Marine offsetting and compensation – Summary of management guidance and policy

Greater Wellington
Te Pane Matua Taiao

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Executive summary

Development along New Zealand's coastlines often has poor outcomes for indigenous marine habitats and biodiversity. We need to find a balance between providing for and protecting human interests along the coast and preserving and giving resilience to the marine environment. History and experience show that with many developments in the marine environment (e.g., reclamations for marinas, ports, transport infrastructure) there is a net loss of biodiversity, and cumulative effects are also increasingly significant.

This issue is exacerbated by limited guidance and evidence for the efficacy of marine offset and compensation efforts; a consequence of having limited baseline information, the complexity of interactions in the marine environment, and large gaps in our ecological knowledge of marine species, habitats, ecosystems, and related processes. Attempting to apply approaches developed for freshwater and terrestrial habitats is problematic due to the unique challenges with mitigating, offsetting, and compensating for adverse impacts in the marine environment.

Regional councils have a responsibility to maintain and improve environmental health and the New Zealand Coastal Policy Statement provides strong national direction to protect and restore indigenous biodiversity and biological and physical processes in the coastal environment. If we continue to allow the huge range of coastal development projects to proceed without robust or strategic guidance and advice on how to effectively compensate for impacts, we risk the loss of significant areas of intertidal and margin habitat, and irreversible impacts to our coastal, intertidal, and subtidal communities and coastal processes.

This report highlights current knowledge and tools relating to marine mitigation, offsetting, and compensation, and identifies gaps where they exist. The aim is to drive consistency in our collective approaches to offsetting and compensation, and to ensure that key words and concepts are clearly defined so that they are used and understood with the same intent by consent applicants and decision makers.

The final report provides:

1. an overview of the policy setting for offsetting and compensation, and principles to be applied;

2. discussion on how to determine the ecological value of coastal habitats and species that may be adversely affected by a development and that may be proposed as mitigation, offsetting, and/or compensation;

3. guidance on how the quantum of offsetting or compensation might be determined in the marine environment, including limitations that may apply; and

4. examples of practical measures and case studies of offsetting and compensating for biodiversity loss in marine ecosystems.

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Contents

1. Introduction

Coastal developments have resulted in numerous reclamations, occupations, and modifications of New Zealand's coastal marine area (CMA). This has greatly reduced the available area of habitats, impacted the healthy functioning of ecosystems, and led to an overall loss of indigenous biodiversity. There is a need to find a balance between providing for and protecting human interests along the coast and preserving and restoring resilience to the marine environment. History and experience show that with many developments in the marine environment (e.g., reclamations for marinas, ports, transport infrastructure) there is a net loss of biodiversity, and this loss is cumulative. Understanding the effects of these developments, and how to manage them appropriately, is often complex and highly challenging. This challenge is exacerbated by the lack of guidance on how to manage adverse effects in the coastal marine environment through mitigation, offsetting, and compensation.

The effects management hierarchy is a framework for avoiding, remedying, minimising (collectively known as 'mitigating'), offsetting, and compensating for environmental impacts, which is used around the world, notably in the freshwater and terrestrial domains and, to a lesser extent, the marine environment. However, there is limited guidance and evidence for the efficacy of marine offsets and compensation efforts. This is a consequence of having limited baseline information, the complexity of interactions in the marine environment, and large gaps in our ecological knowledge of marine species, habitats, ecosystems, and related processes. Attempting to apply approaches developed for freshwater and terrestrial habitats is problematic due to the unique challenges of mitigating, offsetting, and compensating for adverse environmental impacts in the marine environment and a revised approach is necessary in New Zealand.

1.1 Purpose of this guidance

The purpose of this document is to provide a stocktake of current knowledge and tools relating to marine mitigation, offsetting, and compensation and provide guidance on how to use the existing tools and identify gaps where they exist. It has been developed for use by consent applicants and consenting authorities, with an emphasis on approaches to offsetting and compensation for addressing residual adverse effects.

The aim is to provide consistency with the approaches and issues being addressed by both parties throughout the consenting process and to ensure that key words and concepts are clearly defined so that they are used and understood with the same intent by consent applicants and decision makers.

This guidance provides:

- An overview of the policy setting, including statutory and non-statutory documents that relate to the effects management hierarchy;
- Discussion on the effects management hierarchy in the marine environment, with a focus on offsetting and compensation, and principles to be applied;
- Discussion on determining the ecological value of coastal habitats and species that may be adversely affected by development and that may be proposed as mitigation, offsetting, and/or compensation;
- Guidance on how the quantum of offsetting or compensation might be determined in the marine environment, including limitations that may apply; and
- Examples of practical measures and case studies of offsetting and compensating for biodiversity loss in marine ecosystems.

2. Policy setting

There are a number of statutory (Table 1) and non-statutory (Table 2) documents that provide varying levels of direction regarding effects management in New Zealand, including offsetting and compensation. Some are directly relevant to the marine environment and others specifically exclude it but have concepts and approaches that could be considered or adapted for use in the marine environment.

Overall, there is little existing policy direction on offsetting and compensation in the marine environment. This is, in part, likely a key reason why marine offsetting is not a widely established and agreed-upon process in New Zealand. Where policy addresses offsetting and compensation for terrestrial and freshwater ecosystems, it typically excludes the marine environment, acknowledging the lack of baseline information and established practice in this domain. Ultimately, offsetting and compensation need to be considered as an absolute last resort for projects that are considered highly beneficial or essential but are otherwise unable to address adverse effects with avoiding, remedying, or minimising adverse ecological effects.

Table 1: Summary of statutory documents that provide direction on offsetting and compensation of relevance for the coastal marine area

