New Zealand's Biological Heritage National Science Challenge

SO5: Border Scoping Panel Report

Section 1: Creating Impact

Vision and link to the Challenge mission

It is critical that the rate of incursion and establishment by foreign invader species is dramatically reduced to prevent further biodiversity loss. Our unique indigenous flora and fauna, our water and our land are New Zealand's taonga (treasures). Biological invasions are a leading threat to New Zealand's native biodiversity and are one of the main ecological disturbances of today. Through competition, predation, infection and habitat alteration, invasive species are radically changing both the species composition and functioning of our native ecosystems. Biological invasions also have large economic impacts on our primary industries, as well as potentially very significant cultural and social impacts. The increasing rate of global spread and establishment of invasive species throughout the world is unprecedented due to the increasing movement of people and goods. Managing the risks posed by this is our biosecurity system. However, the rapid growth and diversity of trade and tourism, the multiple entry pathways each associated with changing biosecurity risks, and climate change are just some of the complex pressures faced by our existing biosecurity system.

According to Lyn O'Connell, the Deputy Secretary of Australian Biosecurity, "tripling investment will not keep up to risk", therefore we have to do things much smarter and better (PBRI Symposium, Brisbane, August 2019). Our NZ biosecurity system is arguably the most sophisticated and effective in the world, but there is a huge need for transformational changes and improvements to be made. Innovation, but also engagement with mana whenua and end users during biosecurity tool discovery and process design through to adoption and full implementation is essential. ***Our SO5Border vision of success is to intercept more biosecurity threats that present at airports, mail centres and sea ports, before they enter into the environment to spread and establish.*** We invite you to join us in our vision "*Using a co-design process with mana whenua and key end users, effective and acceptable tools and strategies for detection and prevention of threats will be developed and implemented at the border and where possible pre-border.*" Central to this process is the building of a Virtual Biosecurity Co-design Hub (the Hub) that is part of this and other Strategic Outcomes.

2024 Goals agreed during the scoping process.

We have set five goals through to 2024 to implement our vision that define both *what* (impact) will be delivered and *how* (values).

Values

1. Give equitable consideration and implementation of Te Ao Māori understanding, values, approaches, and opportunities.
2. Support mana whenua to enable more active participation in co-design of pre- and at-border detection and prevention tools.

3. Key end users are actively participating from development to deployment of novel border risk detection and prevention tools and strategies.

Impact

4. Provide proof of concept of a co-designed tool for detection and/or prevention of a priority pest.
5. Accelerate deployment of a dynamic and adaptive tool for detection of threats in a high-risk pathway (e.g. soil).

Beneficiaries

Who are we doing this for?

All New Zealanders will be beneficiaries of an effective, culturally inclusive border biosecurity system, as it is vital for protecting our everyday way of life, our taonga, our unique natural heritage and the productivity (including market access) of our primary and tourism industries. More specifically, MPI, ports, primary industries, Māori, tourism operators, travellers, importers and exporters will benefit from better border tools and technologies that will enable a more culturally inclusive, rapid, effective and efficient border biosecurity system.

The work we do in SO5 Border will address the challenges faced by New Zealand's biosecurity system at or before the border. The aim is to improve the efficiency and/or precision of detection of biotic threats present at major air and sea ports, transitional facilities and mail centres before they enter into the New Zealand environment to establish and spread. It is also to develop prevention tools and strategies to prevent or at least greatly reduce the arrival of key risk organisms, as has been done for brown marmorated stink bug and other significant pests.

New Zealand's border biosecurity services are recognised as world class. However, a recent review of New Zealand's border defences for passenger (air and sea), freight and mail pathways identified some challenges. To effectively mitigate evolving biosecurity risks, the technology underpinning Ministry for Primary Industries border biosecurity operations must be more responsive to the shifts in risk profiles, international trade and commerce. Border biosecurity is subject to rapid changes in incipient off-shore biotic threats, increasing travel and trade, and high stakeholder expectations. Operators and infrastructure must respond to rapidly changing demands and new technology developments. This means that ongoing improvements in technical and strategic border protocols are critical for our biosecurity system to remain world class and, more importantly, fit for purpose (Delane, 2019). This is the scale of our border biosecurity challenge and one we can in part address *through the development of advanced, new and intelligent technology and information systems that enable more efficient interception of incipient threats at or before the border.*

Who are the most important beneficiaries?

Engagement with Māori (including Te Tira Whakamātaki), the Ministry for Primary Industries, innovative scientists and other key stakeholders (Department of Conservation, primary sectors, air and sea port representatives) will be vital to ensure collaboration in the prioritisation, development and deployment of border tools and technologies that will create significant impact beyond what is already funded in the biosecurity science and innovation system. Within this framework, the role of tangata whenua as kaitiaki, and mātauranga Māori needs to be recognised and supported. Furthermore, we need to create partnerships between organisations that have a particular ability to reduce or manage biosecurity risk, including but not limited to, Ministry for Primary Industries, port and airport companies, shipping and airline companies, importers and e-commerce businesses.

> *What is lacking in the current system is the collaborative development and deployment of tools and strategies that can significantly improve pre- and border detection and prevention systems. All parties stand to benefit from better engagement.*

New Zealand is directly and indirectly underpinned economically and socially by industries that depend on the country maintaining one of the highest levels of pest and disease freedom in the world (Delane, 2019). Up to 70% of New Zealand's $80 billion export value is from industries that rely heavily on our outstanding biosecurity status. Retaining our '100% Pure New Zealand' reputation is a high priority with direct economic and social consequences for all New Zealanders if our border biosecurity system fails. We also have a national commitment to Māori to take care of New Zealand for now and future generations under the Tiaki promise (Delane, 2019).

Who is the team (institutions, individuals) who will create impact?

To create impact, scientists and engineers from CRIs, universities and private companies need to work extensively with frontline border MPI staff, MPI management and Māori. Representatives from across biosecurity agencies need to be engaged in the process to ensure eventual deployment of developed tools.

The SO5 Border Phase 2 Leadership team that will create impact will consist of, or be able to facilitate, three components: (1) the stakeholders who understand the need, how things work (economically, culturally, socially), and the costs/benefits of introducing new systems/technology; (2) the engineers/scientists who can create new technologies and processes and identify pathways to deployment; and (3) the entrepreneurs who can commercialise new knowledge/technology.

Delivery pathways

What are the pathways by which impact will be created?

