Earth Sciences New Zealand

Activity-Pressure Matrix Scoring Quality Assurance Review

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Contents

Tables

Figures

Executive summary

The Department of Conservation (DOC) recently initiated a multi-stage project to link human activities to marine pressures in a standardised and evidence-based way. DOC contracted Earth Sciences New Zealand (ESNZ, formerly NIWA) to populate a table, or matrix, which identifies and formalises relationships between human activities and their associated pressures. It is called the Aotearoa New Zealand Activities-Pressure Matrix.

External review of the Matrix recommended a targeted review of the scores to improve the transparency, consistency, and evidential basis of Matrix outputs, with particular focus on cells supported primarily by expert opinion.

This report presents the results of a targeted quality assurance review of the Activities-Pressure Matrix. The review combined expert surveys, workshops, and synthesis of feedback to evaluate and refine activity–pressure linkages.

For the targeted surveys, we relied on the expertise of fourteen professional marine scientists working in Aotearoa New Zealand. The surveys were 'targeted' because experts were asked to review and comment on parts of the Matrix (specific marine pressures) that were within their area of expertise. The group of experts collectively provided breadth of expertise but also depth of expertise (due to overlaps in background and work experience). There were nine versions of the survey sent to the fourteen experts.

Survey questionnaires were designed to elicit responses as to the accuracy of Matrix evidence scores and recommendations for improved/updated evidence scores, and to provide literature and rationale for the recommendations. Survey data were collated, synthesised and grouped by ESNZ so that they could be discussed and reviewed during two expert workshops.

Activity-pressure relationships to review in the workshop were prioritised if; 1) the suggested evidence score differed between experts, 2) if only one expert gave an opinion, or 3) if a low or minor impact of the activity on the pressure was noted. Relationships were not included in the workshop if experts had provided literature evidence to support the relationship, or if the suggested evidence score was the same for all respondents. The expert workshops were convened with the same group of 14 experts engaged during the targeted survey phase, although attendance varied between workshops. For each of the relationships discussed during the workshops, a final evidence score was recorded, along with notes of the discussion points and recommended literature evidence.

Results from the surveys and workshops were used to update and improve the matrix, enhancing the clarity, consistency, and confidence in the reviewed relationships. A total of 231 activity–pressure relationships (from an initial set of 313 relationships supported primarily by expert opinion) were reviewed through a combination of targeted surveys and expert workshops. Of the reviewed activity-pressure relationships, 94% of the scores were either validated or supported by improved evidence (e.g., additional literature or stronger expert consensus). The remaining 6% were reclassified as having no plausible relationship (score 5). This review therefore provides confidence in the methodology used to date during the development of the Activity-Pressure and Pressure-Biodiversity matrices.

The revised, completed Activity-Pressure matrix is presented as a companion file to this report; "Activity Pressure Matrix_FINAL.xlsx".

1 Introduction

The coastal marine environment of New Zealand is subject to a wide range of human activities that generate diverse pressures on ecosystems. Understanding the relationships between these activities and the pressures they create is essential for assessing and managing risks to marine biodiversity and for providing an evidence base to support management decisions.

DOC previously contracted ESNZ to develop the Activity-Pressure matrix which links human activities with marine pressures. DOC developed the suite of marine pressures and activities by reviewing existing lists of marine activities and pressures from New Zealand and overseas, including those presented in the United Kingdom's Joint Nature Conservation Committee (JNCC) Pressures Activities Database (Robson et al. 2018), the MarHADs tool (MacDiarmid et al. 2011), and assessments of anthropogenic threats to New Zealand marine habitats (Baird and Wood 2012; MacDiarmid et al. 2012). DOC's review resulted in a categorised list of 65 activities (Appendix B) and 35 pressures (Appendix C) and their definitions.

The Activity-Pressure matrix is designed to form a core component of a broader framework, linking activities to pressures, pressures to biodiversity (Pressure-Biodiversity matrix) and, ultimately, to management responses to activities (Management-Activity matrix). It is also complementary to related initiatives, including spatial mapping of stressor footprints (Lundquist et al. 2025) and DOC's Key Ecological Areas (KEA) framework (Freeman et al. 2017), which together contribute to improving understanding of human impacts on marine ecosystems.

Initial population of the Activity–Pressure Matrix was undertaken through expert workshops and literature reviews (Figure 1-1). Activity pressure relationships in the matrix were given evidence scores (1 to 5) according to the type of evidence supporting each (Table 1-1). External review of the project outputs recommended targeted quality assurance of the matrix scoring to improve the transparency, consistency, and evidential basis of the matrix, with particular focus on cells currently only supported by expert opinion (rather than by grey or peer-reviewed literature). Subsequently, DOC contracted ESNZ to conduct the quality assurance review of the Activity-Pressure matrix. The review was required to confirm that the relationships between human activities and marine pressures are scientifically defensible, consistently applied, and suitable for use in subsequent analyses and decision-making.

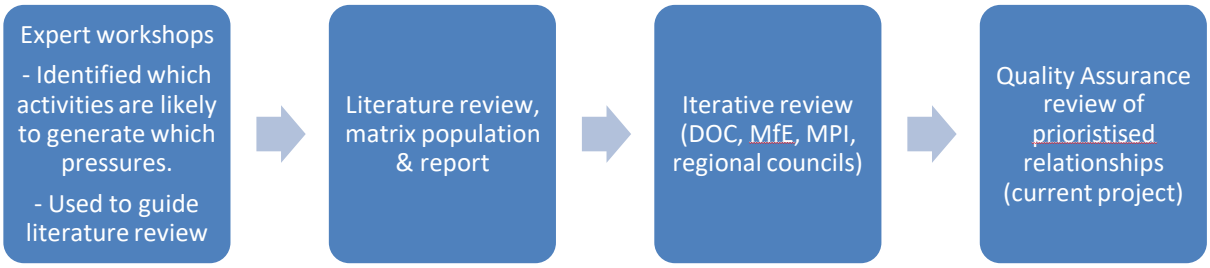

Figure 1-1: Activity-Pressure Matrix development and review process.

Table 1-1: Confidence scores and colouring used in the Activity-Pressure matrix.

Confidence score:	Evidence type
1	New Zealand published literature
2	New Zealand grey literature
3	International published and grey literature
4	Expert opinion
5	No known relationship

2 Methodological approach and outcomes

The quality assurance process systematically prioritised activity–pressure relationships that were primarily supported by expert opinion for inclusion in targeted expert surveys, workshop discussion, and evidence collation to test their scientific defensibility and determine whether confidence scores should be retained, revised, or reclassified.

2.1 Prioritisation

An initial workshop with the project team (Shane Geange, Karen Tunley, Drew Lohrer, Emily Douglas) was carried out to prioritise parts of the Activity-Pressure Matrix for quality assurance review. Columns (pressures), rows (activities) or cells where evidence for activity pressure relationships was largely underpinned by expert opinion (scored 4, orange, Table 1-1) were identified, discussed and selected for expert review.

Relationships prioritised for review were grouped and assigned to experts based on area of expertise, e.g., fishing, physical impacts to the seabed, biodiversity, ocean chemistry. We aimed to have each prioritised relationship reviewed by at least two experts.

2.2 Surveys

Targeted surveys were used to obtain structured expert input on activity–pressure relationships that were primarily supported by expert opinion. The surveys provided a consistent mechanism for experts to assess existing confidence scores, identify relevant evidence, and explain the rationale for any recommended changes.

Survey questionnaires (Figure 2-1) were designed to:

1. determine whether the current expert evidence score (4, expert opinion) was accurate or should be reviewed,
2. assess whether a credible activity-pressure pathway exists,
3. enable survey respondents to contribute known literature, and
4. provide a written rationale or argument for their recommendation.

Cell number	Activity category	Activity	Pressure	Evidence needs reviewing (Yes/No)	Current evidence score	New evidence score	Is there a credible pathway for the activity to generate the pressure?	Rationale (1-2 sentences)
e.g. 444	3: Extraction o	Fishing – bottom trawling	Physical loss (to land or freshwate	Yes	4	5	No	*No plausible cause for this activity to cause this pressure.*
e.g. 242	2: Waste mana	Sewage disposal	De-oxygenation	Yes	4	3	Yes	*This is evidenced in XXXX et al. 2005 [provide full reference]*
e.g. 190	1: Coastal Man	Reclamations and causeways	Introduction of light	No	4	4	Yes	*Current expert opinion is accurate. No known literature that gives evidence of reclamations and causeways causing introduction of light to the marine environment.*

Figure 2-1: Expert opinion survey spreadsheet. Survey spreadsheet including three examples of activity-pressure relationships to be reviewed with example responses.

Survey questions asked experts to:

- Confirm whether the existing evidence score (4: expert opinion) was appropriate.
- Recommend an alternative evidence score where relevant.
- Indicate whether a credible causal pathway exists.
- Provide supporting literature.
- Provide a brief rationale for their recommendation.

Nine survey versions were prepared using the same format, but each was customised so that the activity–pressure relationships assigned for review aligned with the relevant experts' areas of expertise. Each survey version was sent to two or three experts whose scientific expertise best matched the activity–pressure relationships included for review. Surveys were sent out on 29 April 2026, and 10 written responses were received. Each respondent reviewed between 35 and 110 relationships in their survey. Survey responses were collated by topic into two groups for subsequent workshops.

2.3 Workshops

Survey responses from the nine survey versions were organised into two workshop groups. Workshop 1 included 6 expert participants, who collectively reviewed 138 activity–pressure relationships during the survey, of which 39 were discussed during the workshop; Workshop 2 included 5 expert participants, who collectively reviewed 116 relationships during the survey, of which 46 were discussed during the workshop.

For each workshop, survey data was sorted by matrix cell number so that responses could be identified quickly and compared. Workshop discussions focused on relationships where:

- experts disagreed on evidence scores,
- only a single expert response was available, or
- the magnitude or plausibility of the relationship was uncertain.

Relationships were not included in the workshop if experts had provided literature as evidence to support the relationship, or if the suggested evidence score was the same for all respondents (i.e., no disagreement among experts).

For each of the relationships discussed during the workshops, a final evidence score was recorded, along with notes of the discussion points and recommended literature evidence.

2.4 Data collation and evidence score updates

An evidence score change log was generated using collated data from the surveys and workshops (Appendix A). It includes final evidence scores and indicates the decision pathway (Table 2-1) and rationale for each. The rationale includes comments made by experts in the surveys and during the workshop.

Table 2-1: Decision pathways for final evidence scores.

Decision pathway	Definition
Surveys agree	At least two experts provided the same evidence score, with no conflicting scores from other respondents
Literature provided	Literature with evidence provided
Workshop discussion	Score consensus decided during expert workshop

Of the total 231 activity pressure relationships reviewed, outcomes were as follows:

- 45% retained a confidence score of 4 “expert opinion”, indicating no change following review (Table 2-2, Figure 2-2).
- 49% were supported by literature and rescored to a confidence score of 1–3 (refer Table 1-1), indicating increased confidence.
- 6% were reclassified as having no plausible relationship (score 5).
- The remaining relationships were refined through workshop consensus.

Table 2-2: Number of activity pressure relationship scores assigned using each decision pathway. % indicates the proportion of scores (out of 231 reviewed relationships) reached via each decision pathway. Note that some scores assigned with the ‘Literature provided’ decision pathway were also discussed in the workshops (when appropriate literature was suggested).