Policy	Themes for offsetting	Relevance to marine environments	Comments / limitations
Resource Management Act (RMA 1991)	The RMA does not require biodiversity offsetting to address adverse ecological effects for projects that need resource consent. However, a 2017 amendment to the Act has confirmed existing practice developed through case law.	Directly relevant	Although there is no requirement in the RMA to achieve a no net loss outcome for a resource consent to be granted, there are two scenarios under which offsetting, or compensation could be considered: • Where offsetting is specifically referred to in a planning document such as a district or regional plan • Where offsetting is voluntarily proposed as a means of addressing a proposal's effects In most instances, a consent is not likely to be granted without recourse to mitigation, offsetting, and/or compensation.
New Zealand Coastal Policy Statement (NZCPS 2010)	Policies under the NZCPS give clear direction to avoid, and if not possible remedy or minimise adverse effects of activities within coastal environments, including infrastructure, reclamation, and any other effects on indigenous biological diversity. It also directs the avoidance of any 'significant adverse effects' of activities in high value and vulnerable coastal and marine habitats.	Directly relevant	For ecosystems and habitats that meet the criteria of Policy 11(a) of the NZCPS (e.g., threatened or at-risk species), adverse effects are to be avoided. No effects management hierarchy can be applied. For ecosystems and habitats that meet the criteria of Policy 11(b) of the NZCPS, significant adverse effects are to be avoided, and other adverse effects can be avoided, minimised, and/or remedied. Policy 11 does not provide for offsetting or compensation of residual effects in a range of ecosystem and habitat types, effectively defining some of the limits to offsetting in the marine environment. Further information is provided in the NZCPS Policy 11 guidance note.
Crown Minerals Act (CMA 1991)	Provisions under the CMA 1991 require a permit from the appropriate Minister(s) before a person can mine for minerals. The Minister must have regard to potential adverse effects of carrying out the work and can consider offsetting or compensation for addressing residual adverse effects	Directly relevant	In granting access to land in marine or coastal areas for significant exploration or mining activities, the Act states that the Minister must consider the effects mining activities are likely to have on the conservation values of the land concerned, the effect the activities are likely to have on other activities on the land, and the activities' net impact on the land, either while the activities are taking place or after their completion.
Conservation Act (CA 1987)	The CA requires 'concessions' to be granted for activities in a conservation area (e.g., marine protected area), with some specified exceptions. The CA sets out certain matters to be met before a concession is granted, however, the Minister	Directly relevant	The CA allows offsetting and compensation to be carried out in a marine protected area *if* a concession is granted for an activity with residual effects (e.g., construction of wharf). A conservation area might also be proposed as a candidate site for offsetting or compensation where

Policy	Themes for offsetting	Relevance to marine environments	Comments / limitations
	can consider offsetting or compensation, where there are residual adverse effects.		project impacts occur outside the conservation area (with approval of DOC) The CA focuses on the values of the conservation area affected whereas the RMA considers the environment more broadly. The CA does not need to consider social and economic benefits. There are statutory bars to granting concessions that cannot be met using a biodiversity offset. These differences limit the use of offsetting under the CA
Wildlife Act (WA 1953)	The WA 1953 protects certain scheduled marine species (e.g., corals, sharks, rays, fish) and controls activities within wildlife sanctuaries (e.g., marine mammal sanctuaries) via provisions within a conservation management plan.	Directly relevant	Activities within wildlife sanctuaries can be prohibited or restricted. All wildlife in the sanctuary is absolutely protected and provisions for activities are managed within the place-based conservation management strategies and plans. This act is out of date and schedules of protected marine species are long overdue to be updated.
National Policy Statement for Indigenous Biodiversity (NPS-IB 2022)	Includes biodiversity offsetting and compensation principles for managing residual adverse effects (Appendices 3 and 4). Covers key principles such as limits to offsetting, additionality, long term outcomes and lag times, and stakeholder engagement.	Excludes coastal and aquatic ecosystems, but principals are relevant.	While this document excludes coastal and aquatic ecosystems, the inclusion of the principles gives clear direction as to their best practice application, and some direction is directly relevant to the marine environment through the inclusion of highly mobile fauna in the coastal marine area (1.3 (2)(b)). Adherence to the effects management hierarchy sits at the forefront of guidelines on both offsetting and compensation, meaning effects should first be demonstrably avoided, minimised, and remedied before offsetting and/or compensation are to be considered. Many adverse effects on indigenous vegetation, habitats and ecosystems are to be avoided outright, without the option of considering offsetting or compensation.
Regional Policy Statements and Regional Plans	Each region addressed this issue differently from not at all, to specific policies relating to offsetting and compensation.	Varies among regions (e.g., Greater Wellington, directly relevant)	Policy statements and plans are typically, high level documents and provide limited, if any, guidance on effects management specific to the marine environment. As an example, the Greater Wellington Proposed Natural Resources Plan (PNRP) contains schedules of principals to be applied when conducting offsetting and compensation, which align with the National Policy Statement for Freshwater Management 2020.

Table 2: Summary of non-statutory documents that provide direction on offsetting and compensation of relevance for the coastal marine area

Document	Themes for offsetting	Relevance to marine environments	Comments / limitations
Te Mana o Te Taiao – Aotearoa New Zealand Biodiversity Strategy (DOC 2020)	The guiding principles for implementing Te Mana o Te Taiao include a brief section on decision making, which refers to the need to mitigate or remedy adverse effects that may arise from an activity.	Directly relevant	The guidance is high level and doesn't provide further details on mitigation or offsetting than acknowledging that they should be done where activities may impose adverse effects and that the costs should be borne by those benefitting from the activity. Goal 10.4.2 for 2030 does, however, state that: "No loss of the extent or condition [of] marine and coastal habitats which have been identified, mapped and designated as having high biodiversity value", which links to the limits to offsetting.
Ecological Impact Assessment (EcIA) Guidelines (EIANZ 2018)	The guidelines provide guidance on the effects management hierarchy, including offsetting and compensation. This includes principles of biodiversity offsetting, their limits, and how one might address the quantum required.	Current version only explicitly covers terrestrial and freshwater ecosystems. Updates to these (currently in draft) are anticipated to be relevant to marine species and benthic habitats.	Widely used and provides direction about approaches to conduct ecological assessments for terrestrial and freshwater domains. Aspects of these guidelines have been adapted by others at various times so that they can be applied in the marine space. At the time of writing, a separate marine module of these guidelines was under development, which included tables for determining the ecological value of marine rocky shore and soft sediment benthic habitats that were absent from the previous version.
Biodiversity Offsetting under the Resource Management Act (Maseyk *et al*, 2018)	This document provides guidance on biodiversity offsetting, targeting a broad range of audiences, ranging from ecologists assessing and implementing the approaches, decision makers determining whether approaches are appropriate, and policy makers.	Not domain-specific, so relevant to marine environments.	Provides key guidance on the approach and principles for offsetting and compensation but is not specific to the marine environment. In this regard, it may not be possible to implement all approaches due to the high degree of complexity and connectivity of marine ecosystems.
Guidance on Good Practice Biodiversity Offsetting in New Zealand (DOC, 2014)	The guidance is designed for policy makers, planners, developers, and decision-makers who need to gain an understanding of the concepts and current good practice around biodiversity offsetting.	Excludes the marine environment but includes principles and frameworks that could be adapted.	Offsetting in the marine environment is not considered in the guidance.

