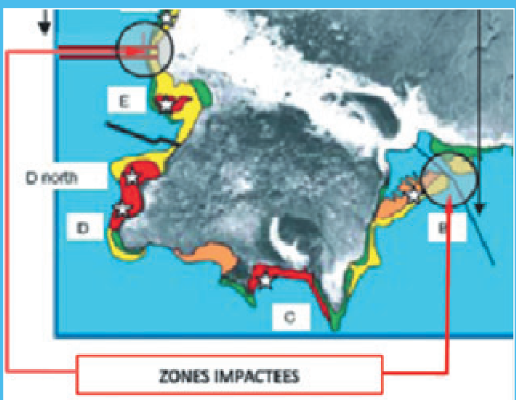
## MINIMIZATION — EXAMPLE 1

### *Minimizing* impacts on coral reefs during LNG development, Yemen

Marine habitats in Balhaf, Yemen, the site of the Yemen LNG Project, include sensitive areas of coral reef with high biodiversity. As a first step, Total undertook intensive coral sensitivity mapping and monitoring. This allowed *avoidance* of many impacts (see *Avoidance* example 2 on page 27). However, there was no alternative to the cooling water intake pipelines and the LNG jetty crossing some areas of coral reef. *Minimization* of these unavoidable impacts included two main measures—coral translocation and in-situ mitigation measures to reduce sedimentation impacts on corals.

For these two areas, a large coral transplantation programme was performed. Priority ‘old growth’ coral stands (of sensitive, slow-growing species) were separated from their base and carefully moved to selected refuge areas with similar ecological conditions. This was the largest-ever such exercise attempted, with costs (excluding project design changes) around US$ 5.3 million over 14 years. A high percentage of the healthy coral colonies were successfully transported from several threatened areas to protected sites. No critical damage due to coral handling was observed. Continued monitoring of the transplanted corals indicates very good success rates, demonstrating the feasibility of coral community transplantation[45].

As a complementary action, silt curtains were deployed between corals and construction works to reduce sediment deposits onto the reef. They consisted of a semi-permeable barrier extending from the surface to the sandy bottom. The geotextile fabric allowed sea water to cross the barrier but retained sediment particles. The efficiency of these devices was demonstrated through monitoring.





*Above left: The Balhaf site showing areas impacted by the LNG jetty and intake cooling water pipelines. Above right: coral translocation in progress. Left: silt curtains deployed during LNG jetty construction.*

[45] Chaîneau *et al.* (2010)

## MINIMIZATION — EXAMPLE 2

### Micro-routing the shore approach for an LNG pipeline in Papua New Guinea

The PNG LNG Esso Highlands (ExxonMobil) Project recognized that the pipeline landfall design originally approved for construction for the PNG LNG plant site would have resulted in significant habitat loss. The landfall of Caution Bay, which is adjacent to the LNG plant site, is lined by a corridor of mangroves. During detailed design, the pipeline was routed through the narrowest section of the mangrove corridor to reduce the need for mangrove clearance. The right of way width within the mangrove was reduced by more than 50%, i.e. from 142 m to 56–83 m. This was possible because of the selected open-cut trench construction method, considered the most technically robust option for this environment, as well as tests of soil stability properties in soft mangrove mud. Prior to mangrove clearance and construction at landfall, trial excavations were conducted in test pits. Excavations showed cohesive soil characteristics, which enabled a reduction in the trench width, spoil heap width and trenching volumes. Mangrove habitat clearance was therefore reduced.

## MINIMIZATION — EXAMPLE 3

### Early planning informs *minimization* measures for offshore Indonesia

**Risk screening**

Three months before BP decided to bid for two deep water oil and gas exploration licences in a remote part of the Arafura Sea off the coast of Indonesia, the upstream environmental and social teams were working with regional colleagues to compile information about the area. BP's environmental and social practices require the company to identify any potential impacts on the local environment or community and build mitigating actions into their plans as they develop.

**Sensitive sites**

The environmental team identified four protected areas within about 180 km of the blocks—one marine environment off Aru Island and three land-based reserves in the Tanimbar Islands group—which were screened out as being too far away to be affected even by potential indirect impacts.

**Sensitive species**

Twenty-seven species of marine mammals were known or believed to use waters around the exploration blocks, including four classed by the IUCN as Threatened or Near Threatened Species.

**Mitigation options**

The team identified the following actions to mitigate the most significant environmental and social impacts and risks:

1. a gradual build-up of power in the airguns used during seismic surveys to reduce disturbance to marine mammals;
2. agreement on an oil spill response plan with the seismic contractor; and
3. selection of specific oil spill mitigation and response measures for operations near Pulau Larat nature reserve, a sensitive site protected by Indonesian Law.

## MINIMIZATION — EXAMPLE 4

### *Minimizing* the impacts of gold mining at two special areas of conservation in Sweden

In principle, every mining project will include actions taken to *minimize* the negative impact on biodiversity through physical and operational controls and through discharge treatment.

One example of a comprehensive strategy to *avoid* impacts on biodiversity can be found at a gold mine in Västerbotten, Northern Sweden. Here the orebody, and therefore the mine itself, is situated within the catchment area of a designated Natura 2000[46] area north of the mine site, a stream with a protected population of freshwater mussels. To *minimize* any impact, all water from the mine site is collected, treated and pumped south over the watershed to another catchment area. Further south is another Natura 2000 area, and to *avoid* impacts at this site the concentration limits in the southern discharge point have been set at very low levels.

[46] Natura 2000 sites are an ecological network of 'special areas of conservation', conserving Europe's most valuable species and habitats. http://ec.europa.eu/environment/nature/natura2000/index_en.htm

# The practice of *minimization*

## Start early, but don't stop: *minimization* through the project lifespan

*Minimization* is best planned early in the lifespan of a project (before or during the ESHIA process), ideally before on-the-ground activities commence. The construction phase tends to be the key phase for *minimization*. However, as well as *avoidance*, *minimization* can often continue during later stages of the project lifespan, where adaptive management may be possible and valuable.

## Understand what's really needed: investing in research to *minimize* more effectively

Carefully designed and thought-through research may often be worth the investment to ensure that efforts are effective, and cost-effective. Research may reveal opportunities for innovative approaches (see *Creative thinking: innovative ideas for innovation*, on page 46). Significant gains are possible through innovation but care must be taken not to invest in too many untested methods.

## Execute the plans: ensuring that *minimization* is carried out effectively

As *minimization* measures are usually undertaken as standard components of environmental management plans, the carefully managed execution and monitoring of these plans is the most important factor in ensuring success.

## Check to see whether it's working: establishing monitoring and an adaptive approach

Well-designed monitoring is crucial in assessing the effectiveness of implemented *minimization* measures. Specific, defined methods and metrics are needed for evaluating success (e.g. regular, consistent mortality inspections on roads and power lines). If results fall short of what is expected, the possible reasons should be reviewed and consideration given to adapting interventions accordingly. Available *minimization* technologies should be reviewed on a regular basis to determine whether new or enhanced opportunities for *minimization* are available and viable.

# Constraints and challenges

### Cost considerations for *minimization* actions

The costs of *minimization* actions can occur throughout a project's lifespan, and may translate into operating costs. Unless *minimization* measures are well-conceived and implemented at the design stage, they may later fail, resulting in unexpected costs for identifying and implementing additional measures during construction and/or operations. Some *minimization* actions cost very little, such as shading light sources, while others can involve large sums of money, such as building fish ladders or wildlife crossings.[47]

### Dealing with data-poor and uncertain situations

In the absence of sufficient data to predict the efficacy of *minimization* measures, an adaptive management approach is good practice. Such an approach involves implementing *minimization* measures based upon best available knowledge, and consequently setting up a monitoring programme to improve knowledge about BES values and sensitivities. For example, a project might monitor the effectiveness of pollution control by monitoring spawning or health measures of marine fish.

If *minimization* measures prove ineffective or insufficient, this improved knowledge is used to adapt or implement more effective ones. Adaptive management is a good opportunity to engage and collaborate with qualified experts. This can build stakeholder support for the approach and contribute to the science of *minimization*.

### Whether and when to move to *restoration* and *offsets*

The end of the *minimization* planning stage is a critical moment in the application of the mitigation hierarchy. This is true for at least three reasons:

1. From this point on, all measures implemented will seek to repair damage done, rather than prevent damage occurring.
2. Once damage has occurred, the potential for repair is not certain. Therefore, *restoration* and *offsets* often (though not always!) present a higher risk than *avoidance* and *minimization*.
3. The costs and effectiveness of *restoration* and *offsets* are often (though not always!) inherently less predictable than the costs of *avoidance* and *minimization*.

When shifting from preventive to remediative measures the following critical questions may be asked:

- What type (severity, magnitude, duration, scale) of potential impacts might remain?
- Can these potential impacts realistically and credibly be managed through *restoration* and/or *offset* measures?

If the answer to the last question is yes, it is feasible to proceed to planning *restoration* and *offsets*. If the answer is no, further design and planning for *avoidance* and *minimization* measures may be needed. This process is illustrated in Figure 5 (page 17), which demonstrates the iterative feedback loop that ensures optimal investment in *avoidance* and *minimization*.

Determining the '*restorability*' of a habitat/ecosystem requires appropriate data and expert consultation. Assessing *restoration* options is covered in Section 3 (pages 47–58).

[47] A number of terms have been used in industry to express the aim to *minimize* impacts as far as feasible, given considerations of cost and the practical constraints of engineering. These include: ALARA (as low as reasonably achievable); ALARP (as low as reasonably practicable); BAT (best achievable technology); BATNEEC (best available techniques not entailing excessive cost); BPEO (best practicable environmental option).

# Creative thinking: innovative ideas for minimization

- Community-based *minimization* actions and job creation: effective community participation regarding the provision of local jobs can be achieved through labour-intensive *minimization* actions. Examples include 'pre-construction salvaging' of plants and animals from sites prior to clearance for mining (e.g. Ambatovy Nickel Project, Madagascar[48]) and collecting seeds/seedlings for use in active revegetation programmes.
- Reduction of impacts on natural resources and biodiversity caused by indirect and third-party impacts such as immigration and induced access.
- Use, enhancement and/or construction of natural ecosystem processes to manage impacts (e.g. water recycling, reed beds, vegetation for erosion control)—often known as 'green infrastructure'.
- Conversion of physical waste streams so that they have beneficial properties for BES (e.g. conversion of a waste water lake into wetland habitat; conversion of spoil heaps into habitat for invertebrates).

[48] www.ambatovy.com/docs

Section 3

# Restoration

## Definitions

In the context of the mitigation hierarchy, *restoration* refers to measures taken to repair degradation or damage to specific biodiversity features and ecosystem services of concern (which might be species, ecosystems/habitats or particular ecosystem services) following project impacts that cannot be completely *avoided* and/or *minimized*.

When repair of damage does not focus on the biodiversity features and functions identified as targets for application of the mitigation hierarchy, it is better termed *rehabilitation* and counts as an additional conservation action (see the *Definitions* section on page 79) that does not contribute to biodiversity loss/gain accounting.

*Restoration* actions begin once impacts have already occurred. However, research and planning early in the project lifespan, and ongoing management throughout, are desirable. *Restoration* to reduce residual impacts will typically involve on-site works, with specific intermediate and long-term goals for the re-establishment of priority aspects of ecosystem structure, function or species composition. Note that this is different to *restoration* activities carried out to implement *offsets* (see Section 4), which will typically take place outside the project's area of operations.

*Restoration* goals in the mitigation hierarchy may relate to the site baseline prior to impacts[49], or to a reference site elsewhere in the impacted ecosystem. Alternatively, the goal may be for an ecosystem with different characteristics from those present before impacts.[50] *Restored* ecosystems will almost always be novel[51] to some extent, because precise reinstatement is impossible.

[49] In some jurisdictions, the legal interpretation of 'restore' means to return a disturbed physical environmental attribute to a condition that is exactly the same as that which existed prior to the disturbance. In many instances, this is technically impossible, and if it is possible, the incremental cost required to attain this benchmark does not necessarily translate into substantial net environmental/ecological benefits. For these reasons, *restoration* in the mitigation hierarchy would rarely have a goal of reinstatement to a precise pre-disturbance state.

[50] This could potentially be a valid approach for *restoration* of some biodiversity features or ecosystem services of concern, but in most cases is likely to be classed as rehabilitation. Government regulators may in some cases constrain opportunities for *restoration*, for example by requiring rehabilitation using non-native plant species.

[51] Hobbs *et al.* (2006). Novel ecosystems: Theoretical and management aspects of the new ecological world order. In *Global Ecology and Biogeography*, Vol. 15, Issue 1, pp. 1–7.

*Restoration* outcomes might include, for example, localized reclamation of a stable substrate, re-establishment of productive lands or fisheries, enhancing habitats for specific conservation values and maintaining natural habitat connectivity. *Restoration* projects are thus varied in spatial extent, management intensity and ecological specificity of goals.

