Biodiversity management in the cement and aggregates sector

Biodiversity Indicator and Reporting System (BIRS)

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1. Businesses adopt policies to manage biodiversity risks, so as to avoid and minimise biodiversity impacts and seek opportunities for biodiversity conservation and benefits for natural resource-dependent people.
2. Supply chains apply sustainability standards and safeguards that positively impact biodiversity and local livelihoods.
3. Public and financial sector policies promote the integration of biodiversity and livelihood values in business decision-making.

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Credits

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Foreword

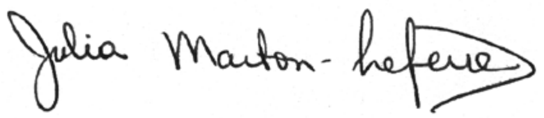
Businesses, especially companies with a direct footprint on the ground, are increasingly mindful of their impacts on biodiversity and how they can address these impacts through proactive biodiversity management. Biodiversity monitoring plays a vital role in the sustainable management of biodiversity and natural resources. Monitoring can provide companies with a better understanding whether they are achieving their intended results, as well as their broader implications. It can also aid in decision making, by ensuring that management decisions take into account up-to-date information. Biodiversity monitoring is also essential for corporate accountability and transparency.

IUCN, International Union for Conservation of Nature, created the Biodiversity Indicator and Reporting System (BIRS) to guide companies in the cement and aggregates sector in adopting a standardized system for monitoring biodiversity at their extractive operations, and to encourage regular reporting on biodiversity attributes at the company level. BIRS was designed specifically for Holcim, over the last three years by an IUCN panel of biodiversity experts, as an easy-to-apply system that can be largely implemented by existing company staff. It has been piloted at a number of operations and adapted based on company and expert feedback. This guide to BIRS describes the key elements of the methodology and provides an overview of how it can be adapted to address specific company needs.

This publication is part of a three-part series addressing the risks and opportunities for biodiversity and ecosystems that result from quarrying for cement and aggregates. While this particular guide is aimed at businesses and focuses on monitoring and reporting, the Integrated Biodiversity Management System looks at biodiversity management in and around company landholdings. The third guide on regulatory tools is addressed to policy makers, to support them in creating an enabling policy environment for improved biodiversity management in the cement and aggregates sector. The series emphasizes the distinct but complementary roles that governments and businesses play in the conservation and sustainable use of nature and natural resources.

BIRS provides the cement and aggregates sector with a unique opportunity to take the lead among extractive industries on biodiversity monitoring and reporting. The system can be adapted to various geographical locations and provides for incorporating data in various categories. This allows cement and aggregates companies to have an overview of the effects of their operations on biodiversity at various levels, from national to regional to global.

Finally, although BIRS was designed with the cement and aggregates sector in mind, IUCN believes that the approach can be adapted to other extractive industries. We invite the readers to share their experience with this guide, as well as more generally with biodiversity monitoring and reporting, to inform new and improved iterations of the guide and BIRS.



Julia Marton-Lefèvre
IUCN Director General

Executive summary

Biodiversity monitoring is an important part of effective biodiversity management on a company's landholdings. Monitoring can improve understanding of how company activities affect biodiversity, assess the effectiveness of biodiversity management activities and contribute to adaptive management of biodiversity at the site level. In addition, it is generally accepted that investment in monitoring will be proportional to the returns.

Because different levels of monitoring will serve different purposes, it is important to determine a company's monitoring objectives prior to designing and implementing a monitoring and evaluation (M&E) system. A comprehensive M&E programme requires at least two levels of monitoring: site-level monitoring focused on site-specific biodiversity characteristics and monitoring across company landholdings to assess overall changes to biodiversity and support standardized reporting.

The Biodiversity Indicator and Reporting System (BIRS) is designed to address this second type of monitoring, looking at a company's landholdings as a whole and assessing their overall level of suitability for biodiversity. The system has been designed with the cement and aggregates sector in mind, given the sector's widespread geographical reach across a diverse set of ecosystems, from industrial areas to degraded and agricultural land to pristine natural environments. The system aims to strike the balance between practicality and scientific robustness and is intended for widespread application.

BIRS is designed to be a key part of an overall biodiversity management system, particularly as a complement to IUCN's Integrated Biodiversity Management System (IBMS). The adoption of an IBMS involves development of a company-level biodiversity policy with vision and objectives, early identification of biodiversity risks and opportunities and differentiated biodiversity management responses that can be implemented at the site level, depending on the value of and expected impacts to biodiversity at each stage of an operation. BIRS builds on this system by allowing companies to understand how biodiversity is doing on all sites and how it is changing over time, as well as identify any indications of the need to adapt company-wide management practices.

BIRS can help companies determine how they are affecting habitats and ecosystems, the effectiveness of their biodiversity mitigation and habitat rehabilitation measures, and how they can measure and report on their management activities. The system is not designed to provide a biodiversity inventory or a biodiversity rating of a site, both of which should have been determined earlier as part of an Environmental and Social Impact Assessment (ESIA) process. It is also not designed to monitor high-value biodiversity management targets pursued through a BAP or as part of a Rehabilitation Plan, which should be monitored through more specific and detailed M&E provisions.

BIRS is an easy-to-apply system for calculating an annual biodiversity condition index for every active or disused extraction site and reserve landholdings, taking into account (1) the extent of every habitat type found on a site (including operational and rehabilitation areas), (2) the ecological condition of these habitats, especially their suitability for biodiversity and (3) the uniqueness and ecological importance of each habitat in the regional context. BIRS essentially represents a balance sheet of a company's 'biodiversity assets' and summarizes the composite value of its landholdings for supporting biodiversity.

Implementing BIRS involves several steps that ultimately lead to the determination of an overall Site Biodiversity Condition Class for each individual operational site assessed. The first steps involve identifying and delineating the different habitats that make up the site, and then estimating the total area for each habitat type. Next, it is necessary to determine the Habitat Context Factor for each habitat block, based on how widespread it is in the landscape, the intrinsic biodiversity value of the habitat, the degree of threat and its ecological importance. Building on this, the next steps involve assessing the condition of each habitat and assigning each a Habitat Condition Class, based on the potential for enhancements and the level of current threat. The final step of the process combines this information on the extent of each habitat type and their context factor and condition indices, to determine an overall Site Biodiversity Condition Class.

Once these Site Biodiversity Condition Classes are determined, the indices of all sites in a selected region or country can then be aggregated into a regional/national index that can, in turn, be combined on a global level – indicating whether the overall biodiversity suitability of the global landholdings over which a company has management control is increasing or decreasing.

Once it is well-established, BIRS can be used for regular and standardized reporting on changes to biodiversity conditions, as well as to set biodiversity-related targets expressed through a Key Performance Indicator (KPI) on biodiversity at the local, national and/or global level.

There are a number of important considerations when rolling out BIRS, including the need to set aside resources for the customization, set up and running of the system, as well as the need to establish appropriate institutional arrangements. It will be important to ensure commitment of financial resources and support at the highest levels of the company. In addition, it may be necessary to increase in-house capacity, including building specific biodiversity expertise among company staff and introducing targeted training programmes, as well as develop relationships with external experts.

Steps to implement BIRS: A quick overview

Step 1 – Identify and delineate habitats.

- Subdivide the entire site into different habitat types, and delineate on a map.

Step 2 – Estimate the area of each habitat type.

- Estimate the surface area (in hectares) for each identified habitat type, rounding to the nearest hectare for large areas and the nearest 0.25 hectares for smaller areas and water bodies.
- Each habitat block larger than 1 ha should be identified and evaluated, and disconnected areas of the same habitat type can be combined.

Step 3 – Determine context factor of each habitat/habitat block.

- Habitat Context Factor is determined by the answers to four questions:
  - How widespread is the habitat in the surrounding landscape?
  - What is the intrinsic biodiversity value of the habitat likely to be?
  - What is the degree of threat to this habitat nationally?
  - What is the ecological importance of this habitat in the surrounding landscape?

Step 4 – Assess condition of each habitat/habitat block.

Step 4a — Decide on survey method.

Step 4b — Choose survey locations.

Step 4c — Record the condition of the habitat.

Step 5 – Evaluate the Habitat (or habitat block) Condition Class.

Step 5a — Record possible habitat enhancements.

Step 5b — Record habitat threat score.

Step 5c — Calculate Habitat Condition Class.

Step 6 – Determine the overall Site Biodiversity Condition Class.

- This value is derived from the extent of each habitat type, and the context factor and condition index of those habitats, and is recorded in the Site Biodiversity Summary Sheet.

Introduction

The importance of biodiversity monitoring in the cement and aggregates sector

The Biodiversity Indicator and Reporting System (BIRS) was developed to help companies in the cement and aggregates sector monitor and evaluate changes to biodiversity on their landholdings, through repeated, consistent assessment and aggregation of the suitability of these landholdings for biodiversity.

The adoption of a monitoring and evaluation (M&E) programme is essential for ensuring effective biodiversity management. A well-designed M&E programme allows a company to assess whether its biodiversity management actions are having the desired effect and also serves to inform management decisions, allowing for adaptive management. Biodiversity monitoring can also deepen understanding of interactions within ecosystems, uncover changes that could not have been foreseen at the onset of monitoring activities, and support stakeholder engagement.

To be successful, an M&E programme needs to be designed as a function of a company's objectives for what it wants to achieve in relation to biodiversity. Such a biodiversity monitoring system should generally have four basic objectives:

1. monitor relative changes in biodiversity;
2. assess the effects of mineral resource extraction on biodiversity;
3. evaluate the effectiveness of biodiversity management measures on performance and outcome levels (against chosen indicators or targets); and
4. provide information for reporting on biodiversity management performance and outcomes.

A comprehensive M&E programme, addressing all four objectives, requires at least two levels of monitoring: (1) monitoring across company landholdings to provide an overview of changes to biodiversity throughout the company and to allow for standardized reporting on biodiversity and (2) specific monitoring of special biodiversity features that might be present on a site and are being addressed through targeted biodiversity management measures as described in a Biodiversity Action Plan (BAP) or Rehabilitation Plan.

While BIRS has been designed to address the first monitoring level, focusing on objectives 1 and 4 above, the second M&E level requires specific monitoring programmes with tailored indicators and probably also requires expert support. These are not discussed in this guide.

About this guide

BIRS was developed over three years by an IUCN panel of biodiversity experts, with input from experts in many disciplines from the IUCN network. It has undergone field testing with company staff and a peer review process to ensure scientific robustness. Affordability and practicality of implementation by a commercial company, using mostly local company staff, were key considerations in the design of BIRS.

This guide describes the BIRS methodology that needs to be put in place at the company level for monitoring biodiversity changes. This guidance is aimed primarily at sustainability and/or environment managers at the company level who are responsible for implementing company-wide systems for biodiversity management.

Chapter 1 explains the link between BIRS and biodiversity management, specifically IUCN's Integrated Biodiversity Management System (IBMS). **Chapter 2** outlines the structure and key features of BIRS. **Chapter 3** explains the key steps for implementing BIRS at the site level, while **Chapter 4** focuses on the aggregation and reporting of indices. **Chapter 5** provides guidance on rolling out BIRS.

1. The relationship between biodiversity management and BIRS

BIRS has been designed to complement IUCN's Integrated Biodiversity Management System (IBMS), by providing a practical biodiversity monitoring methodology that can be applied throughout a company's operations, as part of an overall biodiversity management system. Accurate monitoring is vital for assessing the effectiveness of biodiversity management activities.

The IBMS provides guidance to companies in the cement and aggregates sector on the development of an integrated, systematic and prioritized approach to managing biodiversity throughout the life cycle of their operations, using a risk-and-opportunity-based approach. The IBMS builds off company business processes by integrating appropriate biodiversity measures and considerations into existing strategic and operational processes, rather than creating new planning and management steps.

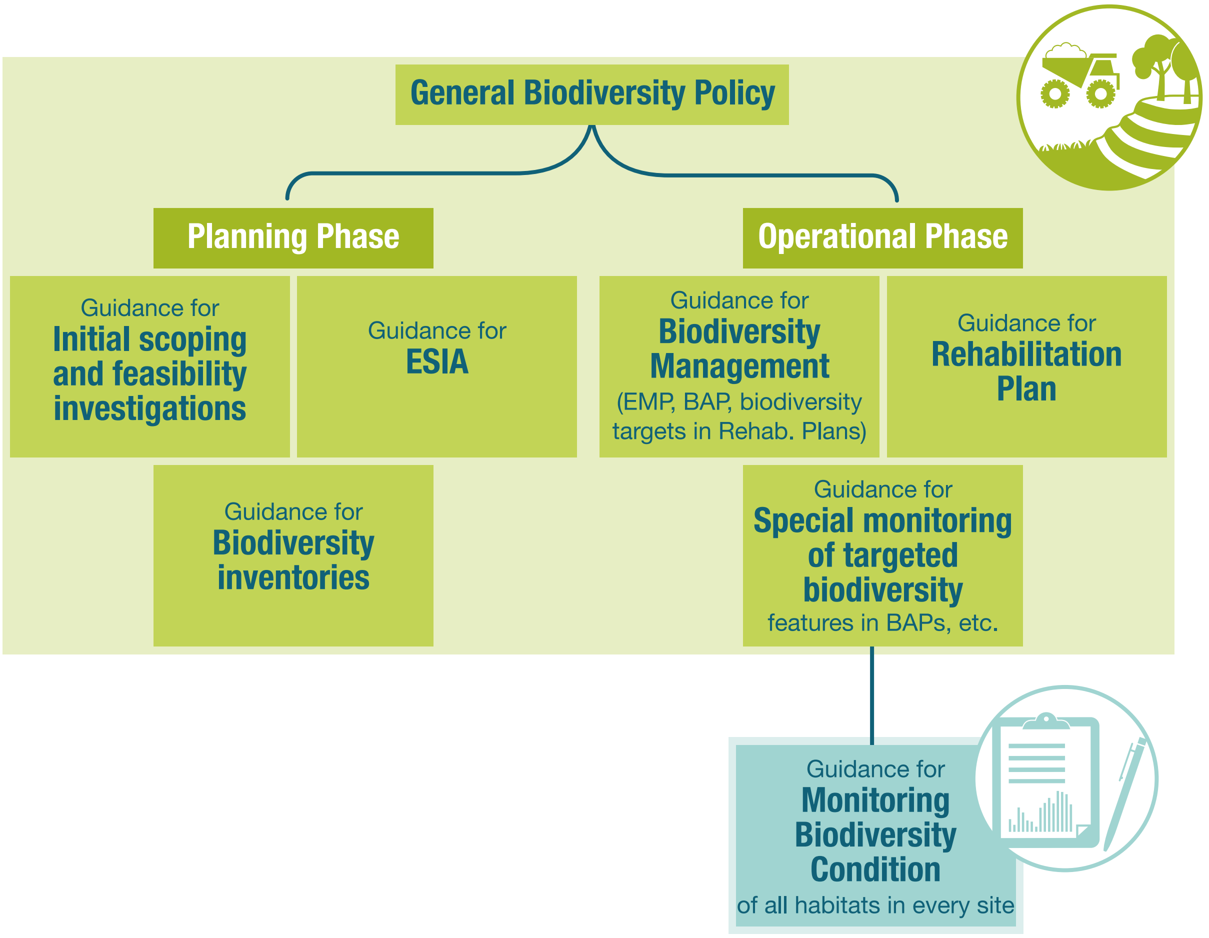
In the IBMS, a risk-based approach is used to integrate biodiversity into all stages of operations, from planning for extraction through to site closure. Differentiated biodiversity management options are proposed, based on the value of and expected impacts to biodiversity at each stage, to ensure that the level of management is commensurate with the level of risk. The Biodiversity Risk Matrix is the principal screening tool for use in an IBMS; the matrix plots biodiversity importance against risk to biodiversity (see Box 1). While the importance is intrinsic and will stay the same irrespective of any development that might take place, the impact measurement is based on a mixture of likelihood of impact and the possibility of mitigation. The matrix allows priorities to be set for detailed evaluation and action, as well as the go/no-go decision.

An effective monitoring system is an important contributor to responsible biodiversity management. The IBMS guide provides general guidance on the need for an M&E system, differentiating between different types of monitoring linked to biodiversity risk, as well as specific needs for sites of high biodiversity importance, areas governed by Biodiversity Action Plans (BAPs) and rehabilitation plans.

BIRS builds on the IBMS by allowing a company to assess changes in the suitability of their sites for biodiversity over time, at all operational sites, thus determining whether there is a need to adapt their company-wide biodiversity management practices. In addition, BIRS includes an assessment of threats to habitats within a site that can support adaptive management at the site level, and provide an overview of common threats posed to biodiversity across the company.

Given that BIRS relies on the assessment of habitat condition using a simplified habitat classification system that can be applied across geographical settings and implemented by non-experts, it is not meant to replace site-level monitoring that is required on sites with high biodiversity importance, where specific biodiversity targets are being pursued through BAPs or rehabilitation plans. The target-specific M&E system, required by BAPs or rehabilitation plans, and the BIRS system are designed to complement each other: BIRS looks at the overall biodiversity suitability of the site, while the M&E provisions of a BAP or rehabilitation plan monitor the success of targeted biodiversity measures.

Figure 1 – Structure of an IBMS and relationship with BIRS



Theoretically, BIRS can be used without implementing a full IBMS. However, it is strongly recommended that the two systems be operated together. The development of an IBMS will provide the baseline information required for BIRS, and the use of IBMS, accompanied by the implementation of BIRS, can enhance the protection and management of biodiversity at extraction sites.

Particular aspects of the IBMS that would facilitate the implementation of BIRS are:

- **Habitat maps of the site.** Although BIRS requires these to be adapted to the simplified habitat classification used in this system, the existence of some sort of current habitat map covering the entire site, from which the BIRS habitat classification can be deduced, is essential.
- **Correct allocation of Biodiversity Importance Category (BIC).** This requires that the presence of globally, nationally and locally important species has been addressed, including verification by an expert that species that are potentially present are actually on the site and dependent on its habitat. An analysis of the proximity of protected areas is also required, implying a consideration of possible conservation priorities outside the site boundaries. For any sites where the BIC and likely impact level indicate that a high level of biodiversity management is appropriate, a BAP should have been developed, according to IBMS guidance. Thus, correct identification of a site's BIC ensures that elements of high biodiversity importance are being specially tracked, on a more detailed level than provided for by BIRS.

