9. PLAN OF STUDY FOR IMPACT ASSESSMENT

An overview of the ESIA and public consultation process, highlighting each phase and corresponding activities, is provided in Chapter 3 and 4, respectively. An outline of the planned specialist investigations is included in Section 9.1 below.

The specialist findings, mitigation, recommendations and other relevant information will be integrated into an ESIA Report and ESMP. The ESMP will provide recommendations on how to establish, operate, maintain and close the proposed project throughout all relevant phases of the project activities. The aim of the ESMP will be to ensure that the project activities are managed to avoid or reduce potential negative environmental impacts and enhance potential positive environmental impacts. The ESMP will detail the impact management objectives, outcomes and actions as required, the responsibility for implementation and the schedule and timeframe. Requirements for monitoring of environmental aspects, as well as compliance monitoring and reporting, will also be detailed.

Future consultations that will be undertaken during the Impact Assessment Phase is summarised in Section 4.3.

9.1 TECHNICAL AND SPECIALIST STUDIES TO BE UNDERTAKEN

The terms of reference for the technical modelling studies and the specialist studies are presented in Section 9.1.1 and 9.1.2 below. These terms of reference have been designed to address all the issues that have been identified by the ESIA project team.
The technical modelling studies (namely noise, drilling discharges and oil spill) will not assess any potential impacts as such, but rather provide supporting information for use in the other specialist studies, which will review and interpret data relevant to identifying and assessing environmental and social impacts that might occur as a result of the proposed exploration activities in their particular field of expertise.

The specialist studies will provide baseline information, and identify and assess impacts according to predefined impact assessment criteria (see Section 9.2). Specialists will apply the mitigation hierarchy by identifying and recommending actions in sequential order of priority by first seeking to avoid impacts and where avoidance is not possible suggest ways in which negative impacts could be mitigated and benefits could be enhanced.

The results of the technical modelling and specialist studies will be integrated into the draft ESIA Report. Three technical modelling studies and five specialist studies will be commissioned to address the key issues that require further investigation and detailed assessment. In addition to the three technical modelling studies, an independent peer review of the Drilling Discharges and Oil Spill Modelling studies will also be undertaken.

9.1.1 Technical Modelling Studies

9.1.1.1 Drilling Discharges Modelling

The specific terms of reference for the underwater oil drilling discharges study are as follows:

- Provide a description of the metocean conditions, such as winds and ocean currents in the licence area with specific reference to the Area of Interest for proposed exploration drilling.
- Model the transport, dispersion and bottom deposition of drill cuttings and associated mud discharged during drilling operations based on drill discharge location(s) using the ParTrack modelling software. The

following criteria will be considered for the selection of discharge locations (release location for the modelling study) leading to worst case scenarios:
  - Distance from the coast;
  - Water depth;
  - Proximity of protected areas (including MPAs and EBSAs); and
  - Metocean dataset.
- Modelling parameters should include aspects such as type and quantity of drilling fluids used and constituents, depth of discharge and volume of cuttings.
- Present results in relation to the drilling area and include the assumptions, modelling parameters and any limitations of the modelling exercise. Modelling output to include:
  - Cumulative risk of drilling operations throughout the water column;
  - Main contributors to the risk of drilling operations in the water column and sediments;
  - Maximum discharge concentrations for main contributors and cuttings in the water column and sediments; and
  - Potential risk, cumulative thickness deposit, grain size change, contaminant concentration in sediments.

Details on the relevant parameters and assumptions used in the drilling discharges modelling study will be provided in the Assessment Phase.

9.1.1.2 Oil Spill Modelling

The specific terms of reference for the underwater oil spill modelling study are as follows:

- Provide a description of the metocean conditions, such as winds and ocean currents in the licence area with specific reference to the Area of Interest for proposed exploration drilling.
- Model the trajectory and fate of a 20-day crude oil blow-out (stochastic and deterministic) for a 90-day period based on spill location(s) using the Oil Spill Contingency and Response (OSCAR) modelling tool. The following criteria will be considered for the selection of discharge locations (release location for the modelling study) leading to worst case scenarios:
  - Distance from the coast;
  - Water depth;
  - Proximity of sensitive areas (including MPAs, EBSAs and CBAs); and
  - Metocean dataset.

  Two spill scenarios (with and without spill response) over four seasons (with 5 years representative metocean dataset) to be modelled for each drill location.
- Present modelled surface and shoreline oiling results as graphical outputs in relation to the drilling area and include the assumptions, modelling parameters and any limitations of the modelling exercise. Modelling output to include:
  - Surface and shoreline oiling probability.
  - Surface minimum arrival time (days).
  - Shoreline concentration after 60 days.
  - Water column contamination probability.
  - Oil fate comparison graphs / diagrams of different oil spill responses.

Details on the relevant parameters and assumptions used in the oil spill modelling study will be provided in the Assessment Phase.

