Project Proposal

A. PROJECT TITLE	Ki uta ki tai: mātāpono me te pūtaiao, ngā korero whakamahuki ma te kaitiaki – From mountains to the sea: values and science to assist kaitiaki/guardian
"SHORT" TITLE	Ki uta ki tai: estuaries thresholds and values
B. THEME / PROGRAMME	Synthesis

C. PROJECT KEY RESEARCHERS

Role	Name	Institution / company	Email
Project Lead	Drew Lohrer	NIWA	drew.lohrer@niwa.co.nz
Mātauranga lead	Shaun Awatere	Manaaki Whenua	
Researcher	Kura Paul-Burke	Uo Waikato	
	Conrad Pilditch	Uo Waikato	
	Rich Bulmer	NIWA	
	Candida Savage/Dana Clark	UoOtago/Cawthron	
Case study partner	Patricia Clark	IKHMG	
	TBD	Little Waihi	
	TBD	New River	

D. CO-DEVELOPED WITH

Name	Role	Organisation / company / agency	Level of partnership
Ian Tuck	Overview of MPI projects investigating habitats of significance to fisheries (including taonga species) and understanding land-based effects	MPI	Comment to project proposal, future involvement in hui around how multiple stressors should be considered
Kris Ramm/ Helen Kettles	Overview of DOC Freshwater and estuarine work	DOC	Comment to project proposal, future involvement in Kaipara area
Megan Carbines	Link to AC working group with NPDFM planners and technical leads and Kaipara Moana Remediation group	Auckland Council	Comment to project proposal, future involvement in Kaipara area and in hui around how multiple stressors should be considered
Alice Bradley	MfE contact and provider of MfE funding	MfE	Relationships with NPS-FW and MfE funded projects
John Dymond	Project lead OLW	Our Land and Water	Contribute to linkages between projects
Naomi Apori	Mātauranga OLW	Our Land and Water	Contribute to linkages between projects

Please note that the Case study partners, and Māori researchers are all co-development partners. Moreover, MfE projects will involve Regional Council personnel who will all become co-development partners

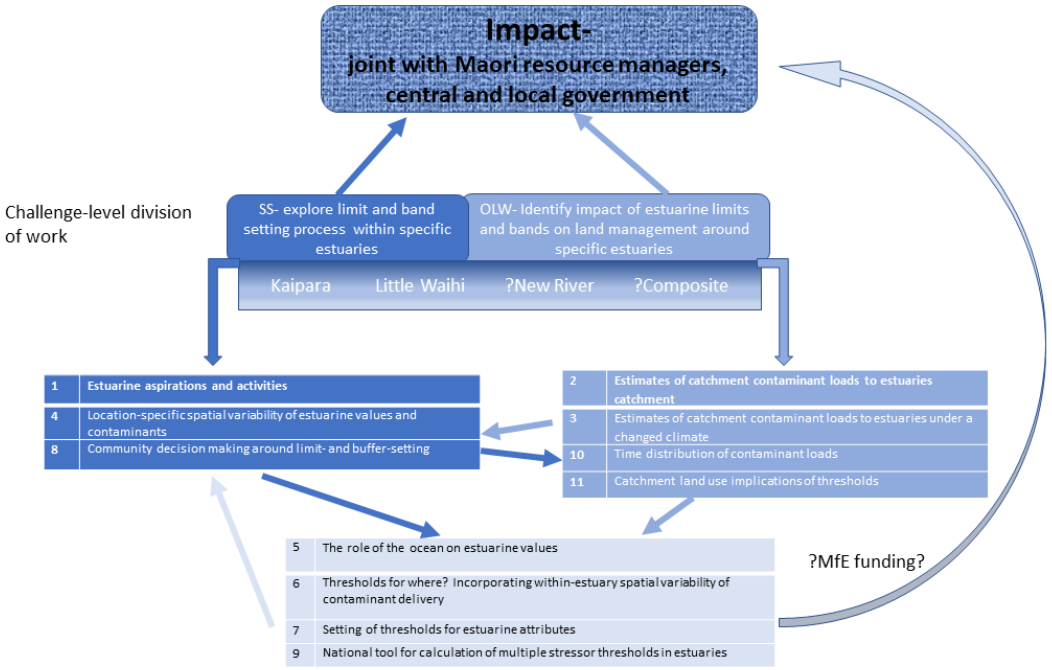
E. ABSTRACT

Aotearoa NZ civil society is committed to acknowledging Te Mana o Te Wai and a need to manage water carefully. The National Policy on Freshwater (NPS-FW) has been developed to ensure that natural and physical resources are managed in a way that prioritises the health and well-being of freshwater ecosystems; the health needs of people; and the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future. Moreover, significant concerns around the country relating to land-based effects on coastal habitats have been highlighted by DOC and MPI, with work being planned or already begun in Kaipara, Hawke Bay, Top of the South, and the Bay of Islands etc. The links between NPS-FM attributes, catchment management, and estuarine health or function have yet to be established. Establishing these links requires a combined approach across the terrestrial, freshwater and estuarine knowledge bases—a perfect opportunity for Sustainable Seas and Our Land and Water to run a combined programme of work.

