International Seabed Authority ISBA/27/C/4

Council

Distr.: General
31 January 2022

Original: English

Twenty-seventh session
Council session, part I
Kingston, 21 March to 1 April 2022
Item 11 of the provisional agenda*
Draft regulations on exploitation of mineral resources in the Area

Draft standard and guidelines for the environmental impact assessment process

Prepared by the Legal and Technical Commission

Standard for the environmental impact assessment process

Contents

* ISBA/27/C/L.1.

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I. Introduction

1. In the present standard, the Legal and Technical Commission sets out the requirements for the environmental impact assessment (EIA) process under regulation 47 of the draft regulations on exploitation.

II. Purpose

2. The present standard sets out: (a) the requirements for the process that an applicant or contractor shall comply with in undertaking an EIA and in preparing an environmental impact statement (EIS) as stated in part IV, regulation 47 of the draft regulations on exploitation; and (b) the process, structure and general content of all EIAs prepared by an applicant or Contractor.

3. The standard is to be read in conjunction with the draft regulations on exploitation, as well as other relevant International Seabed Authority standards and guidelines, including, but not limited to, those related to:

(a) Application for approval of Plan of Work in the form of a contract (to conduct exploitation activities in the Area);

(b) Environmental Impact Assessment;

(c) Environmental Impact Statement;

(d) Environmental Management and Monitoring Plans;

(e) Environmental Management Systems;

(f) Expected scope and standard of baseline data collection.

4. The standard is to be read in conjunction with the appropriate regional environmental management plan.

III. Principles and objectives

5. The standard aims to ensure that EIAs and EISs for activities in the Area are designed with a view to:

(a) Protect and conserve the Marine Environment;

(b) Anticipate and avoid or minimize harmful environmental effects of exploitation activities;

(c) Ensure that there is consistency of EIAs and EISs among different applicants and Contractors;

(d) Ensure that environmental considerations are explicitly addressed and incorporated into the International Seabed Authority decision-making process.

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5. The standard aims to ensure that EIAs and EISs for activities in the Area are designed with a view to:

(a) Protect and conserve the Marine Environment;
(b) Anticipate~~, and~~ avoid, and ~~or~~ minimize harmful environmental effects of exploitation activities;

Rationale

Original wording may imply that minimizing is an alternative to avoiding.

IV. Definitions and abbreviations

6. Except as otherwise specified herein, terms and phrases defined in the draft regulations on exploitation have the same meaning in this standard.

(a) **"Effect"** is the consequence or outcome of an action or activity during the project; it is typically broader and more functional than an impact (see definition below);

(b) **"Environmental impact assessment" (EIA)** is "the process of identifying, predicting, evaluating and mitigating the physicochemical, biological, socioeconomic, and other relevant effects of development proposals prior to major decisions being taken and commitments made".[1] This includes all potential effects, both positive and negative, and encompasses natural and anthropogenic receptors;

(c) **"Environmental impact statement" (EIS)** is the documentation of the environmental impact assessments process, which describes the predicted effects of the project on the environment (and their significance), the measures that the applicant is committed to taking in order to avoid, minimize and reduce them where possible, and the residual (remaining) effects that cannot be avoided;

(d) **"Environmental risk assessment" (ERA)** is a process to identify, analyse and evaluate the nature and extent of activities and the level of risk to characteristics of the environment;

(e) **"Impact"** is the influence of an action/activity during the project on the environment;

(f) **"Risk"** is the probability, high or low, that an activity will cause harmful effects on living organisms and the environment.

V. The environmental impact assessment process

A. Overview

7. The flow chart below (figure I) shows the steps of the EIA process. The steps are shown as sequential, but many are iterative with feedback into previous steps.

Figure I
Steps of the environmental impact assessment process

[1] As defined by the International Association for Impact Assessment https://www.iaia.org/.

B. Screening

8. Screening is a step used to determine which projects should be subject to an EIA and to exclude those unlikely to have harmful environmental effects. When submitting an application for exploitation, all applicants are required to undertake an EIA. However, there could be situations such as when an exploitation contrac t has been approved and the project subsequently has undergone a change that could result in different environmental effects that may be of some significance. The screening process should determine whether or not a new EIS (or another mechanism, such as an addendum to the EIS) is needed.

C. Scoping

9. The applicant or Contractor shall undertake scoping in order to:

(a) Identify the issues and activities that are likely to be important for the project and its EIA;

(b) Define the focus of the EIA studies;

(c) Identify key issues that shall be studied in more detail.

10. The applicant or Contractor shall ensure that they:

(a) Allocate appropriate time and resources for scoping;

(b) Undertake scoping at the outset of the EIA process;

(c) Demonstrate that scoping is undertaken with a reasonable understanding of the environmental setting for the project (i.e. Contract Area and regional setting), existing environmental baseline studies, gaps in existing information and understanding, and the project proposals (e.g. where mining will occur within a Contract Area, the mining technology);

(d) Include consideration of alternatives. This should include alternatives to elements of the planned project already provisionally decided upon (e.g. the typ e of mining technologies to be used), as well as aspects that will be considered and decided through the EIA (e.g. details of environmental mitigation measures and mining operation plans);

(e) Establish the technical, spatial and temporal constraints for the EIA;

(f) Include an environmental risk assessment (ERA) to ensure that all relevant activities and associated impacts are identified, and their importance is assessed so that their effects and the impact assessment methods and the development of mitigation measures in the EIA are in proportion to the most significant or uncertain risks associated with the project;

(g) Address the inherent uncertainties present at this stage of the EIA, through the application of a precautionary approach and the undertaking of studies that allow for a range of potential outcomes and impacts;

(h) Offer a structured plan for the EIA, including activities to be undertaken in each step and proposed approaches and methodologies for addressing the key i ssues identified in the ERA;

(i) Produce a scoping report.

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10. The applicant or Contractor shall ensure that they:
(a) Allocate appropriate time and resources for scoping;
(b) Undertake scoping at the outset of the EIA process;
(c) Demonstrate that scoping is undertaken with an ~~reasonable~~ understanding of the environmental setting for the project (i.e. Contract Area and regional setting), existing environmental baseline studies, gaps in existing information and understanding, and the project proposals (e.g. where mining will occur within a Contract Area, the mining technology);
(d) Include consideration of alternatives. This should include alternatives to elements of the planned project already provisionally decided upon (e.g. the type of mining technologies to be used), as well as aspects that will be considered and decided through the EIA (e.g. details of environmental mitigation measures and mining operation plans);

Rationale

Textual changes have been included to strengthen language and better ensure contractors are sufficiently aware of potential environmental implications.

D. Impact assessment

11. The assessment of impacts is the core of the EIA process. This component brings together all available data on the condition of the environment (the baseline) prior to any activity, the nature and scale of the activities proposed by the applicant or Contractor, the expected effects on the Marine Environment, and the evidence base for how the environment is expected to respond. Together with an enhanced ERA those components provide the basis for determining (a) the significance of the impacts, and (b) the development of mitigation to be incorporated into design and project planning to manage the effects on the Marine Environment.

12. In the assessment of impacts, the applicant or Contractor shall consider the following:

(a) The nature of the impact;

(b) The potential extent, duration, frequency and severity of the impact;

(c) Whether the impact is direct or indirect;

(d) Cumulative and combined impacts;

(e) Routine and non-routine impacts;

(f) Uncertainty associated with the assessment of impacts.

13. The applicant or Contractor shall take account of all identified risks and impacts, but focus, in a proportionate way, on the high risks identified in the scoping repo rt in its assessment of impacts, taking into consideration any new information which may influence such assessment.

14. Where the assessment of impacts draws on the modelled response of species, habitats or ecosystems to disturbance from mining, the applicant or Contractor shall refer to the evidence base for such information and how it has been used to assess the impacts.

15. The applicant or Contractor shall also identify the impacts (including cumulative effects) of the project at a regional scale. Assessment of impacts shall result in understanding the absolute and relative significance of each impact in such a way to allow mitigation of harmful effects to be considered, at both the local and regional levels.

E. Mitigation

16. Subsequent to the identification of impacts and their significance, the applicant or Contractor shall identify and evaluate appropriate measures to avoid or minimize predicted harmful effects.

17. The applicant or Contractor shall apply the mitigation hierarchy (working through a sequence from avoid/prevent through minimize, to restore/rehabilitate, to offset), when evaluating mitigation measures. The applicant or Contractor shall include examination of alternatives to establish the most technically and economically feasible, safe and environmentally sound approaches for achieving the project objectives.

F. Environmental impact assessment reporting

18. The EIS sets out the project parameters and how environmental assessment has been undertaken, including predicted impacts of the project, proposed measures for mitigation, significance of residual impacts, uncertainties in data or analyses that

affect the predictions and how to address these, as well as concerns raised by consultations and how they have been addressed.

G. Review

19. The processing, review and consideration of the EIS is governed by the draft regulations on exploitation (part II, sections 2 and 3).

H. Decision-making

20. The decision-making process is governed by the draft regulations on exploitation (regulations 15 and 16).

VI. Monitoring and environmental impact assessment audit steps

21. Follow-up processes are required to monitor the project and ensure conditions of the contract are met, impacts are adequately monitored in accordance with an agreed monitoring programme, the effectiveness of mitigation and management measures can be assessed, and ways to improve the process are identified.

22. The Contractor shall conduct monitoring and EIA audit steps through the Environmental Management and Monitoring Plan (EMMP).

Draft guidelines for the environmental impact assessment process

Contents

I. Introduction

A. Background

1. The environmental impact assessment (EIA) is an integral component of the planning, development and management of many human activities. The EIA requirements for mineral exploitation in the Area are set out in the Draft Regulations for Exploitation of Mineral Resources in the Area (regulations on exploitation).

B. Purpose

2. The purpose of the present guidelines is to expand the description of the process to be followed in undertaking an EIA for exploitation of mineral resources in the Area and to provide guidance to assist an applicant or Contractor in implementing the required components and stages of an EIA as set out in the draft regulations on exploitation and EIA standard.

3. In accordance with regulation 47 of the draft regulations on exploitation, the EIA process:

(a) Identifies, predicts, evaluates and mitigates the physicochemical, biological, socioeconomic and other relevant effects of the proposed mining activities;

(b) Includes at the outset a screening and scoping process, which identifies and prioritizes the main activities and impacts associated with the potential mining operation, in order to focus the Environmental Impact Statement (EIS) on the key environmental issues. The environmental impact assessment should include an environmental risk assessment;

(c) Includes an impact analysis to describe and predict the nature and extent of the Environmental Effects of the mining operation;

(d) Identifies measures to manage such effects within acceptable levels, including through the development and preparation of an Environmental Management and Monitoring Plan (EMMP).

4. The guidelines should be read in conjunction with the draft regulations on exploitation, the relevant regulations on exploration, as well as other relevant Standards and Guidelines of the International Seabed Authority, including, but not limited to, those related to:

- Application for approval of Plan of Work in the form of a contract (to conduct exploitation activities in the Area);
- Environmental Impact Statement;
- Environmental Management and Monitoring Plans;
- Environmental management systems;
- Expected scope and standard of baseline data collection;
- Hazard identification and risk assessment.