9.1.1.3 Underwater Noise Modelling

The specific terms of reference for the underwater noise modelling study are as follows:

- Identify significant sources of underwater noise in relation to those operation activities and quantify the typical noise characteristics of these sources (such as the source level, the frequency content and the temporal characteristics, etc.).
- Investigate the baseline underwater noise environment based on a review of available baseline noise data for the project area, or relevant metocean data (e.g., current, wind, etc.) when the noise measurement data are not available.
- Establish noise exposure assessment criteria for the identified marine fauna species to be assessed, based on applicable guidelines or regulatory requirements.
- Undertake detailed marine noise modelling predictions for two well locations (worst-case shallow water and deep water locations) as outlined below:
    - For the VSP airgun array and sonar sources, the source levels are proposed to be modelled using the Gundalf Designer software package, including the far-field signatures, directivities and beam patterns;
    - For the drilling operations, the source levels for the proposed drilling rig and supporting vessels are proposed to be derived using empirical formula based on the detailed specifications of the drilling rig and supporting vessels.
    - For broadband noise propagation, transmission loss is proposed to be modelled using the fluid parabolic equation (PE) modelling algorithm RAMGeo at one-third octave band central frequencies;
    - The received levels as a function of range, depth and frequency are then to be obtained via combination of source spectral levels and transmission loss modelling results; and
    - Cumulative sound exposure level (SELcum) modelling prediction is to be performed considering relevant cumulative operational characteristics (such as exposure duration, VSP discharges, etc), in line with ACCOBAMS guidelines.
- Post-processing and analysis of the above modelling results to derive relevant zones of impact, which are to be used for further noise impact assessment.

9.1.2 Specialist Studies

9.1.2.1 General Terms of Reference for the Specialist Studies

The following general terms of reference will apply to the specialist studies:

- Describe the receiving environment and baseline conditions that exist in the study area and identify any sensitive areas that will need special consideration.
- Review the Scoping Comments and Responses Report to ensure that all relevant issues and concerns relevant to fields of expertise are addressed.
- Identify and assess potential impacts of the proposed project activities and infrastructure, including any associated cumulative impacts.
- Describe the legal, permit, policy and planning requirements.

- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts.
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty).
- Where necessary consider the precautionary principle in the assessment of impacts.
- Identify management and mitigation actions using the Mitigation Hierarchy by recommending actions in order of sequential priority. Avoid first, then reduce/minimise, then rectify and then lastly offset.
- Identify alternatives that could avoid or minimise impacts.
- Determine significance thresholds for limits of acceptable change.
- Where applicable, specialists shall use the assessment method for impact prediction and assigning significance (see Section 9.2).

9.1.2.2 Marine Ecology Impact Assessment

The terms of reference for the marine fauna impact assessment are as follows:

- Provide a general description of the benthic environment in the Benguela System along the central and southern Namibian coast, based on current available literature.
- Describe the coastal and offshore habitats that are likely to be affected by exploration activities.
- Identify sensitive habitats and species that may be potentially affected by the proposed exploration activities.
- Describe seasonal and migratory occurrences of key marine fauna.
- Identify, describe and assess the significance of potential impacts of the proposed exploration programme on the local marine fauna, focussing particularly on the benthic environment, but including generic effects on cetaceans, turtles, seals, fish and pelagic invertebrates. The assessment is to consider both planned activities (normal operation) and unplanned events.
- Identify practicable mitigation measures to reduce the significance of any negative impacts and indicate how these can be implemented during the execution of exploration programme.

9.1.2.3 Fisheries Impact Assessment

The terms of reference for the commercial fisheries impact assessment are as follows:

- Provide a description of the fisheries sectors operating in southern Namibian coastal waters, focusing on the project's area of influence.
- Undertake a spatial and temporal assessment of recent and historical fishing effort and catch in the licence area.
- Use available data to describe natural variability in historical trends and check monthly catches for seasonality.
- Assess the risk of impact of the exploration activities on specific commercial fish species and the consequential implications for fish catch by the different fishing sectors.
- Assess the potential impacts of normal operations and upset conditions (small accidental spills and large blow-out) on the fishing activities in terms of estimated catch and effort loss.
- Identify practicable mitigation measures to reduce any negative impacts on the fishing industry.

9.1.2.4 Socio-economic Impact Assessment

The specific terms of reference for the socio-economic impact assessment are as follows:

- Provide a social and economic baseline for the areas potentially affected by the Project's land-based activities (e.g., possible logistics bases which may be used by the project) using available data. This should be tailored to the extent of potential linkages and impacts of the project with the local population and nearby communities.
- Assess the likely social impacts and benefits (direct and indirect) associated with the proposed exploration drilling activities, including potential adverse social consequences of impacts on fisheries and other offshore and maritime activities and sea users.
- Identify the social impacts of a major oil spill.
- Provide practical and reasonable mitigation measures to reduce predicted social impacts, as well as recommendations for the enhancement of social benefits.

The level of information given to the economic aspects of potential impacts and benefits on environmental and social receptors is considered adequate to inform the assessment of impacts and to inform decision-making in this regard.

The assessment of economic impacts as a result of unplanned events (i.e. such as a well blow-out) is challenging to accurately perform due to the many variables, assumptions and uncertainties that would be involved. The outputs of such an assessment are likely to be so broad that it would be of little direct value in informing the impact assessment process or the development of mitigation measures and ultimately decision-making.