Significant impact of SO5 Border activity will be created by underscoring the 'adoption and scale out' process of New Zealand's biosecurity systems services. We will achieve this through a purposeful 'co-design' process that optimises scientific technologies and strategies with cultural relevance for all end users. Central to this process is the building of a Virtual Biosecurity Co-design Hub (the Hub) that is part of this and other Strategic Outcomes (see Figure 1)
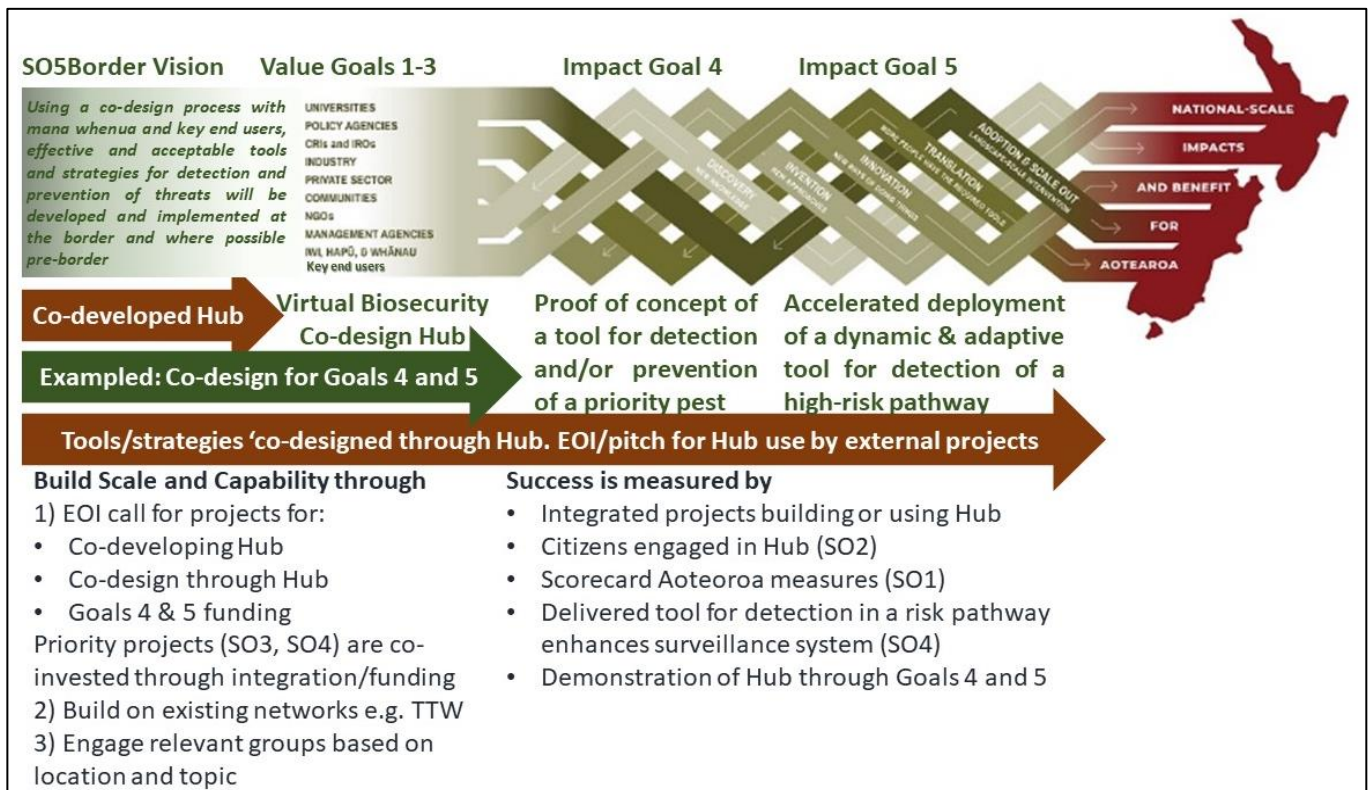

Figure 1. Delivery pathway and success measurement for SO5 Border

A similar concept has recently been implemented in Australia with their virtual "Seed – Biosecurity Innovation Hub" (**https://haveyoursay.agriculture.gov.au/biosecurity-innovation**) that features stories about exciting initiatives and profiles of people who are making great strides in innovation. It also provides a portal where new ideas can be proposed to a broader biosecurity community. We propose a similar model for NZ that can be fast tracked through connection with the leaders of The Seed (see Figure 2) to develop a similar Hub for NZ. The Hub will provide a step change in the development and implementation of New Zealand's biosecurity tools and strategies. It will rely on relationship management and have a strong cultural and social acuity. As a consequence of the collective and integrated co-design by key end users (e.g. biosecurity border staff, port operator, shipping companies and cruise tourists) and researchers, it will lead to a flow of new, turnkey tools and strategies developed for immediate implementation.

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Tuku Iho

The invitation will be open to multiple end users and research providers to use the Hub, which will be funded by BioHeritage National Science Challenge (BHNSC) and other interested parties to create a tool and strategy development pipeline that efficiently delivers ready-to-use tools and strategies to strengthen border biosecurity. The co-design process will provide software and sensors, automation, and data processing to achieve new, faster, more efficient or more sensitive tools or strategies for New Zealand's biosecurity system. The Hub will also actively involve the "Science for Technological Innovation" National Science Challenge (SfTINSC) as it has a current focus on advanced engineering technologies to develop sophisticated biosecurity networks for NZ (**https://www.sftichallenge.govt.nz**).

Figure 2. The Seed, established by the Department of Agriculture, Australia Government, as a virtual biosecurity innovation hub (**https://haveyoursay.agriculture.gov.au/biosecurity-innovation**).