5. The applicable regional environmental management plan (REMP) should also be considered by the applicant or Contractor in the EIA process and any management approaches outlined in the REMP incorporated into the management and mitigation methodologies of the EIA/EIS.

6. The guidelines are not intended to contain legally binding requirements, but set out guidance for achieving the requirements of the regulations and the standard for EIA. There may be several ways to approach or undertake the stages in the EIA process, and it is for the applicant or Contractor to evaluate the most appropriate or effective means of achieving the outcome of a robust EIA process. Hence, the guidelines are not intended to be highly detailed or exhaustive, but to point the applicant or Contractor in the direction of appropriate methods to under take certain activities, or to highlight that there may be several options available depending on the particular resource and environmental characteristics.

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B. Purpose

3. In accordance with regulation 47 of the draft regulations on exploitation, the EIA process:

(a) Identifies, predicts, evaluates and mitigates the physicochemical, biological, socioeconomic and other relevant effects of the proposed mining activities;

(b) Includes information and data from baseline studies that capture spatial and temporal variability;

(b) Includes at the outset a screening and scoping process, which identifies and prioritizes the main activities and impacts associated with the potential mining operation, in order to focus the Environmental Impact Statement (EIS) on the key environmental issues. The environmental impact assessment should include an environmental risk assessment;

(c) Includes an impact analysis to describe and predict the nature and extent of the Environmental Effects of the mining operation;

(d) Identifies measures to manage effects within acceptable levels, including through the development and preparation of an Environmental Management and Monitoring Plan (EMMP).

Rationale

Recommendation to include baseline data requirements.

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3. In accordance with regulation 46 of the draft regulations on exploitation, the EIA process:

~~(a) Identifies, predicts, evaluates and mitigates the physicochemical, biological, socioeconomic and other relevant effects of the proposed mining activities;~~

~~(b) Includes at the outset a screening and scoping process, which identifies and prioritizes the main activities and impacts associated with the potential mining operation, in order to focus the Environmental Impact Statement (EIS) on the key environmental issues. The environmental impact assessment should include an environmental risk assessment;~~

~~(c) Includes an impact analysis to describe and predict the nature and extent of the Environmental Effects of the mining operation;~~

~~(d) Identifies measures to manage such effects within acceptable levels, including through the development and preparation of an Environmental Management and Monitoring Plan (EMMP).~~

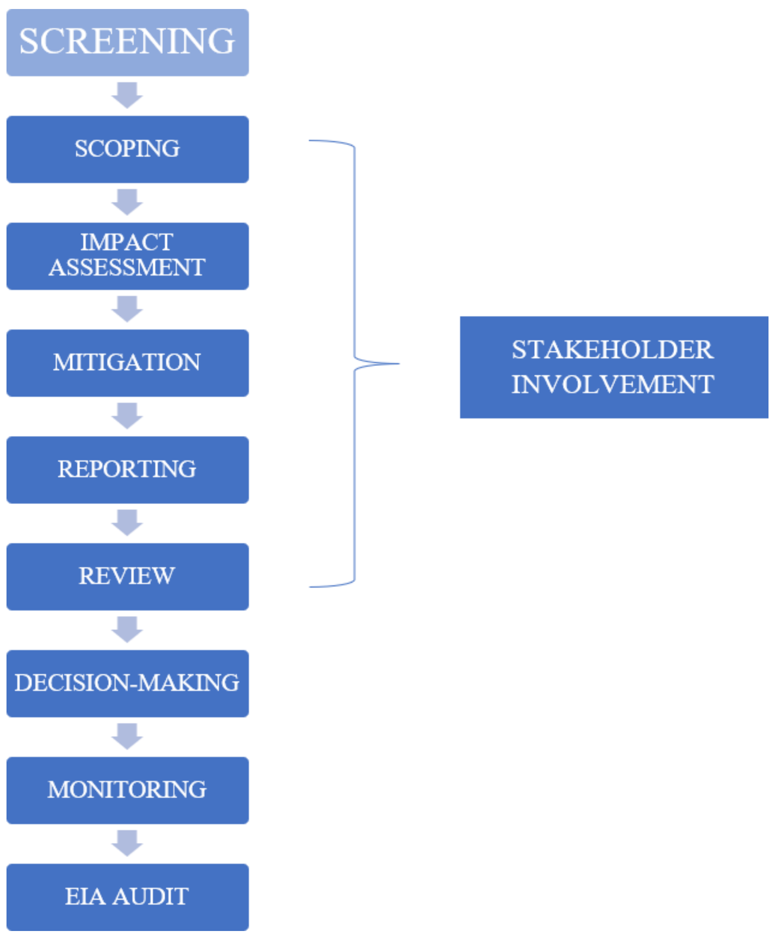
Rationale

We noticed that this paragraph quoted the content of regulation 47 of a former version of the Draft Exploitation Regulations. The facilitator's text has revised the relevant content and moved it to regulation 46bis(2). It should be updated accordingly.

C. Key steps in the environmental impact assessment

7. The EIA process follows the steps specified in the EIA standard, which includes the key components in figure I. The monitoring and EIA audit components are covered as part of the guidelines on Environmental Management and Monitoring Plans (EMMP), and the present guidelines do not discuss those components in any detail. Although an EIA has various components, it should be emphasized that the process is an iterative one with strong interaction required between its components.

Figure I
Key components of the environmental impact assessment process.



Note: Although presented as a sequence, most steps are iterative with feedback between components.

8. The EIA process includes the following steps:

(a) A screening exercise, if appropriate. All applications for approval of a Plan of Work for exploitation will require a prior EIA. However, proposed amendments to an approved exploitation plan of work may require screening to determine whether an EIA is required to assess the impacts of any activity requiring an amendment of the Plan of Work;

(b) A scoping exercise, involving appropriate specialists, stakeholder consultation, and environmental risk assessment. This should be summarized in a scoping report which is shared with stakeholders, in order to seek feedback on the planned content and emphasis of the EIA;

(c) An impact assessment, this will include assessment of baseline data collected during exploration activities and the results of studies that were identified during the scoping process as being required in accordance with the relevant International Seabed Authority regulations on exploration and International Seabed Authority recommendations (e.g., for baseline studies: ISBA/25/LTC/6/Rev.1) and the Guidelines on the Scope and Standard of Baseline Data Collection. The assessments will focus on the most important environmental characteristics highlighted during scoping, and description of the potential impacts of the activity at both a local and regional level;

(d) An evaluation of significant and harmful effects on the environment, founded on clear and transparent assessment criteria and a robust evidence base;

(e) The presentation and evaluation of potential mitigation measures, and subsequent statement of management and monitoring commitments (together with the EMMP), to avoid and minimize effects, and monitor residual impacts;

(f) The production of an Environmental Impact Statement (EIS) that reports the findings of the EIA process.

9. Effective and comprehensive stakeholder engagement and consultation is recommended from the scoping stage throughout the entire EIA process.

10. The successful completion of an EIA process:

(a) Facilitates informed decision-making by providing best practice scientific and quantitative analysis of the effects and consequences of proposed actions;

(b) Assists with the selection of the most practicable and environmentally sound exploitation and monitoring techniques and approaches;

(c) Screens out environmentally unsound options and enables a focus on feasible and acceptable options;

(d) Encompasses all relevant issues and factors, including uncertainty of information, cumulative effects, social issues, and stakeholder concerns;

(e) Directs evaluation processes and development of terms and conditions on the project;

(f) Uses best available scientific techniques and methods to determine significance and harmfulness of effects;

(g) Includes adaptation and feed-back mechanisms to inform the EMMP and future developments.

11. In the following sections, comments and guidance are provided to assist carry out each of the steps in the EIA process. There is more emphasis placed on scoping than the other sections, as this is likely to be a critical step in assessing the status of available data and information as a basis for, and developing plans to, achieve a robust EIA.

II. Screening

12. Screening is not required for applications for approval of a Plan of Work for exploitation, as all applicants are required to undertake an EIA and submit an EIS. However, amendments to a Plan of Work, or monitoring of activities that suggests unexpected impacts, may or may not require an EIA and/or amendment to the EIS. Pursuant to the draft regulations on exploitation, it is the Contractor's responsibility to notify the Authority in the event of any proposed change to the Plan of Work.

13. There are numerous external sources of useful information and details on elements of screening processes and methodology (e.g., European Commission 2017).

III. Scoping

A. General process

14. There are four main steps to be undertaken as part of the scoping process, which are:

- **Step 1 – Initiation of scoping**, scoping is initiated by the applicant or Contractor at the point that they wish to commence their EIA for exploitation. It is expected that the applicant or Contractor will have conducted many studies relevant to the scoping process as part of exploration activities, and the scoping process will assist the applicant or Contractor direct their future studies towards the compilation of an EIS for exploitation. This is to ensure that the scientific baseline data collected during exploration is sufficient to support a robust EIA.
- **Step 2 – Information needed to undertake scoping**, this stage involves identification and collation of the information that the applicant or Contractor must provide to prepare a scoping report. This includes project information and definition, as well as identification of studies that will inform risk assessment and understanding of the extent and nature of impacts associated with the potential mining operation.
- **Step 3 – Scoping consultation**, this involves consultation with scientific experts, other relevant interested parties and the general public.
- **Step 4 – Scoping outputs**, a scoping report is prepared as a formal plan for the EIA process and for specifying the content of the EIS.

B. Scoping initiation

15. The scoping process is initiated by the applicant or Contractor. While many essential studies (including baseline studies) will have been undertaken in the exploration phase, the start of the EIA process should include a formal consideration of the information (and subsequent studies) required for the assessment of the environmental impacts of exploitation.

C. Project information and definition

16. The scoping process should be informed by project plans, including:

(a) Location of the project area including location maps (to scale), and a layout of the proposed mining area or areas (within the Contract Area). Locations of relevant impact reference zones and preservation reference zones may also be marked;

(b) Description of likely activities and equipment associated with the proposal, including:

(i) Mining plans and activities;

(ii) Pumping activities;

(iii) Dewatering and/or ore sorting activities;

(iv) Ore transfer activities;

(v) Ancillary vessel activities;

(vi) Shipping activities including transport of ore, supplies and personnel.

(c) Information regarding the type and nature of the mineral resource (e.g., mineralogical and chemical composition, grain sizes, ore and gangue definitions);

(d) Description of the likely mining plan (especially the mine site envelope) and mining schedule, including appropriate spatial and temporal details and any corresponding production rates and volumes. It is recognized there may be limited information on this at the scoping stage, but these are important elements that will be substantially informed by the EIA and required for the EIS. Hence at least a general description should be provided that will feed into more detail in the EIS.