It is acknowledged that the greatest potential risk of oil and gas exploration activities, in the marine environment, is the impact of an unplanned event such as a well blow-out. While such an event is highly unlikely, they have occurred across the globe with negative environmental, social and economic impacts. A key response to such unplanned events, is a well-specific Oil Spill Contingency Plan (OSCP) that is driven by well-specific oil spill modelling, intensive pre-planning and appropriate preparation.

The ESIA process includes the undertaking of detailed Oil Spill Modelling, which will include both Stochastic Modelling (which will present the probability of contamination above defined threshold values for sea surface and shoreline under different spill scenarios) and Deterministic Modelling (which will study the trajectory and fate of an individual oil slick (usually the worst-case trajectory identified in the stochastic simulation) in order to better understand how the oil spill progresses in the marine environment, estimate the amount of oil that could reach the coast depending on the weather conditions and oil weathering, as well as the minimum time to observe these impacts. This information will enable TEEPNA to establish practical and feasible oil spill response planning.

The ESMP will specify commitments on the approach to and key components of an OSCP. Framework documents for OSCP and Blow-Out Contingency Plan (BOCP), which give an indication of the typical content, will be included in the ESMP.

The management of compensation in the event of an unplanned event (i.e. such as a well blow-out) falls outside of the scope of an ESIA process and will not be addressed directly in the ESIA phase. In the event of an unplanned event (i.e. such as a well blow-out) occurring, a process of determining the economic effects and related compensation would be initiated. Such a process would typically involve government, insurers, the organisation responsible for the incident, industry organisations and the applicable legal system. TEEPNA will plan for and would implement responses in terms of the IPIECA-IOGP Good Practice Guide Series. The "Economic assessment and compensation for marine oil releases" (2015) is the primary reference document in this regard

(https://www.ipieca.org/resources/good-practice/economic-assessment-and-compensation-for-marine-oil-releases). Further details on TEEPNA's commitment and approach will be provided in the Assessment Phase.

9.1.2.5 Climate Change and Air Emissions Impact Assessment

The specific terms of reference for the climate change and air emissions impact assessment are as follows:

- Establishment of a Greenhouse Gas Inventory, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).
- Establishment of Criteria Pollutant Emissions Inventory, including sulphur dioxide (SO_2) oxides of nitrogen (NOx), carbon monoxide (CO), volatile organic compounds (VOC) and particulate matter (PM).
- Screening of atmospheric dispersion modelling using SCREEN3 model (a worst-case scenario). Predict air quality at closest shoreline due to the air emissions of criteria pollutants.
- Climate Change Statement evaluating the significance of GHG emissions.

9.1.2.6 Cultural Heritage Assessment

The specific terms of reference for the cultural heritage impact assessment are as follows:

- Conduct primary anthropological research in selected key communities along the Namibian coastline to describe, discuss and analyse the receiving environment and baseline conditions in the area, as these pertain to issues of culture, spiritual and religious uses of the sea and coast. This primary research will:
  - Identify the intangible cultural heritage impacts of the proposed project.
  - Identify knowledge gaps relating to cultural, spiritual and religious uses of the sea and coast.
  - Assist by way of qualitative assessment, the determination of prevalence, frequency, importance and commonality of cultural and spiritual uses of the oceans and coast. The qualitative assessment will include interview questions regarding frequency for example, of ritual practice, its relative importance in the overall cultural repertoire of the community, the prevalence/commonality of the practice in the selected area.
  - Identify management and practicable mitigation actions.
- Utilise both primary and secondary data collected to assess the potential intangible cultural heritage impacts of both normal operations and upset conditions on the heritage of indigenous, autochthonous and recently settled peoples, their spiritual and religious uses of / connections to the sea and coast and their cultural valuation of these assets.
- Identify mitigation measures to reduce potential negative impacts on aspects of culture and spiritual/religious uses of the sea and coast.

9.2 PROPOSED METHOD FOR ASSESSING IMPACT SIGNIFICANCE

This section sets out the approach and method for the assessment of impacts for the Project and defines the terminology applied and the steps used to evaluate impact significance.

9.2.1 Approach to Impact Assessment

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with a proposed project. Impacts are identified throughout the ESIA process by environmental and social assessment

practitioners, from specialist studies and stakeholder engagement, and refined as more detailed baseline information, modelling data or project design information is available.

For potentially significant impacts or those of stakeholder concern, the impact identification and evaluation process involves the following main steps:

Step 1: Define the Area of influence:

The area of influence of the project is defined as a basis for defining the boundaries for baseline data gathering by taking into consideration the spatial extent of potential direct and indirect impacts of the project. Direct impacts of the project are typically located within a smaller area around the project activities (i.e. in the direct area of influence) while indirect impacts typically extend across a wider area and often relate to the socioeconomic sphere of influence of the project. The area of influence will possibly be reassessed in the Impact Assessment Phase based on the oil spill modelling results.

Step 2: Identification of Potential Impacts

Potential impacts of a project are identified through a process of examining the potential for interactions between project activities and environmental and social receptors (or features). This requires consideration of the range of project activities across different phases of the project (planning, exploration, construction, operation and decommissioning) and the potential for interactions on each of the environmental receptors, features or aspects occurring in the project area of influence. The results are then presented in an '**environmental and social interaction matrix' format** (see Table 8-1). For each project activity, the degree of interaction is rated through colour coding the level and type of interaction in the matrix. This matrix approach to impact identification is designed to highlight where interactions may occur as a way of focussing the impact assessment.