Additionally, Aotearoa NZ's commitment to incorporating Treaty principles into partnerships with whānau/hapū/iwi is integral for collaboration to succeed in achieving outcomes for catchments and estuaries, especially as it underpins the institutions of co-governance, co-management, and co-planning. It is in this context that proposed research projects can effectively achieve impact.

Our Land and Water (OLW) has contributed positively to freshwater limit setting processes and how catchment activities link to them. Sustainable Seas will build on this work in selected case study locations to examine how freshwater limit setting can be linked to outcomes in estuaries. It will achieve this by: (1) identifying local (whānau/hapū/iwi, community groups) aspirations for their estuary and the critical supporting ecosystem components; (2) determining critical stressor thresholds to support these; (3) establishing buffers around thresholds that allow for within-estuary activities and the interactive effects of multiple stressors (including climate variation) and translate these to freshwater inputs. Our Land and Water will then look at the impact of limits derived from the estuaries on land management in the catchment (if and how they can be met) now and under a changed climate.

MfE will be integral to this work programme, sharing the understandings we develop through the process and funding separate pieces of work that together with this project and its companion Our Land and Water project, will produce a nationally relevant process for setting freshwater objectives that allow for estuarine protection and recovery (see Figure below and Appendix 1 for more details). Note that MfE has recently contracted NIWA to collate the data needed for Components 5, 6 and 7 analyses.



F. RELEVANCE TO CHALLENGE OBJECTIVE

This project seeks to link catchment activities with estuarine mauri, cultural, social and economic aspirations for estuaries (including economic activities) in order to allow robust local decision making around freshwater limits and thus the management of landuse. It is focussed on exploring processes by which this can be achieved within an EBM/kaitiakitanga framework and strongly underpins the ability for EBM within estuaries to restore ecological function and mauri.

Section G: Note that while the majority of the outputs listed here are for the selected case studies, overall this body of work will inform national policy and regional management- see section K

G. OUTPUTS	This project will produce the following Outputs:	Linked to which Theory of Change Outputs:	Explain briefly your plan to ensure uptake by iwi and stakeholders:
	1. A conceptual map of the linkages between estuarine ecological components, significant sites and taonga/keystone species, tohu presently used in location, and community aspirations	a. Biophysical and socio-ecological knowledge that supports the development of understanding and tools that underpin EBM as a viable approach to managing Aotearoa New Zealand's marine environment developed and accessibly packaged.	Each case study estuary will have a hapū/iwi researcher, a case study partner (selected by the local community and whānau/hapū/iwi group) and a western science researcher (ecologist) to co-produce this output
	2. Reciprocal capacity building on how best to add	c. Effective partnership models for an EBM approach to decision-making and management	Discussions around how to best deal with cumulative effects and freshwater limit-setting

	buffers/boundaries around thresholds to incorporate cumulative effects, ecosystem interactions, within-estuary activities, and uncertainty	developed, evaluated, and demonstrated. h. Frameworks for decision making that consider multiple values and blue economy activities developed and evaluated.	will occur at a hui, using both a kaitiakitanga and EBM approach, with a focus of producing a method(s) that can be used to demonstrate reasons behind decision making to kaitiaki, managers, farmers and estuarine users
	3. A tool(s) capable of being used to estimate effects of multiple stressors on estuarine health and function, significant sites and taonga/keystone species, tohu and aspirations. This tool(s) will summarise across case study locations and will generate learnings for a nation-wide tool(s)	f. Tools for predicting and managing cumulative and multiple stressors developed, assessed and demonstrated. g. Governance and policy practices that support EBM identified, evaluated and packaged for targeted decision-makers.	The model(s) will be developed by the hapū/iwi researchers, case study partners and ecologists to deal with the conceptual models (Output 1); the situations highlighted by the spatial maps (Output 2); and the methods developed in Output 3
	4. A list of suggested reductions in fresh-water concentrations necessary for restoration of each estuaries functionality and its mauri that can be used by OLW in land-use scenarios	g. Governance and policy practices that support EBM identified, evaluated and packaged for targeted decision-makers.	These reductions would underly the work conducted in the OLW project