If an IBMS is not in place when BIRS is adopted, the two systems could be developed concurrently, though this would place a greater demand on company resources.

Box 1 – Risk and opportunity assessment

Biodiversity impact level

		Potential for mitigation			
		Irreversible	Difficult to mitigate	Can be mitigated by intervention	Easily reversed naturally
Likelihood of impact	Almost certain	A	A	B	C
	Likely	A	B	C	D
	Moderately likely	A	B	C	D
	Unlikely	B	C	D	D

A Very significant **B** Significant **C** Moderately significant **D** Low significance

Biodiversity risk matrix

		Expected impact levels on biodiversity Risk to biodiversity value of site (and/or surrounding area)			
		A	B	C	D
Biodiversity Importance Category	1A	Critical	Significant	Medium	Low
	1B	Critical	Significant	Medium	Low
	2	Critical	Significant	Medium	Low
	3	Significant	Medium	Low	Low
	4	Low	Low	Low	Low

Biodiversity importance categories (BIC)

1a Occurrence on site of:
- globally threatened species (IUCN Red List)
- overlap with or adjacent to internationally recognised protected area
- globally outstanding and/or threatened ecosystem/habitat

1b Occurrence of the above within 500m of site or with relevant ecological connections to the above

2 Occurrence on site or within 500m or with relevant ecological connection of:
- nationally threatened, rare species
- nationally protected (recognised) area, reserve, etc.
- nationally important and/or threatened ecosystem/habitat

3 Site:
- in landscape with diverse, natural ecosystems
- in modified landscape with potential for biodiversity enhancement (biodiversity island)
- with significant local value of the natural environment

4 Site in heavily modified, intensely managed landscape (including monoculture)

2. The biodiversity indicator and reporting system

Purpose and goal

The general purpose of BIRS is to standardize the monitoring and reporting of specified biodiversity characteristics throughout a company's operations, in order to provide an understanding of the effectiveness of the company's biodiversity management practices and to improve awareness of its effects on biodiversity. The adoption of BIRS helps answer a series of questions linked to biodiversity management, monitoring and reporting (see Box 2).

The overall goal of such a system is the annual calculation of a biodiversity condition index for each of a company's extraction sites, combining annual assessments of the extent and condition of the habitats within the site. The calculation of this index summarizes the composite value of the company's landholdings for supporting biodiversity. Site-level indices can be aggregated for reporting at the country, regional and global levels, and ultimately for setting company-level biodiversity targets expressed through Key Performance Indicators (KPI).

Applicability

All landholdings under the company's management control, irrespective of whether they are owned or leased, actively mined, or permanently or temporarily unused, should be included in the BIRS assessment. Land that is owned by the company but leased out to a third party for commercial use or for conservation management purposes should likewise be included.

In addition, a company may also choose to include adjoining or nearby offset areas that might be managed to compensate for habitat losses caused by extraction operations, or former leased areas handed back to the owner which, through targeted rehabilitation efforts by the company, have become valuable for biodiversity. If there is a formal offset area agreed with the relevant authorities as part of permitting, this should be included in the BIRS assessment, whether the land is currently owned by the company or not. Any area constituting an offset that is based on a less formal or voluntary agreement should be included if the company has made a commitment to its management or specific biodiversity outcomes.

Advantages and limitations of the system

Practicality of implementation is an important consideration for business and therefore a key criterion for success of any system designed with the business sector in mind. To fit the needs of the cement and aggregates sector and to help provide companies in the sector with an overview of biodiversity changes throughout their operations, BIRS was designed to:

Box 2 – Questions BIRS seeks to address

A. How are we affecting habitats and ecosystems for which we are responsible?

↓

B. How effective are our mitigation and habitat rehabilitation measures?

↓

C. How do we measure, and report on, our biodiversity management performance?

- be meaningful, but relatively straightforward to measure;
- be largely assessable by non-experts (i.e. company staff);
- be measurable by means of a standardized methodology that can be used worldwide in any habitat or ecosystem;
- allow information to be collated internally as part of an existing environmental reporting system;
- be sensitive to major changes to habitats and biodiversity when they happen as part of mineral extraction operations;
- be expressed by numerical values; and
- allow aggregation of individual site values to national and global levels.

BIRS is also designed to strike a balance between what is practical and affordable for a company and scientific rigour. This requires trade-offs and reveals some important limitations. For example, BIRS uses relatively coarse measures and is not designed to detect small incremental changes in relation to biodiversity; instead, it focuses on bigger and longer-term changes. Where a more refined and rigorous approach to evaluating the success of biodiversity management is required, for example in the presence of a BAP, an M&E system with scientifically more robust provisions should be used.

In addition, it is not always straightforward to determine whether a company's extraction operations are affecting habitats and biodiversity, particularly if these changes are of a more subtle nature than the obvious case of, for example, clearing a forest before mining. Some indirect links may be suspected between biodiversity and a particular action but impossible to prove with the proposed BIRS, for example, possible changes in biodiversity in adjoining habitats (e.g. through noise or dust pollution or through habitat fragmentation). Therefore, a company using BIRS may not be able to pick up subtle changes in biodiversity triggered by its activities or, vice versa, may record negative changes in biodiversity for which it might not be the cause.

Another limitation is that an important element of biodiversity and habitats, the ecological functions and services they provide, cannot be measured in such a simplified approach. BIRS relies on assessment of habitat condition using a simplified habitat classification system, as well as on questions that apply globally and that can be answered by lay persons. Questions that require significant ecological expertise to answer, such as the appraisal of ecological functions, had to be omitted.

Despite these limitations, the BIRS is still able to provide credible and usable information to a company. Because BIRS focuses on changes in biodiversity suitability, rather than absolute levels of biodiversity values, what matters is the magnitude and direction of change between two successive assessments.

General overview of the system

BIRS is an easy-to-apply system for the regular calculation of a biodiversity condition index for each of a company's active or disused extraction sites and reserve landholdings. Deriving this index, the Site Biodiversity Condition Class, involves the following steps:

- identifying and delineating the extent of every habitat type found on a site (including operational and rehabilitation areas);
- estimating the surface area of each different habitat type;
- determining a context factor for each habitat, based on how widespread it is, its intrinsic biodiversity value, the degree of threat to the habitat and its ecological importance in the surrounding landscape;
- assessing the ecological condition of these habitats, especially their suitability for biodiversity (i.e. habitat factors that, actually or potentially, favour biodiversity); and
- evaluating the condition class of each habitat, based on possible habitat enhancements and current level of threat.

Once the condition class values of all sites of a selected region (sub-national) or country have been determined, they can then be aggregated into a regional/national index, which in turn can be combined on a global level to indicate whether the overall biodiversity suitability of the landholdings over which a company has management control is increasing or decreasing.

Figure 2 provides a summary of the key steps of BIRS. These steps are further elaborated in the following chapters.

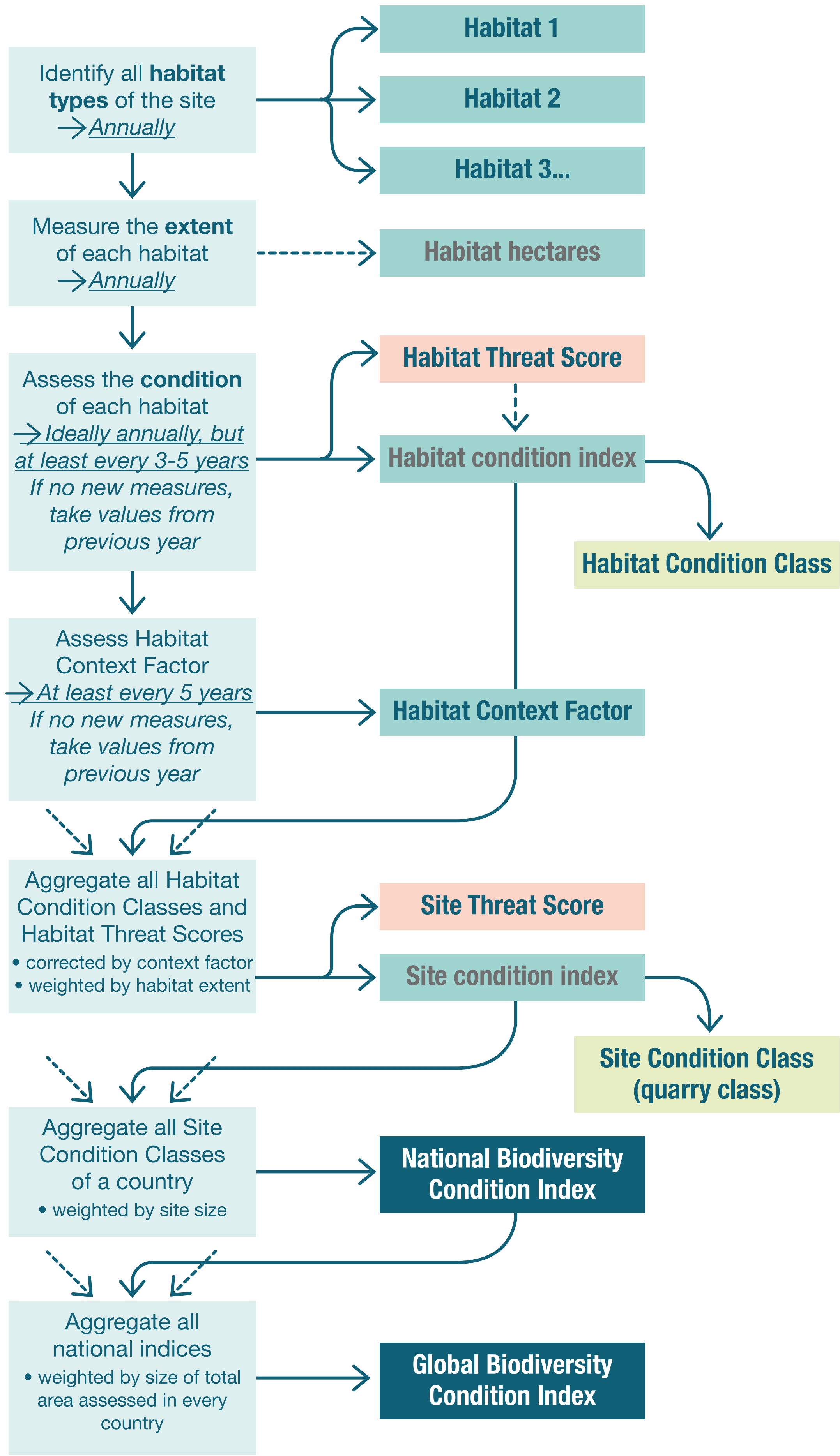
By summarising the composite value of all of a company's landholdings for supporting biodiversity, BIRS essentially represents a summary of a company's 'biodiversity assets' at a local, regional, national or global level of operation. While habitat extent describes the quantity of each asset item on the balance sheet, habitat condition represents the quality of each item. An additional factor, uniqueness and ecological importance, places the habitat extent and quality in a wider context, by looking at the surrounding area.

A rise in the calculated index value, and especially an increase in the Site Biodiversity Condition Class, from one assessment to the next indicates an overall enhancement of the suitability of a site for biodiversity, while a decrease signals a lowering of the site's value for biodiversity. Table 1 provides a summary of the factors that contribute positively or negatively to a site's biodiversity suitability.

Table 1 – Net changes of BIRS score through positive and negative factors

	Largely under company control	Outside company control
Positive	• Reduction of Operational Areas, i.e. turning land into Rehabilitation Areas, either through deliberate or accidental neglect or through active management • Improvement of existing habitats through proactive management, including decrease of threats to habitats • Creation of new habitats with a higher regional context factor • Acquisition of new land containing good-quality habitats	• Habitats on company site becoming regionally more unique (i.e. disappearing in surrounding area through land-use changes, leading to an increase in the value of the context factor) • Changes in the international or national classification/listing of certain species and habitats, thereby affecting context factors
Negative	• Expansion of quarry area, through conversion of natural habitat • Deterioration of existing habitats, including increase of threats • Divestment of land in good condition	• Significant improvement of habitats in surrounding areas (leading to reduction of context factor of company-owned habitats) • Changes in the international or national classification/listing of certain species and habitats, thereby affecting context factors

Figure 2 – General overview of BIRS



3 Steps to implement BIRS

This chapter outlines the six main steps involved in defining a Site Biodiversity Condition Class for each of a company's operational sites. Depending on the size of the site, a full BIRS assessment generally should take between half a day (for small sites) to two days (for very large sites of 1,000 ha or more). Most of this work has been designed to be done by non-experts, i.e. company staff, but the oversight and assistance of a trained expert, such as a consultant or local partner NGO, during the set-up phase and the first assessment is required.

STEP 1 – Identify and delineate habitats

At the end of STEP 1, a habitat map for the site will be available. This map will contain a subdivision of the different habitats present on the site, based on the habitat classification in Figure 3 and the habitat definitions in Annex 1.

Different types of ecosystems and habitats support different levels of biodiversity and different species communities, and thus require different sets of questions for assessing their particular condition and suitability for biodiversity. The starting point for the implementation of BIRS involves subdividing an extraction site into its different components of land use and habitat types, using the major subdivisions shown in Figure 3.

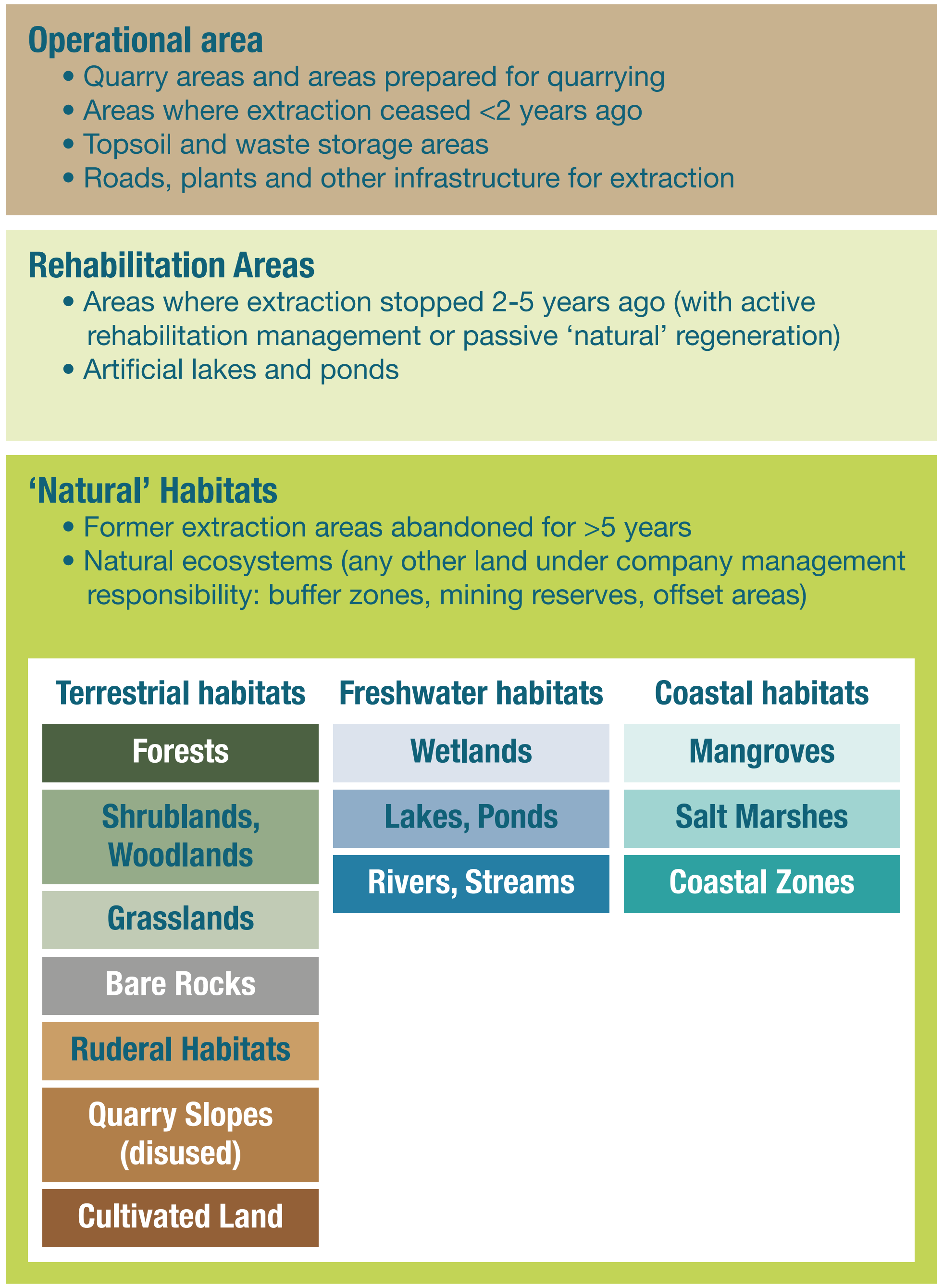
A simplified division of 13 different 'natural' habitat types is used in the BIRS, designed for universal application in resource extraction for cement and aggregates. Though the initial site-level identification of habitats should be completed with the assistance of a trained ecologist, the system is tailored towards easy application by non-expert company staff, through the use of a habitat decision tree (Annex 1).

The BIRS habitat classification identifies and delineates discrete geographical units whose relative biodiversity suitability can be tracked over time through repeated assessments. The classification is not aimed at reflecting the relative biodiversity and conservation importance of specific areas. As noted in Chapter 1, identification of an area's BIC is a prerequisite for applying BIRS.

In general, the results of a BIRS assessment will not be affected if a habitat could be allocated to either of two different habitat types (e.g. if a forest is classified as a shrubland), provided that the classification will be retained over the years. However, re-classification will be required if a habitat has clearly evolved into another type, for example grassland that has turned into woodland, or a wetland that has dried up because of a change in hydrological factors.