Step 3: Compile Impacts – Aspects Register

An impacts-aspects register (see Table 8-3) is typically prepared during the Scoping phase as a basis for further elaborating the potential impacts identified through the initial impact identification stage. For each of the project activities, different aspects associated with the activity and their potential impacts are tabulated. This systematic approach provides a basis for planning the scope of specialist studies to ensure the correct information is obtained to conduct a detailed assessment of the project impacts. It also enables identification of the linkages between different specialist scopes and overlapping impacts, and where there are interdependencies on data and reporting to enable an integrated impact assessment. For instance, social specialists are typically reliant on other specialists for inputs such as water quality, air quality or noise effects and this needs to be factored into work scopes and scheduling. The presentation of an Impacts-Aspects Register further provides stakeholders with a degree of confidence that the specialists and environmental assessment practitioners have adequately identified potential impacts at an early stage.

Step 4: Impact Evaluation

Evaluation of impact significance follows a stepwise process as set out below with reference to definitions in Section 9.2.2.

4a: Assign sensitivity ratings to receptors

The sensitivity of a receptor is defined on a scale of Very Low, Low, Moderate, High or Very High guided by the definitions for biophysical, ecological and social receptors in Section 9.2.3. These are derived from the baseline information, which shall be used to support the sensitivity ratings in the description of impact.

4b: Determine the impact magnitude (or consequence) ratings

Magnitude (or consequence) is determined based on a combination of the "intensity", "duration" and "extent" of the impact following the designations set out in Section 9.2.4. Magnitude is assigned to the **pre-mitigation impact** (i.e. before additional mitigation measures are applied, but taking into account embedded controls specified as part of the project description) **and residual impacts** after additional mitigation is applied.

4c: Determine impact significance rating

The significance of an impact is a function of the intensity and the sensitivity of the impact determined using the matrix table in Section 9.2.5.1 and is assigned to the predicted impact **pre-mitigation and post-mitigation (residual)** after considering all possible feasible mitigation measures in accordance with the mitigation hierarchy.

4d: Applying the Mitigation Hierarchy

Identification of mitigation measures in accordance with the mitigation hierarchy (see Section 9.2.7) is done throughout the ESIA process with emphasis placed on avoiding significant impacts where feasible. Certain avoidance mitigation measures may be identified early in the Scoping Phase and become 'embedded' into the project design and specified in the project description (e.g. drilling sites may be confirmed to avoid sensitive sea floor areas). These embedded controls are not 'added' to the list of mitigation measures or used to determine the post-mitigation significance. Additional mitigation measures may be identified during the impact assessment process and those agreed with the proponent will be used to assess the post-mitigation significance ratings. These may include measures such as helicopters to avoid fly-over of islands at certain heights.

4e: Assign additional ratings to describe the impact

Qualifying ratings are assigned to criteria such as probability (or likelihood of the impact occurring), confidence (in the impact prediction), mitigation potential, extent of resource loss (as defined in Section 9.2.6). reversibility of impact and potential for cumulative impacts.

9.2.2 Definitions of Impact Types and Criteria Used

9.2.2.1 Impact Types

Table 9-1 below defines the criteria used to categorise and describe impacts.

Table 9-1: Impact Categorisation and Description

Term	Definition
Nature of Impact	The direction of impact and whether it leads to an adverse effect (negative), beneficial effect (positive) or no effect (neutral)
Positive	An impact that is considered to represent an improvement to the baseline conditions or introduces a positive change to a receptor.
Negative	An impact that is considered to represent an adverse change from the baseline conditions or receptor, or introduces a new adverse effect.
Neutral	An impact that has no or negligible effect on the receptor.
Type	Cause and effect relationship between the project activity and the nature of effect on receptor
Direct	Impacts that result from a direct interaction between a proposed project activity and the receiving environment (e.g. effluent discharge and receiving water quality). Sometimes referred to as primary impacts.
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway. Sometimes referred to as secondary impacts.
Induced	A type of indirect impact resulting from factors or activities caused by the presence of the Project but which are not always planned or expected (e.g. human in-migration along new access or for jobs creating increased demand on resources).
Residual	The impacts that remain after implementation of the project and all associated mitigation and other environmental management measures.

9.2.2.2 Definitions of Impact Assessment Criteria and Categories Applied

Definitions of the criteria used in assessing impact significance and the assigned categories, and the additional criteria used to describe the impacts, are summarised in Table 9-2 below.