Document	Themes for offsetting	Relevance to marine environments	Comments / limitations
Managing adverse effects on indigenous biodiversity in the Wellington Region (Greater Wellington Regional Council, 2022)	Includes mitigation, offsetting, and compensation principles (Schedules G1, G2 and G3). These principles are intended to guide the assessment of projects seeking resource consent in view of the adequacy of the design and implementation of effects management measures.	Applies to terrestrial, freshwater, and marine domains in the Wellington region but could be applied elsewhere.	The document contains guidance on limits to offsetting (where offsetting is inappropriate), additionality, landscape context, and adaptive management to ensure long-term outcomes. It also addresses principles for calculating and achieving 'no net biodiversity loss'.

3. Effects management hierarchy

The effects management hierarchy is an internationally accepted approach to managing the adverse effects resulting from an activity. Having identified the need for an ecological impact assessment, the key steps are describing ecological features through detailed investigations, evaluating ecological features, assessing potential and actual effects, and establishing impact management options using the effects management hierarchy.

The exact language used has changed over time and, in New Zealand, at the time of preparing this guidance is as follows: firstly, adverse effects should be **avoided**; where they cannot be practicably avoided, they should be **minimised**; where they cannot be minimised, they should be **remedied**. Collectively, these first three steps of the effects management hierarchy can be referred to as mitigation and crucially, are all conducted at the area of impact.

If adverse effects are not able to be sufficiently mitigated, serious consideration should be given to whether it is appropriate for the project to proceed. Offsetting and compensation should be treated as a last resort to manage adverse ecological effects.

For large or complex activities, mitigation may not be able to account for the entirety of the adverse effects that are predicted to result from an activity; in this case, the effects that are unaccounted for are known as the residual adverse effects. Residual adverse effects can be managed firstly with **offsetting** and, where this is not possible or sufficient, **compensation**. The intent for these approaches is to implement them as close to the impact site as feasible. Offsetting is typically based on a like-for-like approach regarding the ecological value or habitat that is being lost or adversely affected. All other efforts to manage residual effects fall under compensation. If, using all these tools, the adverse effect cannot be appropriately managed, the activity itself should be avoided.

The concept of the effects management hierarchy is illustrated in Figure 1

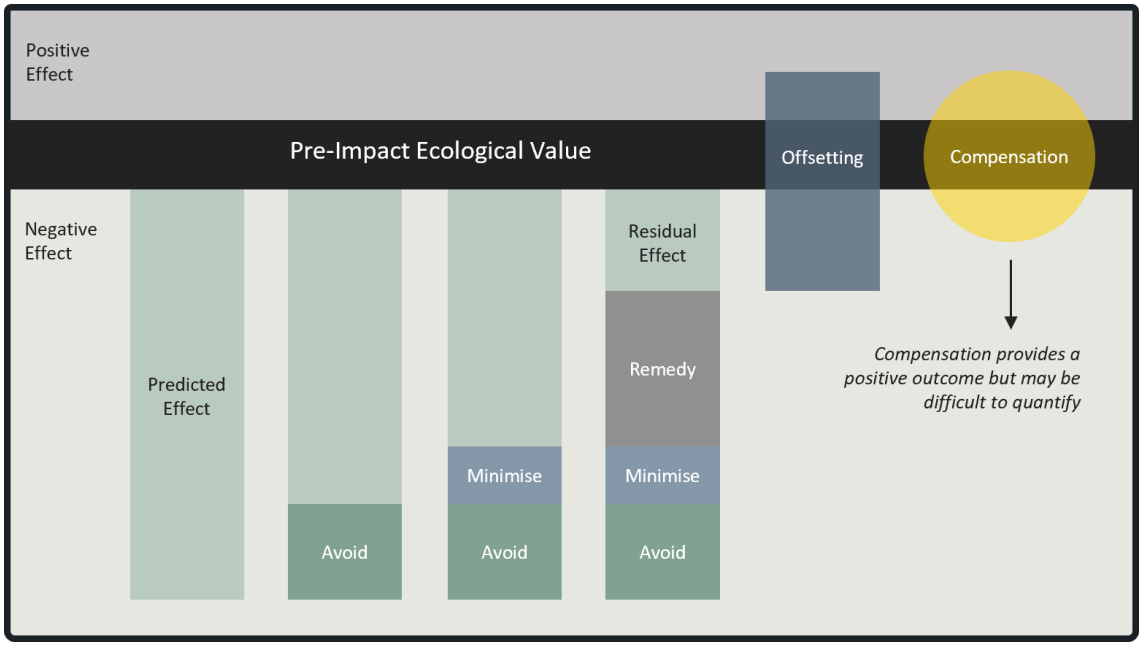

Figure 1: Conceptual illustration of the effects management hierarchy. Based on Maseyk et al. (2018), Figure 2

3.1 Determining ecological value

Determining the level of effect of a proposed activity is dependent on the value of the species, habitats and ecosystems that could be affected. The marine environment is complex and, although our knowledge of this environment is increasing, there is still much we do not know. Consequently, expert judgement likely needs to overlay measurements and observations for most approaches for valuing marine ecosystems.

At the time of preparing this guidance document, there are no published tools to determine the ecological value of marine habitats. The current edition of the Ecological Institute of Australia and New Zealand's (EIANZ) Ecological Impact Assessment guidelines (EcIA) does not encompass coastal-marine ecosystems. Instead, the approach to determine the ecological values of terrestrial and freshwater habitats using the EIANZ approach has been informally adapted over time for use with marine habitats. An update to these guidelines in the form of a marine module has been drafted to include approaches for valuing rocky shore and soft sediment benthic marine habitats. Once reviewed and published, the module could be widely used amongst the New Zealand marine science community. The guidelines and proposed module address aspects such as scale, representativeness, rarity, diversity, and context, which are all important considerations when determining ecological value. However, they overlook values such as ecological function, ecosystem service or any express reference to values for climate change mitigation and adaptation.

The EcIA guidelines and a range of other approaches that could be used for determining the value of species, habitats, and ecosystems in New Zealand are presented in Table 3. Comment is also provided on the appropriateness of each approach when applied to the marine environment.

