# Te Ara Paerangi – Future Pathways

MetService Submission

16 March 2022

MetService TE RATONGA TIRORANGI

MetraWeather

MetOcean SOLUTIONS

# Introduction

MetService staff and managers have participated in MBIE's Te Ara Paerangi – Future Pathways consultation process between November 2021 and March 2022. On behalf of all staff, we welcome and appreciate the tremendous effort made by MBIE in consulting the wider science community on Aotearoa's future Research, Science and Innovation system. This is Aotearoa's opportunity to shape a collaborative, future-looking, and thriving system in which, paraphrasing Sir Paul Callaghan, *scientific talent wants to work*.

MetService is a science-driven State-Owned Enterprise that provides New Zealand's National Meteorological Service (NMS) under a fully commercial model. Although this sets us apart from our global NMS counterparts, and from many other research providers in Aotearoa, we are deeply embedded in the RSI system, with strong and critical ties to universities and Crown Research Institutes (CRIs). Like all scientists, our researchers love science for its own sake; however, MetService is actively involved along the entire research-to-operations pathway. Delivering meteorological and oceanographic products and services to our stakeholders is our core function, and is how we achieve our purpose of *helping people stay safe and make informed decisions, based on the weather*.

Importantly, MetService draws on research outcomes to develop best-practice operational services, and the findings of Te Pae Kahurangi are highly relevant to our work. In particular, the conclusion that "…CRIs sometimes compete with one another and with other science system participants (and vice versa) in unproductive ways" resonates with us, and reflects our observation, over several decades, of a growing fragmentation of the atmospheric science effort in New Zealand. Unproductive competition has led to weak collaboration between key players and infrastructure managers. This means that, at a time of growing risk from severe weather and its impacts, as a country we are not making optimum use of our science capability to help manage the risk more effectively.

While atmospheric and oceanographic science is the domain we operate in, we appreciate that these issues are symptomatic of wider problems within the RSI system. As highlighted in this submission, we believe it is the combination of appropriate funding, flexible Institutions that nurture capability, and central governance of infrastructure, that must be considered together to ensure that each part functions effectively and to foster the collaborative spirit that lies at the heart of a productive science system. This science system trifecta will underpin a secure, diverse, and agile workforce that collaboratively sets and addresses long- and short-term research priorities for the benefit of all New Zealanders.

In this document, we outline the key challenges we have identified through our long-standing engagement with the wider science sector, how they have impacted progress, and some ideas for how they might be resolved. The sections are arranged according to the theme areas in the Te Ara Paerangi Green Paper, addressing those questions within each theme that we feel we can make a meaningful contribution to.

# Research Priorities

### 1. What principles could be used to determine the scope and focus of research priorities?

We recommend using the following principles to guide the identification of research priorities, specifically their **focus**:

- They have broad benefits for New Zealand (beyond, say, an industry sector)
- They align with societal goals (e.g., Aotearoa will be predator-free by 2050)
- They have long-term benefits
- They are sustainable and ethical
- The underlying issue cannot be addressed more efficiently through other means (e.g., legislation prohibiting coal burning is more appropriate than developing a process for large-scale atmospheric $CO_2$ extraction). This point will also help with assessing the **scope** of the research priority, as some issues will be most efficiently addressed with a mixture of science and other means
- A scientific solution that adequately addresses the New Zealand situation does not exist elsewhere.

The **scope** of the research priorities will be influenced by Aotearoa's capability and capacity. Short-term priorities will recruit existing expertise, but long-term and inter-generational issues will require the development and maintenance of additional capacity. Summarising as a principle, we propose that the scope of research priorities be defined in a way that:

- Avoids directing a large proportion of overall capacity to one research priority, beyond the short term, without replacing capacity in other priorities
- Increases agility to respond to future changes to needs and priorities
- Recognises the need for underpinning, not-yet-applied, research and associated frontier capability.

### 2(a). What principles should guide a national priority-setting process?

The process for setting research priorities must be efficient, able to respond to external changes over appropriate timescales, and should not generate or advantage vested interests. It should be experienced as responsive to needs, by communities as much as by experts. While the process will focus on identifying high-level priorities, the implementation of research priorities (question 3) must operate in an agile way, to ensure that the most appropriate approach is consistently taken relative to latest findings.