D. Environmental risk assessment

1. General considerations

17. The scoping process will identify the main activities and impacts relevant to the project, with the objective of focusing the EIA on the key environmental issues, as well as a check on whether available data are sufficient. This process is likely to involve parallel activities that include:

(a) A review of the current environment (including social and economic) values and systems based on data collected by the applicant or Contractor to date and other relevant data collected by third parties, and highlighting those aspects most uncertain or most vulnerable to the impacts of the project;

(b) A review of the intended project's activities, identifying those likely to have environmental impacts;

(c) A review of studies of the environmental effects of seabed mining (and other relevant activities) that have been undertaken by the applicant or Contractor and other parties to date, and an analysis of the relevance and quality of the studies as they might apply to the project.

18. The above activities will inform a preliminary environmental risk assessment (ERA) that will identify the type of environmental impacts and extent to which the proposed project may cause harmful effects to the Marine Environment. The ERA process should involve suitably qualified experts across the range of topics that it addresses.

19. Risk can be viewed in different ways, for example (a) the possibility of harmful effects on the Marine Environment as a consequence of an unforeseen or accidental incident (e.g., process failure leading to a spillage); or (b) a range of consequences (and their significance) of the impacts of a planned activity (e.g., effects of sediment deposition on the benthic ecosystem).

20. Uncertainty may exist at this stage in the EIA process, for example over the extent of sedimentation and how the ecosystem may respond to it. Therefore, expert judgment and the degree of confidence in that judgment (and the evidence base underpinning it) determine the probability factor in establishing environmental risk.

The ERA will need to examine the potential impacts of accidental events and there are numerous examples of tried and tested approaches to achieving this, especially from the oil and gas industry (e.g., Husky Oil 2001). However, these guidelines focus on addressing environmental risk for planned activities as part of normal operations, stemming from current levels of knowledge and associated uncertainty.

21. It is important to note that the preliminary ERA may be revisited and updated as the EIA proceeds, for example at key milestones such as testing of mining equipment, plume modelling and completion of baseline studies and data interpretation. Revisiting and updating the ERA will be especially important for ERAs undertaken very early in the project development process when baseline data and project information may be limited. Hence, the level of detail included may differ between the scoping stage and later in the environmental EIA process as it develops from qualitative through to a more quantitative assessment, where a final ERA should be included as part of the EIS.

2. Environmental risk assessment approach

(a) Overview

22. As noted above, an important objective of the EIA scoping process (and a requirement of the draft regulations on exploitation) is to ensure the EIA focuses on what are foreseen to be the main activities and impacts associated with the potential mining operation and does not spend undue time on elements of little risk (noting that the latter should nevertheless be included and discussed but not in the detail required for high impact activities). To help achieve this objective, the ERA should be viewed as forming part of a continuum of baseline and impact assessment studies that will have started during the exploration phase. Some of these studies may be relevant to the ERA for Exploitation, as the early stages of planning for Exploitation and the commencement of the EIA process are likely to overlap in time with Exploration activities, including baseline data acquisition, preparation of Exploration EIAs (e.g., for seabed mining equipment trials), and monitoring the impacts of those trials.

23. The activities undertaken during exploration and leading up to the scoping phase for an EIA for an exploitation contract, will not be the same for all projects, and an applicant or Contractor should design its ERA approach in the context of the best available information the applicant or Contractor has relevant to their particular project and environmental characteristics.

24. These guidelines do not provide advice on a single or particular method for adoption, as they will be specific to aspects such as the mineral resource, geographical area, environmental setting and available data, proposed technology and equipment characteristics, etc. There are many approaches and methods that can be applied to ERA (refer to the International Seabed Authority guidelines on hazard identification and risk assessment), and these are well documented as part of an ISO 31000 standard, which includes a detailed report on risk assessment techniques, see IEC/ISO 31010 (2009).

25. Other national guidance documentation as well as scientific literature, on risk assessment approaches and systems aligned with the International Organization for Standardization, can be additional useful resources.

(b) Impact identification

26. Preliminary identification of impacts is required during the scoping process to ensure that impacts which could result in harm to the Marine Environment are identified, and that studies are included as part of the EIA scope, in order to ensure the EIA fully quantifies, assesses and mitigates those impacts. Impact identification should consider all the project activities within the scope of the EIA, the impacts the

activities are likely to have and the receptors that are expected to be affected by those impacts. Preliminary impact identification should acknowledge that further impacts may be identified in later stages of the EIA as more is learned about the baseline and/or from mining system component tests.

27. The following are example impact identification methods:

(a) Checklists: based on lists of special biophysical, social and economic factors that may be influenced by mining operations;

(b) Matrices: typically, these are two-dimensional charts, with environmental components on one axis, and development actions/activities on the other. They build on simple checklists and introduce the aspect that different parts of the operation will have different impacts;

(c) Networks: also known as causal chain analyses, these show links between a complex web of environmental system linkages and the effects of the project;

(d) Overlay maps: these are geographic information system layers of the project area, on which successive layers are overlain representing various environmental components that are likely to be affected. They are very useful for understanding the spatial distribution of impacts.

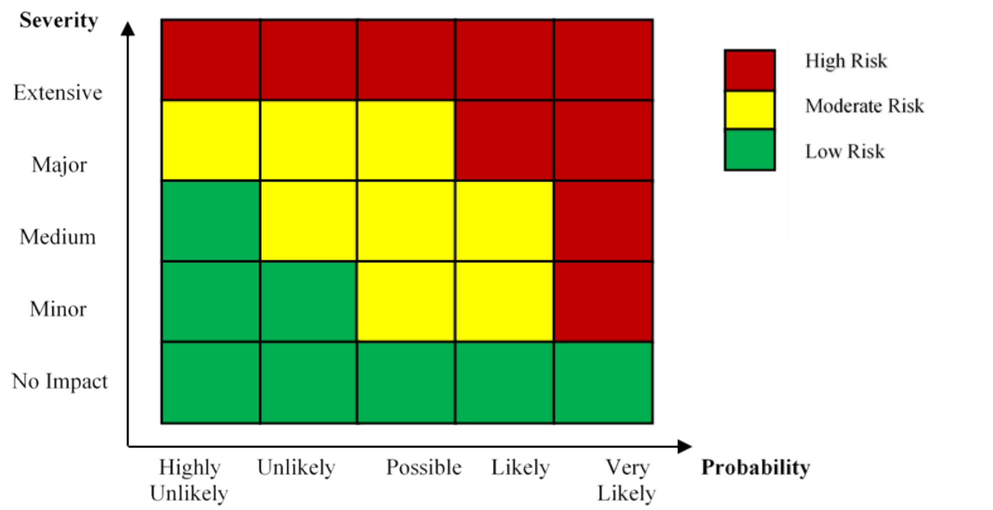
28. Checklist and matrix-type methods are likely to be most relevant at the scoping stage, becoming more sophisticated and quantitative further into the process.

(c) Impact analysis and ranking the importance of issues for the environmental impact assessment

29. For each identified impact, the analysis should consider the magnitude of the impact and the receptor characteristics (importance and sensitivity). The analysis should then draw on the evidence base and on expert input to assess the environmental consequence and the likelihood of that consequence being realised. It can be helpful at this stage if the analysis of impacts considers, to the extent practicable, the same or similar criteria to assess consequence as these will likely be used in the full impact assessment that later follows. This allows the ERA to be a precursor to the full impact assessment and avoids possible disconnects between the ERA and EIA processes.

30. Impact matrices are a way of graphically representing two dimensions of risk: consequence (also known as severity) and frequency (also known as likelihood or probability) (see figure II). Each impact can be characterized as one of three areas of low, medium, and high relative risk based on a combination of likelihood and consequence.

Figure II
Example risk matrix structure



Source: adapted from Swaddling 2016.

31. Such matrices are very common in a range of risk assessments. Their application in the deep seabed mining context can be illustrated by tables used in a generic risk assessment of human activities in the Marine Environment around New Zealand (MacDiarmid et al., 2012) and in an assessment of the potential impacts of deep seabed mining on Pacific Island fisheries (Clark et al., 2017a). These studies applied likelihood and consequence scales based on Fletcher (2005) given in table 1 below. These scales should be tailored to the environmental characteristics of the particular region and habitats, and the likely effects of the proposed project. Hence they may vary between resources and geographical areas.

Table 1
Examples of likelihood, consequence categories and consequence descriptions for several environmental categories

(a) Likelihood categories

Likelihood	*Description*
Remote	No known examples, but not impossible
Rare	May occur in exceptional circumstances
Unlikely	Uncommon, but has been known to occur elsewhere
Possible	Some evidence exists indicating this is could occur
Occasional	May occur from time to time
Likely-certain	It is expected to occur

(b) Consequence categories

Consequence	*Description*
Negligible	Impact unlikely to be detectable at the scale of the stock/habitat/community
Minor	Minimal impact on stock/habitat/community structure or dynamics
Moderate	Maximum impact that still meets an objective (e.g. sustainable level of impact such as full exploitation rate for a target species).
Major	Wider and longer term impacts (e.g. long-term decline in stock size)
Severe	Very serious impacts occur, with relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase).
Catastrophic	Widespread and permanent/irreversible damage or loss will occur-unlikely to ever be fixed (e.g. local extinction/extirpation)

(c) Consequence descriptions

Consequence	*Key species*	*Protected species*	*Ecosystem functional impact*	*Proportion of habitat affected*
Negligible	Undetectable for populations of these species	Almost none are impacted	Interactions may be occurring, but it is unlikely that there would be any change outside of natural variation	Affecting <1% of area of original habitat
Minor	Possibly detectable, but little impact on population size and none on their dynamics	Some individuals impacted but no impact on population.	Affected species do not play a keystone role – only minor changes in relative abundance of other constituents	Measurable but localized; affects <1–5% of total habitat area
Moderate	Affected but long-term recruitment/ dynamics not impacted	Level of interaction/ impact moderately affects population	Measurable changes to the ecosystem components without there being a major change in function (i.e. no loss of components)	Impacts more widespread; 5–20% of habitat area is affected

Severe	Affecting recruitment levels of populations or their capacity to increase	Level of impact severely affects population levels	Ecosystem function altered measurably, and some function or components are missing/declining/ increasing well outside historical acceptable range and/or allowed/ facilitated new species to appear.	Impacts very widespread; 20 to 60% of habitat is affected/removed
Major	Likely to cause local extinctions if continues	Likely to cause local extinctions if continues	A major change to ecosystem structure and function. Different dynamics now occur with different species or groups now affected.	Activity may result in major changes to ecosystem; 60–90% affected
Catastrophic	Local extinctions are imminent/ immediate	Local extinctions are imminent/ immediate	Total collapse of ecosystem processes. The diversity of most groups is reduced and most ecological functional groups (primary producers, grazers etc.) have disappeared. Ecosystem functions such as carbon cycling, nutrient cycling, flushing and uptake have declined to very low levels.	Entire habitat in region is in danger of being affected; >90% affected/ removed

Source: (a) and (b) Clark et al. (2017a), and (c) MacDiarmid et al. (2012).