The Hub will provide a co-design process for discovery through to adoption rather than be focused on a single tool or strategy type. This brings adaptability and agility. New directions or scale will be pursued as required through the new projects that use the Hub for co-design. An important aspect of the Hub is to review many ideas to identify those with most potential for development. Ideas presented through a portal like the Australian's Seed provide an easy way for researchers and innovators to present their ideas for consideration and feedback. All ideas should be treated "like cattle, not pets" to ensure that only those ideas which are fit for purpose will be supported. By following a process which reviews ideas at critical stages of development (Figure 3) such as ideation, validation and prototyping the Hub will reduce the impulse to back a winner at the outset. This approach will allow ideas to pivot or stop prior to large investment, which generally leads to point-of-no-return tool productionisation. A key strength

of the Hub is the acceptance that ideas can fail at any stage with stop points, but with a lower cost, and that failure leads to increased knowledge and future opportunities. Those ideas which yield successful prototypes will be ready for stakeholder product investment, pilot and deployment.
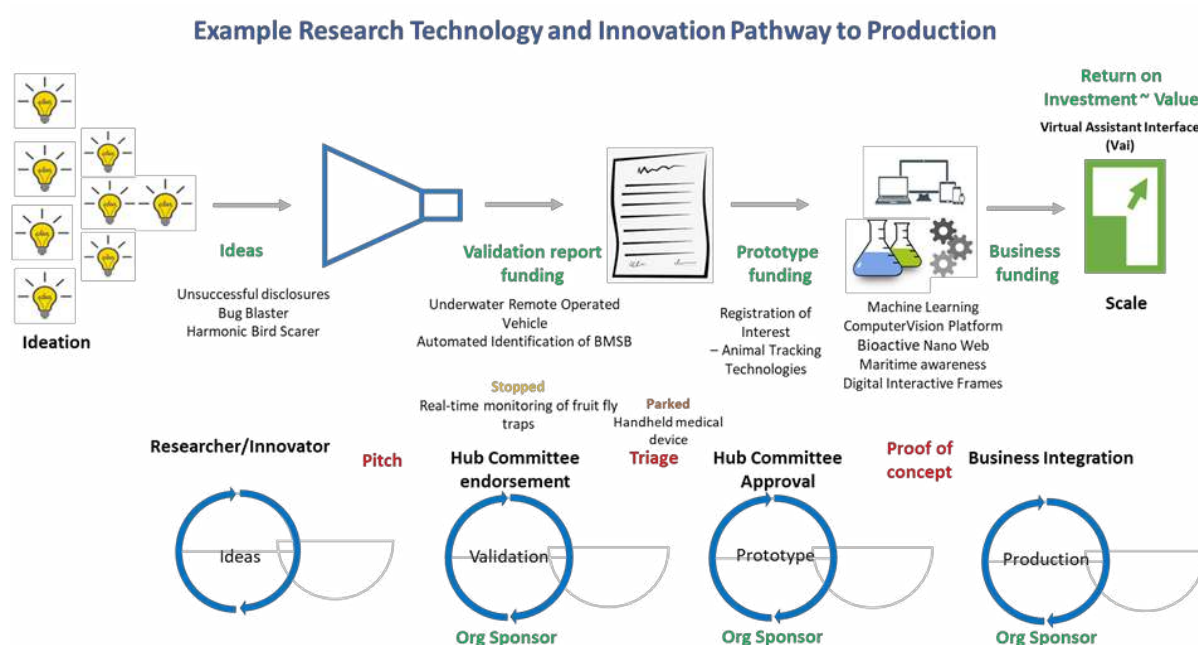

Figure 3: Example of the Research Technology and Innovation (RTI) Pathway to Production

How will you build scale? How do these pathways integrate with investments across the Challenge as a whole (i.e. link to work in other Strategic Outcomes)?

Achieving scale will be a key focus of Hub thinking (Figure 4). Projects that cannot achieve scale will be identified early in the process and culled. Equitable consideration and implementation of Te Ao Māori understanding, values, approaches, and opportunities will be at the essence of the Hub. The Hub will support mana whenua to enable more active participation in co-design of pre- and at-border detection and prevention tools. TTW will be a key participant in the Hub, along with other relevant agencies and key research and technology providers, particularly Better Border Biosecurity (B3) but all other relevant research organisations as well.

The Hub will coordinate effort across all BHNSC Strategic Outcomes where there is an opportunity to develop new border biosecurity tools and strategies. The Hub will integrate relevant research investments across the BHNSC (SO 1-5) and also the SfTINSC (Biosecurity Mission). As per the role of the BH Challenge, the Hub will coordinate research initiatives in the border technology space across all research providers and NZ funding agencies.
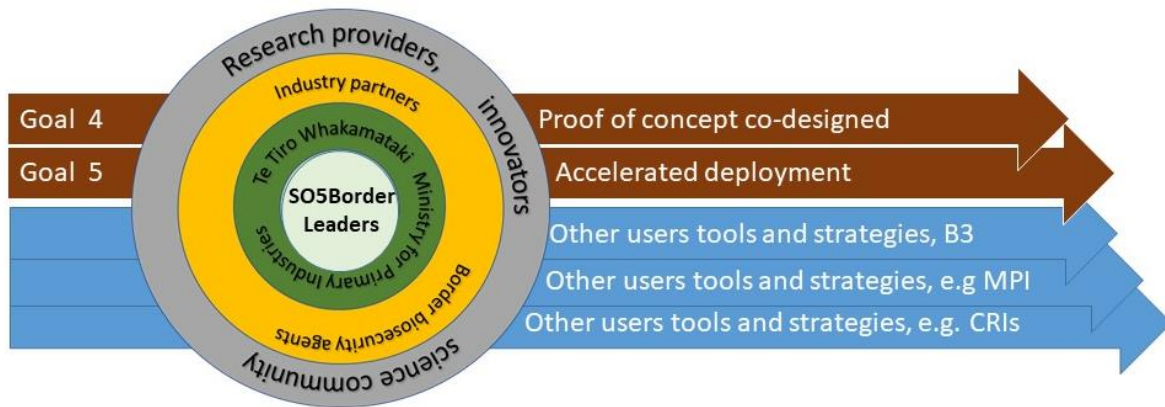
Figure 4. Composition of the Hub that is used to co-design tools and strategies that are funded by multiple users.

Which pathways will be most decisive? Which pathways will be most costly? What are the potential barriers to delivery, and how will they be overcome?

The build and operation of the Hub is the critical and distinguishing pathway for SO5 Border to achieve its goals. Equitable recognition of Te Ao Māori understanding will be essential and a major cost. Importantly, primary relationships must be honoured and the extent of capacity recognised. This approach will generate resilience within the expert, Māori provider network and avoid consultation overload and burn out.

There will potentially be technical barriers (IT issues) to delivery, but NZ's MPI had input into the Australia Seed – Biosecurity Innovation Hub and can learn from this experience. A business case will be required to justify the development of the Hub.

What is the vision for growth? How will you ensure an element of contestability in the overall portfolio of work? How will you bring in new skill sets or ideas into the team? What mechanisms will be used to introduce or refresh capability?