H. OUTCOMES

This project will contribute to the following Theory of Change Outcomes:

- 2. Decision-making practices that are more inclusive, multi-sectorial and account for the effects from cumulative and multiple activities are adopted (FO2, FO4)
- 3. Knowledge from the Challenge (science and mātauranga) is used in decision making to improve ecological health and influences Aotearoa New Zealand's marine management practice and policy (FO3)
- 4. The complementarity of local expressions of Kaitiakitanga and EBM are well understood and enabled (FO2, FO4)
- 5. Decision-making processes explicitly identify and address both risk and knowledge uncertainty in a way that reduces risks to ecological, social, cultural and economic wellbeing (FO1, FO2 and FO3)
- 6. EBM practices are understood and accepted as a viable approach by decision makers, stakeholders and iwi (FO2)
- 7. Māori rights, interests and values are supported through the application of EBM (FO4)
- 8. Researchers and iwi and stakeholders involved during the life of the Challenge continue to actively promote, research in, and use knowledge from the Challenge (FO1-FO4)

I. INTRODUCTION

Raru- The problems

Modelling in the NPS-FM process primarily uses quantitative, numerically focused models, and the scenarios are often problem focused or normative scenarios with "objectively" defined outcomes that are based on NPS-FM attributes, which have been selected to maintain freshwater values. For some time MfE have signalled the need to set limits (or outcomes) based on these attributes that not only maintain freshwater values but consider downstream effects on estuarine values for local users. This has recently been escalated by the PCE report on estuaries and its suggestion that management of estuaries should be included in freshwater management.

However, links between present NPS-FM attributes and estuarine health or function have not been established. Furthermore, limit-setting does not generally allow for the assessment of interactions between loadings of different contaminants. This will be particularly crucial for estuaries, many of which have multiple uses and more than one freshwater input entering them. At present we have no way of quantifying safe bounds that will provide for within-estuary activities and local community, whanau/hapū/iwi hapū aspirations, now or under a changed future climate.

Increasingly, led by Māori, locals desire not just to protect their estuaries from degradation but to promote restoration- if not to the past, then at least to a better, more valued, state. For example, Māori have a range of objectives in relation to freshwater and estuaries that reflect their needs in relation to, for example, wāhi tapu, mauri, mahinga kai, and kaitiakitanga, and extends well beyond biophysical states. There is a need for all values of importance to Māori to be represented in discussions around limits, and for these values to be represented in an appropriate manner, which may not be numeric. This necessitates engaging Māori at the

beginning of the process and involving them in defining the outcomes sought, the knowledge which is used and the methods by which constraints on freshwater and terrestrial activities are determined.

This project seeks to engage local communities and estuarine researchers in determining a process to provide safe bounds on freshwater targets that will allow for estuarine values to be protected and restored.

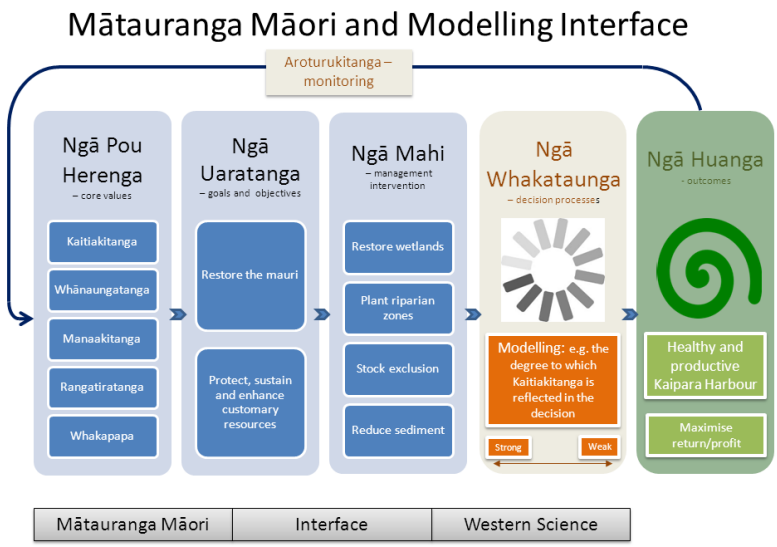
J. AIMS

- Provide underpinning science and tools informed by mātauranga Māori for assessing the changes in land-use management required to restore the ecological structure and function of estuaries and enhance the mauri of estuaries. In particular, create a tool informed by science and mātauranga Māori that allows local communities (whānau/hapū/iwi and community groups) to demonstrate the evidence behind their decisions. This tool will need to be able to deal with the cumulative effects of multiple stressors and activities.
- Provide guidance to the limit-setting process of National Policy on Freshwater (NPS-FW) for protecting estuaries with respect to community/whānau/hapū/iwi aspirations.
- Identify locational enablers and barriers to limit-setting and from these identify processes that could be used nationally to manage estuaries from a guardianship and kaitiakitanga perspective.