32. Confidence (or uncertainty) is an important factor to be considered for ERA; and this examination of confidence levels should continue through the EIA process. The above MacDiarmid et al. (2012) and Clark et al. (2017a) studies factored into the assessment the confidence levels of the experts, in order to account for uncertainty and a precautionary approach (table 2).

Table 2
Description of confidence rating

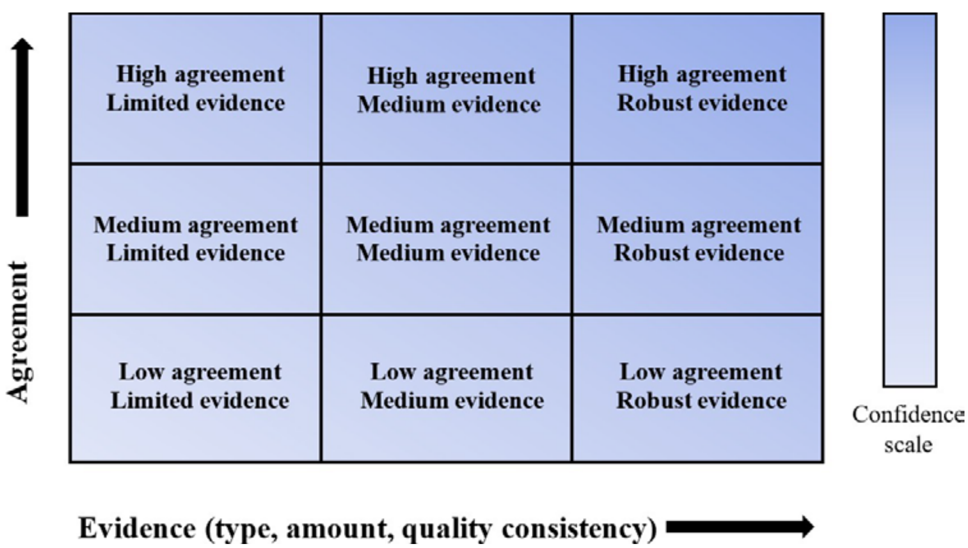
Confidence		*Rationale for confidence score*
Low	a	No data exist and no consensus among experts
	b	Data exist, but are considered poor or conflicting
	c	Agreement among experts, with low confidence
High	a	Consensus among experts, with high confidence, even though data may be lacking
	b	Consensus among experts supported by unpublished data (not been peer-reviewed but is considered sound)
	c	Consensus among experts supported by reliable peer-reviewed data or information (published journal articles or reports)

Source: Clark et al. (2017a).

33. Considering uncertainty in data, analyses and interpretation allows an assessment of where there are major gaps in understanding the impacts of the proposed activities which can help direct further work to improve knowledge and confidence.

34. As well as the approach illustrated above, the Intergovernmental Panel on Climate Change, for example, sets out an approach to confidence/uncertainty whereby a combination of the evidence (type, amount, quality, consistency) and the extent of (scientific) agreement are considered (figure III).

Figure III
Example confidence matrix



Note: Confidence increases towards the top right-hand corner of the matrix.
Source: Mastrandea et al., (2010).

35. On-going scientific research will play a key role in understanding the likely effects of Exploitation activities. It is recommended that an applicant or Contractor may take a structured approach to address uncertainty (beginning with the ERA and continuing throughout the EIA process), in order to demonstrate how uncertainties have been considered initially and how they have subsequently been resolved and/or reduced as the EIA process proceeds.

36. The overall environmental risk can then be considered in various ways, for example: (a) as a combination of the anticipated environmental consequence and the likelihood of the consequence occurring, advised by a consideration of confidence; or (b) as a combination of the likely magnitude of an impact and the likely importance and sensitivity of a receptor, with confidence levels being taken into account for both of these factors.

37. The latter approach can allow the identification of where uncertainty exists most at the scoping stage (be it in the likely magnitude of an impact, in the sensitivity of a receptor to that impact, or in the importance of the receptor to the wider ecosystem – or combinations). This enables the applicant or Contractor to improve planning for actions and studies targeted towards reducing or resolving those uncertainties as the EIA progresses.

38. Impact matrices and closely allied consequence-likelihood tables provide a consistent and concise format that is likely to be appropriate for an initial ERA during scoping. This facilitates communication of environmental risks, ranks the risks of potential operations in order of priority, screens out the insignificant ones and evaluates the need for further information. There are, however, more sophisticated approaches to risk assessment than solely the use of matrices, and these may be considered as more information becomes available. The ISO31000 standard and guidelines is a very good starting point to see what methods could be applicable, especially the methods outlined in ISO31010 (IEC-ISO 2009). A further useful resource on risk identification and assessment options for mining in the Area is the report and presentations from a 2018 workshop on risk management for deep-sea mining (MIT 2019).

39. Whichever ERA method is adopted by an applicant or Contractor, it must meet the basic objective of identifying the most important issues for the EIA to focus on, and do so in a way that is systematic, thorough and underpinned (through expert involvement) by the evidence base existing at the time.

3. Environmental risk assessment outcomes

40. The environmental risk assessment should demonstrate and emphasize high-risk activities, but it also needs to describe low-risk elements: the latter still need to be documented in the ERA (where justification is required for concluding they are not considered relevant), low-risk activities, however, will require less attention in the EIA.

41. The degree of confidence or uncertainty associated with the identification and assessment of risks at the scoping stage must also be considered in the development of the EIA scope. The ERA results may include an evaluation of whether the level of existing information and the extent of the evidence base is sufficient, and if not to advise the scope, nature and priority of future studies required to fully inform the EIA.

42. The ERA report should set out the methodology and criteria used, and clearly communicate the risks identified, prioritize them and describe the actions arising from the assessment process, which will then be incorporated into the scope of the EIA.

4. Summary

43. In summary, applicants or Contractors should identify project activities that will have impacts on the Marine Environment, identify what those impacts will be, the important receptors that will be affected, the likelihood of them occurring, and the level of confidence in assessment of factors.

44. Based on the above process, or one similar, the applicant or Contractor should identify and rank the most important issues for the EIA. This will show that large magnitude impacts on highly important and highly sensitive receptors with a high likelihood of occurrence will require the most attention in the EIA. Where there is higher uncertainty over the initial estimate of any of these factors, then an issue is accordingly ranked of higher importance for attention in the EIA.

45. The ERA process may involve a suitable range of experts and stakeholders, so that differing views and perspectives on risks can be incorporated and the quality of the evidence base and extent of agreement on it can be factored into the process.

46. The initial ERA undertaken at the EIA scoping stage may be revisited, and updated as required, during later EIA stages and before the EIS is submitted, to ensure that the EIA scope remains valid in terms of the environmental effects under consideration.

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Section 3 D. 1) General Considerations
19. Risk can ~~be viewed in different ways, for example~~be construed as : (a) the possibility of harmful effects on the Marine Environment as a consequence of an unforeseen or accidental incident (e.g., process failure leading to a spillage); and~~or~~ (b) a range of consequences (and their significance) of the impacts of a planned activity (e.g., effects of sediment deposition on the benthic ecosystem).
20. Uncertainty may exist at this stage in the EIA process, for example over the extent of sedimentation and how the ecosystem may respond to it. Therefore, the precautionary approach should be applied and informed by expert judgment and the degree of confidence in that judgment (and the evidence base underpinning it) to determine the probability factor in establishing environmental risk. ISBA/27/C/4 14/49 21-17327 The ERA will need to examine the potential impacts of accidental events and there are numerous examples of tried and tested approaches to achieving this, especially from the oil and gas industry (e.g., Husky Oil 2001). However, these guidelines focus on addressing environmental risk for planned activities as part of normal operations, stemming from current levels of knowledge and associated uncertainty

Rationale

This language proposal shows that risk can include both of the components listed instead of only one. The precautionary approach is also referenced as it should be applied.

Section 3 D.2b Impact Identification
(b) Impact identification
26. Preliminary identification of impacts is required during the scoping process to ensure that impacts which could result in harm to the Marine Environment are identified, and that studies are included as part of the EIA scope, in order to ensure the EIA fully quantifies, assesses and mitigates those impacts. Impact identification should consider all the project activities within the scope of the EIA, the impacts the activities are likely to have and the receptors that are expected to be affected by those impacts.

Preliminary impact identification should acknowledge that further impacts may be identified in later stages of the EIA as more is learned about the baseline and/or from mining system component tests.
27. The following are example impact identification methods:
(a) Checklists: based on lists of special biophysical, social and economic factors that may be influenced by mining operations;
(b) Matrices: typically, these are two-dimensional charts, with environmental components on one axis, and development actions/activities on the other. They build on simple checklists and introduce the aspect that different parts of the operation will have different impacts;
(c) Networks: also known as causal chain analyses, these show links between a complex web of environmental system linkages and the effects of the project;
(d) Overlay maps: these are geographic information system layers of the project area, on which successive layers are overlain representing various environmental components that are likely to be affected. They are very useful for understanding the spatial distribution of impacts.
~~28. Checklist and matrix-type methods are likely to be most relevant at the scoping stage, becoming more sophisticated and quantitative further into the process.~~

<u>Rationale</u>

Please remove "Checklist and matrix type methods paragraph 28, as it is quite limiting and is a subjective statement with no context to particular projects.

E. Consultation

1. Consultation during scoping

47. Scoping may include a stakeholder identification exercise which provides the applicant or Contractor with a preliminary stakeholder list in relation to the project. These may include:

(a) Relevant government agencies and civil society groups or communities of the sponsoring State;

(b) Organizations or bodies with interests or operations within the region in which the proposal is located;

(c) Coastal and member States with an interest in the region in which the proposal is located;

(d) Non-governmental organizations with a focus aligned with any of the key environmental, or social or cultural factors engaged by the proposal;

(e) Intergovernmental organizations with a management mandate relevant to the region or project.

48. Consultation with these identified stakeholders during the scoping phase may then be carried out to inform development of the scoping report. This process enables the applicant or contractor to:

(a) Provide enough information about the mining project for stakeholders to understand what is being proposed and to identify potential issues;

(b) Make clear to stakeholders that the scoping process is about incorporating their views into the development of the scope of studies to inform the environmental impact assessment process;

(c) Provide sufficient time for stakeholders to respond to requests for views and information;

(d) Reassure stakeholders that any views that they express at the scoping stage will not preclude them from making further comments and, possibly, disagreeing at a later stage in the environmental impact assessment process;

(e) Ensure that the views expressed are taken into account, and are seen to be taken into account, in the planning and preparing of the scoping report (and ultimately the environmental impact statement) and that an explanation is provided if recommendations are not followed.

2. Consultation planning for the environmental impact assessment

49. The applicant or contractor's intended process for stakeholder consultation in relation to the EIA process may include:

- An indicative schedule and methodology for engagement with key stakeholders throughout the EIA process; and
- A proposed approach for dissemination of study results to key stakeholders in order to obtain and consider feedback.

50. The applicant or contractor's intended process should demonstrate how stakeholders will be reached by the consultations, will receive comprehensive, relevant, timely and appropriately presented information, and will have reasonable opportunity to provide comments through accessible means.