Table 3: Approaches for determining the ecological value of species, habitats, and ecosystems

Value system	Description / Comments	Current Appropriateness for Marine Environment
Ecological Impact Assessment (EcIA) Guidelines for New Zealand – Published by the Environment Institute of Australia and New Zealand (EIANZ) (Roper-Lindsay et al., 2018)	The EcIA is well-established and commonly used for valuing terrestrial, and freshwater species and habitats (section 5 of the guidelines). The current version (2nd edition) excludes criteria for valuing marine habitats.	In the absence of regional or national guidelines or criteria for the assessment of marine ecological values, the EcIA guidelines approach has been adapted by several people to assess marine ecological value of hardshore and soft sediment benthic habitats using a suite of factors relating to abundance, diversity and benthic invertebrate species richness, sediment grain size composition, and sediment contaminant concentrations. Criteria for assigning ecological value to marine habitats are currently in draft form and are proposed to be released as an updated edition or module to the existing guidelines. These are currently being reviewed and should be published by early 2024.
Ecosystem services	Ecosystem services are still a developing topic in New Zealand; however, there have been some publications on marine ecosystem services in New Zealand, for example: MacDiarmid et al. (2013) and Geange et al. (2019). The concept can be used as a tool to describe and value functional, provisioning, regulatory and cultural services in an integrated way. It could also be used as a tool to assess ecological effects by valuing currently provided services, provision following the project impact, and expected provision following the implementation of residual effects management measures. This approach could supplement other approaches where appropriate.	Applicable to the marine environment but may fall short due to limited available data to quantify services and it is currently not commonly applied in New Zealand.
Functionality	This value system focuses on the overall function of an ecosystem rather than any particular value. Like the ecosystem services approach, functionality assesses the ecological function of an ecosystem, and can be compared to the 'baseline' or 'reference' state of such a system. From there, it is possible to compare functionality of the current system to that of the impacted system before and after effects management measures are implemented. This approach could supplement other approaches where appropriate.	As with ecosystem services, this approach may fall short due to limited available data and it is currently not commonly applied in New Zealand. Assessing the functionality of habitats is often disregarded in favour of more simplified approaches, which means the complexities of ecosystems, their interlinked nature and aspects of resilience are not often represented in impact assessments.
Mātauranga Māori	Mātauranga Māori is a multi-disciplinary and holistic approach based on traditional Māori knowledge. It may include aspects such as language (te reo), education (mātauranga), traditional environmental knowledge (taonga tuku	There is no standard approach to assessing Māori cultural values, but it must be led by mana whenua.

Value system	Description / Comments	Current Appropriateness for Marine Environment
	iho, mātauranga o te taiao), traditional knowledge of cultural practice, such as healing and medicines (rongoā), fishing (hī ika) and cultivation (mahinga kai). It is specific to the area (rohe) to which it is applied and the approach must be led by mana whenua.	This approach can be applied to the marine environment but has so far been limited in its application with respect to valuing ecosystems in this context. See, for example, the Marine Cultural Health Programme — a partnership between mana whenua hapū and Napier Port to monitor the health of the marine environment in and around the Ahuriri/Napier area.
New Zealand Coastal Policy Statement (NZCPS, 2010)	Policy 11 of the NZCPS lists narrative criteria by which marine and coastal sites can be considered significant for indigenous biodiversity values. Adverse effects must be avoided depending on which criteria a habitat or ecosystem meets. Policy 11 does not provide any quantification of value, nor assessment of the ecological values or ecosystem services provided by biodiversity.	Appropriate for use in the marine environment but is high-level only and overlooks ecosystem function and services provided by high biodiversity habitats.
Key Ecological Area (KEA) criteria (Stephenson et al, 2018)	Department of Conservation and Ministry of Primary Industries developed these nine criteria to define areas of particular importance for use in marine protected area planning processes. The KEA criteria were based on the Ecologically and Biologically Significant Areas (EBSA) criteria, developed under the International Convention on Biological Diversity (CBD). These have since been adopted by numerous regional councils to assist with identifying and scheduling sites of importance for indigenous marine biodiversity.	Directly applicable to the marine area, these criteria overlap with those in the National Policy Statement for Indigenous Biodiversity and the NZCPS Policy 11, though are arguably more comprehensive with the inclusion of criteria for Ecosystem functions and services, Biological productivity, and Naturalness. These criteria are narrative at present but work is underway to develop numeric thresholds for the Biological Diversity criterion and others as appropriate.

3.2 Scale

The assessed level of effects of an activity is ultimately dependent on the scale in which that assessment was conducted — a particular effect can be significant within the works footprint but become negligible when assessed at a larger scale. This idea was discussed by Dr Sharon De Luca in a note on the issues for Ecological Impact Assessments in New Zealand's marine environment:

"As marine environments are large and interconnected, there can be a tendency for some practitioners to minimise (not necessarily intentionally) the level of effects of a project by considering it at a broad scale. For example, an area of reclamation in an embayment within a harbour could be considered at the harbour scale (very small proportion of the harbour affected, negligible level of effect), at the sub-harbour scale (small proportion of sub-harbour affected, low level of effect), at the embayment scale (moderate/high proportion of the embayment affected, moderate/high level of effect). To avoid this potential down-playing of the effects, it is important that ecologists assess the project at several spatial and temporal scales."

Determining appropriate scales to conduct assessments will require expert judgement and it may be appropriate to conduct them across a range of scales. The scales at which assessments are made will depend on a number of factors including:

- The size of the activity's footprint;
- The rarity and natural distribution of the affected ecological value;
- The mobility of species potentially affected; and
- Temporal scales of the potential effects.

This can be a complex, multifaceted topic and further details on choosing the appropriate scale are discussed in the EIANZ Guidelines.

3.3 Mitigation

At the outset of every project, all opportunities to avoid, minimise, or remedy adverse effects of the proposed activity should be identified and considered. Preferably, an ecologist is included early in the planning stages of the project to assist with identifying adverse effects and identifying potential mitigation early in the design stages. Measures to achieve this include options such as complete avoidance of sensitive marine environments, footprint minimisation, and staged development. Resource consent applications should demonstrate that all practicable measures have been taken for an activity. There are strong linkages between options for avoiding and the Alternatives Assessment that is presented in an Assessment of Environmental Effects under the RMA.

Mitigation must occur in the same area that has been adversely affected. This contrasts with offsetting and compensation, which may be conducted in other locations. Some conceptual mitigation options are presented in Table 4.

