

A guidance framework for marine habitat restoration in Aotearoa New Zealand

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 Department of
Conservation
Te Papa Atawhai

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Acknowledgements

We gratefully acknowledge the support and contributions of Auckland Council, Waikato Regional Council, Ministry for Primary Industries – Fisheries New Zealand and Biosecurity New Zealand.

This document is supported by illustrations by Shaun Lee (Stet) and design elements by Revell Design.

Recommended citation: Richer de Forges M, Kettles H, Alder A. 2026. A guidance framework for marine habitat restoration in Aotearoa New Zealand. Wellington: Department of Conservation | Te Papa Atawhai. Published in collaboration with Cawthron Institute.

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Executive summary

Marine and coastal ecosystems across Aotearoa New Zealand support biodiversity, cultural connections, recreation and economic activity. Key habitats such as saltmarsh, seagrass meadows, shellfish reefs, kelp forests and soft sediment communities have experienced decline in extent, condition and function. Land-based pressures such as sedimentation, nutrient run-off and contaminants, overharvesting, fishing impacts and climate-related pressures are acting cumulatively to prevent or slow recovery and accelerate ecological decline. In many areas, the ecological processes that once supported natural recovery have been disrupted, meaning ecosystems may be slower to recover or fail to recover altogether, even where some pressures have been reduced.

Active marine habitat restoration, the deliberate intervention to assist the recovery of degraded ecosystems, is at times necessary to complement passive restoration and pressure reduction. This guidance framework has been developed to support consistent, evidence-informed and transparent decision-making across active marine and coastal restoration projects in Aotearoa New Zealand. It is intended for anyone involved in planning, delivering, supporting or evaluating marine restoration, including tangata whenua, community groups, practitioners, researchers and agencies across a wide range of experience levels.

The framework is organised around a structured decision pathway covering three phases: getting started, making it happen, and project monitoring. Throughout all phases, the framework emphasises that restoration is a long-term, adaptive process requiring realistic expectations, sustained effort and meaningful engagement with tangata whenua and stakeholders. Reducing and managing pressures to sustainable levels should take precedence, as natural recovery processes are often more effective and enduring. Active restoration is most effective when considered within a broader restoration strategy and where underlying pressures have been identified and managed where possible. Monitoring plays a central role throughout, from understanding system condition and informing early decisions, to evaluating project performance and supporting adaptive management over time.

This guidance reflects the current state of active marine restoration knowledge and practice in Aotearoa New Zealand. It will continue to evolve as new evidence emerges from ongoing projects and research.

Practitioner guide

This guide summarises the decision pathway shown in Figure 5 and should be read alongside the flowcharts. Each phase is explained in detail in the sections that follow, including practical considerations, examples and decision points relevant to restoration in Aotearoa New Zealand.

Project phase	Key question	What to do	Why this matters	
Getting started (Section 2)	Engage early	Who needs to be involved?	Engage with tangata whenua, stakeholders and relevant agencies as early as possible	Builds a shared understanding, reduces risks and supports regulatory and social acceptance
	Understand the system	What has changed and why?	Identify the habitat or species of concern, the pressures acting on it, and the wider ecological and regional context	Clarifies whether restoration is needed and what problem you are trying to solve
	Gather existing and/or collect new information: system and pressure monitoring	What is happening in the system and why?	Use existing data or new data, observations and targeted system monitoring to understand current environmental condition, key pressures and any evidence of natural recovery. Focus on monitoring that helps diagnose causes of change rather than measuring restoration success	Informs whether pressure reduction alone may achieve objectives, identifies constraints on recovery, and supports early decisions about whether active restoration is required
	Reduce pressures first (passive restoration)	Can recovery occur without active intervention?	Assess whether existing pressures (e.g. pollution, sedimentation, fishing) can be reduced or managed	Determines whether passive restoration alone may achieve objectives
	Define objectives	What does success look like?	Set clear, realistic restoration objectives using the restoration continuum and informed by reference systems and site conditions	Ensures restoration goals are achievable and measurable
	Identify approaches and tools	Is active restoration required, and if so, how?	Set appropriate passive and / or active restoration approaches and associated tools based on site conditions, target species or habitat, and objectives	Confirms whether active restoration is appropriate and what tools may be suitable

Project phase		Key question	What to do	What this tells you
Making it happen (Section 3)	Test tools through a proof-of-concept	Will this work in practice?	Design a proof-of-concept to test assumptions, methods and risks at a small scale	Reduces uncertainty before committing to larger-scale action
	Plan for project performance monitoring	How will progress be measured?	Identify indicators linked to objectives and design monitoring before implementation begins	Enables evidence-based decisions to adapt, scale up or stop
	Implement carefully	Are you ready to proceed?	Implement the proof-of-concept only once approvals, resources, risk controls and roles are confirmed	Ensures compliance, safety and ecological integrity
Project monitoring (Section 4)	Evaluate performance	Are you achieving your objectives?	Monitor ecological, cultural, social and economic indicators against restoration objectives. Assess whether the project is performing as expected	Provides the evidence base to determine whether to continue, refine, adapt or stop the project
	Learn and adapt	What have you learned?	Document outcomes, challenges and unintended effects. Use results to refine or redesign the approach, tools and methods	Supports adaptive management and future scaling up of decisions
	Consider scaling up	Is scaling up appropriate?	Assess whether the approach is viable, proportionate and complementary at larger scales	Determines whether to expand, integrate within other management / restoration efforts or conclude the project

1. Context and scope

1.1 Context

This guidance framework focuses on how marine habitat restoration can be approached in practice. The guidance framework aims to:

- Present a practical decision-making framework to guide active marine restoration projects
- Support more consistent restoration practice by clarifying pathways and considerations, including opportunities to reduce regulatory barriers where appropriate

It supports efforts to strengthen marine restoration practice by providing consistent, evidence-based decision-making for active restoration, alongside existing protection, management and other pressure-reduction initiatives. The guidance is intended to complement related strategies, programmes and statutory processes. It also supports coordinated action across agencies, tangata whenua, communities and other stakeholders involved in restoration and wider management of the marine environment.

1.2 Who is this document for?

This guidance is intended for:

- Anyone involved in planning, delivering, supporting or evaluating marine restoration projects. This includes practitioners, community groups, tangata whenua, agencies, researchers and project partners involved in restoration activities, or those participating in decision-making, funding or governance related to restoration
- Both technical and non-technical audiences; it supports a wide range of experience levels, from early-stage project development through to established restoration initiatives

1.3 What will this document deliver?

This document provides a structured, evidence-based framework to support decision-making for active marine restoration in areas across Aotearoa New Zealand.

The document helps anyone considering or developing a restoration project understand when, where and how active restoration may be appropriate. This includes how active interventions should be planned, implemented and evaluated alongside passive restoration and broader management actions.



How this document supports restoration

- Provides a decision-making framework to identify appropriate restoration pathways, including passive restoration, active restoration or a combination of both
- Emphasises the importance of pressure reduction and suitable environmental condition as foundational requirements for successful restoration outcomes
- Outlines a stepwise, evidence-led framework for planning, implementing, monitoring and evaluating active restoration projects, from proof-of-concept through to scaling up
- Highlights the role of monitoring and evidence in assessing effectiveness, managing risk and informing adaptive decision-making over time
- Supports consistent, transparent and defensible decision-making across projects and regions, while allowing flexibility to respond to ecological, cultural and operational contexts
- Encourages alignment between restoration actions and wider management tools for passive restoration, including spatial management, fisheries management and land-based pressure reduction



This document does not

- Provide a comprehensive list of restoration tools, methods or site-specific advice for different species or habitats, as these should be based on local conditions, objectives and expert input
- Provide a comprehensive list of pressures currently impacting the marine environment
- Prescribe a mandated approach for community engagement, project governance, monitoring and reporting
- Supersede mātauranga Māori, local knowledge or existing statutory and policy obligations; rather, it is intended to complement and support their application

1.4 How to use this document



This guidance is structured around a decision pathway, illustrated through flowcharts and a practitioner guide, which together provide a framework for restoration decision-making. **It is not designed to be read from start to finish.** Practitioners are encouraged to engage with the sections most relevant to their project at any given stage.

While the framework is presented as a sequence of phases, restoration projects often progress iteratively, with learning and adaptation influencing decisions at each stage. Throughout the document, engagement is treated as an ongoing process.

Where to start:

I am...	Go to...
New to marine restoration and want to understand the framework first	Section 1 – Context and scope
Familiar with restoration concepts and ready to start planning	Section 2 – Getting started
Assessing whether restoration is appropriate for a specific site	Section 2.3 – Know your system
Looking for guidance on which restoration approach or tools to use	Section 2.4 – Identify approaches and tools
Trying to understand what permits or legislation applies	Section 2.1 – Important considerations
Ready to plan and implement a proof-of concept project	Section 3 – Making it happen
Designing or reviewing monitoring for a project	Section 4 – Project monitoring

1.5 Why does the marine environment need restoration?

Marine ecosystems support biodiversity, cultural connections, recreation and economic activity. However, key habitats – including saltmarsh, seagrass meadows, shellfish reefs, kelp forests and soft sediments – have experienced significant declines in extent, condition or function. In many areas, the ecological processes that once supported natural recovery have been disrupted, meaning ecosystems may be slower to recover or fail to recover altogether, even when some pressures have been reduced.

Historical and ongoing pressures have resulted in widespread habitat degradation, loss of ecosystem function, and reduced resilience across many parts of Aotearoa New Zealand, with a growing body of evidence showing that many coastal and marine habitats have been degraded, spatially reduced or lost altogether^c.

The primary causes of degradation include land-based pressures (such as sedimentation, and pollution from nutrients and contaminants), overharvesting, fishing impacts, and climate-related pressures (such as marine heatwaves and acidification). Climate-related pressures are of particular concern as they can both drive habitat loss and constrain what restoration can realistically achieve. For species at or near their thermal tolerance limits, such as giant kelp in the South Island, restoration should be designed

with climate projections in mind rather than solely against historical baselines. These pressures often act cumulatively, suppressing recovery and accelerating ecological decline. Examples include:

- Large increases in the rate of sediment run-off associated with changes in land use, including forest clearance, urban development and the conversion of wetlands for agriculture
- Reclamation and modification of coastal habitats that has reduced the extent and connectivity of key ecosystems
- Overharvesting of shellfish and finfish species, and the loss of predator populations that maintain ecological balance
- Marine heatwaves driving loss of habitat-forming species, including giant kelp forests

Habitat restoration is therefore required to:

- Rebuild or support ecological processes that enable recovery
- Accelerate recovery where natural processes are unlikely to deliver on their own or where recovery is too slow to prevent further environmental decline
- Improve ecosystem resilience to ongoing and future pressures

Importantly, restoration does not imply returning ecosystems to a single historical state. Instead, restoration efforts are focused on re-establishing native recovery processes, improving ecosystem functions and achieving realistic, context-specific outcomes informed by reference systems and current environmental conditions.

This guidance supports decision-making about which restoration approach is most appropriate in a given context. Decisions about whether recovery can occur through passive restoration measures alone (pressure reduction and protection), or whether active restoration is required to support or accelerate recovery, are informed by monitoring evidence and site-specific conditions.

1.6 Expectations for active restoration projects

Actively restoring degraded ecosystems is a complex and long-term process, and expectations for active restoration projects should be realistic and evidence-informed. Outcomes are rarely immediate and often require sustained effort over extended time frames.

Active restoration is most effective when considered within a broader, long-term restoration strategy and in contexts where underlying pressures have been identified and managed where possible. Reducing and managing human pressures to sustainable levels should take precedence, as natural recovery processes are often more effective and enduring.

In some situations, active restoration activities may be required to:

- Complement passive restoration by accelerating or enabling recovery where natural processes are constrained or unlikely to deliver meaningful recovery outcomes under current conditions

- Re-establish ecosystem functions or species that are unlikely to return without intervention due to altered environmental conditions or the loss of source populations

Monitoring and reporting play a critical role in managing uncertainty by evaluating progress, identifying risk and informing decisions to refine, adapt or scale up restoration over time.

1.7 Concepts that underpin restoration decision-making

This section outlines the core concepts that shape how restoration decisions are made throughout this guidance. These concepts are not steps to follow, but a shared foundation that informs how problems are defined, how objectives are set, and how decisions are interpreted along the decision pathway described in Section 2.

The restorative continuum

The restorative continuum provides a way to position restoration objectives before choosing actions, by clarifying what outcomes are being sought.

Within this guidance, ecological restoration refers to actions to assist the recovery of marine and coastal ecosystems that have been degraded, damaged or destroyed. This includes:

- Re-establishing lost or diminished habitat-forming species (i.e. habitat-forming or biogenic species like seagrass meadows, kelp forests and shellfish reefs)
- Supporting the recovery of ecosystem functions (e.g. water filtration, biodiversity enhancement) and associated ecosystem services

Restoration projects often involve a continuum of activities, where multiple interrelated actions work together to assist natural recovery processes (Figure 1).

How the restorative continuum is used

The restorative continuum recognises that restoration is not a single intervention or endpoint. Instead, it represents a spectrum of approaches that may be applied sequentially or in parallel, depending on the context. These categories are not discrete project stages but overlapping approaches that support recovery at different levels of intervention.

Project objectives should be positioned on the restoration continuum to:

- Clarify the primary aims of a restoration initiative
- Identify the most appropriate combination of passive and / or active interventions to support recovery at a given site

- This includes identifying actions to address ongoing environmental pressures (e.g. reducing pressures, improving management) alongside targeted restorative activities (e.g. urchin barren management, shellfish translocations, pāua reseeded) to support recovery of native ecosystems

Projects may pursue an *ecological restoration* objective while applying multiple restoration activities across the continuum. For example, actions focused on *reduced impacts* or *remediation* may be required to enable, protect or sustain *rehabilitation* or *ecological restoration* outcomes.

The categories of the restorative continuum

The continuum includes four major categories:

- **Reduced impacts:** actions that can include reducing overfishing and land-based pressures, such as elevated sediment and nutrient loads, or controlling marine pests through active management and eradication.
Example: removal of introduced pest seaweeds (e.g. *Caulerpa taxifolia*, *Undaria pinnatifida*) to support native species recovery.
- **Remediation:** actions that involve removing persistent pollutants and restoring processes, such as natural water flow and sediment transport from rivers and estuaries.
- **Rehabilitation:** actions that reinstate key ecosystem functions where substantial native ecosystem recovery may not be possible in the short to medium term. This can include repairing functions such as water filtration, sediment stabilisation or nutrient cycling to support improved ecosystem condition and services, even where full species or habitat recovery is constrained.
Example: planting saltmarsh vegetation or intertidal seagrass in degraded estuaries.
- **Ecological restoration:** actions that actively support native ecosystem recovery, including spatial protection, reintroducing native species or enhancing existing populations.
Examples: translocations of green-lipped mussels from aquaculture farms to re-establish lost beds or removing urchins from barrens to emulate natural predation to allow for kelp forest recovery, or reseeded pāua populations in areas where they have been depleted.

Applying the restorative continuum in practice

Projects are not expected to progress through all the categories of the continuum. Restoration planning should instead focus on the most realistic category for the overarching outcome sought, given the context of the system, pressures and recovery potential.

In practice, this means that:

- A full return to historical condition (i.e. **full recovery**) is often unrealistic due to ecosystem complexity and ongoing pressures
- Restoration may instead focus on **initiating native recovery** processes that support **partial or full recovery** over time
- Many coastal and marine restoration projects, such as saltmarsh / seagrass planting, shellfish translocations and kina management, are best understood as interventions that stimulate recovery processes within native systems. These actions are not endpoints in themselves

Within this continuum, restoration decisions are typically implemented through passive, active, or combined approaches. In practice, many restoration outcomes occur within the *reduced impact*, *remediation*, or *rehabilitation* parts of the continuum. These outcomes may focus on stopping ongoing degradation, repairing key ecosystem functions, or enabling natural recovery.



Using the restoration continuum at scale

For large projects operating across *ki uta ki tai* or broader spatial scales, it is often appropriate to apply multiple categories of the restoration continuum. Project planning should explicitly identify which categories are being applied, where, and in what sequence.

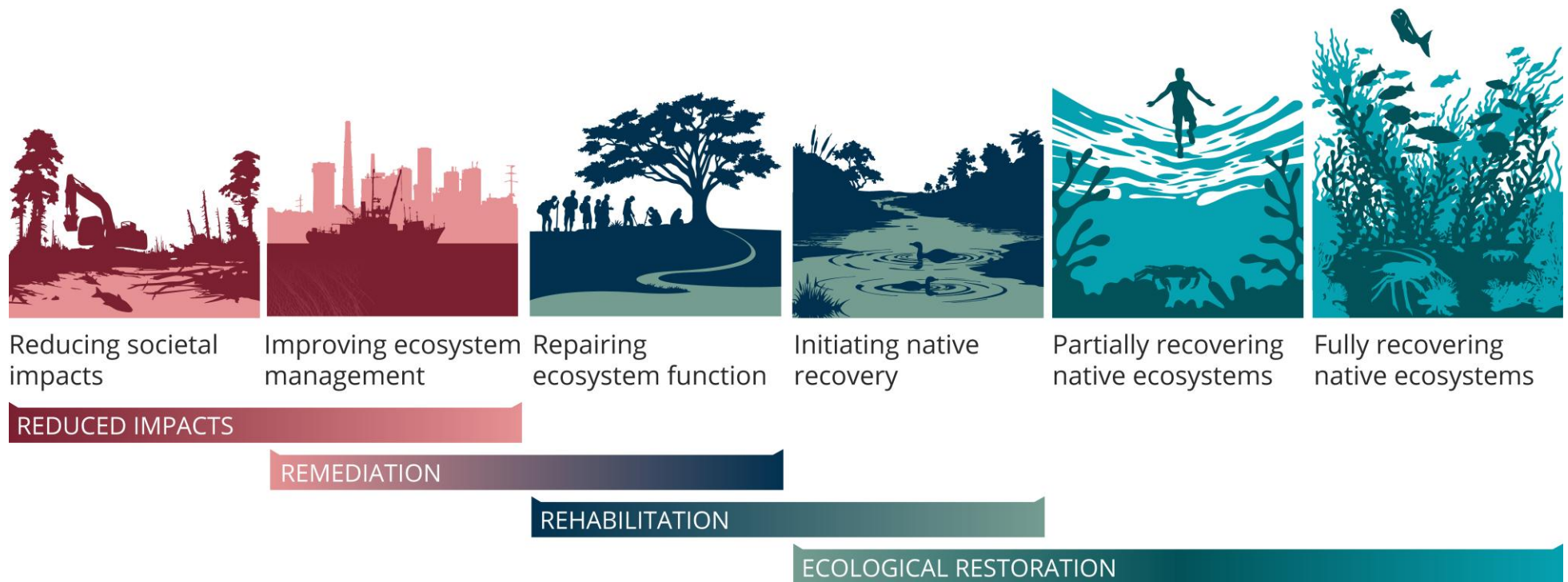


Figure 1. **The restoration continuum for the marine environment** – a framework that can help position the long-term goals of a project. Restoration usually progresses left to right on the continuum to enable ecological health and biodiversity outcomes and enhance the quality and quantity of ecosystem services. These phases can move the system towards full recovery. Source: adapted from figure 5 in ^e.

Passive and active restoration

Passive and active restoration define how the restoration objective could be delivered.

The distinction between passive and active restoration underpins the structure of the restoration decision pathway used in this guidance.

In this guidance:

- **Approach** refers to the overall restoration strategy (passive, active or a combination of both)
- **Tools** refer to the categories of intervention used to implement that approach (e.g. urchin management, shellfish translocation, protection measures)
- **Methods** describe how a tool is applied at a specific site, including technique, scale, timing and frequency

Restoration approaches may be passive, active or a combination of both, depending on the extent of degradation, ecosystem context and restoration objectives. These approaches may be applied sequentially or in parallel as part of a restorative continuum.

Passive restoration

Passive restoration focuses on removing or mitigating pressures that are preventing natural recovery. It represents the foundation for recovery and is typically prioritised before, or alongside, any active intervention.

In Aotearoa New Zealand, passive restoration is implemented through a range of management and protection tools that aim to address underlying drivers of ecosystem degradation, including:

- **Marine protected areas (MPAs):** for subtidal ecosystems, MPAs restrict most forms of extraction, allowing protected systems to recover along natural trajectories. Habitats and species in MPAs can also serve as reference systems for other forms of restoration.
- **Fisheries management:** fisheries management, including customary tools, can help restore trophic interactions by maintaining predator biomass, size structure and reproductive capacity. These interactions support habitat-forming species. For example, setting realistic catch limits can ensure sufficient fish biomass for ecosystem processes and also support cultural, recreational and commercial take. Fisheries management can also include spatial and seasonal closures.
- **Catchment management:** managing catchment land use reduces land-based pressures on marine systems. This work is undertaken by councils, community groups and landowners. It often aims to reduce erosion, and sediment and nutrient inputs into the coastal and marine environment (alongside other objectives).
- **Reducing pollution and improving stormwater infrastructure:** as a component of catchment management, stormwater systems can be a key conduit for contaminants such as rubbish, sewage, plastics, pesticides and heavy metals entering the marine environment. Upgrading infrastructure can reduce these inputs and improve environmental conditions for recovery.

Where pressures have been sufficiently reduced, passive restoration may enable ecosystems to recover without additional actions.

Active restoration

Active restoration refers to deliberate actions intended to initiate or accelerate natural recovery processes and improve the ecological health of habitats and their associated species. Within the restoration continuum, active restoration is applied where pressure reduction alone is unlikely to achieve restoration objectives, or where recovery processes need to be supported or re-started.

In marine systems, active restoration can be grouped into three broad categories:

- Reintroduction of a specific ecological function
- Reintroduction of a species currently missing from a system
- Enhancement of substrate to encourage natural recruitment of habitat-forming species

Active restoration tools do not address the underlying drivers of ecosystem degradation. Their effectiveness therefore depends on key pressures having already been reduced or are being effectively managed through passive restoration measures.

The selection of the active restoration tool is an important early step in project planning. This clarifies restoration objectives, supports communication with tangata whenua and stakeholders, and focuses background research and feasibility assessments. The review of previous restoration initiatives can provide practical insights to inform project design, including lessons from projects undertaken in different marine systems or involving different species.









When not to use active restoration

Active restoration methods should not be used where they risk further degradation, such as introducing marine pests or damaging physical habitats.

Each active restoration tool has specific considerations, risks and implementation requirements. Table 1 provides a high-level overview of some active restoration tools based on previous or ongoing projects in Aotearoa New Zealand and internationally.

Table 1. Active restoration type of intervention and associated tools.

Type of intervention	Tools	Description
	Reintroduction of a missing function back into a system	Some pressures can be addressed by reintroducing a function into a system. For example, in regions where kina predators have been overfished, artificially reducing kina populations – mimicking natural predation – can promote the recovery of kelp forests. However, managing an unbalanced kina population does <i>not</i> address the underlying pressure from a reduced predator numbers (e.g. snapper, rock lobster) or other pressures such as sedimentation or heatwaves.
	Stimulating natural recruitment	Wild spat or juveniles can be attracted to restoration areas as grow-out sites. This option may involve creating a settlement habitat to encourage spat and juvenile survival and can be used to help increase the adult population.
	Farmed stock or natural stock	Spat, juveniles, or adults can be translocated from marine farms or hatcheries, where they are grown under controlled conditions, to an area where these species have been reduced or lost. Spat, juveniles or adults can be translocated from a healthy site within the same region. Plant material, such as seagrass seeds or seedlings and saltmarsh plants, can be similarly grown under controlled conditions or collected from healthy donor sites and transplanted to restoration areas.
	Selectively bred stock	Species of interest may be bred to select specific traits to enhance the chances of success at restoration sites. For example, stock with stronger shells or better resistance to heatwaves, or low water quality may fare better under difficult or changing conditions.  <i>Note: this approach can also introduce unwanted genetic material into wild populations, so it should be considered very carefully.</i>
	Deployment of artificial substrate	Artificial substrates can add complex, 3D structures to the seafloor, which can be used to create habitat and / or a settlement environment for other habitat-forming species. These can be made from an assortment of materials, with the most common being eco-friendly concrete. Internationally emerging applications include living seawalls, artificial tide pools and habitat-enhanced structures designed to increase biodiversity on coastal infrastructure, as well as concrete 3D printing technology create reef structures in areas where naturally occurring hard structures have been lost to bottom-impact activities and / or increased sedimentation.  <i>Note: there are several international best practice guides that can help determine whether artificial substrates are the best option.</i>

Type of intervention	Tools	Description
	Deployment of natural substrate	<p>The deployment of natural materials to the seafloor is used to recover or mimic lost habitat. Shell material, including mussel and oyster shell hash, and limestone are well-established substrates for shellfish reef restoration worldwide. In areas where natural hard reef has been lost or degraded, rocky material such as cobbles and boulders can be used as replacement. Biodegradable structures made from natural materials are an emerging option internationally, designed to provide temporary habitat.</p> <p> <i>Note: artificial and natural substrates serve different restoration purposes and are not always interchangeable. The choice of substrate should reflect the ecological context, restoration objectives and site conditions. Artificial structures are a relatively new restoration tool that might require more testing, but both substrate types carry ecological and biosecurity risks that require careful assessment before deployment.</i></p>

Coastal and marine restoration

Coastal and marine restoration both aim to restore habitats connected to the ocean environment, but they differ in focus and location. Distinguishing between the two is important for project planning, communication with stakeholders and understanding applicable regulatory requirements.