	Score 1-3	Score 4	Score 5	%
Surveys agree	0	41	0	18
Literature provided	113	0	0	49
Workshop discussion	0	63	14	33
Total	113	104	14	

New literature evidence identified through the review was also applied to relevant activity–pressure relationships outside the reviewed set, and scores were updated where appropriate.

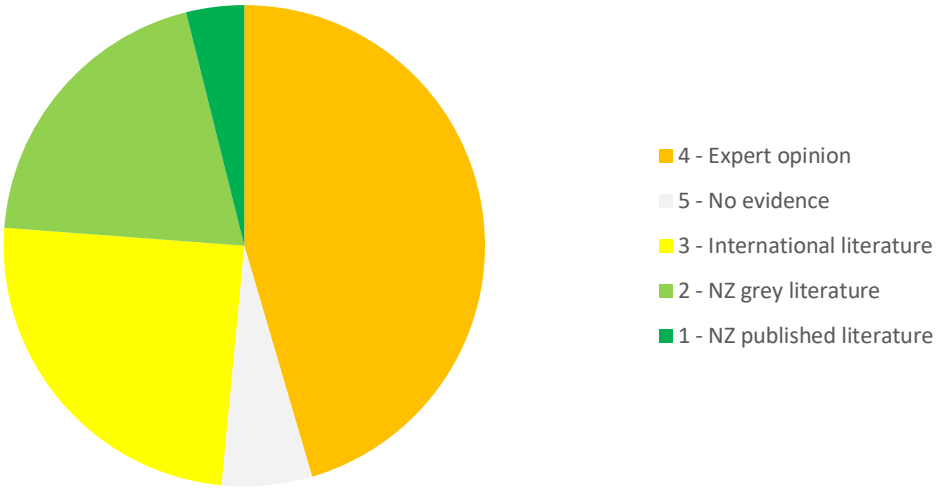

Figure 2-2: Final evidence scores of reviewed activity pressure relationships. Pie represents 231 activity pressure relationships previously underpinned by expert opinion (score 4, orange).

The quality assurance process effectively improved the integrity of the Activity-Pressure matrix and highlighted the low level of error or uncertainty obtained through the initial expert workshops. Only 6% of the reviewed relationships were re-scored as 5 (no evidence for a relationship). This low proportion likely reflects a precautionary approach taken during initial scoring, where plausible but uncertain relationships were retained. Many of the workshop discussions around uncertainty of activity-pressure relationships were about the dependence of relationships on scale and context. This emphasises the importance of the Activity-Pressure matrix and its counterparts being supported by a robust guidance document that ensures accurate, appropriate and defensible use as a decision support tool.

The revised, completed Activity-Pressure matrix is presented as a companion file to this report; "Activity Pressure Matrix_FINAL.xlsx". The file is divided into the following tabs:

- Info – included definitions of the matrix display components.
- Matrix – fully populated and revised Activity-Pressure Matrix.
- Evidence table – list of references providing evidence for each of the identified activity pressure relationships.
- Evidence table full – the full matrix evidence table including cell numbers without literature evidence. This table should be retained to facilitate the addition of future evidence.

3 Alterations to previous activity and pressure definitions

Detailed definitions for each activity and pressure were developed during the previous project phase by the DOC based on those published by the Joint Nature Conservation Committee (JNCC) (Robson et al. 2018). As the wider project progressed, some existing definitions required alterations to ensure they were fit for purpose for managing New Zealand's unique marine environment. Workshop discussions during the current project highlighted the following changes to definitions.

3.1 Changes to activity definitions (Appendix B)

3.1.1 Extraction – water (abstraction)

Definition altered to specify inclusion of river flow diversions such as the Kaituna cut (Makētu) and Woolston cut (Christchurch): "Includes river diversion that reduces or removes flow of freshwater through estuaries and coastal environments."

3.1.2 Sonar surveys

During workshop discussions about physical impacts to the seabed there was uncertainty as to whether sonar surveys use receivers mounted on the seafloor. Further investigation revealed that sonar surveys do not normally deploy equipment to the seabed. The definition has been altered to clarify this: "The use of echo sounders underwater for research or exploratory purposes as well as military purposes. It also considers the vessels, vehicles, and materials needed for these activities. These surveys do not typically use seabed receivers, but some monitoring surveys use moored echosounders."

3.1.3 Gas storage operations

This activity has been removed from the matrix, as it is not currently undertaken or anticipated in New Zealand.

4 Concluding remarks and recommendations

This project has provided an independent, evidence-informed assessment of the Activity-Pressure matrix, strengthening its credibility as a national decision-support tool. This quality assurance process provides confidence in the methodology used to date during the development of the matrices. Of the reviewed activity-pressure relationships previously underpinned by expert opinion, 94% of the scores were validated or given increased confidence scores. This demonstrates that the original expert-derived matrix was largely robust, with relatively few relationships requiring substantive revision.

As noted in previous reports, it is recommended that an approach is developed for assessing the relative strength of each activity–pressure relationship, enabling the matrix to move beyond binary presence/absence and toward a more nuanced, evidence-based representation of impact magnitude and likelihood. In practice, the Activity-Pressure matrix should be used alongside local environmental information to test whether a particular activity-pressure relationship is likely to be consequential in a particular context, considering spatial and temporal scales as well as potential intensity of an activity.

For many of the activities in the matrix, the definitions include the impacts of the vessels involved in coordinating/implementing the activity in addition to the activity itself. This means that many pressures that are generated by vessels in general (e.g., non-synthetic and synthetic compound contamination, noise changes and introduction or spread of non-indigenous species) occur across many activities. Although this provides a catch-all and precautionary approach, it may dilute the nuances or specificity of pressures generated by different activities, which may have consequences for how helpful the matrix is for specific management scenarios. This was a point of discussion in the workshops and may warrant further review.

Because research and knowledge about impacts in New Zealand's marine environment are continually developing, the matrix should be regarded and maintained as a living document.

5 Acknowledgements

Thanks to project team members Shane Geange and Karen Tunley for guidance and support during the project. Our sincere gratitude is extended to the many experts who shared their time and knowledge to complete the surveys and participate in the workshops: Sean Handley, Matt Bennion, John Zeldis, Scott Nodder, Sally Watson, Owen Anderson, Vonda Cummings, Ashley Rowden, Simon Thrush, Judi Hewitt and Graeme Inglis. Thanks to Tom Brough for reviewing the draft report and Jo Downey for editorial support.

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Appendix A Final evidence scores and change log for Activity-Pressure Matrix QA

Descriptions of reviewed activity pressure relationships previously scored as 4 (expert opinion), including decision pathway and rationale for final evidence scores

Decision pathways	
Surveys agree	More than one expert survey indicated the same score
Literature provided	Literature with evidence provided
Workshop discussion	Score consensus decided during expert workshop

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
10	1: Coastal Management Activities	Coastal defence and land claim protection (including. beach replenishment)	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	4	Surveys agree	
27	1: Coastal Management Activities	Coastal defence and land claim protection (including. beach replenishment)	Death or injury by collision	4	4	Workshop discussion	Vessel collisions, lights.
39	1: Coastal Management Activities	Coastal boat ramps, docks, ports and marinas	pH changes	4	4	Workshop discussion	
48	1: Coastal Management Activities	Coastal boat ramps, docks, ports and marinas	Physical loss (to land or freshwater habitat)	4	2	Literature provided	Building of boat ramps, marinas, docks, ports etc can result in physical loss of coastal land habitat.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
56	1: Coastal Management Activities	Coastal boat ramps, docks, ports and marinas	Electromagnetic changes	4	4	Workshop discussion	Magnets used to hold boats against the wharf, electromagnetic fields for cathode systems on wharfs, cabling around wharfs (although a different activity later), current leakage from vessels in marinas.
60	1: Coastal Management Activities	Coastal boat ramps, docks, ports and marinas	Death or injury by collision	4	1	Literature provided	Light pollution from coastal docks or shipping ports may cause disorientation of nocturnal seabirds.
61	1: Coastal Management Activities	Coastal boat ramps, docks, ports and marinas	Visual disturbance	4	4	Surveys agree	
72	1: Coastal Management Activities	Forestry	pH changes	4	4	Surveys agree	Forestry can affect pH in soils and hence rivers/streams, which discharge into the sea. Need to assess what these linkages might be in coastal NZ context, especially in areas where land cover is predominantly forestry.
76	1: Coastal Management Activities	Forestry	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	4	Workshop discussion	Marlborough sounds herbicide spraying on hill slopes to allow pine growth before weeds get away. Contamination effect from forestry chemicals.
85	1: Coastal Management Activities	Forestry	Penetration and/or disturbance of the substrate below the surface of the seabed	4	1	Literature provided	Forestry slash (waste tree material after felling) can through landslides and flooding make its way via rivers into coastal waters. This material can be large enough or in large enough quantities to conceivably cause penetration and/or disturbance of the substrate below the surface of the seabed.
93	1: Coastal Management Activities	Forestry	Death or injury by collision	4	4	Workshop discussion	Slash entering the marine environment.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
105	1: Coastal Management Activities	Farming and Agriculture	pH changes	4	4	Surveys agree	Farming on land can reduce alkalinity in river and hence the buffering capacity (pH) of coastal waters. Need to assess what these linkages might be in coastal NZ context, especially in areas where land cover is predominantly agricultural.
174	1: Coastal Management Activities	Reclamations and causeways	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Machinery involved in construction and maintenance can leak oil, asphalt used on causeways can be hydrocarbon source.
175	1: Coastal Management Activities	Reclamations and causeways	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	4	Workshop discussion / Literature provided	Lumber used on causeways is treated, contaminant control mechanisms in some large causeways in northland, which suggest effect. Types of spoil material used to create reclamations.
184	1: Coastal Management Activities	Reclamations and causeways	Penetration and/or disturbance of the substrate below the surface of the seabed	4	2	Workshop discussion / Literature provided	Reclamation and building of causeways could conceivably penetrate/disturb substrate below surface of seabed - excavation is likely as well as just placement of material on seabed.
192	1: Coastal Management Activities	Reclamations and causeways	Death or injury by collision	4	4	Surveys agree	Nighttime construction may cause light pollution that disorientates seabirds.
193	1: Coastal Management Activities	Reclamations and causeways	Visual disturbance	4	4	Surveys agree	
195	1: Coastal Management Activities	Reclamations and causeways	Introduct4ion or spread of non-indigenous species	4	3	Literature provided	Artificial structures are particularly susceptible to fouling by invasive species and can be stepping stones for the spread of invasive species. International and NZ studies.
199	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Temperature changes - local	4	2	Literature provided	Could cause small-scale, short-duration thermal anomalies in sheltered or poorly flushed systems. Could cause thermal stress in some species if repeated or chronic exposure. It is reasonable that such discharges can cause local temperature variations, when the