Table 9-2: Definitions of Impact Assessment Criteria and Categories

Criterion	Definition	Categories
Sensitivity	Sensitivity is a rating given to the importance and/ or vulnerability of a receptor (e.g. conservation value of a biodiversity feature or cultural heritage resource or social receptor.	Very Low Low Medium High Very High
Magnitude	A term describing the actual change predicted to occur to a resource or receptor caused by an action or activity or linked effect. It is derived from a combination of Intensity, Extent and Duration and takes into account scale, frequency and degree of reversibility	Very Low Low Medium High Very High
Intensity	A descriptor for the degree of change an impact is likely to have on the receptor which takes into account scale and frequency of occurrence.	Very Low Low Medium High

Criterion	Definition	Categories
Extent	The spatial scale over which the impact will occur.	Site Local National Regional International /Transboundary
Duration	Time scale over which the consequence of the effect on the receptor/s will last. [Note that this does not apply to the duration of the project activity]. The terms 'Intermittent' and 'Temporary' may be used to describe the duration of an impact.	Short-term Medium-term Long-term Permanent
Probability	A descriptor for the likelihood of the impact occurring. Most assessed impacts are likely to occur but Probability is typically used to qualify and contextualise the significance of unplanned events or major accidents.	Unlikely Possible Likely Highly Likely Definite
Confidence	A descriptor for the degree of confidence in the evaluation of impact significance.	Low Medium High Certain
Mitigation potential	A descriptor for the degree to which the impact can be mitigated to an acceptable level.	None Very Low Low Medium High
Loss of Irreplaceable resources	A descriptor for the degree to which irreplaceable resources will be lost, fragmented or damaged.	Low Medium High
Reversibility	A descriptor for the degree to which an impact can be reversed.	Irreversible Partially Reversible Fully Reversible
Cumulative	A descriptor of the potential for an impact to have cumulative impacts to arise.	Unlikely Possible Likely

9.2.3 Determination of Sensitivity

Sensitivity is a term that covers the 'importance' (e.g. value of an ecological receptor or heritage resource) or 'vulnerability' (e.g. ability of a social receptor to cope with change) of a receptor to a project-induced change. It takes into account 'Irreplaceability' - measure of the value of, and level of dependence on, impacted resources to society and/ or local communities, as well as of consistency with policy (e.g. conservation) targets or thresholds.

Broad definitions of sensitivity ratings for social, ecological and physical/abiotic receptors are defined in Table 9-3 below. These are not exhaustive and may be modified on a case by case basis, as appropriate. Additional ratings can be developed for other receptors such as cultural heritage.

Table 9-3: Sensitivity Categorisation and Description

Sensitivity Rating	Definition
Social Receptors	Individuals, communities or groups of stakeholders
Very Low	Receptors who are not vulnerable or susceptible to project-related changes and have substantive resources and support to understand and anticipate Project impacts. Such receptors have the ability to avoid negative Project impacts, or to cope with, resist or recover from the consequences of a such an impact with negligible changes to their lives, or will derive little benefit or opportunities from the project.
Low	Receptors who have few vulnerabilities and are marginally susceptible to project-related changes but still have substantive resources and support to understand and anticipate a Project impact. Such receptors are able to easily adapt to changes brought about by the project with marginal impacts on their living conditions, livelihoods, health and safety, and community well-being, or will derive marginal benefits or opportunities from the project.
Medium	Receptors have some vulnerabilities and are more susceptible to project-related changes given they only have moderate access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not fully resilient to Project impacts but are generally able to adapt to such changes albeit with some diminished quality of life. For positive impacts, these receptors are likely to derive a moderate level of benefit or opportunities from the project.
High	Receptors are vulnerable and susceptible to project-related changes, and have minimal access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not resilient to Project impacts and will not be able to adapt to such changes without substantive adverse consequences on their quality of life. For positive impacts, these receptors are likely to derive a substantial level of benefits or opportunities from the project.
Very High	Receptors are highly vulnerable and have very low resilience to project-related changes. By fact of their unique social setting or context, such receptors have a diminished or lack of capacity to understand, anticipate, cope with, resist or recover from the consequences of a potential impact without substantive external support. For positive impacts, receptors are likely to derive substantial benefits or opportunities from the project which could lead to significant and sustained improvement in their quality of life.
Ecological Receptor	Species, habitats or ecosystems including processes necessary to maintain ecosystem functions
Very Low	Species or habitats with negligible importance for biodiversity including habitats that are largely transformed or highly modified.
Low	Species or habitats listed as Least Concern (LC) on the International Union for Conservation of Nature (IUCN) Red List or on regional or national Red Lists and/or habitats or species which are common and widespread, of low conservation interest, or habitats which are degraded and qualify as 'modified habitat' under international definitions (e.g. IFC or World Bank standards).
Medium	Species, habitats or ecosystems listed as globally Vulnerable (VU) or Near Threatened (NT) on IUCN Red List; or listed as VU or NT on national or regional Red Lists, or which meet the IUCN criteria based on expert-driven biodiversity planning processes. It includes habitats that meet definitions of 'natural habitat'; or ecosystems with important functional value in maintaining the biotic integrity of these habitats or VU or NT species.
High	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN, or listed as EN/CR on national or regional Red Lists; or which meet IUCN criteria for range-