# Rationale

*Restoration* is the most important remediative component of the mitigation hierarchy because it aims to reverse impact damage directly, and arrive at a desired upgraded state. *Restoration* therefore has the potential to reduce the liabilities associated with residual impacts.

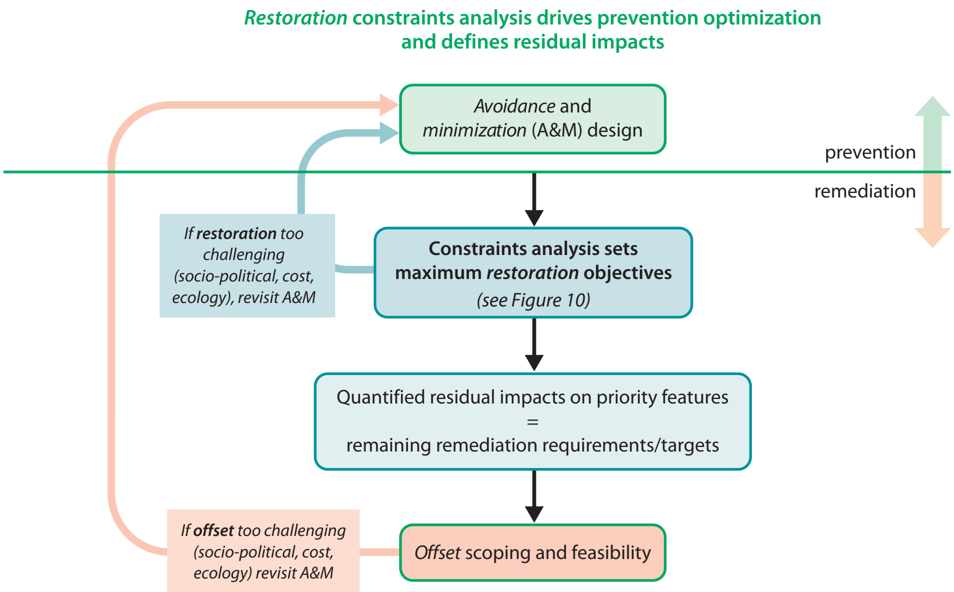
*Restoration* is generally more challenging and uncertain than *avoidance* and *minimization* (where those are feasible). It can also be expensive. Therefore, objectives for *restoration* within the mitigation hierarchy should aim to cover only project-attributable impacts remaining after *avoidance* and *minimization* measures have been iteratively applied (Figure 5) through a *restoration* constraints analysis (Figure 8).

In practice, the extent to which *restoration* can contribute to a project's application of the mitigation hierarchy will vary[52] according to many factors, including the nature and location of a project's impacts, contingent landscape factors, the technical feasibility of and costs associated with implementation measures, stakeholder perspectives and level of input, and, the desired timescales for BES values to be reinstated.

The pace of ecological recovery can be slow. Temporal lags between impacts occurring and *restoration* gains accruing may make it challenging to attain minimum performance targets within project timescales. Temporal lags can contribute to cumulative impacts from ecological effects, for instance if an impacted area of habitat provided an important function in the wider landscape (such as a migratory stop-over site or drought refuge) or highly valued ecosystem services. In these cases, strong emphasis should be put on *avoidance* and *minimization*.

Similarly, where *restoration* is not feasible for priority biodiversity features, further consideration should be given to *avoidance* and *minimization* measures rather than progressing straight to the design of *offsets* (Figure 2, page 12).

**Figure 8** *Schematic showing the iterative application of avoidance and minimization together with a restoration constraints analysis (see* The practice of restoration *on page 54) and offset scoping, to set realistic goals for remediative measures in the mitigation hierarchy*




[52] The Biodiversity Consultancy Industry Briefing Note, *Opportunities for Ecological Restoration in Terrestrial and Marine Environments* (TBC, 2015) reviews the information available on costs, timescale and feasibility for *restoring* different habitats. www.thebiodiversityconsultancy.com/category/resources-categories/industry-briefing-notes

**Table 6** *Advantages of, and considerations for, restoration*

| Advantages | Considerations |
|---|---|
| • In the best scenarios, *restoration* can be a mechanism to balance impacts and achieve targets (such as NNL/net gain) without seeking off-site *offsets*.<br>• Gains are likely to accumulate over time, and with decreasing management input needed once ecological re-establishment thresholds are overcome.<br>• Goals can be set to ensure targeted BES sensitivities will be covered.<br>• It is easier to measure loss versus gain than the outcome of *avoidance* and *minimization* decisions (e.g. hectares).<br>• Often does not require significant up-front investment.<br>• Facilitates linkage of social and environmental management plans.<br>• Justifications for *restoration* will normally be multiple, e.g. social, political, ecological—facilitating the business case for investment.<br>• Visible and evident to stakeholders, helping to manage reputational risk: a damaged site can leave a damaged reputation. A *restored* site leaves a positive legacy beyond the project lifetime; can become a flagship site.<br>• *Restored* areas may have fewer problems than *offsets* related to uncontrolled access, as they are generally within licence areas.<br>• *Restoration* interventions are often labour-intensive and can be a means of local job creation.<br>• Can be particularly effective at re-establishing the supply of provisioning (food and fibre), cultural and regulating (e.g. flood attenuation) ecosystem services to local beneficiaries, because *restoration* occurs at the impact site, and ecosystem functions can be easier to *restore* than community composition.<br>• Satisfies permitting requirements: many jurisdictions set a legal requirement to return sites to an ecological reference state, or to a stable and useful non-conservation land use.<br>• May provide a unique opportunity to maintain spatial ecological connectivity within the landscape or seascape (e.g. for migration corridors). | • Generally has a lower certainty of success than *avoidance* and *minimization*.<br>• *Restoration* for many BES features is poorly understood, and can be challenging, slow and expensive; it can be complicated by logistical, social and political constraints.<br>• *Restoration* may not be an advisable option for 'irreplaceable' or 'vulnerable' BES values (e.g. old growth forest, some locally endemic species) due to the uncertainty of outcomes and time lag for success.<br>• Requires early planning to ensure that adequate baseline information[53] for the impact site is collected to inform feasible *restoration* goals and practice.<br>• May require changes to initial plans in order to *avoid* or *minimize* impacts on the least *restorable* areas or features.<br>• May require long-term management interventions and costs to ensure that the site remains on the correct trajectory for the required outcome (costs eventually diminish once *restored* areas are self-sustaining).<br>• Likely to be less cost-effective (for achieving a particular result) than earlier steps in the mitigation hierarchy.<br>• Costs may be hard to predict unless a nearly identical project in same environment exists.<br>• Although loss-gain quantification may be more straightforward than with *offsets*, *restoration* often requires long time frames to achieve outcomes.<br>• The scientific basis for optimal *restoration* practice is often complex.<br>• Requires expert consultation to derive feasible goals and implementation plans.<br>• It is practically impossible to fully return a site to its pre-disturbance state, especially in terms of species composition.<br>• General rehabilitation that does not address specific BES values of concern may be important for stakeholders, regulatory compliance and reputation, but does not count as the application of *restoration* in the mitigation hierarchy.<br><br>*continued …* |

[53] See CSBI (2015) for guidance on baseline surveys. www.csbi.org.uk/workstreams/biodiversity-data-collection

Table 6 (continued) *Advantages of, and considerations for, restoration*

| Advantages | Considerations |
|---|---|
| • Provides an opportunity to integrate BES mitigation into a landscape/seascape vision. Spatially-specific BES sensitivities can be specifically designed into the *restoration* plan (e.g. an animal feeding corridor).<br>• *Restoration* may provide valuable habitat for locally endemic flora or fauna—a common rationale in the mining industry.<br>• *Restoration* is likely to be less politically and legally complex than *offsets*.<br>• Designing *restoration* goals (e.g. maintaining environmental services flows) through carefully structured stakeholder consultation can develop support for (or reduce opposition to) a project.<br>• Helps manage indirect impacts by replacing the natural resources lost to project impacts, rather than protecting or enhancing a potentially decreasing stock of remaining resources as *offsetting* aims to do. | • *Restoration* needs closer monitoring than other mitigation activities due to unpredictable recovery trajectories and uncertain effectiveness of techniques. |

This iterative approach should aim to reduce residual impacts as far as feasibly possible, and will reduce or eliminate the need for a biodiversity *offset*[54]. *Offsets* have some inherent disadvantages as they are off-site[55], only indirectly address impacts, and their design and implementation are frequently socially and politically complex.

The end of the iterative *restoration* planning stage is therefore a critical moment for applying the mitigation hierarchy. From this point on, it is possible to characterize residual impacts (i.e. describe feature sensitivity, impact magnitude, consequence, etc.) and quantitatively estimate the scale of *offsets* or other remediative actions required to balance residual impacts, according to the policy and regulatory framework applicable.

Table 6 summarizes some of the advantages of *restoration*, and potential drawbacks or points to be considered in its planning and implementation.

## Key principles and steps for implementing *restoration*

Experience with *restoration* projects points to a number of key principles and processes that can help to ensure success. *Restoration* is likely to be most successful if it involves well-tested techniques, is planned early in the project lifespan with the benefit of trials, and implemented as early as possible after a disturbance has occurred. During implementation, effectiveness is optimized if performance is closely monitored, especially in the establishment phase of plantings or animal translocations.

Other key elements of *restoration* success are detailed below. Not all of these will apply to every project. Figure 9 (page 51) summarizes the overall process as a simple flow chart. It is important to keep *restoration* goals (and how to achieve them) in mind throughout the project lifespan.

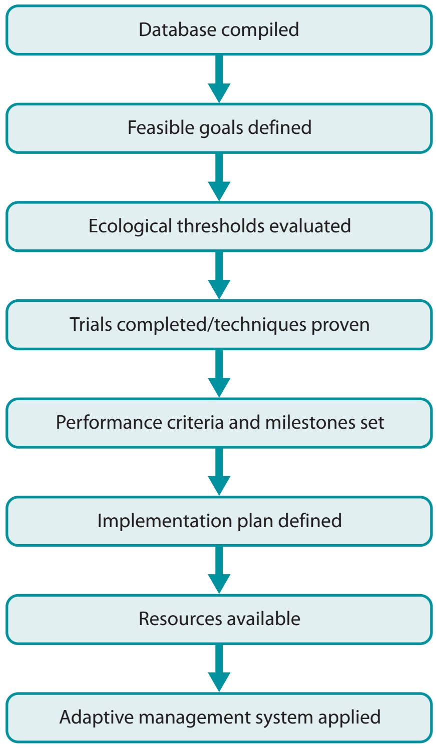
[54] Implementation of an *offset* is likely to be warranted only where significant residual potential impacts remain for priority BES features, with assessment of significance and priority according to applicable policy and policy frameworks.

[55] *Restoration* in locations geographically separate from the project's impacts is a form of *offset* that produces biodiversity gains by reversing historic degradation unrelated to project impacts. This form of *offset* is employed as an alternative or complement to 'averted loss' *offsets*, which produce relative gains by preventing anticipated and likely future degradation.

## Start early and build a solid information base

- Obtain suitably detailed and distributed baseline data[56] for pre-impact conditions in impacted and reference sites, for the specific BES values of concern. Access and use the most relevant datasets and applied ecology expertise.
- Choose reference sites carefully and use them with caution as an input into goals constraints analysis (see below), as well as to provide natural regeneration analogues and locally adapted genetic material.
- Before operations start, use sites as tests/pilots for developing/refining/informing *restoration* methods[57]. Trials can be progressively expanded to help refine an overall implementation strategy.
- Where the techniques or environment are novel, advance field trials can help an assessment of feasibility and point towards approaches more likely to be successful.
- Start research, trials and stakeholder consultation as early as possible in the project lifespan. Early research will help define costs before decisions about *restoration* goals are made.
- Use spatial information management systems to record research, planning and monitoring. Spatial data would ideally be managed on a single GIS platform at an appropriate landscape/seascape scale. Maps produced from such a system are helpful in communicating *restoration* project plans and performance.

**Figure 9** *A summary of the restoration planning and implementation process*




## Define realistic *restoration* goals

- Undertake an up-front review of knowledge gaps and risks in achieving desired end points, including consideration of prior *restoration* successes for similar habitats, species or other desired ecological attributes. Can the approaches be replicated? What adaptations are required?
- Use post-impact scenario and less-disturbed reference systems to define appropriate *restoration* goals. The aim is to determine at what stage the system can become self-sustaining and resilient to natural disturbances (will it require significant long-term human intervention?).
- Use constraints analysis (see Figure 8 on page 48, and *The practice of restoration* on page 54) to ensure that *restoration* goals are ecologically, socially and financially feasible. Strengthen planned preventive measures if needed by revisiting *avoidance* and *minimization*, to reduce the residual impacts to manageable levels. In some cases, *restoration* goals and BES *offset* objectives may have to be considered in parallel to assist in the design of the best remediation package for priority biodiversity features. Where potential *avoidance* options involve significant costs, and the opportunity for *minimization* is limited, leaving significant residual BES impacts, the trade-offs between *restoration* and *offsets* will have to be considered carefully.
- Forecast future resource requirements, in relation to the desired end-point and interventional timescale (e.g. staff support needs, genetic material, top-soil, CapEx/OpEx, etc.).
- Engage project planners, engineers and social scientists with *restoration* ecologists, practitioners and stakeholders to create the vision for an integrated closure, considering any commitments or agreements, and with reference to the wider landscape and local buy-in.