Although the BIRS habitat classification broadly follows the highest hierarchical level of the habitat classification scheme used by the IUCN Red List (Table 2), some simplifications and modifications were necessary due to the following factors:

Figure 3 – Land and habitat type classification for natural resource extraction quarries



→ For decision tree on habitat classification, see **Annex 1.**

- the specific nature of the habitats found on cement and aggregate extraction sites (with deeper marine habitats, for example, being absent);
- the difficulty in unequivocally distinguishing between different habitats, especially by lay observers (e.g. the need for specialist ecological knowledge on functional properties and temporal variations of ecosystems and on natural vs. anthropogenic ecosystems);
- the excessive complexity of developing and implementing monitoring procedures tailored to the various finer-level habitats distinguished in the IUCN classification scheme; and
- the need for a separate BIRS habitat, Ruderal, to take into account the dense and vigorous vegetation developing on roadsides and other disturbed areas in quarries, which often have a significant amount of alien invasive species and

cannot be comfortably fitted within any of the IUCN categories or within any of the other BIRS habitats.

The information on habitat type and extent may already be available where an ESIA has been carried out. Often, more detailed habitat or ecological maps are available, depicting habitats on a finer level than required for BIRS; in such a case, the habitat categories of the ESIA should be grouped into the less-refined BIRS categories.

At sites where operating permits pre-date ESIA regulations and no detailed studies are available, it can be useful to enlist an external expert to assist in the identification and delineation of the different habitat types. A combination of satellite images and/or aerial photographs, together with ground checks, can be used, keeping in mind the balance between the need for accuracy and the need for expediency. Areas of a particular habitat that contain patches of other habitat types of less than one hectare should be treated as the single dominant habitat.

While definitions are provided for all BIRS habitat types in Annex 1, some habitats require additional explanation:

Operational Areas: The operational areas represent pieces of land where, through the removal of most of the organic structure, the visible parts of nature have all but disappeared. These areas represent the heaviest form of interference with local habitats and provide the natural resource extraction company with a minimum base from which to build up the biodiversity value of a site through rehabilitation and proactive biodiversity management of the non-mined land under its control.

Rehabilitation Areas: Rehabilitation of areas where resource extraction is completed is the most widespread form of biodiversity management undertaken by natural resource extraction companies, and is the easiest way for a company to improve its site biodiversity condition index over time. Rehabilitation generally takes one of two forms: The first, natural regeneration, involves leaving such areas alone and allowing natural ecological processes to take their course. The more common alternative, however, is active management intervention to quicken the process of rehabilitation. In the context of the BIRS, the creation of post-mining habitats that are rare or of high priority for biodiversity conservation in the region is particularly important: such habitats have a particularly high positive impact on a Site Class and the company biodiversity balance sheet.

Ruderal Habitats: These are very common in mining areas, particularly on road verges or in other fairly heavily disturbed areas. Some of these features overlap with other habitats under the BIRS classification. As such, this classification category should only be used when the habitat in question, with the best of intentions, cannot comfortably be assigned to any other habitat type, especially because the condition of these Ruderal Habitats will not be scored, but rather assigned a fixed default value in the lower half of the assessment scale. For example, large canopy openings in a forest caused by the fall of a large tree can be colonized by exactly this type of vegetation (minus the alien invasives); the vegetation on old quarry slopes, in particular on the re-contoured slopes, often conforms to this type of habitat; and areas that are transitional and successional between, for example, a shrubland and a forest could also fall under this new definition.

STEP 2 – Estimate the area of each habitat type

In STEP 2, the surface area for each of the identified habitats is estimated (the sum of which should amount to the total area of the site).

Size of habitats and habitat blocks

In many quarries, natural habitats of different types, extraction sites and rehabilitation areas form a complex mosaic of intermixed patches of various sizes (habitat blocks). To make it easier to assess the extent of each habitat type, the following guidelines are used (and should ideally be applied with the help of an expert during the initial set-up process):

- Every habitat block larger than 1 ha should be evaluated separately. However, disconnected blocks of the same habitat type, which appear similar in their habitat structure and have the same regional context value (see Step 3), can be pooled and assessed as one unit. Habitat patches of less than 1 ha should be treated as a habitat inclusion with the habitat that encloses

Table 2 – Relationship of habitat classification used by BIRS and IUCN Red List

IUCN Red List classification	BIRS habitat classification
1. Forest	Forests
2. Savannah	Shrublands, Woodlands
3. Shrubland	Shrublands, Woodlands, (Ruderal Habitats)
4. Grassland	Grasslands, (Ruderal Habitats)
5. Wetland (inland)	Wetlands
	Rivers, Streams
	Lakes, Ponds
6. Rocky areas	Bare Rocks, Quarry Slopes, (Ruderal Habitats)
7. Caves and subterranean habitat	N.A. (see special comment under Step 3)
8. Desert	Included in Grasslands
9. Marine neritic	N.A.
10. Marine oceanic	N.A.
11. Marine deep ocean floor	N.A.
12. Marine intertidal	Mangroves
	Salt Marshes
	Coastal Zones
13. Marine coastal/supratidal	Coastal Zones (IUCN subcat. 13.1-13.3)
14. Artificial – terrestrial	Cultivated Land
15. Artificial – aquatic	Lakes, Ponds
	Cultivated Land
16. Introduced vegetation	Level of invasive vegetation to be assessed as threat factor under each habitat

them or which lies adjacent to them, provided that, together, they are greater than 1 ha (see Step 5).

- For planted Rehabilitation Areas, Lakes and Ponds, Rivers and Streams, the minimum size for the area to be treated as a separate entity is 0.25 ha, i.e. a block of 50x50m.
- Habitat blocks of the same habitat types, whether adjoining or separate from each other, that have a different context value (e.g. a plantation forest versus a natural mixed-wood forest) must be assessed separately (see Step 3). The same questionnaires will be used for both, but the resulting index, like the context value, could be very different.
- If habitat blocks of the same type but with different context factors are greatly intermingled and their precise extent is difficult to delineate and measure on a map, a percentage estimate of each of these habitat sub-types could be made, and the overall habitat extent subsequently proportionally allocated to each habitat sub-division. However, a separate condition assessment of each habitat sub-type would still be required.

The area of every habitat should be recalculated and recorded every year. This figure can be derived from existing maps and/or calculated from the previous year's figures by looking at what has been added or subtracted as a result of new operational areas being developed, areas taken out of production, new land being added through purchase or lease, or existing land being disposed of through sale or termination of lease agreements.

Estimating habitat extent

A central element of the implementation of BIRS is assessment of the surface area (to the nearest one-tenth of a hectare) of the habitat types found at site level. These figures are needed for weighting the sizes of individual habitat types in the calculation of the overall condition index and the determination of the Site Biodiversity Condition Class. As explained in Step 1, ESIA studies may be a good source of information for habitat classification and extent. The paper or digital map can be captured in a Geographic Information System that allows for the calculation of the extent of each habitat in hectares.

In some cases, it will be necessary to subdivide a habitat type into different habitat blocks and estimate their spatial extent separately, specifically when these habitat blocks have an obviously different regional context factor (Step 3). For example, a calcareous grassland on nutrient-poor soil and a meadow on rich soil in a different part of the site may both be classified as Grasslands and assessed with the same questionnaire, but the former, which might be a much rarer habitat in the region, could thus have a higher context factor than the latter. Therefore, the two habitat blocks should be included in the calculation of the site index as separate units, each with a separate figure for its spatial extent. The same could apply to different sets of forests – a stand of good mixed native woodland and a plantation largely consisting of alien species are likely to have different regional context factors and should likewise not be pooled into one habitat unit, although the same habitat questionnaire will be used for their respective assessments.

The sample map in Figure 4 illustrates the different potential occurrences of habitats in a quarry, including:

- Operational Areas;
- Rehabilitation Areas;
- Terrestrial habitat types:
  - in one continuous block (Grassland);
  - separate blocks, but with same context factor (Shrubland);
  - separate or adjoining blocks with different context factors (Forest);
- Lakes and Ponds; and
- River or Stream running through the site.

STEP 3 – Determine context factor of each habitat/ habitat block

STEP 3 will lead to a Habitat Context Factor being attributed to each habitat/habitat block. This factor provides a measure of the uniqueness and importance of, and threat to, the habitat in the wider landscape and will give different weight to habitats in the aggregation process.

For the aggregation of the individual habitat condition indices into the site biodiversity index (Step 6), a Habitat Context Factor has to be determined for every habitat type (or habitat block), measuring the habitat's regional uniqueness and importance. This factor is derived from the following four parameters, each to be assessed on a scale of 1-4 (Table 3):

1. the uniqueness of the habitat in the regional context;
2. the importance of the habitat in relation to regional and global biodiversity;
3. the general level of threat to this habitat type on a national level; and
4. the habitat's importance for providing ecosystem services for the surrounding landscape.

As this task may require broader ecological and conservation knowledge, it may be useful to engage an ecological expert familiar with the region to assess the Habitat Context Factor, for example from a local partner NGO or a consulting agency. Because the context factor is likely to remain constant over long periods, once assessed, it does not have to be re-examined for every annual BIRS assessment. Re-assessment once every five-10 years should be sufficient, unless some large-scale and significant land-use changes have been taking place in the surrounding region, in which case the Habitat Context Factor would need to be re-examined earlier.

Figure 4 – Map of quarry with different habitats

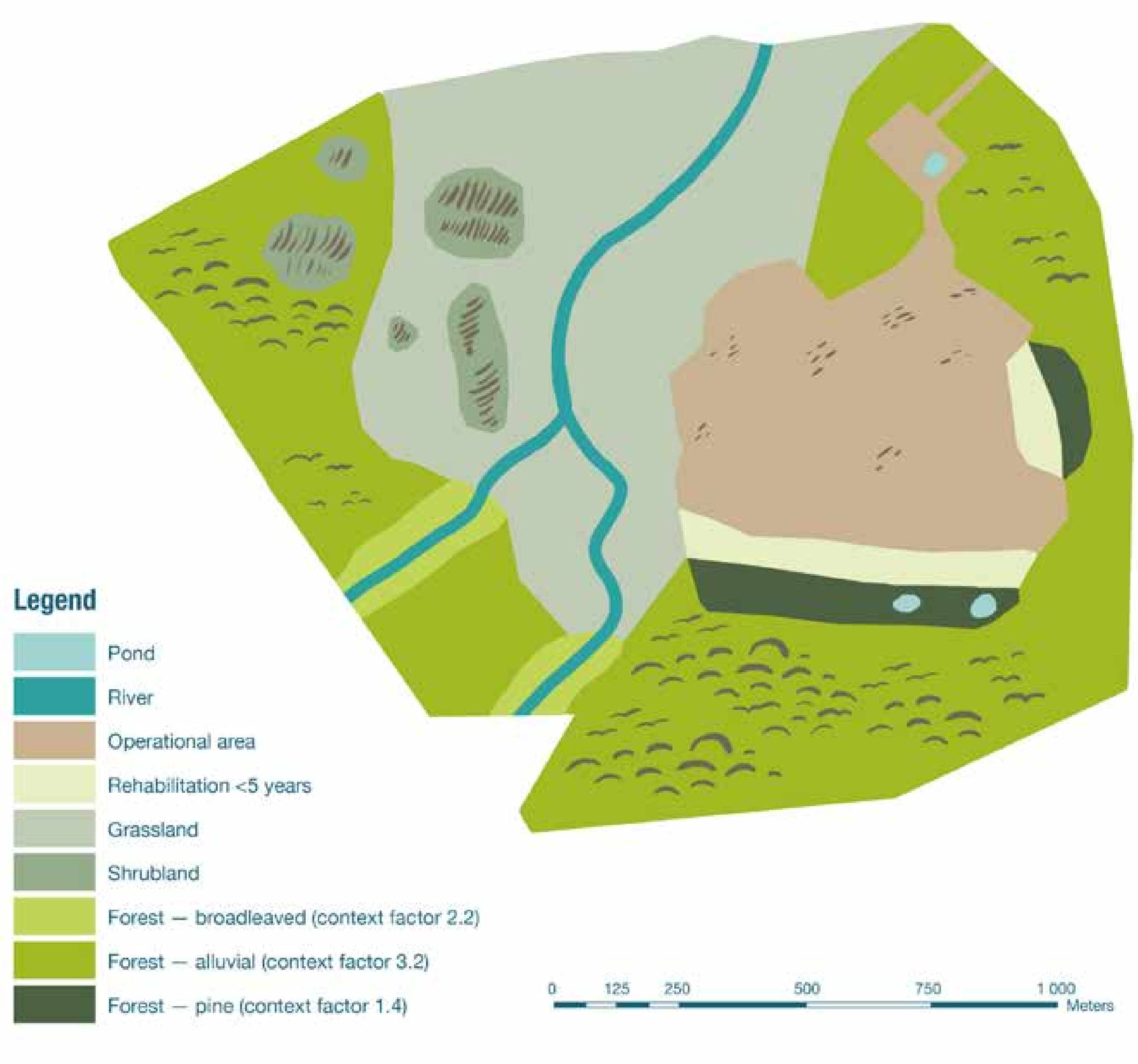


Table 3 – Scoring of regional habitat importance and uniqueness

Value	1	2	3	4
1. How widespread is the habitat in the surrounding landscape (usually 5-10km[1])?	**Common**	**Uncommon**	**Rare**	**Not present**
2. What is the intrinsic biodiversity value of this habitat likely to be? → *For a definition of the status of species, see IUCN Red List[2] and IUCN guidelines for the application of the species criteria for regional and national assessments.[3]*	**Low** No species of regional or national concern	**Medium** Includes species of regional or national concern	**High** Includes nationally rare species	**Very High** Includes nationally very rare and/or endemic species
3. What is the degree of threat to this habitat nationally or in the ecoregion? → *e.g. reference to IUCN Red List of Ecosystems[4]*	**Not threatened**	**Near threatened**	**Vulnerable**	**Endangered**
4. What is the ecological importance of this habitat in the surrounding landscape? *Hydrological connections* *Habitat connectivity or biodiversity corridors* *Important breeding colony or stopover sites* *Buffer zone of adjoining PAs* *Catchment protection*	**Low**	**Medium**	**High**	**Very High**
Habitat Context Factor	**Mean of the four values (to the nearest tenth)**			

[1]This is a guiding figure: It may vary according to the general morphology of the landscape and thus requires some expert judgment. For a quarry in the mountains of Switzerland, 5km are enough, but in the flats of Gujarat, one has to go even beyond 10km.
[2]http://www.iucnredlist.org/
[3]IUCN. (2012). Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0. Gland, Switzerland and Cambridge, UK: IUCN. iii + 41pp. http://www.iucnredlist.org/documents/reg_guidelines_en.pdf
[4]IUCN Red List of Ecosystems: http://www.iucnredlistofecosystems.org
Convention on Biological Diversity – National Biodiversity Strategy and Action Plans: http://www.cbd.int/nbsap

The rationale behind the context factor is that not all habitats are equal in terms of regional importance. If a regionally rare habitat, a habitat with very special biodiversity features (e.g. karst caves) or a habitat with an important ecosystem function for the surrounding landscape (streams, wetlands) is affected by an extraction operation, this represents a bigger impact on regional biodiversity (i.e. causes a bigger reduction of the index) than if mining affects a habitat type that is regionally common and/or does not harbour species of special regional/national importance. Similarly, if, through rehabilitation, a habitat type is being re-created which is regionally rare or uncommon (such as, for example, the construction of a permanent water body or wetland in an area where these have been destroyed in the past due to agricultural development), this will have a positive effect on regional biodiversity, in turn leading to an increase of the overall site index.

For the following areas, no context factor is determined, and a default value of 1.0 is used instead:

- Operational Areas;
- Quarry Slopes disused for less than five years;
- Rehabilitation Areas planted less than five years ago;
- Artificial lakes and ponds created less than two years ago;
- Lakes and ponds from which extraction is taking place; and
- Ruderal Habitats.

STEP 4 – Assess condition of each habitat/habitat block

In STEP 4, the value and suitability of a site's habitats for biodiversity is assessed. This is done using habitat questionnaires once the survey method and location is selected.

STEP 4a — Decide on the survey method

In order to get an overall impression of the habitat condition and its suitability for biodiversity, a series of assessments at representative and accessible points within the habitat is needed. The survey method used may vary according to the habitat type and access limitations.

It is recommended to get an initial overview of the habitat by driving or walking around the site before selecting survey methods and locations. Three different methods are available based on the condition of the terrain:

1. A survey point method is the standard sampling method when habitats are accessible and involves the selection of a number of survey points within the habitat.
2. An area assessment method is used if the terrain is not accessible or unsafe to enter. These assessments should be done from viewpoints.
3. A mixed survey method combining both methods above is used when some parts of the habitat are accessible but others are not.

STEP 4b — Choose survey locations

The locations chosen should be representative of the conditions found in the habitat. The number of locations chosen will depend upon the size of the habitat within the site, the number of distinct blocks of similar habitat, and the range of conditions found within the habitat. A minimum of two sample points should be located in each category of habitat, while a maximum of five sample points would be indicated for most large habitat blocks. In the case of very extensive habitats in a quarry, up to ten sample points may be considered. The wider the range of conditions within a larger area of habitat, the more samples need to be taken. The arithmetic mean of all question scores from all sampling points in the same habitat will provide the habitat condition score.

Assessments at sampling points are carried out by looking in all directions to get an overall impression of the conditions, followed by completion of the relevant questionnaire for that habitat type (see Annex 3). The assessor may walk around in a radius of 10m for a more detailed inspection. Where possible, the GPS coordinates of this point should be recorded and subsequent assessments (as they are required at least every five years) should be undertaken at the same point. Photographs of the habitat at these points may be taken for future reference and comparison.

In terrestrial locations, habitat borders, roads and paths should be avoided, because these can include edge-effect distortions in the readings. Assessors should move at least 20m into the habitat to avoid such edge effects. Some habitats may be difficult or dangerous to access, e.g. because the slope is too great or the vegetation too thick. In wetlands, the ground may be too wet for easy access, and rivers, streams, lakes and ponds may only be assessed from the banks. In such instances, assessors should walk along the perimeter of the habitat, along haul roads, tracks and banks, to get an overall impression of the habitat and then make an assessment from a good vantage point, where as much of the habitat as possible can be seen. Disused quarry slopes should be assessed from a vantage point where as much of the slope as possible can be seen.

