Contaminants Present in Organic Waste: Phase 3 Recommendations Report

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Report for Ministry for the Environment

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1.0 Audience and Purpose of the Report

1.1 Introduction

The Ministry for the Environment (MfE) commissioned Eunomia Research & Consulting, Whetū Consulting Group, and Massey University, to examine issues of contaminants in organic waste. The project aims to understand and address the challenges posed by contaminants in our organic waste material streams in order to mitigate risks to soil, human and animal health and expand end markets for processed organic waste. The project outputs will build on existing knowledge and standards and provide clear action recommendations for addressing the contaminants challenge.

The report is one of a series in the project's three phases:

Phase 1: Review of Regulations and Guidelines

- Establish framework
- Review of NZ standards regulations and guidelines
- Review of international practice
- Gap analysis and synthesis report

Phase 2: Engagement and End Markets

- Develop stakeholder engagement plan
- Tangata whenua engagement
- Industry engagement
- Analysis and reporting

Phase 3: Recommendations

- Thresholds and framework report
- Review by Tangata whenua and industry
- Final recommendations (this report)

1.2 Report Purpose

This report draws together the recommendations across the project, based on stakeholder input and the findings of the work to date. The recommendations aim to address the key gaps and priorities in terms of organic waste contamination and

provide a set of solutions that will meet the objectives of the New Zealand Waste Strategy[1]. Central to the waste strategy is the concept of the circular economy enriched by Te Ao Māori.

2.0 Overview of Approach

2.1 Problem Statement

This project identified the high-level objective of enabling the recovery of maximum value from waste organic materials, while safeguarding health and environmental outcomes.

Maximizing the recovery of organics avoids the negative impacts of sending organics to disposal - including avoiding greenhouse gas emissions and loss of nutrients. On the other hand, there are potentially negative consequences if organics are recovered without due regard to the potential to introduce contaminants into soil, water and their uptake by plants, animals, and people. In other words, because organic waste can be contaminated, there is risk in both recovering more organic waste and in not recovering more organic waste.

What is required is a system that not just enables contaminants to be identified and appropriately controlled, but that ultimately facilitates the optimisation of the recovery of organic wastes to their highest value use, while ensuring that people, and the Mauri of the land, are protected and enhanced.

There needs to be consideration of how to most effectively take account of and manage the different risks through the value chain. This includes:

- risks posed by different feedstocks,
- the degree to which those risks can be managed and mitigated through education,
- managing feedstock risks via collection and processing approaches, and;
- managing risks associated with how various products may be used in the different receiving environments.

This system needs to be responsive to new contaminants such that culturally and environmentally appropriate guidelines and standards can be defined and integrated with waste management. Such a system would require leadership, management, governance and funding to effectively operate.

It is recognised that this project sits within a larger sphere of work that encompasses the identification of strategies and approaches to managing organic materials through the bio-economy. The focus of this work is therefore to support the wider objectives

[1] Ministry for the Environment. 2023. *Te rautaki para | Waste strategy.* Wellington: Ministry for the Environment.

through working to ensure that contamination does not become a constraint on the ability to maximise and optimise the recovery of value from waste organic materials.

2.2 Harmonising with Te Ao Māori

As part of the project, the team considered how Te Ao Māori worldviews might be considered into the project, how they would be identified, and at what point of the continuum these might be considered. The output was a framework to support the consideration of contaminants from a Te Ao Māori lens through a whakapapa-centred analysis.

A pivotal component of this project involved the deliberate integration of views of Te Ao Māori to allow for a wider understanding of the important issues to consider for Māori when facing contaminants within organic waste. This work provided critical considerations that the project team must address to produce a comprehensive and substantial body of work that accurately captures the views of Te Ao Māori on the contaminants within organic waste.

Whakapapa has been utilised to consider holistic views of Te Ao Māori toward contaminants in organic waste and weaves together the various elements.

The concept of whakapapa ensured our considerations of Te Ao Māori toward contaminants are not considered in isolation of the wider cultural context. The approach does provide a mechanism to consider contaminants and/or the various organics processes to better understand the views of Te Ao Māori. Furthermore, the approach allows for better understanding and processing any input from Māori that will be engaged throughout this and subsequent projects.

The resulting Whakapapa-centred Approach for understanding the views of Te Ao Māori on Contamination of Organic Waste (Whakapapa Centred Approach) is a framework to consider different contaminants and explore their impacts as it pertains to Te Ao Māori. This approach was developed as a separate workstream. The decision not to integrate the approach into technical thresholds work, was an intentional one. The report should be read as a standalone piece of work and considered as part of decision making in this space, where knowledge of Te Ao Māori views needs to increase.

As discussed throughout the report, the application of the Whakapapa Centred Approach is relevant and can be used across the board to support increasing knowledge and understanding of the impacts of the sector for Te Ao Māori. It is also recommended that the approach is always used in the following instances:

- **Application in Culturally Significant Contexts**: The framework should be utilised in scenarios where cultural significance is paramount, for example in instances where organic contamination impacts traditional Māori food sources

- **Engagements under Te Tiriti with Iwi**: The framework should be used in collaborations and engagements involving territorial authorities and iwi, under Te Tiriti

- **Defining Pollution Status of Contaminants**: The framework can aid in exploring relevant context to assist defining the pollution status of various contaminants. This is crucial as it incorporates Māori views in assessing new and emerging contaminants, ensuring that their potential impact on Māori communities and the environment is carefully evaluated

- **Supporting Education within the Sector:** Given the higher proportion of Māori involved in community-level organic practices, targeted support is crucial. This includes educational initiatives that leverage the insights proffered through this approach, to inform, educate and empower Māori communities, as well as clearly helping to inform decision makers and operators within the sector to better understand Māori views and the impacts for Te Ao Māori

By leveraging the approach in these areas, some being outside the scope of this project, there is a greater assurance that Māori views are integrated into the management of organic contaminants, aligning environmental practices with the values and needs of Māori.