Coastal restoration focuses on the interface between land and sea, including environments such as beaches, estuaries, saltmarsh and mangroves. Coastal and terrestrial restoration projects often overlap and are typically accessed from shore. These projects may not require specialised marine equipment or high-risk activities such as scuba diving. While this guidance mainly focuses on marine restoration, a range of resources are available for coastal restoration (see Appendix 1 and 2 and also the Coastal Restoration Trust of New Zealand^d).

Marine restoration focuses on ocean and seafloor habitats that are often subtidal and may be located farther from shore. Marine projects typically involve greater technical, logistical and safety considerations, including specialised vessels, diving operations and trained personnel. In many cases, limited ecological knowledge of marine species and their interactions adds further uncertainty. These factors often make active marine restoration more complex and costly than coastal restoration or passive restoration approaches such as marine protection. Such challenges should be identified early and addressed through feasibility and risk planning (see Section 3.1).

Coastal and marine restoration projects should be planned and implemented together, as success in one area can facilitate progress in the other.

Ki uta ki tai

Ki uta ki tai – used when defining the system, identifying the pressures and restoration objectives (see Section 2.3), identifying restoration approaches and tools (see Section 2.4) to ensure land-sea connections are considered, and when designing monitoring that reflect catchment-to-coast processes (see Section 4).

Toitū te marae a Tāne, toitū te marae a Tangaroa, toitū te tangata.

If the land is well and the sea is well, the people will thrive.

Ki uta ki tai is often translated as ‘from the mountains to the sea’. It is an approach grounded in mātauranga Māori that recognises the interconnectedness of land, freshwater, and marine systems, and the relationship between environmental health and human well-being. Central to this approach is the role of wai (water) in linking these environments (a perspective also reflected in ecosystem-based management approaches) across the catchment-to-coast continuum, from upland environments through rivers and estuaries to the marine environment. It supports an integrated understanding of how pressures originating on land can influence marine habitats and recovery processes.

In the context of restoration, ki uta ki tai:

- Highlights the influence of catchment-derived pressures on marine habitats
- Supports integrated consideration of pressures acting across land and sea
- Reinforces the importance of addressing wider system drivers when selecting and sequencing restoration approaches

Applying a ki uta ki tai approach can influence site selection, restoration sequencing, and monitoring design by recognising where upstream pressure reduction is likely to be critical to achieving restoration outcomes (Figure 2).

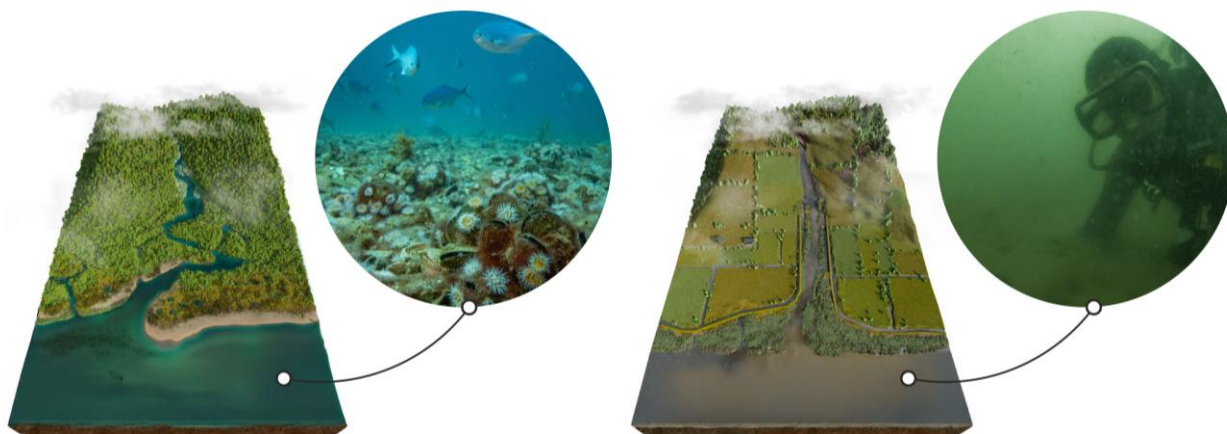


Figure 2. The health of marine coastal ecosystems is intrinsically linked to the health of the river catchments and our terrestrial activities. In this example, deforestation leads to increased sedimentation loads in catchments and coastal marine environments.

Ecosystem functions and services

In this guidance ecosystem functions and ecosystem services are used as practical lenses for defining restoration objectives, selecting monitoring indicators, and communicating outcomes. Depending on the context, ecosystem functions and services may be used as primary restoration objectives, as mechanisms that support recovery, or as metrics used to evaluate progress over time.

The assessment of ecosystem functions and services associated with a restored species or habitat of interest can be used to:

- Identify restoration objectives (see Section 2.3)
- Support communication and engagement with tangata whenua and stakeholders (see Section 2.2)
- Inform evaluation of restoration success across space and time, including the selection of indicators (see Section 4)

Ecosystem functions are the natural processes that occur within ecosystems through interactions between organisms and their physical environment. Examples include primary production, nutrient cycling, habitat formation and water filtration.

Ecosystem services arise when these functions contribute directly to human well-being, such as through food provision, water quality improvement, coastal protection, cultural values and recreational opportunities (Figure 3).

In restoration planning, the distinction between functions and services helps clarify different aspects of decision-making:

- Projects focused on restoring habitat-forming species (e.g. seagrass, mussels or kelp) often prioritise the recovery of key *ecosystem functions*, such as habitat complexity. Monitoring can then assess changes in biodiversity, species composition or habitat structure to determine whether these functions are being re-established.
- Projects framed around *ecosystem services* may focus on outcomes in terms of benefits to people, such as improved water clarity, increased availability of kaimoana or enhanced cultural and recreational values. These outcomes depend on the recovery of underlying ecosystem functions.

Ecosystem services can be broadly organised into four categories:



Supporting: services fundamental to maintaining ecosystem functions; including sediment stabilisation, habitat complexity and nitrogen removal.



Regulating: services that help moderate environmental conditions; including water quality regulation, disease control and coastal protection.



Provisioning: services represented by tangible goods obtained from ecosystem; including food, biomaterials and medicinal resources.



Cultural: non-material services support spiritual well-being, cultural identity, knowledge systems; they include natural aesthetics and support aspects of community engagement, recreation and tourism, and spiritual, religious and / or traditional practices.

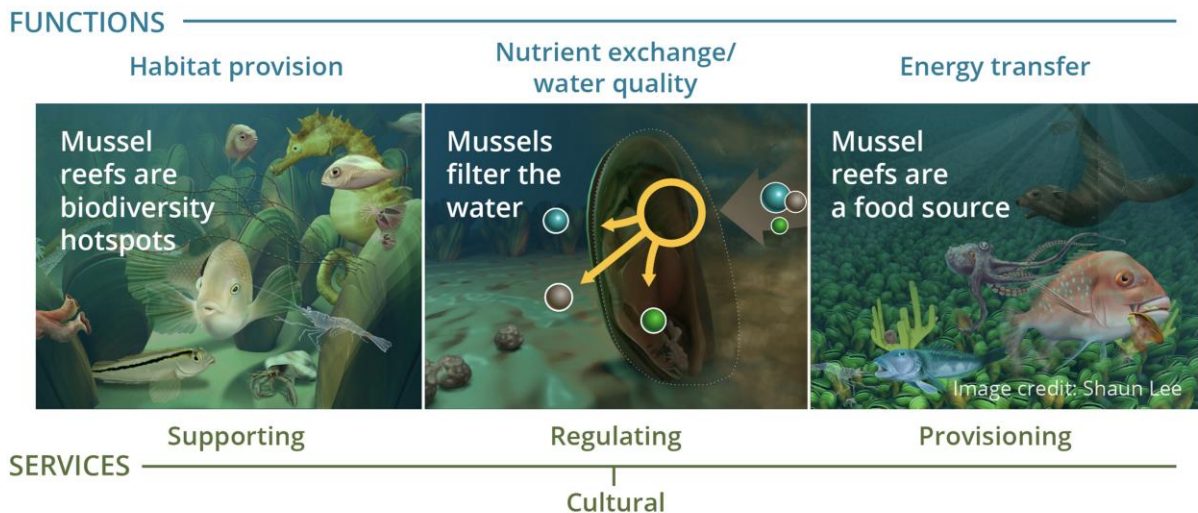


Figure 3. Shellfish beds (in this case green-lipped mussel beds) as an illustrative example of the relationship between ecosystem functions and ecosystem services. Ecosystem services are the benefits that humans derive from these ecosystem functions.

1.8 Uncertainty and knowledge limitations in restoration

Uncertainty and knowledge limitations are used to inform decisions at all stages of the decision pathway.

Because restoration involves intervening in complex and dynamic marine and coastal ecosystems, decision-making occurs in the context of uncertainty and incomplete knowledge. Ecological responses to restoration actions can vary widely across habitats, species, locations and timeframes, meaning outcomes are often difficult to predict with confidence at the start of a project.

Knowledge limitations may arise from a range of factors, including limited baseline data, gaps in understanding ecological processes, variability in environmental conditions, and differences in scale between restoration actions and the processes influencing the recovery.

Recognising these gaps is important because they:

- Influence whether restoration objectives can be achieved through pressure reduction alone
- Affect the choice, scale, and sequencing of active restoration approaches
- Shape the level of risks associated with the intervention

Uncertainty does not imply inaction, but it does require careful consideration of risk, feasibility and confidence when selecting restoration approaches. Where uncertainty is high, restoration approaches should be designed to test assumptions and generate evidence, rather than to deliver immediate outcomes. This reinforces the importance of staged implementation, proof-of-concept projects, and monitoring that can detect both intended and unintended effects.

In practice, recognising uncertainty means that early restoration decisions should prioritise learning, limit irreversible impacts and avoid large-scale intervention until key assumptions have been tested. This directly informs how monitoring is designed and used, as outlined in Section 1.9. Monitoring plays a key role in reducing uncertainty over time and informing decisions on whether approaches should be refined, scaled or stopped.

1.9 The role of monitoring in restoration



In this guidance, monitoring serves distinct purposes at different stages of a restoration project and should be designed to reflect the specific decisions being informed at each stage.

Getting started and early decision-making

Monitoring is used to:

- Understand baseline system conditions
- Identify key pressures
- Assess whether natural recovery is occurring under existing or improved management settings

- Inform whether pressure reduction alone is likely to achieve recovery within a desired time frame

This information supports early decisions about whether pressure reduction (passive restoration) is sufficient, or whether active restoration should be considered.

Active restoration project performance monitoring

Once active restoration is initiated, monitoring shifts to evaluating project performance:

- Assess whether restoration actions are achieving their intended objectives
- Detect unintended effects or emerging risks
- Inform decisions to refine or adapt methods, scale activities, or rescope the project

This information focuses on project performance and is aligned with clearly defined objectives and reference systems.

Regulatory and compliance monitoring

In parallel, monitoring may also be required to:

- Meet consent conditions and approvals requirements
- Demonstrate compliance with regulatory obligations
- Manage risks to the restoration site and surrounding environment

While regulatory and compliance monitoring may overlap with project performance monitoring, it serves a distinct purpose and should be designed to meet specific statutory and risk management requirements.

1.10 Applying restoration in Aotearoa New Zealand



This section provides a synthesis of current understanding, experience and priorities for habitat restoration in the marine and coastal environment in Aotearoa New Zealand. It highlights some common patterns, pressures, ecosystem services and functions associated with priority habitats that can be referred to when working through the decision pathway in Section 2.

The establishment of MPAs, fisheries management measures and other passive restoration tools over recent decades has marked a shift towards reducing damaging activities and protecting existing habitats. These approaches recognise the importance of pressure reduction as a foundation for natural recovery.

Over the last 20–30 years, active marine habitat restoration has gained momentum through initiatives led by tangata whenua, community groups and non-governmental organisations aimed at accelerating recovery processes where pressure reduction alone has been insufficient. Despite this growing activity, the coastal and marine environment remains a complex system facing ongoing pressures, and continued intervention and adaptive management is required to support long-term recovery.

The loss of biodiversity across marine and coastal environment affects both ecosystem functioning and the benefits people derive from the marine environment. Marine ecosystems are estimated to contribute approximately two-thirds of the total annual value of ecosystem services across all environments in Aotearoa New Zealandⁱ, underscoring the importance of conserving and restoring marine habitats that support both ecological recovery and human well-being. To support this, tools and approaches for mapping coastal and marine ecosystem services have been developed in Aotearoa New Zealand providing insights into where ecosystem services are generated and where restoration may improve overall ecological health. These tools can be referred to when considering restoration priorities at regional and local scales. Further information on ecosystem services in the marine environment is available in national assessment reports and academic literature^{c,i,j}.

Restoration priorities

Marine and coastal restoration in Aotearoa New Zealand is guided by three interconnected ecological priorities that together support improvements in water quality, biodiversity and the recovery of other ecosystem services and function, and the restoration of habitats of cultural significance (Figure 4).

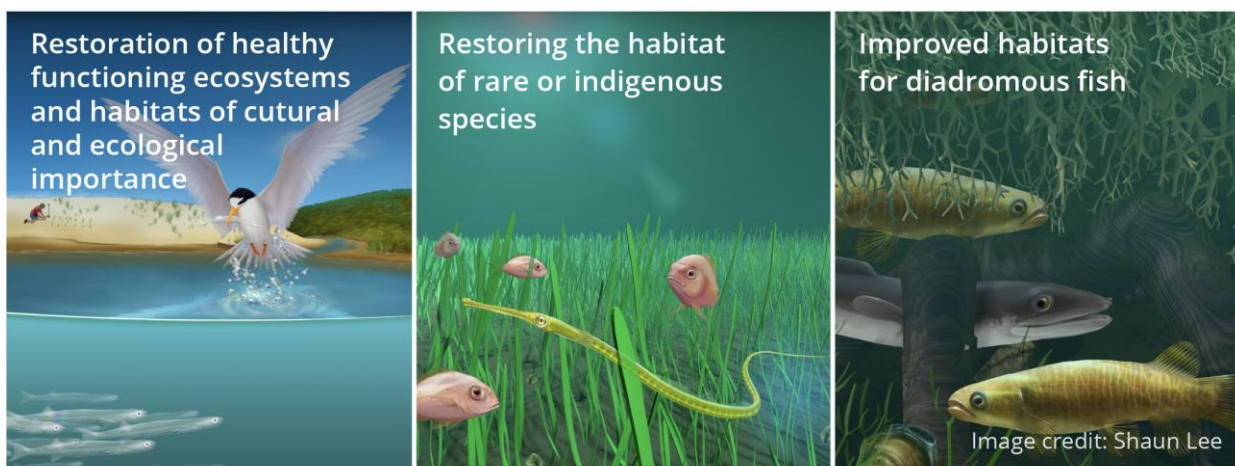


Figure 4. The three marine and coastal restoration priorities.

Restoration of indigenous, biogenic habitats contributes directly to all three priorities. Habitats such as shellfish beds, kelp forests and seagrass meadows can improve water quality through filtration and nutrient uptake, stabilise sediments and support associated species. Restoration of these habitats can also contribute to the recovery of their rare or indigenous species and generate wider benefits by enhancing functions and services in adjacent ecosystems, such as soft sediment environments.

These outcomes are particularly relevant in degraded nearshore systems, including areas that support diadromous fish moving between freshwater and marine environments.

For many restoration priorities in areas closer to the shore, improving water quality and clarity is a key objective. Improved water quality supports natural recovery processes by increasing light penetration

and primary productivity (i.e. photosynthesis – the base of the food chain), which underpin ecosystem recovery. Achieving this outcome requires coordinated action (such as ki uta ki tai) to reduce land-based inputs such as sediment, nutrients, contaminants, and debris, which remain significant pressures on marine habitats and a constraint on their restoration success.

Restoration context and opportunities in Aotearoa New Zealand

This information provides context to support the identification of restoration opportunities relevant to each project. It highlights nationally recurring habitat types, common pressures and restoration approaches that can be referred to when working through the decision pathway in Section 2. It is not intended to be exhaustive as restoration opportunities and priorities will vary by region, and project leads should engage early with relevant agencies, tangata whenua and communities to identify locally specific context, priorities and constraints.

Active marine and coastal habitat restoration is occurring across Aotearoa New Zealand, led by tangata whenua, community groups, researchers and agencies. While the scale and focus of restoration varies by region, common patterns of habitat loss, including the decline of shellfish beds, seagrass meadows, seaweed forests and saltmarsh, are documented across many parts of the country, and efforts to address these losses are growing.

Identifying regional restoration opportunities

Regional councils, the Department of Conservation (DOC) and Ministry for Primary Industries (MPI), and researchers hold information on the distribution and condition of the marine and coastal habitats across their regions. State of the environment reporting, regional coastal plans and existing habitat mapping programmes are useful starting points for understanding what has been lost, what pressures are acting on a system, and where restoration may be feasible. Geospatial tools such as the DOC Marine Data Portal and the Our Estuaries Hub can support identification of habitat distributions and restoration priorities at regional and local scales.

Where ecosystem service mapping is available, it can provide additional context for identifying where restoration may deliver the greatest ecological and community benefit. Tools and approaches for mapping coastal and marine ecosystem services have been developed in Aotearoa New Zealand and can be referred to when considering restoration priorities at regional and local scales⁵.

Migratory fish passage

Migratory fish passage restoration reflects the strong connectivity between freshwater, estuarine and marine systems. It provides context that may be referred to when identifying problems, pressures and restoration objectives in Section 2.

Many of Aotearoa New Zealand's indigenous freshwater fish, including īnanga and tuna / eels, are diadromous, meaning they migrate between freshwater and marine environments to complete their life cycles. These migrations link land, freshwater, estuarine and marine systems, illustrating the importance of connectivity (ki uta ki tai approach) when addressing restoration challenges.

Barriers within catchments – such as dams, culverts, bridges, tide gates, flood gates, weirs and fords – can obstruct or delay fish movements. Where access to critical habitats is restricted, fish may be unable to complete key life stages, leading to population declines or local loss of species. These impacts can have cascading effects across freshwater, estuarine and marine ecosystems.

Restoring fish passage requires ensuring that instream structures allow for safe and effective movement of fish throughout their migration routes. In addition to improving passage within freshwater systems, the restoration of healthy estuarine habitats – such as saltmarsh and seagrass meadows – can support migratory species by providing feeding areas, shelter and transition zones between freshwater and marine environments.

Further practical guidance and tools to support fish passage management and restoration are available through DOC, including:

- New Zealand Fish Passage Guidelines, Version 2.0,^k which outline best practice approaches for designing, modifying and managing instream structures to support fish migration
- Fish Passage Assessment Tool, which can be used to record instream structures and assess their likely impact on fish movements
- Guidance on erosion and sedimentation mitigation, which may also support nearshore marine restoration outcomes

Priority marine and coastal habitats

In addition to addressing freshwater fish passage restoration, several marine and coastal habitat types have experienced significant and widespread loss across Aotearoa New Zealand and should be prioritised for restoration (Table 2). These habitats are described briefly below, with examples of restoration activity occurring across different regions. This information provides national context that can be referred to during Section 2, alongside site-specific values and tangata whenua aspirations.

Table 2. Indicative overview of marine and coastal habitats for restoration in Aotearoa New Zealand, summarising primary pressures and restoration approaches. Detailed habitat information is provided in Appendix 1. Context-specific assessment is always required.

Habitat	Primary pressures	Passive restoration	Active restoration	National examples
<p>Note: Spatial protection through MPAs and fisheries management, and catchment management are broadly applicable passive restoration tools across most habitat types and are not repeated in each row below. The passive restoration column identifies habitat-specific pressure-management approaches</p>				
COASTAL HABITATS				
Saltmarsh	Land reclamation, drainage, grazing; invasive species; sedimentation	livestock exclusion, drainage management, invasive plant control	Planting of native rush and marsh species, tidal flow restoration	Bay of Plenty, Tasman, Wellington

Habitat	Primary pressures	Passive restoration	Active restoration	National examples
Seagrass meadows – intertidal	Sedimentation, reduced water clarity, nutrient run-off	Sediment reduction, stormwater management, water quality improvement	Intertidal meadows – seed-based restoration or seedling transplanting	Whangārei Harbour, Nelson Haven, Waimea Inlet
Seagrass meadows – subtidal	Physical disturbance from anchoring and bottom-contact activities in subtidal meadows	Anchoring and mooring management, seafloor protection from physical disturbance	Limited transplantation trials	No dedicated subtidal seagrass active restoration trials in Aotearoa New Zealand
ROCKY REEF HABITATS				
Kelp forests (<i>Ecklonia radiata</i>)	Loss of kina predators, leading to urchin barrens; sedimentation preventing recolonisation; marine heatwaves as an emerging pressures on northern populations	MPAs, fisheries management to rebuild predator populations, land-based sediment management	Urchin barren management; reintroduction of urchin predators; kelp transplantation and reseeding	Wellington, Otago, Hauraki Gulf / Tikapa Moana
Kelp forests (giant kelp, <i>Macrocystis pyrifera</i>)	Marine heatwaves and ocean warming (primary), sedimentation and reduced water clarity; colonisation by invasive seaweed <i>Undaria pinnatifida</i> following habitat loss	Land-based sediment management, water quality improvement; management of <i>Undaria</i> colonisation	Reseeding of laboratory-cultivated juveniles, green gravel technique; <i>Undaria</i> removal	Wellington, Otago, Marlborough, Banks Peninsula, Southland
BIOGENIC HABITATS				
Green-lipped mussel reefs	Overharvesting, sedimentation, seafloor disturbance	MPAs, fishing restrictions and spatial closures, land-based sediment management	Translocation of farmed stock, shell hash substrate deployment	Hauraki Gulf / Tikapa Moana, Tasman Bay / Te Tai-o-Aorere, Marlborough Sounds
Live grounds – sponge gardens, horse mussel beds, bryozoan thickets, rhodolith beds	Seafloor disturbance, sedimentation	MPAs, closure to bottom-impact fishing gear; anchoring and mooring management, land-based sediment management	None currently known in the marine space – passive restoration is the primary approach	No dedicated live ground active restoration trials in Aotearoa New Zealand

Habitat	Primary pressures	Passive restoration	Active restoration	National examples
SOFT SEDIMENT COMMUNITIES				
Soft sediment communities	Seafloor disturbance, sedimentation, contaminants, nutrient loading	Reduction of seafloor disturbance, land-based sediment and contaminant management	Limited-passive restoration generally preferred, natural recovery where pressures are reduced	Hauraki Gulf / Tikapa Moana (scallop)
Infaunal shellfish beds – pipi, cockle, scallop	Overharvesting, sedimentation, seafloor disturbance, contaminants	Beach and harvesting closures, land-based sediment and contaminants	Limited – some trials with substrate enhancement for scallop spats	
CONNECTIVITY				
Migratory fish passage	Instream barriers; loss of estuarine transition habitat	Catchment restoration, estuarine habitat protection	Barrier removal or modification, saltmarsh and seagrass restoration in transition zones	Nationally distributed – DOC fish passage guidelines available

Appendix 1 provides a complementary overview of the priority habitats, summarising their ecological role, key ecosystem services, primary pressures, preferred restoration approaches and considerations that may influence feasibility and restoration project design. Together, these examples support informed, context-specific decisions in later stages of the guidance.

1.11 Guidance framework and decision pathway

The concepts outlined in Sections 1.7-1.10 provide the conceptual foundation for the decision pathway, which is visualised in Figure 5.

This flow chart provides a high-level overview of the key phases and decision points that underpin the guidance, from understanding the system and pressures through to implementation, monitoring and potential project scaling. Detailed guidance on how to apply the framework is provided in the following sections.