K. PROPOSED RESEARCH

Tikanga Rangahau – Methodology

Within Aotearoa New Zealand, incorporating Treaty principles into partnerships is integral for collaboration to succeed in achieving outcomes for a catchment, especially as it underpins the institutions of co-governance, co-management, and co-planning. Catchment modelling has an important role to play in determining where contaminants are coming from, identifying quantities, loads, and being able to target contaminant source areas across spatial and temporal scales to mitigate contaminant loss (for example mitigation of erosion through successful targeted planting programmes). This approach needs to be combined with an understanding of the ecology of estuaries where resilience and recovery dynamics are strongly linked with the animals and plants that inhabit the seafloor (in particular, shellfish) and their connection to coastal waters. This science/modelling needs to be contextualised within a kaupapa Māori framework for natural resource management (see for example the framework used in Kaipara in figure1 below).



This project will take a case-study based approach, in order to successfully achieve contextualisation within a kaupapa Māori framework. Three case studies will be used, and we will fit the engagement within any processes that are already being conducted in the area. For the Kaipara, we have existing relationships and an invitation to work with the Integrated Kaipara Harbour Management Group (in particular the Kaipara Moana Remediation project which has as partners Kaipara Uri, Auckland Council and Northland Regional Council representatives https://www.kaiparaharbour.net.nz/kaiparamoanaremediation). Shaun Awatere is an advisor to IKHMG, Drew Lohrer has presented estuarine science to them and Megan Carbines is attached to the Auckland Council work. Little Waihi hapū are interested in the project and we have existing relationships through Kura Paul-Burke (Sustainable Seas and estuary groups) and Naomi Aporo (OLW and the Little Waihi catchment group). For each of these case studies we have ecologists who have worked within the areas and are known to the locals. The next step will be to hold discussions with IKHMG and Little Waihi

tangata whenua to identify how they would like to interact, where we can fit in their processes, whether they want one or more hapū/iwi partners and select this person(s). A third case study will be developed during the first year of the project, this is likely to be New River Estuary as it offers a different set of catchment and estuarine activities. Again, this case study will have an allocated hapū/iwi partner, Māori researcher and ecologist assigned to it.

Four major pieces of work will be required. (1) Understanding what the estuary means for the locals/whānau/hapū/iwi, what aspirations they have for it, and from an ecological perspective how healthy it presently is. (2) Understanding what activities and pressures are presently affecting the estuary. (3) Knowing what is where in the estuary. (4) Determining a process/method for linking these three understandings together that will allow robust decisions about how much land- and freshwater-based activities can be allowed while maintaining/enhancing estuarine functionality and its mauri.

We envisage the following work stages, although these may change as co-development processes become fully engaged. For each estuary

- The hapū/iwi case study partner and Māori researcher will engage as appropriate with whānau/hapū/iwi and local community groups to identify aspirations for their estuary, present uses and stressors, and mātauranga Māori based indicators like tohu to inform the management priorities for enhancing estuarine functionality and its mauri. This conversation is the starting point for each case study and will also include a kōrero on what the other work stages would be. In some cases, much of this information may already be available (e.g., Kaipara see Figure 1). We hope that post this, the ecologist will identify ecological components that can help support local/whānau/hapū/iwi management priorities. Together the researchers and the case study partner will attempt to build a conceptual map that would inform local communities and managers of how activities and stressors may affect different values, activities and aspirations including enhancing estuarine functionality and its mauri. If a single conceptual map is not possible, different maps for different knowledge systems will be derived but highlighting points of commonality.
- Mātauranga Māori and other local information around **what** (important ecological components, significant sites and taonga or keystone species) is found **where** in the estuary now and in the past will also be sought. Ecological health will be calculated from nationally used indices if data is available. Spatial maps of important components, significant sites and keystone species may be generated, if desired.
- Our Land and Water will produce forecast and hindcast estimates of faecal indicator bacteria (E. coli), sediment, nitrogen, and phosphorus loads for the rivers and streams entering the estuary. These will be used to determine where in the estuary contaminants are likely to end up. This information will be overlain with the information on "what" is "where" and statistical analyses will be used to derive relationships between inputs and the variables for which we have spatial information. The results of simple one-way relationships and more complex relationships that account for cumulative effects and multiple stressors will be presented at a hui for each case study
- The hui will consider how best to incorporate cumulative effects, indirect and direct effects that are not simple one-way relationships, within-estuary activities, uncertainty and risk perceptions around precaution. At present we envisage a series of buffers being placed around potential limits.
- The findings of the hui will be used to extend the present Estuaries Bayes Net Model (Bulmer et al 2019, Bulmer and Hewitt 2020) for estimating effects of multiple stressors on estuarine health and function to: use input concentrations; and assess effects on significant sites, keystone species, values and aspirations, and possibly to create a separate Te Ao Māori tool (not necessarily BN).
- The findings of the hui and the extended Estuaries Bayes Net model (or other tool) will be used either by the case-study researchers or by them in conjunction with locals to suggest reductions in concentrations/limits necessary for restoration of estuarine function and mauri for OLW land-use scenarios