Table 4: High-level examples of mitigation options in the marine environment

Mitigation Option	Comments	Avoid	Minimise	Remedy
Spatial restriction	Minimise the project footprint or avoid sensitive habitats.	✓	✓	
Temporal restriction	Avoid works that may adversely affect species during at-risk life stages, such as breeding, moulting, or migration.	✓	✓	
Construction management	Avoid or minimise the level of effect of construction activities, for example by containing suspended sediments with a silt curtain or reducing noise by means of a bubble curtain.	✓	✓	
Habitat/community preservation	Protect a habitat/community in part (minimise) or in its entirety (avoid) by excluding development, or effects from development, within the area.	✓	✓	
Alternative methodology	Using alternative methodologies could result in avoiding or minimising adverse effects. For example, an alternative dredging method may result in less suspended sediment being generated.	✓	✓	
Habitat/community restoration or re-creation	Create or improve habitat/community in the same area that was lost or adversely affected by an activity to provide the same or better ecological values and/or function to pre-impact conditions.			✓

3.4 Offsetting

Offsetting aims to redress the residual adverse effects after applying measures to avoid, minimise, and/or remedy. As already noted in this guidance, all efforts should be made to mitigate adverse effects where possible, and offsetting should be considered only a last resort.

For an approach to be considered as offsetting, it must be like-for-like and result in at least no net loss. Some guidance also suggests that like-for-better or 'trading up' is a form of offsetting.[1] Trading up has the potential to provide better environmental outcomes than like-for-like and may be preferable to environmental compensation. An example of trading up could be the replacement of an existing concrete seawall with a new seawall comprising pre-cast habitats and rock pools to enhance biodiversity.

Considering the narrow scope for offsetting in the marine environment, opportunities to improve impacted habitats should be explored. Trading up approaches are likely to be more subjective than like-for-like approaches and it is important that the replacement habitats also offer similar ecological functions to avoid introducing additional adverse effects.

As an example, if a seagrass bed within a construction area is adversely affected, another seagrass bed could be enhanced or reseeded nearby to an appropriate standard to achieve a no net loss or net gain in seagrass area or biomass resulting in a like-for-like offset. However, in most cases, restoring or recreating habitats will be severely restricted by our fundamental lack of information on the biophysical requirements of habitat forming species, or even their reproductive ecology. This may be particularly applicable with reclamations, for example, where an offset might need to include a declamation or conversion of subtidal habitat to intertidal habitat (i.e., to prevent a loss in habitat extent as well as values). Each of these options are likely to have additional effects that would need to be assessed to result in an overall no-net-loss of biodiversity.

It is preferable to propose offsetting approaches based on proven methods. That is, the proposed offsetting method should have a relatively high level of confidence of success and a low risk of failure or unanticipated adverse effects. Based on the review of offsetting and compensation conducted in New Zealand (Section 5), this is likely to be difficult to demonstrate as many projects are recent and lack robust monitoring results and evidence of outcomes. This is a developing area of knowledge in New Zealand and the evidence base is likely to increase over time as marine offsetting and compensation approaches are implemented, monitored, and reported.

3.4.1 Limits to Offsetting

Many biodiversity values are not able to be offset, and if they are impacted then they will be permanently lost (Maseyk et al. 2018). The Limits to Offsetting principle reflects a standard of acceptability for offsetting, and offsetting should not be seen as a pathway to allow uncompensated losses.

Biodiversity offsets are not appropriate in situations where biodiversity values cannot be offset to achieve at least a no-net-loss outcome. If biodiversity values are adversely affected, they may be permanently lost. This includes instances

[1] For example, Maseyk et. al (2018), section 3.1.2.

where systems are irreplaceable or vulnerable; effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse; and where there are no technically feasible options by which to secure gains within an acceptable timeframe.

Another example of limits to offsetting is introduced by the NZCPS Policy 11(a), which requires the avoidance of adverse effects on ecosystems and habitats that meet the listed criteria (e.g., threatened, or at-risk species and ecosystems that are naturally rare). Accordingly, no effects management hierarchy (mitigation, offsetting, or compensation) can be applied.

Similarly, other statutory documents, such as those listed in Table 1, may impose limits on what can be offset.

3.5 Compensation

In a similar manner to offsetting, all efforts should be made to mitigate or offset adverse effects where possible, and compensation should be considered only a last resort.

In many cases, compensation is likely the only viable means of redressing residual adverse effects in the marine environment. It is, therefore, suggested that the standard for compensation in the marine environment should be high. Like offsetting, compensation should be conducted as close to the affected area as possible and guidance suggests it can include approaches that do not meet the requirements for offsetting (e.g., like-for-like or like-for-better). Technically, it includes all other approaches for dealing with residual adverse effects that are likely to result in overall positive environmental outcomes. Compensation should be designed following best-practice design principles and endeavour to achieve the highest value ecological outcomes possible. Like offsetting, compensation actions should be accompanied by robust monitoring and adaptive management.

The ecological value of a compensation approach will be influenced by the environment in which it is being implemented. Different regions, estuaries, and bays have different environmental pressures, priorities, habitats, and species that are highly valued. Ideally, these priorities are identified by stakeholders – this could be a stakeholder-led approach run separately to coastal developments (e.g., catchment or harbour management plans) or it could be triggered by a specific development. Ideally, stakeholder groups would comprise mana whenua, local and central government, conservation groups, and recreational users to capture the broad range of values held by individuals. Compensation packages could then be designed to target the identified priorities to maximise the benefit of those actions.

Although there are a wide range of possible compensation approaches, some inherently have the potential to result in higher ecological outcomes than others. This can be thought of as a hierarchy of compensation approaches. The actual value of a compensation outcome is likely to be site-specific, however, approaches with the highest potential ecological outcomes are 'on the ground' actions, and could include, for example, habitat restoration, or enhancement. Compensation approaches with lesser outcomes could include catchment planting, pest management, or a financial contribution to a fund for environmental research and restoration. Drawing from the principles of offsetting, approaches should be as like-for-like as possible. Solutions should work with and enhance the environment wherever possible, not fight against it.

In general, the further away from the impact site a compensation approach is implemented, the more the overall value of that approach is diminished. For example, high value habitat restoration implemented in a different estuary than the development that it is compensating for may have a much lower overall value than if it were conducted in the same estuary. On the other hand, it may not be possible to conduct that type of restoration in the same estuary as the development. There is a complex balance between implementing high value compensation approaches with lower value approaches closer to the development site. Stakeholder values are likely to play a strong role in deciding which approaches are the most appropriate.

Financial contributions are on the lower end of the compensation hierarchy. This is due to the limited control of the funds to translate into tangible action; notably so if contributing to approaches that have not had demonstrable success. This does provide some opportunity for 'blue skies' thinking and trialling new approaches. However, there needs to be a limit on the quantum of the residual effect that can be addressed with this approach (e.g., no more than 10-20%). This is to reduce the risk of unacceptable outcomes and ensure that there is still some tangible benefit resulting from the compensation efforts by means of 'on the ground' approaches.

The EIANZ (2018) Guidelines acknowledge that full biodiversity offsets may not be achievable for many projects using one approach and that a 'package' of offsetting and compensation approaches may be required to achieve the desired outcomes. This can be visualised along an environmental compensation continuum (Fig 2).