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
							discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
201	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Water flow (e.g., tidal current) changes - local	4	1	Literature provided	Wastewater discharge could affect marine water flow by altering local hydrodynamics, although the magnitude of the effect depends on discharge volume, outfall design, water depth, and environment receiving the flow. Capacity for extreme events to cause more regional water flow impacts. It is reasonable that such discharges could cause local flow variations, when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
204	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	pH changes	4	2	Literature provided	Pollution can have a positive (increase) effect on OA. Need to assess what these linkages might be in coastal NZ context, especially where organic pollutants are discharged directly into the coastal sea. Some examples globally of pH changes from waster/urban discharge causing variable or episodic extremes in localised pH. Likely strongly modulated by local hydrodynamic regime and concentration of outfall. It is reasonable that such discharges could cause local pH variations, when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
209	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	De-oxygenation	4	1	Literature provided	It is reasonable that such discharges could cause local oxygen fluctuations (depletion and/or production), when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
214	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Physical change (to another seabed type)	4	1	Literature provided	At site of outflow pipeline, seabed type will be changed to accommodate infrastructure. Changes in local seabed directly downstream of pipeline could also occur due to increased sediment deposition from wastewater covering pre-existing seabed (e.g., mud/silt layer over rocky seabed). It is reasonable that such discharges could cause physical changes to seabed sediment structure (e.g., grain size), when the discharges are significant relative to the receiving environment volume (e.g., shallow estuaries).
216	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Disturbance of the surface of the seabed	4	4	Surveys agree	It is reasonable that such discharges could disturb seabed surface structure (e.g., grain size), when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
219	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Siltation rate changes	4	1	Literature provided	Sediment laden flows from wastewater could locally change siltation rates and water turbidity, by transporting suspended particles and organic matter from upstream to the discharge point (usually where water velocity rapidly decreases, enhancing sediment deposition). It is reasonable that such discharges could add fine sediments (i.e., silt) to the water column and seabed, when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
224	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Barrier to species movement	4	1	Literature provided	Excess turbidity in the water column from suspended sediment in wastewater outflow could present potential barrier to species movement due to reduced visibility. High gradients of water quality in general could interfere with species movement also

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
226	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Visual disturbance	4	2	Literature provided	Any change to physical or chemical environmental conditions due to wastewater discharge could modify local habitats and disturb local marine life. It is reasonable that such discharges could alter visual conditions, when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
229	2: Waste management activities	Residential and urban wastewater (including storm water) discharges	Introduction of microbial pathogens	4	2	Literature provided	Evidence in international literature for pathogen transport from fresh to marine water systems via wastewater discharge sites. Pathogens can survive bound to small particles (e.g., sediment, plastic or glass debris). It is reasonable that such discharges could alter microbial pathogen concentrations, when the discharges are significant in size relative to the receiving environment (e.g., shallow estuaries).
292	2: Waste management activities	Industrial and agricultural liquid discharges	Visual disturbance	4	4	Surveys agree	
316	2: Waste management activities	Waste disposal - munitions (chemical and conventional)	Penetration and/or disturbance of the substrate below the surface of the seabed	4	4	Workshop discussion	Waste disposal of munitions will likely result in below surface penetration of chemicals through leakage of containers.
320	2: Waste management activities	Waste disposal - munitions (chemical and conventional)	Electromagnetic changes	4	5	Workshop discussion	No discernible relationship.
325	2: Waste management activities	Waste disposal - munitions (chemical and conventional)	Visual disturbance	4	4	Surveys agree	
336	2: Waste management activities	Dredge and spoil disposal	pH changes	4	3	Surveys agree / Literature provided	Dredging can have a positive (increase) effect on OA. Need to assess what these linkages might be in coastal NZ context, especially for dredging that occurs in harbours and spoil dumping that occurs offshore.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
367	2: Waste management activities	Thermal effluent discharges	Emergence regime changes - local	4	4	Workshop discussion	Any changes would likely be highly localised and only under regimes where the discharge energy is much greater than surrounding receiving environment.
371	2: Waste management activities	Thermal effluent discharges	Non-synthetic compound contamination - Transition elements and organo-metals	4	2	Workshop discussion / Literature provided	Tiwai Point discharges discussed.
372	2: Waste management activities	Thermal effluent discharges	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	2	Workshop discussion / Literature provided	Tiwai Point discharges discussed.
374	2: Waste management activities	Thermal effluent discharges	De-oxygenation	4	3	Surveys agree / Literature provided	
375	2: Waste management activities	Thermal effluent discharges	Nutrient enrichment	4	2	Literature provided	
387	2: Waste management activities	Thermal effluent discharges	Noise changes	4	4	Workshop discussion	Yes, if effluent is associated with pumping system. This would be more related to the infrastructure around effluent plants rather than the effluent itself.
389	2: Waste management activities	Thermal effluent discharges	Barrier to species movement	4	4	Workshop discussion	Excess turbidity in the water column from suspended sediment in wastewater outflow could present potential barrier to species movement due to reduced visibility. High gradients of water quality in general could interfere with species movement. Possible, thermal, visual barriers.
394	2: Waste management activities	Thermal effluent discharges	Introduction of microbial pathogens	4	4	Workshop discussion	Impacts more likely to be indirect, for example impacting the spread and behaviour of pathogens, rather than introduction of the pathogen itself.
415	2: Waste management activities	Rocket jettisoning	Penetration and/or disturbance of the substrate below the surface of the seabed	4	4	Workshop discussion	It is conceivable that jettisoned rocket material could penetrate/disturb substrate below the seabed surface, particularly is material is large. Thompson et al. 2025 Ecological Risk

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
							assessment report reviewed: no evidence for seabed effects.
419	2: Waste management activities	Rocket jettisoning	Electromagnetic changes	4	5	Workshop discussion	Thompson et al. 2025 Ecological Risk assessment report reviewed: no evidence for electromagnetic effects.
435	3: Extraction of living resources	Fishing – bottom trawling	pH changes	4	3	Literature provided	Bottom trawling can have a positive (increase) effect on OA by remineralisation of resuspended sediments (modelling only). Need to assess what these linkages might be in coastal NZ context, especially offshore. Oxidation of anoxic sediments exposed by trawling lowers pH of surrounding water.
438	3: Extraction of living resources	Fishing – bottom trawling	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Literature provided	Contaminants in sediments resuspended. Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc
439	3: Extraction of living resources	Fishing – bottom trawling	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Resuspension of historic accumulations of pollutants, leaching of antifoulants from vessels.
444	3: Extraction of living resources	Fishing – bottom trawling	Physical loss (to land or freshwater habitat)	4	5	Workshop discussion	No plausible pathway.
445	3: Extraction of living resources	Fishing – bottom trawling	Physical change (to another seabed type)	4	4	Workshop discussion	Smothering by habitats through resuspended sediment deposition. Assuming here that "another seabed type" means a seabed not directly impacted by the trawling - i.e., another habitat adjacent or distant from where the trawling occurs. Indirect effects - e.g., impact from deposition of sediment suspended by trawling could conceivably be great enough to physically change another seabed type.

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457	3: Extraction of living resources	Fishing – bottom trawling	Visual disturbance	4	4	Surveys agree	
459	3: Extraction of living resources	Fishing – bottom trawling	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water. The NZ report (below) summarises these pathways.
468	3: Extraction of living resources	Fishing – dredging	pH changes	4	3	Literature provided	Dredging can have a positive (increase) effect on OA. Need to assess what these linkages might be in coastal NZ context, especially dredging occurs in harbours and coastal systems. Oxidation of anoxic sediments exposed by dredging lowers pH of surrounding water.
471	3: Extraction of living resources	Fishing – dredging	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Literature provided	Contaminants in sediments resuspended. Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
472	3: Extraction of living resources	Fishing – dredging	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Resuspension of historic accumulations of pollutants, leaching of antifoulants from vessels.
475	3: Extraction of living resources	Fishing – dredging	Organic enrichment	4	3	Literature provided	Conceivable if disturbed sediment is organically enriched, for overlying water.
504	3: Extraction of living resources	Fishing – midwater trawling	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
505	3: Extraction of living resources	Fishing – midwater trawling	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
523	3: Extraction of living resources	Fishing – midwater trawling	Visual disturbance	4	3	Literature provided	

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
537	3: Extraction of living resources	Fishing – traps (potting/creeling)	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
538	3: Extraction of living resources	Fishing – traps (potting/creeling)	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels, ghost gear and abandoned pots recognise chemical contamination as a secondary impact (alongside plastics and entanglement).
541	3: Extraction of living resources	Fishing – traps (potting/creeling)	Organic enrichment	4	3	Literature provided	Baited lobster traps and pots cause localized organic enrichment of underlying sediments through the release and decay of bait material, resulting in increases in sediment oxygen demand and shifts toward opportunistic benthic fauna at the scale of individual traps.
548	3: Extraction of living resources	Fishing – traps (potting/creeling)	Changes in suspended solids	4	3	Literature provided	Trap and pot fisheries can cause short-lived, localized increases in suspended sediments and turbidity during gear setting, hauling, and movement along the seabed, particularly in soft-sediment habitats.
552	3: Extraction of living resources	Fishing – traps (potting/creeling)	Noise changes	4	4	Workshop discussion	Fishing activity generates noise during pot laying. Mainly the boats and is a temporal scale issue. Pots themselves and traps themselves not an issue.
556	3: Extraction of living resources	Fishing – traps (potting/creeling)	Visual disturbance	4	4	Surveys agree	Laying of pots would have temporary impacts above water, and while the pot is set, altering natural features of seabed.
557	3: Extraction of living resources	Fishing – traps (potting/creeling)	Genetic modification and translocation of indigenous species	4	4	Surveys agree	Incidental organism movement via biofouling on gear or vessels is managed through MPI marine biosecurity rules (e.g., Fiordland cleaning requirements, regional pathway plans).
558	3: Extraction of living resources	Fishing – traps (potting/creeling)	Introduction or spread of non-indigenous species	4	2	Surveys agree / Literature provided	Incidental organism movement via biofouling on gear or vessels is managed through MPI marine biosecurity rules (e.g., Fiordland cleaning requirements, regional pathway plans).
559	3: Extraction of living resources	Fishing – traps (potting/creeling)	Introduction of microbial pathogens	4	4	Workshop discussion	Conceivable that gear movements could transfer microbes.