56 See CSBI (2015) for guidance on baseline surveys.

57 For example the Simandou project in Guinea is using disused drill pads as pilot sites for the *restoration* of sub-montane grassland ecosystems. www.riotinto.com/guinea/simandou-4695.aspx

### Take practical steps to support *restoration* success

- Engage appropriate specialists with prior expertise in similar ecosystems and environmental conditions. Seeking the right advice early on can save years of time and significant cost.
- As far as possible, ensure continuity of technical staff. Ecological *restoration* requires specialized skills and incrementally acquired local knowledge.
- Make *restoration* implementation requirements explicit in contractor agreements where appropriate.
- Where appropriate, preserve substrate (e.g. topsoil, coral structures) and genetic material (e.g. via seed banks and nurseries) from the project site.
- Preserve locally adapted genetic material, and search for similar local sites that have experienced disturbance and natural recovery.
- Integrate *restoration* into environmental management plans.

### Monitor and manage adaptively

- Set performance criteria and indicators for measuring success. Owing to the different timescales of projects and ecosystem development processes (even when assisted by *restoration* interventions), most performance criteria will focus on indicators of the system being on a 'self-sustaining trajectory'[58] of recovery, rather than on demonstrating attainment of eventual desired states.
- Monitor *restoration* progression using trajectory analysis (see *Learn by doing: the adaptive management approach* on page 57), with final and intermediate target ranges for a specific set of desired attributes/status indicators.
- Adaptively manage *restoration* interventions according to trajectory analysis results. Intermediate target ranges set performance thresholds for adaptive management decisions to keep recovery trajectories within desired limits.
- Use monitoring information on background environmental trends to inform evaluation of the success of *restoration* outcomes and adaptive management.

Any future versions of this document would aim to provide guidance to help determine when impacts may be considered 'permanent' for the sake of mitigation. This may be site-specific depending on the systems being restored and/or the overall objective of restoration.

## Examples of *restoration* in practice[59]

**RESTORATION — EXAMPLE 1**

**Creating and managing wildflower meadows at a potash mine in the UK**

Around the operational works and office complex at the Cleveland Potash site at Boulby, North Yorkshire in the UK, the company has recreated areas of native grassland, providing a haven for pollinating invertebrates such as bees, butterflies, moths and hoverflies. Careful preparation and seeding with a wildflower mix containing native plants appropriate for the site has resulted in meadows with aesthetic and other biodiversity values. The meadows contain flowers providing valuable nectar sources such as Bird's-foot Trefoil, Ox-eye Daisy, Red Clover and White Clover. Ongoing management is used to maintain the desired attributes, and meadows are cut annually to maintain the nutrient-poor conditions that allow this diverse native grassland plant community to thrive. Parts of the meadows are left uncut through the winter to ensure that functionally important invertebrates overwintering in the dry aerial parts of plants can also survive.

58 Notwithstanding unknown or unpredictable recovery trajectories, most ecosystems tend towards a recognizable type, within a range of conditions—this has led to the 'domain of attraction' model being a widely accepted description of observed *restoration* outcomes, except where thresholds withhold or divert trajectory development.

59 Place names and other details have been removed for some examples.

## RESTORATION — EXAMPLE 2

### *Restoration* of forest and upland grassland—the Agri River Valley, Italy

One of the largest onshore oil fields in Western Europe, eni's Val d'Agri concession, is in the Agri River Valley, a biodiversity-rich area in Southern Italy. The area includes Special Areas of Conservation (Natura 2000 sites designated under the European Habitats Directive[60]), and a National Park was created recently in the upper valley. Low-intensity mixed farming is the main land use on the valley bottom and lower slopes, giving way to natural grassland, woodland and rocky habitats at higher elevations.

Recognizing the sensitivity of the site, eni set up the AgriBiodiversity Project (ABD) as a collaboration with Shell Italia E&P, Fauna & Flora International (FFI), the World Conservation Union (IUCN) and the local University of Basilicata. While also engaging other stakeholders, ABD carried out a systematic assessment of biodiversity-related risks and opportunities, allowing the identification of opportunities to reduce potential operational impacts. The project was able to differentiate specific, localized effects of oil activities from other drivers of change, such as climate change and other human activities (e.g. agriculture, grazing practices, urbanization and infrastructural expansion).

The outcome was a targeted biodiversity action plan (BAP) for impact mitigation, *restoration* and long-term monitoring, which has been implemented in selected sites since 2009. The BAP identified priority habitats for mitigation and *restoration* efforts which can increase access for grazers.

**Upland grassland**

These ecologically important communities are used for seasonal grazing. After trialling different techniques, several key approaches were adopted in 2008 to *restore* pipeline and flowline disturbances:

1) directly re-seeding with locally sourced seeds;
2) controlling the thistle *Carduus collinus*; and
3) spreading seed-rich grass cuttings from the undisturbed area.

By 2011, monitoring showed that the prairies had recovered their original structure, composition and ecological functions, without any increase in non-native species.

**Beech forest**

The upland beech forest in the area is within two Natura 2000 sites and has high biodiversity value. *Restoration* of the forest edge community, through planting, grazing and illegal logging control, aims to reduce edge effects evident on the forest around two well pad clearings.

**Natural/planted forest**

*Restoration* of pipeline and flowline disturbances in this habitat was facilitated by limiting access to people and livestock at the head of the flowline to reduce soil disturbance. Rapid rainfall run-off was also limited to reduce erosion and speed up recolonization. Unwanted plants colonizing disturbed soil (ruderal species) were removed before seeding to limit their spread and competitive advantage, and in some areas the topsoil was enriched with soil from the woodland to limit ruderal growth. Monitoring suggests that these *restoration* measures have been effective so far. In 2011, the flowline corridors were characterized by a shrub community typical of the early successional stages of oak forest, including seedlings of the oak *Quercus cerris*.

**Lessons learned**

The project demonstrated that *restoration* of project impacts in the Agri River valley ecosystems is possible. Suggestions for good practice have emerged as follows:

- Understand key characteristics of the habitats and species of concern.
- Preserve the topsoil of the disturbed area (or, if not possible or if insufficient, obtain topsoil from a nearby reference area without compromising its ecological integrity).
- Re-seed with seeds from ecologically adapted populations nearby.
- Prevent run-off where sites are still dominated by bare soil.
- Manage alien invasive species and other species not characteristic of that habitat.
- Protect *restoration* activities from other disturbances during the early recovery phase.

Partnerships were important for success, both for setting ecological goals and for implementing the *restoration* work itself.

[60] EU Habitats Directive: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

**RESTORATION — EXAMPLE 3**

**Seed storage facilitates *restoration* of native and endemic flora and fauna in Greece**

S&B Industrial Minerals S.A. has undertaken more than 35 years of systematic work and research on land *rehabilitation* in Greece. This has been applied at their major quarries at Milos and Fokis, highlighting the value of knowledge about, and access to, locally adapted species.

At Milos, only native plants are now used in reclamation, owing to the distinct soil type and harsh climate with high temperatures, long drought periods and strong winds. As well as being adapted to the specific soil, native plants have a dormant period in summer and thus need no watering during the typical six-month period of hot, dry weather. Many are also adapted to the saline water and frequent fires characteristic of the island.

Fokis by contrast is a mountainous area, partly in the pseudo-alpine zone. Since 2010, only endemic plant species have been used in rehabilitation work, including the rare *Acer heldreichii* and other species from the pseudo-alpine zone.

So far more than 1.5 million plants have been produced for reclamation at the two plant nurseries of S&B located at Fokis and Milos. Recreation of habitat for native fauna and flora has made substantial progress. Independent studies, sponsored by the Ministry of Environment and carried out by the Department of Biology of the University of Athens, showed that there was no significant difference in the faunal diversity observed between the quarry site on Milos (Chivadolimni) and an undisturbed reference area.

**RESTORATION — EXAMPLE 4**

**Geomorphic reclamation lays the foundation for *restoration* in New Mexico**

At BHP Billiton's coal asset in New Mexico, USA, geomorphic reclamation is a key tool in achieving biodiversity and sustainability goals. Geomorphic reclamation overcomes abiotic thresholds to regeneration by mimicking natural drainage patterns, and provides long-term stability of rehabilitated landforms, serving as the foundation for the establishment of a biologically diverse and sustainable ecosystem.

# The practice of *restoration*

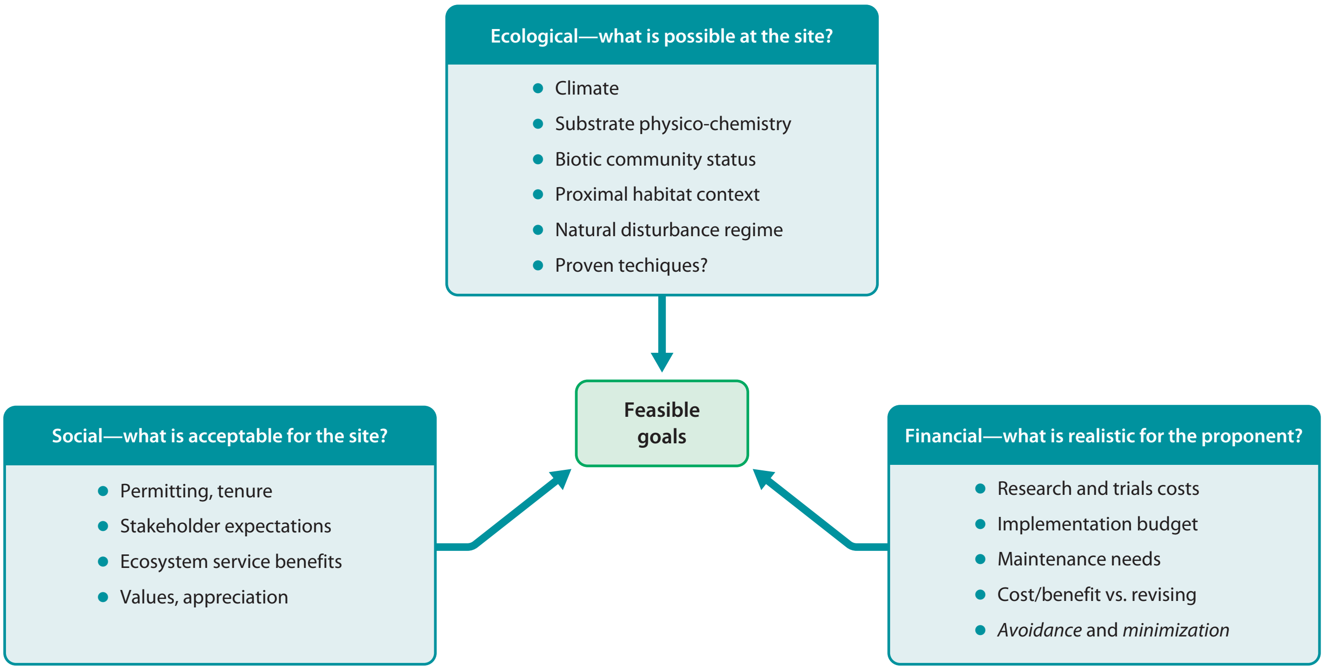
## Analyse constraints: realistic goal setting

*Restoration* is the process of ecological management of a project-affected site to bring it to a target state. The most important step in *restoration* planning is to set realistic biophysical, ecological and financial goals that are socially acceptable to relevant stakeholders. In the context of the mitigation hierarchy, goals also need to be consistent with the overall intended biodiversity outcomes through the application of the Hierarchy as a whole. Figure 10 (page 55) represents these constraints, or design factors, to planning 'feasible' goals for *restoration* as part of the mitigation hierarchy in three dimensions: social, ecological and financial. As outlined in the previous section, this process is likely to be iterative in order to arrive at the appropriate cost-benefit balance between revisiting preventive measures (*avoidance* and *minimization*) versus investment in remediative actions.

During mitigation hierarchy planning, early iterations of *restoration* constraints analysis should drive the *avoidance* or *minimization* of impacts, in particular to ensure that impacts do not surpass any thresholds beyond which *restoration* would be unfeasible (e.g. physico-chemical properties of the substrate). However, this will not always be possible for the entire area of influence, for example at mining pit sites. Final iterations of *restoration* constraints analysis would occur once *avoidance* and *minimization* have been maximized, in order to derive a set of feasible goals considering ecological, socio-political and financial factors.