Figure 2: The environmental compensation continuum

3.6 Monitoring and reporting

All offsetting and compensation approaches should have measurable biodiversity outcomes and/or metrics. These should be clearly identified in a monitoring plan, including the outcomes/metric of success, how these will be measured, and an appropriate timeframe over which the success of the offsetting approach should be realised. Offsetting and compensation approaches may also require ongoing maintenance or management to ensure the estimated ecological value is realised. These should be clearly defined and include appropriate frequencies and timeframes. It may also be beneficial to include considerations of effects on the offsetting or compensation approach that are beyond the control of the project. For example, a marine heatwave may occur, or a major weather event may discharge a significant amount of sediment to the project area. Not achieving biodiversity outcomes and/or metrics due to such events may be unfair and unrealistic.

If an offsetting or compensation approach does not meet the outcomes or metrics of success (i.e., it is unsuccessful within the designated timeframes) it is expected that an alternative or 'back up' form of compensation is applied. These alternatives would ideally be identified at the project outset and form part of a robust adaptive management plan.

The limited number of demonstrable examples of offsetting in the marine environment may justify assigning some benefit to the knowledge gained when implementing such an approach. For example, learning whether a particular approach works or not will improve knowledge in this area with the expectation of improving future offsetting approaches. In this case, the outcomes from monitoring are highly recommended to be made publicly available to improve our knowledge in this space and ideally enhance the efficacy of future applications. The compensation value assigned to learning from the approach

should, however, have limits since ultimately, if an offsetting approach is unsuccessful, it has not offset the adverse effects it was anticipated to redress.

The complexity of the marine environment and the current lack of tried and tested offsetting approaches result in a high degree of uncertainty. Adaptive management is interwoven with monitoring and is likely to be a useful tool to navigate this space and is discussed in the following section.

3.6.1 Adaptive Management

The Biodiversity Offsetting Guidelines (Maseyk et al. 2018) define adaptive management as "*a systematic, iterative process of decision-making that aims to reduce uncertainties and increase knowledge by learning from outcomes resulting from management actions. It requires monitoring of outcomes against clearly stated objectives and the application of acquired knowledge to future management actions*." The principles and complexities of adaptive management in the context of the RMA have been well discussed by Giles and Barton (2020).

Adaptive management is often misunderstood or poorly applied when implemented with a 'we will figure out how to deal with that when the problem arises' mentality. True adaptive management requires firstly establishing objectives, robust monitoring, and potential management actions and then an iterative approach to monitoring, assessment, and decision making (Giles and Barton, 2020).

The application of adaptive management to offsetting in the marine environment requires a staged approach. It may be appropriate to stage various offsetting and/or compensation components based on the findings from robust monitoring. For example, an offsetting approach may be implemented in a restricted form initially but done so with robust monitoring and clear objectives and timeframes in which the benefits should be realised. If the monitoring demonstrates success of the approach, it could be expanded. Alternatively, if the monitoring indicates that the approach is unsuccessful, alternative approaches forming part of an offsetting/compensation package could then be enacted.

4. Quantifying Offsetting and Compensation Measures

Calculating the quantum of loss — be that biodiversity loss, ecosystem service loss, or some other measure — and in turn being able to determine the quantity of offsetting or compensation that should be undertaken, is a multi-faceted challenge. This process should be transparent and able to be understood and reviewed by others. In many cases, quantifying residual adverse effects, and the offset or compensation measures to manage them, has relied on expert judgement, which can be challenged due to a lack of transparency and a reliance on ad-hoc approaches such as a 'multiplier' (e.g., the loss of 5 m^2 of seagrass is offset by the creation of 10 m^2 nearby).

There are limited tools available at present to assist with quantifying offsets and compensation. The two main tools used in New Zealand, albeit not widely in the marine domain, are the Biodiversity Offset Accounting Model (BOAM) developed by Maseyk et al. (2015) and the Biodiversity Compensation Model (BCM) developed by Baber et al. (2021), both of which are presented in Table 5. As with any tool, there are strengths and weaknesses depending on the habitats and species being affected, the amount of information available, and the way the information is used to quantify losses and gains. At the time of preparing this guidance, their use in the marine domain has been limited and, at times, received criticism of their use and/or application.

The BCM is a tool to support decision making by showing the assumptions made to undertake an assessment and show the expected positive ecological outcomes. An advantage of this tool is that it can be run with limited information. This can, however, cause issues with transparency in how conclusions are reached due to aggregating biodiversity components, which has the potential to result in 'concealed trades' of these components (Maseyk et al., 2016); that is, an outcome could be reached that appears as a net positive but with the offsetting/compensation solution missing one or more biodiversity elements from the original system. The approach was also challenged in a recent environment court hearing (Te Kuha mine decision, 2023) where the mathematical formulae within the tool were considered to lead to ecological evaluations that under-represent existing ecological value (concealed trades) and over-estimate the relative value of the particular interventions. Further, the same hearing decision also requested that like-for-unlike components be removed from the BCM and discussed separately using expert judgement; that is, elements of compensation could not be accounted for using the BCM in this case.

The BOAM is not commonly used in the marine environment, likely due to its relatively high requirement for detailed information of the biodiversity elements being affected and offset. The model also only accounts for like-for-like (i.e., only offsetting, not compensation). This alone may limit its use in the marine environment considering that compensation is likely the only viable means of redressing residual adverse effects for many coastal developments.

Based on the above information, there are three potential pathways to achieve a widely used and agreed upon approach for quantifying marine offsetting and compensation elements:

1. Revise the BCM to improve its transparency and address criticism regarding the valuation of existing and proposed biodiversity elements. There is potential for this tool to be used in the marine space due to the lower information requirement and its ability to account for offsetting and compensation approaches.

2. Revise or develop a new tool based on the BOAM that can account for both offsetting and compensation approaches. Further guidance on the use of this tool in marine environments would also be required.

3. Develop a new tool that balances the amount of information required with limiting the amount of aggregation occurring. Ideally, it should be able to account for both offsetting and compensation measures.

Offsetting and compensation quantification tools are essential to avoid sole reliance on expert judgement. Currently, there is a gap in this space for a widely used and agreed upon tool suitable for use in the marine domain – notably one that can accommodate both offsetting and compensation (i.e., like-for-like and like-for-unlike). This stems from multiple factors including a lack of detailed knowledge of marine ecological values and ecosystem functions and the limited viable options to offset and compensate relative to terrestrial and freshwater systems. There is a clear need to either revise existing tools or develop a new tool for use in the marine domain to fill this gap.