2.3 Principles to Address the Problem

The initial work done in this project identified the circular economy principles as outlined in the NZ Waste Strategy as a starting point for how to approach the issue of organic waste contamination. It identified the following key principles:

- To achieve a circular bio-economy for organic wastes, progressive detoxification of organic waste will be required. This will in turn be dependent on broader moves towards a circular economy
- A phased approach recognises that there are immediate issues which require addressing and which can be addressed, but that this should take place in the context of working towards a more productive and resource efficient economy
- The degree to which contamination is an issue (i.e. the degree to which it becomes pollution), is dependent on the use of products made from organic waste and the concentration of the contaminants
- Stakeholders need to have input into potential risks and how they are best managed. For example, if products from waste materials are to be used for growing food this will require buy-in from the farming and food processing sectors
- Determining where harm can potentially occur and the threshold for potential harm is the role of science in coordination with mātauranga Māori. That is, it needs to be based on robust evidence and systematic understanding and application of Aotearoa's community values

- Identifying the most appropriate types of interventions and how they may be applied depends on correctly identifying the part(s) of the value chain where controls can most effectively and efficiently be applied. This should take into account the relative costs and benefits achieved by the interventions, balancing the avoidance of negative impacts from organic waste going to sub-optimal outcomes (such as disposal), against the desire to avoid negative impacts from applying contaminated materials to land
- There may be multiple tools that can be applied (and may need to be applied) to achieve the desired outcome. For example, addressing plastic waste in organics may include restrictions on certain products or materials, education of householders, decontamination at a processing facility, and testing and certification of a final product
- Frameworks developed through this work will need to build on existing regulation and practice as well as provide flexibility to accommodate future change. Solutions will need to be developed in the context of an evolving landscape as new information, new materials, and new practices emerge
- There are a wide range of stakeholders that will intersect with organic waste value chains. The more that willing, informed participation and compliance of stakeholders can be achieved, the greater the progress will be towards a circular bioeconomy for organic wastes
- Solutions should ultimately be financially sustainable by the industry and support a viable and developing market for products made from recovered organic wastes. This includes the sector supporting research, education and market development.

The recommendations put forward in this report aim to address the above as well as issues identified during the stakeholder engagement.

3.0 Recommendations

This section outlines a range of recommended actions that have arisen out of the study. These recommendations reflect the outcomes of the research as well as the input from stakeholder engagement. The actions are divided into the following themes:

A. Clean up system inputs
B. Clean up feedstocks
C. Improve decontamination
D. Align standards and guidelines
E. Expand testing and compliance
F. Develop planning and oversight.
G. Coordinate research and development

Under each theme actions are divided into 'immediate actions', and 'longer term actions'.

From this long list a number of priority actions are then highlighted in the following section, which attempts to construct a suggested programme for delivery.

3.1 Clean up System Inputs

Reducing the generation of problematic contaminants at source will reduce subsequent issues that these substances cause in the organic waste recovery system. This type of initiative was a common theme through the stakeholder engagement.

3.1.1 Immediate Actions

1. **Promote and enforce existing requirements around application of clopyralid**
   There are rules that restrict the sale and application of products that contain clopyralid. These rules are known as controls and are set under the Hazardous Substances and New Organisms (HSNO) Act 1996. The controls are specific to each product and assign responsibilities throughout the value chain. These include the following:
   a. Many products can only be used in farms or workplaces
   b. Manufacturers and importers have to correctly label the product and provide safety data sheets
   c. Sellers have to sell products limited to workplaces only to workplaces
   d. Sprayers have to apply the product correctly and ensure that any clippings are not disposed of (by them or their clients) to compost, mulch, greenwaste collections, or animal feed
   e. Farmers must not dispose of clippings to compost, mulch, or animal feed
   f. Animal feed makers need to ensure that supplies do not contain clopyralid
   g. Manure suppliers cannot sell or supply manure from animals fed on plants sprayed with clopyralid

h. Green waste collectors and composter have to ensure that they do not use clopyralid contaminated feedstocks and should test for clopyralid.[2]

In theory these controls should prevent incursion of clopyralid into the organic waste recovery system. However, industry stakeholders report that the rules are not necessarily followed and people in the value chain may have an imperfect awareness of them and their application.

This action would entail providing additional resource to promote awareness of the rules and follow up any reported instances of non-compliance.[3]

Note: Clopyralid belongs to a family of picolinic acid herbicides (including clopyralid, aminopyralid and picloram). These other picolinic acid herbicides can also be problematic, and there may be a need to extend the existing rules that are focused on clopyralid to the wider family. This situation should be monitored.

2. **Require all compostable packaging to be certified as home compostable to a recognised standard.**

At present there are no requirements for compostable packaging placed on the market to be certified. While there are requirements to be able to back up claims under the Fair Trading Act, these requirements and guidance fall short of requiring certification.[4] It is common to find claims of compostability on consumer products, but no indication of the standard that this is being determined by.

This action proposes introducing regulation (nominally under section 23 1(f) of the Waste Minimisation Act, which pertains to labelling) to require any claims of compostability on consumer products or packaging to be backed by recognised certification, such as AS 5810, EN 13432, or NF T 51-800. It is recommended that

[2] How to keep clopyralid out of compost | EPA

[3] Determining the amount and targeting of additional resourcing is beyond the scope of the present report.