The process for setting priorities does not by necessity require large-scale programmes undertaken at long (e.g., decadal) time intervals. Instead, it should be agile, involving regular check-ins with the public and science community, and the analysis of contracted research reports and contestable research applications (e.g., Endeavour, SSIF, VMCF), in a more-or-less

continuous process. It must include the public and *all* parts of the RSI community. Web-based interfaces for public input, as employed for identifying the National Science Challenges, appear to work well for distinguishing the priorities by the public. Thus, we recommend these guiding principles:

- Research priorities are identified *near continuously* through regular dedicated input-seeking channels and via existing sources, such as reports and research applications
- The process is *transparent and democratic*, with due weight to expert opinion
- The process is *neutral* to the outcomes, not unduly influenced by existing capability and infrastructure, or by the specific interests of existing research providers or beneficiaries of research outcomes
- The process is *fit-for-purpose* in obtaining input (i.e., readily accessible to the public, communities, and experts)
- It is *apolitical* with a long-term focus
- It considers *flexibility* and *adaptability* from the outset as an integral part of setting high-level goals.

### 2(b). How can this process best give effect to Te Tiriti?

Māori should be enabled to set priorities that are relevant to their specific needs. We believe that the process must apply the principles of Partnership, Participation and Protection, and acknowledge the Māori way of doing things (e.g., building relationships before doing business).

### 3. How should the strategy for each research priority be set and how do we operationalise and implement them?

The strategy should address high-level goals, broken down into manageable steps by the researchers involved, using an existing part of the RSI system, such as the Endeavour Fund (adequately grown). This will fund short- and medium-term outcomes, while allowing assessment of results and research priorities in a long-term agile way. It also ensures that new expertise is enabled to contribute. On the other hand, the strategy must allow for the extension of programmes that are demonstrably best fit for addressing the relevant research priority.

The process for setting priorities should be independent to avoid conflicts of interest. It should also be agile, allowing for changes in direction or even abandonment of existing priorities on relatively short timescales. Long-term (e.g., 10-year) research priority-based contracts providing funding to dedicated staff will potentially hamper agility. They also tend to lead to large overheads and complex intra-organisational structures that can block resources from directly addressing the research needs. Avoid a "captured" source of funding for a single institution, with a contracted set of collaborators, which may create an expectation of ongoing funding with no incentive for collaboration.

We do NOT recommend creating additional research priority-managing entities, as this may divert funding away from the research itself, create funding dependencies, remove neutrality from the assessment of outcomes and relevance, and hamper collaboration. Use existing

funding mechanisms with additional resources to address research priorities. This will ensure that the best team(s) with national and international collaborators will address the problem, using the best tools and knowledge available at the time, while allowing regular reviews of the priority. Funding and capability should remain accessible to all institutions who can address the priority, thereby underpinning collaboration and agility in the face of changing conditions.

# Te Tiriti, Mātauranga Māori, and Māori Aspirations

### 5. What are your thoughts on how to enable and protect mātauranga Māori in the research system?

Māori should be enabled and resourced to identify their own research priorities and relevant mātauranga Māori, potentially with support from appropriate umbrella organisations such as the Māori Iwi Leaders Forum. Ensuring that Māori know their research priorities, and have the means to address them, would improve Māori engagement across the RSI system, including the incorporation of Māori interests in the broader research priorities.

With respect to broader research activities, we have made four key observations when working with iwi, in the context of the Moana project (Endeavour Research Fund). Firstly, scientists, drawn from many ethnicities, are often poorly equipped to interact in a culturally appropriate way with Māori. Unintended offence can occur easily, setting relationships and programmes back despite good intentions and excellent science.

Self-funded solutions, such as employing iwi liaison teams within research providers, do make a difference; however, given the diverse range of iwi, these kinds of approaches place a high burden on research providers. Secondly, many iwi are struggling to find the time to engage with all the research projects that ask for their participation. This is particularly true for pre-project engagement, when iwi are asked to put time towards co-designing a project that, given the low success rate of contestable funding in Aotearoa, may not eventuate.