Table 5: Offsetting and compensation tools to determine the quantum of positive effects required

Approach	Description	Applicability to marine context	Limitations
Qualitative Biodiversity Models (QBM) For example, Biodiversity Compensation Model (BCM)	Qualitative Biodiversity Models (QBM) can be used as a decision support tool to provide guidance on the type and amount of offset or compensation required to achieve overall ecological benefits or *expected* net gains (Baber et al. 2021). QBM are based on the expected impacts on extent and quality of habitat likely to be impacted (using available data and expert assessment), the likely extent and quality of habitat likely to result from the effects management measures (such as habitat enhancement or restoration), and an assessment of the likely ecological benefits associated with these measures. The approach can be used to provide guidance on addressing residual adverse effects. It can support decision making and is a tool to show assumptions made as part of the assessment and expected positive ecological outcomes. The aim of the model is to address residual adverse effects in line with the biodiversity compensation principles of the NPS-FM and NPS-IB.	Not commonly used in the marine context, but its use is increasing and has the potential to become more common with further development and guidance.	Only provides an indication of expected ecological benefits. Recommended to convert to a BOAM (described below) once data is available to verify that offsets have been achieved (or not). There is disagreement about whether this tool is appropriate for calculating the quantum of compensation (not like-for-like).
Biodiversity Offset Accounting Model (BOAM)	The BOAM is an accounting system in which the losses and gains are compared and balanced. The model can be used to demonstrate no net loss or a net gain using a disaggregated area x condition currency incorporating 'net present biodiversity value'. The accounting framework helps to determine the size and location of the offset site and the type and amount of activities that can best deliver biodiversity gains, while also achieving broader outcomes such as stakeholder equity and landscape-scale benefits.	Not commonly used in the marine context due to the high level of detail required. However, projects could plan to collect necessary information if this approach was required.	Relies on the availability of explicit quantitative information on species and biodiversity. This can be difficult to achieve for complex habitats, rare or cryptic species, highly mobile fauna, or not clearly defined ecosystems functions such as ecological connectivity. Lack of data or understanding may be an issue for marine habitats.

5. Examples of Marine Offsetting and Compensation

This section presents a range of examples where approaches to offsetting and/or compensation have been incorporated into project design (Table 6). Examples are largely drawn from current or recently approved resource consents that involve a specified project or development in the coastal marine environment, are stipulated in the resource consent conditions, and discussed within the application or hearing decision documents. These are not necessarily examples of best practice, rather they are examples of existing practice that readers may refer to and build upon. As these are relatively recent projects, there is little or no monitoring data available and the success or effectiveness remains to be evaluated.

Additionally, there are a range of restoration and enhancement projects being progressed in NZ and globally that, if successful, could fill critical information gaps and be incorporated into offsetting and compensation packages. These include:

- Seagrass Restoration
- Mussel restoration and enhancement
- Macrocystis restoration

Table 6: Examples of offsetting and compensation in the marine environment

Project	Project description	Effects on habitat(s)	Offsetting/compensation	Monitoring/targets
Te Ara Tupua – Nga ūranga ki Pito-one Shared Pathway 2022-2026 Te Ara Tupua Ngā Ūranga ki Pito-One: Ecology Management Plan (nzta.govt.nz)	Project to develop a walking and cycling link and improve transport resilience between Wellington and Lower Hutt.	The project involves 4.8 Ha of reclamation and permanent occupation of high value marine habitat along the northern edge of Wellington Harbour.	To partly compensate for the loss of marine habitat and biodiversity, intertidal tide pools and enhanced subtidal concrete units with artificial habitat to support marine species will be installed. Tide pools with a minimum surface area of 486 m^2 Subtidal eco-enhanced Xblocs with a minimum enhanced surface area of 3410 m^2 Intertidal eco-enhanced Xblocs with a minimum enhanced surface area of 60 m^2	Monitoring the success of proposed marine compensation will occur five times - A baseline survey prior to installation and post installation surveys 6 months, 12 months, 18 months, 24 months after the installation of the artificial marine habitats. Success will be determined by analysing whether the eco-enhanced Xblocs are resulting in increased biodiversity compared to reference sites.
Kaiwharawhara Ferry Terminal upgrade 2023 - Ongoing Kaiwharawhara Ferry Terminal Upgrade Application (epa.govt.nz) Kaiwharawhara Ferry Terminal Upgrade Decision (epa.govt.nz)	Project to redevelop and upgrade the Ferry Terminal at Kaiwharawhara, Wellington.	The project is anticipated to result in overall loss of marine habitat. Sparse individuals of the macroalgae *Macrocystis pyrifera* (At Risk – declining (Nelson et al., 2019)) will perish under construction of reclamation. The effect of noise disturbance on kororā could not be sufficiently mitigated.	Proposed offset measures include: Kaiwharawhara Estuary will be enhanced through coastal edge design and restoration planting, including estuarine saltmarsh planting on its true right bank; A natural gravel beach will be created on the southern edge of Kaiwharawhara Point; Living seawalls are proposed to be incorporated into the reclamation revetment; Pile sleeves will be fitted to 40% of piles to create “new productive habitat” for marine flora and fauna; and Intertidal rock pools will be created on 30% of the areas available along the reclamation revetment.	Confirm whether 400 m^2 of established saltmarsh planting has been achieved with continued monitoring every 12 months for 5 years. Success is determined if restoration planting has achieved approximately 400 m^2 of established salt marsh habitat after 5 years. Monitoring for beach stability is required quarterly for the first year, reduced to once every 6-12 months for five years following completion. Success is determined if the beach proves to be stable.

Project	Project description	Effects on habitat(s)	Offsetting/compensation	Monitoring/targets
			A compensation package to support research and restoration of *M. pyrifera* has been developed. A PhD research project has been proposed as compensation for noise disturbance on kororā.	Living seawalls, pile sleeves and intertidal rockpools should be monitored for a minimum of two years. To compensate for the noise disturbance on kororā, a specific research topic will be developed to be relevant to the required compensation. Timelines and milestones will be set through the relevant University's requirements of the PhD candidate.
Picton Ferry Terminal Upgrade Project 2020 – 2025 KiwiRail Holdings Limited, Port Marlborough New Zealand, and the Marlborough District Council (Applicants). Picton Ferry Terminal Upgrade Application (epa.govt.nz) Picton Ferry Terminal Upgrade Decision (epa.govt.nz)	Project to redevelop and upgrade the Ferry Terminal at Waitohi Picton.	Nesting habitat for kororā (little penguin) is impacted by the proposed ferry terminal redevelopment. The Applicants acknowledge the loss of nesting habitat but have assessed as unavoidable. The Applicants proposed to provide funding for the enhancement of local habitats in the event any pair of kororā are relocated.	The amount of funding was not stipulated in the Decision document, rather it was a condition suggested by the applicant and adopted as a consent condition, with contributions of certain sums of money to two local conservation organisations on discovery of kororā nesting within 200 m of the construction works.	