Sensitivity Rating	Definition
	restricted species[15] or which meet the definition of migratory and congregatory species[16], but which do not qualify as Critical Habitat based on IUCN Key Biodiversity Area thresholds[17]. It includes habitats or ecosystems which are important for meeting national conservation targets based on expert-driven national or regional systematic conservation planning processes, but which do not meet global IUCN thresholds. It can also include protected areas such as national parks, marine protected areas or ecological support areas designated for biodiversity protection containing species that are nationally or globally listed as EN or CR, or other designated areas important for the persistence of EN/CR species or habitats.
Very High	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN, or listed as EN/CR on expert-verified national or regional Red Lists; or which meet IUCN criteria for range-restricted or migratory /congregatory species and which meet IUCN thresholds for Key Biodiversity Areas. It includes habitats or ecosystems which are of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Habitats of high sensitivity may typically include legally protected areas that meet IUCN categories 1, 1a and 1b[18], or KBAs or Important Bird Areas (IBAs) with biodiversity features that meet the IUCN KBA criteria and thresholds.
Physical Abiotic Receptors	**Water quality, sediment quality, air quality, noise levels**
Very Low	Receptors are highly resilient to project-induced change and changes remain undetectable and within any applicable thresholds.
Low	Receptors are resilient to project-induced change and changes, while detectable, are within the range of natural variation and remain within any applicable thresholds.
Medium	Receptors are moderately resilient to project-induced changes, but these changes are easily detectable, exceed the limit of the normal range of variation on an intermittent basis and / or periodically exceed applicable thresholds.
High	Receptors are vulnerable to project-induced change and changes are readily detectable, well outside the range of natural variation or occurrence, and regularly exceed any applicable thresholds.
Very High	Receptors are highly vulnerable to project-induced change and changes are easily detectable, fall well outside the range of natural variation or occurrence, and will continually exceed any applicable thresholds.

[15] Restricted range species are those with limited Extent Of Occurrence (EOO) (GN74):

- For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 square kilometres (km^2).
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart)

[16] Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem) (GN76). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

[17] IUCN, A Global Standard for the Identification of Key Biodiversity Areas, 2016.

[18] IUCN, "Protected Areas Category", https://www.iucn.org/theme/protected-areas/about/protected-area-categories

9.2.4 Determination of Magnitude (or Consequence)

9.2.4.1 Definitions of Criteria Used to Derive Magnitude (or Consequence)

The term 'magnitude' (or 'consequence') describes and encompasses all the dimensions of the predicted impact including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- degree of reversibility; and
- its geographical extent and distribution.

Taking the above into account, Magnitude (or Consequence) is derived from a combination of 'Intensity', 'Duration' and 'Extent'.

The criteria for deriving Intensity, Extent and Duration are summarised Table 9-4 below.

Table 9-4: Categorisation and Description of Intensity, Extent and Duration

Criteria	Rating	Description
Criteria for ranking of the INTENSITY of environmental impacts taking into account reversibility and scale	**VERY LOW**	Negligible change, disturbance or nuisance which is barely noticeable or may have minimal effect on receptors or affect a tiny proportion of the receptors.
	LOW	Minor (Slight) change, disturbance or nuisance which is easily tolerated and/or reversible in the short term without intervention, or which may affect a small proportion of receptors.
	MEDIUM	Moderate change, disturbance or discomfort caused to receptors or which is reversible over the medium term, and/or which may affect a moderate proportion of receptors.
	HIGH	Prominent change, or large degree of modification, disturbance or degradation caused to receptors or which may affect a large proportion of receptors, possibly entire species or community and which is not easily reversed.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	**SITE**	Impact is limited to the immediate footprint of the activity and immediate surrounds within a confined area.
	LOCAL	Impact is confined to within the project concession / licence area and its nearby surroundings.
	REGIONAL	Impact is confined to the region, e.g., coast, basin, catchment, municipal region, district, etc.
	NATIONAL	Impact may extend beyond district or regional boundaries with national implications.
	INTERNATIONAL	Impact extends beyond the national scale or may be transboundary.
Criteria for ranking the DURATION of impacts	**SHORT TERM**	The duration of the impact will be < 1 year or may be intermittent.
	MEDIUM TERM	The duration of the impact will be 1-5 years.
	LONG TERM	The duration of the impact will be 5-25 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	The impact will endure for the reasonably foreseeable future (>25 years) and where recovery is not possible either by natural processes or by human intervention.

9.2.4.2 Determining Magnitude (or Consequence) Ratings

Once the intensity, extent and duration are defined based on the definitions set out in Section 9.2.4.1, the magnitude (or Consequence) of negative and positive impacts is derived based on Table 9-5 below. It should be noted that there may be times when these definitions may need to be adjusted to suit the specific impact where justification should be provided. For instance, the permanent loss of the only known occurrence of a species in a localised area of impact can only achieve a "High" magnitude rating but could, in this instance, warrant a Very High rating. The justification for amending the rating should be indicated in the impact table.

Table 9-5: Magnitude Determination

Magnitude (or Consequence) Rating	Description *
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium or long term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low or medium intensity*** at a ***local level*** and endure in the ***short term.*** OR **Zero to very low *intensity*** with any combination of extent and duration.

* Note: For any impact that is considered to be "Permanent" or "International" apply the "Long-Term" and "National" ratings, respectively. For impacts at the "Site" or "Local" level apply the "Local" level rating.

9.2.5 Determination of Impact Significance

9.2.5.1 Matrix to Derive Impact Significance

The significance of an impact is based on expert judgement of the sensitivity (importance or vulnerability) of a receptor and the magnitude (or consequence) of the effect that will be caused by a project-induced change.