Thirdly, relationship-building and collaboration are sometimes hampered by legislation, such as Takutai Moana 2011, that may cause tension among different iwi. This can make it impossible for researchers to engage or conduct research in an area, or across several rohe, despite goodwill on both sides.

Fourthly, considerable disagreement around IP ownership may exist. On the one hand, Crown funded research should provide results to the public and other users, whereas iwi may expect ownership of IP that is related to their rohe. This is very difficult, if not impossible, for scientists or iwi liaison teams to resolve.

Any change in the RSI system should aim to avoid the large upfront investment of time and resources for co-designing research projects with highly uncertain funding outcomes. One

option would be to fund Māori engagement as an integral part of research programmes, perhaps in a two-stage proposal, in which a successful pre-proposal provides funding for the co-design stage of the full proposal. Some logistically complex research operations, such as are run by the International Oceanic Discovery Program, request pre-proposals. Such a procedure would still require engagement prior to a pre-proposal stage, but the "heavy lifting" of programme co-design would be done in the full proposal stage, when likelihood of success is high. Iwi would receive fewer, but more realistic engagement requests, while research provider iwi liaison teams would also be able to put greater focus on fewer projects. However, such an approach may be influenced by conflicting iwi interests that are unknown at the outset, potentially reducing the value of the science opportunity.

Providing clear engagement mechanisms for researchers and iwi would be very helpful. This could include independent organisations that facilitate engagement, with government support to ensure that they are available when needed and are sustainable in the long term. These could include, for example, regional Māori knowledge hubs.

A further, similarly resource-intensive, option is to undertake the engagement by a specialised MBIE team. This would focus on funded research, with MBIE facilitating the introduction of the project to interested iwi. All methods need more time, resources and specialised skill than is currently available.

### 6. What are your thoughts on regionally based Māori knowledge hubs?

Māori knowledge hubs, either regional, local, or national, *could* be very helpful for both iwi and researchers. It is critical though that these hubs have the mandate and support from the iwi in their area to make decisions; otherwise, engaging with the hub may just add greater complexity.

If a regional hub has the mandate to facilitate on behalf of all regional iwi, and is sufficiently resourced to reimburse iwi for their time, it could support:

- Liaising with national Māori groups such as National Iwi Chairs Forum and its Iwi Leaders Groups
- Assisting iwi in prioritising research needs
- Advising iwi on protecting mātauranga Māori and IP strategies that aid iwi priorities
- Connecting researchers or iwi liaison teams with iwi representatives or groups of iwi.

# Funding

### 7. How should we determine what constitutes a core function and how should core functions be funded?

In our view, Crown funding for research should support public-good benefits that cannot be adequately funded through other sources, and the outputs of Crown-funded research should be broadly accessible. These should serve as principles underpinning the consideration of core

functions and their funding mechanisms. In particular, Crown research funding should not create outcomes that primarily benefit the research provider, nor should it disadvantage other participants in the RSI system. The alternative – which currently exists in at least some Crown research funding schemes – of allowing outcomes to be captured by research providers through IP ownership, creates barriers to collaboration and to the successful application of research outcomes for wider benefit.

Well-funded organisational core functions, coupled with open sharing of research outputs, will support sustainable research capability and capacity, foster collaboration, address diversity and inclusivity considerations. With that in mind, we suggest that core functions should:

- Reflect outcomes-based research that serves long-term needs in New Zealand, and is considered essential for social or economic prosperity. In effect, that means research that can't be left to the whims of market movements, and includes capability and capacity maintenance.
- Enable the open sharing of research outputs under the NZGOAL framework, and avoid any market advantage being conferred on the research provider through ownership of research outputs.
- Enable the long-term curation and provision of research datasets and other infrastructure.

Unless core function funding sufficiently addresses these three requirements, research providers are likely to continue to compete in unproductive ways. Funding for core functions should be tied to delivering research in specific outcome areas, as expressed, for example, in the CRI Core Purpose Statements. These statements should be strengthened so that, in addition to stating areas of research activity, research providers are also committing to maintaining capacity and capability in those disciplines.