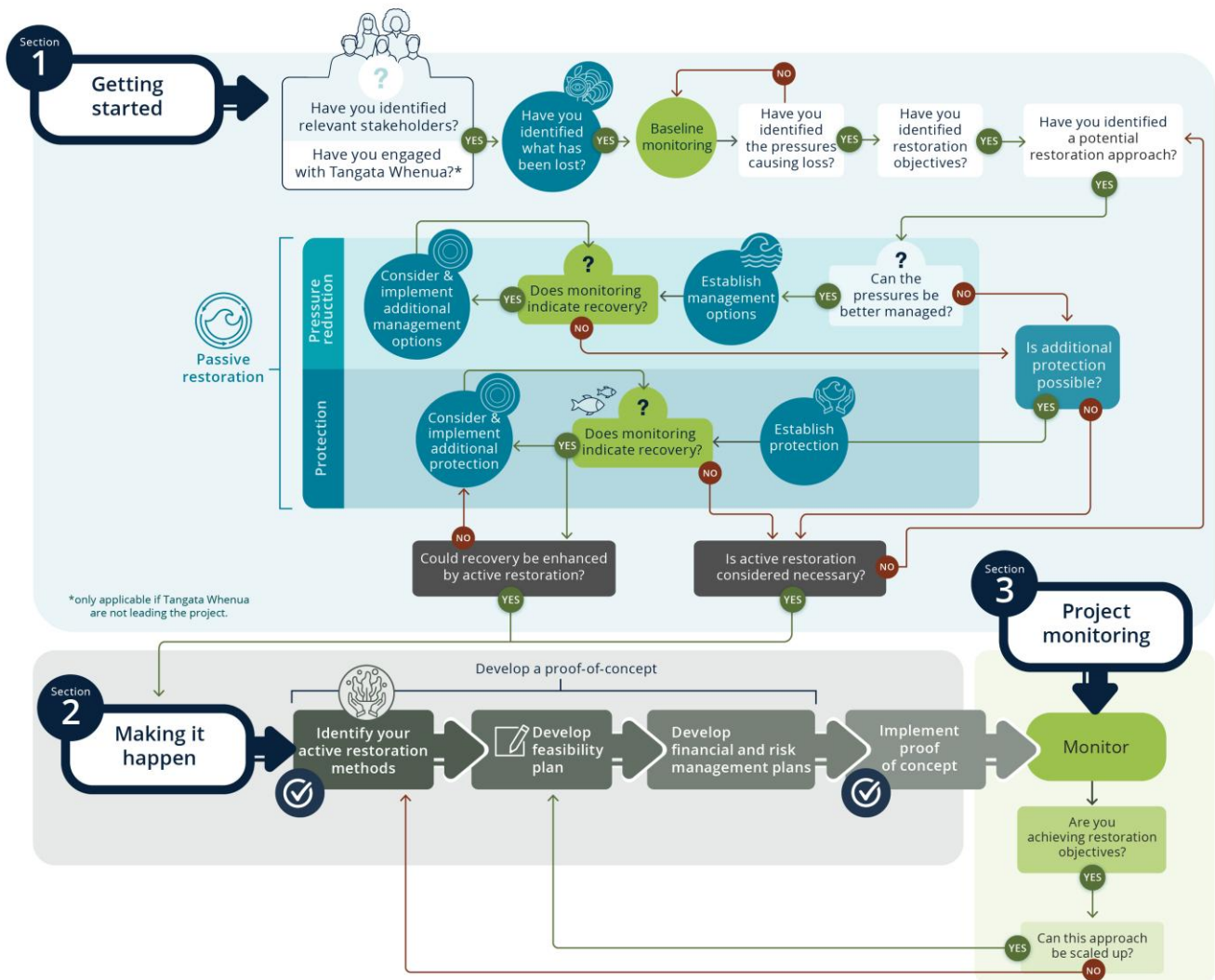


Figure 5. **Decision pathway for planning, implementing and evaluating active marine restoration projects.** This figure presents the overarching decision pathway used throughout this guidance, illustrating how pressure reduction, protection, monitoring and active restoration interact. It highlights the key decision points used to determine whether active restoration is necessary, appropriate and ready to proceed, and shows how projects progress from planning through implementation to monitoring and evaluation. Subsequent figures expand on the specific components of this pathway

2. Getting started



Section 2 is the starting point for applying this framework to a specific place or project.

This section outlines the key steps for initiating an active marine restoration project. It supports early decision-making by helping project participants understand the system, clarify the problem to be addressed and determine whether active restoration should be considered.

Before selecting active restoration tools, pressures on the system must be identified and addressed where necessary as part of passive restoration (see Section 1.7). Early decisions focus on understanding the system, clarifying the problem and the pressures contributing to it, and assessing whether passive restoration alone is likely to achieve the desired restoration outcomes.

The decision pathway provides an overview of how to initiate a restoration project; however, this process rarely progresses in a strictly linear sequence. Engagement, information gathering and monitoring often occur iteratively and continue throughout the project life cycle. The steps outlined in this section establish the foundation for project feasibility and long-term success.

Early engagement with tangata whenua and relevant stakeholders underpins all stages of this process. Monitoring during the early phase refers to system and pressure monitoring undertaken prior to active restoration.

Cultural values and indicators should be considered alongside ecological objectives from the outset, as they influence project design, engagement, monitoring and long-term evaluation. Where projects include cultural objectives, these should be carried through into monitoring design, including cultural monitoring developed with, and led or approved by, tangata whenua (see Section 4.3).

Early engagement with tangata whenua



It is important to engage with tangata whenua from the earliest stages of a restoration project and throughout the project's life cycle. Where tangata whenua are not initiating or leading the project and early engagement is not feasible, project leads should undertake preparatory work to understand the ecological, cultural and historical context of the area. This preparation supports informed and respectful kōrero when engagement occurs. While practical constraints may delay engagement during early information-gathering stages, projects should not proceed beyond initial scoping without engaging with tangata whenua.

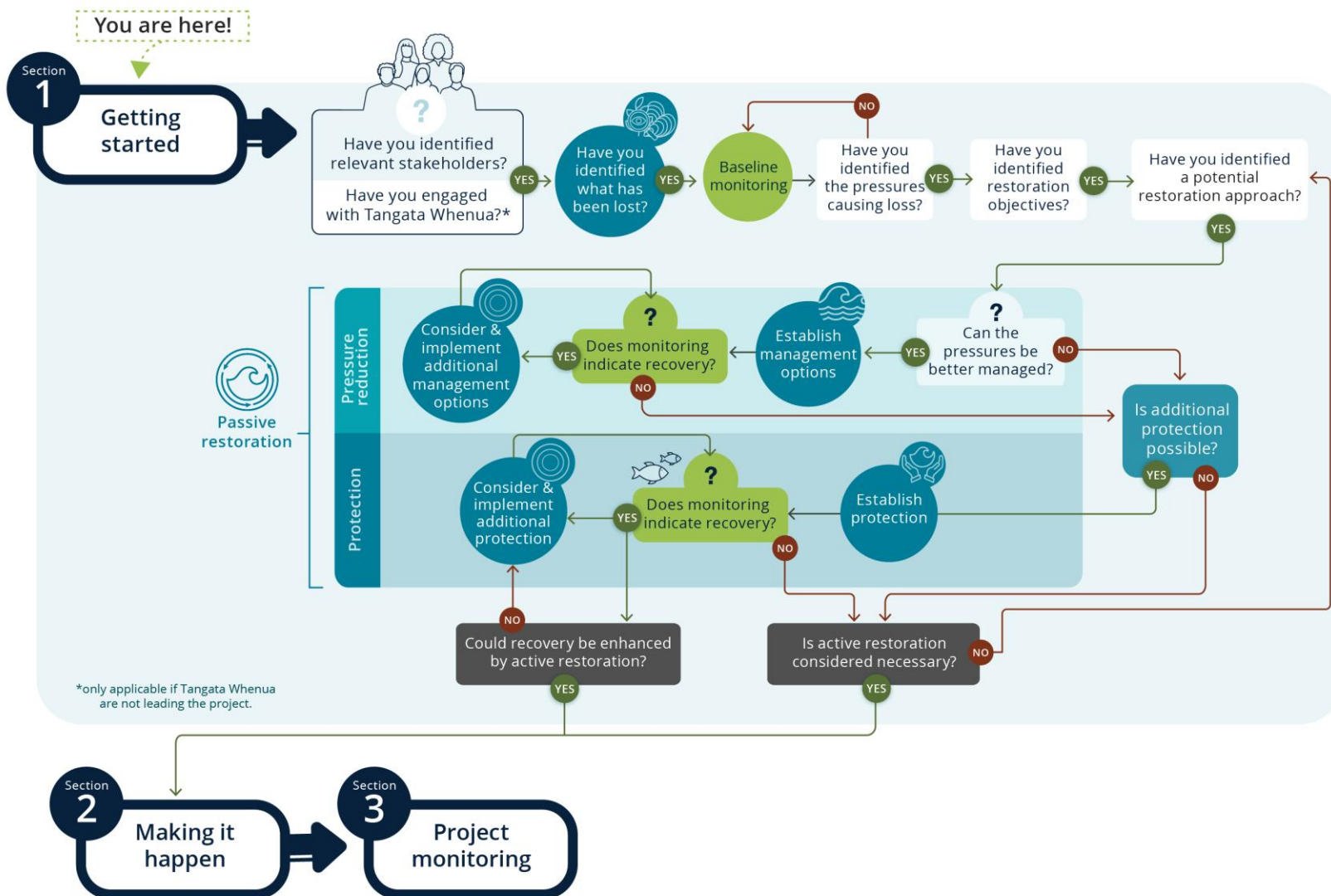


Figure 6. **Early planning steps within the restoration decision pathway.** This figure focuses on the 'getting started' phase of the decision pathway. It expands on the initial stages of the decision pathway that illustrates the sequence of early decision points – from identifying ecological loss and pressures through to determining whether complementary active restoration is required.

2.1 Key considerations for project planning

This section is designed to be used alongside the flow chart in Figure 6 and provides guidance on what to think about at key points in the pathway. Not all considerations will be equally relevant to every project and should be applied in a way that reflects project context, objectives, and constraints.

Each section highlights types of information, constraints and risks relevant as projects move through Section 2.3 (understanding your system), Section 2.4 (identifying restoration approaches), and Section 3.1 (developing a proof-of-concept).

Ecological context

Wider ecological context

Use this section when interpreting observed change at a site, including consideration of ecosystem functions, ecosystem state, and natural variability (see Section 2.3).

Ecological context provides the broader spatial and ecological understanding needed to interpret site-specific observations and frame the ecological problem at appropriate scales. It highlights broader ecological patterns that should be considered when interpreting site-specific observations.

This ecological context informs the understanding of:

- How ecosystems function at local and regional scales, including the role of habitat-forming species and their associated communities
- What natural recovery looks like, including expected variability, recovery processes, and the spatial and temporal scales over which recovery may occur under reduced pressures
- What ecological baselines are relevant, recognising that historical conditions, where available, may inform expectations of ecosystem structure and function
- How pressures interact across the wider environment, including cumulative effects from land-based inputs, climate driven pressures, overfishing and overharvesting pressures, and other human activities that may influence ecosystem condition and recovery
- Ecological connectivity between sites, including larval dispersal, movement of mobile species, and linkages between habitats
- The influence of catchment-scale processes and land-sea connections on local ecosystem condition
- Whether similar ecological changes are occurring elsewhere in the region, indicating broader drivers than localised effects
- How population structure and genetic connectivity may influence recovery potential

It also helps interpret observed change, including consideration of:

- A loss of ecosystem functions

- A shift in ecosystem state
- Natural variation within the system

It also helps determine whether observed change relates to local population loss, reduced recruitment, or broader system-level processes.

Ecological suitability for active restoration

Use this section after the ecological problem has been defined to assess whether active restoration is ecologically appropriate or whether pressure reduction alone is likely to achieve recovery (see Section 2.4).

Once an ecological problem has been identified, additional ecological considerations inform whether it is appropriate to explore active restoration, or whether recovery is more likely to occur through pressure reduction alone. This provides an ecological sense-check before progressing toward development of a proof-of-concept. They focus on whether intervention aligns with ecological context and is unlikely to cause unintended harm.

Key ecological factors include:

- The indigenous status of the species or habitat of interest, and alignment with the natural composition and function of the ecosystem
- The existing condition of the site, including the presence of high biodiversity or intact ecosystem functions where intervention may be unnecessary or risk disrupting healthy systems
- Ecological interactions and life-history characteristics (such as recruitment or species interactions) that suggest that active intervention is likely to contribute to recovery
- Potential effects of intervention on other species, including through altered competition, predation, or disease dynamics

This assessment determines whether active restoration is an ecologically appropriate pathway to explore and inform early thinking about potential tools and methods as feasibility planning begins.

Biosecurity

Use this section when assessing biosecurity risks to the restoration site and surrounding environment arising from the movement, sourcing or placement of organisms, materials or equipment (see Section 3.1)

Biosecurity is relevant at different points in the decision pathways. This section specifically addresses biosecurity as a risk arising from restoration activities. For biosecurity as an ecological pressure affecting the site, see Section 2.3.

Biosecurity risks arise because of intervention, particularly where restoration involves the movement, sourcing, or placement of organism, materials, or equipment. These risks form part of the feasibility and

risk management plans and should be assessed before proceeding with active restoration and revisited as projects scale up or change scope. Assess whether:

- Proposed restoration tools and methods could introduce or spread marine pests, diseases, or parasites
- Risks can be managed through project design, methods, or sequencing
- Risks can be reduced to an acceptable level as part of proof-of concept

When developing a proof-of concept, practitioners should:

- Seek expert biosecurity advice where needed and identify relevant permissions
- Review requirements under relevant legislation
- Manage processes to prevent the accidental introduction and spread of marine pests during activities such as harvesting, transporting, translocating and deploying organisms or materials (see Appendix 6, including Table A6.1 and A6.2 and the accompanying decision-making flow diagrams)
- Consider the risk of marine pests colonising introduced substrates (e.g. artificial reefs; Figure 7), potentially creating pathways for pest spread
- Identify biosecurity risk early in project planning, recognising that unmanaged marine pests can undermine restoration outcomes. Examples of species posing biosecurity risks are provided in Figure 8
- Consider potential genetic and ecological impacts associated with translocation or sourcing of organisms, including unintended consequences for existing communities

Some biosecurity risks may trigger permitting or approval requirements, which are addressed in the 'Permitting and consents' section.



Figure 7. Example of the colonisation of an artificial reef by a marine pest, the Mediterranean fanworm (*Sabella spallanzanii*).

The MPI website provides information on registers and lists for pests and diseases. The Marine Pests website contains information on wider marine pests and useful links that include regional marine biosecurity programmes¹.



Always verify the current status of pests

The distribution and status of a marine pest can change over time. Regularly check current registers and regional pest management plans before and during restoration activities.

¹ <https://www.marinepests.nz>

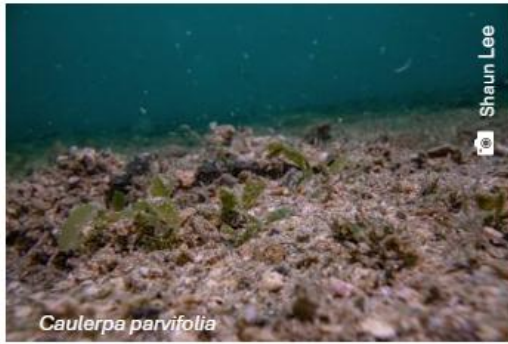


Figure 8. Examples of marine pests encountered in coastal marine environments in Aotearoa New Zealand.

Regional context



Use this section when considering how pressures affecting a site are currently managed and how site-based restoration fits within wider regional management settings (see Section 2.4)

Regional context focuses on how pressures affecting a site are addressed through existing regional initiatives, management measures, and coordinated programmes. It supports identification of restoration approaches that are appropriate in scale and scope and helps determine whether site-based action alone is sufficient or whether alignment with broader regional efforts is needed.

Key considerations include:

- Existing management measures, restoration initiatives or spatial protections operating in or nearby the area, including MPAs, fisheries closures or areas subject to customary management (e.g. Hauraki Gulf Marine Park – Revitalising the Gulf^a, or the network of marine reserves being established along the southeastern coast of the South Island). These may support or constrain a project, provide useful reference conditions, and influence site suitability and expected recovery trajectories
- The spatial scale at which pressure reduction or recovery processes are likely to be effective, and whether the proposed approach is appropriate at that scale
- The presence of areas consented for specific activities (e.g. marine farms) or subject to spatial management measures that may influence site selection and methods

Geospatial tools such as DOC Marine Data Portal and regional council mapping resources can support the integration of multiple information sources when exploring site suitability, scale and alignment with existing management. Figure 9 illustrates examples of management interactions that may be relevant to consider.

Regional context should be revisited as projects progress, particularly where restoration activities are scaled up, coordinated across multiple sites, or aligned with broader regional programme.



Responding to spatial and regulatory constraints

Where regulatory or spatial constraints prevent establishment of a restoration site, alternative locations should be reassessed against ecological suitability, and project feasibility and objectives.

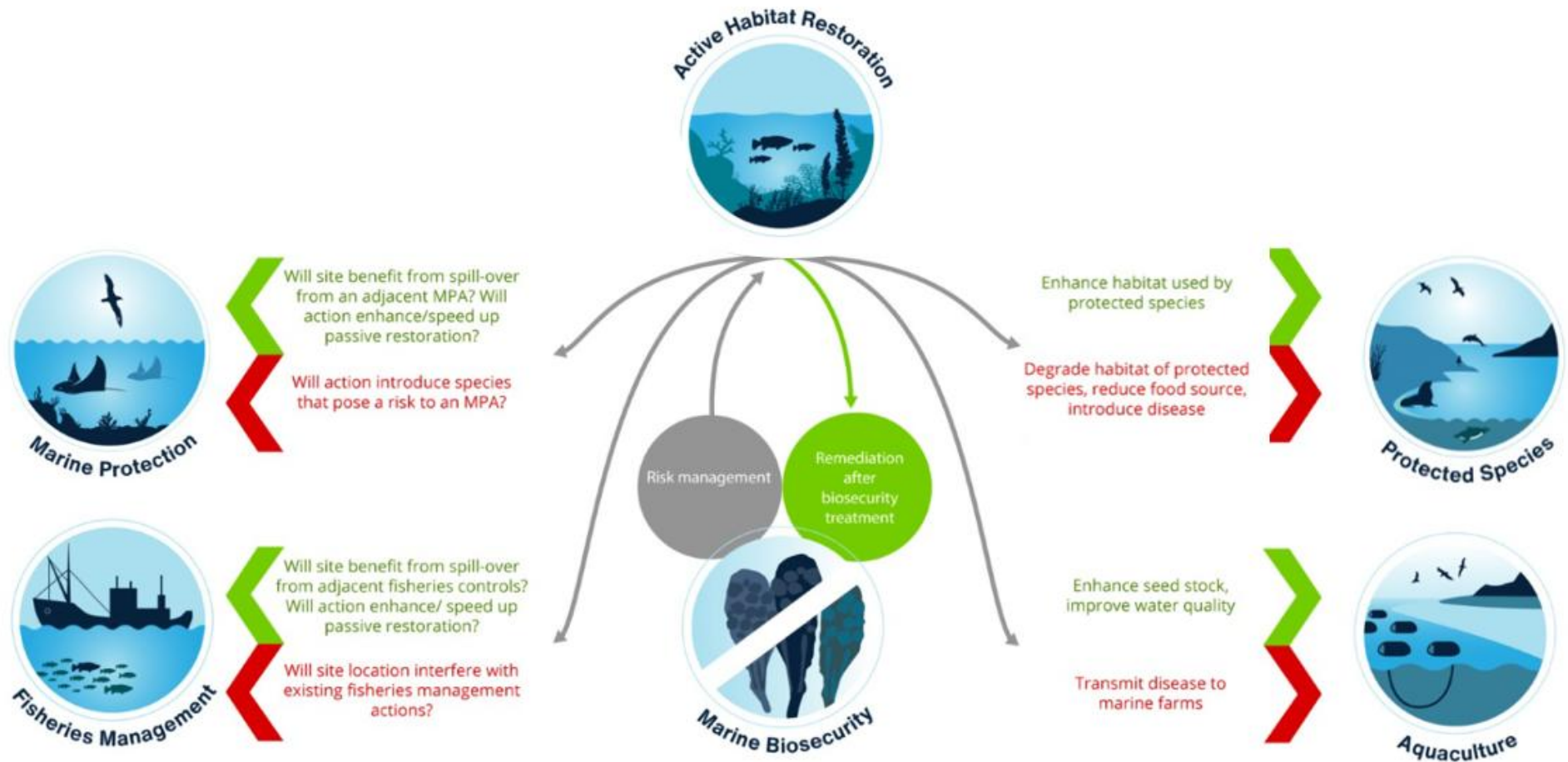


Figure 9. Examples of potential interactions (positive and negative) between an active restoration project and other actions in a region

National and regional statutory context



Use this section to support the identification of statutory settings that can affect restoration projects (see Section 3.1)

Statutory settings influence restoration in two ways:

- Through national and regional management settings that shape ecosystem condition and recovery potential
- Through legal and regulatory requirements that apply when undertaking restoration activities. Both are relevant to feasibility planning but do not determine whether restoration is required

Understanding statutory settings helps practitioners anticipate requirements that may influence feasibility, timing, scale, or approach, and supports early identification of constraints and opportunities as restoration tools and methods are developed and refined.

Regional statutory context

At the regional level, statutory management settings shape how restoration activities interact with other authorised uses of the coastal marine area. All restoration projects operate within regional and unitary planning frameworks and may interact with other activities and management objectives.

Regional coastal plans set out objectives, policies and rules that govern activities in the coastal marine area and manage actual or potential effects arising from use, development or protection. Reviewing these plans during site selection and feasibility assessments supports early identification of constraints and opportunities; and may highlight alignment with regional restoration objectives and programmes.

Understanding how pressures are managed through regional statutory tools and strategies is an important component of feasibility planning (see Appendix 3).

National statutory context

At the national level, restoration activities are guided by statutory direction under the New Zealand Coastal Policy Statement (NZCPS),¹ which sits under the Resource Management Act 1991 (RMA). The RMA provides a comprehensive legislative framework for managing the country's natural and physical resources. Its primary purpose is to promote the sustainable management of resources, ensuring they meet current needs without compromising their use for future generations.

The NZCPS sets out national policies that achieve the purpose of the RMA in relation to the coastal environment of Aotearoa New Zealand. Regional policy statements and regional and unitary plans must give effect to the NZCPS, which contains objectives and policies relevant to restoration, including:

- Objective 1 – safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land
- Objective 2 – preserve the natural character of the coastal environment and protect natural features and landscape values through: encouraging restoration of the coastal environment

- Objective 5 – ensure that coastal hazard risks taking account of climate change, are managed by protecting or restoring natural defences to coastal hazards
- Policy 14 – restoration of natural character^m

Awareness of national statutory context supports feasibility planning and helps ensure that restoration projects are developed in a way that aligns with existing objectives and policies, without predetermining restoration approaches or outcomes.



Potential changes in legislation

Project leads should confirm the status of the RMA and NZCPS and any successor documents with relevant agencies at the time of the project planning.

Permitting and consents



Use this section when developing a proof-of-concept for active restoration (see Section 3.1)

Early awareness of regulatory and spatial constraints may also inform identification of feasible restoration approaches in Section 2.4.

This section provides an overview of common permitting and consent considerations to help project leads understand when these may be required and which relevant agencies to engage with. Approval requirements may vary depending on activity, location and the restoration approach, tools and methods proposed.

Most active restoration projects will require one or more permissions before activities can proceed. These may include:

- Resource consents – approvals under regional or unitary plans for activities that may affect the coastal marine area, such as placement of structures, disturbance to the seabed, or exclusion of activities
- Special permissions or exemptions – approvals required under specific legislation (e.g. Biosecurity Act or Fisheries Act) to allow activities that would otherwise be restricted, such as translocation, removal or deployment of organisms
- Activity-specific approvals – required for particular actions or controls associated with a project, such as temporary access restrictions.

Approval requirements vary depending on activity type, location, scale, and the restoration tools and methods proposed.

When permits or consents may be required

Active restoration activities may trigger approval requirements where they involve physical disturbance, placement or removal of material, movement of organisms, or restrictions on use of the coastal marine area. This can include permissions associated with:

- Restoration activities themselves (e.g. placement of structures, translocation or removal of organisms)
- Measures to protect a restoration site during or after implementation
- Access controls or temporary restrictions required for safety or ecological reasons

Specific permissions or restrictions on activities apply for various reasons, including:

- Managing environmental risks, such as those associated with introduced species or diseases
- Protecting site-specific values, such as cultural, historical, biodiversity or recreational values
- Giving effect to specific rights and interests like those assigned by Te Tiriti o Waitangi / Treaty of Waitangi

In some locations, active restoration may be constrained or prohibited, while in others it may be encouraged.

Biosecurity-related approvals and considerations

Some restoration activities may trigger approvals specifically related to biosecurity risk management, particularly where they involve the movement, sourcing, or placement of organisms, materials, or equipment.

Depending on the activity and location, this may include permissions or exemptions under relevant legislation to manage the risk of introducing or spreading marine pests, diseases, or unwanted organisms. These requirements are typically considered as part of feasibility planning and proof-of-concept development, alongside permitting considerations

Relevant legislation and responsibilities may include the Resource Management Act 1991, the Biosecurity Act 1993, and the Fisheries Act 1996.

For example:

- Movement of species for restoration: requires a permit from Biosecurity New Zealand and, in some cases, coastal consent and / or biosecurity permissions from regional councils
- Species removal or translocation: assessed case-by-case. Biosecurity New Zealand can support Biosecurity Act 1993 Section 52 applications (see Appendix 6) in conjunction with the regional councils' Regional Pest Management Plan exemption process
- Pest spread management: legal responsibilities under the Biosecurity Act 1993. Regional councils and unitary authorities provide local leadership in pest management (section 12B of the Biosecurity Act 1993)

Early engagement and feasibility considerations

Understanding permitting and consent requirements early supports feasibility planning and helps avoid delays later in the project. Early engagement with relevant agencies and groups can help clarify:

- The types of permissions or consents that may apply
- The agencies responsible for relevant approvals
- Any site-specific potential constraints or opportunities

Where permits and consents are required, timelines and conditions may influence project scope, sequencing or choice of restoration tools and methods. These considerations should be factored into the development of the proof-of-concept.