The creation, promotion, and operation of the Hub will be key to growth, and the development and use of new border biosecurity technology, particularly for detection and prevention purposes. Goals 2 (*Support mana whenua to enable more active participation in co-design of pre- and at-border detection and prevention tools*) and 3 (*"Key" end users are actively participating from development to deployment of novel border detection tools*) will be met as more Māori and other key end users engage in the use of the Hub and are involved in deployment as well as in design. Active communication and promotion of the hub to Māori and to all stakeholders will be required to ensure success. The timeline in "Essential Activities" below illustrates steps to be taken to ensure growth and success in achieving the goals.

The Hub will be designed with 'seed and scope' and 'fast fail' approaches in mind as only quality proposals that show potential high impact to enhance biosecurity will get through the pipeline for deployment. New skills, particularly in engineering but other areas as well, will be required in the design, development, and deployment of tools and strategies to enhance detection and prevention at the border. The BHNSC will work with the SfTINSC to bring in engineering skills not obviously available from BHNSC partners. The Hub will have both governance and technical advisory to ensure the right mix of skills are involved in projects and that new skills are recruited as required, through all stages of the projects.

What mechanisms will be needed if the team needs to pivot in a new direction?

The Hub will provide a co-design process for discovery through to adoption rather than be focused on a single tool or strategy type. This brings adaptability and agility. New directions or scale will be pursued as required through the implementation of new projects that use the Hub for co-design.

Risks

What are the perceived or actual risks inherent in your investment strategy? How might these impede progress towards creating impact? Are there potential risks or issues in working with non-traditional research organisations?

Co design, a central tenet of the Hub, comes with an acknowledged risk from over focus on engagement and relationship management to the detriment of innovation and production. Over a short timeframe, close management of the co design process will be key to ensuring concepts and discussions turn to practical outcomes and this will be managed by the SO5Border leadership team.

To achieve the Goals of SO5 Border requires considerable involvement of Māori and particularly TTW. Māori biosecurity resources are stretched and there is a risk that they will become too stretched to fully achieve the goals. Having TTW in existence goes a long way to mitigating this risk but the demands on TTW and Māori biosecurity resources in general will need to be carefully managed.

There is technical and political risk in establishing and operating the Hub that will need to be carefully managed to ensure a smooth process. The Australians appear to have done this in a relatively short period so there is a model to follow. There will be a need for diplomacy with other agencies involved in the biosecurity space to prevent "bureaucratic jealousy" with the setting up of the hub.

Communications and relationship management

What relationships will be most decisive? How will these relationships be managed? What communication channels are essential?

Effective engagement and relationship management is crucial to improving our prevention and detection of invasive threats to New Zealand. For instance, this includes engagement and relationship management/communication between national and regional government agencies and authorities (MPI, Customs NZ, Immigration, EPA, regional councils), industries, importers, researchers, Māori, and the broader community. Each of these groups play one or more roles including regulator, educator, priority-setter, coordinator, or advocate for New Zealand's ecological and productive systems. Therefore, by developing communication channels and applying partnerships with other groups/organisations, we will be better able to mitigate and manage the impacts of invasive species through the successful, co-designed development of better border tools and strategies.

The crucial relationships to support our goals and deliver true impact include the relationships between Māori, both at a regional and national level, government, end users and researchers. To develop a true and authentic co-design process, understanding the roles and responsibilities, priorities and expectations, and maintaining open and honest lines of communications is vital. Currently, the development and adoption of tools and technologies often lies solely on a single organisation or single partnership. However, to be able to effectively deliver a co-design process, a multi-layer relationship amongst all stakeholders is required.

We recognise the diversity of stakeholders in New Zealand's pre- and at-border space, and their distinct and differing priorities and expectations. As such, through The Hub a variety of engagement tools and approaches will need to be implemented to ensure stakeholders' differing interests and needs are understood and responded to appropriately.

Our approach to engagement with the Hub will aim to;

- Bring together stakeholders to share views and plan cooperatively and collectively;
- Enhance information and knowledge exchange with and between stakeholders;
- Create a stronger shared understanding of the roles, priorities and responsibilities of government, research institutions, Māori and end users in prevention and detection of invasive threats; and
- Increase collaboration between stakeholders for improved detection outcomes for New Zealand.

Thought must be given to what channels are used to achieve our goals, because using an unsuitable channel for collaboration can lead to unsuccessful outcomes. Complex networks/messages require stronger channels of communication, such as face-to-face, that can facilitate interaction to ensure clarity. To achieve our engagement approach through the Hub, essential communication channels will include;

- Personal communication/face-to-face channels in the form of hui/wānanga and smaller "working groups". Understanding values and ideologies can be complex, therefore it is important to hold these face-to-face interactions so that ambiguity can be clarified, and the speakers can establish whether the audience has received the message correctly through asking and/or answering questions. For example, to ensure equitable consideration and understanding of Te Ao Māori values, as outlined in Goal 1, personal, face-to-face communications will be an essential and primary channel that the Challenge will utilise.
- Electronic communication channels will be essential to interacting with a wider range of people and stakeholders. For example, the establishment of a virtual hub by which all stakeholders can access the consistent and correct information and updates (as mentioned above).

Enabling advocates in this process is important. Often when new concepts are conveyed, scepticism for doing something differently is triggered. These advocates are trusted sources within certain groups/organisations which allow for a consistent message to be relayed to a group of potentially unconvinced audiences.

Section 2: Incentivising Investment'

Essential activities

What high-level research, innovation, or translation activities are essential to delivering & sustaining impact (via the 2024 Goals)?

The SO5Border 2024 goals speak to both how we will deliver impact (values Goals 1-3) and what we will deliver (impact Goals 4 and 5) (Figure 1).

Co-innovation with Māori

Our value goals (Goals 1-3) are strongly driven by the principles of co-innovation and co-design with key stakeholders, research providers and Māori. Our first two goals specifically support active participation of Māori in our co-design process. The kaitiaki knowledge and values of Māori can provide solutions to the development of tools and strategies for detection and eradication of biotic threats. Their active participation in the development of high priority, pre-and at-border detection and prevention tools is also important to ensure implementation of Te Ao Māori understanding, values and approaches in any outcome. To achieve true partnership with our stakeholders, and with iwi, from

across New Zealand in our co-innovation pathway we will engage specifically with Māori through hui, Wānanga (Te Wānanga o Aotearoa, Te Wānanga o Raukawa and Te Whare Wanaanga o Awanuiarangi) and Māori 101 providers (e.g. University of Auckland). This engagement will be led though our partnership within the Challenge with Te Tira Whakamātaki, and enabled through the Hub, social media and existing end-user relationships with iwi.