In some environments, passive *restoration* via natural regeneration with little or no external intervention may produce the desired outcome in an acceptable time frame (e.g. patches within forests with suitable soil profiles and seed-rain). The potential of passive *restoration* as a strategy depends on the ecosystem resilience to the impact type, which can be assessed from an evaluation of the current habitat matrix in the context of ecosystem-use history.

**Figure 10** *Setting feasible restoration goals through constraints analysis*

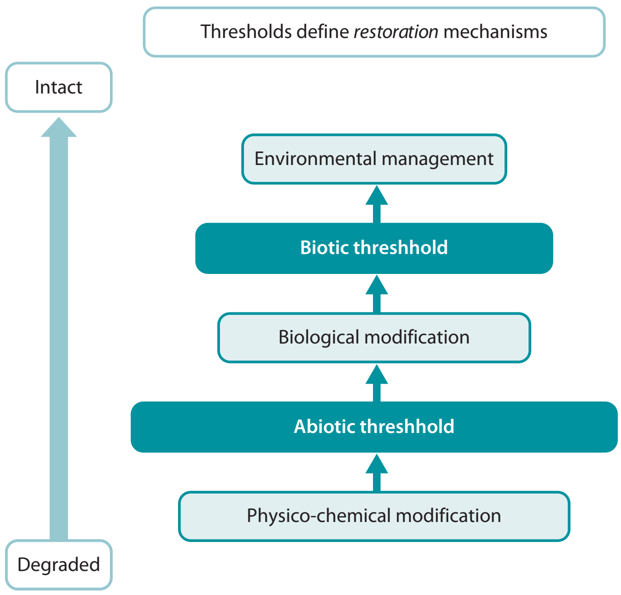



Ecosystems are in constant flux, switching over time between states, within a broad range of types dictated by prevailing environmental drivers. When this ecological property is combined with the reality of ongoing environmental change, accelerated by climate change, it becomes clear that it is often unrealistic to specify tightly-defined *restoration* outcomes (e.g. in terms of species composition), especially when they also require long timescales for regeneration. *Restoration* is therefore unlikely to be able to achieve 'no net loss' (where that is a voluntary or regulatory goal for the project), at least for material project-attributable impacts on vulnerable biodiversity features or complex ecosystems; hence, residual impacts may remain. In these circumstances, broader *restoration* goals such as reinstating habitat structure or functional properties that can supply ecosystem services (e.g. soil formation, carbon sequestration, flood or tsunami attenuation and clean water supply) may be more appropriate and achievable. This may involve reliance on *offsets* to achieve the necessary gains for specific biodiversity features.

## Manage using thresholds: pillars of restoration success

Variations in ecosystem complexity, species diversity, environmental sensitivity, specific chemical conditions, and different regeneration rates all affect *restoration* potential and the likelihood of success, and therefore call for case-by-case solutions. The practical management response to this uncertainty is to identify abiotic and biotic thresholds, and design intervention mechanisms to overcome these thresholds (Figure 11). Ecological thresholds can be thought of as barriers to natural regeneration, and resources should target these to facilitate a self-sustaining recovery. For example, physico-chemical modification could involve mechanical preparation of substrate structure and chemical composition, or engineering of hydrological patterns; biological modification is likely to involve introduction or enrichment of species; environmental management could involve a grazing regime or predator control.

**Figure 11** *Graphic representation of different thresholds and restoration intervention mechanisms along the condition/ degradation gradient*




It is still difficult to find targeted guidance for particular *restoration* challenges in many ecosystems. However, an increasing array of research articles and practice guidelines is emerging to support the implementation of *restoration*. A good place to start is with a search of the internet and scholarly articles databases using terms describing the ecosystem and desired attributes. The resources available through the Society for Ecological Restoration International, including the Global Restoration Network[61] and the Foundation Documents[62] are other useful starting points. Another growing source of *restoration* examples is the Conservation Evidence website[63]. Examples of ecosystems for which a wealth of knowledge on *restoration* techniques is available include freshwater wetlands, saltmarshes, temperate forests and mangroves. See TBC (2015) for an analysis of the availability of information on *restoration* techniques among different biomes and ecosystem types.

The ability to evaluate *a priori* the potential of generic *restoration* techniques in certain environments is limited by low historic levels of success reporting globally[64], complicated by a lack of robust scientific frameworks for measuring success against ecological criteria. Nonetheless, multiple research reviews of *restoration* efforts over the past few decades show that the majority of these efforts have led to an improvement of biodiversity and/or ecosystem services[65]. Yet, a flexible, adaptive management approach is usually necessary (learning from the *restoration* attempt itself), timescales for success vary greatly, and seldom do *restored* sites reach their pre-impact state for the BES features of concern.

Where *avoidance* and *minimization* are unable to prevent severe[66] project-attributable environmental degradation, it is typically not feasible to return such degraded areas to their pre-disturbance state. In these cases, thresholds may have been crossed that prevent recovery within reasonable time frames, ecological communities may fail to reassemble predictably, and cumulative environmental change over long timescales often makes such a goal

61 www.globalrestorationnetwork.org

62 www.ser.org/resources/resources-list-view/foundation-documents

63 www.conservationevidence.com

64 Ruiz-Jaen, M. C. and Aide, T. M. (2005). Restoration Success: How is it being Measured? In *Restoration Ecology*, Vol.13, Issue 3, pp. 569-577.

65 Maron, M. *et al.* (2012). Faustian bargains? Restoration realities in the context of biodiversity offset policies. In *Biological Conservation*, Vol. 155, pp. 141-148.

66 Meaning that impact intensity is sufficient to cause the system to cross an abiotic threshold which will require physico-chemical modification of the substrate before biological regeneration can commence.

unattainable. These are important considerations in determining whether the application of *restoration* is an appropriate response in the mitigation hierarchy.

## Assess trajectories: evaluating performance criteria and success

As with goal setting, evaluating *restoration* success can be approached from cultural, economic, abiotic and biotic perspectives. In many cases *restoration* programmes start with highly disturbed or degraded habitats, and the timescales required for the affected habitat to approach a fully functional state and for goal attainment are typically long. In practice, therefore, most performance criteria will focus on indicators of the system being on a self-sustaining trajectory of recovery, rather than focus on the eventual goal. At this stage of recovery, the habitat structure is likely to be immature and the desired species composition may not yet be established.

Clearly-described quantitative end points and intermediate targets are needed to manage *restoration* and address stakeholder input. From the biotic perspective, indicators of key ecosystem attributes (e.g. vegetation structure and cover) may be selected, either to measure goal attainment directly, or to establish whether suitable ecological processes are reoccurring. Reference sites may be used, with caution, to help set end points and targets; science-based ecosystem models may also help to quantify intermediate targets and end points.

Time-series data can be collated for these indicators to plot their trajectories. This allows evaluation of progress towards end points and targets, and makes it possible to judge whether system recovery can reasonably be assumed to be heading towards defined goals[67]. Trajectories can also be used to adapt management, and communicate with external stakeholders.

Because project site closure and divestment will often come before *restoration* goals are fully attained, trajectory analysis is increasingly being used to predict success[68]. Any residual impacts predicted to remain after *restoration* is complete will need to be small enough to be acceptable to stakeholders and regulators (e.g. ALARP—as low as reasonably practicable). If residual impacts are predicted to be larger, biodiversity *offsets* may need to be evaluated.

## Learn by doing: the adaptive management approach

Data from trajectory analysis of performance criteria can be usefully incorporated into a typical monitoring and evaluation framework ('BACI'—see below) in order to drive adaptive management of *restoration* interventions for the attainment of long-term goals. The BACI framework relates to the following classes of information in the case of *restoration*:

B - Before project impact ecological baseline
A - After project impact ecological baseline
C - Control information from a reference site(s)
I - Impact/results of the *restoration* implementation.

[67] Koch, J. M. and Hobbs, R. J. (2007). Synthesis: Is Alcoa Successfully Restoring a Jarrah Forest Ecosystem after Bauxite Mining in Western Australia? In *Restoration Ecology*, Vol. 15, Issue Supplement s4, pp. S137-S144.

[68] Dey, D. C., and Schweitzer, C. J. (2014). Restoration for the future: Endpoints, Targets and Indicators of Progress and Success. In *Journal of Sustainable Forestry*, Vol. 33, Supplement 1, pp. S43-S65; and
Ruiz-Jaen, M. C. and Aide, T. M. (2005). Restoration Success: How is it being Measured? In *Restoration Ecology*, Vol. 13, Issue 3, pp. 569-577.

By developing baseline information with ongoing research, it can be useful to build a conceptual model of how the ecosystem functions and responds to inputs of materials or environmental stressors. These models can help build an understanding of the structure and function of the ecosystem, in particular what the controlling factors might be for key developmental processes (e.g. fire or flooding of a certain frequency and intensity may be essential to stimulate regeneration). Such an understanding enables more effective adaptive management decisions.

Where *restoration* or *offset* activities are ongoing and of significant scale, they may benefit from periodic field review by a small team of external experts. Expert review could be sought first at the stage of detailed planning for *restoration/offsets* projects, to ensure that techniques to be used and the expected gains are appropriate and realistic. Subsequent review at (say) five-year intervals would provide a check that activities are on track, and scope for implementing adaptive management if needed. As well as improving outcomes, external review may help to reassure stakeholders that remediation work is being addressed seriously and is continuing to a high standard.

Section 4

# Offsets

## Definitions

The CSBI defines *offsets* as '*Measurable conservation outcomes, resulting from actions applied to areas not impacted by the project, that compensate for significant, adverse impacts of a project that cannot be avoided, minimized and/or restored*'[69]. There are numerous definitions of biodiversity *offsets*, spanning the regulatory, business and scientific sectors[70] (see the *Definitions* section on page 79 for more detail).

*Offset* definitions often specify an end goal of NNL or net gain, to provide complete compensation[71] for significant residual impacts of the project. This may also be required by regulators, financing conditions or company policy. However, *offsets* may not always aim to compensate fully for residual impacts, nor be implemented in an NNL framework, providing an alternative outcome based on the social, political and regulatory expectations.[72]

*Offsets* almost always involve conservation interventions related to land or sea management[73] away from the site of direct project impact. Typically, *offsets* are in an area where the BES features of concern (and subject to significant

69 Adapted from CSBI (2013a). *Framework for Guidance on Operationalizing the Biodiversity Mitigation Hierarchy*.

70 Key common elements within the *offset* definitions include: i) *offsets* involve actions that provide measurable gains for biodiversity; ii) *offsets* compensate for significant residual negative impacts after earlier steps in the mitigation hierarchy have been applied; and iii) *offsets* aim for a specific and measurable outcome, most commonly to target no net loss or a net gain if required by regulation, a financing institution or internal company policy, for biodiversity on the ground.

71 The term 'compensation' used here and elsewhere in this chapter is used in a general sense to mean remediation of impacts; it does not imply financial measures or payments.

72 'No net loss' is a common aim for *offsets*, and required by some regulators and financial institutions. A recent IUCN study has examined the conditions for a biodiversity *offset* to achieve 'no net loss' (which are narrow) and the conditions for *offsets* to achieve outcomes better than the status quo of (often financial) compensation. The IUCN study finds that there is enormous potential for current compensation practices to be improved, even if these do not end up achieving 'no net loss'. See Pilgrim and Ekstrom (2014). The Taninthayi nature reserve in Myanmar (TBC, 2014a) provides an example of a compensation project set up outside a 'no net loss' framework, which has had positive outcomes.

73 Mechanisms used to effect *offsets* could include (among others) conservation easements, covenants, community agreements, improved management of a site with clear tenure, and improved legal and/or on-the-ground protection for new, proposed or existing protected areas.

residual impact) are present[74]. However, this may not be the case where an *offset* involves 'trading up', i.e. where it targets BES features that are judged to be of higher priority than those impacted by the project. Biodiversity *offsets* may be set up in terrestrial, freshwater or marine systems.

As well as *offsets*, projects may undertake 'additional conservation actions' (ACAs). The term refers to a wide range of interventions that are intended to be positive for BES, the impacts of which may be hard to quantify[75]. ACAs may or may not target BES features that have been significantly impacted by a project, but unlike *offsets* they are not designed to provide measurable gains that can be set against those impacts[76].

# Rationale

BES *offsets* are the fourth and last component of the mitigation hierarchy[77] and are designed to compensate for significant adverse residual impacts that remain after efforts have been made to *avoid*, *minimize* and *restore*[78]. Ideally, the application of appropriately comprehensive and targeted *avoidance*, *minimization* and *restoration* would fully address a project's biodiversity-related risks and impacts—i.e. no material residual impacts/risks would remain that might warrant an *offset*.