F. Scoping report

51. A scoping report may include the following:

(a) Brief description of the planned mining project including any timelines (e.g., for construction), ancillary features, and plans/maps/photos to aid description of the site and the proposal;

(b) Feasible alternatives that will be examined in detail and others that have been discounted, including explanations;

(c) Any relevant strategic or policy decisions that have already been made and which may affect the project;

(d) Relevant regulatory frameworks and documentation that determine the outcomes that will be considered acceptable by the regulator. In addition to the United Nations Convention on the Law of the Sea and the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea, these include:

(i) Relevant International Seabed Authority rules, regulations and procedures, standards and guidelines, and the relevant regional environmental management plan;

(ii) National laws and any other international instruments that apply to the proposed exploitation activities;

(iii) Other national laws and international instruments relevant but ancillary to the exploitation activities (e.g., those related to shipping, applicable biodiversity, fisheries, marine scientific research, climate change);

(iv) Any voluntary standards, principles and guidelines which the scoping report has taken into consideration (e.g., the Equator Principles, the International Finance Corporation Performance Standards on Environmental and Social Sustainability, the International Marine Minerals Society Code for

Environmental Management of Marine Mining, standards set by the International Organization for Standardization or similar);

(e) A list of stakeholders, the methodology used to identify them, their interests and how they have been engaged through scoping and will be further engaged in the environmental impact assessment process;

(f) An initial desktop study of the current environment in the proposed contractor area (and broader region where appropriate). This includes social and economic values and characteristics;

(g) Identification of applicable studies that have been undertaken by the applicant or contractor or other party to date and the relevance and quality of the studies as they might apply to the project;

(h) Identification of effects likely to result in harm to the marine environment from the implementation of the activities (based on the environmental risk assessment);

(i) Work that must be undertaken by the applicant or contractor to address any information gaps or uncertainties, including:

(i) type of studies to be undertaken (e.g. desktop, modelling, survey);

(ii) the purpose of each of the further studies to be undertaken;

(iii) methodologies to be adopted for the assessment of each issue;

(iv) the extent (spatial and temporal) of the study area to be considered for each issue;

(v) the intended output from each study;

(j) Timing and milestones for the environmental impact assessment process;

(k) Process followed for producing the scoping report, including details of stakeholder consultations undertaken;

(l) The process for dealing with changes to the scoping document in response to significant project changes or substantial new information.

52. When further studies beyond those conducted during exploration activities are identified as being necessary to address key issues, the scoping report should outline the following:

(a) The type and scope of studies required to identify the baseline conditions associated with each key issue (in accordance with the relevant environmental factors outlined in annex IV to the draft regulations on exploitation);

(b) The type and scope of studies required to quantify or predict the direct, indirect and cumulative environmental impacts for each key issue. These studies should include consideration of impacts in relation to their duration, extent and reversibility (which will subsequently determine the significance of the impact). The studies should also be designed to assess impacts in the context of other regional activities and effects on the function of ecosystems on a regional scale, with reference to the relevant Regional Environmental Management Plan;

(c) The scope of studies required to enable the applicant or contractor to propose in the subsequent EIS and EMMP valid, measurable, and effective mitigation and management strategies based on best available scientific evidence and best technological and applicable industry practice;

(d) The scope of studies required to enable the applicant or Contractor to propose in the subsequent EIS and EMMP appropriate monitoring methodology for each issue throughout the life of the mining project (for example, during commissioning/validation, operations, decommissioning and closure).

IV. Impact assessment

53. In the following sections, the term impact is commonly used, but often will apply also to the effects depending on how the applicant or contractor structures the approach to the assessment.

A. The importance of baseline data

54. Baseline data are integral to the EIA, and especially relevant to the Impact Assessment process. The scoping step will have included a review of baseline data collected during exploration, and key gaps that need further studies to support assessment of the main impacts identified from the ERA. The applicant or Contractor should refer to the Guidelines on Baseline Data to aid in this review and evaluation of further work required.

B. Impact assessment objectives

55. The impact assessment stage should predict the effects that may result from the project, and assess not only the type, but also the significance of each possible impact and effect. In evaluating significance, the EIA process is seeking to reach the following targets:

(a) Further refine identification of the important environmental impacts, so that mitigation efforts are focused;

(b) In the EIS, report the nature and extent of potential impacts, residual effects and mitigation measures, to allow the Authority to make a decision regarding approval of the proposed mining project, and to develop suitable requirements to attach to any such approval.

56. This assessment is closely linked with the key issues identified in the scoping ERA, and the plan laid out in the Scoping Report. It is important to note that methods and terminology used in assessment steps can often seem similar to those used in the scoping ERA. However, the next steps involve much more detailed analyses and assessment of the simpler likelihood and consequence concepts applied in scoping. There are many ways to undertake impact assessments and the guidance below focuses on the key aspects of assessment that should be covered, irrespective of the approach or methodology chosen to suit the specific situation.

C. Prediction of impacts

1. Impact hypotheses

57. The identification of potential for effects on the marine environment should lead to a concise statement of the expected potential consequences of the mining project, i.e. the impact hypothesis, which can then inform the key aspects to cover as part of a monitoring plan developed under the EMMP. For further guidance on the EMMP, see the Guidelines on the Preparation of an Environmental Monitoring and Management Plan.

The assessment of impacts should capture the range of potential effects and lead to formulating key questions. For example:

(a) How will sediment and any associated bioavailable elements, heavy metals and contaminants be transported and dispersed in the Marine Environment?

(b) How will the concentrations of sediments, elements, metals and contaminants change as they disperse and settle?

(c) Which marine organisms are present (or likely to be present, based on past monitoring or life history information) in the zone of exposure?

(d) What are the expected exposure pathways?

(e) How would acute or sublethal toxicity be expressed in terms of consequences for populations of organisms in the vicinity of the mining project?

58. These questions can be rephrased as hypotheses based on estimated effects that can be tested statistically with empirical data during the mining operation. For example:

(a) Suspended sediment plumes above ambient concentration will not extend beyond the expected reference zone;

(b) Mobile marine organisms will move away from the area of highest settled sediment;

(c) Leaching of elements from ore collection will not disperse beyond the area of mining.

59. This hypothesis style moves beyond simple description of impacts to enable questions to be answered which subsequently aids the development of appropriate and effective mitigation measures.

2. Prediction approaches

60. Several techniques may be used for predicting and presenting potential impacts. The choices should be appropriate to the circumstances. Choices may be based on:

(a) Expert judgment with adequate reasoning and supporting data, this technique requires high professional experience;

(b) Experiments or tests;

(c) Numerical calculations and mathematical models, these can require a lot of data and expertise in mathematical modelling without which hidden errors can arise;

(d) Physical or visual analysis;

(e) Geographical information systems;

(f) Environmental risk assessment;

(g) Economic valuation of environmental impacts.

3. Modelling approaches

61. Predictive models are one tool that can assist the consideration of environmental impacts associated with a proposed project. An applicant or Contractor may employ appropriate modelling work in its EIA, including particularly:

- Habitat mapping
- Predictive habitat suitability modelling
- Hydrodynamic modelling of sediment plumes and sedimentation footprints
- Modelling of genetic connectivity.

62. Where an applicant or Contractor uses predictive models for the purpose of informing an EIA, the following details should be included to enable a robust assessment of the model outputs:

- Modelling methodology
- Inputs, including the value, quantity, spatial and temporal extent of all data to the model
- Assumptions used in the model
- Sensitivity testing of the model
- Calibration of the model (e.g. from component testing (i.e., collector tests) or test mining)
- Description of the model runs, including the duration of time the model has been applied, the seasonal variations incorporated, and how these relate to the estimated project life
- Remaining uncertainties relating to the model and its interpretation.

63. An applicant or Contractor is strongly encouraged to have predictive models reviewed by independent scientific experts as part of the EIA process, and to include such review reports as annexes to the EIS.

64. Where predictive models have been used to inform an EIA, the Contractor should ensure the monitoring programme (see Guideline on the EMMP for more information) is sufficiently comprehensive to allow for the validation of predictions made by the model. Notification of these results should also be reported by the Contractor to the International Seabed Authority as part of the annual reporting procedures (and shared with relevant external stakeholders).

D. Impact significance

65. There are many factors to take into account when considering the potential significance of an impact and their effects. Table 3 contains examples of issues spanning environment, legal, and society.

Table 3
Issues to consider when determining the significance of impacts

The nature, duration and magnitude of the impact:

- Is it positive or negative?
- Is the impact a large change from the baseline condition?
- Is the impact of long duration, reversible or irreversible?
- Is the geographic extent of the impact large relative to the habitats disturbed?
- Will mitigation involve proven methods, be costly, impossible or difficult?

The nature of the affected resources and receptors:

- Is the affected area of high importance or value for its biodiversity?
- Is the affected area of high importance or value for its human resource use?
- Does the affected area provide important ecosystem services?

- Is the affected area sensitive to the impacts the project will cause?
- Are the affected existing marine uses sensitive to the impacts the project will cause?
- Is there a high level of existing impact or likely future pressures leading to cumulative impacts?

Legal issues:

- Is there potential for non-compliance with applicable International Seabed Authority rules, regulations and procedures, and applicable international instruments, as well as national laws and regulations?
- Is there a potential conflict with any established International Seabed Authority policies or plans (including REMPs)?
- Could impacts extend across different maritime zones, including to areas within national jurisdiction?
- Will the rights of other sea users be affected?

State and stakeholder views:

- What are the views of International Seabed Authority members and observers, and coastal States?
- What are the views of other marine users in the region?
- What are the views of civil society organizations?
- What are the views of scientific organizations?
- Will socioeconomic conditions, health or amenity be impaired?