In summary, the impact assessment method is based on the following approach:

Significance = Magnitude (or Consequence) x Sensitivity

Where Magnitude (or Consequence) = Intensity +Extent + Duration

Once ratings are applied to each of these parameters the matrix presented in Table 9-6 is used to derive Significance:

Table 9-6: Matris for Determining Significance

		SENSITIVITY				
		VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
MAGNITUDE (OR CONSEQUENCE)	VERY LOW	NEGLIGIBLE	NEGLIGIBLE	VERY LOW	LOW	LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW	MEDIUM
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM	HIGH
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH	VERY HIGH
	VERY HIGH	HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

9.2.5.2 Definitions of Significance Ratings

Broad definitions of impact significance ratings are provided in Table 9-7 below. Impacts of 'High' and 'Very High' significance require careful evaluation during decision-making and need to be weighed up against potential long-term socioeconomic benefits of the project to inform project authorisation. Where there are residual biodiversity impacts of 'High' and 'Very High' significance this will require careful examination of offset feasibility and confirmation that an offset is possible prior to decision-making.

Table 9-7: Definitions of Significance Ratings

Significance Rating	Interpretation
Very High	**Impacts** where an accepted limit or standard is far exceeded, changes are well outside the range of normal variation, or where long-term to permanent impacts of large magnitude (or consequence) occur to highly sensitive resources or receptors. For **adverse residual impacts** of very high significance, there is no possible further feasible mitigation that could reduce the impact to an acceptable level or offset the impact, and natural recovery or restoration is unlikely. The impact may represent a possible fatal flaw and decision-making will need to evaluate the trade-offs with potential social or economic benefits. **Positive** social impacts of very high significance would be those where substantial economic or social benefits are obtained from the project for significant duration (many years).
High	**Impacts** where an accepted limit or standard is exceeded; impacts are outside the range of normal variation or adverse changes to a receptor are long-term. Natural recovery is unlikely or may only occur in the long-term and assisted and ongoing rehabilitation is likely to is required to reduce the impact to an acceptable level. High significance **residual impacts** warrant close scrutiny in decision-making and strict conditions and monitoring to ensure compliance with mitigation or other compensation requirements.

Significance Rating	Interpretation
	Positive social impacts of high significance would be those where considerable economic or social benefits are obtained from the project for an extended duration in the order of several years.
Medium	Moderate **adverse changes** to a receptor where changes may exceed the range of natural variation or where accepted limits or standards are exceeded at times. Potential for natural recovery in the medium-term is good, although a low level of residual impact may remain. Medium impacts will require mitigation to be undertaken and demonstration that the impact has been reduced to as low as reasonably practicable (even if the **residual impact** is not reduced to Low significance). **Positive** social impacts of medium significance would be those where a moderate level of benefit is obtained by several people or a community, or the local, regional or national economy for a sustained period, generally more than a year.
Low	**Minor effects** will be experienced, but the impact magnitude (or consequence) is sufficiently small (with and without mitigation) and well within the range of normal variation or accepted standards, or where effects are short-lived. Natural recovery is expected in the short-term, although a low level of localised residual impact may remain. In general, impacts of low significance can be controlled by normal good practice but may require monitoring to ensure operational controls or mitigation is effective. **Positive** social impacts of low significance would be those where a few people or a small proportion of a community in a localised area may benefit for a few months.
Very Low	Very minor effects on resources or receptors are possible but the predicted effect represents a minimal change to the distribution, presence, function or health of the affected receptor, and **no mitigation is required**.
Negligible	Predicted impacts on resources or receptors of very low or low sensitivity are imperceptible or indistinguishable from natural background variations, and **no mitigation is required**.

9.2.6 Additional Assessment Criteria

Additional criteria that are taken into consideration in the impact assessment process and specified separately to further describe the impact and support the interpretation of significance, include the following:

- **Probability (Likelihood) of the impact occurring** (which is taken into account mainly for unplanned events);
- **Degree of Confidence in the impact prediction;**
- **Degree to which the impact can be mitigated;**
- **Degree of Resource Loss** (i.e. the extent to which the affected resource/s will be lost, taking into account irreplaceability); and
- **Reversibility** – the degree to which the impact can be reversed.
- **Cumulative Potential –** potential for cumulative impacts with other planned projects or activities.

Definitions for these supporting criteria are indicated in Table 9-8 below.

Table 9-8: Categorisation and Description of Additional Assessment Criteria

Criteria	Rating	Description
Criteria for determining the PROBABILITY of impacts	**UNLIKELY**	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 5% chance of occurring.
	POSSIBLE	Where the impact could occur but is not reasonably expected to occur i.e. 5-35% chance of occurring.
	LIKELY	Where there is a reasonable probability that the impact would occur, i.e. > >35 to ≤75% chance of occurring.
	HIGHLY LIKELY	Where there is high probability that the impact would occur i.e. >75 to <99% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. 100% chance of occurring.