The choice of season, time of day and weather conditions are important. Sampling should be done when conditions are optimal for observing the full diversity of a habitat, for example during a season when there is good plant growth, e.g. early summer in temperate climates and in the early rainy season in tropical climates. Ideally, weather conditions should be fine, without strong wind or rain. Each subsequent assessment should be done as close as possible to the original sampling time in terms of seasonality, time of day and actual weather conditions. Information can then be recorded on the data recording sheets provided in Annex 2.

STEP 4c — Record the condition of the habitat

A fundamental part of BIRS is the annual assessment of the condition of a site's habitats and, by implication, their value and suitability for biodiversity. In the assessment process, each habitat – except the Operational Areas, the newly established Rehabilitation Areas and the greatly disturbed Ruderal Habitats – is individually scored for its condition. For each habitat type, a specific set of questions aims at assessing factors that, by and large, are related to biodiversity. Each question is scored on a scale of 1-4, with 1 being the least suitable for biodiversity and 4 being the most suitable.

Questionnaires

Except for the Ruderal Habitats (which are given a standard condition score of 2.0), 12 different questionnaires have been developed for assessing the condition of the 'natural' habitat types. For reasons of practicality, the questionnaires had to be designed to work in the respective habitats on all continents; different questionnaires for habitats in different continents or regions would result in too complex a system for a globally operating company that seeks to examine its biodiversity capital worldwide.

The questions are mainly directed towards key indicators of habitat quality, including:

- morphological diversity of the habitat;
- vegetation structure;
- spatial heterogeneity of the vegetation;
- leaf litter, decaying vegetation, dead wood;
- presence of outstanding ecological features (such as karst or breeding colonies of birds); and
- presence of animal indicator groups and of pollinators.

The scores are related to the following general ecological assumptions:

- biodiversity is ultimately a function of habitat diversity;
- structurally more diverse habitats lead to a higher species diversity; and
- higher habitat quality is reflected by a higher species diversity.

Although equating habitat structure with habitat condition and with suitability for biodiversity may be a scientific over-simplification, it can still provide a valid approximation for an overall assessment of the relative quality of habitats.

An example of such a habitat questionnaire is given in Annex 3. All the questionnaires are available as a separate document. It is important to remember that, while these questionnaires have been designed with simplicity in mind to promote their use by cement company staff, it is highly recommended that they be tested before implementation, and eventually adjusted to address company-specific biodiversity issues.

Table 4 – General pattern of scoring of habitat condition questions

	Value	1	2	3	4
Negative factor		Many	Above average	Below average	Few
		(Very) high	High-medium	Medium-low	(Very) low
		(Very) bad	Bad-average	Average-good	(Very) good
Positive factor		Few	Below average	Above average	Many
		(Very) low	Low-medium	Medium-high	(Very) high
		Poor	Marginal	Suboptimal	Optimal

Finally, it must be stressed that some habitats may intrinsically have a relatively low level of plant and animal diversity, but still be important for regional, national or global biodiversity. In addition, the intrinsic species diversity in different regions of the world varies considerably. Thus, the Habitat Condition Class (and the Site Condition Class) resulting from the BIRS assessment are relative values for looking at changes at the site, national and global levels, and cannot be used for comparing the absolute biodiversity values of different sites or different countries.

Scoring

All individual habitat indicators assessed for BIRS are scored on a scale of 1-4, i.e. each question has four possible answers. For some questions, visual guidance is also provided on the questionnaires. The general pattern behind the scoring (explained in Table 4), depends on whether the indicator is positive or negative for the condition of a habitat (i.e. its biodiversity suitability).

While the scoring might be equated with a valuation from bad to good in relation to some questions, in other cases it will only represent a categorization on a continuous scale of specific characteristics of a habitat. The scoring is not a measure for the absolute status of biodiversity at a site, but rather provides a measure for relative habitat changes in the wake of resource extraction and other operational activities.

Data recording

The following parameters should be recorded at individual survey points:

For each habitat or habitat sub-block (if relevant):
- habitat type;
- name or geographic position of habitat sub-block (if relevant);
- habitat code (as provided at the bottom of the sheets);
- extent of habitat area (or sub-block);
- date;
- observer(s);
- weather;
- scores for questions on context factor;
- presence of habitat enhancements; and
- scores for questions on habitat threats.

For each survey point of that habitat (or habitat sub-block):
- scores for questions on habitat condition; and
- geographical coordinates (latitude and longitude).

There are several possible methods for recording survey data in the field. With an app on a handheld device, such as a tablet or smart phone, all the habitat questionnaires and their explanations and pictorial guides can be stored on the devices, allowing answers to be recorded directly. This would also facilitate downloading the recommended photo documentation and GPS position of each survey point, as well as the calculation of the various indices and the habitat and site classes, right to the company's central data storage.

In the absence of such an electronic system, data recording can be done on paper, with the information then transferred into a computer database and combined with information on habitat extent and context factors. Examples of Excel-based recording forms for the individual habitat condition assessments and the summary form for the composite site condition index are provided in Annex 2. The calculation of indices and classes is done automatically in these forms, after the required field data have been entered.

Default values and special habitats

- **Operational Areas** should be treated as one unit, requiring only one total area figure, and allocated a fixed default condition score of 1.0, reflecting their generally low value for biodiversity. This also includes areas where resource extraction has ceased less than two years ago, even if active rehabilitation management has already been initiated.
- **Rehabilitation Areas** (both, actively managed areas and areas where natural regeneration is taking place):
  - natural or managed Rehabilitation Areas that are two-to-five years old have a default score of 2.0; and
  - areas more than five years old should be assigned to one of the habitat types and assessed by means of the respective habitat questionnaires.
- **Quarry Slopes** that have not been mined for more than five years should be assessed by means of the Quarry Slopes questionnaire. Like the rehabilitation areas, quarry faces abandoned two-to-five years ago have a default score of 2.0.

- **Artificially** created **lakes and ponds** should be assessed with the Lakes, Ponds questionnaire, irrespective of how long ago they were established. If they are part of active operations, they would be assessed using the questionnaire, but have a context factor fixed at 1.0 and a habitat threat score that takes into account operational activity.

- **Ruderal Habitats**, which in many cases are difficult to survey because of their almost impenetrable nature, are given a fixed default score of 2. While they do offer a greater potential for biodiversity than the Operational Areas (default score of 1), their disturbed nature, alien invasive plant component and different structure and composition to original natural habitats make for a generally lower level of biodiversity. This relatively low default score should provide an incentive to transform these areas into better-quality habitats through proactive management.

Calculation of Habitat Condition Index

The index for the condition of each survey point is calculated as the arithmetic mean of the scores for each question. The significance of the different questions is considered equally and no weighting factors are applied.

The index value of the entire habitat is calculated as the arithmetic mean of all the survey points of that particular habitat type, whether in the same or different habitat blocks (as long as they have the same context factor).

The suitability of each habitat for biodiversity may be enhanced by the presence of inclusions of other higher-value habitats or outstanding biodiversity features, or decreased by the presence and intensity of a range of threats.

STEP 5 – Evaluate the Habitat (or habitat block) Condition Class

In STEP 5, the Habitat Condition Class is calculated after adjustments are made to the habitat condition index based on two additional parameters: habitat enhancements and habitat threats. While the first allows for an increase in the Index based on special habitat traits, the second can lead to a decrease in the index value when marked threats are present.

STEP 5a — Record habitat enhancements

Three supplementary questions, if answered positively, provide an opportunity to increase the calculated habitat condition index by 0.2 each. If all three apply, this would increase the index by 0.6 (i.e. by two habitat class categories):

1. *Does the habitat contain any **terrestrial habitat inclusions**?* Some habitat blocks are enriched by small inclusions of other terrestrial habitat types, too small in size to merit separate assessment, but possibly important for local biodiversity because they add to the overall structural and species diversity of a habitat block (e.g. small forest islands within an area of cultivated land, a patch of heathlands in a grassland habitat, a karst outcrop in a forest or a patch of calcareous grassland in an area of shrublands or woodlands). To qualify, these patches must be between 0.25 ha and 1 ha in size; smaller areas are to be discarded, larger areas would qualify to be assessed as a separate habitat block. Patches of Operational Areas, extraction areas abandoned less than five years ago and Ruderal Habitats should be disregarded as habitat inclusions, as should areas that show the characteristics of a habitat edge.

2. *Does the habitat contain any **aquatic habitat inclusions**?* Ponds or any other permanent water bodies smaller than 0.25 ha located in terrestrial habitats (e.g. in grasslands or shrublands/woodlands or a wetland patch in a forest) are not assessed separately, but they still could be of considerable importance for local biodiversity and will also result in an increase of the habitat condition value.

3. *Are there any **outstanding biodiversity features** in the habitat?* These would include features, such as the presence of karst caves (which often harbour very special and rare animal types), springs or a breeding colony of bats or herons that, over long time periods, have been firmly linked to this particular locality. Only one feature should be scored, even if there are several different such features.

These enhancement questions can also be applied to Operational Areas, thus increasing such areas' default index value to 1.2. For example, an aggregate quarry in France has small temporary (ephemeral) pools of water that serve as the preferred breeding ground for a rare European toad.

The special case of karst

Karst areas (especially associated caves and underground water courses) are particularly important for biodiversity, and conservation conflicts often arise in such limestone sites through resource extraction. Thus, these unique habitat formations present a special case for monitoring. Even before BIRS is implemented, at an early stage of the IBMS process, the presence of karst, especially when endemic species are known to occur in possible caves, should result in the site scoring a high Biodiversity Importance Category (BIC), which would in turn place it in a high risk category of the Biodiversity Risk Matrix and require the development of a BAP. This will require more extensive detailed monitoring than is provided for in BIRS.

The presence of karst areas will also affect parts of the BIRS process. Several BIRS habitat types could be associated with karst (e.g. Forests, Grasslands, Bare Rocks). Because of their ecological importance and unique biodiversity features, they would have a high context factor, thus disproportionately affecting the Site Biodiversity Condition Class. The presence of karst in a habitat could also lead to additional habitat enhancement points, and thus increase the calculated index value of the respective habitat. However, if karst features are threatened through mining operations, dumping of waste etc., they would trigger a higher threat score, reducing the index value of a particular habitat.

STEP 5b — Record Habitat Threat Score

BIRS also assesses a score for the level of threat to the habitat, looking at the following factors:

1. signs of soil erosion;
2. negative effects from grazing or browsing by domestic or wild animals;
3. invasive alien plants;
4. negative effects from quarrying or associated operational activities that spill over into the habitat being assessed;
5. uncontrolled use of non-quarrying natural resources;
6. dumping of non-mineral solid waste;
7. water pollution; and
8. threats to habitat by uncontrolled fires.

As part of the condition assessment, each of these potential threats should be evaluated by means of a Threat Questionnaire that assesses the presence of eight different threats (see Annex 3). The answers are likewise given on a scale of 1 (no threat) to 4 (highest level of threat).

In contrast to the habitat condition index, which is the simple arithmetic mean of all answers of a questionnaire, the Habitat Threat Score is calculated differently. First, to ease understanding, the scale of 1-4 is transposed to 0-3, so that 'no threat' is expressed with a zero value. Second, since the various threats are additive, the total score is the sum of all (transposed) values. Although this sum can, theoretically, lie between 0 (none of the threats present) and 24 (all eight threats present at the highest level of intensity), empirically it will hardly ever be above 10. The total represents the Habitat Threat Score, with all values above 10, if they arise at all, given the maximum value of 10.

Only one score should be given to each habitat type (or habitat block if it has a different context factor). A threat score is not calculated for the Operational Areas, except for underwater extraction of aggregates from lakes, ponds and rivers.

The Habitat Threat Score, together with the aggregated Site Threat Score (Chapter 6.3) provides guidance and incentive for site managers to improve the biodiversity condition of the site through targeted management measures to reduce relevant threats to habitats.

While the Habitat Threat Score will be presented as a separate value for each habitat, it will also influence the habitat condition index and the Habitat Condition Class derived from it. A top score of 10 would reduce the Habitat Condition Class by two; thus for every habitat threat score point, the overall habitat condition index will be reduced by 0.06.

STEP 5c — Calculate Habitat Condition Class

The habitat condition index calculated from the results of the individual habitat survey points will lie between the values of 1.0 (if all questions are rated as 1) and 4.0 (if all questions are rated as 4). Theoretically, if habitat enhancements and threats are taken into account, it could go below or above these boundary values, but this is unlikely to be the case in practice.

Since the habitat condition index, even if presented with only one decimal point (i.e. 30 subdivisions between 1.0 and 4.0), reflects an unwarranted accuracy of a relatively coarse system, for reporting and communication purposes it is transformed into a Habitat Condition Class on a more or less equally divided scale of 1-10 (Table 5), indicating at the extremes a degraded, very poor habitat (Class 1) or a very good habitat that is excellent for biodiversity (Class 10). The conversion of the habitat condition index to a Habitat Condition Class value is done for reasons of presentation; it does not involve any additional measurements or observations.

STEP 6 – Determine the overall Site Biodiversity Condition

STEP 6 will lead to the overall calculation of the biodiversity condition for the site using the indices determined for each habitat and habitat block.

A core element of BIRS is the identification of an overall value for a site (quarry) that expresses its broad biodiversity condition. In this case, the biodiversity condition can be described as the site's suitability for biodiversity. This measurement should be determined once a year for every active or disused extraction site and for every piece of reserve land owned or managed by the company.

This composite index summarizing the biodiversity condition of each site is derived from 1) the extent of each habitat type (or habitat block) found on a site, 2) the context factor of that habitat and 3) the condition index of each habitat resulting from the field assessments. While this measurement will initially be calculated as an index, using the respective index values of each habitat or habitat block, as with the habitats themselves, it will then be converted into a site class, based on a scale of 1-10.

The components of these site-based calculations are summarized in Table 6, which lists the questionnaires to be used for assessing respective habitat conditions and the value of the particular context factors – either as the arithmetic mean of the four context questions (Table 3) or by allocating a fixed default value.

Derivation of the composite site condition index

Two simple steps lead to the composite (biodiversity) condition index of a site (quarry):

1. *Each habitat condition index is multiplied by its corresponding context factor*. If, for a specific habitat type, more than one index has been assessed because of the presence of habitat blocks with different context values (e.g. pine plantation and natural mixed-wood forest), each block should be treated separately. Operational Areas, Rehabilitation Areas and Ruderal Habitats (with fixed default scores and context values) are treated in the same manner. In theory, the resulting 'corrected' habitat index can range from 1 (habitat condition of 1 and context factor of 1) to 16 (habitat condition of 4 and context factor of 4). Values above 10 will be very rare and should therefore be checked; such values would require the combination of a very high habitat condition index assessed in the field together with a very high context factor.

Table 5 – Class boundaries

	Habitat Condition Class			Site Condition Class (Quarry Class)		
Class	Low	High	Diff.	Low	High	Diff.
1	-2.00	1.49	3.5	-2.00	1.49	3.5
2	1.50	1.89	0.4	1.50	1.99	0.5
3	1.90	2.19	0.3	2.00	2.39	0.4
4	2.20	2.49	0.3	2.40	2.69	0.3
5	2.50	2.78	0.3	2.70	2.99	0.3
6	2.80	3.09	0.3	3.00	3.29	0.3
7	3.10	3.39	0.3	3.30	3.59	0.3
8	3.40	3.59	0.2	3.50	3.99	0.5
9	3.60	3.79	0.2	4.00	5.99	2.0
10	3.80	4.00	0.2	6.00	16.00	10.0

NOTE: Table 5 will be revised in November 2014, based on additional empirical date. Please make sure to download a new version after this date.

Table 5 – Components of site condition index

Habitats		Assessment questionnaire	Score	Context Factor
Operational Areas	Quarry areas, areas prepared for quarrying, topsoil and waste storage areas, roads, plants and other infrastructure	None	Default: 1	Default: 1
Quarry Slope	Disused for <2 years	→ To be treated as Operational Area	Default: 1	Default: 1
	Disused for 2-5 years	None	Default: 2	Default: 1
	Disused for >5 years	Questionnaire for *Quarry Slopes*	1-4	1-4
Rehabilitation Areas (managed or natural rehabilitation)	Started <2 years ago	→ To be treated as Operational Area	Default: 1	Default: 1
	Started 2-5 years ago	None	1-4	Default: 1
	Started >5 years ago	→ To be treated under respective habitat		
Artificial lakes and ponds (including extraction lakes)	Created <2 years ago or still operational	Questionnaire for *Lakes, Ponds*	1-4	Default: 1
	Created >2 years ago and no longer operational	Questionnaire for *Lakes, Ponds*	1-4	1-4
Natural habitats				
Terrestrial	**Forests**	Respective habitat questionnaires	1-4	1-4
	Shrublands, Woodlands			
	Grasslands			
	Ruderal Habitats	None	Default: 2	Default: 1
	Bare Rocks	Respective habitat questionnaires	1-4	1-4
Freshwater	**Wetlands**			
	Rivers, Streams			
	Lakes, Ponds			
Coastal	**Mangroves**			
	Salt Marshes			
	Coastal Zones			
	Cultivated Land			

Box 3 – Calculation of composite site condition index – example

		Extent	Habitat condition score	Context Factor	Calculations	
		ha	CS	CF	CS*CF	(CS*CF)*ha
1	Operational Area	20.0	1.0	1.0	1.0	20.00
2	Habitat A	3.6	2.7	1.7	4.59	16.52
3	Habitat B	15.9	3.1	1.0	3.10	49.30
4	Habitat C	6.5	2.2	1.0	2.20	14.30
5	Habitat D	1.8	3.4	2.8	9.52	17.14
	Total SUM	47.8				117.26
Composite score for site		SUM((CS*CF)*ha) / SUM (ha)				2.45

2. The site condition index is subsequently calculated as the mean of all 'corrected' indices weighted by their respective habitat extent.

An example of a composite site biodiversity condition index calculation is shown in Box 3.

Through this approach, habitats that are regionally rare (e.g. karst formations) and/or have a high importance for regional biodiversity and/or fulfil important ecological functions for surrounding habitats (e.g. water courses) make a higher contribution to the overall site index than common habitats or Operational Areas. From a biodiversity management perspective, BIRS is designed to reward proactive measures, such as the creation of new habitats (especially lakes, ponds and wetlands) that may regionally be uncommon.