Uncertainty:

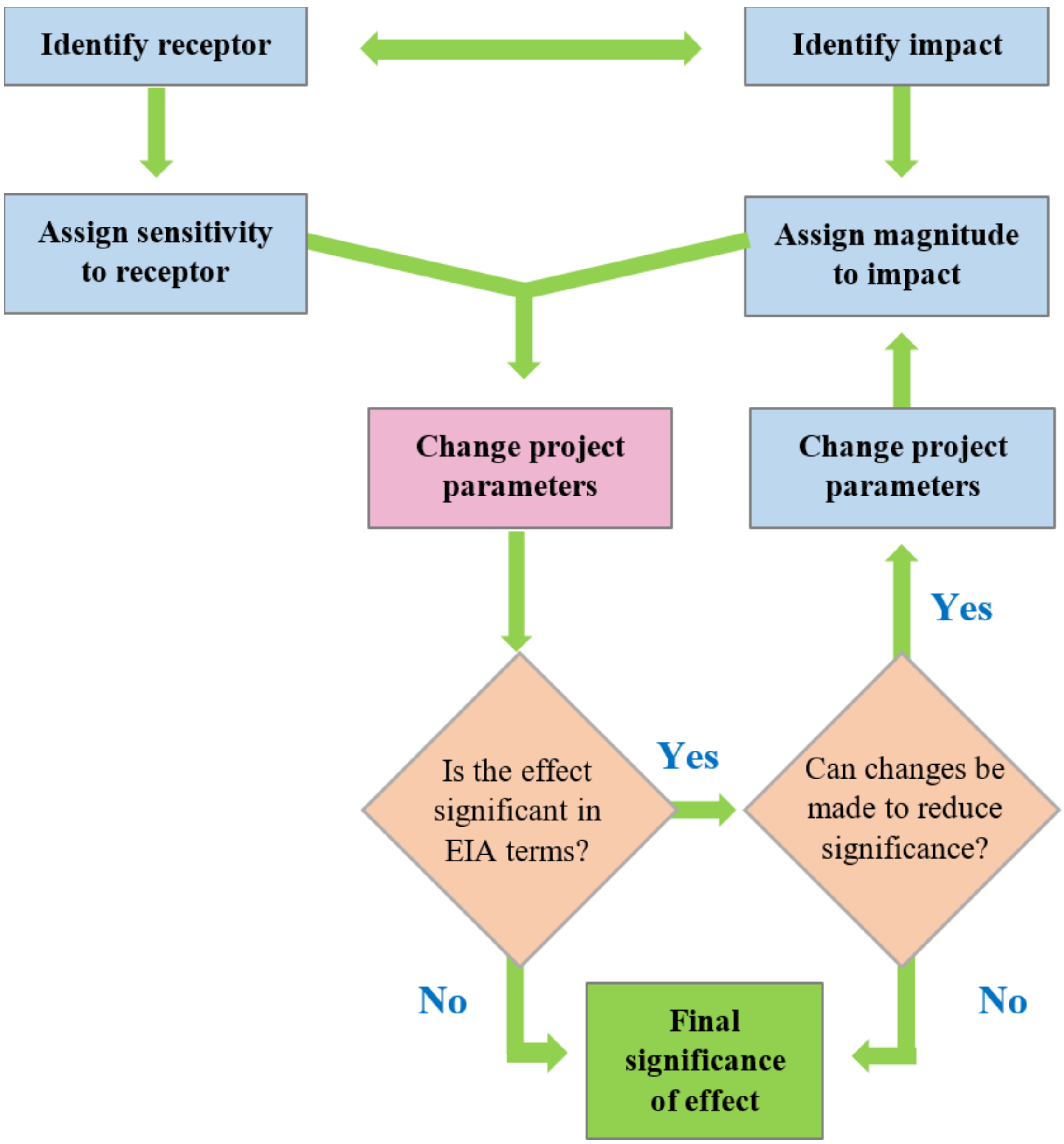
- Is the magnitude or significance of impacts uncertain because of lack of knowledge?
- Are there methods available to predict and evaluate uncertain impacts or can they be developed?
- How well developed is the evidence base for effects on the ecosystem in terms of the amount, quality and consistency of scientific data?
- Could the activities potentially set off an unpredictable chain of events, the start of which is obvious but the final outcome (e.g. beyond the end of mining) of which cannot be predicted?

66. An approach described in the next section is common in impact assessments, and involves the sensitivity (to the particular impact concerned), vulnerability and value of a receptor being combined with the impact magnitude (and probability, where appropriate) using informed judgment to arrive at a significance assessment for each impact. The assessment of significance considers mitigation measures that are embedded within the proposed activities. Hence it is a much more detailed evaluation than done for the Scoping Report and includes analysis of additional data and information collected during exploration activities associated with baseline surveys, component testing, and test mining where undertaken. It retains a categorical approach rather than continuous values, and typically results in a matrix-type output. However, as stressed throughout these guidelines, the key to a successful EIA

involves assessment of similar components, even if analysed using different methods and presented in different ways.

67. Significance can be evaluated by considering the magnitude of an impact in combination with the importance/sensitivity of the receptor or resource that is affected (see figure 4 below).

Figure IV
Iterative approach to assessing significance and project measures



Source: Dong Energy 2016.

1. Magnitude

68. The magnitude (scale of change from the baseline, spatial extent, duration, frequency and reversibility) of an impact should be estimated, taking into

consideration that an impact may represent a range of magnitudes. Where it is possible to predict quantified impacts, this should be included, for example: area of habitat loss; volumes of sediment removed; change in noise levels at various distances from source; and pollutant concentrations at various distances from source.

69. For some impacts, e.g., noise, air and water pollution, significance may be assessed directly against numerical criteria and standards where these exist. Where it is predicted that such thresholds may be exceeded, mitigation plans must be incorporated into the project design to reduce the magnitude of the impact (and the significance of its effect) to within specified and previously agreed standards.

70. For other impacts, it may be necessary to propose site-specific quantitative or qualitative assessment criteria, based on the level of change from the baseline environmental data, loss of components of the baseline environment, and the nature of a change (what is affected and how); the impact's size, scale or intensity; its geographical extent; its duration, frequency, reversibility and, for unplanned events, likelihood of occurrence.

71. Definition of magnitude categories will be case-specific, but are likely to be similar to those given in table 4.

Table 4
Example of magnitude criteria

Magnitude of impact	*Criteria for assessing impact*
Large	Total loss or major/substantial alteration to key elements or features of the baseline conditions such that post development character/composition/attributes will be fundamentally changed
Medium	Loss or alteration to one or more key elements or features of the baseline conditions such that post development character/composition/attributes will be materially changed
Small	A minor, but measurable, shift away from baseline conditions, not a material change. The underlying character/composition/attributes of the baseline condition will be similar to the pre-development situation.
Negligible	Within the range of normal natural variability in baseline conditions. Change barely distinguishable.

Source: modified from Dong Energy 2016.

2. Sensitivity

72. In defining the sensitivity to a particular type of impact for each receptor, the tolerance of, adaptability to, recoverability from impact and value and/or importance of the receptor should be taken into consideration. Value and/or importance relates to scale of conservation importance, rarity, and potential for substitution. While it can be broken down in many ways, examples are:

(a) Species importance, can be assessed according to the following, but not only these, criteria:

(i) Species with highly localized distributions;

(ii) The extent to which they are under threat;

(iii) The importance of the species to wider ecological communities and the ecosystem (e.g. predator/prey relationships, ecosystem engineer);

(iv) The degree of protection of species under national law, and international instruments;

(b) The population being assessed, for the purposes of a particular species (e.g. in the context of a geographical range). This may lead to an effect of higher significance at a local level but lower at regional level;

(c) Habitat importance, can be assessed according to the following criteria:

(i) Classification as potentially important ecological areas (e.g., key ecological areas, ecologically or biologically significant areas or vulnerable marine ecosystems);

(ii) The diversity of species supported;

(iii) Life history traits of species supported;

(iv) Use by restricted-range or endemic species;

(v) Functional significance such as use for seasonal feeding, breeding and migration by important species;

(vi) Structural complexity;

(vii) Provision of ecosystem services.

73. Table 5 (below) shows examples of the criteria for scoring sensitivity.

Table 5
Example of receptor criteria used in scoring sensitivity

Sensitivity	*Examples of receptor*
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance.
Moderate	The receptor/resource has moderate capacity to absorb change without significantly altering its present character, or is of high importance.
Low	The receptor/resource is tolerant of change without detriment to its character, is of low or local importance.

Source: Dong Energy 2016.

Significance

74. The overall significance of an effect is determined by combining the magnitude of the impact with the sensitivity of the receptor. A matrix approach is commonly used. The significance may be one of, or a range of, not significant, minor, moderate, major or substantial. In cases where a range is suggested for the significance of effect, there remains the possibility that this may span the significance threshold (i.e. the range is given as minor to moderate). In such cases the final significance is based upon the expert's professional judgment as to which outcome delineates the most likely effect, with an explanation as to why this is the case.

75. The lack of an evidence base for how species and habitats in the deep sea will respond to human disturbance is a challenge for assessing the significance of impacts. In a similar way to the ERA in the Scoping Report, an evaluation can be based on the

combination of assessment of importance/sensitivity of a receptor, against the scale of the impact (an example is given of the sort of resultant table in Table 6).

Table 6
Illustration of deriving significance of impact

	Magnitude of impact			
Sensitivity of receptor	*Negligible*	*Small*	*Medium*	*Large*
Negligible	Not significant	Not significant or minor	Not significant or minor	Minor
Low	Not significant or minor	Not significant or minor	Minor	Minor or moderate
Moderate	Not significant or minor	Minor	Moderate	Moderate or major
High	Minor	Moderate or major	Moderate or major	Major or substantial

Source: modified from Dong Energy 2016.

76. This process has been based largely on approaches used to assess environmental impacts. Broadly similar approaches can be applied in assessing socioeconomic impacts, but the views of stakeholders and affected parties may play a stronger role in determining significance and developing appropriate mitigation.

77. Below we present an example that illustrates in ecological terms how an effect of major significance may vary from an effect of moderate significance and in turn from an effect of minor significance

78. An effect of **major significance** is one that affects an entire population or species or community and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations. An effect of major significance may also adversely affect the integrity of the habitat, by substantially or irreversibly changing in the long term its ecological features, structures and functions, across all or most of its area, that enable it to sustain the habitat, complex of habitats and/or population levels of species that make it important.

79. An effect of **moderate significance** is one that affects a portion of a population and may bring about a change in abundance and/or distribution over one or more generations but does not threaten the integrity of that population or any population dependent upon it. An effect of moderate significance may also affect the ecological functioning of a site, habitat or ecosystem, but without adversely affecting its overall integrity.

80. An effect of **minor significance** is one that affects a specific group of localized individuals within a population over a short time period (one generation or less) but does not affect other trophic levels or the population itself. An effect of minor significance may also involve effects of limited extent, or to some elements of the habitat.

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Table 3 Issues to consider when determining the significance of impacts
• ~~Is the impact a large change~~What is the change from the baseline condition?

Rationale

Change should be measured from the baseline condition and not only if it is considered ‘large’.

E. Cumulative impacts

81. The assessment of cumulative impacts in a deep-sea mining EIA is important. It needs to consider three key elements: (1) Multiple sources of impact (either different types of mining operation, or different sectors such as fishing); (2) Additive or interactive processes (repetition leading to accumulation of impacts); (3) Different types of cumulative effects.

82. There are several evaluation criteria that should be considered:

(a) Temporal accumulation – often where perturbations are so close in time there is no opportunity for recovery between disturbances (consider duration and frequency of perturbation);

(b) Spatial accumulation, where perturbations are so close in space that they overlap (consider geographic scales, boundaries, directional patterns);

(c) Perturbation type (single, multiple, likely trigger for further effects). This should also consider indirect effects further from the area of physical disturbance;

(d) Processes of accumulation, including synergistic effects or progressive “nibbling” in small amounts (consider cause and effect, what is additive versus interactive);

(e) Functional effects (causing changes in ecological processes or controlling properties);

(f) Structural effects (spatial changes in biological or physical composition).