While much of the information/investigations outlined above are in-place and thus the findings are location-specific, translation to a national scale will be achieved in 4 ways. Firstly, the present locations have been carefully chosen to cover different estuary types/sizes with different surrounding landuses / climatologies. This would also hold true for any other case-study estuaries selected. We are also considering, if New River estuary does not work out, making the third case study an imagined location that encompasses composite aspirations and environments to allow capacity building for government agency staff and locals. Secondly, for the estuarine work, information from the previously funded MfE project "Managing Upstream Phase 1" will be used to place local aspirations and stressors within the national context. Thirdly, previous and ongoing work in both the Challenges (for example Sustainable Seas work on participatory processes, local management and values and risk assessments) will be used to extend the local-specific findings. Fourthly, we are submitting a more extensive set of projects to MfE for funding that will build the information available on context-dependencies and thus allow us to make national predictions.

L. LINKS TO PHASE I RESEARCH

This project will use knowledge gained from: "Our Seas" Participatory processes project; "Valuable Seas" Mauri Moana, Mauri Tangata, Mauri Ora and Measuring ecosystem services and assessing impacts; and "Dynamic Seas" Tipping point project

M. LINKS TO & INTERDEPENDENCIES WITH PHASE II RESEARCH PROJECTS

This project will link with

- Project 1.1 "Cumulative effects" using information generated from RA1 Mahere tapuwae (footprints), RA2 Whakaranea (stressor interactions, function and ecosystem service delivery) and RA3 Haumanu moana (assessing recovery potential of shellfish and kelp)
- Project 3.2 "Communicating risk and uncertainty", using information generated by RA2 Analysis of cumulative effects and scaling on uncertainty, RA4 and RA5 Building/adapting and socialising tools (ensuring that learning developed in both projects are shared)
- Project T1 Awhi Mai Awhi Atu project, RA1 Ngā tohu o te taiao (recognising, interpreting and responding to tohu), RA3 Mahi tahi (mātauranga Māori and ecology to inform models), RA4 Kaitiakitanga based approach to EBM, knowledge dissemination, decision-making
- Project 4.2 Aim 3: Opportunities and Barriers for EBM (contributing knowledge of the limit-setting process (this project) and legal and policy context (4.2))
- and Project 4.3 Enabling Kaitiakitanga and EBM (shared learnings between the projects)

Note that none of these are critical dependencies

N. VISION MĀTAURANGA (VM)

Coastal Māori express grave concerns regarding the degradation of marine environments and want action to prevent further degradation and to restore mauri. Damage to the marine environment transgresses the basic concepts of a Māori worldview in ways that undermine cultural and individual identity. The degradation of marine ecosystems – has a significant detrimental effect on the relationship of Māori with their rohe moana (traditional marine environments). Identifying ways in which mātauranga Māori can be captured and incorporated through co-developed trans-disciplinary research and tool development to assist kaitiakitanga of marine taonga species and spaces is a high priority (Ministry for the Environment & Stats NZ 2019). More importantly, given that there is presently an intention that limits be set for freshwaters that protect estuaries, it is critical that potential processes for this be developed by Māori, and indeed the underlying concept of limit setting, be examined by Māori to determine its appropriateness in Te Ao Māori, in the case study areas.