Site Threat Score

The Site Threat Score, to be reported alongside the Site Condition Class, is derived from the threat scores for each habitat type. First, the mean of habitat threat scores weighted by the respective habitat extent values is calculated. Second, this number is converted to a form that allows comparisons between the levels of threats of sites of different sizes, by multiplying the mean of the habitat threat scores with the proportion of natural habitats of a site affected by at least one threat (Box 4). Operational Areas and Ruderal Habitats, which are not assessed but have a default condition score, are excluded from this calculation.

Since the habitat threat scores have a downgrading effect on the respective habitat condition indices, the Site Threat Score, by implication, will automatically also be reflected in the final value of the Site Condition Class.

Site Threat Report

Since the principal purpose of the habitat threat scores and the Site Threat Score aggregated from them is to help guide action at the site level to reduce the main threats to the natural habitats, and thus increase their suitability for biodiversity, it will be useful to develop a Site Threat Report to complement the Site Threat Score. This report, an example of which is given in Box 5, summarizes the different habitat threat scores according to the eight threat types, giving the total area of a site that is affected by a particular threat and the area-weighted mean score for each threat type.

It is important to note that neither the Site Threat Score nor the Site Threat Report necessitates any

Box 4 – Calculation of site threat score – example

			Extent	Habitat Threat Score	
			ha	HTS	HTS*ha
1	Operational Area		20.0		
2	Habitat A		3.6	5	18.00
3	Habitat B		15.9	2	31.80
4	Habitat C		6.5		
5	Habitat D		1.8		
	Total Area	**SUM**	**47.8**		
	Total 'natural' areas (Habitats A-D)	**SUM(NA)**	27.8		
	'Natural' areas affected by threats (Habitats A+B)	**SUM(NAT)**	19.5		
	Proportion of 'natural' areas affected by threat **SUM(NAT) / SUM(NA)**	**P**	0.70		

Calculated mean value MV	**(SUM(HTS*ha) / SUM(NA))*P**	**1.78**
Site Threat Score	Values > 0 < 2 = Score **1** Values > 2 < 10 = Score **2-9** (integer of MV) Values > 10 = Score **10**	**1**

additional assessments or records; they are produced by processing information that has already been gathered as part of the site assessments of habitat extent, condition and threat.

Site Condition Class

Just as the habitat condition indices are converted into a Habitat Condition Class, the calculated site biodiversity condition index will be converted into a Site Condition Class (also called Quarry Condition Class). Like the Habitat Condition Class, the values for the Site Condition Class will range from 1-10, which removes the somewhat false and misleading accuracy of the continuous index value and gives the company an easy-to-report measure of the overall biodiversity status of every extraction site.

However, in contrast to the Habitat Condition Class, the allocation of the Site (or Quarry) Condition Class cannot be done through an equal division of the theoretical scale of 1-16 (a result of multiplying the condition score with the context factor). In practice, values above 6.0 will be very rare, while most of the resulting indices will probably lie between 2.0 and 5.0. Thus, a different division of the scale is used (Table 5).

Box 5 – Site threat report – example

A Site Threat Report can highlight the threats that are decreasing habitat condition scores, so that management understands where action could increase the overall site index. This report lists all the threats recorded for habitats present on the site, together with the area affected by each threat and the average threat score weighted by area of each habitat affected.

	Threat	Area affected (ha)	Average threat score (weighted by area)
1	Signs of soil erosion		
2	Negative effects of grazing or browsing		
3	Invasive alien plants	21.0	1.7
4	Negative effects of quarrying or associated operational activities	27.0	1.5
5	Uncontrolled use of non-quarrying natural resources		
6	Dumping of non-mineral solid waste		
7	Water pollution	1.5	1.0
8	Threats to habitat by uncontrolled fires		

4 Aggregation and reporting of indices

National and Global Biodiversity Condition Indices

The assessment of the composite biodiversity condition of a site and of the derived **Site Biodiversity Condition Class** as described in the previous chapter is the core of BIRS. Just as this value is an aggregation of individual habitat condition indices, a company's various site condition values can in turn be aggregated on to higher geographical units.

The site indices lend themselves to being combined into a **Country Biodiversity Condition Index**, summarizing the overall biodiversity suitability of all of a company's landholdings in a particular country. These national indices can then be aggregated into a company-wide **Company (Global) Biodiversity Condition Index**. Table 7 shows these two levels of aggregation, but other groupings can easily be considered, for example a smaller subset of countries where a company operates, or all of the quarries that feed into a single cement plant.

All scales of aggregation that are larger than the site level should respect the fundamental characteristic of BIRS as an area accounting system, where biodiversity suitability and other biodiversity factors are attributed to discrete areas. Accordingly, national and global biodiversity indices contain a single weighting factor: the national indices consist of site results weighted by the size of the respective sites, and the global index consists of national indices weighted by area of land assessed in each country.

Reporting on biodiversity assets

The purpose of these various indices is to provide a company with a system to report on biodiversity on its landholdings. It is not a measure of biodiversity per se, but rather an indirect measure of the suitability of the habitats contained in its landholdings for biodiversity, mainly using factors relating to habitat structure as a proxy for biodiversity quality. A company adopting the system has the opportunity to demonstrate accountability and transparency in its biodiversity management practices, but also good stewardship of biodiversity in its landholdings.

There are many different ways in which the indices can be utilized for corporate reporting. On the one hand, the data can be used to provide a regular report on the size of a company's habitat assets (extent in ha) and the biodiversity value of these assets (habitat condition). On the other hand, the company can analyse the data from year to year, or across any other time interval it may choose, and document changes in the quantity and quality of these assets. Furthermore, and most importantly, the company can set targets in relation to individual sites, plants or countries, or at the global corporate level, for the index levels that it wants to attain over a defined period of time.

The most obvious reporting parameters are the Site Condition Class and the National and Global Biodiversity Condition Indices, but many permutations of data analysis and presentation are possible (Table 8), including:

- various (two- or three-dimensional) matrices analysing the distribution of parameters such as habitat condition classes, site condition classes and habitat types in relation to individual countries or operating companies;
- one-dimensional distribution graphs (bar charts or curves) of parameters such as site sizes, habitat sizes, habitat condition classes, site condition classes; and
- two-dimensional distribution graphs analysing two parameters (such as habitat size vs. habitat condition class).

Table 7 – Aggregation of indices

Geographic level	Value/Index	Derived from
Individual habitats (or **habitat blocks** if they have varying condition factors)	Habitat condition index **Habitat condition class**	Assessment of habitats
Site (individual quarries and extraction sites)	Composite site index **Site condition class**	Aggregation of habitat indices, corrected for habitat context and weighted for extent
National	**Country biodiversity condition index**	Aggregation of all site indices, weighted by site areas
Global	**Company (global) biodiversity condition index**	Aggregation of all national indices, weighted by the total area of the land assessed (company landholdings in a country)

Table 8 – Corporate reporting of indices

Geographic level	Primary reporting parameters	Examples of possible additional reporting parameters
Site (individual extraction sites)	• **Site Condition Class** • Composite site condition index	• List of habitat classes (and biodiversity condition indices)
National	• **Country Biodiversity Condition Index** • List of site condition classes of the country	• Matrices of habitat condition classes of all national quarries, grouped by: o quarries o habitat types, and/or o class numbers • Matrix of all habitat types in a country by habitat condition classes • Distribution of habitat sizes by habitat condition classes
Global	• **Company (Global) Biodiversity Condition Index** • List of National Biodiversity Condition Indices	• Matrix of site condition classes of all company land holdings by country • Matrix of all habitat types across all land holdings by habitat condition classes

Box 6 – Net positive impact (NPI) or No net loss (NNL)

NPI/NNL is said to be realized when the presence of a business in a region ultimately generates positive impacts on biodiversity, i.e. impacts that are broadly accepted to outweigh, over a quantified timescale, the biodiversity disturbances and damage associated with the company's activities. Commitments to NPI/NNL for biodiversity are grounded in the mitigation hierarchy, which holds companies to pursue impact avoidance and reduction, as well as restoration, prior to the offsetting of residual impacts. The implementation of an NPI/NNL commitment involves project-level planning of responses to biodiversity impacts, as well as the establishment of a baseline with the quantification of various biodiversity elements, such as species and ecosystems. The adoption of an NPI/NNL approach is particularly relevant in situations where there is potential for high biodiversity impacts and where the use of the mitigation hierarchy can optimize the extent of natural areas that are left intact.

It is important to note that BIRS is not designed to help achieve commitments to net positive impact (NPI) or no net loss (NNL) goals for biodiversity (Box 6). While BIRS, as a monitoring system, generates biodiversity data at regular intervals to assess how a company's biodiversity assets change over time, an NPI/NNL approach relies on the forecasting of biodiversity impacts using a predetermined baseline, and on planning appropriate responses in line with the mitigation hierarchy. Both approaches can contribute to biodiversity conservation, and they are not mutually exclusive. BIRS and NPI/NNL could be used together, with a focus being placed on NPI/NNL only in areas of critical biodiversity, whereas BIRS implementation would be in all company landholdings.

Reporting on changes

If the composite site index and the Site Biodiversity Condition Class are assessed annually, this will result in a time series of data showing how the company's biodiversity assets are changing in value over time. The goal, of course, would be an overall increase in value over time, achieved through a generally proactive approach to the management of biodiversity assets.

One way to track changes is through the index value itself. However, changes from year to year have to be interpreted with caution, as they could be due to natural fluctuations of certain parameters and/or changes outside the company's control. Furthermore, not all indices are affected by such fluctuations in exactly the same manner.

Three types of changes have to be taken into account when interpreting alterations in the indices:

1. Positive changes due to proactive measures by the company to improve the habitat or site condition classes (with an implicit effect on the national and global indices), such as:
   - targeted habitat management to improve an existing habitat's condition;
   - creation of a new habitat with a high regional context value in areas where resource extraction has been completed;
   - good management of planted rehabilitation areas;
   - acquisition and good management of adjoining offset areas;
   - retaining disused extraction areas and letting them regenerate into interesting natural habitats, either naturally or with management assistance; and
   - acquisition of new reserve land or buffer zones around existing sites.

2. Negative or positive changes to the Site Condition Class and the national and global indices due to land-use changes resulting from the company's resource extraction policies and targets, such as:
   - development of previously held natural habitats (reserve land) for resource extraction;
   - return of leasehold land to owner after completing resource extraction;
   - acquisition of new leasehold land for future mining;
   - closure or sale of entire sites; and
   - purchase of new sites.

3. Negative or positive changes of all indices resulting from external factors that are outside the company's control, such as:
   - natural event (e.g. storm, flooding) affecting a natural habitat;
   - significant and fast changes in the land use around a site, resulting in a higher (or lower) context factor for certain natural habitats of the site;
   - new industrial or other kinds of developments around the site, with negative impacts on the site's natural habitats; and
   - incidents of air, water or soil pollution spilling over into the site.

The aim of a company using BIRS should be that, over a number of years, the type 1 changes outweigh the net result of the type 2 and 3 changes.

Since changes of the habitat condition or composite or site indices might not necessarily be meaningful over short time periods, the BIRS indices become more valuable the longer they have been collected, and longer-term trends in their changes can be statistically examined.

Instead of analysing the index values directly, the frequency distribution of habitat condition classes (at site and national levels) and site condition classes (at national and global levels) may provide a better way of presenting an increase in suitability of the company's biodiversity assets.

Biodiversity key performance indicators (KPI)

Once the system is globally established and data are being compiled on a regular basis, BIRS offers several possibilities for identifying medium- and long-term key performance indicators (KPIs) for biodiversity-related targets, including:

- level of Global Biodiversity Condition Index;
- minimum level for all national indices;
- percentage of sites in or above a certain Site Condition Class;
- hectares of habitat in or above a certain Habitat Condition Class;

- number of sites changing into a higher Site Condition Class; and
- reduction of threat score below a defined threshold.

Many more possibilities offer themselves, on various geographic levels (from site to global) and in relation to selected or all habitat types. The choice of one or more specific biodiversity KPIs ultimately depends on the company's overall strategy and how these can best be linked to production and economic targets.

Biodiversity management performance

To complement the biodiversity indices, it is recommended that a company using BIRS develop a system of indices to evaluate how well the company is doing in relation to biodiversity management capacity and performance, looking at internal arrangements and processes designed to integrate biodiversity considerations into all management procedures, as well as efforts on the ground to pursue biodiversity-related targets in BAPs or other planning documents.

Such a system could be designed individually by a company, based on the internal performance tracking systems they might already use, and at the plant or national levels, depending on where biodiversity management responsibilities are largely residing.

As it is intended to assess aspects of the organization rather than the landholdings, the smallest scale at which an index might be produced is the operational unit (cement plant or aggregate quarry). The next meaningful scale would be the level at which executive management of various operating units takes place (part of a country, a country, or several countries in a region). Finally, there could also be a global index.

Alternatively, a common standard could be developed by cement and aggregate industry associations. The advantage of this approach would be the ability to compare results between companies.

An index at the plant or quarry level could be designed in a similar manner as the biodiversity-related indices, consisting of a number of individual indicators (each to be rated on a scale of 1-4), for example:

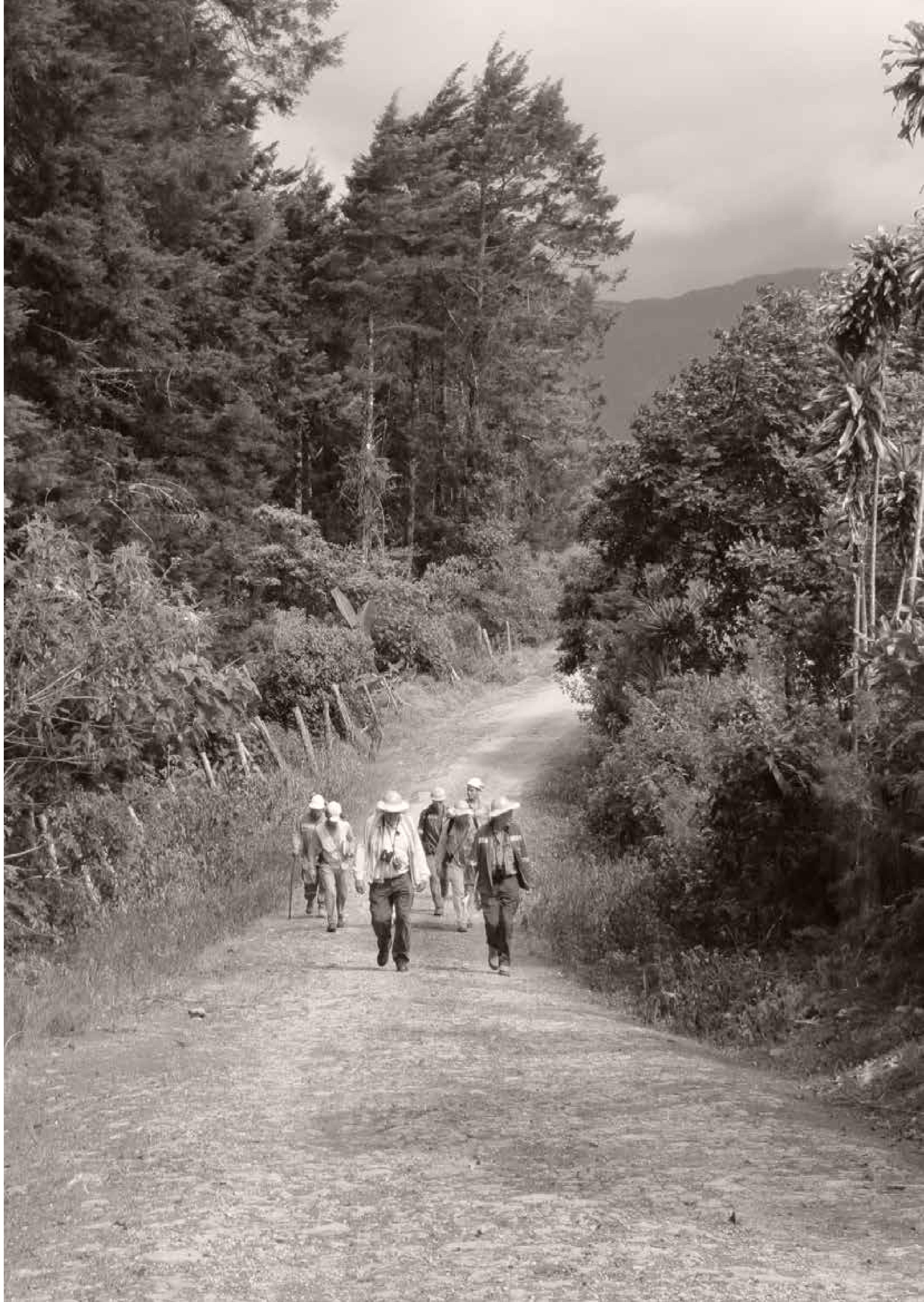
- Basic management indicators **to measure progress in implementing the IBMS and BIRS**:
  - Has the biodiversity importance category of a site been determined?
  - Is a basic biodiversity inventory available?
  - Has the monitoring system been set up?
  - Are sufficient resources available to ensure annual assessment?
  - Have staff been trained in the monitoring methodology?
  - Has a partnership with a biodiversity expert organization been developed (NGOs, local wildlife groups, university)?
  - Have staff generally been made aware of biodiversity issues and the associated management systems?
  - Have local/national biodiversity activities been supported by the company?

- Progress in relation to rehabilitation targets:
  - Has a Rehabilitation Plan been developed?
  - Are annual targets of the Rehabilitation Plan being achieved?

- Progress in relation to targets for Species/Habitats of Special Interest (to be recorded at sites of high biodiversity value where special biodiversity targets have been defined):
  - Has a Biodiversity Action Plan (BAP) been developed?
  - Does it contain measurable targets against which annual progress can be assessed?
  - Are these annual targets being achieved?
  - Is there independent verification of these efforts?

Measurement of environmental performance is a difficult challenge, for which results on their own only tell part of the story. It is necessary to consider the context – geographic, institutional or other – within which results are achieved. BIRS seeks to do this through the use of context factors, and for a management performance indicator, something similar might be necessary.

Finally, and crucially, in any self-reporting system, when progress is tracked against a series of qualitative criteria, the results could be meaningless unless there are internal and external verification processes. Thus, the development of such a biodiversity management performance index should include a robust audit element, including external assurance.