### 8. Do you think a base grant funding model will improve stability and resilience for research organisations, and how should we go about designing and implementing such a funding model?

Base grants can be tied to specific core research functions, but should consider underpinning and related costs, including databases, infrastructure, capacity building and maintaining at least a minimum research capability in essential areas. On that basis, we think a long-term base grant funding model would improve stability and resilience. Building on question 7, a base grant fund should consider the research provider's ability to:

- maintain, curate and provide data obtained during Crown funded research, after project funding has stopped
- build and maintain capability and capacity
- purchase and maintain infrastructure
- maintain specific long-term research capabilities. .

Criteria for receiving base grant funding should be transparent and open to any provider meeting the criteria, not just existing CRIs or other large research organisations. Base grant funding should:

- Not disadvantage the grant-funded entity in comparison to other providers – for example, where there is a requirement to maintain a specific capability, that should be funded even if it can't be fully utilised on a consistent basis.
- Not create an unfair market advantage for the grant-funded entity, or fund effort that can be effectively delivered without Crown funding support.

# Institutions

Collaboration issues in the current system have been clearly highlighted in both the Te Pae Kahurangi review of CRIs and the Te Ara Paerangi Green Paper, for example:

- The Te Pae Kahurangi report notes that, while there are many examples of purposeful collaboration between CRIs, "CRIs sometimes compete with one another and with other science system participants (and vice versa) in unproductive ways". The report also notes that each CRI "is working to enhance efficiency and effectiveness at the organisation level, but much less so at the collective level", and makes specific recommendations to reduce barriers to collaboration and unnecessary duplication of effort.
- The Te Ara Paerangi Green Paper notes that "we continue to observe elements of unproductive competition across all organisations in the research system", and that "overall, we see a system where demand for its support outstrips the supply of resources".

Unproductive competition also exists between CRIs and SOEs, as evidenced by the relationship between MetService and NIWA. In 1992, the Meteorological Service of New Zealand, then part of the Ministry of Transport, was split into two parts, with the operational weather forecasting component becoming MetService, a State-Owned Enterprise, while the climatology and atmospheric research components became part of NIWA, a CRI.

The two agencies were formed with distinct and essential roles, with the expectation that they would work collaboratively to improve weather services for New Zealanders. Instead, MetService and NIWA have taken divergent paths, with each evolving its own research-to-operations pathway. While the reasons for this are complex and span a 30-year history, the over-riding factor for the past 15 years has been competition at the operational end of the value chain. With the agencies directly competing in the commercial weather services sector, neither is incentivised to collaborate with the other as part of a research-to-operations pathway. The consequences of that include:

- Substantial duplication in the development of weather forecasting infrastructure, in all aspects of the forecasting process from observational networks, to modelling capability, to the human expertise required to deliver products and services

- In particular, the Crown's long-term investment in NIWA atmospheric modelling capability – we understand this to be $millions annually over the past two decades – has not contributed to improvements in New Zealand's severe weather warning service
- Growing confusion about the operational roles of the two agencies, which now have significant overlap in the short- to medium-term weather forecasting space, could undermine New Zealand's Civil Defence and Emergency Management capability, particularly in the readiness and response phases.

These issues reflect a research-to-operations pathway within atmospheric science that has been badly disrupted through competition between Crown-owned participants in the RSI system. In light of our relationship with NIWA, and more widely with the CRIs, we offer the following responses to the Te Ara Paerangi questions 9 and 13.

### 9. How do we design collaborative, adaptive, and agile research institutions that will serve our current and future needs?

The respective roles of Crown agencies within the RSI system should be clarified, and critically assessed, so that there is a common understanding of the Crown's overall participation in the system and how that should evolve. Set clear expectations for core purpose/functions and how Crown agencies will engage across the science sector. These settings should be reviewed on a regular basis and adjusted as required, to enable the RSI system to make most efficient use of scarce resources to deliver wide benefit.