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583	3: Extraction of living resources	Fishing – spear fishing	Litter	4	4	Surveys agree	Fishers targeting kingfish for example use "flashers" that could fragment (plastic) or be lost.
585	3: Extraction of living resources	Fishing – spear fishing	Noise changes	4	5	Workshop discussion	No persistent effect on marine environment.
586	3: Extraction of living resources	Fishing – spear fishing	Introduction of light	4	4	Surveys agree	Conceivable, for personal transition to/from fishing, but unlikely as a target species attractant. Torches - probably.
587	3: Extraction of living resources	Fishing – spear fishing	Barrier to species movement	4	5	Workshop discussion	Inconsequential
588	3: Extraction of living resources	Fishing – spear fishing	Death or injury by collision	4	5	Workshop discussion	Inconsequential
589	3: Extraction of living resources	Fishing – spear fishing	Visual disturbance	4	5	Workshop discussion	Inconsequential
590	3: Extraction of living resources	Fishing – spear fishing	Genetic modification and translocation of indigenous species	4	4	Workshop discussion	Conceivable that gear movements could transfer indigenous species.
591	3: Extraction of living resources	Fishing – spear fishing	Introduction or spread of non-indigenous species	4	2	Workshop discussion / Literature provided	Conceivable that gear movements could transfer NIS.
592	3: Extraction of living resources	Fishing – spear fishing	Introduction of microbial pathogens	4	5	Workshop discussion	Inconsequential
593	3: Extraction of living resources	Fishing – spear fishing	Removal of target species	4	3	Surveys agree / Literature provided.	
594	3: Extraction of living resources	Fishing – spear fishing	Removal of non-target species	4	4	Workshop discussion	Cracking open kina to attract target species.
603	3: Extraction of living resources	Fishing – set netting	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Literature provided	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal,

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							microplastic absorption from discarded synthetic ropes, buoys etc.
604	3: Extraction of living resources	Fishing – set netting	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
613	3: Extraction of living resources	Fishing – set netting	Penetration and/or disturbance of the substrate below the surface of the seabed	4	3	Literature provided	Minor and localised benthic disturbance associated with static anchoring and limited seabed contact. Impact to the substrate is evidenced via removal of biogenic species and damage to physical habitat.
614	3: Extraction of living resources	Fishing – set netting	Changes in suspended solids	4	4	Workshop discussion	Weighted or anchored at bottom, can disturb sediment. Flatfish targeting will have net on the bottom. Potential but relative to back not elevating above ambient.
618	3: Extraction of living resources	Fishing – set netting	Noise changes	4	4	Workshop discussion	Fishing activity generates noise during set netting. Noise related to vessel used to set and retrieve nets.
622	3: Extraction of living resources	Fishing – set netting	Visual disturbance	4	4	Surveys agree	Laying of nets would have temporary impacts above water, and while the net and anchors is set, altering natural features of seabed.
623	3: Extraction of living resources	Fishing – set netting	Genetic modification and translocation of indigenous species	4	4	Workshop discussion	Conceivable that gear movements could transfer indigenous species.
624	3: Extraction of living resources	Fishing – set netting	Introduction or spread of non-indigenous species	4	2	Workshop discussion / Literature provided	Conceivable that gear movements could transfer NIS.
625	3: Extraction of living resources	Fishing – set netting	Introduction of microbial pathogens	4	5	Workshop discussion	Inconsequential
640	3: Extraction of living resources	Fishing - lines	Organic enrichment	4	4	Surveys agree	Conceivable if disturbed sediment is organically enriched, for overlying water.

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646	3: Extraction of living resources	Fishing - lines	Penetration and/or disturbance of the substrate below the surface of the seabed	4	3	Literature provided	While likely to be verry minor impact, the weights used for line fishing could penetrate the seabed.
654	3: Extraction of living resources	Fishing - lines	Death or injury by collision	4	2	Literature provided	In NZ, significant mortalities of seabirds and other marine fauna have been associated with long-line fisheries, often through entanglement in gear.
655	3: Extraction of living resources	Fishing - lines	Visual disturbance	4	4	Surveys agree	
657	3: Extraction of living resources	Fishing - lines	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water. The NZ report (below) summarises these pathways.
658	3: Extraction of living resources	Fishing - lines	Introduction of microbial pathogens	4	3	Literature provided	Similar equipment recognised as vectors in aquaculture; aquaculture literature provided.
673	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Organic enrichment	4	4	Surveys agree	Conceivable if disturbed sediment is organically enriched, for overlying water.
679	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Penetration and/or disturbance of the substrate below the surface of the seabed	4	4	Workshop discussion	While likely to be minor impact, the weights on bottom of beach seines could penetrate the seabed as the net is dragged along seabed when being recovered.
687	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Death or injury by collision	4	3	Literature provided	Seabirds and marine mammals are known to aggregate around schools of fish targeted by purse seine operations. This can lead to incidental capture or disorientation by lights when fishing occurs at night.
688	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Visual disturbance	4	4	Surveys agree	
690	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.

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691	3: Extraction of living resources	Fishing - seines (encircling), excluding beach seining	Introduction of microbial pathogens	4	3	Literature provided	Similar equipment recognised as vectors in aquaculture; aquaculture literature provided.
702	3: Extraction of living resources	Fishing – Danish seine and beach seine	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Literature provided	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
703	3: Extraction of living resources	Fishing – Danish seine and beach seine	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
704	3: Extraction of living resources	Fishing – Danish seine and beach seine	De-oxygenation	4	3	Literature provided	Sediment resuspension can de-oxygenate overlying water.
705	3: Extraction of living resources	Fishing – Danish seine and beach seine	Nutrient enrichment	4	4	Surveys agree	Sediment resuspension could release stored nutrients.
706	3: Extraction of living resources	Fishing – Danish seine and beach seine	Organic enrichment	4	4	Surveys agree	Conceivable if disturbed sediment is organically enriched, for overlying water.
715	3: Extraction of living resources	Fishing – Danish seine and beach seine	Litter	4	3	Literature provided	
717	3: Extraction of living resources	Fishing – Danish seine and beach seine	Noise changes	4	4	Surveys agree	Fishing activity generates noise during seining.
718	3: Extraction of living resources	Fishing – Danish seine and beach seine	Introduction of light	4	4	Workshop discussion	Fishing activity uses lights during seining, vessel lights at night.
719	3: Extraction of living resources	Fishing – Danish seine and beach seine	Barrier to species movement	4	3	Literature provided	Seines heard and catch fish.

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720	3: Extraction of living resources	Fishing – Danish seine and beach seine	Death or injury by collision	4	3	Literature provided	Laying of nets would have temporary impacts above water, and while the net and anchors is set, altering natural features of seabed. Seabirds and marine mammals are known to aggregate around schools of fish targeted by purse seine operations. This can lead to incidental capture or disorientation by lights when fishing occurs at night.
721	3: Extraction of living resources	Fishing – Danish seine and beach seine	Visual disturbance	4	4	Surveys agree	
723	3: Extraction of living resources	Fishing – Danish seine and beach seine	Introduction or spread of non-indigenous species	4	2	Literature provided	Conceivable that gear movements could transfer NIS. The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
735	3: Extraction of living resources	Fishing - Diving and snorkelling	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Surveys agree	
736	3: Extraction of living resources	Fishing - Diving and snorkelling	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	4	Workshop discussion	Leaching of antifoulants from vessels.
745	3: Extraction of living resources	Fishing - Diving and snorkelling	Penetration and/or disturbance of the substrate below the surface of the seabed	4	2	Workshop discussion / Literature provided	Some diver and snorkelling fishing could cause penetration of substrate below seabed surface - e.g., bivalve removal.
753	3: Extraction of living resources	Fishing - Diving and snorkelling	Death or injury by collision	4	2	Workshop discussion / Literature provided	Fin strike.
756	3: Extraction of living resources	Fishing - Diving and snorkelling	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
787	3: Extraction of living resources	Harvesting – seaweed and other sea-based food	Visual disturbance	4	4	Workshop discussion	Human presence disturbing animals, seabirds, seals, etc.

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		(e.g., paua, kina, mussels, pūpū etc.)					
801	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Contaminants in sediments resuspended. Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
802	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	4	Workshop discussion	Resuspension of historic accumulations of pollutants, leaching of antifoulants from vessels.
803	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	De-oxygenation	4	4	Surveys agree	Sediment resuspension can de-oxygenate overlying water.
804	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Nutrient enrichment	4	4	Workshop discussion	Sediment resuspension could release stored nutrients.
805	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Organic enrichment	4	4	Workshop discussion	Conceivable if disturbed sediment is organically enriched, for overlying water.
809	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Temporary and/or reversible change of habitat structure (extraction)	4	3	Literature provided	Remote extraction could disturb the benthos.
814	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Litter	4	4	Surveys agree	
816	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Noise changes	4	4	Surveys agree	

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817	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Introduction of light	4	4	Surveys agree	Remote extraction activities likely to involve light.
819	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Death or injury by collision	4	3	Literature provided	Remote extraction will kill organisms.
820	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Visual disturbance	4	4	Workshop discussion	Extraction methods likely to create visual disturbance.
822	3: Extraction of living resources	Extraction of genetic resources e.g., bioprospecting and maerl (blue technology)	Introduction or spread of non-indigenous species	4	2	Literature provided	Conceivable that extraction equipment could get contaminated with NIS if not sterilised. The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
864	4: Production of living resources	Aquaculture - shellfish	pH changes	4	3	Literature provided	Calcification of shellfish can have a positive (increase) effect on OA (release of CO2) as well as positive by locking away IC in shell material. Need to assess what these linkages might be in coastal NZ context, especially for aquaculture in coastal and deep-water systems. Respiration and calcification processed combine to lower pH.
963	4: Production of living resources	Translocations and transplanting	pH changes	4	3	Literature provided	Translocation and transplanting of organisms will affect carbon dynamics. Need to assess what these linkages might be in coastal NZ context, especially in coastal systems.
1116	5: Extraction (and disposal) of non-living resources	Salvage operations	Death or injury by collision	4	4	Surveys agree	Nighttime operations that cause light pollution may cause disorientation of seabirds.
1124	5: Extraction (and disposal) of	Extraction – water (abstraction)	Salinity changes - local*	4	2	Literature provided	

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	non-living resources						
1125	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Water flow (e.g., tidal current) changes - local	4	2	Literature provided	
1126	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Emergence regime changes - local	4	2	Literature provided	Reduced local water availability or altered tidal circulation, due to abstraction, could can change inundation patterns and water residence times. Reduced local water availability or altered tidal circulation, due to abstraction, could can change inundation patterns and water residence times.
1127	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Oxygen changes	4	2	Literature provided	
1133	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	De-oxygenation	4	4	Workshop discussion	De-oxygenation could be indirect impact of abstraction, due to changes in local water circulation, sedimentation and organic matter accumulation and/or ecosystem function changes.
1134	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Nutrient enrichment	4	2	Literature provided	It is reasonable that freshwater abstraction could alter nutrient conditions and thereby change trophic status, when the abstractions are significant in size relative to the receiving environment (e.g., shallow estuaries).
1135	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Organic enrichment	4	2	Literature provided	It is reasonable that freshwater abstraction could alter organic enrichment conditions and thereby change trophic status, when the abstractions are significant in size relative to the receiving environment (e.g., shallow estuaries).
1137	5: Extraction (and disposal) of	Extraction – water (abstraction)	Physical loss (to land or freshwater habitat)	4	2	Literature provided	

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	non-living resources						
1138	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Physical change (to another seabed type)	4	2	Literature provided	
1139	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Temporary and/or reversible change of habitat structure (extraction)	4	2	Literature provided	
1140	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Disturbance of the surface of the seabed	4	2	Literature provided	
1143	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Siltation rate changes	4	2	Literature provided	It is reasonable that freshwater abstraction could alter siltation conditions and thereby change trophic and geomorphic status, when the abstractions are significant in size relative to the receiving environment (e.g., shallow estuaries).
1146	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Noise changes	4	4	Workshop discussion	Sub surface pumps, particularly if from groundwater offshore. Pathway to noise pollution likely depends heavily on abstraction method (e.g., whether pumped or by gravity intake).
1155	5: Extraction (and disposal) of non-living resources	Extraction – water (abstraction)	Removal of non-target species	4	2	Literature provided	Entrainment or trapping of any marine species during water abstraction is possible, either directly within abstraction intake systems or indirectly (e.g., altered flow speeds due to abstraction may alter pelagic species distributions).