Site protection and associated permissions

In addition to approvals for restoration activities, projects may need to consider additional measures to protect restoration sites. This may include restrictions on:

- Public access
- Anchoring
- Fishing

These restrictions may require a coastal permit under the Resource Management Act. Activities that exclude people from the coastal marine area may also require a permit for exclusive occupation. Restrictions may also be implemented for health and safety reasons, including to ensure the safety of vessels or people working in the restoration area, or as part of any subsequent monitoring or activity.



Regulatory processes, permits and approval pathways change over time

Restoration projects should confirm current requirements early in planning, particularly where new tools, methods or locations are proposed. Seek advice at the earliest stage by contacting the relevant government agency (e.g. Department of Conservation or Fisheries New Zealand) and the applicable regional council to confirm approval pathways, information requirements and potential constraints.

Further guidance

Tables 3 and 4 summarise common consent and permitting considerations across different restoration scenarios and indicate agencies typically involved. These tables are intended as reference material to support early planning and discussion, rather than to prescribe approval processes.






Table 3. Overview of permissions that may apply to active restoration projects and key agencies to contact. Permits and consents are often required when projects involve collecting or moving marine life, disturbing the seafloor or installing permanent structures.

Relevant agency / group	Approval type	Relevant legislation or planning document	When is this needed?	Where do I find more information?
Regional council	Resource consent	Resource Management Act 1991	<p>You will need to apply for a resource consent to carry out the activities listed below, except where they are listed as a permitted activity in the relevant plan. The application for resource consent requires consultation with tangata whenua:</p> <ul style="list-style-type: none"> • Construct a structure in, on, under or over any foreshore or seafloor • Disturb the foreshore or seafloor • Deposit substances in, on, under or over any foreshore or seafloor • Occupy any part of the common marine and coastal area • Remove sand, shingle, shell or natural material • Carry out activities in, on, under or over any coastal marine area for which a resource consent is required. 	Webpages of unitary and regional councils
Ministry for Primary Industries / Fisheries New Zealand (FNZ)	Special permit	Fisheries Act 1996, Section 97	<p>Special permits are of potential relevance to marine restoration projects and can be issued for the purposes of:</p> <ul style="list-style-type: none"> • Education • Investigative research • Management or eradication of unwanted aquatic life • Carrying out trials and experiments with fishing vessels, fishing gear or any other apparatus or technique that relates to the sampling of aquatic life (e.g. fish, invertebrates or seaweed). <p>Permits can also be issued for any other purpose approved by the Minister.</p>	Further information about special permits and application forms are available from the Ministry for Primary Industries

Relevant agency / group	Approval type	Relevant legislation or planning document	When is this needed?	Where do I find more information?
Ministry for Primary Industries / Biosecurity New Zealand (BNZ)	Exemption	Biosecurity Act 1993, Section 52	An exemption may be granted if, as part of the restoration project, the project lead knowingly communicates, cause to be communicated, release, or cause to be released, or otherwise spread any pest or unwanted organism.	Further information can be found here: https://www.mpi.govt.nz/biosecurity/how-to-find-report-and-prevent-pests-and-diseases/handling-unwanted-organisms/
Regional Council	Exemption	Regional pest management plan 2020–2030	An exemption may be granted if, as part of the restoration project, the project lead knowingly communicates, cause to be communicated, release, or cause to be released, or otherwise spread any pest or unwanted organism.	Webpages of unitary and regional council
Department of Conservation	Permit	Hauraki Gulf/Tikapa Moana Marine Protection Act 2025	Carry out activities in the High Protection and Seafloor Protection Areas of the Hauraki Gulf Marine Park.	Hauraki Gulf / Tikapa Moana permits
	Research permit	Marine Reserves Act 1971	A permit may be needed to undertake research relating to restoration within a marine reserve. This includes any activity that would usually be illegal in a marine reserve (e.g. placing structures on the seafloor; taking or introducing marine life).	DOC marine reserve permit
	Permit	<ul style="list-style-type: none"> Wildlife Act 1953 Conservation Act 1987 Reserves Act 1977 	<ul style="list-style-type: none"> Access to public conservation land may require a permit Filming and drone use on public conservation land requires a permit Research and collection and other activities on public conservation land may require a permit. 	Further information can be found here: DOC permits
	Concession	<ul style="list-style-type: none"> Conservation Act 1987 	A concession may be required where a restoration project involves active intervention on public conservation land, including coastal wetland reserves. This includes activities such as planting, substrate placement or other physical works that go beyond access or research. Coastal wetland habitats including seagrass, saltmarsh and estuarine vegetation occur on DOC-managed reserves in some areas.	DOC concessions
Port authority	Verbal or	N/A	<ul style="list-style-type: none"> Approvals for site access 	N/A

Relevant agency / group	Approval type	Relevant legislation or planning document	When is this needed?	Where do I find more information?
and adjacent landowners	written approval		<ul style="list-style-type: none"> Any notice to mariners associated with Land Information New Zealand (LINZ) and relevant port authority and harbourmaster. 	
Customary title holder		<p>Marine and Coastal Area (Takutai Moana) Act 2011</p> <p>Treaty settlements</p>	<p>Check with tangata whenua as well as DOC and Ministry for Primary Industries if the restoration is within a customary marine title area.</p>	<ul style="list-style-type: none"> Relevant tangata whenua Te Tari Whakataua https://whakataua.govt.nz/ Government agencies: DOC, MPI / FNZ https://www.doc.govt.nz/about-us/our-role/legislation/marine-and-coastal-area-act/ Regional councils

Table 4. Examples of potential site restrictions that may apply during or following a restoration project, and the regional or national agencies typically responsible for these restrictions.

	 Harvest or collection	 Passive restoration tool	 Access by vehicles	 Access by vessels	 Access by people
	Managing sustainable harvesting once a restored habitat is well established and expanding	Applying a marine protection tool to <u>benefit a portion of a</u> restored area	Managing vehicle access on a beach	Ensuring a vessel undertaking restoration activities can <u>operate safely</u>	Protecting a site from trampling Protecting workers involved in restoration activities
Department of Conservation		✓			
Fisheries New Zealand	✓	✓			
Maritime New Zealand				✓	
Ministry of Transport				✓	
Harbourmaster				✓	
WorkSafe New Zealand					✓
Regional Council		✓	✓		✓

Resource needs



Use this when developing a proof-of-concept

Resourcing and capacity considerations support feasibility planning by helping practitioners assess whether a restoration project can be delivered effectively and in the designated time frame. These considerations do not determine whether restoration is required, but they influence whether a proposed approach, tools and methods are realistic, appropriate in scale, and likely to achieve the identified objectives and outcomes.

In addition to participants' time, each project stage will have additional costs in terms effort and funding. Developing a strong understanding of the resource requirements helps ensure projects stay in scope and may also support engagement with tangata whenua, stakeholders or potential funders.

Reviewing comparable restoration projects and engaging with relevant organisations and practitioners can provide early indications of likely costs and resource requirements. This can help scope the project realistically and inform budgeting of both time and funding.

Project leads should identify the costs (both budget and capacity) associated with:

- **Stakeholder and tangata whenua engagement:** although volunteers can be helpful during the planning process, projects should have available resources to fund key workers and advisors. This support may be through wages, a form of koha or even booking a meeting space.
- **Permits and consents:** as part of the permit and consent application costs (for proof-of-concept and large-scale initiatives), project leads may need to engage with legal professionals to draft and submit the required documents. In addition, specialists may be contracted to conduct initial baseline surveys and / or subsequent consent monitoring.
- **Project logistics:** when developing the feasibility plan (see Section 3.1), project leads should include a budget to cover sourcing the key species (e.g. mussels from aquaculture operations), equipment (e.g. boats, tools) and personnel time. This should also extend to the monitoring plan, which will require similar resources to conduct and report on project outcomes.

2.2 Communicate early and inclusively



Identify and map stakeholders and tangata whenua

When developing a plan, project leads should identify all people or groups who may influence, be affected by, or contribute to the restoration project. Stakeholder and tangata whenua mapping is a simple but effective exercise that helps identify who has an interest in the project and the level of involvement required to achieve the desired outcomes. Evidence from systematic review of community-based coastal marine restoration projects highlights that effective governance, including inclusive engagement, social equity and long-term interdisciplinary collaboration, is among the strongest predictors of restoration success[†].

The steps to create a stakeholder map:

- **Identify:** list the people, groups or organisations who might be affected by the restoration project or have an interest in the process or outcomes. This could include local community members, businesses, government agencies, environmental groups and even visitors. Tangata whenua should always be included.
- **Analyse:** estimate the level of influence each stakeholder and tangata whenua may have on the project and how they might be affected by its outcomes. Some groups and individuals may have significant influence in terms of supporting or constraining the project, while others could be more strongly impacted by its outcome.

- **Map:** create a visual map or chart that shows all the stakeholders and tangata whenua and their level of influence and interest. This will help build the 'big picture' of who is involved and map their relationships.

Stakeholder and tangata whenua mapping is a valuable tool in ecological restoration because it promotes effective communication, fosters collaboration and improves project planning. By identifying and understanding the needs and influences of various groups, communication strategies can be tailored to build stronger relationships and proactively address potential conflicts. For more detail, see the template and example in Appendix 5.

Engagement with tangata whenua



Any habitat restoration project in Aotearoa New Zealand should engage with relevant tangata whenua throughout the project life cycle. This ongoing communication is required under Te Tiriti o Waitangi / Treaty of Waitangi, and it also provides valuable experience and support to help achieve project objectives. Tangata whenua should be involved from the early planning stages to ensure that the project is co-developed in a culturally sensitive manner. For tangata whenua, environment, culture and well-being are inseparable, hence restoration projects that isolate ecological from social dimensions risk missing the relationships that sustain stewardship over time ^t.

Protocols for appropriate engagement and available resources to support project work will vary among tangata whenua. Prior to project planning, it is important to identify and engage with tangata whenua who have mana whenua or mana moana in the project area. The local council and government agencies can help identify the relevant individuals or groups and advise on protocols. Some tangata whenua may also support individuals with specific roles related to kaitiakitanga / stewardship (known as kaitiaki) of the marine or wider environment. These individuals may represent the first point of contact to ensure the relevant iwi, hapū or whānau are aware of the project.

Cultural considerations

Drawing on real-world experience working with tangata whenua, practitioners should:

- Respect local cultural protocols and recognise that processes and expectations vary between tangata whenua groups
- Allow sufficient time for meaningful engagement, tangata whenua are often working at capacity and timeframes may range from months to years depending on existing commitments and available resourcing
- Provide appropriate resourcing (e.g. koha or payment) for time contributed during planning and delivery
- Where projects involve multiple tangata whenua groups, account for existing relationships as these may influence project timing and progression
- Respect and acknowledge any boundaries defined by tangata whenua and account for these within restoration plans
- Build and apply cultural competency throughout the project life cycle, including appropriate use of te reo Māori, tikanga and communication styles

Mātauranga Māori

Mātauranga Māori describes the body of knowledge originating from Māori ancestors, including Māori world views, perspectives, creativity and cultural practices encompassing both traditional knowledge and culture. This covers the knowledge, comprehension and understanding of everything visible and invisible existing in the universe. Mātauranga Māori – both the knowledge and the approach – reflects over 750 years of living within, and as part of, the ecosystem. It has been developed using techniques consistent with the scientific method, including an empirical approach to generating knowledge that incorporates systematic observation, measurement and experimentation. Therefore, tikanga and mātauranga Māori can add significant value and provide strong guidance to restoration projects.

Establish a communication plan

Effective and timely communication is a key contributor to a project's success. Engaging early with individuals and groups identified through stakeholder mapping is vital for gaining project support. Throughout the project life cycle, maintaining culturally appropriate communication will help address and resolve any major concerns. Early engagement is especially important to establish a co-developed approach with those who hold mana whenua and mana moana, consistent with Te Tiriti o Waitangi / Treaty of Waitangi principles. This will also facilitate word-of-mouth communication, which may encourage involvement in the project and ensure that relevant groups are informed of local developments and how these impact their day-to-day interests. All restoration projects should establish a communication plan that is updated at every stage (e.g. early engagement, development of the feasibility plan and business plan, proof-of-concept updates, and monitoring and reporting). Codesign and sustained engagement build the social licence and trust that underpin long-term restoration success and adaptive management ^t.

An effective communication plan should keep tangata whenua and stakeholders informed, foster collaboration and support marine restoration efforts:

- **Define key messages:** identify the core messages to convey about the project. What is its purpose? Why is it important?
- **Identify the audience:** determine who needs to know about the project. This could include local communities, stakeholders, government agencies and marine users. Understanding the audience will guide the communication methods.
- **Choose communication channels:** decide how information will be shared. Options include newsletters, social media, community meetings and local media, tailored to each audience segment.
- **Designate a spokesperson:** identify a person or team responsible for communicating with the public and stakeholders to ensure consistency in messaging and build trust.
- **Assess resources:** evaluate the resources required, including existing communication tools, the potential need for a website or social media presence, and any printed materials like brochures or flyers.
- **Plan for media engagement:** prepare clear, concise responses for anticipated enquiries from the media and the public.

- **Identify communication risks:** recognise potential issues that may arise and establish a plan for how to address them, considering whether the approach will be proactive (sharing information before being asked) or reactive (responding to enquiries).
- **Acknowledge contributors:** foster collaboration by recognising the individuals or groups who have supported the project.
- **Update regularly:** develop a schedule to keep the audience informed throughout the project's life cycle. Regular updates build trust and engagement.
- **Coordinate with other efforts:** share information and findings with other restoration initiatives in the area to maintain a unified approach, leverage shared resources, and contribute to a growing collective understanding of restoration outcomes across Aotearoa New Zealand. Where projects involve community or volunteer participation in monitoring activities, engaging early with relevant agencies can further support opportunities to share knowledge and data across projects.

2.3 Getting started: know your system

Develop a clear understanding of the environmental system that will be the focus of the restoration project. This understanding underpins all subsequent decisions, including whether pressure reduction alone is sufficient or whether active restoration should be considered. Apply the relevant considerations of Section 2.1 to build a clear, site-specific understanding of what has changed, what is influencing the change and whether recovery is occurring.

Begin by determining whether habitats, ecosystem functions or species have been lost. Apparent absence of these may reflect natural variability rather than degradation, so both current and historical conditions should be assessed.

When describing the current state of the site, use the ecological context in Section 2.1 to interpret these observations at appropriate spatial and temporal scale. Relevant information may include:

- The habitats present now, compared with what was present historically
- How the area has interacted with adjacent habitats over time
- Whether changes observed at the site reflect localised loss or broader shifts occurring across the region

Developing an understanding of a system can take time. Use available data, recorded observations and local knowledge to assess current system dynamics. Where necessary, undertake additional monitoring or targeted research to identify ongoing pressures and any evidence of natural recovery. This information should be used to determine whether passive restoration alone is likely to achieve restoration objectives before active restoration is considered. As information is collated, this should allow for identification of the underlying ecological problem and the factors limiting recovery.

At this initial stage, monitoring refers to the baseline system and pressure monitoring undertaken before any restoration is implemented. This baseline monitoring supports early decision-making to

establish whether active restoration is appropriate. It also provides the 'before' data for subsequent proof-of-concept development, implementation and before–after, control–impact (BACI)-based project performance monitoring (for more information see Sections 3.2 and 4).

Cultural values and indicators should be considered alongside ecological objectives from the outset, as they influence project design, engagement, monitoring and long-term evaluation.

Identify the problem

Clearly identify and define the ecological problem affecting the area of interest. This may include changes in species composition, habitat structure or key ecosystem processes resulting from natural events, human activities or a combination of both. Identifying the problem requires a site-specific assessment to determine what has changed and why.

Consider the following questions:

- Has the area lost a critical ecosystem function or service?
- Is this loss associated with degradation of habitat, the decline of a key species, or both?
- What pressures have driven or are continuing to drive this loss?

Defining the central problem establishes the primary objective of the restoration project. Engage with local knowledge holders and experts (e.g. tangata whenua, researchers, citizen scientists) to strengthen the understanding of the problem and its ecological, social and cultural dimensions.

Identify the pressures and their current management

Identifying the pressures that have historically affected a site, whether they are still present and their current management, is essential for understanding current ecosystem condition and informing appropriate restoration responses. Key questions are listed below:

- **Identify the pressures**
 - What pressures have historically affected the habitat?
 - Are these pressures still present, and could they affect restoration success?
 - What insights are available from historical or recent monitoring data?
- **Assess current management**
 - Can these pressures be managed more effectively?
 - Does monitoring indicate that existing pressure management is resulting in ecological recovery?

This information should inform proof-of-concept design (see Section 3.1), selection of restoration approaches and monitoring project performance design. For example, if sedimentation is identified as a pressure for green-lipped mussels:

- Catchment and coastal restoration may be required

- Site selection should avoid heavily sedimented areas
- Monitoring should include sedimentation rates and effects on mussel health

Identify the restoration objectives

Once the causes for ecological loss and relevant, current pressures have been identified, define clear restoration objectives. Objectives should reflect the biological, ecological and social context of the problem, the desired restoration outcomes, and the scale and feasibility of the intervention. This includes consideration of resources, time frames and governance arrangements.

Objectives may align with different points on the continuum, including reduced impacts, remediation, rehabilitation, or ecological restoration, depending on the severity of degradation, feasibility, and recovery potential. Not all projects will aim for, or require, full ecological restoration.

Objectives should also specify whether pressure reduction alone is sufficient or whether complementary active restoration is required. Where relevant, climate change considerations should inform site selection, species choice and long-term monitoring.

Restoration objectives should define:

- The desired outcome in relation to the identified problem and pressures. The restorative continuum should be used to clarify the type of outcome sought (e.g. Reduced impacts, rehabilitation, or ecological restoration)
- The indicators used to measure progress
- The magnitude of change to be achieved
- The time frame for achieving the restoration objective^e

For example, a core objective for a seagrass project may be to increase seagrass meadow coverage by 10% over 5 years. This could be measured using aerial (e.g. drone) photos of the seagrass meadow over time.

Objectives determine the scope of restoration approaches and tools. Projects with objectives aligned with full ecological recovery in marine environments will typically require extended time frames and a combination of passive and active restoration. Clear long-term goals and interim milestones should be established to guide implementation, support communication and inform funding decisions.

Identify the reference system

Measure restoration progress against appropriate reference systems rather than historically lost ecological states. **Reference systems** represent comparable, non-degraded examples of indigenous ecosystems and provide benchmarks for evaluating restoration outcomes.

A reference system may be based on an existing site or a modelled ecosystem, which is informed by:

- Key species

- Chemical and physical characteristics (e.g. water chemistry, wave exposure, depth)
- Structural attributes (e.g. substrate, biological communities)
- Functional processes (e.g. water filtration, sediment stabilisation)
- Associated organisms' characteristic of the habitat

Understanding the reference ecosystem is required to:

- Guide project design
- Set clear and achievable restoration objectives
- Determine where the reference system sits on the restoration continuum, including any ongoing pressures
- Inform monitoring design and evaluating progress

Examining an existing, suitable reference system can help develop a clear vision of the desired future state for a restoration site. This vision should then be used to define specific, measurable objectives that guide restoration activities and support ongoing assessment.

If a suitable reference ecosystem is not available, a modelled system should be developed using the best available information. For example, subtidal green-lipped mussel reefs over soft sediments are now largely absent in Aotearoa New Zealand. In these cases, reference conditions may be informed by remnant mussel populations on rocky reefs, intertidal systems, historical information or expert-derived ecological models.

2.4 Identify approaches and tools



The selection of passive, active or combined restoration approaches determines how restoration objectives positioned on the restorative continuum are delivered in practice. While overarching objectives may align with a particular point on the continuum, delivering them often involves applying multiple restorative activities across the continuum, either sequentially or in combination. Restoration approaches and tools should be identified while considering the ecological, biosecurity and regulatory context of the site.

Use the understanding of the system, problem and the key pressures to determine which restoration approaches and tools are most likely to achieve the project's objectives. Early identification supports clear communication with tangata whenua and stakeholders about the problem being addressed and the range of possible solutions.

Before selecting any active restoration approach, assess whether pressures can be reduced or removed with passive restoration. In many cases, achieving restoration objectives will require a combination of passive and active approaches. The selected approaches and associated tools should be clearly articulated in the feasibility and business plan (see Section 3.1).

Passive and active restoration approaches can be combined in different ways depending on site conditions, target species or habitats, and project objectives (Table 5). Where conditions vary across the project area, approaches may need to be applied in combination and tools tailored accordingly. Examples of how passive and active restoration approaches can be combined include:

- **Using passive restoration to support active restoration**

Mapping to the restorative continuum: *ecological restoration* objective, supported by *reduced impacts* measures.

Passive restoration can protect remnant habitats or wild populations (e.g. broodstock) across life stages, by maintaining source populations and genetic diversity. This can improve the effectiveness and durability of active restoration efforts.

For example, protecting remnant green-lipped mussel reefs while actively translocating mussels to suitable seabed areas may increase the long-term success of restoration efforts.

- **Using passive restoration tools to protect active restoration sites**

Mapping to the restorative continuum: *ecological restoration* objective, supported by long-term *reduced impacts* measures.

Passive protection tools can be applied to safeguard ecosystems, habitats or populations during and after active restoration.

For example, a restored mussel reef may include a fully protected area alongside zones designated for sustainable harvest.

- **Using active restoration to initiate passive recovery processes**

Mapping to the restorative continuum: *rehabilitation* or *early ecological restoration* objectives, supported by subsequent *reduced impacts* measures.

Active restoration may be used to initiate recovery processes that then allow passive restoration to occur. For example, reducing populations of overabundant herbivores, such as kina, can increase the likelihood of natural kelp forest recovery. Combining this approach with land-based and freshwater pressure reduction may be required to restore nearshore environments (e.g. the Te Kohuroa Rewilding Initiative).

- **Using active restoration to accelerate recovery prior to passive protection**

Mapping to the restorative continuum: *ecological restoration* objectives, supported by early *rehabilitation* measures.

In some cases, active restoration may be undertaken before the implementation of a passive protection measure. For example, targeted removal of kina from barrens before establishing an MPA may accelerate kelp forest recovery. Pre-conditioning an area in this way can assist the recovery of habitats, species and associated ecosystem services.



When active restoration may not be required

Active restoration within passively managed areas is not always necessary. Where pressures have been effectively reduced, natural recovery processes may be sufficient to achieve the restoration objectives. Where active intervention is proposed in passively managed areas, projects should have a clearly defined purpose, demonstrating why natural recovery alone is unlikely to be sufficient, and consider potential ecological implications when designing the proof-of-concept trials.

Tables 5 and 6 together summarise common considerations, constraints and trade-offs to support the selection of restoration approaches. They are intended to inform early decision-making and discussion, rather than prescribe site-specific solutions.

Table 5. Key differences between passive and active restoration approaches – provides a high-level comparison of passive and active restoration approaches.

Consideration	Passive restoration	Active restoration
Primary purpose	Remove or reduce pressures preventing natural recovery	Initiate or accelerate recovery where passive measures alone are insufficient
When to consider	As the first response in all projects	Only after pressures have been reduced or are being managed
Typical tools	Fisheries management, customary tools, MPAs, catchment management, pollution reduction	Species translocation, urchin removal, substrate enhancement, assisted recruitment
System condition required	Ecological conditions capable of supporting natural recovery once pressures are addressed	Ecological conditions suitable for intervention, e.g., survival of reintroduced species, natural recovery after removal of a pressure
Risk profile	Generally lower ecological and biosecurity risk	Higher ecological, biosecurity and operational risk
Biosecurity considerations	Focus on preventing new incursions and spread	Requires explicit biosecurity risk assessment and mitigation
Genetic considerations	None	Can require consideration of source populations
Regulatory complexity	Often lower	Often higher; permits and approvals required
Scalability	Pressure reduction management are often scalable	Scaling requires additional proof-of-concept testing

Building on the general comparison above, Table 6 applies these differences to common project context to support practical decision-making about when passive, active or combined approaches may be appropriate.

Table 6. Indicative guidance on how project contexts may influence the selection of passive and active restoration approaches at a site. Context-specific assessment is always required.