In line with Te Pae Kahurangi recommendation 4, CRI ownership and funding arrangements should be revised to "strengthen incentives for purposeful collaboration among CRIs and with other science system participants". Specifically, we suggest CRIs be incentivised to focus on collaborative research, rather than operational delivery or commercialisation of research outputs. Furthermore, in keeping with our comments under **Funding,** we suggest that the outputs of Crown funded research undertaken by CRIs (or other research providers) be made openly available, to maximise the benefit of those outputs across the science sector and avoid disadvantaging other sector participants.

### 13. How do we better support knowledge exchange and impact generation? What should be the role of research institutions in transferring knowledge to operational environments and technologies?

Crown funding for research that aims to deliver practical (operational) benefits should be conditional on a robust benefits realisation plan, including:

- Appropriate representation across the research-to-operations pathway within the project team. Where Crown agencies participate in funded research projects, their role should be consistent with expectations.
- A well-defined mechanism for transfer of knowledge, technology, or other research outputs, to other participants in the RSI system.

- Policies for ownership of intellectual property arising from Crown-funded research that are consistent with organisational core purpose/function and the NZGOAL framework.

# Research Workforce

### 14. How should we include workforce considerations in the design of research priorities?

Workforce development should be integrated into research priorities setting and funding mechanisms. A thriving RSI system is fundamentally driven by its people: it is diverse, inclusive, it develops well-rounded people, and provides them with opportunities to deliver exceptional science.

As discussed under **Research Priorities**, independent of research focus, capacity must remain available and secure over the medium and long term. Resourcing **Institutions** with base grants will underpin capacity development. The availability of capacity will empower people to adapt to other areas as needed, and will foster collaboration with other research providers. Empowering people to be flexible and collaborate widely, such as in workforce sharing, will support the response to emerging research priorities.

### 15. What impact would a base grant have on the research workforce?

As discussed under **Funding**, a base grant should include support for the growth and ongoing maintenance of essential research capability and capacity, including retention of capabilities that are highly specialised and difficult to access. As stated above, resourcing research priorities and institutions via base grants will ensure sufficient capacity and an adaptable workforce.

### 16. How do we design new funding mechanisms that strongly focus on workforce outcomes?

High-level funding mechanisms that promote hiring of early career researchers, retention of highly specialised capability, and diversity, will support workforce development as well as serving broader business needs. They should avoid dependence on contestable grants with uncertain outcomes, and support a capability pipeline for research providers and the wider economy.

Early career researchers are in urgent need of dedicated funding to provide the New Zealand science system with a viable pipeline of capability and capacity. The entry hurdle into permanent scientific employment is very high, exacerbated by New Zealand's remoteness in an international recruitment market. More grants are needed, with the suggested proviso that the number of early career grants (to individuals or organisations) should be proportional to the number of graduating doctoral students, which may differ by subject depending on its need as determined by research priorities.

Increasing the number of highly sought-after STEM graduates would be helpful, but may require some form of intervention to incentivise universities to attract students in those disciplines. We appreciate that universities must respond to market demand from prospective students, which may be focusing their attention more on non-STEM disciplines.

Funded exchanges or secondments, or a mechanism by which experts can work for a fixed time at a different organisation, will help with capability retention, skills development, and greater connectedness across the science sector. This would also help organisations adapt to short-term issues by easily accessing capability. Ideally, such schemes are based on mutual exchange, and can support and facilitate better collaboration and sharing of infrastructure.

All funding mechanisms can be used to target diversity or Te Tiriti considerations within the pool of eligible researchers, addressing capacity and diversity issues at the same time.

Non-academic research providers employ recent PhD graduates as junior scientists, providing these scientists with stability and an opportunity to find their career path in a different environment from academia. Such non-mainstream research providers should be equally incentivised to hire early career scientists, which will support national capability and capacity building, but will also add value to the career spectrum by immersing these scientists in the research-to-operations value chain that an enterprise company offers.