83. Key steps in a Cumulative Effects Assessment and Management process (CEAM) incorporate a management aspect to specify mitigation measures for cumulative effects overall (useful advice for CEAM is Canter & Ross 2010).

F. Uncertainty

84. An applicant or Contractor should identify and detail uncertainties through the whole of the EIA, as this is consistent with, if not essential for, undertaking a scientifically robust EIA. This should cover both the identification of environmental values (the baseline study) and the assessment of impacts. The following groupings provide a useful way to approach this requirement (Clark et al. 2017b):

(a) Acknowledge uncertainty, arising when there is incomplete understanding of structures, processes, interactions or system behaviours;

(b) Uncertainty related to the unpredictability of chaotic (often random) components of complex systems or of human behaviour;

(c) Structural uncertainty, arising from inadequate models, ambiguous system boundaries, or oversimplification or omission of processes from models;

(d) Value uncertainty, arising from missing or inaccurate data, inappropriate spatial or temporal resolution, or poorly-known model parameters;

(e) Interpretation uncertainty, arising when values or terms are or may be interpreted differently by different user groups.

85. An applicant or Contractor may use the following steps to reduce uncertainty as part of the EIA methodology used, and should describe how this was done in the EIS (Rouse and Norton 2010):

(a) Identify sources of uncertainty;

(b) Reduce uncertainty where possible;

(c) Acknowledge and manage the residual (unavoidable) uncertainty.

Assessment confidence

86. Where uncertainty can be statistically defined, then it can be included in range estimates of particular measures or metrics. However, this might not be possible in all situations. A qualitative description may be adequate, though an objectively defined scale is more helpful, and can be used even if the decision as to confidence level can only be based on expert judgment, rather than frequency data, as long as this limitation is stated. Such a scale that is meaningful in normal language might be: certain, probable, unlikely:

- Certain/near-certain: probability estimated at 95 per cent chance or higher.
- Probable: probability estimated above 50% but below 95%.
- Unlikely: probability estimated above 5% but less than 50%.
- Extremely Unlikely: probability estimated at less than 5%.

G. Environmental performance

87. The issue of environmental performance is a key one for assessing whether mitigation measures (through equipment design, operational methods, avoiding or minimizing an impact at source) will be adequate in reducing impacts to acceptable levels (residual impacts). Threshold criteria (for changes in the receiving environment) will need to be developed as scientific knowledge grows with further exploration and studies proposed to support the EIS or EMMP for the application of an exploitation contract.

88. Until such time as sufficient data on the Area exists to allow the Authority to establish thresholds for a range of key components that are assessed in the EIA process, an applicant or Contractor should use project-specific and area-specific impact thresholds based on data and analyses commensurate in quality with the importance of the impact. In collaboration with the scientific community, an applicant or Contractor should ensure that baseline condition studies allow determination of the normal range of variability experienced across ecosystem characteristics and properties in and around the proposed Mining Area. Defining this range then allows consideration of thresholds near the limits of the normal range of variability, using approaches such as statistical analysis and modelling, as indicated by Best Available Scientific Evidence.

89. The following sections discuss EIA thresholds that are used by industries that have certain elements in common with seabed mining, as well as scientific methodology for determining project-specific thresholds. This information is neither comprehensive nor definitive but is provided to assist an applicant or Contractor in evaluating potential threshold parameters and metrics.

Peer industry thresholds

90. An applicant or Contractor is encouraged to review studies performed by peer industries on the Marine Environment to identify potential scientific methodologies, risk assessment models, methods for establishing impact thresholds, and implementation of feedback monitoring of ecosystem properties to guide the performance of the applicant or Contractor's EIA. There can be useful information available from offshore oil and gas drilling, dredging, proposed sulphide mining, and deep-sea tailing placement/disposal.

91. Appendix 1 comprises tables providing some illustration of biological and physiochemical impact thresholds and methodologies, sorted by both applicable depth regime and applicable activity or process. The tables may be helpful to Contractors to link to experience from other industry sectors.

V. Mitigation

92. This stage involves evaluation of measures necessary for mitigation of impacts, in order to avoid, reduce and, if possible, remedy predicted harmful effects. Where appropriate, these should be incorporated into an EMMP.

A. Evaluating alternatives

93. An EIA process through the EIS and EMMP should describe the alternatives explored by the applicant or Contractor. Alternatives and mitigation can range from a high level to very detailed aspects of project design:

(a) Alternative locations for all or part of the project;

(b) Alternative technologies or modifications to technology;

(c) Alternative layouts or operational designs e.g., strips of impact rather than blocks;

(d) Alternative environmental measures e.g., connectivity corridors through a Contract Area.

94. Whatever process is adopted to facilitate the evaluation of options, it is important that it is undertaken in a structured and logical way, and that the decisions reached are properly recorded and reasoned for later incorporation into the appropriate section of the EIS.

B. Mitigation hierarchy

1. General considerations

95. An applicant or Contractor is required by the draft regulations on exploitation to identify, evaluate, commit to and implement measures to mitigate impacts. Mitigation for each impact type should be clearly specified in the EIS and EMMP.

96. Contractors should consider the mitigation hierarchy (figure V) when developing their mitigation and management strategies in the EIS and EMMP. The mitigation hierarchy concept is based on progressively assessing mitigation options.

Figure V
Four-class mitigation hierarchy triangle

Source: SPC, Swaddling 2016.

97. Emphasis should be strongly on the "Avoid/Prevent" and "Minimize" sections of the hierarchy. It is not an acceptable practice in EIAs to move to the later stages of the hierarchy unless all other options are exhausted. Rehabilitation or offsetting of effects on the Marine Environment may be difficult or impossible to achieve but should still be considered if relevant.

2. Avoid/prevent

98. The mitigation hierarchy specifies that avoidance is the most effective and preferable way to deal with harmful environmental impacts. Once a harmful effect has been identified in the EIA process, the applicant or Contractor should consider whether it can be avoided, for example through feasible alternatives to parts of the proposal, such as changing the specific location, redesigning methods, adaption of technology, scaling down operations, etc.

3. Minimize

99. If an impact cannot be avoided, it should be minimized or reduced as far as practicable. This is commonly achieved through engineering designs, but can also introduce management measures such as spatial or temporal restrictions that can reduce duration, intensity and/or extent of unavoidable impacts (see examples in Secretariat of the Pacific Community 2013, Swaddling 2016, Sharma and Smith 2019).

4. Rehabilitate or restore

100. Rehabilitation or restoration measures are those taken to reinstate a degraded site following exposure to impacts that could not be completely avoided or minimized. Within this level, a second hierarchy exists:

(a) Restoration to return an area to the original ecosystem that existed before impacts;

(b) Rehabilitation to restore basic ecological functions and/or ecosystem services.

101. Options for restoration or rehabilitation should be considered for all projects, even where there is considerable uncertainty whether restoration or rehabilitation is a feasible objective (Van Dover et al. 2014, Cuvelier et al. 2018).

102. Consultation with research institutions and commercial entities may be useful in assessing whether rehabilitation options are feasible (e.g. MERCES project,[2] Task 7.3 of the JPI-Oceans MiningImpact2 project[3]).

5. Offset

103. Offset measures are those taken to compensate for residual harmful impacts Generally, offsetting is achieved by setting aside other areas to be protected from future impacts. In terrestrial and some coastal jurisdictions, offset measures can include situations where the offset area is unlike the impacted area.

104. However, in the deep-sea mining context, the standard use of "offset" measures is unlikely to be appropriate or acceptable. An alternative type of compensatory approach is spatial management where protected areas have similar environmental characteristics to impacted areas at either local or regional scales. This can potentially include spatial management measures such as preservation reference zones in a Contract Area, and Areas of Particular Environmental Interest in a broader regional context.

105. Environmental criteria for determining the location and size of such spatial management areas include:

(a) **Representativity**: this covers a potentially wide range of habitat and biological diversity, and may necessitate multiple areas;

(b) **Connectivity**: ideally sites should be linked to ensure the exchange of species between areas where required for maintaining ecosystem structure/function;

(c) **Replication**: more than one site should be protected to account for natural variability and the possibility of catastrophic change;

(d) **Size**: the site(s) should be large enough to ensure the ecological viability and integrity of the environment and communities.

C. Residual effects

106. Residual effects are those that remain even after the implementation of mitigation measures. Predictions for these should be reported clearly in the EIS, including description of impact, magnitude of impact, the receptors affected (importance and sensitivity), mitigation to be undertaken and proposed monitoring. Proposed monitoring measures should include any expectation of adaptive management to allow the residual effects to be reconsidered and uncertainty to be addressed. The treatment of residual effects will be a key element of the EMMP.

VI. Reporting

107. The EIS is designed to document clearly the anticipated impacts of the project, significance and harmfulness of effects, identification of possible measures for mitigation, identification of the residual effects and concerns raised by consultation. The EIS should be a stand-alone document.

108. Annex IV of the draft regulations on exploitation specifies the form and expected content of the EIS. The guidelines on the preparation of an EIS elaborate on these requirements.

[2] See www.merces-project.eu/.
[3] See jpi-oceans.eu/miningimpact-2.

109. In addition to the information submitted as part of the EIS, it is recommended that the applicant or Contractor document and record the steps and progress of the entire EIA process and its outcomes. This may be more procedural description and detail than will be provided in the EIS, but as a separate record it may be a useful resource for responding to any queries arising from the Authority or for improving the process where shortcomings might be identified.

A. Summary of planned management and monitoring commitments

110. A summary of management and monitoring commitments made by the applicant or Contractor as a result of the impact assessment and consideration of mitigation measures, will form the basis of contractual obligations on the Contractor in terms of implementing the outcomes of the EIA process. Such a summary statement (sometimes termed a "Commitments Register") is often provided in table form, with commitments forming the basis for clauses in the Exploitation Contract, and the content of the EMMP.

VII. Review

111. A comprehensive review process is essential to determine if the content of the EIA (EIS and EMMP) provides a satisfactory assessment of the project and can contribute to the decision-making process.

A. Internal review

112. The applicant or Contractor should thoroughly review the EIA before submission to ensure the EIA process was followed and was robust. Checks on the manner in which the EIA was carried out include the following:

Process-specific

- The assessment process was adjustable to the specific situation without compromising the integrity of the process;
- Criteria applicable to various steps were established that were appropriate for the specific situation without compromising the integrity of the process;
- Data collection effort was sufficient to characterize and prioritise residual risks;
- Assessment and reporting efforts involved multiple techniques and a diverse set of professional experts;
- Inclusive stakeholder consultation was conducted.

Performed with scientific integrity

- It applied Best Available Scientific Evidence;
- It presented usable, actionable information and outputs; and
- The assessment utilized best expert judgment and sound data collection and analysis, subject to independent verification and validation.

Sustainability focus

- The process supports sustainable development;

- It included assessment, evaluation and analysis of potential consequences for socioeconomic, physiochemical and biological environments;
- It aligned with efforts, goals, and standards of regional and global organizations; and
- The assessment process demonstrated adherence to regional and global instruments and guidance.