✓ choose approach * context dependent ✗ do not choose approach

Project context or constraint	Passive restoration	Active restoration
Evidence of natural recovery is already occurring	✓	*
Ongoing pressures can be reduced or effectively managed	✓	*
The species or habitat is likely to recover naturally if pressures are removed (e.g. remnants habitat present; suitable substrate for recolonisation)	✓	✓
Rapid ecological response is required to prevent further loss	*	✓
Reference ecosystem is available	✓	✓
Habitat-forming species are functionally absent from the site	*	✓
Project aims to initiate natural recovery process	*	✓
Project aims to accelerate recovery beyond passive restoration timeframes	*	✓
Active restoration tools and methods are technically challenging, e.g. the site is too deep, or restoration methods are cost prohibitive	✓	✗
Site supports diverse or complex biodiversity communities, high risk for unintended ecological impacts	✓	✗
Active restoration may cause further degradation, e.g. introducing species that are not indigenous or physical disturbance	✓	✗
Technical capacity and specialist expertise are limited	✓	✗
Uncertainty about appropriate active restoration tools and methods. For example, a lack of understanding about which species to restore first	✓	✗
Long-term protection tools are feasible	✓	*

Project context or constraint	Passive restoration	Active restoration
The project budget limited	✓	*
Opportunities exist for people to be involved in restoration efforts, e.g. saltmarsh replanting sites, species translocation activities, monitoring, sharing knowledge	*	✓

3. Making it happen



The previous section focused on understanding the system, defining the problem, and deciding whether active restoration is appropriate. This section shifts from decision-making to delivery of an active restoration project.

Once active restoration has been confirmed as necessary and appropriate, the focus shifts to implementation, testing and evaluating restoration actions through a proof-of-concept approach. This section outlines how to develop and implement a proof-of-concept, manage risk, plan monitoring, and use evidence from early trials to inform scaling or redesign (Figure 10).



Figure 10. **Key steps for implementing an active marine restoration project.** This figure focuses on the ‘project implementation’ phase of the decision pathway. It expands on the core steps required to move from planning to action. It outlines the sequence of identifying active restoration methods; developing feasibility, proof-of-concept and risk management plans; implementing the proof-of-concept; and transitioning to project performance monitoring.

3.1 Develop a proof-of-concept

Before developing a project’s proof-of-concept, confirm that the following have been defined:

- The system of interest, the ecological problem to be addressed, and the relevant stakeholders and tangata whenua
- How the selected restoration approach, tools and methods will address that problem
- The key ecological, social, cultural, regulatory and operational considerations

This information should be consolidated into a feasibility plan to guide the design and implementation of the proof-of-concept. Proof-of-concept projects should be designed at an appropriate scale to test assumptions, address key uncertainties and assess whether selected tools and methods are suitable for broader application, including whether refinement, scaling, or discontinuation is warranted.

Proof-of-concept projects should align with available resources, governance capacity and long-term commitment. They should be structured to generate learning, regardless of outcome, including where restoration objectives are not achieved.

Identify active restoration methods



Confirm the active restoration tools to be applied (e.g. species reintroduction) and the methods required to implement them (e.g. sourcing adult mussels from aquaculture facilities and transporting them by barge). Methods will vary by species, habitat, site conditions and project objectives (see Appendix 4).

Develop a feasibility plan



Use the defined objectives (see Section 2.3), selected approaches and tools (see Section 2.4), and key considerations (see Section 2.1) to assess whether the proposed restoration scope is feasible.

The feasibility plan should compile information needed to assess:

- What is known and not known about the species, habitat or system at the proposed site
- Whether restoration is achievable under current and foreseeable environmental conditions
- What reference system or ecological objective will guide restoration design
- Whether the project objectives are achievable within environmental, social and economic constraints
- Who should be involved at different stages of the project (see Section 2.2)

The feasibility plan may be concise but must answer the core questions of what will be done, why, where, when and how the project will be managed. A feasibility plan must be completed before proceeding to proof-of-concept implementation. The plan should also inform financial planning and engagement with stakeholders, tangata whenua, regulators and potential funders.

Risk management planning



Develop a risk management plan as part of the feasibility process. The plan identifies potential ecological, logistical, regulatory and social risks and define strategies to manage them.

The risk management plan should address the key questions outlined in the feasibility plan. Examples of risks and guiding questions are provided in Table 7.

Table 7. Questions to consider when developing a risk management plan.

Risk area	Key questions to address	Examples of potential risks
Ecological and environmental	<p>Have all significant pressures been sufficiently removed or managed to allow recovery?</p> <p>Are the physical conditions conducive to survival?</p>	Recurrence of major pollution events, ongoing unsustainable fishing pressure, high disease prevalence in source populations.
	Will the site remain suitable under future climate change scenarios (e.g. increased sea level, temperature or acidity)?	Climate change: projected water temperature rise exceeding species tolerance within the project's lifespan.
Logistical and operational	Is it technically and safely possible to implement the necessary restoration activities at the chosen site?	Logistics: site being too deep or remote; unsafe boat access due to unexpected exposure to high wave energy; equipment failure underwater or technical constraints.
	Are the required techniques, equipment and trained personnel available and within the project's financial scope?	Operations: unavailability of specialised dive teams; higher-than-expected costs for sourcing biogenic material (spat, plants).
Regulatory and social	<p>Can necessary permits and consents be obtained in time?</p> <p>Are there social or cultural objections to the project's location or methodology?</p>	Regulatory: delays in obtaining the required consents under the Resource Management Act 1991; objections from local tangata whenua, or commercial stakeholders.
	Is the project sufficiently aligned with local and regional management plans (e.g. regional coastal plans, local restoration programmes)?	Social: loss of community support or volunteer engagement; conflict arising from perceived impacts on existing resource use.

For each identified risk, define an appropriate mitigation strategy. For proof-of-concept projects, mitigation should prioritise reducing uncertainty through targeted testing (Table 8).

Table 8. Example of a high-level risk management plan for a generic restoration project.

Risk	Mitigation strategy (proof-of-concept focus)
High pressure presence	Prioritise pressure reduction before active restoration; design the project to test the effectiveness of pressure-management actions.
Uncertain environmental suitability	Deploy small-scale pilot trials (e.g. experimental transplanting plots) to test survival and performance under current site conditions (e.g. salinity, wave energy).
Logistical difficulty (e.g. exposure)	Design the implementation schedule that strictly adheres to safe conditions for operation (e.g. suitable weather windows); secure appropriate vessel capacity and experienced crews for site access.
Regulatory delays	Engage early with regulatory agencies in the feasibility phase to clarify consent requirements and timelines.
High pressure presence	Prioritise pressure reduction before active restoration; design the project to test the effectiveness of pressure-management actions.
Uncertain environmental suitability	Deploy small-scale pilot trials (e.g. experimental transplanting plots) to test survival and performance under current site conditions (e.g. salinity, wave energy).
Logistical difficulty (e.g. exposure)	Design the implementation schedule that strictly adheres to safe conditions for operation (e.g. suitable weather windows); secure appropriate vessel capacity and experienced crews for site access.
Regulatory delays	Engage early with regulatory agencies in the feasibility phase to clarify consent requirements and timelines.

Financial planning

Secure funding to support the full life cycle of the restoration project, from planning and implementation through to long-term monitoring. Each phase has distinct cost requirements and should be budgeted for explicitly. Funding pathways should be identified early to ensure continuity across short- and long-term project stages.

Where possible, identify opportunities to align with other restoration initiatives in the area, including both active and passive projects. Coordination can support:

- Shared use of financial, logistical and staffing resources
- Exchange of expertise and information across knowledge systems
- A more integrated and efficient approach to restoration at regional and national scales

Business plan

Develop the business plan as an extension of the feasibility plan. The business plan should define the logistical and financial requirements of the project and set out a pathway from proof-of-concept to longer-term implementation, where appropriate. This will help project leads secure funding for engagement and communication, project management, restoration actions, research (where required), monitoring and reporting before implementing a proof-of-concept project.

At a minimum, the business plan should include:

- A long-term plan identifying key steps, objectives and indicative timelines
- Expected outcomes from the proof-of-concept phase and how these will inform future decisions
- A clear outline of skills, logistics and costs for each project stage
- Key partnerships required to support implementation and funding

For example, green-lipped mussel projects may need to account for long-term access to shell-drying facilities, transport of shell material, and agreements for sourcing mussels from aquaculture operations.

Project costs

Active restoration projects can involve substantial costs, which vary depending on:

- Project location (coastal or offshore)
- Selected restoration methods
- Spatial scale of restoration
- Monitoring and reporting requirements
- Sourcing of biological material
- Personnel and operational costs
- Permitting and consent processes

Use cost information from comparable restoration projects to inform budgeting and identify efficiencies where possible. Examples include shellfish restoration costs assessment² and costs analyses from kelp forest restoration using kina managementⁿ.

Philanthropic and contestable funding

Early-stage restoration projects, particularly proof-of-concept initiatives, are often supported through philanthropic or contestable funding sources. These funding types differ in how funds are allocated, the level of competition involved, and the expectations placed on projects:

- **Philanthropic funding** is typically provided by private individuals, trusts, foundations or corporate donors to support causes aligned with their values. Funding decisions are often relationship-based and may offer greater flexibility in how funds are used. Philanthropic funding is commonly

² See: <https://www.natureaustralia.org.au/what-we-do/our-insights/scientific-papers/shellfish-reef-restoration-guidelines/>

used to support early project stages such as baseline research, community engagement, pilot trials or communication activities.

- **Contestable funding** is awarded through a competitive application process, usually administered by government agencies, regional authorities or funding bodies. Projects are assessed against predefined criteria, and funding is allocated to a limited number of proposals. Contestable funding often comes with specific reporting, timeframes and deliverables and may be well suited to clearly defined project components or milestones.

Some restoration projects may rely on philanthropic funding to establish proof-of-concept, then transition to contestable funding as objectives, methods and outcomes become more clearly defined. In other cases, a combination of both funding types may be required to support different project phases.

Future opportunities for long-term funding

Long-term restoration outcomes are unlikely to be sustained through volunteer effort or philanthropic funding alone. Projects should therefore consider how funding requirements may evolve over time and identify pathways that support durability beyond the proof-of-concept phase.

Emerging frameworks associated with a sustainable blue economy provide opportunities to better integrate restoration outcomes with long-term funding mechanisms. Initiatives such as the sustainable blue economy^o describe pathways where marine and coastal restoration contributes to ecological recovery while also supporting economic activity, social outcomes and livelihoods. In this context, restoration projects may increasingly be viewed as investments in environmental assets rather than short-term interventions.

Internationally, organisations such as the World Bank have identified the potential for blue economy approaches to promote economic growth and social inclusion while maintaining environmental sustainability^p. This framing highlights opportunities for restoration projects to align with broader policy, regulatory and investment drivers, particularly where outcomes contribute to water quality, biodiversity, climate resilience or ecosystem services.

As restoration tools and monitoring approaches mature, restoration outcomes may be recognised through emerging mechanisms such as biodiversity credits, blue carbon initiatives, resilience or water quality credit schemes. These mechanisms are still evolving, and their applicability will vary by project type, location and regulatory context. Where appropriate, projects should track developments in these areas and assess whether participation could support long-term funding or co-investment.

Expressing the benefits of restoration in terms of ecosystem services may support engagement with a broader range of funders and partners. While not all benefits are readily quantifiable, some services can be measured and, in certain contexts, translated into economic terms. Research programmes, including work undertaken through the Sustainable Seas National Science Challenge, are exploring how restoration outcomes may be linked to viable business models and revenue pathways.

Global initiatives such as the United Nations Decade on Ecosystem Restoration further reinforce the expectation that countries, including Aotearoa New Zealand, will invest in restoring degraded

ecosystems to meet international commitments and Sustainable Development Goals. Over time, these drivers may contribute to more stable and diversified funding environments for restoration projects that demonstrate clear ecological outcomes and alignment with broader environmental and policy objectives.

Proof-of-concept cost variability

The scale, duration and cost of proof-of-concept projects will vary by species and habitat. Projects involving well-studied systems may focus on testing implementation methods. Projects targeting understudied habitats or species (e.g. hururoa / horse mussel reefs³) may prioritise testing environmental suitability. In some cases, proof-of-concept development may require multiple years of investment before informing broader application.

3.2 Implement the proof-of-concept project

Proof-of-concept implementation will vary between projects depending on the habitat, species, site conditions and selected restoration tools.

Implement a proof-of-concept only after the feasibility phase confirms the objectives, methods, governance, and key risks. Use implementation to test assumptions, reduce uncertainty, and generate evidence to inform whether the approach should be refined, scaled, redesigned, or stopped. Plan for the same engagement, approvals and compliance requirements that would apply to a larger project.

Confirm implementation readiness

Before implementation begins, confirm that:

- Required permits and approvals are in place
- Biosecurity and risk management measures are operational
- Roles, responsibilities and decision-making authority are clear
- Resources, equipment and personnel are secured for the full duration of the trial

Do not proceed if unresolved risks could compromise compliance, ecological outcomes or safety.

Apply restoration methods at an appropriate scale

Implement the proof-of-concept at a scale that:

- Matches available resources and operational capacity
- Allows for controlled testing of methods
- Enables monitoring of outcomes and unintended effects

³ Note that the information available on horse mussels is rapidly increasing with the growing number of research projects.

Apply methods consistently and record technique, timing, frequency, and any deviations to enable comparison across sites and over time.

Integrate project performance monitoring from the outset

Monitoring must be embedded into implementation and aligned with the project's objectives and reference system. Monitoring should:

- Track performance indicators identified in the feasibility plan
- Detect early signs of success, failure or unintended impact
- Support adaptive management decisions during the trial

Monitoring protocols should be established before implementation begins.

Manage implementation risks

Implementation should follow the risk mitigation strategies defined in the risk management plan. This includes:

- Adjusting timing or methods in response to environmental conditions
- Halting activities if predefined risk thresholds are exceeded
- Documenting deviations from the original plan and the reasons for them

Risk management during implementation should prioritise preventing further degradation of the site or surrounding environment.

Document outcomes and learning

Design proof-of-concept projects to generate learning regardless of outcome. Record all implementation activities, including:

- Methods used and any modifications made
- Environmental conditions during implementation
- Monitoring results and observations
- Operational challenges and constraints
- The likely causes of poor performance where objectives were not met, based on available evidence
- Any contextual factors outside the project's control, such as an unforeseen pollution event or extreme weather, that may have influenced outcomes

Where possible, distinguish between outcomes attributable to the restoration approach and methodologies itself and those attributable to external factors. This distinction is critical for deciding whether the approach should be refined, scaled, redesigned, or stopped.

When restoration objectives are not achieved

Not all proof-of-concept projects will deliver the outcomes anticipated. Partial or complete failure to meet restoration objectives is a recognised and informative outcome in restoration practice, and should be treated as a source of learning rather than a reason to abandon the restoration pathway.

Communicating outcomes to stakeholders and tangata whenua

Transparent communication of all outcomes, including unintended negative ones, is essential for maintaining trust with tangata whenua, stakeholders and funders. Practitioners should plan for this possibility from the outset by establishing agreed reporting protocols that cover both successful and unsuccessful results. When communicating poor outcomes, project leads should:

- Present results clearly and honestly, with sufficient context for non-technical audiences to understand what was attempted and what was learned
- Avoid framing failure as a reason to pursue more intensive intervention without evidence that conditions have changed
- Acknowledge the contributions of all participants, including tangata whenua, volunteers and community members, regardless of outcome
- Identify what the results mean for the broader restoration programme and any implications for adjacent or related projects

Using results to inform next steps

Monitoring results from an unsuccessful proof-of-concept should feed directly into a structured review of the restoration approach, methods and tools. Depending on the evidence, next steps may include:

- Refining the methods or tools and designing a revised proof-of-concept
- Reconsidering the restoration objectives in light of site constraints or updated understanding of the system
- Prioritising further pressure reduction before any new active restoration action is attempted
- Concluding that active restoration is not appropriate or feasible at the site under current conditions, and focusing instead on passive restoration and protection or selecting a more appropriate site

A decision to conclude active restoration activities at a site is a valid and sometimes necessary outcome. It should be documented and communicated with the same rigour as a decision to scale up, and should not preclude future restoration if conditions change.

Implementation structure

Most proof-of-concept projects follow a common implementation structure that integrates pressure reduction, monitoring, and active restoration, often using a before–after, control–impact (BACI) design.

In practice, the selection and combination of approaches should be informed by site-specific conditions, restoration objectives, monitoring evidence and feasibility considerations, and may be applied sequentially or in parallel depending on context.

The BACI structure typically includes (Figure 11):

- **Baseline site surveys** ('before'): conducted before restoration activities start
- **Action** ('after'): implementation of the selected restoration approach, tools and associated methods
- **Control and post-restoration site surveys**: conducted immediately after implementation, including surveys at appropriate control sites
- **Impact**: regular monitoring at intervals defined in the monitoring plan to assess restoration impacts over time

This monitoring structure enables comparison between restored and non-restored areas and supports assessment of restoration outcomes relative to baseline conditions (project performance). Refer to 'Section 4: Project monitoring' for monitoring guidance.

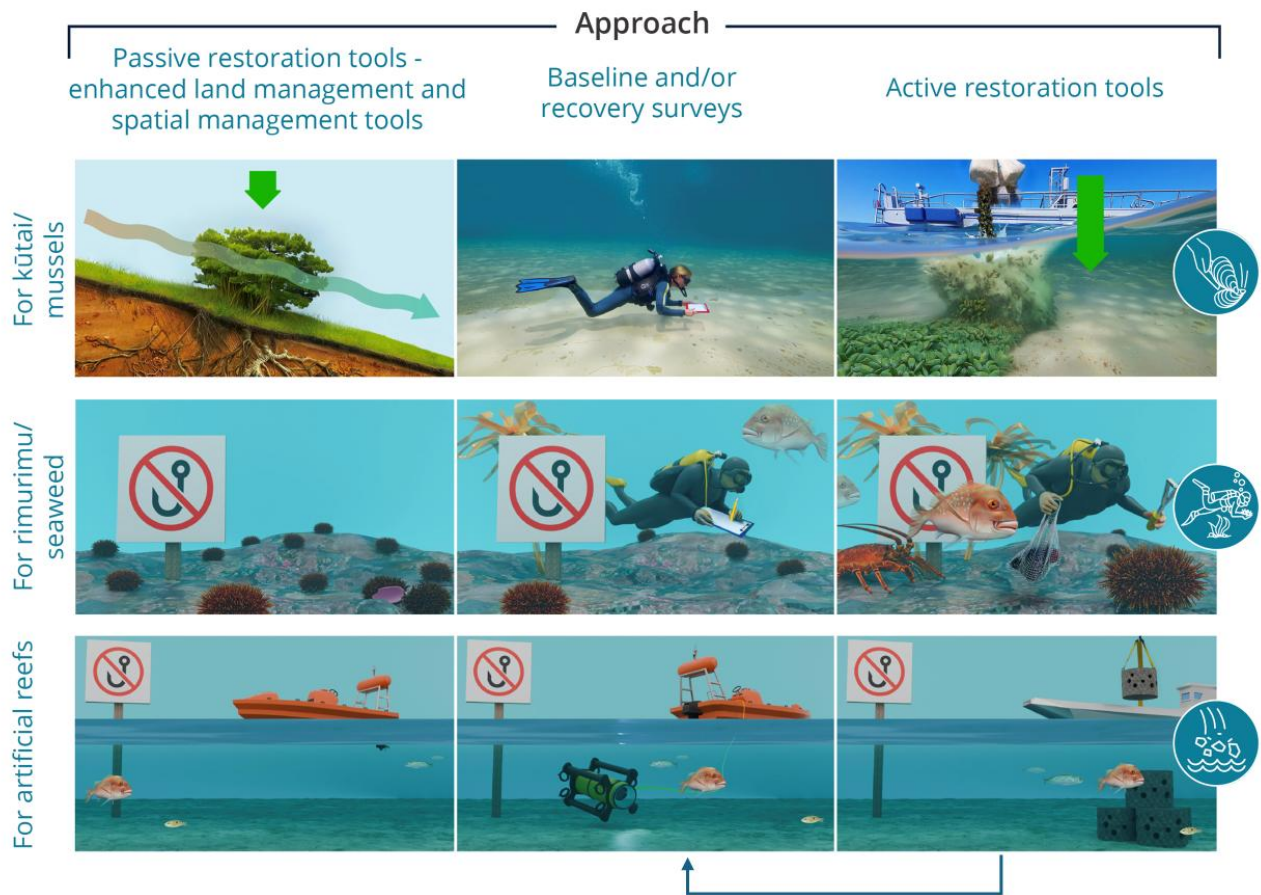




Figure 11. **Example implementation structures for marine habitat restoration.** The figure presents three separate examples across different habitat types, illustrating how passive restoration tools, baseline and recovery monitoring, and active restoration interventions may be applied within the before–after, control–impact (BACI) monitoring structure.




Examples of proof-of-concept projects across different habitat types and illustrate how this implementation structure has been applied in practice are presented below for different habitats.

Using the proof-of-concept examples



The proof-of-concept examples below illustrate how restoration approaches, tools and methods can be applied in practice. They are not intended to represent all habitat types or define a comprehensive list of survey requirements. Project-specific survey design should be determined through the feasibility and monitoring planning processes.

<h2 style="margin: 0;">Intertidal seagrass meadow</h2>	
<p>Problem Loss of coverage</p>	
<p>Pressures</p> <ul style="list-style-type: none"> • Poor water quality and high sediment loads • Biosecurity- <i>Caulerpa taxifolia</i> 	
<p>Passive restoration</p> <ul style="list-style-type: none"> • Stormwater infrastructure improvement • Land retirement opportunities • Riparian planting along catchment (active restoration upstream enables passive restoration/natural recovery downstream) 	
<p>Presence of an intact reference ecosystem ✓</p>	
<p>Primary restoration objective</p> <p><i>Restoration continuum</i> Partially recovering native ecosystems</p>  <p>Partially recovered seagrass coverage and/or expanded areas of seagrass meadows</p>	<p>Active restoration</p> <p>Species reintroduction</p>  <p>Reseeding-Gather seeds, grow-out seedlings, transplant to selected sites</p>




- **Baseline site surveys:** using a mixture of techniques (e.g. satellite data, drone imagery, transects), survey the area to determine the extent of existing meadows. For seed-based restoration on intertidal meadows, monitor seagrass meadows regularly until flowering season is determined. Note: If the study area is an intertidal meadow, surveys can be done at low tide. If subtidal, surveys will likely require scuba gear and trained personnel.
- **Action:** for intertidal meadows, collect seagrass seeds from pollinated flowers; germinate in specialised facility and raise seedlings. Transplant seedlings to ten 1 m² test plots at selected sites throughout the meadow.
- **Control and post-restoration survey:** survey transplanted seedlings and estimate new aerial coverage.
- **Impact:** Conduct regular site surveys. Survey transplanted test plots at regular time intervals following restoration action. Monitor for survival, blade growth and expansion of seagrass coverage.

Soft sediment green-lipped mussel reefs	
Problem Soft sediment green-lipped mussel reef lost to historical dredging and overharvesting	
Pressures	
<ul style="list-style-type: none"> • Dredging • Poor water quality and high sediment loads 	
Passive restoration	
<ul style="list-style-type: none"> • Fisheries management: dredging excluded from area • Marine Protected Area • Customary management • Stormwater infrastructure improvement • Riparian planting along catchment 	
Presence of an intact reference ecosystem	
	
Primary restoration objective <i>Restoration continuum</i> Repairing ecosystem function Initiating native recovery 	Active restoration Species reintroduction 
Establish mussel reef in area to recover seafloor habitat.	Mussel translocation from aquaculture

- **Baseline site survey:** using a tow camera, remotely operated vehicle (ROV) and / or diver, carry out surveys of prospective mussel translocation sites. Check for existing biogenic habitat, substrate types and unwanted organisms (UO).
- **Action:** translocate small quantities of mussels from aquaculture to selected survey sites.
- **Control and post-restoration survey:** survey translocated mussels to estimate factors like mussel survival, reef area and mussel density.
- **Impact:** Conduct regular site surveys. Survey translocated mussels at 1 month, 6 months, 12 months and 24 months post-translocation. Monitor for mussel survival, growth and condition, as well as non-native species and indigenous organisms growing among the mussels.

<h2>Kelp forests — paddle weed <i>Ecklonia radiata</i></h2>	
<p>Problem Kelp forest habitat lost to overabundance of grazing kina</p>	
<p>Pressures</p> <ul style="list-style-type: none"> • Grazing pressure form kina barrens due to overfishing of their large predators • Sedimentation 	
<p>Passive restoration</p> <ul style="list-style-type: none"> • Fisheries management • Customary management • Marine Protected Area 	
<p>Presence of an intact reference ecosystem </p>	
<p>Primary restoration objective</p> <p><i>Restoration continuum</i> Partially recovering native ecosystems Fully recovering native ecosystems</p> <ul style="list-style-type: none"> • Partially and fully recovered kelp forest (depending on the combination of active and passive restoration tools). • Recovery of kelp forest to provide habitat for rocky reef area. 	<p>Active restoration</p> <p>Reintroduction of a specific function </p> <p>Kina removal</p>



- **Baseline site survey:** using scuba divers, survey prospective kina removal sites. Check current kina density, current kelp forest cover, depth profile and substrate types.
- **Action:** conduct kina removals at selected surveyed sites.
- **Control and post-restoration survey:** survey kina removal site to estimate remaining kina density.
- **Impact:** Conduct regular site surveys. Survey kelp forest recovery at the site at 1 month, 6 months, 12 months and 24 months post-kina removal. Monitor for kelp recruitment, kelp growth, kina density and fish diversity.