[4] Environmental-claims-guidance-July-2020.pdf (comcom.govt.nz)

the certification standard required be home compostable, as this is a higher standard than commercially compostable and is more likely that products certified to this standard will be able to be practically composted in New Zealand.

3.1.2 Longer Terms Actions

3. **Product Stewardship.** It is suggested to develop product stewardship schemes that pass on the cost of contaminant removal to producers, and/or require full chain of custody to be in place for product to be on the market.

   Nominally this would require key contaminating products and substances to be identified and regulated product stewardship schemes developed for these (where they are not in place or planned). While there will be myriad considerations in the design of any relevant product stewardship schemes, the proposed mechanisms that it is suggested are considered in the design of such schemes include:

   a. That processors of organic wastes be able to pass on the costs of removal and disposal of contaminants to the producers (nominally this could be done on a weight basis), and/or;
   b. That products or materials that constitute significant contamination in organic waste streams are declared priority products and required to have a product stewardship scheme in place that provides for full chain of custody in place. In other words, all products would have to be accounted for to its end of life, and systems in place to provide for their collection and recovery, including measures to ensure they do not enter the organic waste stream. The priority products/materials would have to be identified, but the key contaminants identified in this study could constitute a starting point.

4. **Ban or restrict problematic contaminants** including clopyralid, PFAS, and CCA treated timber. Each of these substances have been identified in this study as endemic and problematic contaminants that are difficult to prevent entering into the organic waste stream. Presence of these contaminants increases the necessary level of control and can restrict organic waste end use. Ultimately their control is likely to require a ban at source.

   Bans or restrictions could be enabled through Section 23 1(b) of the Waste Minimisation Act, which provides for regulation ‘prohibiting the manufacture or sale of products that contain specified materials’.

   Banning each of these types of contaminants would require significant work. There would need to be practically and commercially viable alternatives in place to transition to, and there would likely need to be negotiation with affected industries to understand the implications and develop a transition plan. The difficulties of effecting a ban on PFAS for example can be illustrated by the recent

roll-back of efforts by the European Union to instigate a widespread ban on a range of 'forever chemicals'.[5]

For bans or restrictions to be effective they would need to be supported by appropriate sanctions for non-compliance.

5. **Support and implement the global plastics pollution treaty.** International negotiations have been taking place through the United Nations since November 2022 to develop a treaty to combat plastic pollution. A legally binding international treaty is expected to be negotiated by the end of 2024. Following this it will need to be ratified by each country. Core elements of a treaty are likely to include a:

   - shared global goal/common long-term vision to the plastic pollution problem
   - common approach to national action plans covering the life cycle of plastics
   - mechanism to harmonise reporting and monitoring of actions and effects of measures
   - financial mechanism to deliver technical support and capacity building
   - science and knowledge mechanism to provide access to quality-assured information for stakeholders at all levels.

   New Zealand is also part of the 'High Ambition Coalition' (HAC) which is pushing for restrained consumption and production of plastics and the development of circular economy approaches and solutions.

   It is recommended that New Zealand continue to promote this stance and work actively to negotiate and ultimately ratify a legally binding treaty consistent with the HAC intentions. Being part of an international effort to deliver a circular economy for plastics will be essential for ultimately being able to create a circular bio-economy.

6. **Ban compostable packaging except where a product stewardship scheme is in place that provides full chain of custody**. This initiative represents a step beyond requiring compostable products to be certified (as recommended above).

   In addition to only allowing the importation/manufacture of certified home compostable packaging this initiative would seek to restrict the use of compostable products to use cases where there is the ability to control the full chain of custody and effectively guarantee that they have been recovered and managed in an approved process. For example, use of compostable packaging might be restricted to scenarios such as stadiums and events where there is control over the collection and subsequent processing of the material, or use as

[5] EU abandons promise to ban toxic chemicals in consumer products | PFAS | The Guardian

liners for collection of food wastes.

This initiative recognises that the number of organic waste recovery operations that wish to accept compostable packaging (even certified home compostable packaging) is limited. Where compostable packaging is widely used in the community it is difficult to control its disposal through the correct channels. By restricting its use, this would avoid it becoming a contaminant in organic waste streams (microplastics) and also simplify messaging around disposal of packaging in organic waste streams.

3.2 Clean up Feedstocks

Cleaning up feedstocks entails measures to reduce the incidence of contaminants being introduced into the organic waste stream.

3.2.1 Immediate Actions

7. **Invest in standard messaging** for education of households and key user groups, including community and marae. This initiative is particularly relevant for collections of organic waste from households. The introduction of kerbside standardisation for organic waste and recycling is expected to help efforts to reduce confusion among the general public. However, it is likely to require ongoing and frequent messaging with clear information that enables the public to readily differentiate acceptable materials and contaminants. It will also be important to provide messaging on the importance of following the rules – one of the issues with contamination in household collections is 'wish cycling' where people aren't sure but put material in anyway because they would like to see it get recovered. They are trying to do the 'right thing' but end up creating issues.

   The standard messaging should extend beyond household kerbside collections and encompass a range of common use cases including in community and marae situations.

   It is recommended that messaging and communications be developed initially to support the kerbside standardisation programme and that this then is extended to further audiences and use cases. Education and waste prevention programmes should be ongoing to ensure messages are reinforced and good practice is supported over time. The programmes themselves should be evaluated for efficacy and the most effective interventions applied widely. It is recommended that consideration be given to how funding for prevention could be better enabled through existing funding channels such as the Waste Minimisation Fund.