4 Rolling out BIRS

A company that wishes to successfully implement BIRS needs to make commitments and allocate resources over a sufficient period to customize the methodology, institutionalize knowledge of its purpose and processes and iron out problems that will inevitably occur during the introduction of the system.

The decision to implement BIRS implies an ongoing pledge of time and money that should not be underestimated. Some of the key managerial and administrative points to be considered when implementing BIRS are summarized below.

Management commitment

The decision to implement BIRS should be made at the highest level of the company and supported by directors in their subsidiary boards, where decisions on the allocation of resources are frequently made.

Required base information

For reasons explained in Chapter 1, when implementing BIRS at an extraction site, the Biodiversity Importance Category (BIC) should have been identified correctly beforehand, as this will determine whether the BIRS needs to be supplemented with a more detailed M&E system, specifically focusing on those biodiversity features of special importance.

The key base pieces of information required for the implementation of BIRS are up-to-date habitat and mining maps of the site, in order to assess the spatial extent of every BIRS land category and habitat type, and any relative changes that might have occurred from one assessment to another.

Costs

BIRS, like every other monitoring system, will cost money. While, generally, the higher the investment, the better and more meaningful the results, BIRS tries to keep cost levels as low as possible, but in a manner that allows for meaningful answers about the company's overall biodiversity performance and its impact on habitats to be gained from the data.

The costs of the system will also result in clear benefits to the company, including reduced risk from biodiversity issues (including shorter permit cycles), development of in-house capacity to manage biodiversity risks, stronger licences to operate from local partnerships and enhanced brand reputation.

Internal capacity

To oversee and support BIRS implementation, it is recommended that a company build specific biodiversity expertise among its own staff (Table 9). Initially, this could consist of one or more persons with graduate or postgraduate biological or ecological qualifications employed in a central technical services group. On a more advanced level, a resource base with an ecologist in each geographical area corresponding to the division of executive responsibilities could be envisaged. If there are clusters of operating sites in a relatively small area, it may be desirable for a qualified person to be employed to cover biodiversity issues only at these sites.

The development of in-house capacity has many benefits for a company, including:

- the ability to commission and manage expert inputs cost-effectively;
- rapid improvements in biodiversity data collection and internal and external reporting;
- timely reductions in biodiversity risks; and
- creation of a virtual community of practice, which can be strengthened in an ongoing manner through peer-to-peer support, the transfer of good practice experience and the use of various on-line tools and collaborative forums.

As part of BIRS implementation, field assessors at the site level will need to be identified and trained. Prior ecological training is not considered necessary for field assessors, but the ideal characteristics of a person to be trained as a BIRS site assessor are summarized in Box 7.

External expertise

The need for a local expert to provide some input has been noted at several points in this document. Although BIRS has been designed to be run mainly by the company's own, mostly non-expert staff, expert knowledge is needed at key points in the set-up and review of the system at each site (Table 9). This can be most effectively done by a locally based individual, an ecological consulting group or a conservation group with which the company may already be cooperating. The particular knowledge required by such an external expert/expert group is given in Box 8.

Implementation plan

A company seeking to adopt BIRS as a management tool throughout its global operations needs to develop an implementation plan, transforming the general BIRS recommendations into its own language and tailoring them to its existing operational processes. This is the best method of internalising new requirements, especially when they relate to a topic that is not part of the core concern of the company.

In preparation for the implementation of BIRS, a company will need to adapt the system's elements to its own business practices. Elements to consider include policy, risk management, environmental data collection, target setting and reporting. Since recommendations on how BIRS should relate to other business systems have been kept

Box 7 – Desirable characteristics of BIRS site assessors

- General interest in and knowledge of environmental issues affecting the industry they are working in (pollution, water use, climate change, etc.)
- Interest in and some knowledge of the natural world – wild animals, plants, etc. – without necessarily any qualifications in biological sciences
- Good knowledge of the extraction site, including:
  - full geographic extent of landholdings;
  - extraction plans;
  - history of extraction;
  - presence of important biodiversity features; and
  - background studies such as ESIA
- Knowledge of local communities, their prevailing land uses and environmental impacts
- Good observation skills
- Mapping and/or GIS skills
- Enthusiasm

Table 9 – Lead functions and need for expertise

Major steps	Company operational staff	Company biodiversity expertise[1]	External expertise
Development of BIRS			Lead
Company-specific Implementation Guide	Advice	Lead	Advice, review
Setting-up at sites			
• Training		Lead	Assistance, review
• Identification of habitats		Lead	Assistance
• Habitat Context Factors		Assistance	Lead
• Sampling points	Lead	Advice	Advice
Annual data collection			
• Training		Lead	Advice, review
• Habitat extent	Lead	Advice	
• Habitat condition	Lead	Assistance	
Calculation of Habitat and Site Classes	Lead	Assistance	
Quality control of incoming data		Lead	Advice
Verification, auditing		Assistance	Lead

[1]If no internal biodiversity expertise is available, the tasks in this column would have to be covered by external expertise.

Box 8 – Characteristics of local biodiversity experts

- Good knowledge of ecosystems, habitats and priority species present in the area where the extraction site is located (nominally 5–10 km radius)
- Good knowledge of conservation plans, status and priorities in the same area
- A generalist rather than specialist background and approach
- A strong practical rather than theoretical approach to field ecology and conservation
- An open-minded approach to biodiversity assessments being carried out by non-experts ('citizen science')
- Willingness to work with private sector extractive industry companies to achieve better conservation outcomes

to a minimum, it should be possible for a company to add its own style without having to unpick the logic of the system.

As a general rule, it is recommended that instructions for the people on the ground who have to operationalize BIRS locally should, wherever possible, be built into existing planning and guideline documents, rather than developing new separate guidelines.

Some key points to be considered in the implementation process are given below.

Training

Although the field assessments at the heart of BIRS are designed to be carried out by non-specialists, the effective implementation of the system must be facilitated by targeted training actions. The need for training in what BIRS is, what it is not, what it seeks to achieve and how it is carried out could be given to a range of technical staff at the company level, so that there is a good awareness of what is being implemented. This training will include the BIRS programme managers, and will have to include advice on how to select and nominate site assessors.

The key people who need to be trained are the BIRS site assessors. They will require more detailed explanations and instructions on how to interact with local biodiversity experts in the setting-up process, how to judge and answer the questions in the field on habitat condition, how to deal with uncertainties, and how to record their observations. Priority training should be given to the nominated site assessors from the first batch of extraction sites chosen for implementation (see below). The same training can then be given to each group of assessors. As implementation proceeds, the best trainers will be those who have been through the implementation process and can speak to their peers on the basis of their personal experience.

Rollout and implementation sequence

If a company has a large number of extraction sites, simultaneously implementing BIRS across the entire company would require a large and expensive input of external expertise. A phased rollout is therefore recommended, allowing internal capacity to build so that sites involved in later phases can be guided and supported by staff from sites that were involved in earlier phases. The baseline conditions also tend to vary across a large company – some sites, often for historical reasons, have built a better knowledge of biodiversity and the issues associated with its management than others. A phased approach will allow later sites to learn from the experiences of the earlier sites.

The choice of extraction sites for an early phase should build on this variation. The 'leading' site in each region or country could be chosen as part of an early cohort, so that its experience can be shared in the same geographical area where issues are likely to be similar. An alternative is to choose a country or region where good data exist and the regulatory environment is largely supportive to biodiversity initiatives by the private sector. This approach would have benefits, including being able to test the process of aggregating results to a larger scale, but it would also have the disadvantage of lessons learned that might not be easily transferable to other countries.

Depending on the number of sites, there may be two or more rollout phases if the company has a broad international presence.

A 'road map' committing the company to a number of phases leading to full implementation across all sites should be prepared, with time lines, resource needs, training plans and costs. This will help to keep management aware of what is involved in the decisions made by the executives.

Review and quality control

One of the most challenging aspects of implementing BIRS will be achieving consistency of results across the company's entire landholdings. This will require ongoing review processes, from regular (internal) critical checking of incoming data, to the assessment of the credibility of results and recurring external quality control (Table 9). In the early stages of implementation, close collaboration with external experts familiar with BIRS would provide valuable feedback and facilitate the process. Any revisions to BIRS implementation resulting from this feedback should be well-documented, so that the comparability of time series data sets is not compromised.

For quality control, it would be best to eventually integrate review of the BIRS reports into an existing internal assurance process (environmental audit programme or similar). External verification of key results should also be part of such a process, to increase the credibility of external public reporting.

Glossary of terms

Artificial lake or pond: Water body created as a result of mining operations (sand or gravel pit in areas with high groundwater levels; water-filled bottom of a hard-rock site).

Biodiversity Action Plan (BAP): Document summarizing proposed site-based actions *'to maintain or improve the biodiversity values during the operational and post-closure phases of an extraction site'*.

Biodiversity Importance Category (BIC): Biodiversity importance of an extraction site as determined in the early stages of the IBMS process.

Biodiversity Key Performance Indicator (KPI): Company-defined indicator to measure long-term performance (or outcome) of biodiversity management efforts.

Biodiversity Management Performance: Recommended system of company-defined indices to measure biodiversity management capacity and performance, to complement the Biodiversity Condition Class.

Biodiversity Management System: Integrated system of policies, procedures and guidance for the management of biodiversity at all stages of the planning and operation of extraction sites, developed for Holcim by the IUCN Biodiversity Advisory Panel.

Biodiversity suitability: Habitat factors that, actually or potentially, favour biodiversity.

Context Factor: *Habitat Context Factor*

Ecosystem services: Diverse benefits that human societies derive from ecosystems, including supporting services, provisioning services, regulating services and cultural services.

Extraction Site: Area of land containing one or more mineral production facilities, such as mines, quarries and gravel pits, including their associated access and processing infrastructure. In addition, most extraction sites also contain areas of 'natural' habitat and modified 'natural' habitat.

Global Biodiversity Condition Index: Aggregation of all *national biodiversity condition indices* into an overall global figure expressing the biodiversity suitability of a company's entire global landholdings.

Habitat block: Distinct area of habitat of a uniform *habitat type*.

Habitat Condition Class: Conversion of the *habitat condition index* into ten different classes.

Habitat condition assessment: Assessment of the quality of habitats using key indicators such as morphological diversity, vegetation structure, vegetation heterogeneity, leaf litter, soil etc., each to be evaluated on a scale of 1-4.

Habitat condition index: Index value between 1.0 and 4.0 (resulting from the *habitat condition assessment*), expressing the condition of a habitat and its suitability for biodiversity.

Habitat Context Factor: Factor (between the values of 1.0 and 4.0) expressing the regional importance and uniqueness of a habitat, to be taken into account in the calculation of the site *condition index*.

Habitat enhancements: Small inclusions of *habitat patches* of different habitat types or presence of important biodiversity features in a habitat.

Habitat extent: Surface area (to the nearest one-tenth of a hectare) of the different *habitat types* found on an extraction site.

Habitat importance: Component of the *Habitat Context Factor*.

Habitat inclusion: Small patches of habitats bigger than 0.25 ha, but smaller than 1 ha, completely surrounded by another habitat (excluding Operational Areas, resource extraction areas abandoned less than five years ago, Ruderal Habitats and habitat edges).

Habitat Threat Score: Single threat, or combination of several threats, to a habitat, ranging between the values of 0 and 10.

Habitat type: Thirteen different types of *'natural'* habitats distinguished by the BIRS system.

Habitat uniqueness: Component of the *Habitat Context Factor*.

National Biodiversity Condition Index: Aggregation of all site condition indices into an overall national figure expressing the biodiversity suitability of the company's entire national landholdings.

Natural capital: Vegetation-based biodiversity value of the landholdings under the management of a company.

'Natural' habitats: Thirteen different major types of habitats used for a global categorisation of those areas of an extraction site not used for operational purposes.

Net Positive Impact (NPI): Biodiversity management concept ensuring that, on balance, impacts of a project, coupled with various mitigating measures, have a positive net effect on biodiversity.

No Net Loss (NNL): Originating from the Business and Biodiversity Offsets Programme, this term means that project-related impacts on biodiversity are balanced by a series of mitigation measures.

Operational Areas: Areas of an extraction site that are directly, or indirectly, used for operational purposes.

Outstanding biodiversity features: Occurrences of physical features (e.g. karst, caves) that are of high significance for priority species, or of concentrations of individuals of priority species (e.g. breeding colonies of rare or endangered birds).

Planted Rehabilitation Areas: *Rehabilitation Areas* where vegetation has been actively re-established through seeding or planting.

Quarry Condition Class: *Site Condition Class*.

Quarry Slope: Steep-to-vertical faces where extraction of rock, sand or gravel is taking place, or has taken place less than five years ago.

Regional habitat importance: Component of the *Habitat Context Factor*.

Rehabilitation Area: Former mining areas where extraction has ceased two-to-five years ago and where, through targeted restoration measures (application of topsoil, seeding, planting) or through deliberate or accidental neglect, a 'natural' vegetation cover is being re-established.

Ruderal Habitat: Habitat found on previously disturbed land with mostly dense and vigorous vegetation (often with alien invasive plants) and no defined structure of trees or shrubs.

Site (biodiversity) condition index: Composite index (weighted mean) of all *habitat condition indices* of a site.

Site Condition Class: Conversion of the *site condition index* into ten classes.

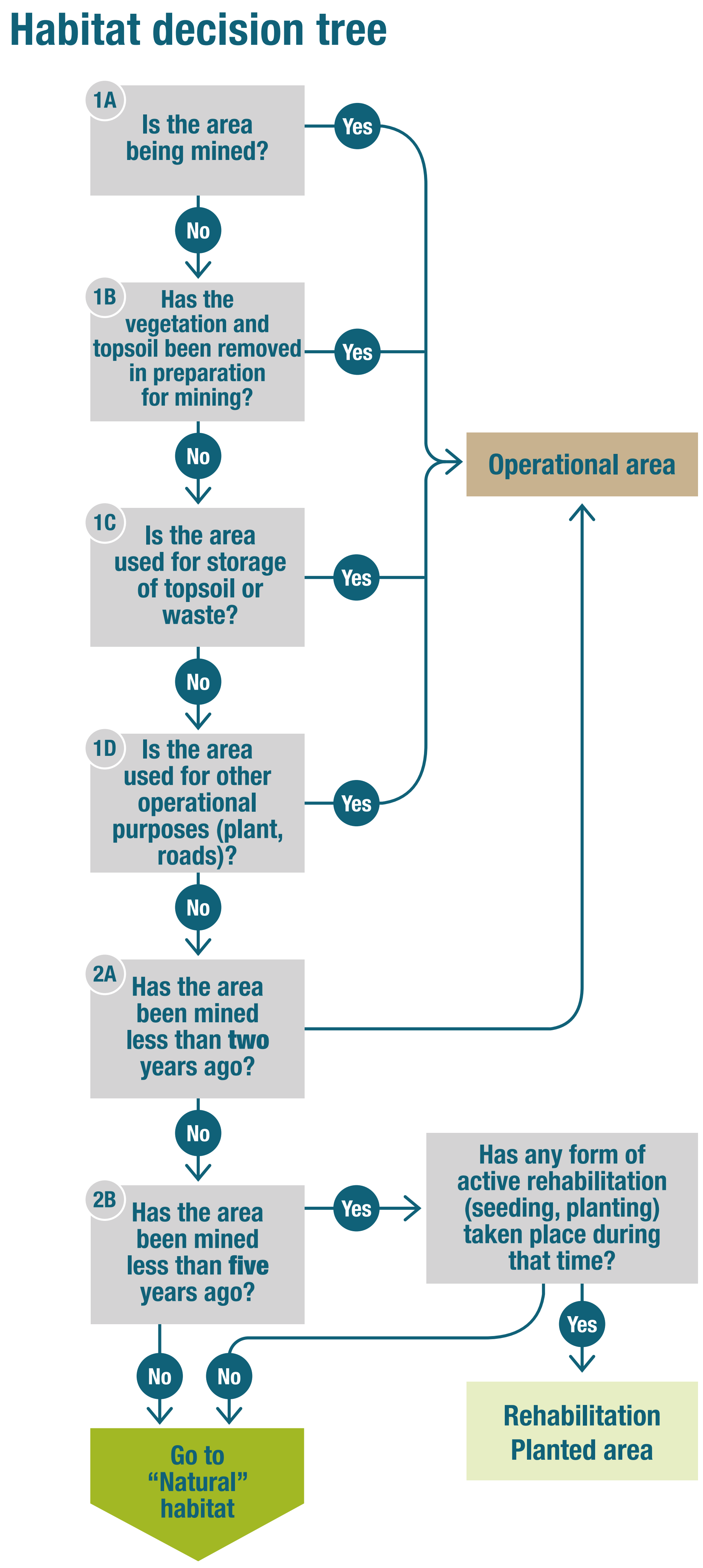
Site Threat Score: Index aggregated from the various *habitat threat scores* of a site (weighted mean, multiplied by the proportion of 'natural' habitat affected by at least one threat).