<h2>Kelp forests — giant kelp <i>Macrocystis pyrifera</i></h2>	
<p>Problem Giant kelp forest habitat lost or in significant decline due to marine heatwaves and ocean warming, compounded by sedimentation and colonisation by invasive kelp (<i>Undaria pinnatifida</i>)</p>	
<p>Pressures</p> <ul style="list-style-type: none"> • Marine heatwaves and ocean warming (primary) • Sedimentation and reduced water clarity — significantly amplifies temperature-driven loss • Colonisation by <i>Undaria pinnatifida</i> following habitat loss, preventing natural recolonisation 	
<p>Passive restoration</p> <ul style="list-style-type: none"> • Land-based sediment management and water quality improvement • Management of <i>Undaria pinnatifida</i> at and around restoration sites 	
<p>Presence of an intact reference ecosystem  Partial — remnant populations exist in some southern locations</p>	
<p>Primary restoration objective</p> <p><i>Restoration continuum</i> Partially recovering natural ecosystems</p>  <ul style="list-style-type: none"> • Partial recovery of giant kelp canopy to re-establish habitat structure for pāua, <i>kōura</i> and reef fish • Maintaining populations at range limits in the face of ongoing climate pressure 	<p>Active restoration</p> <p>Species reintroduction</p>  <p>Reseeding of cultivated juveniles</p> <ul style="list-style-type: none"> • <i>Undaria</i> removal as site preparation before reseeding • Laboratory cultivation from locally sourced spores, selecting for thermal resilience where possible • Green gravel technique

- **Baseline site survey:** using scuba divers or ROV, survey prospective restoration sites along rocky subtidal reefs. Record current kelp canopy cover, substrate type, depth profile and water clarity. Note presence and density of *Undaria pinnatifida* as colonisation by this invasive species will need to be managed before or alongside kelp restoration. Record water temperature conditions, as poor water clarity combined with elevated temperatures significantly reduces restoration success.
- **Action:** where *Undaria* is present, undertake targeted removal prior to kelp reseeding. Cultivate *Macrocystis* juveniles from locally sourced spores in a nursery facility, selecting for thermal resilience where possible. Juveniles can be attached to the substrate using the green gravel technique.
- **Control and post-restoration survey:** survey reseeded juveniles at treatment and control sites to estimate initial survival and density. Record *Undaria* presence at both sites.

- **Impact:** conduct regular surveys. Monitor kelp survival, frond growth and canopy development at regular intervals from reseedling. Monitor for *Undaria* re-establishment alongside water temperature and clarity as ongoing contextual variables. Recovery of pāua, rock lobster and reef fish can serve as broader indicators of ecosystem restoration progress.

Artificial reef

<h1>Substrate enhancement</h1>	
Problem Loss of complex, hard bottom habitat from soft sediment systems; limiting natural recovery of biogenic habitat-forming species	
Pressures	
<ul style="list-style-type: none"> • Commercial dredging removing natural hard substrate • Bottom-contact fishing gear preventing recovery • Increased sedimentation 	
Passive restoration	
<ul style="list-style-type: none"> • Fisheries management: closure to bottom-impacting fishing gear 	
Presence of an intact reference ecosystem ✔	
<p>Primary restoration objective</p> <p><i>Restoration continuum</i> Initiating native recovery</p>  <ul style="list-style-type: none"> • Initiating the recovery of hard bottom habitats • Creating settlement environment for target species where natural hard substrate has been lost 	<p>Active restoration</p> <p>Substrate enhancement</p>  <p>Artificial substrate- deployment of eco-friendly concrete reef structures to create complex 3D habitat</p>

- **Baseline site survey:** using a mixture of survey methods (e.g. scuba divers, ROVs, tow cams, side-scan sonar and / or multi-beam sonar), survey prospective artificial reef sites. This should include depth, prevailing currents and existing habitats.
- **Action:** deploy reef structures at selected surveyed sites.

- **Control and post-restoration survey:** survey artificial reef sites to estimate total area and complexity created / occupied by reef structures. Include any organisms already present within the site.
- **Impact:** Conduct regular site surveys. Survey artificial reef complexity, biogenic and mobile species communities at artificial reef site(s) at 1 month, 6 months, 12 months and yearly thereafter. Monitor for marine pests, indigenous encrusting biota and fish diversity.

Evidence gaps and design considerations for artificial reefs

Although a small number of artificial reefs have been deployed in several locations, there remains limited evidence on their effectiveness in restoring endemic biodiversity at scale. In particular, further work is needed to understand their ecological function, longevity and interaction with existing soft sediment habitats.

Artificial reefs should not be considered a default restoration response and require careful justification within the context of the site conditions, objectives and alternative restoration tools.

Because artificial reefs are often placed in areas that already provide important ecosystem services and function, project design should explicitly consider potential trade-offs, including displacement of existing habitat functions and the risk of unintended ecological effects. Proof-of-concept projects should therefore be designed to test clearly defined hypotheses, include appropriate control sites, and incorporate monitoring that can inform decisions about refinement, scaling or cessation.



3.3 Scaling up the project



Scaling up should only be considered after monitoring evidence from the proof-of-concept demonstrates that the selected approach, tools and methods are feasible, effective and manageable.

Decisions about scale should account for:

- The ecological system and species involved
- Alignment with regional planning and management frameworks
- Regulatory complexity and consenting requirements
- Availability of resources, expertise and long-term funding
- The presence or absence of suitable reference systems

Before increasing scale, a reassessment is needed to identify how the project interacts with other restoration, protection or management activities within the region, including those identified through marine spatial planning.

Scalability of the approach

Small-scale projects are designed to test assumptions and reduce uncertainty. Scaling up is not a simple extension of proof-of-concept activities. It introduces additional ecological, logistical and financial complexity, and most active marine restoration in Aotearoa New Zealand remains experimental or small scales.

Scaling should proceed incrementally, supported by additional testing, monitoring and evaluation, and decisions to expand should assess whether costs, effort and operational requirements remain proportionate to expected ecological gains.

When considering whether and how to scale, assess whether:

- Multiple small projects can be integrated to achieve cumulative outcomes
- Restoration tools and methods can be applied consistently across larger areas
- Restoration actions are likely to initiate natural recovery processes that reduce reliance on continued intervention
- Scaling will complement, rather than compete with, other conservation or management actions

Evidence from other systems, including international examples, can help inform decisions about scalability. However, approaches should be tested, adapted and validated under local conditions before being implemented at larger scales.

Feasibility planning for large-scale restoration

Scaling up requires revisiting feasibility, risk management and financial planning to reflect increased scope and complexity. Before proceeding, revise plans to address:

- Revised objectives and performance indicators
- Expanded risk profiles and mitigation strategies
- Additional organisational capacity, personnel and equipment requirements
- Long-term funding and operational sustainability

In some cases, scaling may require a new feasibility assessment rather than modification of the original proof-of-concept plans, particularly where project scope, methods change substantially.

4. Project monitoring



This section provides practical guidance on monitoring active restoration projects through *project performance monitoring* (Figure 12). For an overview of the different types of monitoring used across the restoration decision pathway, see Section 1.9.

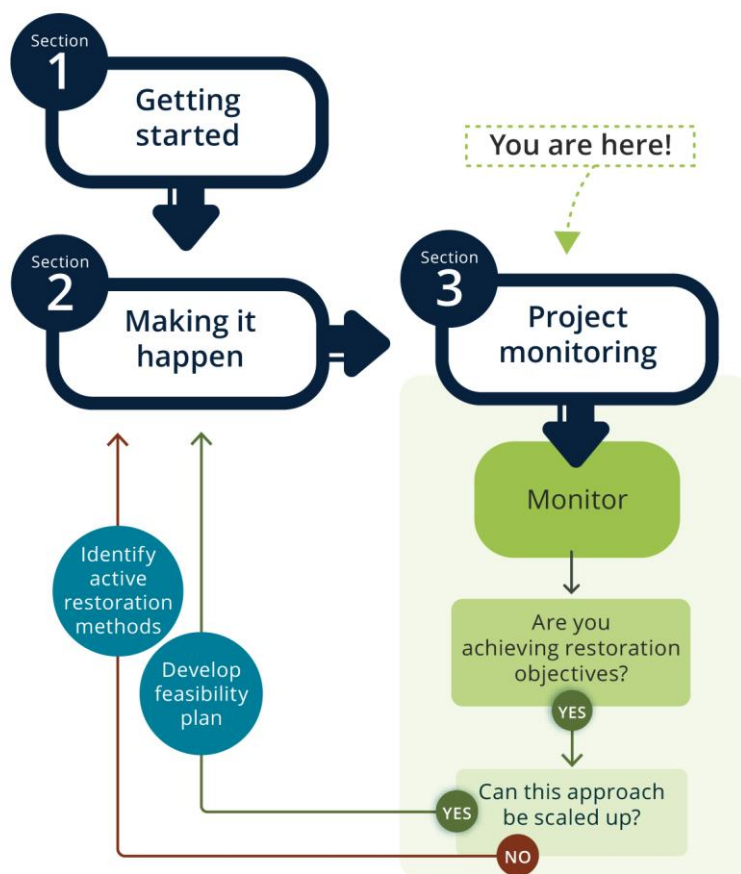


Figure 12. **Project monitoring decision pathway.** This figure focuses on the ‘project monitoring’ phase of the decision pathway. It expands on how *project performance monitoring* is used following proof-of-concept implementation to assess progress against objectives, inform adaptive management, and support decisions to refine, scale, integrate or conclude restoration actions.

Once active restoration is initiated, monitoring shifts to *project performance monitoring*. This monitoring evaluates whether restoration actions are effective and identifies unintended effects, informing adaptive management throughout project implementation. Project performance monitoring should be explicitly linked to restoration objectives and reference systems, and designed to support the assessment of restoration outcomes. It should follow a BACI design, using baseline data collected during the getting started phase as the “before” condition. Monitoring may also be required to meet consent, permit and compliance obligations, which should be integrated into the monitoring programme from the outset.

4.1 Monitor and report project performance









Use monitoring results to:

- Assess progress towards objectives
- Compare outcomes between restoration and control sites
- Decide whether restoration approaches, tools or methods should be refined, scaled, continued or stopped

Interpret monitoring results within a broader environmental, economic, social and cultural context (Table 9). This is necessary to understand how restoration outcomes contribute to broader restoration goals and how they perform relative to other management interventions operating in the same area.

Table 9. Examples of indicators that can be tracked to assess progress against restoration objectives and support comparison across sites and management approaches.

Element	Indicator	Description	Example
Ecological	 Density/ Abundance	Number of individuals per unit area	Kelp or shellfish per 1 m ²
Ecological	 Growth Rate	How fast the restored species is growing	Centimetres of kelp or shellfish growth per year
Social	 Community engagement	Measures the level of local participation and buy-in	Number of volunteers / volunteer hours, attendance at project meetings or presentations
Social	 Access and equity	Assesses whether the project affects fair access to marine resources and benefits for all groups	Feedback on perceived changes in public awareness and access to restoration sites
Cultural	 Mauri	Measures the spiritual health and well-being of the restored environment	Measurable indicators for these elements are likely to vary from project to project
Cultural	 Katiakitanga	Could assess the capacity and role of local iwi / hapū / whānau in actively managing restored area	Could involve tracking the number of iwi / hapū / whānau representatives involved in project development / governance / monitoring

Track and communicate progress

Monitoring results should be synthesised into formats that support decision-making and allow progress to be communicated clearly to stakeholders, tangata whenua, funders and the wider community.

One option for summarising and communicating progress is the Society for Ecological Restoration (SER) Recovery Tracker, which uses a five-star rating system to assess ecosystem recovery^e. The scale ranges from one star (minimal recovery) to five stars (recovery comparable to a healthy reference ecosystem). The system applies an evaluation based on six key ecosystem attributes (Figure 13):

- **Absence of threats:** harmful factors are minimal
- **Physical conditions:** the environment supports the ecosystem
- **Species composition:** the right mix of native species is present
- **Structural diversity:** the ecosystem has varied habitats and structures
- **Ecosystem functions:** natural processes such as nutrient cycling are working well
- **External exchanges:** the ecosystem interacts well with surrounding areas

Ratings across these attributes can be combined into a visual summary that highlights overall progress, identifies areas requiring further attention and supports transparent reporting. A template for applying the SER Ecological Recovery Tracker is provided in Appendix 7.







Use summary tools such as this to communicate outcomes consistently over time and to support decisions about refinement, scaling or continuation of restoration activities.



Application beyond ecological indicators

Recovery Tracker tools can also be applied to social and cultural outcomes where these form part of the project objectives. Examples of how social and cultural dimensions can be incorporated are provided in the SER guidelines^e.

Ecological Recovery Tracker

		RECOVERY					TOTALS
 Absence of threats	Contamination	1	2	3	4	5	11
	Invasive species	1	2	3	4	5	
	Over-utilisation	1	2	3	4	5	
 Ecosystem function	Productivity, cycling	1	2	3	4	5	4
	Habitat interactions	1	2	3	4	5	
	Resilience recruitment	1	2	3	4	5	
 Species composition	Desirable plants	1	2	3	4	5	6
	Desirable animals	1	2	3	4	5	
	No undesirable species	1	2	3	4	5	
 External exchanges	Seascape flows	1	2	3	4	5	9
	Gene flows	1	2	3	4	5	
	Habitat links	1	2	3	4	5	
 Structural diversity	All strata present	1	2	3	4	5	4
	All trophic level	1	2	3	4	5	
	Spatial mosaic	1	2	3	4	5	
 Physical conditions	Substrate physical	1	2	3	4	5	10
	Substrate chemical	1	2	3	4	5	
	Water chemo-physical	1	2	3	4	5	

Recovery score:
44/90

Figure 13. Example of the SER Ecological Recovery Tracker used to summarise ecological recovery outcomes for a restoration project, based on the five-star recovery scale (adapted from the SER Recovery Wheel). See Appendix 7 for a blank template.

4.2 Monitor consent requirements



Where restoration activities require resource consent, monitoring must meet the specific conditions set by the consent authority. Consent monitoring is used to verify compliance and to manage or mitigate any actual or potential adverse environmental effects associated with restoration activities.

Consent conditions may require monitoring such as site inspections, data collection and formal reporting. Parameters may include, but are not limited to, marine pest species presence or abundance, sediment and water quality, habitat condition and associated species.

Consent monitoring requirements will vary by activity, species and site. Project teams must review consent conditions carefully and ensure that monitoring methods, frequency and reporting align with those requirements for the duration of the consent.

Monitoring results should be documented and reported as required to demonstrate compliance and inform any corrective actions if conditions are not being met.

4.3 Monitor cultural indicators



Cultural monitoring complements ecological and project performance monitoring by assessing how restoration aligns with tangata whenua values, aspirations and relationships with place. Cultural indicators should be identified early and carried through the project life cycle, with monitoring approaches led or approved by tangata whenua. Monitoring approaches that allow communities to define what well-being and restoration success mean, rather than applying defined metrics first, are more likely to generate enduring stewardship [†].

Cultural monitoring should be developed with, and led or approved by, tangata whenua. Where restoration projects include cultural objectives, monitoring must reflect local cultural values, priorities and tikanga.

Where cultural indicators are not yet defined at the proof-of-concept stage, projects should allow time, resources and space for kōrero with tangata whenua to support their development. Cultural indicators are integral to assessing restoration progress and should be considered alongside ecological, economic and social indicators.

See Section 2.2 for guidance on early engagement and co-development of project objectives.

Cultural monitoring in projects not led by tangata whenua

Where a project is not led by tangata whenua, those leading the project should support the development and delivery of cultural monitoring through the following phases, in partnership with tangata whenua:

Phase 1: Establish foundations

- Resource iwi-led participation through funded working groups, monitoring personnel, rangatahi and kairangahau
- Support iwi, hapū and whānau to exercise kaitiakitanga, including monitoring, protection, management and decision-making for marine taonga species, ecosystems, mahinga kai and wāhi tapu
- Enable iwi, hapū and whānau to document and use their own cultural narratives, mātauranga and oral histories for their purpose
- Support the development of iwi-defined monitoring frameworks, indicators and tools grounded in mātauranga Māori and kaitiaki priorities
- Build capability through wānanga and hands-on field training for iwi kaitiaki and Te Taiao practitioners

Phase 2: Integrate monitoring approaches

Develop the cultural monitoring programme and identify where cultural indicators align with, complement or sit alongside ecological, social and economic monitoring components.

Phase 3: Deliver cultural monitoring

- Support and enable iwi, hapū or whānau practitioners to implement cultural monitoring independently
- Ensure monitoring outputs are used in project decision-making and reporting in ways agreed with tangata whenua

Existing cultural health initiatives in use across Aotearoa New Zealand should be considered in partnership with iwi, hapū and whānau, where relevant.

Selection and use of cultural indicators








Tangata whenua should lead decisions on which cultural indicators are used. Practitioners may support implementation where requested. Indicators must be evaluated through the monitoring process and approved by tangata whenua, including where indicators are adapted or transferred from other cultural health frameworks. Cultural indicators are not transferable from one project to another.

4.4 Monitor social and economic indicators

Monitoring social and economic indicators in marine restoration involves understanding how projects affect coastal communities and those involved in the restoration process (Table 10). This includes gauging public perception, alongside monitoring how people connect with and use the restored areas. Integrating ecological and socio-economic indicators within shared monitoring frameworks is essential. Restoration projects that evaluate well-being, economic benefits and biodiversity together provide stronger evidence of outcomes and build greater social legitimacy over time⁵.

Tracking awareness, attitudes, values and benefits among users and non-users provides insights into the effectiveness of project communication and how social impacts evolve over time. This helps ensure restoration efforts foster stewardship and contribute to the well-being and economic prosperity of coastal communities.

Table 10. Examples of social and economic monitoring indicators.

 COMMUNITY ENGAGEMENT	 ECONOMIC IMPACTS	 SOCIAL WELL-BEING	 EQUITY AND ACCESS	 GOVERNANCE AND DECISION-MAKING
Levels of participation, support and involvement of local communities in the restoration project	Effects of the project on local economies, such as job creation, tourism revenue and changes in fishing or aquaculture yields	Impacts on human health, recreation and volunteering opportunities	Distribution of benefits and costs associated with the project, including equitable access to resources and opportunities	Effectiveness of governance structures and decision-making processes in supporting the project and enabling stakeholder involvement



Community engagement and risk management

Restoration projects involve uncertainty. Strong community engagement can help manage social risk, support adaptive decision-making and build shared understanding of project outcomes over time.

Use the results to understand how restoration outcomes are experienced by communities, identify unintended impacts, and inform adjustments to project design, engagement or governance, where required.

4.5 Monitoring results to inform scaling decisions

Monitoring results from proof-of-concept projects provide the primary evidence base for deciding whether an active restoration design can be scaled up.

Evidence should be used to assess whether restoration objectives are being achieved, risks are understood and manageable, unintended effects are acceptable, and outcomes are likely to be replicated at larger scales or across additional sites.

Decisions to scale up should consider ecological effectiveness, biosecurity risk, cost, operational feasibility, and interactions with other management actions.

Where monitoring indicates mixed or uncertain outcomes, projects should prioritise refinement of methods, additional testing or extended monitoring before scaling up. In some cases, monitoring may indicate that passive restoration alone is sufficient, or that intervention should cease.

Scaling up should be treated as a new decision point rather than a continuation of the proof-of-concept phase, and may require updated feasibility assessment, engagement, approvals and monitoring design (Figures 5 and 12).

These decisions, including whether approaches are adapted, expanded, integrated with other actions, or concluded, should be guided by the considerations in Section 3.3.

5. Parting thoughts

He rau ringa e oti ai.
Many hands make light work.

Restoring the health and resilience of Aotearoa New Zealand's marine and coastal habitats requires coordinated, long-term effort grounded in sound planning, effective pressure management and adaptive restoration practice. Applying this guidance, integrating ki uta ki tai, and engaging early and meaningfully with tangata whenua and stakeholders will support restoration projects that are well designed, evidence-informed and aligned with regional and national management objectives.

This framework is intended to support consistent, transparent and evidence-informed decision-making across restoration initiatives. By linking objectives, approaches, monitoring and learning, projects can be refined over time to contribute to the recovery of ecosystem health, mauri and the enduring health of our marine and coastal taonga.

This guidance will continue to evolve as new knowledge, monitoring results and practice-based insights emerge, including those informed by mātauranga Māori.

6. Glossary

Term	Definition
Adaptive management	A structured, iterative process of decision-making in the face of uncertainty, where management actions are treated as experiments to learn and improve strategies over time.
Biogenic species	Organisms that play a significant role in shaping their physical environment by modifying and / or creating habitat. In the Aotearoa New Zealand marine environment, these species include mangroves, seagrass, sponges, tube worms, kelp and mussels.
Conservation translocation	The deliberate movement of organisms from one site to another where the primary objective is a conservation benefit. In Aotearoa New Zealand, some mussel restoration projects have relied on translocations from aquaculture.
Control area	Designated area that has similar environmental characteristics to the restoration site but is left unrestored to serve as a baseline for comparison. It allows practitioners to monitor background changes and compare them to those observed in the restored area, helping to evaluate the effectiveness of restoration efforts and distinguish between background fluctuations and restoration-induced improvements.
Damage	Acute and obvious harmful impact on an ecosystem, such as selective logging, road building, poaching or invasions of non-native species ^e .
Degradation	Chronic human impacts resulting in the loss of biodiversity and the disruption of an ecosystem's structure, composition and functionality. Examples include long-term grazing impacts, long-term overfishing pressure, sedimentation impacts and persistent invasions by non-native species ^e .
Destruction	The most severe level of impact, when degradation or damage removes all macroscopic life, ruining the physical environment. Ecosystems are destroyed by such activities as land clearing, urbanisation, coastal erosion and mining ^e .
Ecological recovery	The shift of an ecosystem back to a previous historical natural state, including its animal populations. This differs from restoration, where the rehabilitated state is not expected to match the original state and is anticipated to only show improvement on the degraded state.
Ecological restoration	Any activity or process that assists the recovery of historical ecological function to an ecosystem that has been degraded, damaged or destroyed ^e .
Ecosystem	A biological community of interacting organisms and their physical environment.
Ecosystem function	The natural processes that occur within an ecosystem and are driven by the interactions between living organisms and their physical environment. They include categories such as supporting (e.g. primary production, nutrient cycling, decomposition) and regulating (e.g. climate regulation, disease regulation, flood, water purification, biological control).

Term	Definition
Ecosystem services	Ecosystem functions that contribute to human well-being and societal development. The services fall into different areas such as provisioning (e.g. food, genetic and medicinal resources), and cultural and amenity (aesthetic, spiritual, recreational, tourism, educational).
Indigenous ecological knowledge (IEK)	Accumulated knowledge, practices and beliefs about living beings and their environment that is acquired by indigenous communities over generations through direct contact with their environment. In Aotearoa New Zealand, tangata whenua hold a vast body of IEK that provides valuable insights into the structure and functioning of ecosystems, sustainable resource management, and the interconnectedness of humans and the natural world.
Infauna	Animals that live within the seafloor, rather than on top of it. They burrow into the sediment, creating homes and finding food within the sand, mud or gravel.
Intertidal	Area of the seashore that is covered at high tide and uncovered at low tide.
Kaimoana	Seafood.
Kōrero	(Verb) Speaking and conversing. (Noun) Discussion, conversation or discourse, and information relating to a topic.
Live ground	Area of the seafloor that provides suitable conditions for the settlement, growth and survival of benthic organisms that likely comprise mixed biogenic habitat assemblages of sponges, bryozoans, ascidians, hydroids, tube worms and other groups.
Local ecological knowledge (LEK)	Detailed knowledge, practices and beliefs held by individuals or communities who have lived in, and interacted with, a particular ecosystem over an extended period. This knowledge provides valuable insights into the local environment and species interactions. In Aotearoa New Zealand, the LEK held by fishers, farmers and other long-term residents can provide a rich source of information about specific characteristics and changes to local environments.
Mahinga kai	Traditional food and food cultivation or gathering place.
Mana moana	Authority over the sea and lakes. According to Māori custom, land rights extended to adjacent sea or lakes, with fixed boundaries for inshore and deep-sea fishing and the gathering of seafood.
Mātauranga Māori	A deep and evolving knowledge generated by iwi, hapū and whānau, about place and practices over multiple generations. Mātauranga is shared through lived experience, stories, songs, place names, rituals, teachings and original instructions, and is learned through observation and participation.
Pressure	An environmental factor that has the potential to cause harm to an ecosystem. This can be natural factors like wave exposure that physically disturb a site; or human-induced pressures such as pollution, habitat destruction, overfishing, unwanted organism species and climate change.