8. **Support targeted education.** Māori involvement in organic waste reuse is more prominent at the community level, such as in composting and food production. Given the low contamination tolerance in food-grade organic waste reuse, this

poses a higher contamination risk for Māori engaging in local food production. Therefore, educating and raising awareness about the risks of contaminated compost, which can severely impact Māori communities, is essential. Further, the impact that this sector, outputs, products and decision making has on Te Ao Māori and te taiao, necessitates those within the sector to better understand the things that are important to Māori**. The Whakapapa Centred Approach** is a potential tool to support this sharing of knowledge. This and other resources should be developed to support knowledge sharing across both spectrums.

9. **Promote kerbside best practice**. There are a range of factors that contribute to reducing contamination in kerbside organic waste collections, including methodology (automated versus manual), bin inspections, compliance actions, use of caddies and liners, types of materials targeted in the collections, and communications. The recently released International Solid Waste Association (ISWA) guide[6] outlines some of these and WasteMINZ is currently in the process of commissioning the development of a kerbside organics guide for NZ. These tools should be widely promoted and supported.

10. **Develop standardised contract clauses** for contracts between collectors and processors **to establish feedstock standards**. An issue for organic waste processors is the quality of input material – particularly from kerbside collections. Processors can put in place systems and equipment to decontaminate input material, but if the input material exceeds specified limits, then reducing contamination to acceptable levels becomes problematic and expensive.

    It is recommended that a set of standard contract clauses be developed for use by operators and territorial authorities to provide clarity on contamination limits, how these are monitored and measured, who has responsibility for the quality of input material and who bears the costs for contaminant removal above given thresholds and/or improving the quality of input material.

3.2.2 Longer Terms Actions

11. **Restrict discharge of problematic contaminants into wastewater systems.** This could include requirements for on-site treatment of wastewater from industrial sites before discharge to sewer. One of the issues with regard to recovery of biosolids is the presence of heavy metals and other persistent organic pollutants. Industrial and commercial inputs to the sewerage system are controlled through trade waste discharge permits or agreements (usually under a trade waste bylaw). These set limits and controls around the discharges. If the level of contaminants in the biosolids end product is to be reduced, then the primary method for achieving this (for contaminants that cannot be remediated through

[6] ISWA (2023) A Practitioner's Guide to Preventing and Managing Contaminants in Organic Waste Recycling.

wastewater processing or biosolids processing), is through reducing the entry of the contaminants into the sewerage system. Nominally this would mean lowering the discharge limits that are set in bylaws, permits or agreements. This would in turn imply that organisations currently discharging contaminants over the new lower limits would have to find alternative sources of disposal (for example through hazardous waste collection services) or would have to undertake onsite treatment of wastewater to reduce contaminants to below the limit levels. Further options include incentivising reduction of contaminant levels through application of additional charges where limits are exceeded. These additional charges could be set at a level designed to incentivise on site treatment or other methods to achieve compliance.

3.3 Improve Decontamination

3.3.1 Immediate Actions

12. **Encourage the organics management sector to invest in decontamination equipment.** Municipal waste streams such as combined food organics garden organics (FOGO) and source separated food waste can be heavily contaminated due to poor separation by house holders and or lack of knowledge of what can be composted or what is allowed in the bin. With central government mandates for all local territorial authorities to provide an organic service, this problem is expected to become more widespread.

    Apart from manual decontamination (which is considered problematic from a health and safety perspective), there are a range of automated technologies available. Technologies for decontamination of feedstocks include screening, magnetic separators, screw separators, centrifugal separators, floating/sedimentation, or solubilisation (dissolving). Decontamination of product can be done through magnetic separation, air separators, or density separators.[7]

    It is our understanding that decontamination equipment can be funded through the WMF as long as it can be shown to increase diversion. However, it is not explicitly provided for in the WMF criteria, and such equipment may not fit the criteria where it is not originally specified as part of a service but is added once the need becomes apparent. In such instances no new diversion will take place (in fact additional disposal may result as contaminants are retrieved and landfilled), but the equipment would help improve product quality and optimal use. It is recommended that MfE include organics decontamination as a WMF investment signal which would further incentivize decontamination applications that include private investment.

[7] ISWA (2023) A Practitioner's Guide to Preventing and Managing Contaminants in Organic Waste Recycling.

13. **Promote best practice**. There are examples of best practice, globally and in Aotearoa that can be referenced to lift the overall level of practice. This includes managing contaminants through kerbside collection systems, and decontamination of feedstocks. Resources already exist for this such as the recently released International Solid Waste Association (ISWA) practitioner's guide.[8] Promotion of best practice could include:
    - Identification and dissemination of relevant guidance material
    - Practitioner workshops
    - Industry training.

3.3.2 Longer Terms Actions

14. **Fund weighbridges at organic waste processing sites** to improve data capture. While not directly contributing to contamination reduction or an increase in recovery of organic waste to highest value uses, improved data capture will be a vital mechanism to inform policy and identify priority areas and waste streams. Weighbridges at organic waste processing sites will enable data capture in terms of quantities of material accepted, feedstock source, and gross contamination levels (where for example these are sent to landfill). Aggregation of this data could help monitor and track recovery rates, which feedstocks are utilised in different areas, and compare contamination rates across different feedstocks and areas. This would aid in targeting support and interventions.

    MfE previously made funding available for weighbridges to help waste sites prepare for introduction of the extended waste levy. A similar mechanism could be used in support of data collection at organic material processing facilities. Funding could be provided with the expectation of appropriate data provision.