Our co-innovation and engagement activities with Māori will aim to identify emerging Māori scholars, innovators and community leaders to play a key role in our co-design and scale out process for novel border biosecurity tools. This approach will ensure professional, academic and commercial development for Māori and also increase Māori representation in technology, biosecurity and science research. Specifically, our activities during the early phases of engagement will involve granting of scholarships (e.g. to support scholars in emerging life sciences, computing, data science and engineering, etc), implementation of science or industry internships (to support young professionals and technology innovators) and off-shore field research at high risk sites with key stakeholders (e.g. MPI) and industries (e.g. Napier Port). This will build engagement between key agencies and iwi (preferably local mana whenua), and also support identification and ranking of threats and risks specifically to taonga species (SO3). This intensive engagement and focus on building knowledge and confidence in Te Ao Māori will enable more active participation of Māori in the broader stakeholder, researcher and industry co-development workshops which will form the basis of our 3rd goal. Further to this, spill-over benefits will include empowerment of community leaders to champion biosecurity within their regions, potentially translating to implementation of biosecurity measures in hapū and iwi environmental management plans or provision of marae-based training in cultural competencies to agencies with biosecurity responsibilities (e.g. SO5 Post-border).

Virtual Biosecurity Co-design Hub

The Hub will host a website that provides social media updates and perspectives. It will comprise key personnel who can co-ordinate hui and wānanga and provide other resources as required to its users (e.g. Callaghan Innovation/Research institutes, KiwiNet, company or business partner, spin-off technology, and importers). Though virtual, the Hub will be hosted by a single entity e.g. MPI, Callaghan Innovation, or Manaaki Whenua, however each of the Challenge parties and aligned project organisations may host physical workspaces. The Hub will provide an incubator environment for discovery, invention, innovation, translation, adoption and scale out (SO 3-

> **Virtual Biosecurity Co-design Hub**
> - portal where new ideas can be proposed to a broader biosecurity community
> - funded to create a tool and strategy development pipeline
> - relationship management and strong cultural and social acuity
> - designed with 'fast fail' in mind
> - will have both governance and technical advisory
> - reviews ideas at critical stages of development
> - ideas can fail at any stage with stop points, but with a lower cost

5) as well as assessment (SO 1 and 2). The Hub provides an information source for SO 6-7.

The development of the Hub will be achieved through BHNSC funds, matched with others who have an interest in building and studying such a facility, as well as future users of the Hub. The Hub will act as a conduit between innovators, collaborators, technology developers, Māori and key end users. It will support and develop proposals, from blue sky/strategic innovative ideas through to those projects which can have immediate impact at our borders (Figure 5).
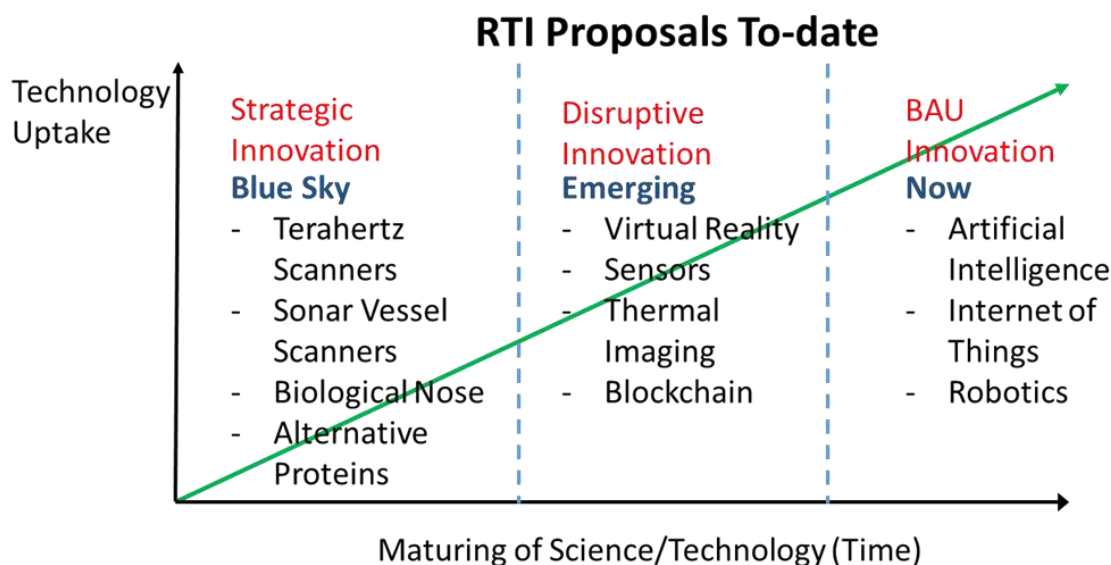
RTI Proposals To-date

Figure 5. Examples of Research and Technology Innovations (RTI) to date

Co-design Workshops

Co-developing and co-designing tools (Goal 3) to increase the efficiency of detection of an identified high priority threat or pathway at the border (identified together with SO3 and SO4) will require workshops with key end-users (MPI, Northport, Port of Tauranga, primary sectors), scientists (B3, universities and technical innovators) and iwi. These will be informed through the development of the Hub. There will be a call for priority projects (through expression of interest) that define the critical biosecurity border issues and enable group discussion. This will help identify key gaps and inform Challenge leaders where investment in novel tools or deployment of existing tools **will make a step change to our border biosecurity systems**. The process for the operation of the Hub needs to be developed, but will include an innovation pipeline and the requirement for business cases to justify investment in projects.

Proof of Concept of a Novel Tool

The outcome of our 4th goal is a "Proof of concept of a novel tool for detection or prevention of a high priority pest" at or before the border, including testing in a real-world situation. To ensure this tool is aligned to the priority needs of our border biosecurity systems (i.e. at air or sea ports, transitional or mail facilities) and, ultimately, benefit those who manage the high-risk pathways and influx of goods, foods and people at the border, the SO5Border leadership group will identify this priority tool through the co-development process defined for Goal 3 above.

A fundamental first step to ensure we have prioritised correctly will be to undertake an environmental scan of what emergent technologies are current out in the border research space and prioritising based on this stocktake. Undertaking this stocktake alongside our S05 sibling – SO5 "Post Border" – would be beneficial as there is relevant crossover in certain areas. Combining a tool across the whole SO5 space would allow us to alleviate the current problem of lack of scale up for deployment due to a small "border- tool market" resulting in little efficiency and uptake.