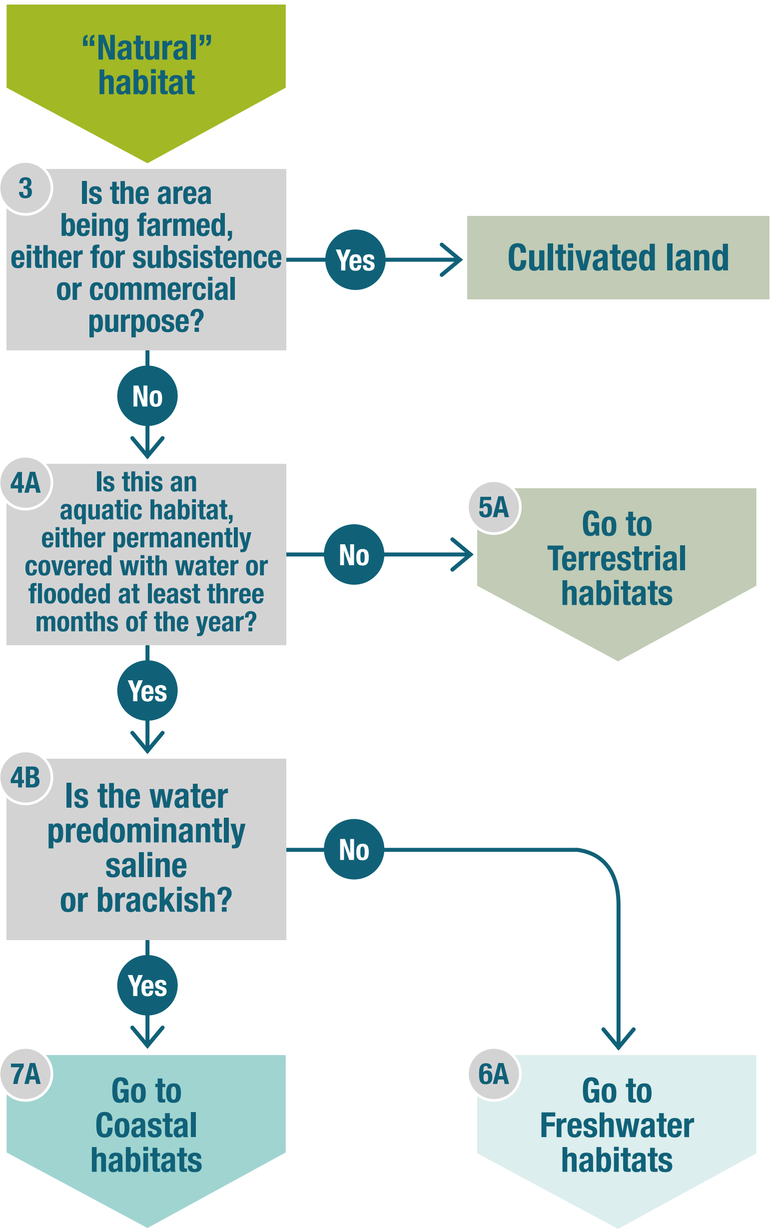
Site Threat Report: Report (in table format) complementing the *Site Threat Score*.

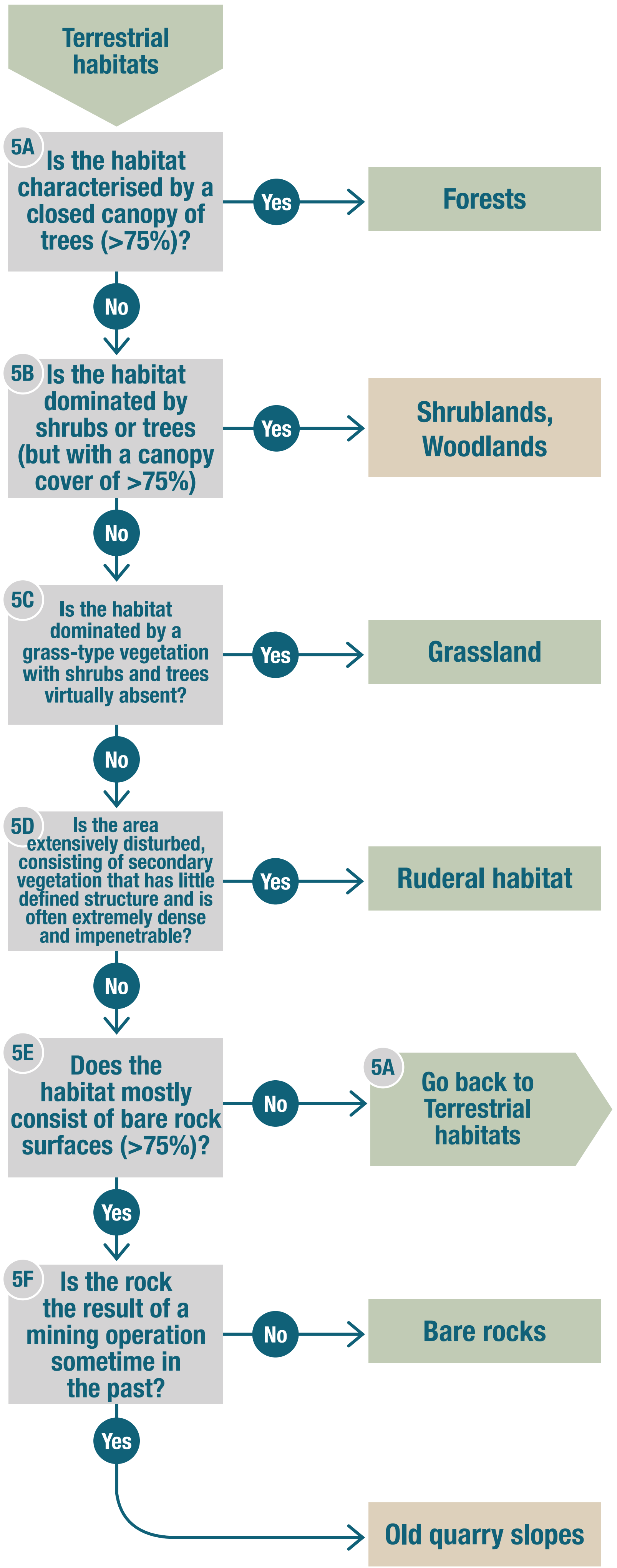
List of abbreviations

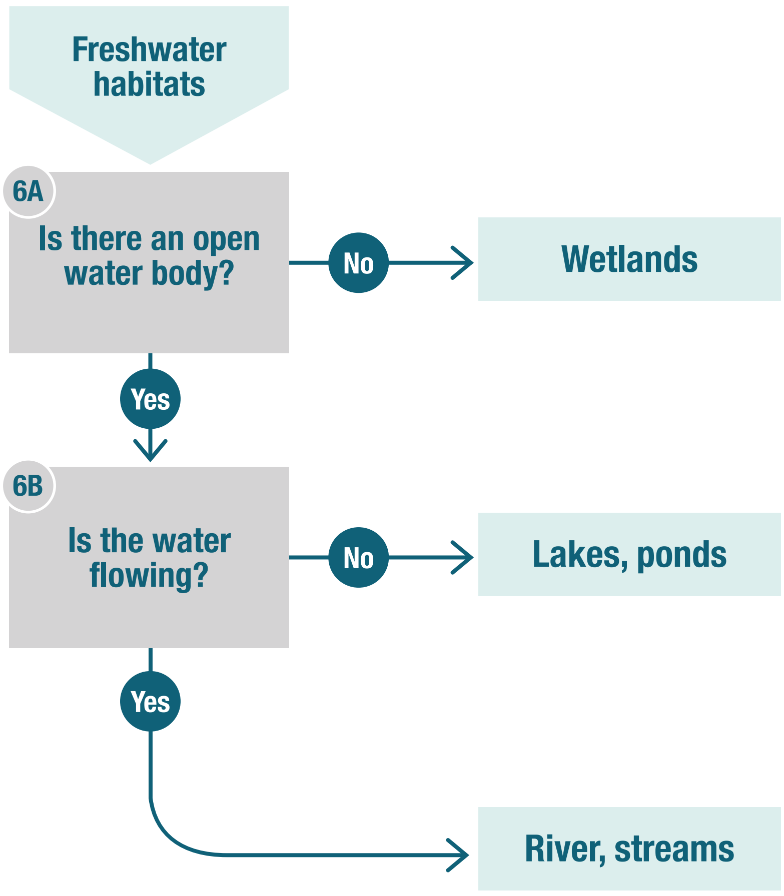
BAP	Biodiversity Action Plan
BBOP	Business and Biodiversity Offsets Programme
BIC	Biodiversity Importance Category
BIRS	Biodiversity Indicator and Reporting System
BMS	Biodiversity Management System (specific for Holcim)
IBAT	Integrated Biodiversity Assessment Tool
IBMS	Integrated Biodiversity Management System (for managing biodiversity risks and opportunities in the cement and aggregates sector)
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicator
M&E	Monitoring and Evaluation
NGO	Nongovernmental Organization
NNL	No Net Loss
NPI	Net Positive Impact
WBCSD	World Business Council for Sustainable Development

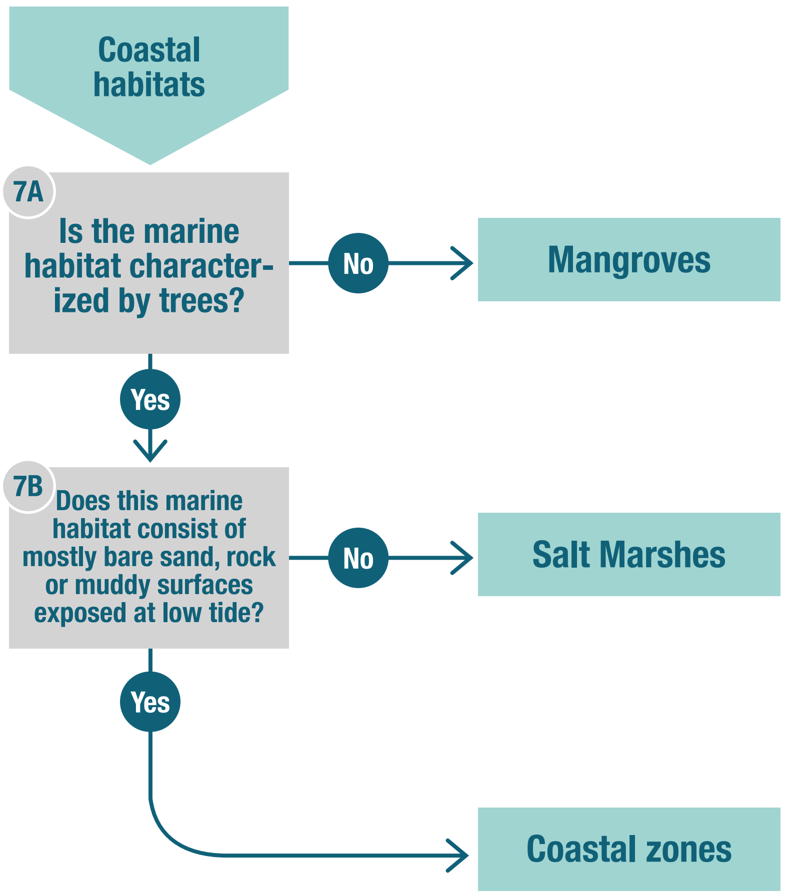
Annex 1: Habitat Decision Tree and Habitat Definitions




"Natural" habitat
3 Is the area being farmed, either for subsistence or commercial purpose?
Yes
Cultivated land
No
4A Is this an aquatic habitat, either permanently covered with water or flooded at least three months of the year?
No
5A Go to Terrestrial habitats
Yes
4B Is the water predominantly saline or brackish?
No
Yes
7A Go to Coastal habitats
6A Go to Freshwater habitats


Terrestrial habitats
5A Is the habitat characterised by a closed canopy of trees (>75%)?
Yes
Forests
No
5B Is the habitat dominated by shrubs or trees (but with a canopy cover of >75%)
Yes
Shrublands, Woodlands
No
5C Is the habitat dominated by a grass-type vegetation with shrubs and trees virtually absent?
Yes
Grassland
No
5D Is the area extensively disturbed, consisting of secondary vegetation that has little defined structure and is often extremely dense and impenetrable?
Yes
Ruderal habitat
No
5E Does the habitat mostly consist of bare rock surfaces (>75%)?
No
5A Go back to Terrestrial habitats
Yes
5F Is the rock the result of a mining operation sometime in the past?
No
Bare rocks
Yes
Old quarry slopes





Habitat Definitions

Operational areas

Operational Areas include:

- active quarry areas;
- areas prepared for resource extraction (vegetation and topsoil removed);
- topsoil and waste storage areas
- roads;
- plants and other infrastructure;
- areas where resource extraction has been discontinued for less than two years; and
- land where mining has been discontinued for less than five years and no rehabilitation has been taking place.

Areas where resource extraction stopped more than five years ago should be classified as a 'natural' habitat type.

(Planted) Rehabilitation areas

This includes all land where operations have ceased for at least two years but that are not older than five years. The habitat can be the result of deliberate or accidental neglect, or it can represent the outcome of targeted restoration actions. Rehabilitation areas older than five years should be allocated to one of the 'natural' habitat types.

Forests

Habitat that is characterized by the presence of trees with a total cover of 75 percent or more and reaching a canopy height of 3m or more (if canopy is less than 3m, classify as Shrublands & Woodlands habitat). Orchards and agroforestry are specifically excluded from Forest habitat and fall in the habitat category of Cultivated Land.

Shrublands, Woodlands

This habitat encompasses the range of vegetation from sparse to closed shrubland and from sparse to closed woodland, with a canopy closure of less than 75 percent (at which point the habitat is classified as Forest). The essential characteristic is the presence of shrubs and/or trees. The grass layer is often well-developed (savannahs), but may be less prominent, too (heathlands). This habitat is often grazed and browsed by wild and/or domestic herbivores.

Grasslands

Habitats that are characterized by the absence of trees and shrubs and the dominance of grasses in the ground layer. Planted or sown pastures that are established for the purpose of intensive livestock production are excluded from this habitat and fall in the Cultivated Land category. This habitat is often grazed by wild and/or domestic herbivores.

Ruderal habitats

This habitat is generally found on previously disturbed land, including road verges. Its vegetation is mostly dense and very vigorous, with no clearly defined structure of the shrubs and trees, although the vegetation may be low and open in early successional stages. Alien invasive plant species are often a prominent feature. This habitat is not commonly encountered under 'natural' undisturbed conditions. Key characteristics of this habitat include:

- no clear consistent structure in terms of woody density and canopy height (although this could also apply to 'natural' shrublands and woodlands);
- luxuriant, very dense and impenetrable vegetation (secondary growth);
- vines and climbers that may be thorny;
- a strong presence of alien invasive plant species; and
- a transitional nature (i.e. developing into something else).

Bare rocks

Natural rock habitat that has never been mined, characterized by extensive patches (>75%) of bare rocks without significant grass, shrub or tree cover, even under favourable rainfall conditions. Limestone pavements would be the most typical example. Old quarry faces left to natural rehabilitation should be assessed with the special questionnaires for Quarry Slopes. Extensive areas of open karst rocks (<25% vegetation cover) should be treated as Bare Rocks, while small outcrops of karst in other habitat types (e.g. Forests, Grasslands, Shrublands, Woodlands) should be treated as habitat inclusions under the respective habitat questionnaires.

Old quarry slopes

Extraction sites (quarries and pits) create new environments that are often complex in terms of slope, orientation and substrate. These complexities can offer many opportunities for biodiversity to colonize the slopes. The slopes of abandoned quarries or pits, or any slopes of active quarries or pits that have been abandoned or rehabilitated for at least five years, should be assessed using this questionnaire. The Quarry Slope can be subdivided into five specific features: (1) highwalls, (2) benches and haul roads, (3) angle of repose talus slopes, (4) re-contoured slopes and (5) toe berms and debris zones. Not all five units may necessarily be present on every quarry slope. The assessment is based on subdividing each assessed slope into proportions represented by each of the five slope features. Some questions require separate answers for each feature; other questions must be answered for the entire slope being assessed. The proportions of each slope feature should be estimated as they are projected onto the inclined plane representing the average slope angle from toe to crest.

Wetlands

Wetlands are areas where the ground is saturated with water and include bogs, marshes, swamps and seasonally flooded grasslands. Some wetlands may have pools of standing water, while some may not show any signs of surface water but may have water just below the ground surface. The plants that grow in these places are adapted to waterlogged conditions. Often, wetlands are made up of a mosaic of different wetland features, depending upon the amount of water, or the frequency of flooding. Some wetland areas just have low vegetation, others will have reeds, shrubs and trees.

Rivers, streams

These are predominantly natural waterways, including springs, streams and rivers. Underground rivers represent a very unique karst flowing water habitat. Any flowing water wider than 1m should be considered as a separate habitat. Man-made waterways may include canals and ditches that flow very slowly. Some degree of channelling and hardened embankments may result from quarrying operations. Seasonal streams occur where there is a marked difference between wet and dry seasons; as water levels drop, the water flow may stop and only remnant pools will be found until the river or stream starts flowing again. Such remnant pools may be important dry season refuges for aquatic life.

Lakes, ponds

Open water bodies include natural pools, ponds and lakes, as well as standing water bodies resulting from quarrying operations, either as an intentional or an accidental outcome. Open water bodies larger than 0.25 ha (e.g. 50 m x 50 m) should be assessed as separate habitats. Man-made lakes may be an important part of the quarrying operations, e.g. for process water storage and supply, for settlement of sediment from washings before discharge to a water course, and as an active part of the extraction of aggregates.

Mangroves

Mangroves are coastal forests that can grow in the intertidal zones, with salinities up to that of sea water. They grow along the banks of estuaries, in inlets and bays, and as a thin fringing strip along the coast. They consist of highly specialized tree and shrub species that have adaptations to deal with the high salinity in the water. Growing in the intertidal zone, they are able to cope with regular inundation and exposure of the roots by the tide because of their specialized root formations. Mangroves are important for coastal protection and as a breeding ground and habitat for many fish, shellfish and crustacean species, and the birds that feed on them

Salt marshes

A salt marsh, also known as a coastal salt marsh or tidal marsh, is a coastal ecosystem in the upper coastal intertidal zone between land and open salt water or brackish water that is flooded by the high tides. It is flat, low-lying land, dominated by dense stands of salt-tolerant plants such as herbs, grasses or low shrubs. The diversity of the salt marsh depends upon the frequency with which the land is covered by the tide and the remaining salinity of the soils. The land may be divided up by a number of small creeks, with mud exposed as the tides go down.

Coastal zones

The coastal zone (rocks, beaches, mud flats) is the area of transition between the land and the sea. It extends from the backshore, which may consist of sand dunes or cliffs, to the beach and intertidal zone – the zone between high and low tides. The coastal zone may contain a variety of different features, dependent upon the shore materials and the tidal and current patterns, which contribute to the diversity of the zone. The shore materials may vary from rocky cliffs and pebbles to sandy beaches and mud flats. If the shoreline slopes gently, the intertidal zone may extend hundreds of metres, but if the shoreline slopes steeply, then the intertidal zone will be relatively short. The tidal range is an important determinant of the coastal zone habitats, with the difference between high and low tide varying between less than one metre to more than four metres.