Joint graduate schools can support capability and capacity building for specific capability needs. MetService, in partnership with Victoria University of Wellington (VUW), has established a pathway for graduates to train as meteorologists via the VUW Master of Meteorology course. This programme builds on VUW undergraduate papers to deliver a highly specialised course that equips students for a career in operational meteorology. The programme is delivered jointly by VUW and MetService staff, aligned with both industry and academic requirements, and ultimately leading to World Meteorological Organization certification for the students.

Placements as part of university courses (akin to in-school placements of teachers during their training) are also ways to support ECR while benefitting potential future employers.

# Research Infrastructure

### 17. How do we support sustainable and efficient, and enabling investment in research infrastructure?

Infrastructure should be broadly defined as referring to technical and scientific assets, including monitoring and observing networks, databases and collections, and 'bricks and mortar' campuses. Because New Zealand has no dedicated fund for research infrastructure investment, there is limited information available regarding existing, under development, or required infrastructure. This is likely to lead to duplication of investment and lost opportunities for synergies through collaboration. For example, while the recent expansion of New Zealand's Deep-ocean Assessment and Reporting of Tsunamis (DART) buoy network was a multi-agency

effort, an opportunity was likely lost by not considering the co-installation of meteorological sensors. This would have provided valuable information from data-sparse areas for atmospheric hazard monitoring and numerical modelling, at modest additional cost.

We suggest that a central infrastructure database be created along with a mechanism for sharing of infrastructure. This infrastructure catalogue should be centrally funded and managed, with defined quality expectations for included infrastructure.

Efficient and cost-effective access to infrastructure should be the aim of infrastructure management. Sharing of significant infrastructure is not just a necessity for a small country, it also adds significant value by:

- Improving research outcomes through increased access by larger pool of experts
- Underpinning research priorities through streamlined access to infrastructure and technical expertise
- Connecting multidisciplinary teams and projects
- Enabling maintenance and long-term technical support
- Attracting international expertise and kudos
- Maximising / optimising use of infrastructure
- Incentivising merit applications (i.e., excellent research)
- Maximising scope of infrastructure instead of duplicating (e.g., size of a remote sensing network)
- Maximising funding reach (more bang for buck).

To reap these benefits, co-location of infrastructure user groups should be considered. In this we include campuses as workspaces, as well as access to technical and scientific infrastructure. If suitable, large infrastructure should be accessibly located, considering the potential (not just initial) scope of user groups. This is an especially valuable proposition for infrastructure with both research and operations applications. Co-locating campuses of infrastructure managing entities and user organisations can improve access and value-add through maximising collaboration and outcome creation.

Partial co-location of operational functions has also been shown to be beneficial for integrated coordination and response. For example, within the Emergency Management sector, it is common for an Emergency Operations Centre (EOC) to be activated in response to a crisis event, with the centre staffed by representatives of multiple agencies and designed to improve coordination and communication for effective response outcomes. In a similar fashion, potential benefits could be realised with the co-location of the 24x7 operational hazard monitoring and response functions, including 24x7 operations at MetService's National Forecast Centre, the National Geohazards Monitoring Centre, and the National Emergency Management Agency. All three agencies have close working relationships for the monitoring and warning of hazards and further efficiencies could be gained by exploring partial co-location options.

Infrastructure must be funded over its lifetime or its expected required use time, including plans for asset replacement if required. Specifically, operating expenditure should be part of the

funding. This principle also applies to research outputs that are effectively assets delivering enduring benefit – for example, long-term datasets or sample collections. To achieve that, the traditional approach to project funding, which ignores ongoing infrastructure costs, must be reconsidered. Countless datasets are inaccessible to the public or require extensive pre-processing to be available for use. We believe that a centrally funded data holding and serving infrastructure is necessary to alleviate the current situation and prevent further loss of data. This will set expectations on timely delivery and quality of data, and enable public access and down-stream research, discovery, and commercialisation.

Other options to consider with respect to research infrastructure are:

- Shared funding of infrastructure with other stakeholders – e.g., central or local government agencies, or business, that would derive direct benefit from the infrastructure
- Ongoing management of research infrastructure by a representative body of funders and user groups, to ensure effective utilisation of the assets and appropriate access to all potential users.