3.4 Align Standards and Guidelines

3.4.1 Immediate Actions

15. **Agree a framework for identifying priority contaminants and thresholds**. The suggested framework is outlined in the Framework and Thresholds report[9].

16. **Establish a panel/working group to review contaminants and thresholds** and establish a reference list for application to various standards and guidelines. One of the issues identified in the study is that different groups in the sector responsible for producing guidance or standards relevant to their part of the

[8] ISWA (2023) A Practitioner's Guide to Preventing and Managing Contaminants in Organic Waste Recycling.
[9] Eunomia Research & Consulting (2023) Organic Waste Contamination Management Framework and Thresholds. Report for Ministry for the Environment.

sector, work independently to identify priority contaminants and thresholds. There is no standard method for identifying emerging contaminants or reviewing and establishing thresholds such as PFAS or microplastics.[10]

It is recommended to address this by establishing an ongoing panel/working group or similar that would convene when required to assess contaminants and thresholds and establish a 'reference list' that could then be used in the various standards and guidelines. The panel would require representation from key stakeholders and sufficient technical expertise to undertake the required evaluation and establish robust limits that will be adopted by stakeholders.

17. **Establish definitions for the 'end of waste'** – where material has been sufficiently processed or remediated to be regarded as no longer a waste product. Where products are perceived as being derived from waste this can adversely affect their market and cultural acceptance. There is likely to be a point for most waste materials where they have transformed sufficiently that they no longer meaningfully resemble the original waste material.

    It is recommended that 'end of waste' definitions, standards, and certification protocols for specific organic waste materials and/or products (such as biosolids or biosolid derived products) be established to help to drive market acceptance and enhance recovery of these materials. Work on this definition should align with the Whakapapa Centred Approach (refer to section 2.2).

18. **Finalise the current 2017 Draft "Guidelines for the Beneficial Use of Organic Materials on Productive Land".** These guidelines update the 2003 biosolids guidelines. The 2017 draft guidelines present a robust body of technical background and analysis. It is recommended that the appropriate government bodies and stakeholders (including MfE, MoH, MPI, WaterNZ, CIBR, Watercare) increase involvement to enable them to be finalised. This could provide a vehicle for the current project to feed into.

19. **Review and update NZS 4454:2005.** New Zealand's only official compost standard has not been reviewed or updated since it was introduced in 2005. It is recommended that a review of the standard consider the following:
    - Contaminants covered
    - Contaminant thresholds
    - Processes and products covered
    - Updates to technologies and methodologies
    - Changes to AUS 4454: 2012 and the potential to align the standards and/or work with Standards Australia to update and align both standards

[10] While the EPA has processes and a work plan for assessing hazardous substances, (Adding to the reassessments work plan | EPA) much of what constitutes contaminants of concern (i.e. pollution) in respect of organic waste streams are not necessarily problematic in the appropriate context.

- Market recognition and acceptance
- Development of certification protocols and pathways.

Standards NZ, which are a commercial arm of MBIE, are the custodians of NZS4454. A review of the standard however would need to be commissioned by the Ministry for the Environment and/or Ministry for Primary Industries.

3.4.2 Longer Terms Actions

20. Work with sector bodies to **establish appropriate standards and certification pathways for all organic waste products** and materials, for example: biosolids, vermicompost, digestate, manures, biochar. Ideally there will be comparable standards and pathways for certification of all products made from organic waste.

    A consistent approach will be important to build confidence in the market for different organic waste products. It will be important that all sectors in the value chain are aligned and connected. This includes producers of organic feedstocks, producers and users of materials that can become contaminants, organic waste collectors and processors, product users (including food growers and food processors), as well as those involved in testing, monitoring, regulation, compliance, and policy.

    A comprehensive approach could encompass different levels of requirements based on feedstocks and end use. The regime applied should balance the desire to encourage beneficial use through not imposing additional barriers and cost, while having in place appropriate controls to protect the environment and human health. For example, products made from higher risk feedstocks and intended for application to higher sensitivity end uses could require mandatory certification, while products from lower risk feedstocks and/or destined for lower sensitivity applications could utilise voluntary standards, guidance and certification.

21. **Align standards, guidelines and certification with international standards** and market requirements/expectations. When reviewing and developing standards, guidelines, and certification (as recommended above), these should, where possible, align with international standards or guidance. A significant proportion of New Zealand's agricultural output is exported, and it is therefore sensible to align standards with that standards and expectations of key markets.

22. **Develop culturally focused standards** or incorporate cultural considerations into existing standards. (Refer to section 2.1 of the Organic Waste Contamination Framework and Threshold report).

23. **Revise the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS).** Interpretation of the NESCS regulations have resulted in soils not being put to their best use. Rules and policies focus on imported soils (both natural soil and soil substitutes/replacements derived from organic waste) having to meet background contaminant levels rather than levels that are appropriate for the intended use of the land. There is a risk that the NESC could be a barrier to the large-scale application of imported soils. It is recommended that the NESCS be amended to clarify the confusion regarding soils above background concentrations but within acceptable concentrations, therefore creating greater opportunities for the use of soils with contaminant levels appropriate for the land use.

3.5 Expand Testing and Compliance

3.5.1 Immediate Actions

24. **Develop and commission a national testing programme** for organic waste soil amendment products and where they are applied. The purpose of the programme would be to determine the extent of the issue of contaminants in organic waste products and provide a baseline. This programme would be based on agreed standardised testing protocols.