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1240	6: Energy generation	Renewable energy – wave energy construction/operation/maintenance/decommissioning (not including cables)	Penetration and/or disturbance of the substrate below the surface of the seabed	4	3	Workshop discussion / Literature provided	Construction and placement of renewable energy infrastructure would involve penetration/disturbance of substrate below seabed surface. At least for likes of marine windfarms and tidal barrages, and even wave energy infrastructure needs to be anchored to seafloor.
1251	6: Energy generation	Renewable energy – wave energy construction/operation/maintenance/decommissioning (not including cables)	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
1159	5: Extraction (and disposal) of non-living resources	Addition – water (abstraction)	Emergence regime changes - local	4	2	Literature provided	
1160	5: Extraction (and disposal) of non-living resources	Addition – water (abstraction)	Oxygen changes	4	2	Literature provided	
1171	5: Extraction (and disposal) of non-living resources	Addition – water (abstraction)	Physical change (to another seabed type)	4	2	Literature provided	
1277	6: Energy generation	Marine hydrocarbon extraction - construction/operation/decommission (not including pipelines)	Electromagnetic changes	4	4	Workshop discussion	Similar to other infrastructure, include cathodes and anode.
1306	6: Energy generation	Marine hydrocarbon extraction - exploration phase	Penetration and/or disturbance of the substrate below the surface of the seabed	4	3	Workshop discussion / Literature provided	The exploration phase of marine hydrocarbon extraction will involve test drilling and sampling for monitoring effects. So, penetration of the seabed surface and disturbance of the substrate will occur.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1310	6: Energy generation	Marine hydrocarbon extraction - exploration phase	Electromagnetic changes	4	4	Workshop discussion	Vessels and drilling rigs could cause electromagnetic changes, electro mag surveys.
1361	7: Transport	Vessel moorings (including small rec vessels)	Non-synthetic compound contamination - Transition elements and organo-metals	4	3	Literature provided	Prolonged use by stationary vessels concentrates contaminants in localised sheltered areas with often low water flushing. Current expert opinion is accurate. Correlated with vessel intensity more than with mooring use. Some evidence of heavy metal contamination at anchorage sites for recreational vessels.
1362	7: Transport	Vessel moorings (including small rec vessels)	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Literature provided	Higher risk where offshore bunkering occurs. Difficult to differentiate risk of HC contamination at mooring vs in general port region.
1363	7: Transport	Vessel moorings (including small rec vessels)	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels. Impact on marine environment from antifoulants well recognised, distribution and transport in marine environment is less well understood. Associated with increased vessel traffic generally rather than specific to mooring sites.
1365	7: Transport	Vessel moorings (including small rec vessels)	Nutrient enrichment	4	3	Literature provided	Nutrient enrichment probably more likely from vessels in transit, or a risk in high traffic areas generally (from either sewage discharge or food waste).
1366	7: Transport	Vessel moorings (including small rec vessels)	Organic enrichment	4	3	Literature provided	Similar to nutrient enrichment.
1375	7: Transport	Vessel moorings (including small rec vessels)	Litter	4	3	Literature provided	Vessels generally considered to be a source of litter to the marine environment.
1378	7: Transport	Vessel moorings (including small rec vessels)	Introduction of light	4	3	Literature provided	Offshore bunkering of large vessels can introduce light pollution that impacts sea birds. This is often done at anchor not necessarily at a fixed mooring. The impact of shading (reduction of light) may also be a pressure to consider from moored vessels.

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1379	7: Transport	Vessel moorings (including small rec vessels)	Barrier to species movement	4	3	Literature provided	Many types of human structures in the marine environment can impede species movement, across a range of species types. Limited information on moored vessels specifically, could be difficult to differentiate from general port operations or other urban infrastructure (e.g., wharves).
1380	7: Transport	Vessel moorings (including small rec vessels)	Death or injury by collision	4	3	Literature provided	Most literature focusses on large vessel collision with large marine mammals, but there is evidence that smaller animals are impacted. The lack of literature is probably related to reporting biases rather than a lack of relationship. Also, a lot of reporting is done on moving vessels, less so stationary or moored vessels.
1381	7: Transport	Vessel moorings (including small rec vessels)	Visual disturbance	4	2	Literature provided	
1414	7: Transport	Anchoring	Visual disturbance	4	4	Surveys agree	
1416	7: Transport	Anchoring	Introduction or spread of non-indigenous species	4	2	Literature provided	
1438	7: Transport	Shipping – general (at sea)	Penetration and/or disturbance of the substrate below the surface of the seabed	4	3	Workshop discussion / Literature provided	Ships can lose cargo (e.g., containers) while at sea, sometimes cargo is dumped on purpose (e.g., dead animals), and ships themselves can be lost at sea in bad weather, accidents etc. All the aforementioned could conceivably cause penetration/disturbance of substrate below the seabed surface.
1461	8: Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Cars, boats, jet skis etc.
1471	8: Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Penetration and/or disturbance of the substrate below the surface of the seabed	4	2	Workshop discussion / Literature provided	Beach activities - such as digging in sand or raking of beaches to clean them - can cause penetration/disturbance below surface.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1475	8: Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Electromagnetic changes	4	5	Workshop discussion	Inconsequential
1479	8: Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Death or injury by collision	4	1	Literature provided	Coastal seabird groundings/collisions correlate with coastal lighting, with more occurring in brighter locations. Coastal tourism facilities with bright lights will result in collisions.
1482	8: Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Introduction or spread of non-indigenous species	4	4	Workshop discussion	Plausible pathway but unlikely. The only mechanism would be the coastal reclamation and artificial structures that are covered by other pressures.
1494	8: Recreation and leisure	Ecotourism (whale watching, scuba diving etc)	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
1504	8: Recreation and leisure	Ecotourism (whale watching, scuba diving etc)	Penetration and/or disturbance of the substrate below the surface of the seabed	4	4	Workshop discussion	Ecotourism covers a lot of activities, and while likes of whale watching is unlikely to result in penetration/disturbance below the seabed surface (unless from anchored vessel) - other activities like dive tourism which could involve anchored vessels and could conceivably cause such impacts. If vessel included, running aground, loss of vessel.
1515	8: Recreation and leisure	Ecotourism (whale watching, scuba diving etc)	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
1537	8: Recreation and leisure	Boating	Penetration and/or disturbance of the substrate below the surface of the seabed	4	2	Workshop discussion / Literature provided	Boating activities, including anchoring, loss or grounding of vessels, could result in penetration/disturbance of seabed.
1560	8: Recreation and leisure	Vehicle use on the foreshore	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vehicle exhaust settling directly on a beach or adjacent water, then washed into the sea.
1561	8: Recreation and leisure	Vehicle use on the foreshore	Synthetic compound contamination (including.	4	5	Workshop discussion	Inconsequential

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
			pesticides, antifoulants, pharmaceuticals)				
1581	8: Recreation and leisure	Vehicle use on the foreshore	Introduction or spread of non-indigenous species	4	3	Literature provided	Can cause spread or proliferation of invasive coastal plants.
1593	9: Marine research	Physical sampling	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	3	Workshop discussion / Literature provided	Contaminants in sediments resuspended when using benthic sampling equipment such as sleds, dredges, trawls, and cores. Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal, microplastic absorption from discarded synthetic ropes, buoys etc.
1594	9: Marine research	Physical sampling	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Resuspension of historic accumulations of pollutants, leaching of antifoulants from vessels.
1595	9: Marine research	Physical sampling	De-oxygenation	4	4	Workshop discussion	Potentially, from release of ballast water (but highly unlikely to be more than transitory). Depends on the definition of 'physical sampling' as experiments of various types can cause anoxia, but the act of taking samples (by cores, observations, dredges, etc) are unlikely to have large effects. Resuspending nutrients and creating deoxygenation.
1604	9: Marine research	Physical sampling	Changes in suspended solids	4	3	Workshop discussion / Literature provided	Potentially, from dredging or other seafloor disturbing activities. Likely to be transitory in nature.
1605	9: Marine research	Physical sampling	Siltation rate changes	4	1	Workshop discussion / Literature provided	
1612	9: Marine research	Physical sampling	Visual disturbance	4	4	Surveys agree	
1614	9: Marine research	Physical sampling	Introduction or spread of non-indigenous species	4	2	Literature provided	
1616	9: Marine research	Physical sampling	Removal of target species	4	4	Surveys agree	

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1617	9: Marine research	Physical sampling	Removal of non-target species	4	4	Surveys agree	Difficult using some methods to collect ONLY the target species.
1626	9: Marine research	Remote sensing	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal. Depends on methods used.
1627	9: Marine research	Remote sensing	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
1638	9: Marine research	Remote sensing	Siltation rate changes	4	5	Workshop discussion	No plausible cause for this activity to cause this pressure.
1640	9: Marine research	Remote sensing	Electromagnetic changes	4	4	Workshop discussion	Yes, for electromagnetic surveys.
1642	9: Marine research	Remote sensing	Introduction of light	4	4	Surveys agree	Lights on underwater remote sensing instrumentation (ROVs, AUVs, towed camera systems), but this light introduction is generally a very short-lived effect/pressure and of minimal concern.
1643	9: Marine research	Remote sensing	Barrier to species movement	4	4	Workshop discussion	Large vessels, drones, electro-chemical signals multi-beam echo-sounders.
1644	9: Marine research	Remote sensing	Death or injury by collision	4	3	Workshop discussion / Literature provided	Collison with AUV.
1645	9: Marine research	Remote sensing	Visual disturbance	4	4	Workshop discussion	In situ remote sensing vessels, plus their lights. Drones as an example of disturbing marine mammals or seabirds.
1647	9: Marine research	Remote sensing	Introduction or spread of non-indigenous species	4	4	Workshop discussion	Hull fouling, ballast discharge, insufficient cleaning of gear between uses/locations.
1659	9: Marine research	Seismic surveys	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal. Vessel rather than the gear. Considering the vessels needed for these activities, there is a potential for hydrocarbon contamination from fuel and oil spillage/leaks.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1660	9: Marine research	Seismic surveys	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels. Considering the vessels needed for these activities, there is a potential for antifoulant contamination.
1668	9: Marine research	Seismic surveys	Disturbance of the surface of the seabed	4	4	Workshop discussion	Cabling associated with seismic cables.
1670	9: Marine research	Seismic surveys	Changes in suspended solids	4	4	Workshop discussion	Borehole seismic surveys involve drilling into the seafloor. Cables.
1673	9: Marine research	Seismic surveys	Electromagnetic changes	4	4	Workshop discussion	Mostly around ship use rather than the activity itself.
1675	9: Marine research	Seismic surveys	Introduction of light	4	4	Workshop discussion	Ship lights, operating at night.
1677	9: Marine research	Seismic surveys	Death or injury by collision	4	3	Literature provided	Collision with ship.
1678	9: Marine research	Seismic surveys	Visual disturbance	4	4	Workshop discussion	Vessels disturb wildlife.
1680	9: Marine research	Seismic surveys	Introduction or spread of non-indigenous species	4	2	Literature provided	
1692	9: Marine research	Sonar surveys	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal.
1693	9: Marine research	Sonar surveys	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
1701	9: Marine research	Sonar surveys	Disturbance of the surface of the seabed	4	5	Workshop discussion	Discussion of potential use of seabed mounted receivers. Further searches revealed these are not typically used for sonar surveys, therefore no plausible cause for this activity to cause this pressure.
1703	9: Marine research	Sonar surveys	Changes in suspended solids	4	5	Workshop discussion	Discussion of potential use of seabed mounted receivers. Further searches revealed these are not typically used for sonar surveys, therefore no plausible cause for this activity to cause this pressure.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1706	9: Marine research	Sonar surveys	Electromagnetic changes	4	4	Workshop discussion	Towed sonar systems will have an isolated EMF around the tow cable, but the sonar itself will not induce EMF.
1708	9: Marine research	Sonar surveys	Introduction of light	4	4	Workshop discussion	From vessels operating at night.
1710	9: Marine research	Sonar surveys	Death or injury by collision	4	4	Workshop discussion	Collisions with vessels.
1711	9: Marine research	Sonar surveys	Visual disturbance	4	4	Surveys agree	Vessels
1713	9: Marine research	Sonar surveys	Introduction or spread of non-indigenous species	4	2	Literature provided	Insufficient cleaning of vessel and/or instruments between uses/locations; ballast discharge.
1725	10: Defence and national security	Military activities	Non-synthetic compound contamination - Hydrocarbon and PAH Contamination	4	4	Workshop discussion	Airborne PAHs from vessel exhaust settling directly on the water, bilge water disposal.
1726	10: Defence and national security	Military activities	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	4	3	Literature provided	Leaching of antifoulants from vessels.
1734	12: Defence and national security	Military activities	Disturbance of the surface of the seabed	4	4	Surveys agree	Installation and operation of seabed mounted equipment, seabed sampling.
1735	13: Defence and national security	Military activities	Penetration and/or disturbance of the substrate below the surface of the seabed	4	4	Surveys agree	Installation and operation of seabed mounted equipment, seabed sampling. Military activities, including explosion and disposal of ordnance, loss or grounding of military vessels, could conceivably result in penetration/disturbance of seabed.
1736	14: Defence and national security	Military activities	Changes in suspended solids	4	4	Surveys agree	Potentially, from dredging or other seafloor disturbing activities. Likely to be transitory in nature.
1737	15: Defence and national security	Military activities	Siltation rate changes	4	4	Workshop discussion	
1739	10: Defence and national security	Military activities	Electromagnetic changes	4	4	Workshop discussion	Mine countermeasures (MCM) vessels towing high-voltage cables through the water.