A working group will be established to manage the process of novel tool resourcing and co-development through to the proof of concept stage. Resourcing will need to be determined by the leadership team and could involve direct funding through the BioHeritage Challenge or co-funding through partnership with an appropriate funding platform (SiFTI, SSIF, SFFF, AgCARM etc).

Deployment of new Detection Technology

The outcome of our 5th goal is "accelerated deployment of a dynamic and adaptive tool for detection of a high-risk pathway". To identify this tool the hub will request expressions of interest from across the border biosecurity science and innovation system, including border agencies. This will table tools that have already demonstrated proof-of-concept, but require scale up or a commercial testing phase to determine their suitability to improve the efficiency of the targeted pathway/process. Priority tools will be identified with all partners through workshops enabled by our first three goals. Impact will be delivered through testing the scalability of the tool for commercial scale out. Preference will be given to tools where there is no obvious business partner (i.e. commercial beneficiary) but that show real promise in terms of delivering step change.

Essential to the scale out process will be the development of an appropriate intellectual property (IP) and business model with the tool developer, and identification of appropriate funders to resource the scale out and testing phase. This could be in part or fully funded by the Biological Heritage Challenge depending on the resourcing requirements and identified investment and commercialisation pathways.

Summary of Essential Activities

A summary of our essential activities over the course of the five-year programme are shown in the graphic below.
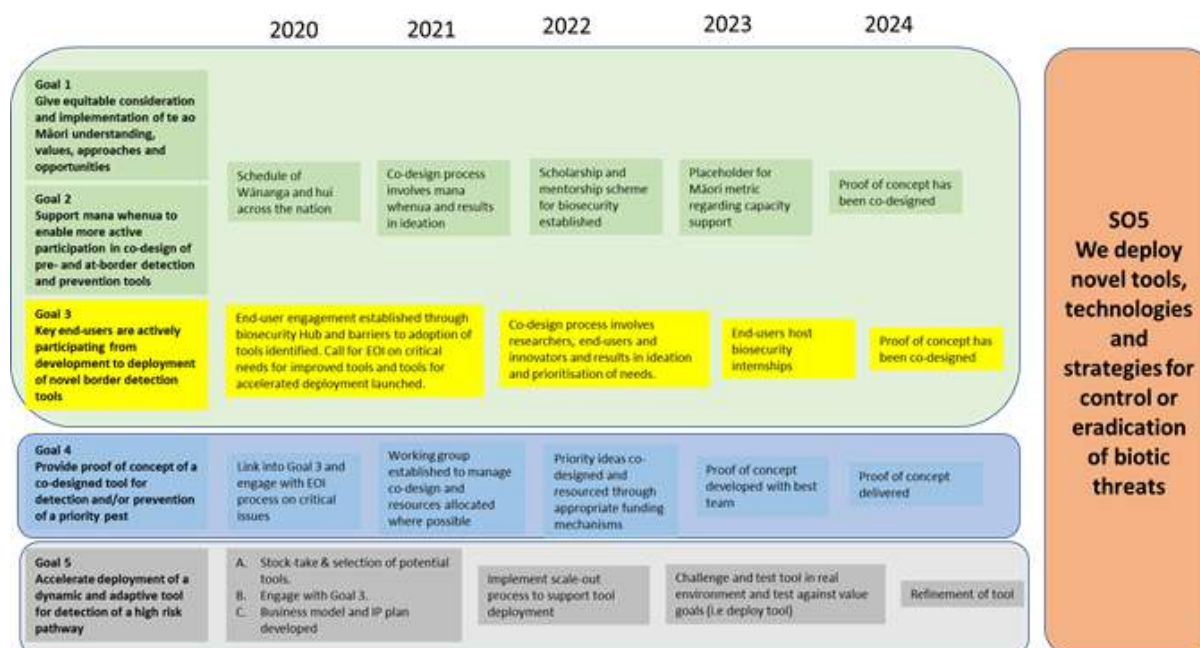

Figure 5. Essential activities from 2020 to 2024.

Essential partnerships and relationships

What relationships will be most decisive to transformation?

To achieve our 2024 goals our relationships with Te Tira Whakamātaki and the Ministry for Primary Industries (MPI) will be most critical, to identify pathways (air travel, sea or air freight, courier mail etc) that require transformation through development of novel tools or acceleration of existing tools. It is MPI's role to develop systems to protect and sustain New Zealand's natural assets that drive the multi-billion dollar export economy that defines our unique New Zealand way of life. MPI has direct oversight of all New Zealand's border biosecurity pathways and processes, as well as relationships with our key trading partners. They can therefore play a key role in directing our science and innovation to the processes that require underpinning research to achieve transformation. A partnership between Te Tira Whakamātaki and MPI, facilitated through the BHNSC, will assist in rapid implementation of Māori, and by association Te Ao Māori, directly into the centre of New Zealand border biosecurity governance. This will help to ensure cultural transformation of the biosecurity system.

Relationships with port (including water and air) or border authorities (e.g. Northport, Napier Port, Port of Tauranga, New Zealand Post) relevant to our priority tools (once identified) are also essential to ensure tools are co-developed with the people who will be using them. This will ensure tools are designed to be fit for purpose from the start, with the potential to significantly overcome existing constraints and limitations of current border biosecurity technologies. Further to this, relationships with industries/end-users who will benefit from tools are important, such that technologies are targeted to the high priority, existing and emerging biotic threats. This could involve engagement with the Department of Conservation, industry biosecurity managers and/or stakeholder groups (e.g. Forest Owners Association, Kiwifruit Vine Health, Pipfruit, Hort NZ, Dairy NZ), depending on the process that is targeted and the pests that are able to move through this entry point.

Another key relationship will be maintaining the already strong connection with the science and innovation community (which can include industry), that have the know-how and innovations to provide transformational change. Depending on the system/process targeted for transformational change this could require skills in big data analytics, software design, artificial intelligence, biotechnology, robotics and/or social engagement. Engaging this community will be essential to deliver the tools but likely the least challenging as the science and innovation community are poised to see their ideas realised and funded to create benefit for New Zealand. Typically, these innovators will come from the Crown Research Institutes, private sector innovation companies and universities, most of which are already partners of the Biological Heritage Challenge. Some key partners, for example, could include Callaghan Innovation, KiwiNet, SfTINSC, university engineering departments, Aeronavics, Genera, Asure Quality etc.