This project has a commitment and willingness to partner and work with the concepts behind the Vision Mātauranga policy. We have allocated specific funding to support a local case study partner for each case study whose priority will be engagement, although they will also be critical to outcome and tool developments. In particular, we will seek input on the spatial and temporal scales that are of cultural significance to mana whenua. We understand that 'ki uta ki tai' is more than just connecting mountains to sea; it is about connecting people to water and landscapes and bridging across generations. The project seeks to investigate ways to bring together mātauranga Māori and western science. This will be achieved by increasing two-way skill, capacity and capability development through knowledge generating wānanga and hui around estuarine management and cumulative effects (see P2) to assist dual understandings and explanations of estuaries. This may involve, if appropriate and agreed, the inclusion of cultural health indicators and tohu as nodes in Bayes Net models designed to incorporate multiple stressors and cumulative effects. These will be blended with western science determine the probabilities of thresholds and management interventions to avoid them.

Vision Mātauranga Deliverables

Partnerships:

VM P1 The project uses a range of new and existing relationships with hapū/iwi or Māori organisations. Existing relationships include: The Integrated Kaipara Harbour Management Group (IKHMG https://www.kaiparaharbour.net.nz/, initiated by Ngāti Whātua), and Te Rūnanga o Ngāti Whakahemo. New working relationships are likely to include Ngāi Tahu hapu with interests in the New River catchment and estuary and are presently being negotiated by Naomi Apori (OLW)

VM P2. The project will increase 2-way skill, capacity and capability development through co-developed wānanga, but particularly through hui held to consider how best to incorporate, into estuarine management, cumulative effects, indirect and direct effects that are not simple one-way relationships, within-estuary activities, uncertainty and risk perceptions around precaution. It is intended that these hui are two-way learning experiences.

Distinctive Contribution:

VM D1. The project will result in distinctive and innovative outputs specifically tailored to Māori interests around protecting and enhancing estuarine mauri.

VM D2. Project outputs are aligned to the identified issues and aspirations of whānau/hapū/iwi partners.

Meaningful Outcomes:

VM M1. The project identifies and reflects Māori aspirations by ensuring Māori issues and needs are a priority within the codeveloped research plan with a direct aim of trialling a process that is intended by the NSFW to be applied to all estuaries to understand whether it will meet Māori aspirations and management processes.

VM M2. The project provides for the appropriate dissemination of knowledge and outputs to Māori, via hui-ā-iwi, or marae hui. Other outcomes will be those determined by whānau/hapū/iwi partners but are likely to include tohu for individual locations.

O. ENGAGEMENT REQUIRED WITH IWI AND STAKEHOLDERS

This project works in partnership with iwi from Kaipara, Bay of Plenty and, potentially, Southland to support case studies (see above for specifics).

The project has working relationships and shared personal with Tangaroa project T1 (Awhi Mai Awhi Atu) and Theme 3 project 3.1 (Perceptions of risk and uncertainty) and will work to ensure these will flourish to best support the implementation of EBM.
Co-development partners presently include Auckland Council (also Northland Regional Council through the Integrated Kaipara Harbour Management Group), DOC, and MPI.

We have met with Auckland Council modellers and iwi engagement teams to ensure that we build on and generate maximum benefit from prior and ongoing research in the Kaipara Harbour; it is important that we do not duplicate effort or deliver missed messages that could undermine their important prior work. We have also engaged with regional and territorial authorities throughout Aotearoa New Zealand via the Coastal Special Interest Group (CSIG), recently presenting the unified Sustainable Seas / Our Land & Water / Ministry for the Environment work plan at a 30-participant CSIG meeting and fielding questions for an hour.

DOC is recently prioritising research supporting limits-based management, with one of their areas for this work being the Kaipara. Fishery managers (particularly inshore) are increasingly focussed on investigating habitats of significance to fisheries (including taonga species), understanding land-based effects on these, and being able to communicate these to councils and iwi.

The work plan is part of a planned programme to support MfE outcomes, with MfE recently contracting NIWA to collate the data that will underlie components 5, 6 and 7 (see Figure in abstract). Future co-development partners will include Bay of Plenty Regional Council, and possibly Environment Southland or other council with urban estuary concerns. The scope of work has been presented to MfE and to the CSIG, and all indications are that we have full engagement from the CSIG in what we are proposing.

Engagement will be supported and managed through our allocation of personal dedicated to each case study (case study partner, Māori researcher and ecologist) and the overview by Drew Lohrer and Shaun Awatere. We have double-checked with our Māori researchers and confirmed that the resourcing necessary for iwi engagement in case study areas is sufficient for the project to succeed. VM researchers involved in the project (Kura Paul-Burke, Shaun Awatere, and Richard Bulmer) have the skills and experience to deliver outputs (such as blended western science and mātauranga Māori Bayes Net models) and Te Ao Māori tools. They are already specifically doing this mahi in other Sustainable Seas projects that they co-lead (project 1.1 and 3.1), and they will be supported by work proposed by OLW researcher Naomi Apori for Little Waihi. Together, these researchers will ensure that the values and aspirations of Māori are included in the aims and practices of estuarine management, supporting kaitiakitanga.