Term	Definition
Rāhui	A temporary prohibition, closed season, ban or reserve. Traditionally a rāhui is placed on an area, resource or stretch of water as a conservation measure, or as a means of social and political control for a variety of reasons, which can be grouped into three main categories: rāhui, conservation and politics.
Reference (eco)systems	A representation of a non-degraded version of the native ecosystem that is the target of ecological restoration. These are usually complete with flora, fauna, abiotic elements, functions and processes of the historical system.
Reference models	Models that indicate the expected condition of a restoration site if it had not been degraded (with respect to flora, fauna and other biota, abiotic elements, functions, processes and successional states). This condition is not necessarily historical but rather reflects background and predicted changes in environmental conditions. In the context of climate change and ongoing environmental pressures, reference models may reflect achievable future states rather than historical conditions and should be treated as dynamic rather than fixed endpoints.
Rehabilitation	Management actions that aim to reinstate a level of ecosystem functionality and productivity to degraded natural systems where the goal is renewed and ongoing provision of ecosystem services rather than the biodiversity and integrity of a designated reference ecosystem.
Remediation	Management activity that removes pollutants and / or other pressures that degrade natural systems.
Spat	Larvae of shellfish, particularly bivalves such as oysters, mussels and scallops.
Subtidal	Area of the seabed that lies below the low-tide mark and is continuously submerged by water.
Tangata whenua	In relation to a particular area, means the iwi, hapū or whānau that hold mana whenua, mana moana over that area.

7. Appendices


Appendix 1. Provides an overview of some habitats for restoration

This overview summarises their ecological role, key ecosystem services, primary pressures, preferred restoration approaches and considerations that may influence feasibility and restoration project design.



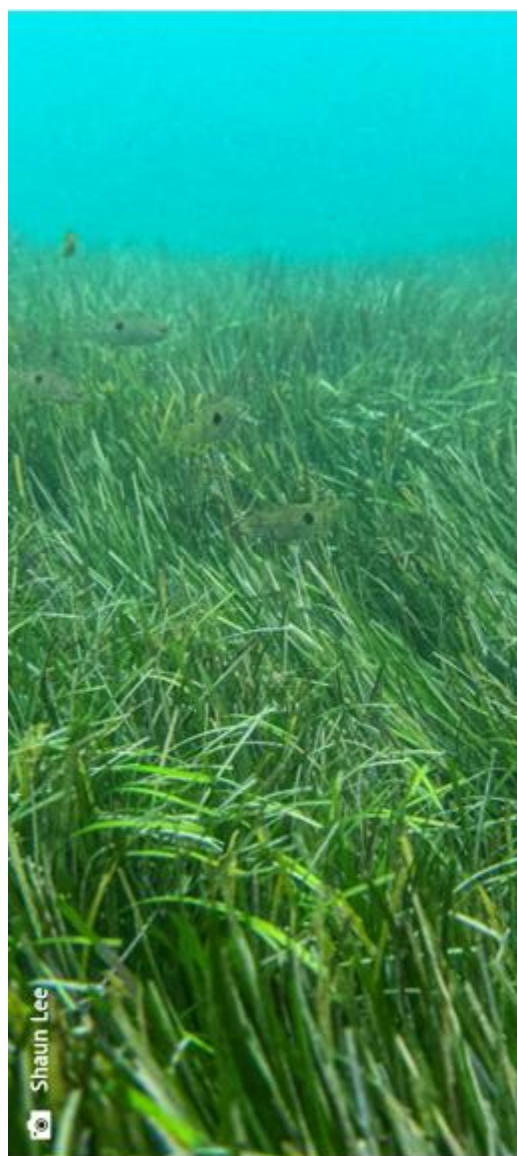
Fish passages and associated habitats for migratory species

Potential sites for restoration	<ul style="list-style-type: none"> • Historical areas with known fish migration • Areas with current populations of migratory species
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Feeding opportunities • Spawning habitats • Shelter • Habitat connectivity
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Presence of structures inhibiting fish movement • Loss of estuarine and freshwater habitats • Channelisation of waterways • Stormwater management
Active restoration	<ul style="list-style-type: none"> • Update and install appropriate coastal fish passage structures • Restore estuary and nearshore habitats • Work in tandem with freshwater restoration techniques such as the addition of woody material and / or artificial habitats for spawning (e.g. hay bales and debris clusters)
Examples of rare and indigenous species associated with the habitat	<ul style="list-style-type: none"> • Fish: kanakana / lamprey, īnanga, tuna / freshwater eels
Caveats and considerations	<ul style="list-style-type: none"> • Potential conflicts with land-use stakeholders • Downstream impacts of removing barriers (e.g. potential flood risks) • Fish passage restoration may require significant alterations to coastal infrastructure involving tangata whenua and multiple stakeholders such as regulators, engineers and scientists / environmental consultants



Anna Bertheisen

Repo / Saltmarsh	
Potential sites for restoration	<ul style="list-style-type: none"> • Areas around estuaries that will likely be inundated with sea-level rise • Areas away from seawalls, roads and coastal infrastructure, which may limit opportunities for restoration and long-term sustainability of restoration efforts
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Primary production • Sediment stabilisation • Carbon sequestration and storage • Spawning habitat • Habitat for other species • Customary practices using saltmarsh plant species (e.g. for weaving) • Tourism / recreation (e.g. where there are tracks or viewing platforms)
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Invasive or nuisance plant species (e.g. exotic <i>Spartina</i> species) • Grazing by livestock and introduced pests (e.g. rabbits) • Drainage, reclamation and the presence of shoreline hardening • Trampling (e.g. livestock) • Climate change (e.g. sea-level rise)
Active restoration	<ul style="list-style-type: none"> • Replanting of saltmarsh vegetation • Reinstating tidal and river flows
Passive restoration	<ul style="list-style-type: none"> • Pest control (e.g. rabbits) • Exclusion of livestock • Management of access to trampling pressure (e.g. from vehicles) • Implementation of restrictions on drainage or reclamation • Weed control and removal of competitors (e.g. <i>Spartina</i> species) • Avoid, remedy or mitigate coastal development impacts • Reduce risk of intertidal 'coastal squeeze' due to sea-level rise
Examples of rare and indigenous species associated with the habitat	<ul style="list-style-type: none"> • Plants: oioi / jointed wire rush, sea rush, makamaka / saltmarsh ribbonwood, remuremu / shore goodenia • Birds: moho-pererū / banded rail, matuku-hūrepo / Australasian bittern, tūturiwhatu / New Zealand dotterel
Caveats and considerations	<ul style="list-style-type: none"> • Limited information on historical extent • Alterations to hydrological regimes (i.e. flow) likely to require significant changes to coastal infrastructure involving tangata whenua and multiple stakeholders such as landowners, regulators, engineers and scientists / environmental consultants • Climate change impacts may be large (e.g. storm intensification/frequency) and difficult to manage



Karepō / Seagrass meadows	
Potential sites for restoration	Areas where seagrass was historically present and where pressures can be effectively managed
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Primary production • Nutrient transfer • Habitat for other species • Spawning / nursery habitat • Seafloor stabilisation • Carbon sequestration and storage • Coastal protection • Water clarity
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Sedimentation • Nutrient input from run-off • Effluent discharge • Coastal development • Climate change • Disease • Vessel anchoring and mooring • Grazing by geese and swans • Vehicles, trampling (e.g. livestock)
Active restoration	<ul style="list-style-type: none"> • Intertidal seagrass meadows: transplantation, beachcast fragmentation, seed-based restoration • Subtidal seagrass meadows: all three listed above; however, these have not been trialled in New Zealand
Passive restoration	<p>Land-based management examples:</p> <ul style="list-style-type: none"> • Avoid, remedy or mitigate coastal development impacts • Reduce stormwater and effluent discharges • Restrictions on reclamation • Reduce risk of intertidal 'coastal squeeze' due to sea-level rise • Management of anchoring / mooring • Management of grazers (e.g. geese, swans) • Management of vehicles, trampling and access
Examples of rare and indigenous species associated with the habitat	<ul style="list-style-type: none"> • Fish: tāmure / snapper, flatfish such as pātiki / yellow-belly flounder, ray species such as whai keo / New Zealand eagle ray, pipefish • Invertebrates: pūpū tuatea / white bubble shell, New Zealand mantis shrimp, tuangi / cockles, pipi • Birds: kōtuku-ngutupapa / royal spoonbill, tōrea / oystercatcher, kakiānau / black swans, tūturiwhatu / New Zealand dotterel, kuaka / bar-tailed godwit
Caveats and considerations	<ul style="list-style-type: none"> • Reducing land-based inputs of sediments and other pollutants would greatly increase chances of successful restoration but may involve many land users and stakeholders • Limited information on historical extent • Climate change impact resulting from global pressures (e.g. desiccation, marine heatwaves, storm intensification / frequency) and difficult to manage



Paul Caiger

Rimurimu / Kelp forest (*Ecklonia radiata*)

<p>Potential sites for restoration</p>	<p>Rocky reef habitats where urchin barrens have increased, key urchin predator populations have been reduced or lost; high sedimentation loads potentially prevent settlement of new seaweed (must be combined with catchment restoration). Note- this species is mostly encountered in the North island and north of the South island. For other kelp species such as <i>Macrosystis pyrifera</i> (giant kelp) encountered in Wellington, the South island and the subantarctic region, the pressure profile is different and mostly linked to marine heatwaves and general ocean warming.</p>
<p>Examples of ecosystem services and functions</p>	<ul style="list-style-type: none"> • Spawning / nursery habitat • Primary production • Habitat for other species • Carbon fixation • Tourism opportunities
<p>What are some relevant conditions and pressures to consider in restoration efforts?</p>	<ul style="list-style-type: none"> • Overfishing of urchin predators • Sedimentation • Climate change (e.g. marine heatwaves)
<p>Active restoration</p>	<ul style="list-style-type: none"> • Urchin barren management • Kelp transplantation • Kelp reseedling
<p>Passive restoration</p>	<ul style="list-style-type: none"> • Closures to fishing or kelp harvest • Land-based management of sediment, pollutants and run-off • Marine protected areas
<p>Examples of rare and indigenous species associated with the habitat</p>	<p>Numerous temperate rocky reef species rely on kelp forests. Some notable species include:</p> <ul style="list-style-type: none"> • Fish: tāmure / snapper, kiore moana / sea horse, red moki, blue mao mao, hāpuku / groper, mararī / butterfish, whai keo / eagle ray, pekapeka / carpet shark • Invertebrates: kōura / rock lobster, pāua, <i>Lunella</i>, Cook's turban • Mammals: kekeno / New Zealand fur seal, all dolphins, maki / orca
<p>Caveats and considerations</p>	<ul style="list-style-type: none"> • Reducing land-based inputs of sediments and other pollutants would increase chances of successful restoration but may involve many land users and stakeholders • Somewhat limited information on historical extent



Soft sediment kūtai / green-lipped mussel reefs	
Potential sites for restoration	<p>Historical range of dense mussel reefs include:</p> <ul style="list-style-type: none"> • Areas with relic shell beds • Areas with a historical presence of mussels or where similar shellfish habitats have been lost and require a similar return of function
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Water filtration • Habitat for other species • Medicinal resource • Reduction of wave energy • Harvest and sustenance • Food for other species • Sediment stabilisation
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Fishing / mussel harvest • Dredging • Sedimentation • Unwanted Organism species • Predation • Climate change (e.g. ocean acidification)
Active restoration	<p>Note: Contingent on the key barriers to recovery at specific to bed locations:</p> <ul style="list-style-type: none"> • Transplanting adult mussel from aquaculture into small, high-quality habitat areas to re-establish beds • Reconnecting historical beds with spat supply (if spat limited), such as strategically placed broodstock farms / structures • Provision of settlement substrate for spat • More broad seabed restoration activities, such as increasing habitat complexity or sediment stabilisation to improve habitat suitability
Passive restoration	<ul style="list-style-type: none"> • Land-based management of sediment run-off • Protection of remnant populations that may provide spat to restored areas • Closures to fishing / protection from harvest and dredging impacts
Examples of rare and indigenous species associated with the habitat	<p>Numerous marine species are associated with mussel reefs. These include:</p> <ul style="list-style-type: none"> • Fish: whai keo / New Zealand eagle rays, tāmure / snapper, paketi / spotty • Invertebrates: wheke / octopus, pātangaroa / 11-armed sea star
Caveats and considerations	<ul style="list-style-type: none"> • Reducing land-based inputs of sediments and other pollutants • Lack of spat recruitment • Lack of suitable habitats • Lack of protection for remaining remnant populations • Gaps in ecological knowledge (e.g. larval supply)



Shaun Lee

Tapa / scallop beds	
Potential sites for restoration	<ul style="list-style-type: none"> • Areas known to support historical populations • Areas with suitable habitat • Sites closed to harvest, recreational and commercial dredging
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Food for other species • Sediment stabilisation • Water filtration • Nutrient transfer
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Predation • Sedimentation • Nutrient enrichment • Reduced seabed habitat complexity / structure • Harvesting and destructive fishing methods (habitat deterioration / loss from bottom fishing) • Vessel anchoring and mooring • Climate change (e.g. ocean acidification)
Active restoration	<ul style="list-style-type: none"> • Reconnecting historical beds with spat supply (if spat are limited), such as strategically placed broodstock farms / structures • Bed reseeding either via wild-caught spat directly or grown-out larger-sized scallops • Translocating spat / adults into high-quality habitat areas to boost local populations / numbers for improved spawning success • Provision of settlement substrate for spat • Broader seabed restoration activities such as increasing habitat complexity or stabilising sediment to improve habitat suitability
Passive restoration	<ul style="list-style-type: none"> • Management of anchoring • Protection of important brood areas • Fishing controls: closures to harvest / protection from destructive fishing methods
Examples of rare and indigenous species associated with the habitat	<p>Numerous species are associated with scallop beds. These include:</p> <ul style="list-style-type: none"> • Fish: tāmure / snapper • Invertebrates: wheke / octopus, bryozoans
Caveats and considerations	<ul style="list-style-type: none"> • Limited information on historical extent • Uncertainty around factors limiting recovery, relating to source sinks and larval supply; likely different barriers in different areas (e.g. larval connectivity, habitat quality issues, predator composition).



Hururoa / horse mussels	
Potential sites for restoration	<ul style="list-style-type: none"> • Areas known to support historical populations • Areas with a historical presence of horse mussels and / or where similar shellfish habitats have been lost and require a similar return of function
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Nutrient transfer • Habitat for other species • Sediment formation • Seafloor stabilisation • Water filtration
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Fishing and dredging • Anchoring • Sedimentation • Climate change • Offshore industry development • Aquaculture enrichment
Active restoration	<ul style="list-style-type: none"> • Transplanting adults into small, high-quality habitat areas to create dense beds • Deployment of spat collectors on the seabed <p>Note: few methods trialled and more research needed</p>
Passive restoration	<ul style="list-style-type: none"> • Management of anchoring • Protection of broodstock • Closures to fishing / protection from fishing impacts • Reduction in land-based pressures
Examples of rare and indigenous species associated with the habitat	<ul style="list-style-type: none"> • Fish: tāmure / snapper, terakihi • Invertebrates: sponges, bryozoans, tubeworms, ascidians, a variety of snail species
Caveats and considerations	<ul style="list-style-type: none"> • Reducing land-based inputs of sediments and other pollutants • Limited information on historical extent • Gaps in ecological knowledge (e.g. lack of source populations for transplantation, wild or from aquaculture)



Live ground (i.e. mixed soft sediment invertebrate assemblages with biogenic habitat)

Potential sites for restoration	<ul style="list-style-type: none"> • Areas where remnants of habitat exist
Examples of ecosystem services and functions	<ul style="list-style-type: none"> • Nursery habitat • Habitat for other species • Food source for other species • Nutrient transfer
What are some relevant conditions and pressures to consider in restoration efforts?	<ul style="list-style-type: none"> • Fishing • Sedimentation • Anchoring • Invasive species • Climate change
Active restoration	None currently known
Passive restoration	<ul style="list-style-type: none"> • Closure to impacts from bottom-impacting fishing gear (e.g. dredges) • Land-based management of sediment run-off • Management of anchoring / mooring
Examples of rare and indigenous species associated with the habitat	<ul style="list-style-type: none"> • Invertebrates: tupa / scallops, sponges, bryozoans, rhodoliths, serpulid worms
Caveats and considerations	<ul style="list-style-type: none"> • Reducing land-based inputs of sediments and other pollutants would increase chances of successful restoration but may involve many land users and stakeholders • Limited information on historical extent, gaps in ecological knowledge (e.g. larval supply)



Shaun Lee

Infaunal bivalves (pipi, cockles, surf clams, etc.)

What are some relevant conditions and pressures to consider in restoration efforts?

- Sedimentation
- Fishing / harvest
- Vehicle impacts
- Climate change

Examples of ecosystem services and functions

- Nutrient transfer
- Habitat for other species
- Food for other species
- Carbon sequestration and storage
- Harvest and sustenance
- Mahinga kai
- Water filtration
- Bioturbation (sed. oxygen and structure)
- Sediment stabilisation (binding particles reducing erosion)
- Fuelling the bottom-up food web (supplying food web biomass from phytoplankton and detritus processing)
- Sediment formation

Active restoration

- Translocation of adults into small, high-quality habitat areas to create dense beds
- Collection of spat, growth to small juvenile sizes, and then reseedling
- Shell addition

Passive restoration

- Closures to fishing
- Protection of broodstock
- Rebalance the food chain
- Invasive species management

Examples of rare and indigenous species associated with the habitat

- Fish: tāmure / snapper, flatfish such as pātiki / yellow-belly flounder, whai keo / New Zealand eagle ray
- Invertebrates: tuangi / cockles, pipi, toheroa
- Birds: kōtuku-ngutupapa / royal spoonbill, tōrea / oystercatcher, tūturiwhatu / New Zealand dotterel, kuaka / bar-tailed godwit

Caveats and considerations

- Reducing land-based inputs of sediments and other pollutants would increase chances of successful restoration but may involve many land users and stakeholders
- Limited recorded information on historical extent

Appendix 2. Examples of active restoration projects in Aotearoa New Zealand

Active marine and coastal restoration is occurring across Aotearoa New Zealand, led by tangata whenua, community groups, researchers and agencies. The projects listed below illustrate the range of restoration activity currently underway and are intended as a starting point for practitioners seeking examples relevant to their context. This list is not exhaustive. Further information on restoration resources and guidance is provided in Appendix 4.

Project	Location	Objective	Link(s)
Saltmarsh			
Pūkoro Mirando – Living Water partnership	Firth of Thames, Waikato	Saltmarsh restoration alongside catchment and estuary restoration	livingwater.net.nz
Waimea Delta Wetland Enhancement and Core and Restore	Waimea Inlet, Nelson / Tasman	Saltmarsh planting and channel excavation to restore coastal wetland. Alongside the Core and Restore project which has a climate change action lens on saltmarsh restoration	Waimea delta wetland enhancement Shortened Estuary Restoration Report April2024 Core & Restore Blue Carbon Tasman Environmental Trust
Regional council restoration	Waikawa, Marlborough	Saltmarsh restoration – planting and habitat	A summary of saltmarsh restoration, Waikawa Estuary, Marlborough

Project	Location	Objective	Link(s)
Seagrass meadows (rimurēhia)			
Restore the Meadows – Restoring Aotearoa New Zealand's Seagrass Meadows	Nelson Haven, Waimea Inlet, Delaware / Wakapuaka estuaries	Seed-based seagrass restoration – developing a nationally scalable blueprint for intertidal restoration	cawthron.org.nz/seagrass-restoration
Northland Regional Council, NIWA and the Whangārei Harbour kaitiaki roopu seagrass restoration	Whangārei Harbour	Testing of three alternative seagrass transplantation methods	Restoration of seagrass beds in Whangarei Harbour Earth Sciences New Zealand NIWA
Kelp forests – rimurimu (<i>Ecklonia radiata</i>)			
Kina removal for kelp forest ecosystem restoration	Noises Island group, Hauraki Gulf	Kelp forest restoration through kina barren management	thenoises.nz
Te Kohuroa Rewilding Initiative	Leigh, Northland	Kelp forest ecosystem and catchment restoration	tekohuroarewilding.org
Waiheke Marine Project	Waiheke Island, Hauraki Gulf	Kelp and broader marine habitat restoration	waihekemarineproject.org

Project	Location	Objective	Link(s)
Kelp forests – rimurimu (<i>Macrocystis pyrifera</i>)			
Love Rimurimu	Te Whanganui-a-Tara / Wellington Harbour	Giant kelp restoration through laboratory cultivation and reseedling	loverimurimu.org
Cultivating resilient marine forests – giant kelp restoration programme	Otago coast (Taieri Mouth to Brighton and wider Otago shelf)	Giant kelp restoration and climate resilience research – hatchery and reseedling methods	
Green-lipped mussel reefs (kūtai)			
Revive our Gulf – mussel reef restoration	Kawau Bay, Ōkahu Bay, Ponui Island, Hauraki Gulf	Green-lipped mussel bed restoration on soft sediment	reviveourgulf.org.nz
Pelorus Sound / Te Hoiere mussel bed restoration	Pelorus Sound and Kenepuru Sound, Marlborough Sounds	Green-lipped mussel bed restoration on soft sediment – testing translocation methods across substrate types	marinefarming.co.nz/mussel-bed-restoration
Estuaries and catchment restoration			
Whangateau HarbourCare	Whangateau Harbour, Northland	Estuary ecosystem and catchment restoration	Whangateau Harbour Care Restore Rodney East
Southland’s estuaries	Southland	Estuary restoration options	Remediation options for Southland estuaries- NIWA

Project	Location	Objective	Link(s)
Restoring estuaries map	Nationwide	An interactive map of restoration work, around the country, to improve the health of estuaries and catchments	Restoring estuaries interactive map
Migratory fish passage			
Fish passage restoration	Nationally distributed	Barrier removal and modification to restore diadromous fish migration	doc.govt.nz/fish-passage

Appendix 3. Supporting agencies for active restoration activities

Agencies to contact include the Department of Conservation (DOC); Ministry for Primary Industries (MPI), including Fisheries New Zealand (FNZ) and Biosecurity New Zealand (BNZ); Regional or Unitary Councils. For tangata whenua engagement, also consider contacting Te Tari Whakatau | The Office of Treaty Settlement and Takutai Moana.

	Project stage	Advice
Getting started	Have you identified relevant stakeholders?	Will the agencies provide support? The agencies could provide advice and in-kind help if requested support is planned and aligns with their current work priorities.
	Have you engaged with tangata whenua?	Central government, regional councils and Crown agencies can provide advice on tangata whenua to contact in your area of interest.
	Is passive restoration possible?	DOC, MPI and regional councils can provide targeted advice on which tools to use. The tools can be used individually or in combination depending on your restoration objectives.
	Is active restoration considered necessary?	Do you need advice on how to integrate passive and active restoration tools? Share your feasibility plan with DOC and MPI to seek technical support and feedback on your approach.
Making it happen	Develop a feasibility plan	Do you need additional baseline studies to support your feasibility plan (such as habitat mapping)? Agency officials can provide advice on accessing unpublished information to complement publicly available documents such as DOC marine protected areas monitoring plans.