Where significant adverse impacts do remain, these can potentially be addressed via a BES *offset*.

### Government regulation

Relatively few governments as yet have policies that require or enable BES *offsets*, but the number is increasing[79]. Such schemes have specific provisions on how *offsets* should be planned, designed and implemented. In some cases, government-required BES *offsets* are tied to a market mechanism for trading credits, such as a habitat bank[80].

### Requirements for financing

Many international financing institutions have, or are developing, environmental safeguard policies that require *offsets* where projects result in significant, unavoidable residual impacts on BES[81]. Notably, the IFC's Performance Standard 6 (IFC, 2012a) is also followed by the 79 Equator Principle banks and by 32 OECD (Organisation for Economic Cooperation and Development) export credit agencies. PS6 requires a 'net gain' for 'Critical Habitat'[82] and, where feasible, 'no net loss' for 'Natural Habitat'[83].

### The business case for BES *offsets*

An increasing number of companies have adopted voluntary 'no net loss' or 'net gain' goals for biodiversity management[84]. Meeting these goals is often achieved through the use of biodiversity *offsets*.

[74] This may not always be the case. For example, it has been proposed to *offset* residual project impacts caused by increased sedimentation on Australia's Great Barrier Reef by funding improved agricultural practices on land in coastal catchment areas.

[75] See the definition of ACAs on the UNEP-WCMC Biodiversity A–Z website: http://www.biodiversitya-z.org/content/additional-conservation-actions-aca

[76] An example of an ACA might be a general environmental awareness programme supported by the project and focused on local communities or schools.

[77] An alternative representation of the mitigation hierarchy is 'avoid/reduce/remedy'; biodiversity *offsets* are a component of the 'remedy' category.

[78] The terms '*restore*' and '*restoration*' are used in a general sense to describe this remediative component of the mitigation hierarchy. In some jurisdictions and technical descriptions, 'restoration' implies returning a disturbed physical environmental attribute to a condition exactly the same as that which existed prior to the disturbance. This sense does not necessarily apply here. '*Restoration*' in the mitigation hierarchy may include or equate to 'reclamation' or 'rehabilitation', i.e. returning a disturbed physical environmental attribute to a stable and useful state (but different to its condition prior to disturbance).

[79] TBC (2014b); ten Kate and Crowe (2014).

[80] Well-established schemes include: New South Wales (Australia) Biobanking; State Government of Victoria (Australia) vegetation credit register; Canadian fish habitat; US species conservation banking; US wetlands banking; and German habitat banking. (See *Weblinks* on page 75.)

[81] Most international finance institutions have environmental and social safeguards/frameworks mandating *offsets*, including the Africa, Asia and Inter-American Development Banks, the European Bank for Reconstruction and Development (EBRD), and the World Bank Group (International Bank for Reconstruction and Development, International Finance Corporation and the Multilateral Investment Guarantee Agency).

[82] PS6 defines Critical Habitats as areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. The World Bank's draft Environmental and Social Safeguard 6 and equivalent standards of other MFIs adopt similar, though not always identical, definitions.

[83] Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

[84] For a recent review, see: Rainey, H. *et al.* (2014). An example is Rio Tinto's biodiversity strategy: www.riotinto.com/documents/ReportsPublications/RTBidoversitystrategyfinal.pdf

The business case for adopting such goals, and implementing *offsets*, may include several factors, for example:

- reduced risks and liabilities;
- strengthened relationships with stakeholders (local communities, regulators, NGOs and others);
- trust built on a credible reputation—growing the 'social licence to operate' with local, national and international benefits;
- continued access to natural capital and land;
- increased investor confidence and loyalty;
- improved staff loyalty;
- increased regulatory goodwill, avoiding delays in permitting;
- influence over emerging environmental regulation and policy;
- know-how built for cost-effective compliance with increasingly stringent environmental regulations;
- 'first-mover' benefits in the market; and
- strategic opportunities in new markets and businesses, as adoption of similar goals for biodiversity becomes more widespread.

In practice, the application of a voluntary approach will be driven by technical and economic considerations, socio-economic factors, reputational concerns and the need to ensure stakeholders are satisfied that *offsetting* for significant residual impacts is adequate and appropriate to meet the stated goal.

## Key principles

Several governments and international processes have defined principles for biodiversity *offsets*[85]. These are intended to help ensure that *offsets* lead to genuinely positive conservation outcomes, that developers can distinguish between sound and unsound *offset* investments, and that the views of relevant stakeholders are taken into account.

The principles for *offsets* have been expressed in various ways[86] but the core technical criteria include:

- Application of the mitigation hierarchy: the earlier components of the mitigation hierarchy should always be systematically applied, as explained in earlier chapters of this guidance.
- Recognition of limits: is redress for project-attributable losses actually possible?
- Equivalence: is an *offset* a fair exchange for what is lost?[87]
- Outcomes: is the *offset* designed, implemented and monitored to achieve clear, stated and (where possible) quantitatively assessed outcomes for biodiversity?
- Stakeholder engagement: have the appropriate stakeholders been engaged in planning and design of the *offset*, and will they continue to be engaged in its implementation?
- Additionality: will an *offset* result in a real positive change on the ground, which would not have resulted anyway?
- Longevity: will an *offset* last at least as long as a project's impacts?

These criteria need to be carefully considered when planning, designing and implementing biodiversity *offsets*.

## Types of *offsets*

Although *offsets* can appear very diverse, there are two basic types:

1. **'Restoration' *offsets:*** designed to remediate past damage to biodiversity (due to factors unrelated to the development project in question) by making positive conservation management interventions, such as the rehabilitation or enhancement of biodiversity components (or even recreation of ecosystems and their associated biodiversity values) at suitable *offset* sites.
2. **'Protection' or 'averted loss' *offsets:*** designed to protect biodiversity in an area demonstrated to be under threat of imminent or projected loss (due to factors unrelated to the development project in question).

[85] For example, see: NSW (2014), the New South Wales Government policy on biodiversity offsets (www.environment.nsw.gov.au/resources/biodiversity/140672biopolicy.pdf); and the BBOP *offset* principles (http://bbop.forest-trends.org/documents/files/bbop_principles.pdf).

[86] *Offsets* principles are discussed further in a number of reports and publications, including: IUCN (2014a); Pilgrim and Ekstrom (2014); ICMM-IUCN (2013); and BBOP (2012a).

[87] In practice, this usually means whether the BES conserved is ecologically very similar to the biodiversity impacted, or of a different kind and a higher conservation priority (when 'trading up' is justified). Equivalence is discussed at greater length in Gardner *et al.* (2013) and Quétier & Lavorel (2011).

The two kinds of *offsets* are not exclusive. For example, an *offset* could aim to remove invasive species ('restoration') while also protecting a site against predicted future habitat degradation ('averted loss').

## Key steps in *offsetting*

Frequently, *offsets* are complex projects with a number of different facets—all of which need to be considered in design and implementation. These include:

- Technical considerations: What are the intended outcomes? How will these be measured and in what currencies? How will the *offset* integrate landscape considerations and align with regional or national conservation plans?
- Management considerations: What conservation interventions will be used and how will these be implemented? How will day-to-day management of the *offset* be handled? How will progress be monitored and adaptive management implemented?
- Stakeholder considerations: How will the *offset* address stakeholder expectations—ensuring 'buy in' to the *offset* process and plans, and participation and partnership where appropriate? How will social and biodiversity aspects be integrated? Implementing *offsets* on land where communities enjoy legal or customary tenure or use rights should involve effective consultation with the affected communities. Where implementing offsets could potentially have significant adverse impacts on affected communities, they can only be implemented with Informed Consultation and Participation (ICP)[88] with those communities.
- Economic and sustainability considerations: What will the *offset* cost to set up and manage? How will resources be generated and made available to conserve the *offset* in perpetuity (or as long as it is required to run)?
- Governance considerations: Who owns and who manages the land (or sea) involved in the *offset*? What partnerships and legal arrangements are necessary? Should these remain static or evolve over the course of the project? How will decisions be taken on such changes?

Outside a few regulatory frameworks that use *offset* banking approaches (see *Government regulation* on page 60) there is as yet limited experience in setting up and managing *offsets* on the ground. Lessons learned so far suggest that issues of sustainability, governance and stakeholder participation demand more attention than they have generally received, especially as some of the issues here may be unfamiliar to companies in the course of their usual operations. There is considerable scope for *offset* design and management to be informed (more than it has been to date) by growing experience in the successful design and management of Protected Areas.[89]

The key steps in *offset* design are summarized in Figure 12 on page 65. It is important to recognize the major role of affected stakeholders throughout the *offset* design process, and in particular prior to the selection of an *offset* site and the approval of draft *offset* implementation and management plans[90].

Before entering Phase 1 (*offset* contextualization) it is important to have gone through some preparatory steps, as outlined elsewhere in this guidance document:

- Identify and assess the key BES features in the project's location and area of impact (including through consultation with local and indigenous communities to determine social and cultural BES values, where appropriate).
- Apply the previous components of the mitigation hierarchy (with iterations if necessary).
- Quantify project-attributable biodiversity-related losses and gains.
- Assess significant adverse residual impacts that could warrant a biodiversity *offset*.

For a more detailed explanation of the key steps outlined below, see *The practice of offsetting* on page 66.

[88] IFC PS6 indicates that where implementing offsets would involve potentially significant adverse impacts on affected communities, they can only be implemented with Informed Consultation and Participation (ICP). ICP is defined in para 31 of IFC's PS1. The level of consultation with respect to Indigenous Peoples is beyond the scope of this document. In some cases, as outlined in IFC's PS7, this would require Free Prior and Informed Consent (see UN-REDD, 2013 for guidance).

[89] See for example recent papers on Protected Area effectiveness including: Edgar *et al.* (2014); Geldmann *et al.* (2013); and Watson *et al.* (2014).

[90] More detailed information on *offset* design can be found in BBOP (2012b). ICMM-IUCN (2013) provides an overview, and valuable background information can be found in recent IUCN publications available at https://portals.iucn.org/library/node/44900 and https://portals.iucn.org/library/node/44775.

### Phase 1: BES *offset* contextualization

Step 1: Review the project scope and activities.
Step 2: Review residual adverse impacts and determine the need for an *offset*.
Step 3: Review the legal framework and/or policy context for a biodiversity *offset*.
Step 4: Review broad-brush *offset* costs (both set-up and management) for different plausible scenarios of conservation intervention and governance/ management arrangements.
Step 5: Using this information, introduce discussion of *offsets* into ongoing stakeholder participation and engagement processes.

### Phase 2: BES *offset* strategy

Step 6: Use project-specific goals, national or regional conservation planning frameworks, and strategic stakeholder engagement to identify potential sites or projects for *offset* possibilities.
Step 7: Produce an annotated list of *offset* options.
Step 8: Screen the *offset* options (sites/projects) for theoretical, technical and socio-political feasibility (see Box 9).
Step 9: If no options are feasible, and residual impacts are unacceptable, return to iterative application of the earlier steps of the mitigation hierarchy (see pages 16–17) to reduce predicted residual impacts. Otherwise, from this screening, select one or two prime options for detailed feasibility studies[91].
Step 10: Record the rationale for selecting these options, and outline the proposed general approach for *offset* implementation, including institutional arrangements and partnerships, in a short report—the 'Biodiversity Offset Strategy'.

### Phase 3: BES *offset* design and management planning

Step 11: Conduct detailed feasibility studies for proposed sites/projects, including loss/gain accounting for predicted biodiversity gains against residual impacts (see *The practice of offsetting* on page 66). and assessment of options for institutional arrangements and partnerships. Make final site/project selection.
Step 12: For the chosen site(s) and/or projects, carry out a detailed design and management planning process based on sound science.
Step 13: Carry out a set of design tasks in parallel, ensuring that information flows between all the processes:
- (a) Technical design: Research and choose among possible types of conservation intervention (e.g. protecting land, planting trees, invasive weed removal). Ensure that issues of equivalence, additionality and permanence are clearly addressed, and that estimates of potential gains vis-à-vis residual impacts are well founded, based on good field data and realistic assumptions, and incorporate uncertainties/risks of failure and time lags. Further on-ground studies should be commissioned as necessary.
- (b) Social design: Building on earlier stakeholder engagement, carry out appropriate consultation and communications, and involve relevant stakeholders in participatory planning. Biodiversity *offsets* are more likely to fail for stakeholder-related reasons than for any other reason. It is important to ensure that an *offset* is acceptable to affected stakeholders by undertaking appropriate engagement and communications. Issues of social equity regarding the land management changes that are being proposed need to be addressed appropriately. Where *offsets* affect lands where communities enjoy legal or customary tenure or use rights, they can only be implemented with Informed Consultation and Participation (ICP) with affected communities[92].

[91] For a recent example, see the 2012 report on Rio Tinto's biodiversity *offsets* strategy for the Oyu Tolgoi project (TBC and FFI, 2012).