Project	Project description	Effects on habitat(s)	Offsetting/compensation	Monitoring/targets
Kennedy Point Marina 2021 – 2023 Kennedy Point Marina	Construction of a new marina on Waiheke Island.	A small section of rock revetment was deconstructed to allow for piling works during construction and then subsequently replaced. The section of revetment and wider breakwater was inhabited by kororā who use this area for nesting and breeding.	Consent conditions required artificial burrows or nest boxes for kororā to be incorporated into the reinstated rock seawall. Four additional nesting boxes were installed under the nearby boardwalk in addition to replacing the original habitat (compensation as not like-for-like).	A monitoring and management plan was developed to confirm the ongoing habitation of the breakwater by kororā. This included monthly monitoring during construction.
East-West Link 2016 – Ongoing EWL Application Summary Dec 2016 (nzta.govt.nz)	The East-West Link is a proposed strategic transport corridor that will connect the Western Ring Route (SH20) at Onehunga and the Southern Motorway (SH1).	Permanent habitat loss by occupation of CMA with coastal structures.	Planting of saltmarsh vegetation and coastal edge vegetation to replace areas lost by the project footprint. Restore and recreate new areas of saltmarsh habitat (more than what was originally there).	Pre, during and post construction monitoring required. No monitoring results published at the time of preparing this guidance.
Northport Development, Marsden Point (Northland Port). Proposed Northport Development Application (nrc.govt.nz)	Construction of a deepwater port at Marsden Point.	Construction of a dredge basin across 64ha of the seabed floor to a construction depth of -13m CD, and -15m CD in sections Impact will be to the seabed floor, dredging to a depth of -13m CD	Financial contribution of $25,000 per annum towards funding scientific studies; and Payment of $50,000 per annum for 10 years to Northland Regional Council to contribute towards 'improvements to the health of the Whangarei Harbour'. Embedded in two consent conditions, the focus is on the consent holder to provide financial contribution towards scientific research as well as finding activities listed as improving the health of Whangarei Harbour. Activities include: Re-seeding shellfish beds Study of New Zealand Dotterel nesting/roosting/feeding areas Addressing broader concerns of tangata whenua	Not yet defined

Project	Project description	Effects on habitat(s)	Offsetting/compensation	Monitoring/targets
Eastland Port Wharf 7 Redevelopment 2020 - ongoing Australian Coast & Ports Conference 2021: *Reclamation for Eastland Port: ecological mitigation-part science, reality, goodwill and community expectations*. M Poynter, B Skelton, D Ahern & A Jeffs	Redevelopment of Wharf 7 at Eastland Port.	Juvenile crayfish (pueruli) have historically been recorded to settle periodically in high numbers into a section of papa rock beneath a piled wharf in the port. This area was proposed to be reclaimed to support a replacement wharf.	Eastland Port engaged Auckland University and 4Sight Consulting to design, deploy and monitor pueruli settlement into artificial settlement habitats at the site over a period of two settlement seasons. It was intended that post wharf reconstruction, the devices would be attached to the quay wall at and adjacent to the new wharf. The habitats were designed to provide specific requirements of pueruli and to provide a settlement density equivalent to that offered by the natural habitat.	The pilot study showed crayfish used the artificial devices and should settle at appropriate densities. However final wharf design reverted to a piled structure rather than reclamation, potentially obviating the need for the proposed offset.
Project Kia Whakaū: Southport Channel and Harbour Deepening 2022 - ongoing Project Kia Whakau Decision (es.govt.nz)	The project is to dredge and remove seabed materials to 9.7m chart datum (CD) in the harbour entrance channel, 10.7m CD in the Island Harbour berth basins, and 9.45m CD in the swinging basin.	Bluff Harbour entrance channel (dredge activity), adjacent to Awarua Bay (including the unmodified large eel grass beds and maritime marsh adjoining the Waituna Wetlands Scientific Reserve and Tiwai Peninsula Conservation Land). Cited as ecologically important to marine mammals, birds, flounder, and other marine species.	Compensation payment of $50,000 to the Bluff Hill Motupōhue Environment Trust, to compensate for any potential residual adverse effects of the works on little penguins. The Decision noted there was no assessment provided by the applicant on how the quantum of the compensation was arrived at, and also commented that they acknowledge there is no agreed or consistently applied approach for determining the quantum of compensation.	The Decision noted the amount would benefit the Trust for establishing nesting boxes, predator control, weed control, and/or enhancement of penguin habitat.

6. Summary

Coastal developments are having adverse effects on coastal marine ecosystems, including reducing the number and/or quality of coastal species, habitats, and ecosystems and an overall loss of indigenous biodiversity.

There is very little policy direction on offsetting and compensation in the marine environment, which is likely a key reason why marine offsetting is not a widely established and agreed upon process in New Zealand. Offsetting and compensation need to be considered as an absolute last resort for projects that are essential, but otherwise unable to address adverse effects with mitigation.

Where offsetting or compensation packages are considered, the calculation of ecosystem values that are being affected and that are being proposed offsets or compensation should be done so robustly and transparently. At this point in time, the most widely used method for assessing ecological effects is following the EIANZ Ecological Impact Assessment Guidelines; however, it is noted that the current published version excludes marine ecosystems, and the informally adapted marine tables have not been reviewed. Determining the quantum of offsets or compensation is not widely conducted in New Zealand, but there is growing use of the Biodiversity Compensation Model, albeit with known limitations. Additional guidance on how this is best used for marine environments is likely to assist with increasing its use and is likely to result in a more standardised approach to calculating the quantum of offsetting and compensation required to address residual effects.

Examples of offsetting or compensation implemented in New Zealand are all relatively recent and there is very little evidence of the success of the approaches used. Accordingly, outcomes for offsetting and compensation approaches must be clearly articulated and robust measures put in place to monitor progress. There should be clear objectives about what a successful outcome will look like, and this should also include appropriate timeframes within which these benefits are realised. Adaptive management may be a key tool to manage the complexity and uncertainty of implementing untested methods in the marine environment and ensuring that an acceptable level of offsetting or compensation is achieved.

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