    While this study has identified organic waste contamination as an ongoing issue, there is a lack of quantitative evidence regarding the extent of the problem, and where it may be concentrated in terms of problematic contaminants, feedstocks, and even geographic areas. There is also variable methodology used to analyse some contaminants, meaning the comparability between studies is invalid. Developing an objective evidence base of quantitative information will ultimately be critical for effective management and targeting of actions.

    It is recommended that a testing programme be developed that provides a statistically robust picture of the incidence of key contaminants across different waste streams and organic waste products and where these are applied. The testing programme should focus not only on commonly tested contaminants but also emerging contaminants (e.g. microplastics, PFAS).

    There are two possible components to a testing programme. It is suggested that an initial one-off programme be developed in order to establish a baseline data set and determine the quantitative evidence for the extent of the issue. Depending on the outcomes of this, ongoing data gathering and monitoring could be undertaken to evaluate progress against the baseline. This could encompass or be linked with review of existing testing data (refer below) in order to limit duplication and cost.

25. **Provide additional resource for enforcement of existing standards and rules.** Improved outcomes could be obtained by stricter enforcement of existing standards and rules (such as for clopyralid use). A more coordinated, inter-agency approach may be appropriate to enable additional outcomes within limited resources.

26. **Establish an anonymised database of compost/organic waste derived product test results.** The purpose of this would be to help track contaminant levels without requiring additional testing to be carried out. If an anonymised database was developed this could provide input information to the national testing programme suggested above. This would enable the national testing programme to focus on where there are gaps in the data, as well as emerging contaminants.

3.5.2 Longer Terms Actions

27. **Reduce barriers to accessing testing**. This could be achieved by exploring mechanisms to reduce the costs of testing for priority contaminants as well as from waste streams/products where there is currently insufficient testing. The priority areas could be established through the national testing programme. Options could include:
    - **Funding the development of standardised testing protocols for emerging contaminants such as microplastics**. One of the issues surrounding testing for microplastics at present is the lack of a standardised protocol for testing in compost products and soils. Various methodologies have been employed by researchers to quantify microplastic particles in organics and the environment, however, the risk presented is inconsistency of results. Work needs to be done to establish standard protocols for sampling, processing and to attain thresholds of microplastic loading in organics. Furthermore, if required, polymer types need to be analysed through Fourier Transform Infrared Spectroscopy (FTIR) or Raman Spectroscopy to enable an understanding of the source of contamination, however, these are costly and might need additional funding.
    - **Subsidising cost of specific tests.** Subsidies could be applied where it has been identified that cost is a significant barrier to tests being carried out (e.g. clopyralid, PFAS, microplastics). Work would need to be done to determine an appropriate level of subsidy and whether it would apply across the board or be targeted (for example at products from at risk sources, or from indicator sites). The need for this could be derived from the outcomes of the national testing programme recommended above.
    - **Funding capital for testing facilities/equipment.** Funding for capital expenditure can often be more readily obtained than other initiatives such as subsidies. This would be an alternative approach to reducing the costs of testing and could be targeted at specific types of tests. It would also assist in testing laboratories being able to justify the expansion of capacity.

- **Bulk purchase of tests to reduce costs.** One of the reported issues is the relatively low number of tests means that laboratories are not set up for processing higher volumes, which would lower the costs. A further option therefore to reduce the cost of testing would be for central government to bulk purchase tests to reduce their costs and pass these savings on to operators. The intent is that this would be fiscally neutral for government.

  Bulk purchasing could also be done as part of the national testing programme outlined above. Further work would be required to determine the number and types of tests that would be included in a bulk purchasing programme, the level of savings that might eventuate, and the degree to which this would incentivise higher uptake of testing.

  A further consideration for this option could be whether to apply a level of subsidy to the bulk purchase – so the full cost of the tests is not necessarily passed on to operators. If the data being generated from the tests is also inputting into the national testing programme, then there would be justification for central government contributing to the costs as they are utilising the data.

3.6 Develop Planning and Oversight

3.6.1 Immediate Actions

28. **Support the establishment of a collective iwi/Māori voice** to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management. Support could be through appropriate resourcing and inclusion in relevant forums.
29. **Develop a sector plan** that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development. The plan should identify roles and responsibilities and funding sources. The focus of the sector plan should be on enabling and working towards achieving the highest value use of waste organic materials while ensuring the safety and health of people and the environment.

    The sector plan should have a wider focus than just organic waste operators and should encompass the range of stakeholders identified in this study (e.g. feedstock suppliers, councils, research organisations, testing organisations, standards and certification bodies, central government, the agricultural sector and other end users, food processors and exporters, as well as organic waste processors).

    The work undertaken in this study and the recommendations put forward here could provide a starting point for the development of a sector plan.

Leadership of the sector plan would be vital. Key stakeholders engaged through this study could form the initial working group to take the development of a sector plan forward. Funding would be required to ensure that it was appropriately resourced[11].

3.6.2 Longer Terms Actions

30. **Establish an entity or role(s)** within an organisation that has responsibility for oversight and delivery of the sector plan. Establishing clear responsibility for delivery and resourcing the delivery appropriately is a fundamental component to ensuring that actions contained within a plan actually happen.

    The project team is agnostic regarding exactly where this responsibility should sit, although it is our view that it should involve paid role(s) and will likely require some form of central government support in order to become established. As reducing contamination in organic waste will have a private benefit, the responsible entity should be supported by the sector as it fulfils its functions over time and facilitates a viable and thriving organic waste resource recovery sector. However, roles and responsibilities and how these evolve and are funded should be determined through the proposed sector plan.