P. PROJECT COMMUNICATIONS

We will use our connections (see above) to engage media in communications about the issues the underpinning science, partnership with iwi and community groups and challenge case studies. In particular, this project is conducted in conjunction with an Our Land and Water project and we would be expecting our communications to be aligned. Furthermore, OLW has a project manager that will facilitate engagement with MfE to ensure impactful communications and outcomes

Q. RISK & MITIGATION

Intellectual and cultural property rights where whanau/hapū/iwi may wish to keep certain information closed impacting publications and public presentations. Mitigation includes conversation and shared agreement of what is open and what is closed knowledge, at beginning of the research.

R. CONSENTS & APPROVAL required to undertake research	• Human ethics approval will be sought through NIWA for work in this project, although it is not intended to consider the research done in here as having human subjects. Rather it is a co-developed research/management project. • If any environmental sampling is required, this will be discussed with local communities and regional councils and DOC to ensure appropriate approvals are obtained • Animal ethics will not be required for this research

S. REFERENCES

Bulmer, R. H., Stephenson, F., Hewitt, J. E. 2019. Exploring the impact of multiple stressors on estuarine ecosystems using a Bayesian Network model. Prepared by NIWA for the Parliamentary Commissioner for the Environment. Report number 2019246HN.

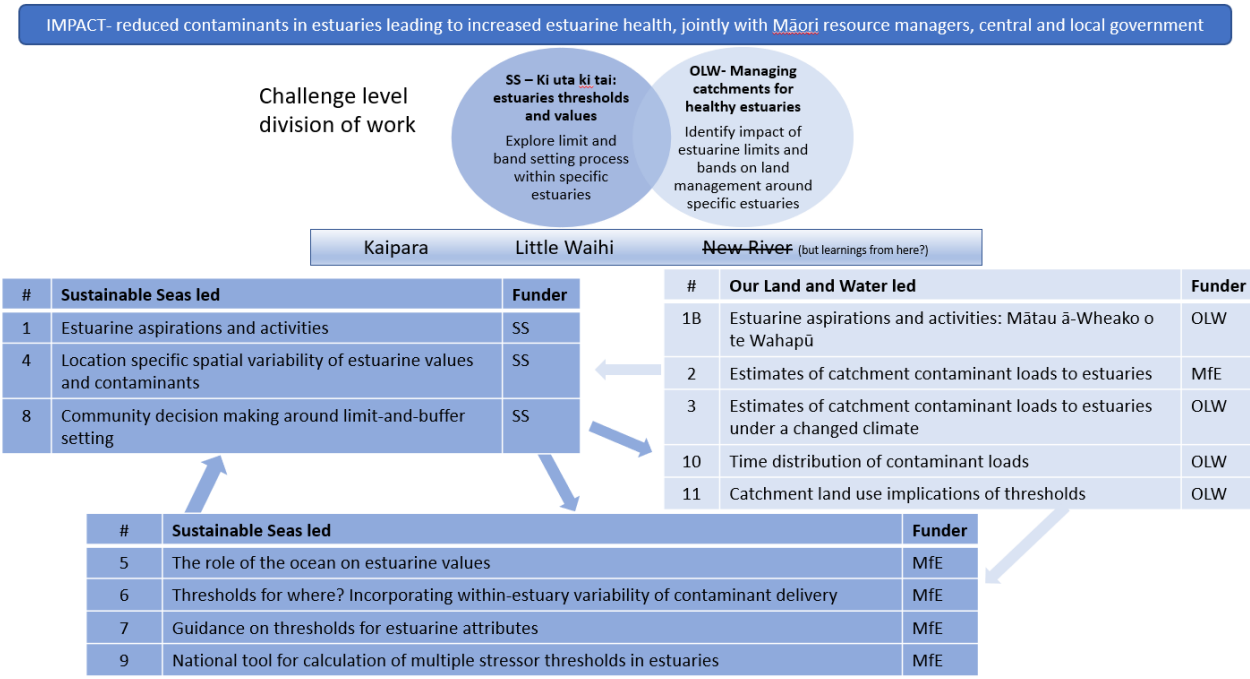
Bulmer, R., and J. Hewitt. 2020. Bayesian Modelling of Multiple Stressors on Six Hawke's Bay Estuarine Ecosystems. Hawke's Bay Regional Council Publication No 5478.