Criteria	Rating	Description
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	**LOW**	Low confidence in impact prediction (≤ 35%)
	MEDIUM	Moderate confidence in impact prediction (between 35% and ≤ 70%)
	HIGH	High confidence in impact prediction (> 70%).
	CERTAIN	Absolute certainty in the impact prediction (100%)
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the residual impact.
	VERY LOW	Some mitigation is possible but will have marginal effect in reducing the residual impact or its significance rating.
	LOW	Some mitigation is possible and may reduce the residual impact, possibly reducing the impact significance.
	MEDIUM	Mitigation is feasible and will reduce the residual impact and may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the residual impact and impact significance rating.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**LOW**	Where the activity results in a marginal effect on an irreplaceable resource.
	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for REVERSIBILITY - the degree to which an impact can be reversed	**IRREVERSIBLE**	Where the impact cannot be reversed and is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS – the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects	**UNLIKELY**	Low likelihood of cumulative impacts arising.
	POSSIBLE	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

9.2.7 Application of the Mitigation Hierarchy

A key component of this ESIA process is to explore practical ways of avoiding or reducing potentially significant impacts of the proposed project. These are commonly referred to as mitigation measures and are incorporated into the proposed project as part of the ESMP. Mitigation is aimed at preventing, minimising or managing significant negative impacts to as low as reasonably practicable (ALARP) and optimising and maximising any potential benefits of the proposed project. The mitigation measures are established through the consideration of legal requirements, best practice industry standards and specialist input from the ESIA team.

The mitigation hierarchy, as specified in IFC Performance Standard 1, which is widely regarded as a best practice approach to managing risks, is based on a hierarchy of decisions and measures, as presented in Figure 9-1 and described in Table 9-9. This is aimed at ensuring that wherever possible potential impacts are mitigated at source rather than mitigated through restoration after the impact has occurred. Any remaining significant residual impacts are then highlighted and additional actions are proposed.

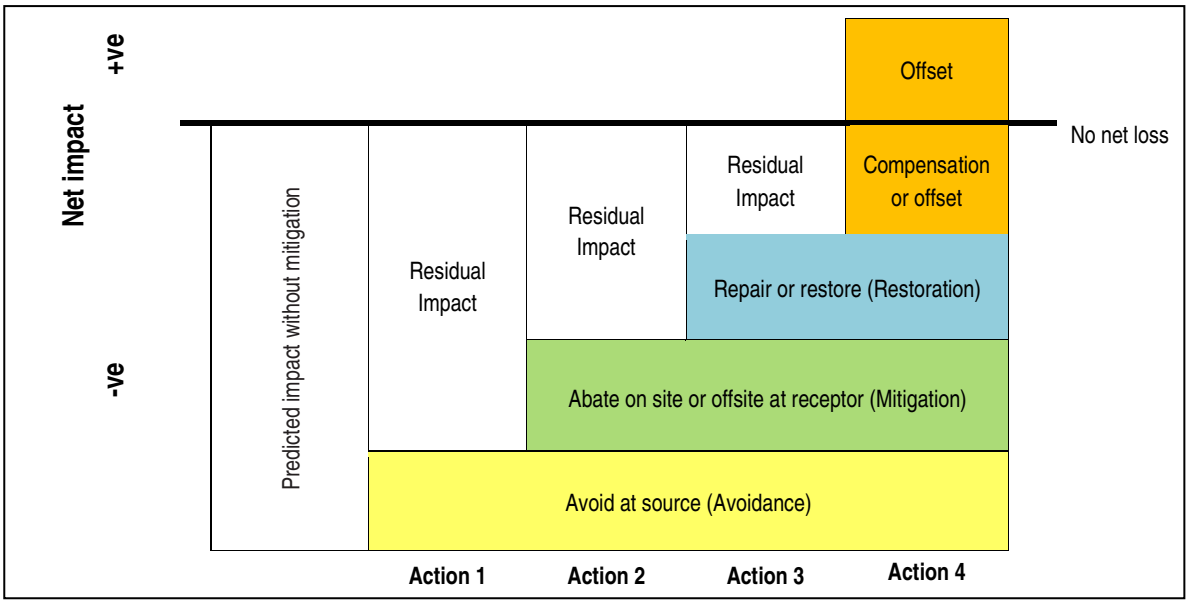

Figure 9-1: Mitigation Hierarchy

Adapted from: www.thebiodiversityconsultancy.com

Table 9-9: Sequential Application of the Mitigation Hierarchy

Avoid at Source	Avoiding or reducing at source is essentially 'designing' the Project so that a feature causing an impact is designed out (e.g., a waste stream is eliminated).
Abate on Site	This involves adding something to the basic design or procedures to abate the impact (often called 'end-of-pipe') or altered (e.g., reduced waste volume) and is referred to as minimisation Pollution controls fall within this category.
Abate Offsite/at Receptor	If an impact cannot be abated on-site, then measures can be implemented off-site – an example disposing of waste generated on-board at a proper waste facility onshore. Measures may also be taken to protect the receptor.
Repair or Restore	Some impacts involve unavoidable damage to a resource, e.g., shoreline pollution arising from an oil spill. Repair essentially involves restoration and reinstatement type measures, such as clean-up of the shoreline.
Compensate or Offset	Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate. An example could be compensation for loss of earnings if fisheries were to be permanently impacted by a Project activity.