[92] ICP is defined in para 31 of IFC's PS1. The level of consultation with respect to Indigenous Peoples is beyond the scope of this document. In some cases, as outlined in IFC's PS7, this would require Free Prior and Informed Consent (see UN-REDD, 2013 for guidance).

(c) Governance design: Assess options for *offset* governance and management. This may include considerations of land/sea tenure (land purchase, conservation easements, new community or government-managed Protected Areas, community management agreements). Options should be considered in the context of national policy and legal mechanisms and of stakeholder input, recalling that the interests of different stakeholder groups may need to be balanced. Key roles and responsibilities in implementing the *offset* need to be described.

(d) Financial design: Ensure that the *offset* is economically feasible for the period of a project's responsibility. As a minimum, resources must be in place for the first years after establishment, with a viable plan for provision after that. Appropriate long-term financial mechanisms might involve, for example, one-off payments to a trust fund, use of bonds or insurance. Techniques from standard business planning can be used to assess an *offset's* financial appropriateness and viability.

Step 14: Develop an integrated BES Offset Management Plan, which details the legal, institutional and financial arrangements to be put in place for implementation[93].

## Phase 4: BES *offset* implementation

Step 15: Implement the BES Offset Management Plan, including appropriate monitoring and evaluation, and ensure adaptive management in response to monitoring information.

[93] For an outline of the contents of a BES Offset Management Plan, see BBOP (2009a).

### Box 9 *Offset* pre-feasibility assessment

A stepwise assessment of the theoretical, technical and socio-political/economic feasibility of *offsetting* will narrow down the options for *offset* sites and mechanisms to a small set of choices (see Figure 7 on page 19) and also increase the certainty that those options are workable as potential *offsets*.

**Theoretical feasibility**

Is there sufficient available and ecologically suitable land or sea in the country or region for an *offset* to be possible? Is there scope, in theory, for *restoration* or better protection to provide the additional gains in biodiversity needed?

**Technical feasibility**

Are there known conservation methods that could achieve the *restoration* or better protection needed to provide adequate *offset* gains, within the required timescale and for a realistic cost? Is it feasible to sustain the *offset* over the entire time that it needs to function?

**Socio-political and economic feasibility**

Can such changes in land use actually be put in place at the candidate *offset* sites? Are the stakeholder engagement and political processes necessary for such changes likely to be feasible? Are there relevant and workable governance models available? Is the investment needed to set up and maintain the *offset* through its lifespan available, or is there a viable plan to generate it?

**Figure 12** *Summary of the steps and outputs in biodiversity and ecosystem services offset design*

| Phase | Activities | Outputs |
|---|---|---|
| **Phase 1:** ***Offset* contextualization** | ***Offset* scoping**<br>• Quantify residual impacts on biodiversity quantified<br>• Scope of potential *offset* sites in the region<br>• Assess potential *offset* implementation strategy | **Potential *offset* sites list** |
| **Phase 2:** ***Offset* strategy** | ***Offset* screening**<br>• Potential *offset* sites screened against ecological, technical, political and social criteria | **Set of candidate sites** |
| **Phase 3:** ***Offset* design and management planning** | ***Offset* feasibility and design**<br>• Feasibility studies for candidate *offset* sites<br>• BES accounting for the chosen site(s) | ***Offset* site(s)** |
| | ***Offset* management planning**<br>• Management actions<br>• Partnership building, governance structure<br>• Sustainable financing<br>• Monitoring and evaluation framework | ***Offset* management plan**<br>**Monitoring plan**<br>**Governance structure** |
| **Phase 4:** ***Offset* implementation** | ***Offset* implementation**<br>• Implementation of conservation actions<br>• Monitoring and evaluation<br>• Adaptive management | **Demonstrated progress towards *offset* goals** |

**Ongoing stakeholder involvement: participation, validation, implementation**

# Example of *offsets* in practice

## OFFSETS — AN EXAMPLE

### A marine *offset* for a coal terminal in Australia

A project to *restore* a nationally recognized and listed endangered regional ecosystem is the first marine *offset* project for BHP Billiton's coal business. The boundary of the Great Barrier Reef World Heritage Area in Queensland, Australia overlies BHP's Hay Point Coal Terminal port operations. The Marine Plant Restoration Project was developed and implemented as a marine fish habitat *offset* measure to compensate for impacts on mangrove and intertidal habitat areas. The project also ensures no net loss to the ecological, aesthetic and water quality values of the area from construction activities that were associated with the port.

The project has aided habitat recovery for threatened fauna and flora species, including the mangrove mouse, and provided critical nursery grounds for crustaceans and fish species within Sandringham Bay Conservation Park. This has ensured that local mangrove protection and *restoration* will match mangrove loss due to the project, as well as providing enduring benefits across a range of social and ecological parameters. Surveys show no impacts from construction activities to the mangrove mouse population or its habitat. The *restoration* of hydrology was successful and significant natural recruitment of saltmarsh vegetation is occurring.

# The practice of *offsetting*

## Buy off the shelf? Regulatory *offsets*

Where there are regulatory frameworks pertaining to biodiversity *offset* design and delivery, *offsets* can usually be planned and implemented in a more or less straightforward manner:

- On a case-by-case basis, use the guidelines and principles provided by the regulator, in close consultation with regulatory personnel.
- Where such a market exists[94], seriously consider the option of buying an appropriate quantity of biodiversity credits 'off the shelf' in a market-based mechanism (e.g. a habitat or conservation bank). Often, this can be considerably simpler and less risky than designing and implementing a 'self-service' *offset*, where that is an alternative option.

## Engage stakeholders and build partnerships: voluntary and finance-requirement *offsets*

This is the more common, and less straightforward, case. Often, such *offsets* are in countries with complex land ownership and management arrangements. Simply leasing or purchasing a portion of land may not be a viable sustainable option in many cases.

Success in designing and implementing such *offsets* usually depends on engaging a range of stakeholders, which is likely to be a combination of:

- national or provincial government agencies;
- national or local conservation trust funds;
- community-based organizations, where appropriate;
- individual land owners in cases where customary land ownership prevails;
- a partner NGO with national presence, institutional capacity and a track record of success in implementing site-based conservation; and
- a specialist consultancy group.

*Offset* implementation over a long period of time is challenging. Working with one or more management partners can greatly increase the likelihood of success. The Biodiversity Offset Management Plan should identify who takes on specific responsibilities, and describe the legal, institutional and financial arrangements in place so this happens.

## Add up loss and gain: biodiversity accounting

The concepts of 'no net loss' and 'net gain' of biodiversity (see the *Overview* on pages 8–20) are relatively new. Not surprisingly, there are no universally accepted approaches for determining the type, nature and size of an *offset*, the appropriateness of proposed intervention measures, and the assessment of the ultimate success of the implemented measures.

Biodiversity is intrinsically difficult to measure and compare quantitatively; no single metric can describe biodiversity as a whole. Nevertheless, methods have been developed (and continue to be refined) for calculating loss and gain of particular biodiversity values. These may

[94] TBC (2014b); ten Kate and Crowe (2014).

focus on habitat as a useful proxy for biodiversity as a whole (e.g. 'quality hectares', a measure of habitat area x condition), or on a small set of key species (e.g. 'units of distribution', a measure of the proportion of the population of a particular species in a defined locale).

Any *offset* approach that aims to demonstrate how far residual impacts have been addressed (including a no net loss or net gain approach) calls for calculation of project-attributable losses and gains for the specific biodiversity features of concern. In the context of IFC PS6, for instance, these will be those species that have given rise to Critical Habitat designation and are also materially impacted by the project, as well as any Natural Habitat significantly impacted. Often, it will also be appropriate to include other species or habitats that are of particular concern to stakeholders.

For calculating losses, residual impacts on biodiversity features need to be considered at a landscape scale relevant to the ecology of the biodiversity features of concern (including 'indirect' impacts such as induced/facilitated access to an area with noteworthy biodiversity). In identifying the biodiversity features of concern, and selecting potential *offset* options (if warranted), cumulative impacts of multiple projects across the landscape may also need to be taken into account. The baseline for loss calculation is normally the situation prevailing before project implementation begins—one reason why it is important to undertake baseline biodiversity surveys for impact assessment[95].

Calculating gains involves a number of predictions of how biodiversity values will change following the implementation of an *offset* compared to what would have happened without the *offset* (the 'counterfactual' scenario). This is a complex technical task as biodiversity features show natural variation over time, and can be affected either positively (e.g. through other expected conservation investments) or negatively (e.g. through ongoing habitat loss, or wildlife poaching). Gain calculations thus call for a knowledge of baseline conditions pre-*offset* (gained, ideally, by targeted baseline surveys) and an estimate of trends in pressures and conservation responses (based on expert knowledge and assessment) to accurately establish the 'counterfactual'. There is also a need to ensure that investing in an *offset* does not simply displace pressures on biodiversity to other places (so-called 'leakage'), thus diminishing or eliminating gains. Expert involvement is essential in 'net gain' type deliberations.

## Find the right site: some practical shortcuts

The *offset* site selection process can be time-consuming, costly and complex. Focusing on sites that are already designated as conservation priorities, but may be inadequately protected, can reduce the negotiation period and transaction costs, ease stakeholder discussions, (sometimes) de-risk land rights issues and ultimately improve outcomes. Such sites could be identified in a number of ways including via:

- aggregated *offsets* that have already been identified (see *Joined up thinking? The pros and cons of aggregated offsets* on page 69);
- national conservation plans, including the National Biodiversity Strategy and Action Plans (NBSAPs) produced under the Convention on Biological Diversity;
- priorities for conservation identified by internationally credible mechanisms, such as the Key Biodiversity Areas standard developed by IUCN (including BirdLife International's Important Bird and Biodiversity Areas); and
- existing protected areas that are under-resourced and would benefit from additional longer-term investment.

There are some caveats:

- Equivalence (whether or not the option represents fair and appropriate redress) may be an issue where potential *offset* sites are substantially different from the impact site(s). Where *offset* and impact sites are far apart, loss of ecosystem services for particular stakeholder groups may also be a consideration—this can be a significant social risk for certain projects[96].
- Demonstrating additionality may be problematic where governments have (or arguably should have) allocated funding for conservation implementation, such as for existing protected areas. These concerns need to be investigated and addressed on a case-by-case basis.

[95] See CSBI (2015) for guidance on baseline surveys. www.csbi.org.uk/workstreams/biodiversity-data-collection

[96] A solution in this case could be a 'composite *offset*', with one (or more) *offset* sites that deal with like-for-like-or-better BES exchanges in the context of landscape-level planning, and another set of *offset* activities close(r) to the project's impacts to offer redress to local communities whose ecosystem services have been affected by the project.

## Think long term: ensuring *offset* permanence

In principle, the changes in land management or use needed to implement a biodiversity *offset* are no different from those implemented routinely by government and non-government conservation organizations, for example in protected areas. However, outcomes for *offsets* need to be quantified and verified if their contribution to the application of the mitigation hierarchy is to be demonstrated.

Similarly, if *offsets* are to compensate for significant residual impacts, they need to last for at least as long as the impacts they are *offsetting*. In many cases, this means that *offset* outcomes should aim to be permanent, or at least to be sustained for a protracted period of time, often beyond the life of a project.

Permanence may call for legal designation or agreement, for example through the establishment of conservation easements or the designation of protected areas under national law. Usually, this must be combined with long-term financing mechanisms that cover not just set-up costs but also ongoing management and monitoring costs. These might be, for example, trust funds or secured government budget commitments. If trust funds or similar mechanisms are to be used, the costs should be factored into project budgets at the earliest possible stage. Not all costs need necessarily be borne by the project. In some circumstances (for instance, where the *offset* is addressing a clear global conservation priority, and providing gains for biodiversity features beyond the ones impacted by the project) it may be possible to attract trust fund contributions from other sources, such as foundations. Managed land may also be able to generate some revenue, in time, towards recurrent costs. However, the probable size of such contributions can easily be overestimated.

The medium- to long-term future cannot be reliably predicted. There is thus usually intrinsic uncertainty about how far the predicted biodiversity gains of an *offset* can, or will be, realized. Uncertainty can be dealt with by discounting predicted gains proportionately (e.g. resulting in an increase in the physical size of an *offset*). Often the extent of uncertainty is itself uncertain, so again a precautionary approach (informed by expert opinion) is advisable.

Uncertainty could also be addressed via some type of insurance mechanism. While *offset* insurance approaches are being developed for greenhouse gas emissions, this is unexplored territory for biodiversity *offsets* as yet.

'Off the shelf' *offset* credits, purchased through habitat banks or similar regulated regimes, are a way of effectively addressing uncertainty. However, it may take years after *offset* regulations are introduced for credits to become available, and in many regions land tenure arrangements may make such schemes unworkable. For marine *offsets*, habitat banks are unlikely to be feasible except where terrestrial *offsets* can reduce threats that emanate from land (e.g. sediment load for coral reefs).