    Key functions of an entity or role could include (but are not be limited to):
    - Coordination and stewardship of the development of a sector plan
    - Leading stakeholder engagement and ensuring appropriate input from different interest groups
    - Identifying roles and responsibilities within the sector and ensuring these are clearly communicated
    - Ongoing communication and information exchange
    - Facilitating liaison between government agencies
    - Identifying and securing ongoing funding
    - Overseeing the delivery of elements of the sector plan
    - Coordinate research and development (see section 3.7 below)
    - Ongoing monitoring development and iteration of the sector plan and associated activities to respond to developments.

3.7 Coordinate Research and Development

3.7.1 Immediate Actions

31. **Identify research priorities** as part of the sector plan (refer to 3.6.1 above), in the context of a circular bioeconomy. Central government has a role to connect the existing and ongoing research across the different related action areas, and to ensure that the findings from this research are integrated into wider circular

[11] It is beyond the scope of this work to identify funding sources; however it is our view that existing funding channels such as the Waste Minimisation Fund may be appropriate.

economy planning and practice.

32. **Identify areas of further research for Te Ao Māori views,** mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants and their impacts in Aotearoa.

3.7.2 Longer Terms Actions

33. **Secure appropriate funding sources** for the research priorities identified in the sector plan. Research funding can come from multiple sources. Identifying the most appropriate sources would initially be part of the sector plan development, but is likely to be variable over time, and so would need ongoing attention.

34. **Ongoing delivery, monitoring and development** of the research plan. As with the sector plan, establishing clear responsibility for implementation will be critical for success. Whether this responsibility sits with the same organisation that would have responsibility for the sector plan or is a separate entity would need to be determined.

35. **Market development.** Establish a sector-wide body to promote standards, product certification and markets to create an end-to-end system that gives confidence to consumers. A foundational aim of this present study is to identify how organic waste materials can be optimally recovered and directed towards their highest value use. Ensuring that products made from organic waste materials have appropriate levels of certification or assurance for their end markets will be an important mechanism for encouraging greater utilisation of these products. However, the certification or assurance (such as voluntary adherence to a standard), will be limited in its market impact by the level of recognition and acceptance/value of that standard in the marketplace.

    It is recommended to establish a sector wide body to develop and implement a marketing strategy aimed at ensuring widespread acceptance of the relevant standards and overall framework. This body should have the backing of relevant industry organisations and processors that would stand to gain from enhanced market acceptance of their products. This body could be a function of, or offshoot of, the sector body recommended above.

3.8 Summary of Recommendations and Identification of Key Actors

The table below summarises the recommended actions noted above. It also notes whether they are primarily addressing systemic or operational issues and identifies organisations that are likely to have a key role in their implementation. Please note that the organisations identified are not exhaustive and are indicative only based on the views of the project team.

Table 1: Long List Recommendations by Type and Key Organisations

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
Section 1: Clean Up System Inputs	1	Promote and enforce existing requirements around application of Picolinic acid herbicides (including clopyralid, aminopyralid and picloram).	Operational	EPA, WasteMINZ Organic Sector Group
	2	Require all compostable packaging to be certified as home compostable to a recognised standard.	Systemic	MfE
	3	Product Stewardship. Develop product stewardship schemes that pass on the cost of contaminant removal to producers, and/or require full chain of custody.	Systemic	MfE
	4	Ban or restrict problematic contaminants including clopyralid, PFAS, and CCA treated timber.	Systemic	EPA, MBIE
	5	Support and implement the global plastics pollution treaty.	Systemic	MfE, MFAT
	6	Ban compostable packaging except where a product stewardship scheme is in place that provides full chain of custody.	Systemic	MfE
Section 2: Clean Up Feedstocks	7	Invest in standard messaging for education of households and key user groups, including community and marae.	Operational	MfE (WMF), Local Authorities, WasteMINZ, WRIF, Para Kore
	8	Support targeted education.	Operational	MfE (WMF), Local Authorities, WasteMINZ, WRIF

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
	9	Promote kerbside best practice.	Operational	MfE (WMF), Local Authorities, WasteMINZ, WRIF
	10	Develop standardised contract clauses for contracts between collectors and processors to establish feedstock standards.	Operational	MfE (WMF), Local Authorities, WasteMINZ, WRIF
	11	Restrict discharge of problematic contaminants into wastewater systems. This could include requirements for on-site treatment of wastewater from industrial sites before discharge to sewer.	Operational	Water NZ, Councils, Water entities, Taumata Arowai/National Water Services Regulator
Section 3: Improve Decontamination	12	Encourage the organics management sector to invest in decontamination equipment.	Operational	MfE (WMF)
	13	Promote best practice. There are examples of best practice, globally and in Aotearoa that can be referenced to lift the overall level of practice.	Operational	MfE, WasteMINZ, Water NZ
	14	Fund weighbridges at organic waste processing sites to improve data capture.	Operational	MfE (WMF)
Section 4: Align Standards and Guidelines	15	Agree a framework for identifying priority contaminants and thresholds.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESP, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association, Mana Whenua

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
	16	Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESP, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association, Mana Whenua
	17	Establish definitions for the 'end of waste' – where material has been sufficiently processed or remediated to be regarded as no longer a waste product.	Systemic	MfE, WasteMINZ
	18	Finalise the current 2017 Draft "Guidelines for the Beneficial Use of Organic Materials on Productive Land".	Systemic	Water NZ, MfE
	19	Review and update NZS 4454:2005.	Systemic	Standards NZ
	20	Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESR, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
	21	Align standards, guidelines and certification with international standards and market requirements/expectations.	Systemic	MfE, Standards NZ, Assure Quality, Biogro, Manaaki Whenua Landcare Research, ESR, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association
	22	Develop culturally focused standards or incorporate cultural considerations into existing standards.	Systemic	Mana Whenua, MfE, Standards NZ, Assure Quality, Biogro
	23	Revise the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS).	Systemic	EPA, MfE, EINZ, Manaaki Whenua Landcare Research, 'cleanfill' operators
Section 5: Expand Testing and Compliance	24	Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESR, EPA, Laboratory service providers
	25	Establish an anonymised database of compost/organic waste derived product test results.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESR, EPA, Laboratory service providers, Food sector
	26	Provide additional resource for enforcement of existing standards and rules	Operational	EPA, Local and regional authorities