Cultivated land

This includes all areas where the soil has been tilled and where agricultural crops have been seeded or planted for subsistence and/or commercial purposes. It includes annual and perennial crops. The latter may consist of tree orchards, oil palm plantations and permanent pastures that are planted, fertilized or strengthened. Fallow lands that are temporarily not being actively farmed are also included.

Annex 2: Recording Sheets for Habitats and Sites

HABITAT RECORDING SHEET

For survey points with the same habitat code and Context Factor

Habitat Type	Forest	Sub-Block	Indigenous forest block
Habitat Code	31	Extent (ha)	1.0
Date	12.08.13		
Observers	Biodiversity Panel	Weather	sunny, light wind

Habitat Condition Sheet Nr.

Habitat Condition Class	5
Mean score of all survey points (incl. enhancements and threats)	2.5

Context factor	1.25
Habitat Threat Score	4

Habitat Context Factor	Score
1. How widespread in surrounding?	2
2. Intrinsic biodiversity value?	1
3. National threat to habitat?	1
4. Ecological importance of habitat?	1

Habitat enhancements 0.380	Yes=1
1. Terrestrial habitat inclusions?	1
2. Aquatice habitat inclusions?	
1. Outstanding biodiversity features?	1

Threats to habitat -0.300	Score
1. Erosion	2
2. Grazing, browsing	
3. Invasive alien plants	3
4. Disturbance	
5. Resource extraction	2
6. Solid waste	
7. Water pollution	
8. Fire	

Survey points	1	2	3	4	5	6	7	8
Latitude	09.54.58.0	09.54.58.6	09.54.56.2	09.54.59.3				
Longitude	84.11.22.1	84.11.23.7	84.11.23.5	84.11.20.9				
Questions								
Q1	2	3	3	4				
Q2	3	3	1	4				
Q3	1	1	1	4				
Q4	3	4	1	3				
Q5	4	2	2	3				
Q6	4	2	1	3				
Q7	2	1	1	2				
Q8								
Q9								
Q10								

SITE BIODIVERSITY SUMMARY SHEET

Revision 1 July 2014

SITE	Brown		COUNTRY	Canada			BIC		YEAR	2014
Habitat Sheet	**Habitat Code**	**Habitat Type**	**Sub-block**	**Area (ha)**	**% of total area**	**Number of survey points**	**Mean Habitat Score**	**Habitat Class**	**Habitat Threat Score**	**Context factor**
Habitats with default score and context factor	11	Operational		3.3	8.5		1.0			1.0
	22	Rehabilitated		2.6	6.7		2.0			1.0
	35	Ruderal		0.6	1.6		2.0			1.0
Automatic transfer of data from Habitat Sheets: 1	41	Cultivated Land		20.5	52.5	1	2.5	5		1.0
2	53	Lakes, ponds	L2, L3, L4	3.4	8.6	3	2.7	5	3	1.5
4	31	Forest	F1, F2	7.7	19.8	2	2.7	5	2	1.0
5	51	Wetland	W6	0.9	2.3	1	3.8	10		2.8
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
			Total hectares	39.0	100.0	11.1	Site Threat Index			0.7
			ha "Natural" Habitats	35.1			32%	*of 'natural' habitat affected*		
		Calculated site biodiversity index		2.7		Site (Quarry) Biodiversity Class				5

Annex 3: Habitat Questionnaires

Questionnaire on forests

Definition: Habitat that is characterised by the presence of trees with a total cover of 75% or more and reaching a canopy height of 3m or more (if canopy is less than 3m, classify as Shrublands & Woodlands habitat). Orchards and agroforestry are specifically excluded from forest habitat and fall in the habitat category of 'Cultivated Land'.

Survey approach: Choose survey points that appear representative of the habitat. Avoid 'edge effects,' as the margin of the habitat may provide a very different impression from the interior of the habitat. When answering the questions, look around in a circle of about 10-20m radius.

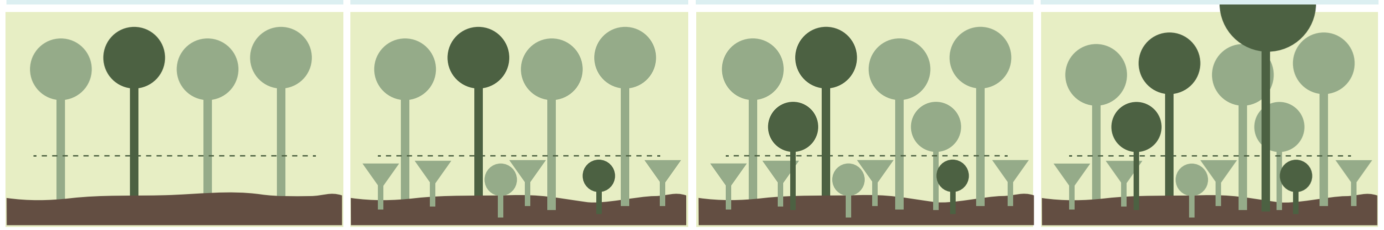
1. How high is the average canopy layer?

1. Less than 5m	2. 5-10m	3. 10-20m	4. More than 20m

Taller forests generally indicate a more mature forest that is likely to harbour a more diverse fauna and flora compared to a younger forest. A higher canopy, regardless of maturity, should also provide for more niches and specific habitats for a larger variety of organisms.

2. How many layers of vegetation can you see (without counting the ground cover)?

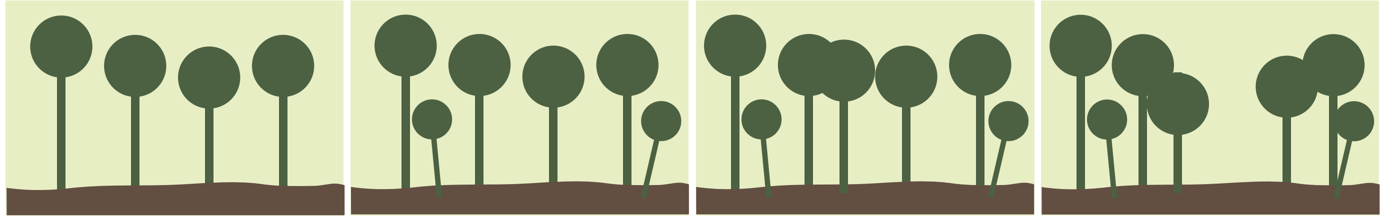
1. Canopy layer only	2. Canopy layer with a single shrub and/or tree layer underneath that is less than 3m high (= 2 layers)	3. Canopy layer with an intermediate layer, as well as a shrub and/or tree layer underneath that is less than 3m high (= 3 layers)	4. Canopy layer with emergent trees, as well as an intermediate layer and a shrub and/or tree layer underneath that is less than 3m high (= 3 layers with emergent trees)



The 'layering' of the trees and shrubs is an important determinant for biodiversity. Generally, the more complex the layering, the more different habitats are created that may favour different species and thus increase biodiversity.

3. What is the pattern of spacing of the trees?

1. Mostly regular spacing (especially including planted forests)	2. Mixture of regular and irregular spacing (including planted forest that is now developing naturally)	3. Irregular spacing throughout	4. Highly irregular spacing with canopy openings that are at least the size of the average diameter of the canopy trees



The degree of uniformity, or lack thereof, in the spacing of the trees is a good determinant of the relative heterogeneity in the habitat. The less uniform the individual trees or clumps are spaced, the more diverse the habitat conditions become.

4. What is the overall impression of the density of the forest at eye level?

1. Virtually unobstructed view all around the observer within a radius equal to the average height of the trees in the top layer	2. Occasional obstruction of the view within a radius equal to the average height of the trees in the top layer	3. Frequent obstruction of the view within a radius equal to the average height of the trees in the top layer	4. Limited view within a radius equal to the average height of the trees in the top layer

Generally, the degree to which the view at eye-level is obstructed will indicate a greater presence of different shrubs, trees and other plants, which implies greater diversity.

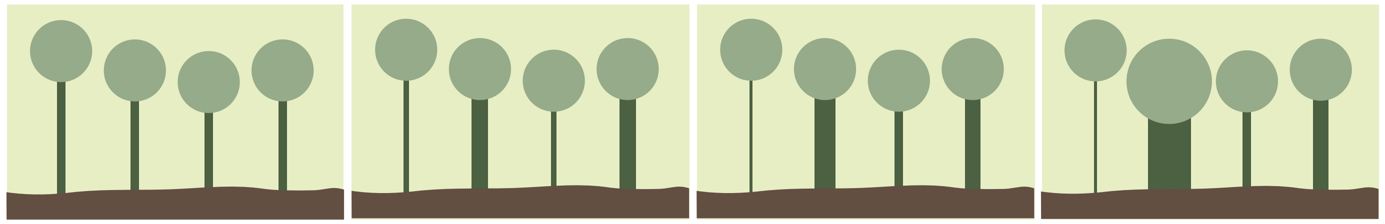
5. What is the general spacing of the trunks of the canopy trees?

1. <2m	2. 2-5m	3. 5-10m	4. >10m

Generally, the farther apart the trees are from each other, the better the light conditions that will benefit a number of other plants and animals.

6. How is the spread of the trunk diameters of the trees that are 3m or higher?

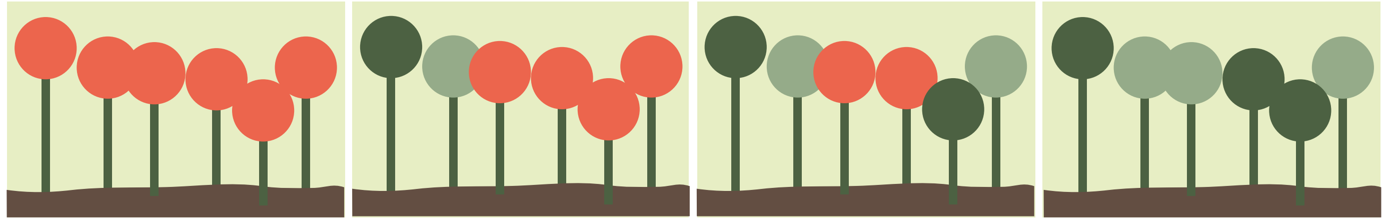
1. Most tree trunks of similar diameter (even-aged)	2. Two main classes of trunk diameters present	3. Large differences in trunk diameters, but no outstanding trees present	4. Large differences in trunk diameters with some outstanding trees relative to the size of the commonly found trees



The degree of uniformity in the distribution of the trunk diameters of the trees is a good determinant of the relative heterogeneity of the habitat. The less uniform the trunk diameters are, the more diverse the habitat conditions are likely to be.

7. Are the canopy tree species native to the region or country?

1. Only or overwhelmingly non-native species	2. Predominantly non-native species (more than 50%)	3. Predominantly native trees	4. Only native trees



As the main determinant of the forest, tree composition has a major effect on biodiversity. More native (indigenous) trees generally means a more natural and diverse forest.

8. How healthy do the trees in the canopy appear?

1. Very poor health (Many tree crowns with obvious dieback, especially from the top and from the outside inwards. Abundance of dead or dying trees.)	2. Poor health (Several tree crowns appear under stress with some dieback. Frequent dead or dying trees.)	3. Healthy (Most trees have healthy-looking crowns with active growth. Occasional dead or dying trees.)	4. Very healthy (Trees overwhelmingly have healthy-looking crowns and appear to be growing vigorously. Hardly any dead or dying trees.)

The health of the trees has profound implications on the stability and the long-term future of the forest. This assessment is made in terms of the apparent vigour and growth of the trees in particular, as far as their crowns are concerned.

9. Do you see dead wood (logs, branches or trees of at least arm thickness) on the ground and/or standing?

1. Hardly any dead wood present	2. Occasionally dead wood present	3. Frequently dead wood present	4. Abundant dead wood of different sizes

Coarse woody debris plays an important role in forest ecosystems. About 20-25% of forest-occurring species may depend on decaying wood.

10. How well-developed is the leaf litter and soil organic layer (including moss and discounting rocks)?

1. Mostly bare soil	2. Patchy or virtually continuous layer of plant litter that is not decomposing well and that is not being integrated in the soil layer (incl. the layer of pine needles often found in plantations)	3. Patchy or virtually continuous thin layer of plant litter that is decomposing well and that is clearly being integrated in the soil	4. Virtually continuous deep layer of plant litter that is decomposing well and that is clearly being integrated in the soil

Soils play an important role in the formation of plant communities, their species and structural diversity. Organic matter content of the soil represents one of the best soil-related predictors of species diversity parameters. This includes living mosses.

You also need to answer eight questions on human-induced **threats to the habitat and its biodiversity**, for which a separate questionnaire is available. Not all threats might apply to this habitat. These threats could be corrected and improved by targeted management measures.

Questionnaire on threats to habitats and their biodiversity

The following eight questions on human-induced threats to the habitats and their biodiversity have to be assessed for every habitat or habitat block. Not all threats are relevant for all habitats. The ***Habitat Threat Index*** is the cumulative total of all threat scores minus 8. Therefore, the potential Habitat Threat Index lies between 0 (none of the threats present) and 24 (all 8 threats at their highest level of intensity). These threats could be corrected and improved by targeted management measures.

1. Do you see signs of **soil erosion**?

1. No signs of erosion	2. Mild erosion: pedestalling, exposed plant roots or small run-off channels	3. Moderate: surface scratches and rills as well as signs of less severe erosion such as pedestalling and exposed roots	4. Severe: gully erosion as well as signs of less severe erosion such as surface scratches, rills, pedestalling and exposed roots

2. Is the habitat negatively affected by **grazing** and **browsing** by domestic animals?

1. No	2. A little	3. Some	4. A lot

3. Do you see **invasive alien plant** species?

1. None	2. Occasional	3. Frequent	4. Abundant

4. Is there a negative impact on the habitat through **disturbance** by:
- quarrying
- other operational activities or associated infrastructure (roads, dykes, plants, jetties)
- other non-mining activities (such as buildings development, or roads)

1. None	2. A little	3. Some	4. A lot

5. Is there any negative impact on the habitat or its biodiversity by the uncontrolled **use of** (non-quarrying) **natural resources** (e.g. timber, hunting, fishing, aquaculture)?

1. None	2. A little	3. Some	4. A lot

6. Do you see any signs of dumping of **solid waste**, inert materials, garbage, household items?

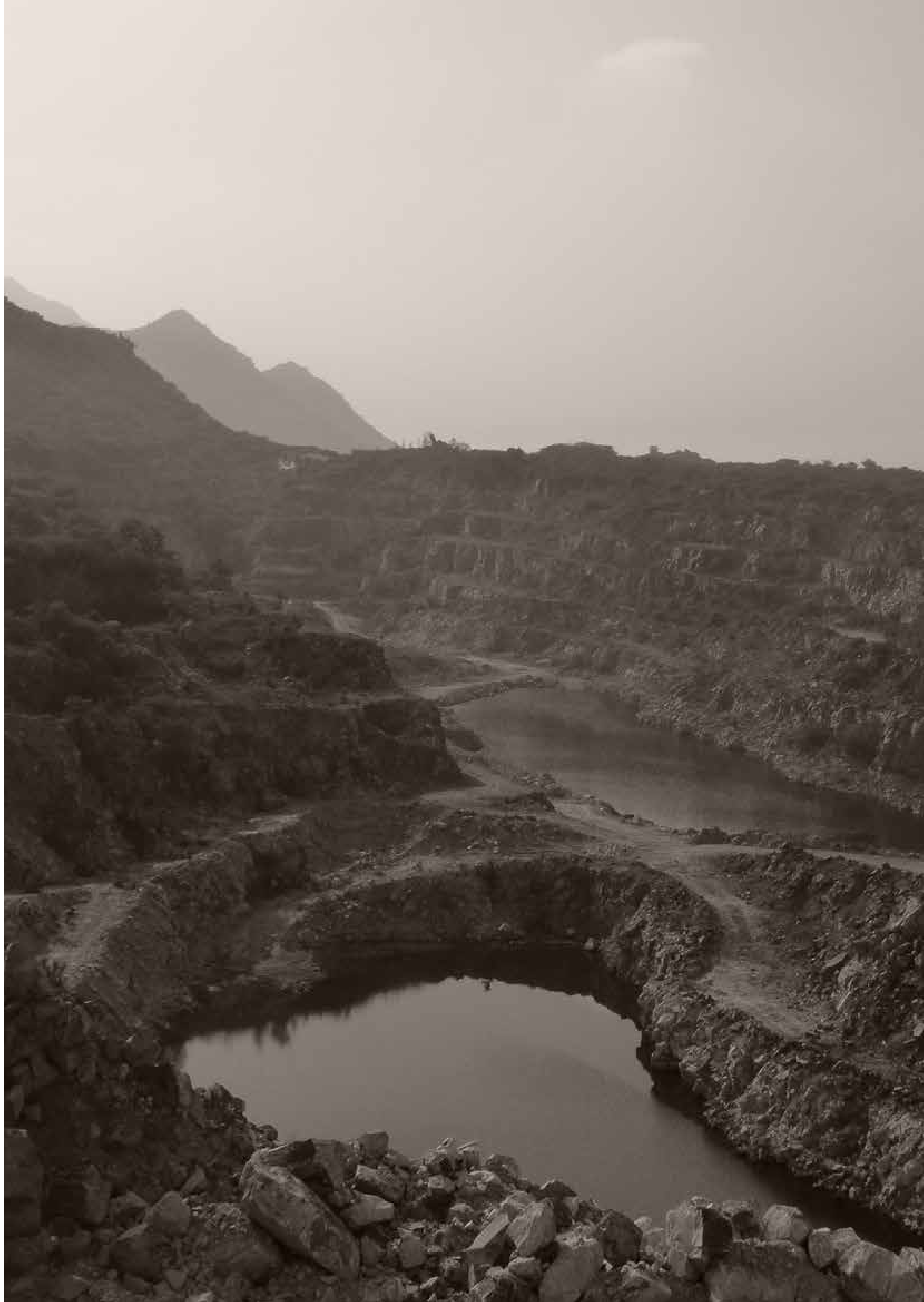
1. None	2. A little	3. Some	4. A lot

7. Do you see signs of **water pollution**, e.g. waste pipes discharging, oil on the surface, foam/scum, bad smell, high suspended solids?

1. None	2. A little	3. Some	4. A lot

8. Is there a threat to the habitat from undesirable **fires**?

1. None	2. A little	3. Some	4. A lot



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