Biodiversity *offsets* cannot be set in a static context. Environmental changes, including those associated with climate change, are a reality in the medium to long term. Managing *offsets* adaptively is therefore vital if anticipated gains are to be realized and not undermined. An adequate offset monitoring and evaluation system is therefore needed for this purpose. Financial support for this needs to be built into whatever long-term financial arrangements are made for supporting the *offset*.

### Patience is needed: how long do offsets take to set up?

The types of biodiversity *offset* that industry is now expected or required to undertake, by host-country government regulation and/or external financiers, may take two years or more to set up. Several projects are currently four to eight years into the set-up process for their stipulated biodiversity *offsets* and have not yet started active implementation on the ground. This is not surprising, given the time required for permitting of industrial concessions and the land-use planning/ stakeholder consultation required.

Where a government or government–private sector system has been set up to provide *offset* credits, conveyancing can take 3–24 months, and typically involves much less effort on the part of a project proponent. Example systems include the New South Wales biobanking scheme, the Victoria State Native vegetation credit register and the US species conservation or wetland mitigation banks[97].

### Keep on track: monitoring offset performance

Tracking biodiversity *offset* performance is important for managing the implementation schedule and budget, evaluating progress towards established goals/outcomes, and for adapting interventions when needed. With multiple stakeholders and long-term aims—and often rapidly changing social and economic contexts—biodiversity *offsets* can readily experience scope-shift[98]. Therefore, the careful tracking of targets, actions and outcomes is critically important. Setting up, training and resourcing a dedicated monitoring unit (part of the project team or via a contractor or partner, or with elements of all three) will help to ensure consistency of approach and that monitoring is not neglected or overlooked. As for major *restoration* efforts, external expert review at intervals may help to keep *offset* performance on track (see page 58).

## Constraints, challenges and creative thinking

A number of issues are emerging as industry continues to design and implement biodiversity *offsets*. Some of the most significant of these are outlined below.

### Joined-up thinking? The pros and cons of aggregated *offsets*

Aggregated *offsets* are where a single *offset* site is used to compensate for the impacts of multiple projects. Where credits from such a site are sold to project proponents, it becomes a type of conservation bank. For a project proponent, this approach has many advantages: it reduces transaction costs, can limit or prevent schedule delays, and outsources many difficult technical and political questions (including the significant socio-political issues of land-use change) to other institutions with a clear mandate for tackling these issues. National biodiversity *offset* schemes may involve a network of aggregated *offsets*, selected to fill gaps or enhance connectivity in existing Protected Areas networks.[99]

For government and conservation NGOs, aggregated *offsets* have the great advantage of allowing integration of biodiversity *offsets* with large-scale conservation planning, ensuring that regional or national conservation priorities are addressed, and that *offsets* are sufficiently large and well-connected to function effectively within wider landscapes.

Despite these positives, few aggregated biodiversity *offsets* yet exist. One reason is that they require significant seed funding to set up, with no guarantee of success. Using aggregated *offsets* may also make it difficult to demonstrate equivalence—the particular habitat or species being impacted may not be conserved in the aggregated *offset*. Industry may also feel that aggregated

97 New South Wales (Australia) Biobanking; State Government of Victoria (Australia) vegetation credit register; Canadian fish habitat; US species conservation banking; US wetlands banking; and German habitat banking, pp. 58–84. (See *Weblinks* on page 75.)

98 Fundamentals are provided in ICMM-IUCN (2013).

99 In Liberia, a proposed national biodiversity *offsets* scheme is tied to the expansion of the protected areas network. Sites chosen as aggregated *offsets* sites are among those with the highest value for biodiversity conservation: see http://documents.worldbank.org/curated/en/2015/04/24418254/national-biodiversity-offset-scheme-road-map-liberia%E2%80%99s-mining-sector

*offsets* are not closely linked enough, in public perception, to their project, and thus that they do not effectively address issues of reputational risk and stakeholder (especially local community) acceptance.

Aggregated *offsets* are being actively explored at present as part of proposed government regulatory schemes. For instance, the World Bank is promoting the use of national biodiversity *offsets* schemes, and has pilot projects in Liberia and Mozambique.

### How it works on water: offsets at sea

Most experience with *offsets* so far has been in terrestrial systems. However, the requirements of host-countries (usually), international financing institutions and other financiers as well as voluntary company-specific commitments apply just as much to the marine realm. Marine *offsets* are not fundamentally different to terrestrial ones. However, they do pose some specific challenges and complexities, for several reasons:[100]

- **Geography:** Marine systems are highly interconnected, and so a project's potential biodiversity-related impacts may be diffuse and widespread. In the water column and on the surface, ecologically important features are often highly mobile, and in unpredictable ways. Many species routinely move vertically, far more than in the terrestrial environment. In coastal environments, there are also strong interactions between land and water, so the sea is influenced by what is happening on the land—but not usually the other way around.
- **Ecology:** Marine organisms can have particularly complex life histories. They may inhabit different ecosystems at different life stages, and may also move from being highly mobile and widespread, as larval forms, to being sedentary and localized as adults. Many species show intense concentrations over short periods, meaning that some species may be very widespread but also highly dependent on a few locations, e.g. for breeding. Concentrations are linked to the non-continuous and variable resources of the marine environment.
- **Politics:** Tenure and ownership systems are usually very different with regard to the sea versus on land. Outside national jurisdictions, the high seas have no effective biodiversity-focused governance.
- **Data:** While there is an increasing number of good marine biodiversity datasets, data are often patchy and scanty as compared to terrestrial systems. Some ecosystems (such as the benthos and the open ocean) are intrinsically difficult to survey and monitor.

Experience in marine *offsets* is still very limited. However, as long as the particular characteristics of the marine realm are borne in mind, it should be possible to design and implement *offsets* in the ocean environment just as on land.

### Offset social success: worth striving for

Projects involving land-use change are often problematic with regard to their biodiversity risks and related impacts. An *offset* may take many years to demonstrate technical success for its target biodiversity features. With appropriate design, however, it could achieve 'social success' among key stakeholders much earlier. Early social success of an *offset* can address some project-related risks for at least the first 5–10 years of an *offset's* implementation period. Such success could encourage further financing and support of the project, and help achieve ancillary objectives such as maintaining the local social licence to operate and host-country government support.

A focus on achievable implementation targets for a biodiversity *offset*, such as community acceptance and participation and government engagement, in addition to technical/scientific outcomes, will help to ensure long-term success.[101] The success of some land-use compensation programmes not designed as biodiversity *offsets* is evidence of the importance of social success[102].

[100] See TBC (2013)

[101] BBOP (2009b) discusses engagement of stakeholders in a cost-benefit context.

[102] TBC (2014a)—a review of the Taninthayi Nature Reserve in Myanmar.

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Business and Biodiversity Offsets Programme: http://bbop.forest-trends.org/pages/mitigation_hierarchy

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Global Restoration Network: www.globalrestorationnetwork.org

Integrated Biodiversity Assessment Tool: https://www.ibatforbusiness.org/login

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Strategic Environment Assessment Information Service: www.sea-info.net

US species conservation banking: www.fws.gov/endangered/esa-library/pdf/conservation_banking.pdf

US wetlands banking: http://water.epa.gov/lawsregs/guidance/wetlands/mitbanking.cfm

UNEP WCMC Biodiversity A-Z: www.biodiversitya-z.org

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For a detailed example of applying the mitigation hierarchy at a major mine development, including quantitative biodiversity loss/gain accounting and offset design, see technical impact assessment documents for the Oyu Tolgoi project at http://ot.mn/en, especially:

- Biodiversity Impacts and Mitigation Actions for the Oyu Tolgoi Project (ESIA Appendix 3)
- Biodiversity offsets strategy for the Oyu Tolgiu project (ESIA Appendix 4)
- Net Positive Impact forecast for the Oyu Tolgoi project (ESIA Appendix 5)

The above ESI Appendices are available at: http://ot.mn/en/about-us/environmental-social-impact-assessment/esia#tabs-6

# Definitions

The definitions below are intended to clarify terminology used within the scope of this guidance. Unless otherwise indicated, they follow CSBI (2013a), which drew primarily but not exclusively from the IFC Performance Standards and documents produced by the CSBI member associations.

These definitions are intended to capture the broadly-understood meanings of terms (where those exist) while reflecting the specific needs of this CSBI guidance, which is focused on the practical implementation of biodiversity conservation via the mitigation hierarchy. Where substantively different definitions are also in common use, these are also noted.

Useful additional directories and glossaries of terms are provided by UNEP-WCMC's Biodiversity a-z (www.biodiversitya-z.org) and BBOP (bbop.forest-trends.org/pages/glossary).

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**Additional conservation action (ACA)**

An intervention intended to be positive for BES, but not providing measureable gains that can be set against residual impacts. ACAs may or may not target the BES features significantly impacted by a project.

**Area of influence**

An area likely to be affected (impacted) by:

- activities that are directly part of, or controlled by, a project (direct impacts);
- unplanned but predictable actions or conditions caused by the project, including those occurring later or at a different location (indirect or secondary impacts);
- external activities or facilities necessary to conduct the project and that exist primarily to support the project; and
- other existing, planned or reasonably predictable activities or resource uses that combine with the project; or activities or resource uses that create more than incremental effects (cumulative impacts).

**Avoidance**

Measures taken to anticipate and prevent adverse impacts on biodiversity before actions or decisions are taken that could lead to such impacts.

**Biodiversity and ecosystem services**

Biodiversity is the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species and of ecosystems[103]. Diversity is thus manifested across a range of scales, from the microscopic to the global. Biodiversity has a range of values based both on its existence and on its current and future, direct and indirect uses by people.[104] Biodiversity underpins the provision of ecosystem services, which are benefits people obtain from ecosystems. These include provisioning services such as: food and water; regulating services such as regulation of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient

[103] Convention on Biological Diversity: https://www.cbd.int/convention/articles/default.shtml?a=cbd-02

[104] For further details, see the A-Z of Biodiversity at http://www.biodiversitya-z.org/content/biodiversity.pdf

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| **Biodiversity and ecosystem services** *(continued)* | cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits. For further details, see the Millennium Ecosystem Assessment (www.millenniumassessment.org). |
| **Counterfactual scenario** | The project scenario under which there has been no application of the mitigation hierarchy. |
| **Critical habitat** | Areas with high biodiversity value, including:<br>● habitat of significant importance to Critically Endangered and/or Endangered Species;<br>● habitat of significant importance to endemic and/or restricted-range species;<br>● habitat supporting globally significant concentrations of migratory species and/or congregatory species;<br>● highly threatened and/or unique ecosystems; and/or<br>● areas associated with key evolutionary processes.<br><br>Critical habitat may be natural or modified. For the purposes of this guidance, and where applicable, the existence of ecosystem services of significant importance to the above species or to dependent community lives or livelihoods may also indicate high biodiversity value consistent with critical habitat. |
| **Cumulative impacts** | Impacts resulting from the successive, incremental, and/or combined effects of a development when added to other existing, planned and/or reasonably anticipated future ones (IFC, 2012c).<br><br>Examples include:<br>● reduction of water flows in a watershed due to multiple withdrawals; and<br>● forest habitat damage due to the combination of logging, road-building, resulting traffic and induced access. |
| **'Like-for-like or better' principle** | For *offsets*, conservation either of the same biodiversity values impacted by the project (an 'in-kind' *offset*) or those considered to be of a higher priority (an 'out-of-kind *offset* that involves 'trading up', i.e. where the *offset* targets biodiversity of higher priority than that affected by the project). |
| **Minimization** | Measures taken to reduce the duration, intensity, significance and/or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely *avoided*, as far as is practically feasible. (*Minimize* as used here does not imply an intention to 'reduce to zero', which is its legal meaning in some jurisdictions. Some companies have chosen to avoid using the words '*minimize*'/'*minimization*' and instead use words like 'limit'/'limitation' and 'reduce'/'reduction'.) |
| **Mitigation hierarchy** | The sequence of actions to anticipate and *avoid*, and where *avoidance* is not possible, *minimize*, and, when impacts occur, *restore*, and where significant residual impacts remain, *offset* for biodiversity-related risks and impacts on affected communities and the environment. |

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| Modified habitats | Areas that, prior to the onset of any activity related to the project, may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. |
| Natural capital accounting | The assessment of losses and gains of biodiversity and ecosystem services using a standardized approach to measure and account for BES in both physical and monetary terms. |
| Natural habitats | Areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. |
| No net loss | The point at which project-related impacts are balanced by measures taken through application of the mitigation hierarchy, so that no loss remains. |
| Net gain | The point at which project-related impacts on BES are outweighed by measures taken according to the mitigation hierarchy, so that a net gain results. May also be referred to as net positive impact. |
| Offset (BES offset) | Measurable conservation outcomes, resulting from actions applied to areas not impacted by the project, that compensate for significant, adverse project impacts that cannot be *avoided*, *minimized* and/or *restored*. (See also Box 10, below) |

*continued …*

**Box 10 Three definitions of biodiversity *offsets***

**IFC Performance Standard 6**

Biodiversity *offsets* are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate *avoidance*, *minimization* and *restoration* measures have been taken … A biodiversity *offset* should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats.