Cell Number	Activity category	Activity	Pressure	Initial evidence score	Final evidence scores	Decision pathway	Rationale
1741	17: Defence and national security	Military activities	Introduction of light	4	4	Surveys agree	Lights on ship, underwater instrumentation.
1742	18: Defence and national security	Military activities	Barrier to species movement	4	4	Workshop discussion	
1743	19: Defence and national security	Military activities	Death or injury by collision	4	3	Literature provided	Collision with ship.
1744	20: Defence and national security	Military activities	Visual disturbance	4	4	Surveys agree	
1746	21: Defence and national security	Military activities	Introduction or spread of non-indigenous species	4	3	Literature provided	
1776	11: Other man-made structures	Submarine cables and pipelines - operations, maintenance, decommissioning	Death or injury by collision	4	4	Surveys agree	Nighttime laying or decommissioning could cause light pollution that disorientates seabirds. Vessel use.
1779	11: Other man-made structures	Submarine cables and pipelines - operations, maintenance, decommissioning	Introduction or spread of non-indigenous species	4	2	Literature provided	The activities of associated vessels and infrastructure may spread invasive species in biofouling or ballast water.
1821	11: Other man-made structures	Artificial reefs and other environmental structures	pH changes	4	4	Workshop discussion	
1843	11: Other man-made structures	Artificial reefs and other environmental structures	Visual disturbance	4	4	Workshop discussion	
1875	11: Other man-made structures	Cultural and heritage sites/structures (e.g., wrecks, archaeological sites etc.)	Death or injury by collision	4	4	Workshop discussion	Credible pathway, although unlikely.

Appendix B Description of Activities used in the Aotearoa New Zealand Activity-Pressure Matrix

Category	Activity	Activity Description
Coastal Management Activities	Coastal defence and land claim protection (including. beach replenishment)	Development and maintenance of coastal defences including management of beaches, bunds, ditches/drainage, managed realignment sites, beach/sediment recharge or on-going sediment feeding, management of vegetation, sand dune stabilisation. Includes consideration of vessels/machinery/vehicles and materials associated with activity.
	Coastal boat ramps, docks, ports and marinas	Building, expanding, and upgrading coastal boat ramps, docks, berths, ports and marinas. This includes creating new facilities as well as improving existing structures. Includes consideration of vessels/machinery/ vehicles, and materials associated with activity e.g., jack-up barges, piling plant, dredgers, barges.
	Forestry	Considers (i) the effects of removing existing forests and (ii) afforestation (the planting of trees). Includes consideration of machinery/vehicles and materials associated with activity.
	Farming and Agriculture	The use of coastal areas for grazing of domestic animals (e.g., cows, sheep and horses) and drainage and fertilisation of coastal areas to improve grazing and agriculture. Includes consideration of machinery/vehicles and materials associated with activity.
	Strandline clearance	Considers the removal of natural debris, such as seaweed and driftwood, which accumulates along the high tide line on beaches. The process of clearing the strandline is often done to maintain the cleanliness and appearance of beaches, but it can also impact the local ecosystem, as the debris provides habitat and nutrients for various coastal species.
	Reclamations and causeways	This activity considers reclaiming land from below the high-water mark to create new areas for quaysides, coastal defences, or port estates. This often involves building new walls or hard defences and filling in behind them to raise the land level. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
Waste management activities	Residential and urban wastewater (including. storm water and aquarium) discharges	This considers the construction, maintenance, and ongoing use of outfall pipes. These pipes could discharge liquids at varying temperatures, salinities, oxygen, nutrient concentrations. Includes consideration of vessels/machinery/vehicles and materials associated with construction, maintenance operational usage of infrastructure.
	Sewage disposal discharges	The release of wastewater, which includes sewage, from sewage treatment facilities. This wastewater can be treated or untreated.
	Industrial and agricultural liquid	The release of liquid waste products from industrial and agricultural activities into the marine environment. Discharges can contain chemical contaminants, organic matter and thermal pollution. These discharges can have significant environmental impacts if not properly managed.
	Waste disposal - munitions (chemical and conventional)	Sites where military ordnance has been discarded. These sites can pose environmental and safety risks due to the potential for chemical leaching and unexploded ordnance. Significant quantities of munitions were disposed of in the ocean around New Zealand after World War II, with continued disposal of

Category	Activity	Activity Description
		obsolete or surplus munitions in subsequent years. Known sites include the Hauraki Gulf and Wellington harbour.
	Dredge and spoil disposal	The disposal of dredged materials originating from the bottom of water bodies, like rivers, lakes and harbours.
	Thermal effluent discharges	The discharge of heated water or steam into the environment, typically into rivers, lakes, or oceans, after being used in the cooling processes, for example in thermal power stations and geothermal power plants.
	Rocket jettisoning	Refers to the practice of jettisoning rocket stages and other space debris over the ocean after they have been used. This is often done to minimize the risk of jettisoned rocket stages causing damage on land. Includes deposition of material in the marine environment as a byproduct of space launch activities.
Extraction of living resources	Fishing – bottom trawling	The use of large, weighted nets dragged along the sea floor to catch fish and other marine organisms. This technique targets species that live near or on the bottom of the ocean, such as flatfish, orange roughy, and squid. Includes single otter trawl, twin otter trawl and beam trawl.
	Fishing – dredging	The dragging of a heavy frame with an attached net or metal mesh bag along the sea floor to collect shellfish and other benthic organisms. This technique is commonly used to harvest species like scallops, oysters, and clams.
	Fishing – midwater trawling	The towing of large net through the water column, to target species that live in the midwater zone, such as mackerel, hoki, and squid.
	Fishing – traps (potting/creeling)	This activity includes the use of pots, creels and traps, as well as fyke nets and other similar gear.
	Fishing – spear fishing	A method of fishing where individuals use a pole spear (Hawaiian sling) or speargun to catch fish. This technique is typically done while snorkelling or diving, and commonly targets snapper, kingfish and butterfish.
	Fishing – set netting	The use of a net that is anchored or staked in place in the water to catch fish as they swim into it. This technique is commonly used in both coastal and freshwater environments to target a variety of fish species, including snapper, flounder and mullet. Non-target species, including protected species, can become entangled in set nets.
	Fishing - lines	The targeted removal of fish species using static hooks and lines that are left in place for a period before being recovered to retrieve the caught fish. Includes hand lines, rod and reel and longlines. Excludes beach seine.
	Fishing - seines (encircling)	A method of fishing that uses a large net, called a seine, to encircle and capture schools of fish. This technique is commonly used in both coastal and open ocean environments but typically does not involve contact with the seabed. Includes ring seines.
	Fishing – Danish and beach seines	Beach seine nets that are deployed from the shore and dragged back to the beach. Often used to target pilchards, mackerel and kahawai. Danish seine is a demersal fishing method, operated from a vessel, where gear is set by attaching one weighted rope to an anchor buoy and then laying out the rope, net, and second

Category	Activity	Activity Description
		weighted rope in a wide circle as the vessel steams around; once the circle is complete, the ropes are hauled together, herding fish inward, after which towing stops and the net is winched aboard to gather the fish concentrated by the closing ropes."
	Fishing - Diving and snorkelling	This activity involves the collection of target species by divers, snorkelers such as scallops, lobster and kina. Includes recreational diving but excludes spear fishing.
	Harvesting – seaweed and other sea-based food (e.g., paua, kina, mussels, pūpū etc.)	The collection of marine organisms by hand, excluding diving and snorkelling, without the use of nets, traps, lines or other fishing gear. This technique is often used for collecting shellfish, seaweed, and other easily accessible marine resources.
	Extraction of genetic resources e.g., bioprospecting (*blue technology*)	Bioprospecting involves collecting natural materials and developing new products from useful organic compounds found in biological resources. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
Production of living resources	Aquaculture - finfish	This activity considers finfish grown in cages/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Aquaculture - shellfish	This activity considers shellfish (mussels, oysters) grown on racks or trestles in the intertidal or grown on ropes/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Aquaculture – macro-algae	This activity considers seaweed grown on ropes/nets suspended from surface structures or lines. These structures may be anchored to the seabed. It also considers the vessels, machinery, vehicles, and materials needed for these activities.
	Ocean fertilization	Adding nutrients (e.g., iron, nitrogen and/or phosphorous) to the ocean to stimulate the growth of phytoplankton and enhance marine productivity. It also considers the use of vessels to transport and disperse nutrients over targeted areas, and wave pumps and floating tubes that bring nutrient-rich deep water to the surface.
	Translocations and transplanting	This activity considers transplanting or translocating marine organisms to bolster local populations. Examples include replanting seagrass in areas where it has been lost or seeding shellfish beds to enhance and restore local populations.
Extraction (and disposal) of non-living resources	Extraction – sand and gravel (aggregates)	This activity involves removing sand and gravel from the seabed using suction or grab dredgers for construction and beach replenishment. This activity is associated with numerous vessel movements, sediment alteration and resuspension.
	Extraction – minerals	This activity considers the extraction of minerals from the seabed such as polymetallic nodules and includes the use of seafloor mining devices, riser and lifting systems and mining support vessels.
	Extraction – maintenance dredging	This activity includes the periodic or regular removal of material from previously dredged areas (e.g., berths, channels, marinas). The method of dredging may vary, and material may be removed for disposal elsewhere or redistributed within the immediate