Ensuring mutually beneficial relationships with investors and funders, both potential and existing, will be necessary to ensure our goals can be achieved. While some funding will come from the BHNSC, further funding from the private, not-for profit, government sectors, CRIs and universities will play a key role in boosting S05 capabilities, and maintaining a close relationship will be essential to ensuring their on-going support. For instance, potential funders include those developing biosecurity related tools but requiring enhanced engagement with end users and Māori.

What agreements do you have in place, or do you need, to ensure buy-in from key partners?

Our five goals establish the pathways we will use to identify the tools needed to achieve transformative change in the biosecurity system. These pathways outline that our key partners will be identified through an intensive engagement process and through expressions of interest (EOI), managed through the SO5 Border leadership team. The two most important partners to kick start our process, MPI and TTW, are already on-board this Challenge with representation on the SO5 Border team and at the leadership level. Further to the Scoping Panel Report Phase, the SO5 Border leadership will lead the identification of priority tools and technologies, and then key partners to deliver those tools. During the EOI process,

interested parties will need to identify how they will access relevant data and resources to carry out research activities, or request that the Challenge, through their extensive network, assists in finding the appropriate partners to provide the requisite and outstanding resources. Partners who could be involved in this process will again include members from relevant universities, policy agencies, CRIs & IROs, SfTINSC, industry, private sector investors, communities, NGOs, the Australian Biosecurity Innovation Hub and iwi, hapū, whanau.

Essential resources

What systems resources (research funding, data, infrastructure, capability etc.) are essential to delivering & sustaining impact?

People and Capability

No matter the complexity and size of our goals, for impact to be delivered and sustained, human resource is essential. Having the right people, with the right skills and knowledge, is probably the most complex and difficult resource to establish but also the most critical. Our value goals (1-3) are people centric – they require a range of stakeholders to be _available_ and _capable_ to contribute to these goals. It's this people capability that is arguably the most valuable resource and therefore crucial for delivering and sustaining impact.

Goal 2 specifically acknowledges the need to build capability within Māori to have the right people with the right skills to contribute towards developing an authentic co-design process. Developing this capability, which is essentially the collective skills, abilities, expertise and values of the individual/group/organisation, will be an outcome of Goal 2. This will occur through the Challenge investing in training, mentorship/coaching and clear communication channels. For the Challenge to deliver impact through Goal 2, it is essential that we support Māori in building capability.

For Goal 1, the knowledge transfer of Te Ao Māori values is essential to ensure there is fair and considered implementation of these values throughout the remainder of our goals. Knowledge brokers are considered the "doers" of knowledge transfer. We need the right people who have the capability to work with a wide range of stakeholders, and facilitate the development of relationships, to help close the current gap that is evident between Western science and mātauranga Māori.

To deliver our impact through Goals 4 and 5, it is essential that we have the right people, with the appropriate skills to execute tool development and implementation through an authentic co-design process (Goals 1-3).

The capability required to establish and operate the Hub is identified in the Delivery Pathway and Essential Activities sections and illustrated in Figures 1 and 3.

Funding

The quality of the impact created through our 2024 goals will be somewhat dependant on acquiring appropriate funding. While acquiring funding is essential across all the SO5 Border goals, Goals 4 and 5 specifically will require research/scientific funding to both develop the tools and to carry already developed tools through to adoption and scale out. There is acknowledgment from across the Challenge that the funding streams within the research communities are fragmented. Our Impact goals (4 and 5) look to align with those organisations that are involved in tool development and seek co-funding, offering the support and alignment of the Challenge to achieve any funding bids that may be required.

As such, funding across our goals will involve a portion of direct funding through the Challenge and a portion of co-funding through partnership with an appropriate funding platform (SfTINSC, SSIF, SFFF, AgCARM etc).

A key funding source will need to contribute towards our training/scholarship.

Data

Data analysis can help to understand where there are clear gaps in the border that would benefit from a new tool or technology or the adoption of a tool. It would allow the SO5 Border team to undertake a thorough stocktake of the border tool pathway to understand where best to invest both Challenge funding, and any co-investment received. Also, understanding where the biggest slippage through our border is could direct our investment in a tool. I.e. seeds through the mail centre or soil contamination on low-risk containers.

Section 3: Quantifying Cost Elements

Budget details and cost narrative

Which essential activities are the most expensive? Which essential resources are the most expensive? Which partnerships will be costly to establish and maintain? Which are the costs inherent in delivering impact? What plans do you have to leverage co-investment from the key partners to cover some of the cost elements?

Costs of the SO5 Border activities over five years (Table 1) are either direct (e.g. to wānanga and hui across the nation in 2020), matched with in-kind contributions from other users (e.g. end-user engagement to identify barriers to adoption), shared (e.g. working group of best team established to manage co-design, resource allocation, and deliver for Goal 4 or 5), or paid to BHNSC by the user for the use of the Hub (e.g. $80K per tool). Estimated total costs (excluding in-kind contributions) change from being exclusively supported by BHNSC in 2020 to being leveraged at least two-fold by 2024, with additional leverage accumulating with every new user of the Hub who contributes a fee (estimated at $80K) to assess the proven benefits of facilitation with end users (including Māori). In this way the Hub that is based on the Value Goals 1-3 provides a nationwide service to build scale and national capability that is otherwise difficult to achieve. Ongoing costs to the Hub include infrastructure, data storage, intellectual property, workshops and key personnel.

Table 1. Costs of the SO5 Border activities from 2020 to 2024.