	Project stage	Advice
	Develop proof-of-concept	<p>Do you need Geographic Information System (GIS) / mapping advice to support your habitat suitability assessment? If you cannot find the required geospatial information on the web page (see below), contact DOC if unpublished information would be useful for your needs.</p> <ul style="list-style-type: none"> • DOC GIS portal: https://doc-deptconservation.opendata.arcgis.com/ <p>Refer to existing habitat data available for your location:</p> <ul style="list-style-type: none"> • DOC Marine Data Portal • Peer-reviewed papers and technical reports <p>Contact DOC and MPI research teams if habitat mapping and other research projects will be carried out in the vicinity or at your site (e.g. Ministry of Business, Innovation and Employment [MBIE] proposals, government marine ecosystems research).</p> <p>Will your activity be located close to an existing, planned or potential future area-based management zone (e.g. marine protected areas, cable zones)?</p> <ul style="list-style-type: none"> • Consult the regional council coastal plans • Contact agencies to check if they can provide advice on other unpublished information and / or updates.
Project performance monitoring	Monitor	<p>Contact councils, DOC and MPI to share monitoring resources such as templates and toolboxes.</p> <p>If you need support to carry out site monitoring, contact agencies in advance. Staff will advise if this site can be linked with other planned research or operational activities (e.g. MPI and fisheries monitoring, habitat mapping, biodiversity surveys, etc.)</p>

Appendix 4. Supplementary information on restoration from national and international initiatives

Taxa / habitats	Description	Countries
Eight different ecosystems (saltmarsh, shellfish reef, kelp forest, mangrove, seagrass, coral reefs)	Australian Coastal Restoration database The Australian Coastal Restoration Network brings together information on coastal restoration projects	Australia
	The feasibility of restoring Tasman Bay mussel reefs	New Zealand
Shellfish reefs / beds	Ecological restoration of mussel reefs onto soft sediment using transplanted adults	New Zealand
	The Nature Conservancy's restoration guidelines for shellfish reefs (mussels and oysters)	Worldwide
	Restoring shellfish beds to harbours and estuaries: a guide for community groups	New Zealand
	Restoring shellfish reefs: global guidelines for practitioners and scientists	Worldwide
	The benefits of bivalve reef restoration: a global synthesis of underrepresented species	Worldwide
Coastal restoration ,coastal dunes, saltmarsh	Our Estuaries Hub – restoration resources; Our Estuaries Hub – spatial database	New Zealand
	Coastal Restoration Trust of New Zealand ;	New Zealand
Seagrass meadows	Review of the low impact seagrass restoration in Aotearoa New Zealand	New Zealand
	Seagrass restoration is possible: insights and lessons from Australia and New Zealand	New Zealand, Australia
	A blueprint for seed-based seagrass restoration in Aotearoa New Zealand	New Zealand
	Restore the meadows: a seagrass research project led by Cawthron Institute	New Zealand
Kelp forest	Kelp restoration guidebook: lessons learned from kelp restoration projects around the world	Worldwide
	Kelp forest restoration in the Santa Monica Bay	USA
	Kelp forest restoration in Australia	Australia
	Green gravel technique: a novel restoration tool to combat kelp forest decline	Australia

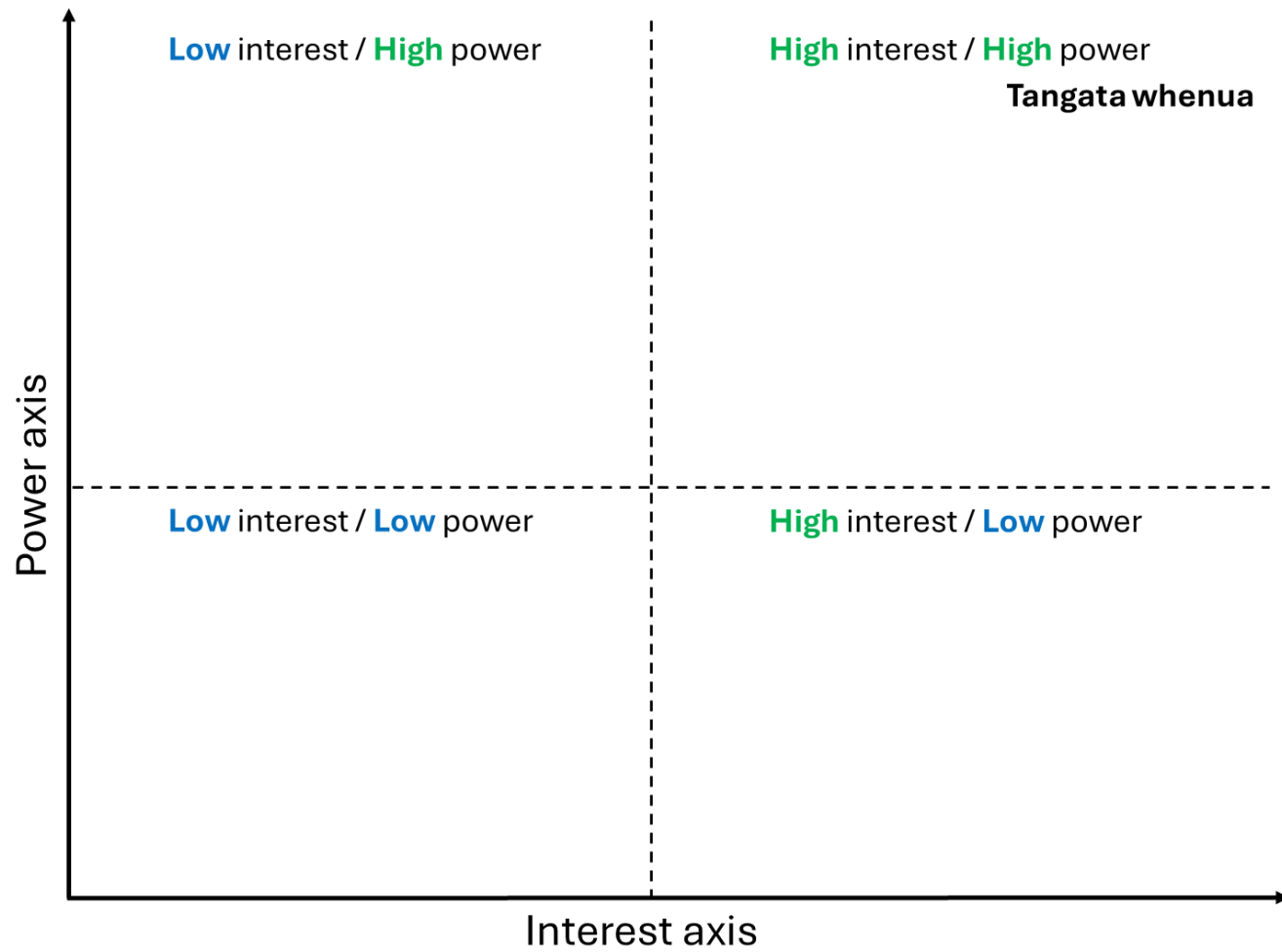
	Sea urchin removal as a tool for macroalgal restoration: a review on removing 'the spiny enemies'	New Zealand
	Playing to the positives: using synergies to enhance kelp forest restoration	Worldwide
	Reproduction, hatchery and culture applications for the giant kelp	New Zealand
Artificial reefs	National artificial reef guidelines 2023	Australia
	London Convention and Protocol/UNEP: guidelines for the placement of artificial reefs	Worldwide

Appendix 5. Stakeholder map template

Use the template below to map out the different individuals, groups and / or organisations that may have an interest in the project. A constructed example is included on the following page for reference. Where possible, identify specific individuals within certain organisations who can be contacted directly. Tangata whenua should be consulted in this process, as they will always have high interest in the well-being of the marine system in question. Use the following information to help guide the process:

- **Low interest / low power:** engagement is unlikely to add meaningful value
- **Low interest / high power:** practitioners should be aware of these groups and engage, where appropriate, to encourage stronger interest
- **High interest / low power:** practitioners should build trust with these groups by keeping them involved and informed, as they can often directly support project design and implementation
- **High interest / high power:** practitioners should engage carefully with these groups, as their involvement is critical to a project's success.

The following examples of 'power' include: cultural, economic, networking, regulatory / legislative; information / knowledge (e.g. mātauranga Māori, academic), etc. The following examples of 'interest' include: habitat restoration / conservation, fisheries, tourism, aquaculture, navigation, recreation, cultural / well-being, etc.



Appendix 6. Example of biosecurity risk assessment for marine restoration activities

In the Hauraki Gulf, mussel reef restoration involves translocating green-lipped mussels from farms in the eastern Coromandel to soft sediment sites on the seafloor. Since these farms host marine pests, including unwanted organisms (UO) such as Asian kelp (*Undaria pinnatifida*), clubbed tunicate (*Styela clava*) and the Mediterranean fanworm (*Sabella spallanzanii*), mussel deployments are conducted under Section 52 permissions of the Biosecurity Act 1993.

Initially, biosecurity risk mitigation measures for translocating mussels were not scalable. Practitioners had to hold large quantities of mussels out of seawater at land-based locations for more than 24 hours and rinse them with fresh water to eliminate pests. Due to these logistical challenges and the widespread presence of these organisms throughout the Gulf, these measures were reassessed by Biosecurity New Zealand (BNZ), in collaboration with the Department of Conservation and Auckland Council. Specialised advice was developed to support decision-making and assessments as part of the Ministry for Primary Industry's Section 52 and 53 permission process for mitigating biosecurity risks in shellfish restoration.

The current guidance offers a framework for managing biosecurity risks, using mussel reef restoration in the Hauraki Gulf as a case study. This guidance can be applied by using the tables on the following pages as part of the project's risk assessment. In addition, diagrams have been developed to help project teams identify biosecurity risks and address their management. While the examples presented below were designed around mussel reef restoration in the Hauraki Gulf, the underlying principles broadly apply to most marine habitat restoration projects – especially for projects involving artificial reefs, as they introduce new substrate that may be readily colonised by marine pests. Following the BNZ guidance also supports that agency's process when evaluating permits for marine pests' translocations.



Understanding risk factors

The available pest and disease risk management options will depend on the risk factors associated with a given deployment, and these should be assessed on a case-by-case basis.

Table A6.1. This table provides an indicative example of the level of biosecurity risk assessment that may be required for restoration activities involving **species reintroductions** or **substrate enhancement**. It is intended to assist those leading the project in identifying when regulatory engagement is likely to be required. The table is not exhaustive and does not replace early engagement with relevant agencies. It summarises Biosecurity New Zealand guidance on assessing and mitigating biosecurity risks associated with mussel translocations, including example scenarios representing different levels of marine pest risk and corresponding mitigation measures. The scenarios align with the Section 52 permission process under the Biosecurity Act 1993. The risk factors and mitigation measures presented are illustrative only and provided for deliberative purposes. The assessments in this table draw on baseline system and pressures monitoring and feasibility investigations undertaken prior to implementation.

		Low risk	Moderate risk	High risk
Active restoration project stage	Risk factor	Risk factor assessment	Risk factor assessment	Risk factor assessment
Getting started	Scale of movement	Within the same coastal and marine systems where the species may disperse naturally.	Within the same region, but between distinct coastal and marine systems where dispersal would not occur naturally.	Between two regions where marine pests are absent from the receiving environment.
Getting started – baseline monitoring	Site information (presence / absence of marine pests)	The translocation site has been surveyed – marine pests are present.	The translocation site has been surveyed – marine pests are present.	The translocation site has been surveyed – marine pests are NOT present.
Making it happen – develop a risk management plan	Density of marine pests (if present)	Marine pests are present in high densities (comparable to densities on similar substrates in known hotspots, e.g. harbour and marinas).	Marine pests are present in low densities.	Marine pests are absent.
	Pathway considerations	The translocation site is not a high-traffic area where the marine pests could access pathways for further movement.	The translocation site is near a high-traffic area where the marine pests could access pathways for further movement.	The translocation site is in an area with high potential for further spread to other locations.

		Low risk	Moderate risk	High risk
Making it happen – implement proof-of-concept	Available mitigation	Relevant information to support the assessment is provided.	Relevant information to support the assessment is provided. Physical removal of marine pests is undertaken prior to release. Materials and stock are treated to kill marine pests (fresh water, acetic acid, etc.).	Relevant information to support the assessment is provided. Physical removal of marine pests is undertaken prior to release. Materials and stock are treated to kill marine pests (fresh water, acetic acid, etc.).

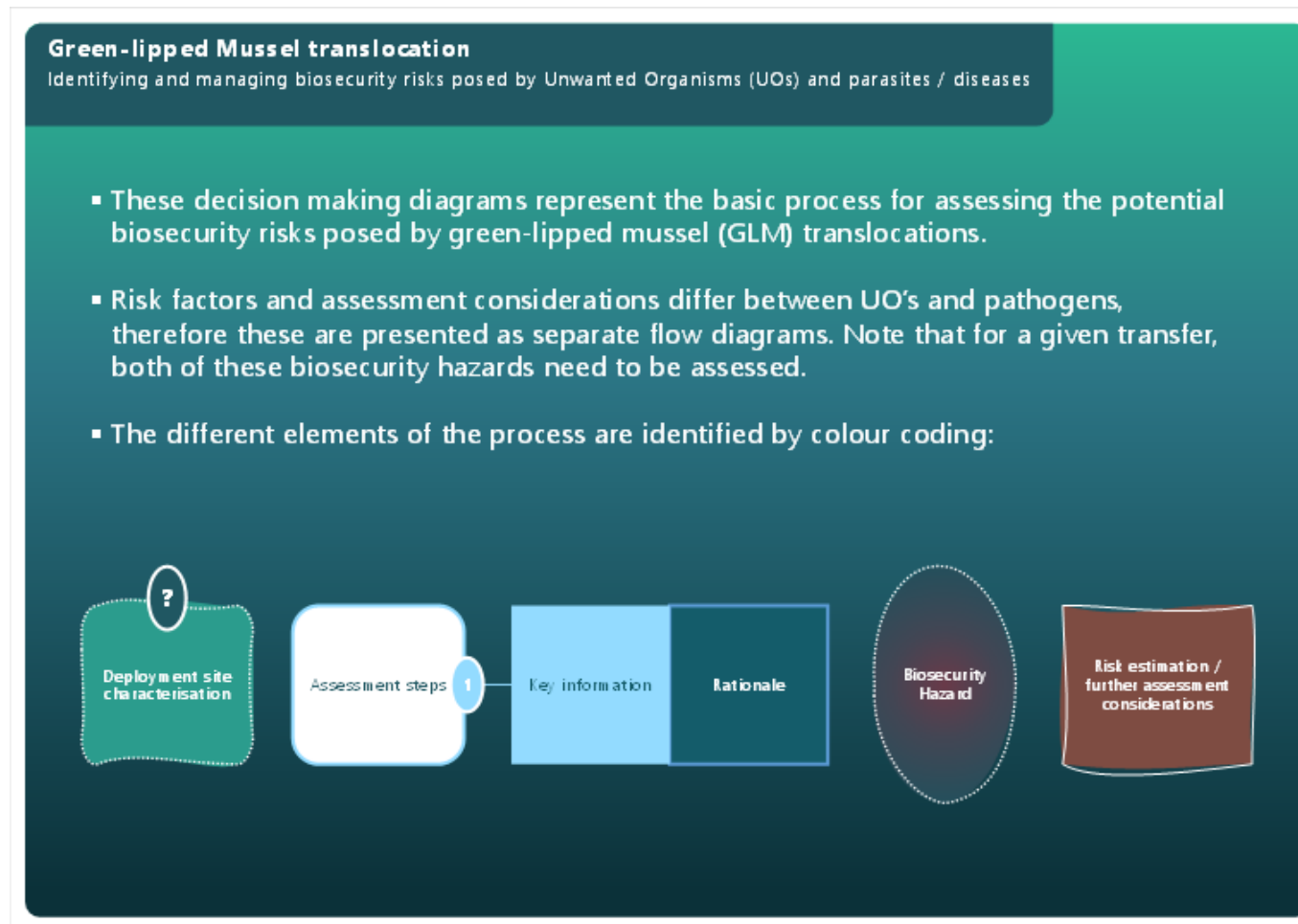
Table A6.2. Risk factors worth considering when applying for a Section 52/53 permit – example from mussel translocations within a same region

Risk factors	Potential questions	Detailed information
What biosecurity hazards (pests and disease organisms) are present at the source (e.g. mussel farm) and restoration sites?	How widespread are these hazards? At what densities or prevalence?	This information is important for determining the likelihood of translocation and the impact, as well as the potential steps to safeguard against introducing new pests / diseases to receiving areas, or supplementing population growth of pests already present at the receiving sites.
Geographic extent / scale of the mussel movement	Are shellfish located over distinct areas within the same region? * Are they located between different regions or coastal areas ?	In some instances, the inter-regional or long-distance movement of aquatic animals has been linked to pest and disease emergence in aquaculture. These movements provide opportunities for pests and pathogens to bypass natural barriers and encounter new habitats or hosts. With pathogens, movement can also contribute to the emergence of new diseases.
Characteristics of the receiving area(s)	What is the management status of pest and disease organisms?	Could the movement of mussels undermine regional pest management efforts?

Risk factors	Potential questions	Detailed information
	Are there valuable existing environmental, social, economic or cultural attributes?	Introduction of pests and / or pathogens can diminish the value of these attributes.
	Are artificial substrates to support mussel reef establishment present?	Substrates can be readily colonised by high densities of marine pests, such as clubbed tunicate and the Mediterranean fanworm, providing an opportunity for marine pests to become established in a new area.
	Is maritime transportation infrastructure present (marinas, moorings, anchorages, etc.)? If so, how close by is it?	Transportation infrastructure provides ongoing opportunities for further pest and disease spread to restoration sites.
Availability and efficacy of treatment methods for pests and pathogens	Are there methods available to treat pests and pathogens at scale?	Freshwater baths have been used to control marine pests in mussel deployments.
Source shellfish management practices	Are the shellfish healthy and is pest presence monitored? If so, how frequently?	Routine monitoring and recording of shellfish health and the presence of pest species enables effective management of the production environment. Production improvements create a less stressful environment, helping to prevent the occurrence and spread of disease.

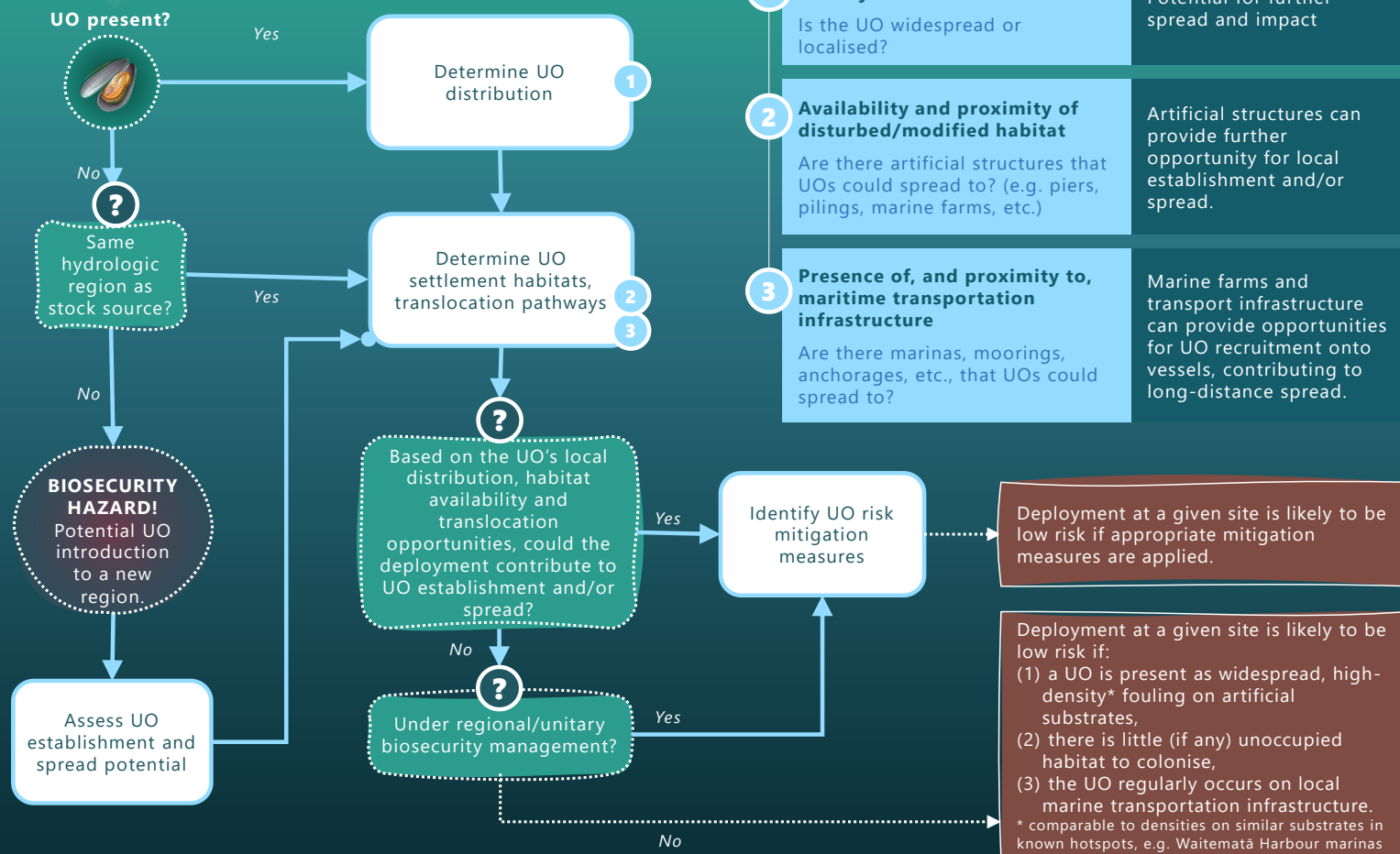
* If translocations are cross regional / unitary boundaries within a hydrologic region, the local government of a receiving area should be consulted accordingly to ensure that any biosecurity and consent obligations are addressed.

Figure A6.1. Key for the following biosecurity risk assessment decision-making flow diagram for mussel translocations for mussel reef restoration in the Hauraki Gulf (developed by Biosecurity New Zealand). The assessment is limited to marine pests (includes unwanted organisms) parasites and diseases in Aotearoa New Zealand that can affect or be carried by wild and farmed shellfish. These decision-making diagrams are intended to be a general guide and are neither exclusive nor limiting. Assessment considerations and risk factors can vary from case to case, which may necessitate using a variation of the presented approach.



Green-lipped mussel translocation – identifying and managing Unwanted Organism (UO) biosecurity risks

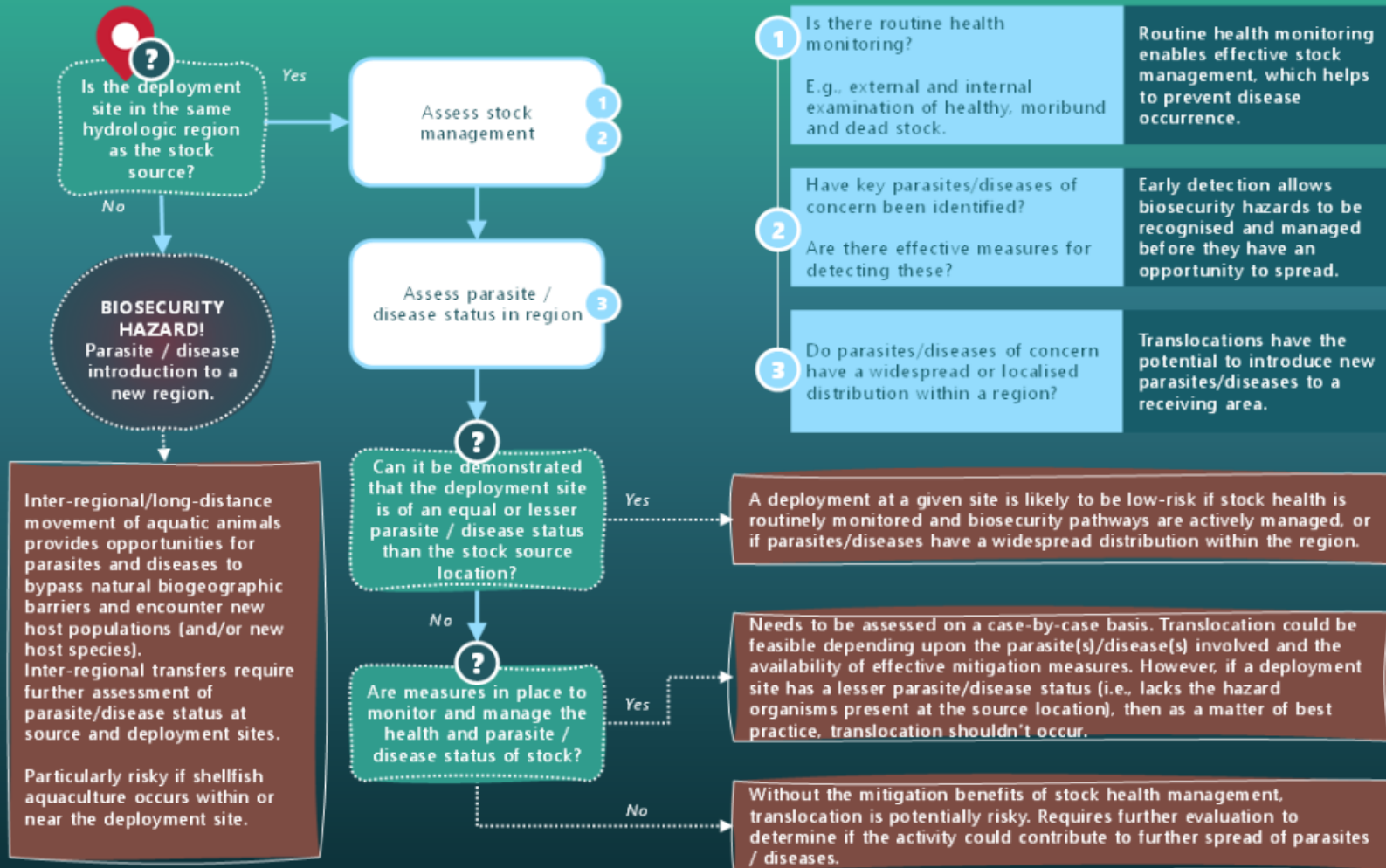
DEPLOYMENT SITE CONSIDERATIONS



NB: Under this assessment advice, it is assumed that the site of origin has an UO present.

Green-lipped Mussel translocation – assessing and managing parasite / disease hazards

For deliberative purposes only.



Appendix 7. Ecological Recovery Tracker template

The Ecological Recovery Tracker template is provided for practitioners to record and communicate ecological recovery progress across their own restoration project. An example of a completed tracker is shown in Figure 13 and explained in Section 4.1. This template has been adapted from the Society for Ecological Restoration (SER) framework Recovery Tracker wheel ^e.

RECOVERY							TOTALS
 Absence of threats	Contamination						
	Invasive species						
	Over-utilisation						
 Ecosystem function	Productivity, cycling						
	Habitat interactions						
	Resilience recruitment						
 Species composition	Desirable plants						
	Desirable animals						
	No undesirable species						
 External exchanges	Seascape flows						
	Gene flows						
	Habitat links						
 Structural diversity	All strata present						
	All trophic level						
	Spatial mosaic						
 Physical conditions	Substrate physical						0
	Substrate chemical						
	Water chemo-physical						

Recovery score:
0/90

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Mauri ora!



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