APPENDIX

Description of overall components and sources of funding requested

#	Component	Description	Funder
1	Estuarine **aspirations and activities**	Identifying for case study estuaries: whānau/hapū/iwi and local community aspirations; tohu that can be used to measure progress towards these; any supporting ecosystem components; and the major present or potential within-estuary activities and the stressors they engender.	SusSeas
2	Estimates of catchment **contaminant loads** to estuaries catchment	Modelled estimates of faecal indicator bacteria (*E. coli*), sediment, nitrogen, and phosphorus loads for major rivers entering all estuaries in New Zealand. Also modelled estimates of mean discharge (water) and mean temperature, and national map of attenuation to estuary of each contaminant.	OLW
3	Estimates of catchment contaminant loads to estuaries under a **changed climate**	Estimates (as per deliverable 2) to be made for 2010-2020 and under a changed climate in 2050 and 2100.	OLW
4	**Location-specific spatial variability** of estuarine values and contaminants	For the case study locations, produce maps and statistical summaries of within-estuary spatial variability in: • tohu and ecosystem components of interest (cockle abundance, ecological health indicators, etc.). • contaminant fate (i.e. where inputs end up) • activities and stressors	SusSeas
5	**The role of the ocean on estuarine values**	Understanding **when and where** freshwater and ocean inputs drive estuarine mahinga kai, endangered species and health using estuaries across New Zealand selected for their available information. Analyses will be used to derive • temporal variability of estuarine mahinga kai, health indicators, in-estuary water or sediment concentrations, and oceanic drivers • relationships between freshwater (based on component 2) and oceanic inputs/drivers, between in-stream and within-estuary water quality, and between these and estuarine mahinga kai and health indicators	Govt
6	***Thresholds for where*** Incorporating within-estuary spatial variability of contaminant delivery	For estuaries across New Zealand, selected from those with available information • derive summaries of within-estuary spatial variability in mahinga kai and estuarine health indicators, where contaminants end up (contaminant fate) and response of ecosystem components to stressors • test the relative efficiencies of different levels of modelling in deciding contaminants fate	Govt

7	Setting of **thresholds for estuarine attributes**	• Evaluation of stressor-response curves for ecosystem components of interest to derive thresholds for attributes	Govt
8	**Community decision making** around limit- and buffer-setting	• In conjunction with case study partners consider how best to add buffers/boundaries around thresholds to incorporate cumulative effects, ecosystem interactions, within-estuary activities, and uncertainty. • Further develop the Estuaries Bayes Net Model for estimating effects of multiple stressors on estuarine health and function to: use input concentrations; and assess effects on tohu, values and aspirations. • Analyse data from components 1, 2, 4 and 5, to suggest reductions in concentrations/limits necessary for restoration of the estuary mauri for OLW land-use scenarios in component 10.	SusSeas
9	**National tool** for calculation of **multiple stressor thresholds**	From components 5 – 8, create a new estuarine Bayes Net model capable of calculating the cumulative impacts of both in-stream contaminant delivery and within-estuary multiple stressors to be used to estimate thresholds and buffers for all estuaries in New Zealand.	Govt
10	**Time distribution** of contaminant loads	Estimated distribution of relative (to mean) contaminant discharges (E. coli), sediment, nitrogen, and phosphorus for major rivers entering all estuaries in New Zealand (by regionalisation of measurements at water quality sites). Also estimated distribution of discharge and temperature. Distributions to be for all time and for different seasons.	OLW
11	Catchment **land use implications of thresholds**	Estimating areas and land uses within a catchment that can or cannot meet thresholds for contaminant discharge in 2020, 2050, 2100. (Need attenuation map and spatialised mitigation data).	OLW



#	Sustainable Seas led	Funder
1	Estuarine aspirations and activities	SS
4	Location specific spatial variability of estuarine values and contaminants	SS
8	Community decision making around limit-and-buffer setting	SS

#	Our Land and Water led	Funder
1B	Estuarine aspirations and activities: Mātau ā-Wheako o te Wahapū	OLW
2	Estimates of catchment contaminant loads to estuaries	MfE
3	Estimates of catchment contaminant loads to estuaries under a changed climate	OLW
10	Time distribution of contaminant loads	OLW
11	Catchment land use implications of thresholds	OLW

#	Sustainable Seas led	Funder
5	The role of the ocean on estuarine values	MfE
6	Thresholds for where? Incorporating within-estuary variability of contaminant delivery	MfE
7	Guidance on thresholds for estuarine attributes	MfE
9	National tool for calculation of multiple stressor thresholds in estuaries	MfE