Category	Activity	Activity Description
		area. Includes consideration of vessels/machinery/vehicles associated with activity.
	Salvage operations	Includes salvage of vessels or infrastructure, e.g., from oil and gas, wrecked on or near the coast. This activity considers the pressures associated with salvaging, including the removal of wrecked structures and pressures caused by supporting vessels.
	Extraction – water (abstraction)	The temporary or permanent removal of water from the marine environment. Includes river diversion that reduces or removes flow of freshwater through estuaries and coastal environments.
	Addition - water	Addition of water (e.g., through freshwater diversion) to the marine environment.
Energy generation	Renewable energy – offshore wind construction, operation and maintenance, decommissioning (not including cables)	Construction activities include seabed preparation (possibly dredging), cuttings/dredging disposal, piling, drilling, anchoring, mooring, vessel movement, vessel discharges/emissions, installation of scour protection, introduction of artificial substrate. Operation and maintenance activities include regular vessel movement, vessel discharges, rotor sweep, lighting, presence of turbine and foundation structures. Also includes use of jack up barges for maintenance and deposition of additional scour protection. Decommissioning activities include vessel movement, vessel discharges, use of jack up barges, removal of structures/scour protection and associated habitat, use of explosives, cutting, drilling, excavation of seabed close to foundations. For cabling, please refer to the separate activity which should be considered as part of this activity.
	Renewable energy – wave/tide energy construction, operation and maintenance, decommissioning (not including cables)	Construction activities include seabed preparation (possibly dredging), cuttings/dredging disposal, mooring, anchoring, piling, drilling, vessel movement, vessel discharges/emissions, installation of scour protection, introduction of artificial substrate. Operation and maintenance activities include vessel movement, vessel discharges, lighting, operation of devices. Decommissioning activities include vessel movement, vessel discharges, removal of structures/cables and associated habitat, use of explosives, cutting, drilling. For cabling, please refer the separate activity which should be considered as part of this activity.
	Marine hydrocarbon extraction - exploration	This activity includes searching for oil and natural gas deposits beneath the ocean floor using controlled-source electromagnetic surveys and exploratory drilling. For seismic surveys, please see and include the separate activity.
	Marine hydrocarbon extraction - construction, operation and maintenance,	Construction activities include the construction of oil and gas infrastructure in the marine environment including, but not limited to, the installation of rock dump to stabilise jack up rigs, cementing, introduction of other protection material such as concrete mattresses, matting and gravel, the temporary

Category	Activity	Activity Description
	decommissioning (not including pipelines)	installation of infrastructure (such as pipelines, debris baskets, etc), drilling wells and plugging and abandonment, accidental effects, vessel movement, installation of subsea infrastructure etc. Operation and maintenance activities include production/operation, with routine supply, return of wastes to shore, power generation, chemical use, produced water, and re-injection of reservoirs. Decommissioning activities include the plugging and abandonment of wells, removal of structures and associated habitat, use of explosives, cutting, drilling. Disturbance of drill arisings and cuttings. Placement of rock to cover remaining structures or to provide base for jack-up legs. Includes operation by supporting vessels, vessel discharges, use of ROVs, lifting and jack-up rigs. For pipelines, please see and include the separate activity.
Transport	Shipping – port operations	Includes trans-shipment of cargo, loading and unloading of vessels, landside handling, logistics and on-ward transportation e.g., road, rail within port estate. Includes handling of hazardous cargo. Includes consideration of vessels/machinery/vehicles associated with activity.
	Vessel berths and moorings	Operational use of berths and the presence of these structures and vessels using them. Includes consideration of vessels when berthing/berthed. Use of vessel moorings and activity associated with mooring a vessel. Mooring is a temporary or permanent structure to which a vessel may be secured, e.g., swing mooring, trot, fore and aft mooring, pile mooring. Includes consideration of vessels when mooring or moored.
	Anchoring	Covers activity of anchoring generically and use of allocated anchorage areas where vessels are permitted to anchor inside and outside harbours/ports. Including consideration of vessels when anchoring, anchored or weighing anchor
	Shipping – general (at sea)	Movement of all commercial or 'non-recreation' vessels of all scales, from container ships, tankers, cruise liners to pilot vessels, tugs and small watercraft, (including fishing vessels when not fishing). Includes operational, incidental and accidental discharges/emissions from all types of vessels, including noise pollution, exhaust fumes, wastes and wastewater, sewerage, oils, lubricants and chemicals, marine litter and other flotsam and jetsam.
Recreation and leisure	Coastal tourist sites (public beaches and resorts)	Includes activities where a vessel is not used. Includes swimming, surfing and event type activities (e.g., beach clean-ups, festivals).
	Ecotourism (whale watching, scuba diving etc)	Exploration and appreciation of marine environments while minimizing environmental impact and promoting conservation. Examples include snorkelling and diving, whale and dolphin watching, kayaking and paddle boarding, marine biology tours. Includes vessel operations.

Category	Activity	Activity Description
	Boating	Recreating on a boat. Encompasses a wide range of activities, including cruising, sailing, motorboating, kayaking and canoeing, and yachting.
	Vehicle use on the foreshore	Operation or parking of vehicles on the area of land that lies between the high and low tide marks along a coast. Vehicles can damage sensitive ecosystems, such as dunes and tidal flats, and disturb wildlife.
Marine research and exploration	Physical sampling	Physical sampling of the seabed, foreshore (intertidal) and/or water column in situ using a variety of marine survey techniques. It also considers the vessels, vehicles, and materials needed for these activities.
	Remote sensing	This includes methods of obtaining data or images from a distance, e.g., from satellites, AUV or aircraft and includes LIDAR. It also considers the vessels, vehicles, and materials needed for these activities.
	Seismic surveys	Any survey that uses airguns, including 2D/3D/4D and OBC (On Bottom Cabling) surveys and any similar techniques that use airguns. It also considers the vessels, vehicles, and materials needed for these activities.
	Sonar surveys	The use of echo sounders underwater for research or exploratory purposes as well as military purposes. It also considers the vessels, vehicles, and materials needed for these activities. These surveys do not typically use seabed receivers, but some monitoring surveys use moored echosounders.
Defence and national security	Military activities	Military exercises undertaken that involve the use of the sea surface (e.g., boats, surface explosions and surface target towing), water column (e.g., submarine use and diving) or seabed (e.g., installation and operation of seabed mounted equipment, seabed sampling and degaussing).
Other man-made structures	Submarine cables and pipelines - operations, maintenance, decommissioning	Includes the laying cables and pipelines. Methods vary depending on the water depth and include laying either directly on the seabed, covered with material for protection, or buried. Seabed trench excavation through ploughing and hydraulic jetting is frequently used for burial. Protection can also be added where there is a reasonable risk of damage by rock placement on the seabed over the cable or pipeline. It also considers the vessels, vehicles, machinery and materials needed for these activities. This activity includes the retrieval or access of cables and pipelines for repairs or maintenance and their replacement following maintenance. The activity also includes vessel movement and anchoring during the operation. Includes the removal or decommissioning of a cable or pipeline when it is no longer needed. When removal is deemed appropriate, cables and pipelines may be retrieved through grabbing and raising. The decommissioning process can include vessel movements and anchoring along the cable or pipeline route.
	Artificial reefs and other environmental structures	Artificial reefs are human-made structures placed underwater to promote marine life. They can be made from a variety of materials, including concrete, steel, tires, natural materials (e.g., rocks, shells), specialized structures designed to mimic natural

Category	Activity	Activity Description
		reef formations and sunken vessels. It also considers the vessels, vehicles, machinery and materials needed for the placement and maintenance of artificial reefs.
	Cultural and heritage sites/structures (e.g., wrecks, archaeological sites etc).	Includes the presence of wrecks and archaeological sites.

Appendix C Description of Pressures used in the Aotearoa New Zealand Activity-Pressure Matrix

Category	Pressure	Pressure Description
Local hydrological changes (within a specific, often geographically limited, area)	Temperature changes - local	Events or activities that change local water temperature, like thermal discharges from power stations or temperature changes in the vicinity of subsea power cables, can affect the area around the source. This does not include regional temperature changes from global warming.
	Salinity changes - local	Events or activities increasing or decreasing local salinity. This includes freshwater discharges from pipelines that reduce salinity; hydro-morphological modification (e.g., navigational dredging) if this alters the halocline, or erection of barrages or weirs that alter freshwater/seawater flow/exchange rates.
	Water flow (e.g., tidal current) changes - local	Changes in water movement associated with tidal streams (the rise and fall of the tide, riverine flows), prevailing winds and ocean currents. The pressure is associated with activities that have the potential to modify hydrological energy flows. For example, tidal energy generation devices remove (convert) energy, and such pressures could be manifested leeward of the device; dredging may deepen and widen a channel and therefore decrease the water flow; canalisation and/or structures may alter flow speed and direction; managed realignment (e.g., seawalls) can alter tidal streams.
	Emergence regime changes - local	Events or activities that change how long and how often intertidal species are underwater or exposed during tides. For example, beach re-profiling could change gradients and therefore exposure times, dredging may change the natural tidal range, managed realignment or reclamation in estuaries can reduce the intertidal area. This excludes pressure from sea level rise.
	Oxygen changes	Changes in the oxygen levels in seawater, including marine deoxygenation (decreases in oxygen levels). Anthropogenic-induced marine deoxygenation can result from excessive organic matter and nutrients (like nitrogen and phosphorous) into the marine environment (e.g., from agricultural runoff and wastewater). Excessive nutrients can lead to algal blooms which consume oxygen when they decompose. Excessive organic matter is consumed by aerobic microorganisms which can cause deoxygenation.
	pH changes	Activities that result in changes in the pH of marine waters. This includes the run-off of nitrogen-based fertilizers, which can indirectly affect pH levels through processes like eutrophication, and the discharge of untreated or partially treated wastewater into the ocean, which can introduce various chemicals that alter the pH of marine waters.

Category	Pressure	Pressure Description
	Wave exposure changes - local	Local changes in length, height and frequency of waves. Exposure on an open shore is dependent upon the distance of open seawater over which wind may blow to generate waves (the fetch) and the strength and incidence of winds. Anthropogenic sources of this pressure include artificial reefs, structures such as piers, jetties, breakwaters, and barrages, and wrecks that can directly influence wave action or activities that may locally affect the incidence of winds, e.g., a dense network of wind turbines may have the potential to influence wave exposure, depending upon their location relative to the coastline.
Pollution and other chemical changes	Non-synthetic compound contamination - Transition elements and organo-metals	The increase in the levels of transition elements compared with background concentrations, due to their input from land/riverine sources, by air or directly at sea. For marine environments the main elements of concern are Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc and Organo-metallic compounds such as the butyl tins (Tri butyl tin and its derivatives). These can be highly persistent and chronic exposure to low levels has adverse biological effects (e.g., imposex in molluscs).
	Non-synthetic compound contamination - Hydrocarbon and PAH contamination	Increases in the levels of these compounds compared with background concentrations. Naturally occurring compounds, complex mixtures of two basic molecular structures: straight chained aliphatic hydrocarbons (relatively low toxicity and susceptible to degradation) and multiple ringed aromatic hydrocarbons (higher toxicity and more resistant to degradation). These fall into three categories based on source (includes both aliphatics and polyaromatic hydrocarbons): petroleum hydrocarbons (from natural seeps, oil spills and surface water run-off), pyrogenic hydrocarbons (from combustion of coal, woods and petroleum) and biogenic hydrocarbons (from plants and animals). Ecological consequences include tainting, some are acutely toxic, and can cause carcinomas and growth defects.
	Synthetic compound contamination (including. pesticides, antifoulants, pharmaceuticals)	Increases in the levels of these compounds compared with background concentrations. Synthesised from a variety of industrial processes and commercial applications. Chlorinated compounds, which include polychlorinated biphenols (PCBs), dichlor-diphenyl-trichloroethane (DDT) and 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8- TCDD), are persistent and often very toxic. Pesticides vary greatly in structure, composition, environmental persistence and toxicity to non-target organisms. Includes insecticides, herbicides, rodenticides and fungicides. Pharmaceuticals and Personal Care Products originate from veterinary and human applications compiling a variety of products, including over the counter medications, fungicides, chemotherapy drugs and animal therapeutics, such as growth hormones. Due to their biologically active nature, high levels of consumption, known combined effects, and their detection in most aquatic environments they have become an emerging concern. Ecological consequences