113. The evaluation of the performance of the EIA should include an assessment of whether the right technologies and methods were used in gathering environmenta l baseline data, as outlined in relevant International Seabed Authority recommendations (e.g., ISBA/25/LTC/6/Rev.1 and Corr.1) and the Guidelines on Baseline Data.

114. Best Environmental Practices are defined in the Exploitation Regulations and may include, but are not limited to:

- Use of best available techniques;
- Adoption of an ecosystem approach to assessment and mitigation – considering environmental effects at the broad ecosystem level;
- Comprehensive data collection, information management, and sharing of non-commercially sensitive data through the global data repository of the International Seabed Authority (ISA DeepData) as well as other relevant international/regional data repositories;
- Transparency of processes, operations, and monitoring;
- Consideration of other marine users and uses;
- Consideration of indirect and cumulative impacts, as well as potential interactions of impacts;
- Incorporation of ecosystem services into baseline estimates and monitoring plans, and
- Effective mechanisms for stakeholder and independent expert engagement;
- Capacity building through the establishment of partnerships and collaborations.

115. There are several sources of checklists that can be used to evaluate how the EIA process has been conducted (e.g., European Union 2001).

B. External review

116. The applicant or Contractor will need to submit the EIS, once complete, to the Authority. The review by the International Seabed Authority of the EIS will include a stakeholder consultation period, as governed by the draft regulations on exploitation (part II, sections 2 and 3).

I – Members

Canada

Rationale

Paragraphs 48 and 116

China calls upon the Authority and facilitator to clarify the criteria, procedure, and timeline for public consultation, which is beneficial for a contractor to practice.

VIII. Decision-making

117. The draft regulations on exploitation (part II, sections 3 and 4) set out the decision-making process based on the information provided in the EIS and other relevant documents.

IX. Monitoring

118. The draft regulations on exploitation require that the EIS include a section on monitoring, and that an EMMP be provided as part of the environmental plans defined in the regulations.

119. Further details are contained in the Standards and Guidelines for EIS and EMMP.

X. Environmental impact assessment audit

120. The Contractor should undertake regular follow-up and audit processes. These are necessary to monitor the project and ensure conditions are met, impacts are adequately monitored, and the effectiveness of mitigation and management measures can be assessed. This follow-up and audit process has a direct linkage to the EMMP.

121. Follow-up and audit procedures will feed into the review of the EMMP and Plan of Work required under the draft regulations on exploitation (part IV, section 4).

XI. Stakeholder involvement

122. An applicant or Contractor is urged to engage with and consult stakeholders in a meaningful way during the EIA process. The aim is to ensure that the concerns and interests of stakeholders are considered and acknowledged during the preparation and drafting of an EIS. This can help ensure that the EIA is comprehensive, complete and takes into account various stakeholder perspectives, as well as Best Available Scientific Evidence. As noted in section 3.5, the scoping phase of the EIA includes a process for determining relevant stakeholders for consultation, as well as their engagement with the production of the draft scoping report for the EIS. Consultations could also be held at other stages where appropriate in the EIA process (e.g., impact assessment tasks).

123. Stakeholder consultation should be conducted in a meaningful manner. This means:

- providing appropriate access to up-to-date and comprehensive information about the mining plans and environmental data and impacts; and
- providing reasonable opportunity for those consulted to raise enquiries and to make known their views.

124. The draft regulations on exploitation recommend that the EIS includes details of stakeholder consultation. This should cover the following:

- Stakeholder groups consulted (with their agreement, although names and contact details of individuals consulted might not be included);
- Type of engagement undertaken (e.g., provision of written materials and facilitation of written feedback, webinars, face-to-face meetings, telephone discussions);
- Description of the manner in which the engagement has been tailored to the

stakeholders' needs, (e.g., the presentation of information in multiple languages, or in a manner which is effective for stakeholders with disabilities, reading impairments or cultural barriers that may prevent effective transfer of information (such as the prohibition of women attending public meetings));

- Date and time engagement was conducted;
- Issues raised (at each engagement stage);
- How these issues have been incorporated (or otherwise) into the EIS;
- How the incorporation (or otherwise) has been communicated with the stakeholders.

I – Members

China

123. Stakeholder consultation should be conducted in a meaningful manner. This means: providing appropriate access to up-to-date and comprehensive information about the mining plans and environmental ~~data and~~ impacts, excluding any industrial secret, proprietary data or any other confidential information; and

Rationale

China believes that the "comprehensive information" in this paragraph should exclude confidential information including industrial secret and proprietary data. Alternatively, "comprehensive" should be deleted.

XII. Definitions and abbreviations

125. Except as otherwise specified herein, terms and phrases defined in the draft regulations on exploitation have the same meaning in these guidelines.

"Effect" is the consequence or outcome of an action or activity during the project. It is typically broader and more functional than an impact (see definition below).

"Environmental Effects" are any consequences in the Marine Environment arising from the conduct of exploitation activities, whether positive, negative, direct, indirect, temporary or permanent, or cumulative effect arising over time or in combination with other mining impacts.

"Environmental impact assessment" (EIA) is "the process of identifying, predicting, evaluating and mitigating the physicochemical, biological, socioeconomic, and other relevant effects of development proposals prior to major decisions being taken and commitments made".[4] This includes all potential effects, both positive and negative, and encompasses natural and anthropogenic receptors.

"Environmental Impact Statement" (EIS) is the documentation of the EIA process, which describes the predicted effects of the project on the environment (and their significance), the measures that the applicant is committed to taking to avoid, minimize and reduce them where possible, and the residual (remaining) effects that cannot be avoided.

"EMMP" means Environmental Management and Monitoring Plan.

"Environmental Risk Assessment" (ERA) is a process to identify, analyse and evaluate the nature and extent of activities and the level of risk to characteristics of the environment.

"Impact" is the influence of an action/activity during the project on the environment.

"REMP" means Regional Environmental Management Plan.

"Risk" is the probability, high or low, that an activity will cause harmful effects on living organisms and the environment.

XIII. References

126. There is an extensive literature on EIA. In this list we provide selected papers and reports that are referred to in the Guideline text, or that are useful general reference for additional guidance and information. References cited in the appendix are listed separately.

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Appendix

Information available from selected peer industries relevant to environmental impact assessments for deep-sea mining:

Note: The tables include categorical identifiers to define existing methodologies:

- "Threshold" indicates that a threshold has been established by at least one of the selected industries
- "Impact assessment" indicates that a method of determining a specific impact exists (i.e., modelling)
- Empty cells indicate that a threshold or method of determining impact does not exist for the given industry or activity and p otential impact.

	Impacts to consider			*Assessment of impacts*			
	Categories		*Example impact*	*Peer industries*			
Activity				*Oil and gas*	*Dredging*	*Seafloor massive sulfide mining*	*Academia*
Vessel or platform operations		Air	Exhaust or similar	Threshold[1,2]	Impact assessment[10]		
		Noise	Incidental to operations; engines or similar	Threshold[2]			Threshold[12]
	Emissions	Light	Incidental to operations; floodlights or similar	Threshold[2]			
		Chemical discharges	Accidental discharges of fuel or similar	Impact assessment and threshold[2,3,4]	Impact assessment[10]		
		Sediment discharges	Accidental discharges of extracted material or tailings			Impact assessment	
Transport of materials (through water column)	Emissions	Noise	Incidental to operations; engines or similar				Threshold[12,13]
		Light	Incidental to operations; floodlights or similar				
		Chemical discharges	Accidental discharges of fuel or similar	Impact assessment and threshold[3,4]			
		Sediment discharges	Accidental discharges of extracted material or tailings				

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	Impacts to consider			Assessment of impacts			
	Categories		Example impact	Peer industries			
Activity				*Oil and gas*	*Dredging*	*Seafloor massive sulfide mining*	*Academia*
Return-water discharge		Air	Volatilization related to mining activities				Impact assessment and threshold
		Noise	Incidental to operations; engines or similar				
	Emissions	Light	Incidental to operations; floodlights or similar				
		Chemical discharges	Accidental discharges of fuel or similar	Impact assessment and threshold[3–9]			
		Sediment discharges	Accidental discharges of extracted material or tailings				
Extraction or materials		Noise	Incidental to operations; engines or similar				Impact assessment and threshold[13]
	Emissions	Light	Incidental to operations; floodlights or similar				Impact assessment[13]
		Chemical discharges	Accidental discharges of fuel or similar				
		Sediment discharges	Accidental discharges of extracted material or tailings		Impact assessment[10]		Impact assessment and threshold[13–16]
	Oxygen reduction of sediments			Threshold[4]			Impact assessment[13]
	Loss of habitat			Threshold[9]			Impact assessment and threshold[13]

			Regimen					
Activity			*Depth (m)*	*Zone*	*Categories*		*Ecosystems*	*Impact*
Vessel or platform operations				Surface	Emissions	Air	Surface biota; plankton (phytoplankton and zooplankton), surface, near surface fish (e.g., tuna), seabirds, turtles, marine mammals	Exhaust or similar
						Noise		Incidental to operations; engines or similar
						Light		Incidental to operations; floodlights or similar
						Chemical discharges		Accidental discharges of fuel or similar
						Sediment discharges		Accidental discharges of extracted material or tailings
	Transport of materials		0–200	Epipelagic zone	Emissions	Noise	Photic biota; plankton (phytoplankton and zooplankton), surface, near surface fish (e.g., tuna), seabirds, turtles, marine mammals	Incidental to operations; engines or similar
						Light		Incidental to operations; floodlights or similar
						Chemical discharges		Accidental discharges of fuel or similar
						Sediment discharges		Accidental discharges of extracted material or tailings
		Return-water discharge	200–1 000	Mesopelagic zone	Emissions	Noise	Midwater biota; zooplankton, mesopelagic and bathypelagic fishes, deep diving mammals	Accidental or related to transit
						Light		
						Chemical discharges		Accidental discharges of fuel or similar
						Sediment discharges		Accidental discharges of extracted material or tailings
			1 000–6 500	Bathypelagic to Abyssopelagic	Emissions	Noise	Midwater biota; zooplankton, mesopelagic and bathypelagic fishes, deep diving mammals	Accidental discharges of extracted material or tailings
						Light		
						Chemical discharges		Accidental discharges of fuel or similar
						Sediment discharges		Accidental discharges of extracted material or tailings

Activity	*Regimen*		*Categories*		*Ecosystems*	*Impact*
	Depth (m)	*Zone*				
Extraction of materials	Sea floor (may occur at any depth)		Emissions	Air	Seafloor biota of any seafloor depth, benthic invertebrate and fish communities, infauna to an appropriate depth of sediment, demersal fish up to 50m from seafloor	Volatilization related to mining activities
				Noise		Related to mining activities
				Light		
				Chemical discharges		Related to mining activities; potential interactions with seabed materials or fluids
				Sediment discharges		Discharges of tailings; plume and burial potential
			Loss of habitat			Destruction of seafloor; removal of nodules and accessory materials
			Oxygen reduction of sediments			

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