Year 2020 (Total cost = $540K plus in kind, Cost to BHNSC = $540K)	BHNSC	Other Users
Schedule of wānanga and hui across the nation	$150K	matched in-kind
End-user engagement to identify barriers to adoption	$100K	in-kind
Relationship development and engagement to develop Virtual Biosecurity Co-design Hub	$150K	in-kind by some users
Development of website and information channels	$80K	
Stocktake of tools in-use and in-development and mapping of their targets, pathways and efficacy	$80K	in-kind
Co-ordination with SO3/SO5PB to determine target(s) for Goal 4 (tool for detection and/or prevention of a priority pest) and Goal 5 (accelerate deployment of a dynamic and adaptive tool for detection of a high-risk pathway (e.g. soil).	$25K	in-kind
Development, assessment, and initiation of EOIs on critical needs for improved tools (Goal 4) and for accelerated deployment (Goal 5)	$35K	in-kind
2021 (Total cost = ~$990K (+ $80K per additional tool), Cost to BHNSC = ~$610K)		

Relationship management of Virtual Biosecurity Co-design Hub and its use (Goals 4 and 5, and other users) including communications	$150K	in-kind by some users
Co-design process involving mana whenua resulting in ideation	$80K	in-kind
Working group of best team established to manage co-design, resource allocation, and delivery for Goal 4 (BHNSC and other end-users, $380K)	$380K (BHNSC and other end-users)	
Working group of best team established to manage co-design, resource allocation, and delivery for Goal 5 (BHNSC and other end-users, $380K)	$380K (BHNSC and other end-users)	
Working group of best team established to manage co-design other users of The Hub		$80K per tool
2022 (Total cost = ~$1180K (+ $80K per additional tool), Cost to BHNSC = ~$800K)		
Relationship management of Virtual Biosecurity Co-design Hub and its use (Goals 4 and 5, and other users) including communications	$150K	in-kind by some users
Co-design process involving mana whenua resulting in ideation (includes scholarship and mentorship scheme)	$120K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 4	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 5 (scale out)	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design for other users of The Hub		$80K per tool
2023 (Total cost = ~$1150K (+ $80K per additional tool), Cost to BHNSC = ~$650K)		
Relationship management of Virtual Biosecurity Co-design Hub and its use (Goals 4 and 5, and other users) including communications	$150K	in-kind by some users
Co-design process involving mana whenua resulting in ideation (placeholder for Māori metric regarding capacity support)	$120K (BHNSC and other end-users)	
End users host biosecurity internships	$120K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 4	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 5 (challenge and test tool in real environment and test against Value Goals)	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design for other users of The Hub		$80K per tool
2024 (Total cost = ~$1030K (+ $80K per additional tool), Cost to NSC BH = ~$490K)		
Relationship management of Virtual Biosecurity Co-design Hub and its use (Goals 4 and 5, and other users) including communications	$150K	in-kind by some users
Co-design process involving mana whenua resulting in ideation (placeholder for Māori metric regarding capacity support)	$120K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 4 (proof of concept achieved)	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design, resource allocation, and delivery for Goal 5 (refinement of tool)	$380K (BHNSC and other end-users)	
Working group of best team to manage co-design for other users of The Hub		$80K per tool

Total 5 year cost for NSC BH: 3.1 million

Total 5 year cost including co-funding: 5.2 million

Section 4: Evaluating Success

2024 Goal Metrics

Goal metrics are detailed below.

	Description	Date
	Phase 2: SO5 Border Leadership team appointed, that includes key capability from MPI and TTW.	March 2020
	At least one hui has been held with the SO5 Border Leadership team and other key industry and Māori stakeholders. The aim will be to outline high priority border pathways where transformation is critical to prevent incursion. Opportunities for tools or strategies to result in substantial transformation through a co-design process will be discussed with a view to EOI submission.	June 2020
	The operating principles and resourcing requirements of a virtual Biosecurity Hub have been co-designed with the relevant SO leadership teams, MPI and TTW and these have been shared and validated with other key biosecurity providers. This is a stop/go point.	June 2020
	An EOI process has been developed to scope: 1) concepts for transformational tools/strategies (Goal 4) and 2) tools/strategies for deployment (Goal 5) that have the potential to transform a high priority border pathway.	August 2020
	A survey of iwi engaged in biosecurity initiatives and the potential for further engagement through the hub has been conducted.	September 2020
	At least one hui has been held where four tools and concepts identified through EOI process are prioritised and selected for further co-design and funding. The key barriers to development, adoption and scale out of potential tools are addressed through the co-design framework.	January 2021
	A funding platform for development and/or acceleration of at least four tools/strategies that have the potential to significantly transform a border pathway has been identified and secured through the Challenge Leadership team.	March 2021
	At least three Māori students, post-graduates or young professionals have been selected and funded to participate in a Goal 4 or Goal 5 outcome through a university, CRI or industry internship.	March 2021
	A virtual Hub has been established and resourced and is being used as a portal for national communication and engagement of border biosecurity	June 2021

	facts, figures and science. The results of the survey are used as a metric on current levels of engagement with Māori.	
	A workshop is held where the progress of four selected tools are discussed between the leadership team and key partners. Barriers to progress or synergies to accelerate outcomes are identified and mitigated/progressed. A stop/go point for tools not showing promise or where shift to alternative outcomes identified and new metrics put in place if necessary.	March 2023
	A hui is held where the learnings of the Māori scholarship and mentorship programme are shared with a wider group. The hui is used as an opportunity to share the progress of tool and technology development and opportunities for continued active involvement in the co-design process.	June 2023
	At least one tool selected for commercial scale out is being tested in an actual situation and data is being collected on limitations to achieve full operational efficiency and compliance with port/pathway quality standards.	September 2023
	At least three significant outcomes can be identified from the Hub operating as a platform for engagement of all partners involved in developing and providing tools for the border, or broader Challenge outcomes. At least one of these outcomes demonstrate that the Hub has resulted in greater engagement of Māori in the biosecurity network.	December 2023
	The leadership team has met and agreed that all projects are on track to deliver to 2024 Goals, with appropriate mitigation steps put in place.	December 2023
	Proof of concept is demonstrated of at least 2 tools that have the ability to transform a high priority border pathway.	September 2024
	At least 1 tool has been progressed from the Proof of Concept phase to commercial scale out and will significantly transform a border pathway (either through detection or improved strategic process).	September 2024
	There is a measurable increase in engagement of diverse stakeholders in border tools and technologies, enabled through the hub and demonstrated by an increase in research collaborations, funded programmes and new relationships with the Challenge (referenced against initial survey).	September 2024
	Feedback/outcomes from three Māori students/post-grad/internship programmes demonstrate the value of their integration into the biosecurity system and the resulting broader engagement of iwi.	September 2024
	A workshop is held to discuss the outcomes of the programme and the next steps to continue building on the progress that has been made in achieving the 2024 goals.	December 2024

SO5B Design Team

Carol Rolando (Scion)

Rachael Horner (Plant and Food Research)

Fabien Medwecky (University of Otago)

Robin MacDiarmid (Plant and Food Research)

Desi Ramoo (Ministry for Primary Industries)

Erin Lane (Kiwifruit Vine Health)

Mahuru Wilcox (Manaaki Whenua – Landcare Research)

Brogan McGreal (Plant and Food Research)