Category	Pressure	Pressure Description
		include physiological changes (e.g., growth defects, carcinomas).
	De-oxygenation	Any deoxygenation that is not directly associated with nutrient or organic enrichment. The lowering, temporarily or more permanently, of oxygen levels in the water or substrate due to anthropogenic causes (some areas may naturally be deoxygenated due to stagnation of water masses, e.g., inner basins of fjords). This is typically associated with nutrient and organic enrichment, but it can also derive from the release of ballast water or other stagnant waters (where organic or nutrient enrichment may be absent). Ballast waters may be deliberately deoxygenated via treatment with inert gases to kill non-indigenous species.
	Nutrient enrichment	Increased levels of nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Nutrients can enter marine waters by natural processes (e.g., decomposition of detritus, riverine, direct and atmospheric inputs) or anthropogenic sources (e.g., wastewater runoff, terrestrial/agricultural runoff, sewage discharges, industrial discharges, aquaculture, atmospheric deposition). Nutrients can also enter marine regions from 'upstream' locations, e.g., via tidal currents to induce enrichment in the receiving area. Nutrient enrichment may lead to eutrophication (see also organic enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.
	Organic enrichment	Resulting from the degraded remains of dead biota and microbiota (land and sea), faecal matter from marine animals, flocculated colloidal organic matter and the degraded remains of sewage material, domestic wastes, industrial wastes etc. Organic matter can enter marine waters from sewage discharges, aquaculture or terrestrial/agricultural runoff. Black carbon comes from the products of incomplete combustion (PIC) of fossil fuels and vegetation. Organic enrichment may lead to eutrophication (see also nutrient enrichment). Adverse environmental effects include deoxygenation, algal blooms, changes in community structure of benthos and macrophytes.
	Radionuclide contamination	Introduction of radionuclide material, raising levels above background concentrations. Such materials can come from land or sea -based operations (e.g., oil platforms, medical sources) and historical disposal of radioactive waste from contaminated medical equipment and radium at sea.
Physical loss (permanent change)	Physical loss to land or freshwater habitat	The permanent loss of marine habitats. Activities that claim part of the coastal marine environment, e.g., new coastal defences that encroach on and move the Mean High Water Springs mark seawards, dredging if it alters the position of the halocline. This excludes changes from one marine habitat type to another marine habitat type.

Category	Pressure	Pressure Description
	Physical change to another seabed type	The permanent change of one marine habitat type to another marine habitat type, through the change in substratum, including to artificial (e.g., concrete). Activities include the installation of infrastructure (e.g., surface of platforms or wind farm foundations, marinas, coastal defences, pipelines and cables), the placement of scour protection where soft sediment habitats are replaced by hard/coarse substrate habitats, removal of coarse substrate (marine mineral extraction) and dredging where the residual habitat differs structurally from the activity state, creation of artificial reefs, mariculture, the protection of pipes and cables using rock dumping and mattressing techniques, placement of cuttings and piles from oil and gas activities. This pressure excludes dredging where the depth of sediment is changed locally but the sediment typology is not changed.
Physical damage (reversible change)	Temporary and/or reversible change of habitat structure (extraction)	Temporary and/or reversible change of habitat structure through extraction, e.g., from marine mineral extraction where a proportion of seabed sands or gravels are removed but a residual layer of seabed is similar to the pre-dredge structure and as such biological communities could re-colonise; or navigational dredging to maintain channels where the silts or sands removed are replaced by non-anthropogenic mechanisms so the sediment typology is not changed. Includes disturbance to foreshore, beach or dune habitats.
	Disturbance of the surface of the seabed, including abrasion	The disruption or alteration of the seabed's top layer due to various activities. This can be caused by natural processes like hydrodynamics and bioturbation, as well as human activities such as bottom contact fishing gear, anchoring, propeller wash from vessels, aquaculture, port anchorage, dredging, swing moorings, the construction and maintenance of offshore installations. These activities can lead to changes in the geological, physical, and chemical conditions of the seabed, impacting the benthic (seafloor) ecosystems. Abrasion relates to the damage of the seabed surface. Activities associated with abrasion can cover relatively large spatial areas (such as fishing with towed demersal trawls) or relatively localised activities (such as swing moorings, potting or bottom longlining).
	Penetration and/or disturbance of the substrate below the surface of the seabed	The disturbance of sediments where there is limited or no loss of substrate from the system. The physical impact on the layers beneath the seabed's surface. This includes activities that penetrate or disturb the sediment, such as anchoring, taking of sediment/geological cores, cone penetration tests, cable burial (ploughing or jetting), certain fishing activities, e.g., scallop dredging, bottom trawling, compression of sediments, e.g., from the legs of a jack-up barge could also fit into this pressure type. These activities can cause changes in the physical structure and composition of the seabed, potentially impacting marine habitats and ecosystems. Includes erosion or disturbance to sub-surface substrate in foreshore, beach or dune environments.

Category	Pressure	Pressure Description
	Changes in suspended solids	Changes in water clarity from sediment and organic particulate matter concentrations. It is related to activities disturbing or introducing sediment and/or organic particulate matter and mobilising it into the water column. Could be 'natural' land run-off and riverine discharges or from anthropogenic activities such as all forms of dredging, disposal at sea, cable and pipeline burial, secondary effects of construction works such as breakwaters. Particle size, hydrological energy (current speed and direction) and tidal excursion are all influencing factors on the spatial extent and temporal duration. Salinity, turbulence, pH and temperature may result in flocculation of suspended organic matter.
	Siltation (sedimentation) rate changes	Alteration (increases or decreases) of the natural rates of siltation (sedimentation) through the settling out of silt/sediments suspended in the water column. Activities associated with this pressure type include mariculture, land claim, navigational dredging, disposal at sea, marine mineral extraction, cable and pipeline laying and various construction activities. It can result in short lived sediment concentration gradients and the accumulation of sediments on the sea floor. Is related to light smothering, where a thin layer of material covers something, restricting its access to air or light but not completely cutting it off.
Other physical pressures	Litter	Refers to any human-made solid material that is discarded, disposed of, or abandoned in the coastal marine environment or ocean. This includes items like plastics, metals, wood, rope, and fishing gear, as well as their broken-down pieces, such as microplastics. Ecological effects can be physical (smothering), biological (ingestion, including uptake of microplastics; entangling; physical damage; accumulation of chemicals) and/or chemical (leaching, contamination).
	Electromagnetic changes	Localised electric and magnetic fields associated with operational power cables and telecommunication cables (if equipped with power relays). These cables may generate electric and magnetic fields that could alter behaviour and migration patterns of sensitive species (e.g., sharks and rays).
	Noise changes	Increases over and above background noise levels (consisting of environmental noise (ambient) and incidental man-made/anthropogenic noise (apparent)) at a particular location. Species known to be affected are marine mammals and fish. Effects include hearing loss, discomfort, injury, and in extreme cases, death in addition to indirect effects such as acoustic masking and behavioural modification. The impact depends on factors like sound pressure, loudness, exposure level, and frequency. High amplitude and low-frequency sounds are particularly harmful. Noise can travel long distances (10s of kms) but is affected by water depth and seabed features. Noise levels associated with construction activities, such as piledriving, are typically significantly greater than operational phases (i.e., shipping, operation

Category	Pressure	Pressure Description
		of a wind farm). Includes noise produced by shore-based activities such as vehicle use and tourist activities.
	Introduction of light	Direct inputs of light from anthropogenic activities. This includes lighting on structures during construction or operation to allow 24 h working; new tourist facilities (e.g., promenade or pier lighting), lighting on oil and gas facilities etc. Ecological effects may be the diversion of bird species from migration routes if they are disorientated by or attracted to the lights. It is also possible that continuous lighting may lead to increased algal growth.
	Barrier to species movement	Obstacles that prevent animals from moving freely between different habitats. These barriers can disrupt migration, breeding, feeding, and other essential activities. Barriers include physical structures such as tidal barrages; infrastructure including offshore wind farms, aquaculture setups; pollution where high levels of turbidity act as a barrier by inhibiting navigation; electromagnetic fields that some species find difficult to cross and habitat alteration that fragments habitats and makes it difficult for species to move between them. Includes upriver movements or movements across open waters. Species affected are mostly birds, fish, mammals.
	Death or injury by collision	Injury or mortality from collisions of biota with both static and/or moving structures. Examples include collision with rigs (e.g., birds), static screens in intake pipes (e.g., fish at power stations), wind turbine blades (e.g., birds), tidal devices (e.g., fish and mammals) and fishing vessels (birds).
Biological pressures	Visual disturbance	The disturbance of animals by anthropogenic activities. Examples include increased vessel movements, such as during construction phases for new infrastructure (bridges, cranes, port buildings etc), increased personnel movements, increased tourism, increased vehicular movements on shore disturbing bird roosting areas, seal haul out areas etc.
	Genetic modification and translocation of indigenous species	Genetic modification can be either deliberate (e.g., introduction of farmed individuals to the wild, GM food production), accidental (e.g., escapees from salmon farms or the translocation of GM species in ballast water) or a by-product of other activities (e.g., mutations associated with radionuclide contamination). Anthropogenic movement of native species to new regions can also introduce different genetic stock.
	Introduction or spread of non-indigenous species	The introduction of non-indigenous species, e.g., Asian paddle crab, Mediterranean fan worm, exotic Caulerpa, and their subsequent spreading. Ballast water, hull fouling, stepping stone effects (e.g., aquaculture farms) may facilitate the spread of such species.
	Introduction of microbial pathogens	The introduction of microbial pathogens via untreated or insufficiently treated effluent discharges, run-off from terrestrial sources (e.g., toxoplasmosis) and vessels, ballast water releases. Escapees (e.g., farmed salmon) could be infected and spread pathogens. Aquaculture

Category	Pressure	Pressure Description
		could release contaminated faecal matter, from which pathogens could enter the food chain.
	Removal of target species	The removal of target species through commercial exploitation of fish and shellfish stocks, recreational fishing, bioprospecting and scientific sampling. The physical effects of fishing gear on seabed communities are addressed by the " Disturbance of the surface of the seabed, including abrasion" and "Penetration and/or disturbance of the substrate below the surface of the seabed" pressure types, so this pressure addresses the direct removal / harvesting of biota. Ecological consequences include the sustainability of stocks, impacting energy flows through food webs and the size and age composition within fish stocks.
	Removal of non-target species	By-catch associated with fishing activities, bioprospecting, research, mineral extraction and dredging etc. This pressure addresses the direct removal of individuals, the physical effects of fishing gear on seabed communities are addressed by the " Disturbance of the surface of the seabed, including abrasion" and "Penetration and/or disturbance of the substrate below the surface of the seabed" pressure types. Ecological consequences include disruption of food webs and changes to the population dynamics of marine biota.