**BBOP (BBOP Standard on Biodiversity Offsets, page 13)**

Biodiversity *offsets* are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity *offsets* is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity. While biodiversity *offsets* are defined here in terms of specific development projects (such as a road or a mine), they could also be used to compensate for the broader effects of programmes and plans.

**Australia Government (Environment Protection and Biodiversity Conservation Act 1999: Environmental Offsets Policy 2012)**

An *offsets* package is a suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project … *Offsets* should align with conservation priorities for the impacted protected matter, and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain.

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| **Quality hectares** | A biodiversity metric that weights habitat area by its quality (often assessed on a scale of 0–1, or 0–100%) in terms of intactness or suitability for specific biodiversity features of interest. |
| **Residual impacts** | Project-related impacts that might remain after on-site mitigation measures (*avoidance*, set-asides, management controls, abatement, rehabilitation/*restoration*, etc.) have been implemented. Any reliable determination of residual impacts on biodiversity needs to take into account the uncertainty of outcomes due to mitigation measures. |
| **Restoration** | An established broad definition of *Restoration* is 'the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed'.[105] In the context of the mitigation hierarchy, it is the 'measures taken to repair degradation or damage to specific biodiversity features of concern (which might be species, ecosystems/habitats or ecosystem services) following project impacts that cannot be completely *avoided* and/or *minimized*'.<br><br>*Restoration* does not imply an intention to *restore* a degraded ecosystem to the same state and functioning as before it was degraded (which is the meaning in some specific jurisdictions, and may be an impossibly challenging or costly task). *Restoration* may instead involve land reclamation or ecosystem repair to return specific biodiversity features and functions, among those identified as targets for application of the mitigation hierarchy, to the ecosystems concerned.<br><br>When repair of damage does not focus on the biodiversity features and functions identified as targets for application of the mitigation hierarchy, it is better termed 'rehabilitation' and counts as an 'additional conservation action' (see definition, above) that does not contribute to biodiversity loss/gain accounting. |
| **Set-asides** | Land areas within the project site, or areas over which the client has management control, which are excluded from development and which are targeted for the implementation of conservation enhancement measures.<br><br>Set-asides will likely contain significant biodiversity values and/or provide ecosystem services of significance at the local, national and/or regional level.<br><br>These are likely to be most acceptable if defined using internationally recognized approaches or methodologies (e.g. high conservation value, systematic conservation planning). |
| **Significant conversion or degradation** | The elimination or severe diminution of the integrity of a habitat caused by a major and/or long-term change in land or water use; or a modification that substantially *minimizes* the habitat's ability to maintain viable populations of its native species. |
| **Strategic environmental assessment (SEA)** | Refers to analytical and participatory approaches that aim to integrate environmental considerations into policies, plans and programmes and evaluate the inter-linkages with economic and social considerations (OECD, 2006). SEA provides the context and framework for individual project environmental impact assessments. |

[105] SER (2004): *SER International Primer on Ecological Restoration*, Version 2. Society for Ecological Restoration International, Science and Policy Working Group.

# Acronyms

| | |
|---|---|
| ACA | Additional Conservation Action |
| ALARP | As Low As Reasonably Possible/Practical |
| BACI | Before-After-Control-Impact experimental/survey design |
| BAP | Biodiversity Action Plan: a plan to manage potential risks to changes in biodiversity or ecosystem services arising from environmental aspects of assets and activities; it lists the actions to take to conserve or enhance biodiversity. |
| BBOP | Business and Biodiversity Offsets Programme |
| BES | Biodiversity and Ecosystem Services |
| CBA | Cost-Benefit Analysis: a systematic and comparative approach to economically sound financial decision making |
| CEA | Cost-Effectiveness Analysis: a decision-making assistance tool for identifying the most economically-efficient way to fulfil an objective |
| CSBI | Cross Sector Biodiversity Initiative: a partnership between ICMM, IPIECA and the Equator Principles Association |
| EBRD PR6 | European Bank for Reconstruction and Development Performance Regulation 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources |
| EPAP | Equator Principles Action Plan |
| EPCM | Engineering, Procurement, Construction and Management contracts |
| EPFI | Equator Principles Financial Institution |
| ERD | Extended-reach drilling |
| ESAP | Environmental and Social Action Plan |
| ESHIA | Environmental, Social and Health Impact Assessment |
| ESIA | Environmental and Social Impact Assessment |
| GIS | Geographic Information System |
| IBAT | Integrated Biodiversity Assessment Tool |
| ICMM | International Council on Mining and Metals |
| IFC PS6 | International Finance Corporation Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources |
| IPIECA | The global oil and gas industry association for environmental and social issues. |
| MFI | Multilateral Financial Institution |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NNL | No Net Loss |
| NPI | Net Positive Impact (net gain) |
| ToRs | Terms of Reference (contractual/scope of work specification) |
| UNEP | United Nations Environment Programme |
| World Bank ESS6 | World Bank Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources |
| WCMC | World Conservation Monitoring Centre |

# Appendices

## Appendix 1: Horizon scan of future developments for *avoidance* and *minimization*

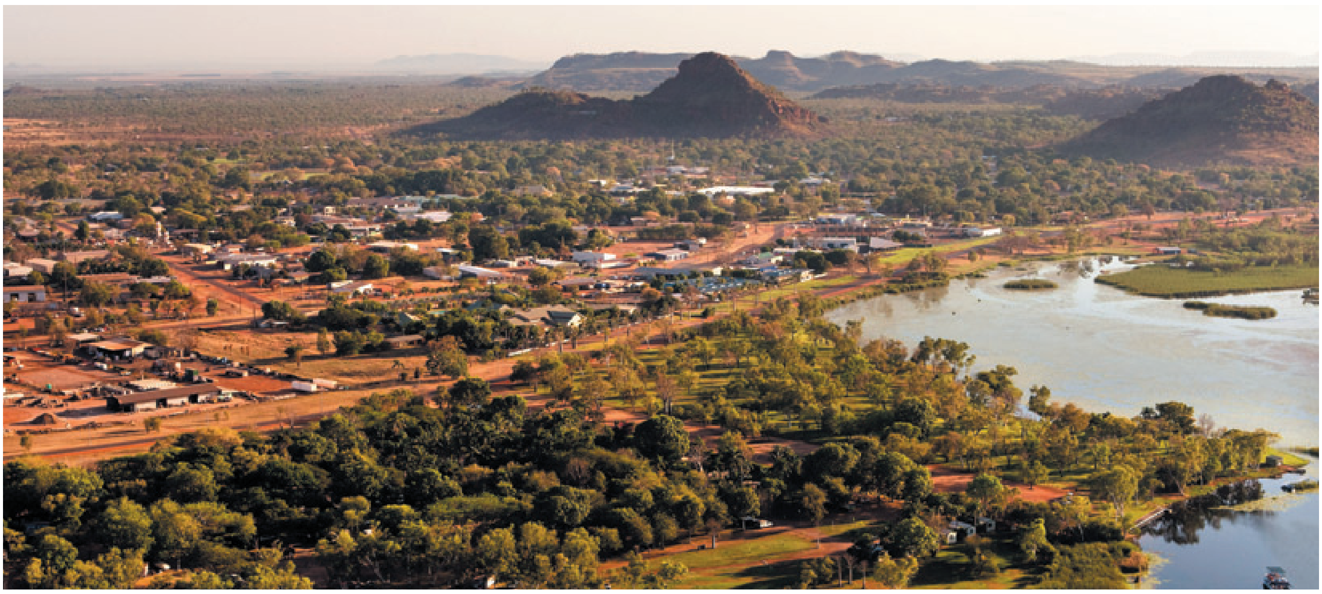
The availability, quantity and quality of biodiversity data are all improving, as are engineering techniques that make a wider range of mitigation options possible. Access to economic data is also improving, making it possible to more readily compare costs and benefits of alternative mitigation options. Oil and gas industry innovations are arguably developing more rapidly than within the mining sector; floating LNG production platforms and extended reach directional drilling are examples.

### The resolution of biodiversity data is increasing

An increasing granularity of biodiversity data sets is likely (e.g. access to higher-resolution satellite data sets, enabling a better understanding of spatial habitat distribution and even individual fauna species locations). This means that researchers and commercial developers will be able to have an improved and finessed understanding of the status and sensitivity of BES values in many locations.

### Information on the threat status of biodiversity is increasing

Ongoing work on a Red List of Ecosystems to go alongside the Red List of Species will greatly aid biodiversity risk management. A Red List of Ecosystems will inform a greater understanding of BES values, and will provide more accessible information on the location and status of habitat types that warrant consideration for *avoidance* or the implementation of appropriate *minimization* measures. Although a full global list is not expected to be published until 2025, many assessments will be carried out sooner and companies are already able to apply the Red List of Ecosystems criteria to the specific ecosystems in question. New Zealand has already benefited from such a pilot[106].



[106] http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2012.01868.x/abstract

### The number of Protected Areas is increasing

The designation of new Protected Areas will continue to increase on both land and sea, as countries aim to achieve the Aichi targets. Improving information on the threat status of species and ecosystems, and formalization of the IUCN global standard on Key Biodiversity Areas, will stimulate and direct the designation of new Protected Areas, under the Aichi Target 11 requirement to protect the areas most important for biodiversity and ecosystem services. This may impose constraints on development through 'no go' stipulations by governments but may also clarify where it is particularly important to consider *avoidance*.

### Natural capital accounting under development

Natural capital accounting may provide a single platform on which to assess losses and gains of biodiversity and ecosystem services. Considerable efforts are being made to develop this concept at the national and corporate levels, with much scope for linking it with project level assessments. The approach involves developing a more consistent standardized way to measure and account for BES in both physical and monetary terms

### Policy and regulatory developments are accelerating

Some governments require IFC Performance Standard conformance related to BES, in addition to national regulatory requirements. There may be an increasing emphasis (from regulators, policymakers and stake-holders) on documenting and demonstrating the implementation of the mitigation hierarchy, and the effectiveness of *avoidance* and/or *minimization* measures that are implemented for/by a project. This coincides with a current trend for the development of standards related to BES in some jurisdictions.

### Greater understanding of indirect BES-type impacts

Indirect impacts on BES are likely to become better understood in the coming years. As a result, there may be an increased expectation to manage and mitigate indirect impacts through the mitigation hierarchy.

# Appendix 2: Knowledge gaps in *avoidance* and *minimization*

Knowledge gaps can hinder the full development and implementation of the mitigation hierarchy with regard to BES-related challenges/situations. Future developments may fill these gaps and provide more opportunities for effective mitigation measures in more sectors. Many types of knowledge gaps exist related to BES topics, including:

- **Mitigation methods and their effectiveness:** operational experience is necessary to assess whether any untested mitigation method may be effective. Inappropriate mitigation method approaches/ideas can lead to higher costs and delays. Mitigation methods are evolving. Peer-communication across and within mining and oil and gas sectors could be useful.
- **Biodiversity data:** improvements are being achieved in data types, amounts, distribution in time and space, etc. For example, IUCN and its partners are working to map suitable habitat for particular species, so as to show more accurately where they may be present. However, more work is needed.
- **Knowledge of the sensitivity of biological receptors to physical impacts:** greater knowledge is required on key sensitivities, for example on total suspended solids and other types of effluent, and on their effects on tropical freshwater species.
- **New industrial technologies:** advances continue in new technologies such as directional drilling, underground mining, etc. New technologies have to be tested and may not always be applicable in every environment.
- **Knowledge to help identify *minimization* opportunities:** many opportunities for *minimization* have not been realized, especially in non-OECD countries. Some of these can be acted upon immediately with the correct use of available data and expertise. Industry can request this in ESHIA ToRs.
- **Financial data to inform cost-optimized mitigation:** some projects have been able to derive financial cost figures to compare the returns on investment through different stages of the mitigation hierarchy. Unfortunately these data are often only available after a period of implementation. However, useful estimates of costs can normally be derived early on, to inform the optimization process illustrated in Figure 5 on page 17. A benchmarking exercise to assess variation and average in mitigation measure costs could be useful (e.g. 'How much should I spend?').

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The Cross-Sector Biodiversity Initiative (CSBI) is a partnership between IPIECA, the International Council on Mining and Metals (ICMM) and the Equator Principles Association. Formed in 2013, the CSBI is a unique collaboration for bringing together the knowledge and expertise of biodiversity matters from its three participating sectors: finance; oil and gas; and mining.



Cross Sector Biodiversity Initiative

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