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
	27	Reduce barriers to access to testing.	Operational	MfE, MPI, Manaaki Whenua Landcare Research, ESR, EPA, Laboratory service providers
Section 6: Develop Planning and Oversight	28	Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management.	Systemic	MfE, Mana Whenua
	29	Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESP, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association, Mana Whenua
	30	Establish an entity or role(s) within an organisation that has responsibility for oversight and delivery of the sector plan.	Systemic	MfE
Section 7: Coordinate Research and Development	31	Identify research priorities as part of the sector plan in the context of a circular bioeconomy.	Systemic	MfE, MPI, Manaaki Whenua Landcare Research, ESP, EPA, Fertiliser NZ, Federated Farmers, WMINZ Organic Sector Group, Bioenergy Association, Mana Whenua

Action Step	Ref	Recommended Action	Type of Action	Entities with a Key Role
	32	Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants and their impacts in Aotearoa.	Systemic	Mana Whenua
	33	Secure appropriate funding sources for the research priorities identified in the sector plan.	Systemic	MfE, Sector representatives
	34	Ongoing delivery, monitoring and development of the research plan.	Systemic	MfE, Sector representatives
	35	Market development. Establish a sector-wide body to promote standards, product certification and markets to create an end-to-end system that gives confidence to consumers.	Systemic	MfE, Standards NZ, Assure Quality, BioGro, Sector representatives

4.0 Priority Actions

The above actions were subject to a prioritisation exercise. Actions were assigned a priority of either highest priority, medium priority, or longer-term actions. The full programme of actions and their assigned priorities through this exercise is presented in Appendix A.1.0. The prioritisation exercise included input from the Technical Advisory Group, and Eunomia and MfE project staff. The TAG completed a survey to help determine priorities and the outcomes of the TAG prioritisation exercise are presented in Appendix A.2.0. All priorities identified by the TAG are included in the priority actions below (these are highlighted in **bold**). In addition, there are a number of actions included which either are considered relatively easy to implement and/or were considered important by the project team to ensure a balanced programme of action moving forward.

The high priority actions are summarised in the table below:

Table 2: High Priority Actions

Action Type	Action	Key Action Areas	Rationale for Inclusion
Clean up system inputs	1. Promote and enforce existing requirements around application of picolinic acid herbicides (including clopyralid, aminopyralid and picloram).	Household organics	This is a simple initiative that requires no new regulation or policy. It was mentioned as a foundational by TAG members during discussions.
	2. Require all compostable packaging to be certified as home compostable to a recognised standard.	Compostable Packaging	TAG Priority
Clean up feedstocks	7. Invest in standard messaging for education of households and key user groups, including community and marae.	Household organics, Multiple waste streams	These are all initiatives that can dovetail with existing programmes and support (for example communications around Love Food Hate Waste, and kerbside standardisation).
	8. Support targeted education.	Multiple waste streams	
	9. Promote kerbside best practice.	Household organics,	

Action Type	Action	Key Action Areas	Rationale for Inclusion
	11. Restrict discharge of problematic contaminants into wastewater systems.	Biosolids	TAG Priority
Improve decontamination	12. Encourage the organics management sector to invest in decontamination equipment.	Household organics,	This can be achieved through minor tweaks to existing funding criteria.
	13. Promote best practice decontamination in processing.	Household organics, Multiple waste streams	These actions can be delivered through existing forums and channels (for example WasteMINZ, Waste & Recycling Industry Forum) and potentially with a small amount of additional support.
Align Standards and Guidelines	**15. Agree a framework for identifying priority contaminants and thresholds.**	General	TAG Priority
	16. Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines.	General	TAG Priority
	17. Establish definitions for the 'end of waste' – where material has been sufficiently processed or remediated to be regarded as no longer a waste product.	Biosolids, Multiple waste streams	Potentially can be included in pending updates to existing legislation and regulations.
	18. Finalise the current 2017 Draft "Guidelines for the Beneficial Use of Organic Materials on Productive Land".	Biosolids, Multiple waste streams	TAG Priority
	19. Review and update NZS 4454:2005.	Multiple waste streams	TAG Priority

Action Type	Action	Key Action Areas	Rationale for Inclusion
	20. Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar.	Multiple waste streams	TAG Priority
	21. Align standards, guidelines and certification with international standards and market requirements/expectations.	Multiple waste streams	TAG Priority
	22. Develop culturally focused standards or incorporate cultural considerations into existing standards.	Multiple waste streams	TAG Priority
Expand Testing and Compliance	**23. Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.**	General	TAG Priority
Develop planning and oversight	**26. Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management.**	General	TAG Priority
	27. Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development.	General	TAG Priority
Coordinate Research & Development	29. Identify research priorities as part of the sector plan in the context of a circular bioeconomy.	General	Important to provide a balanced programme of action moving forward
	30. Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants and their impacts in Aotearoa.	General	

5.0 Further Research

The current study has necessarily operated under a number of constraints, which limit the scope of what has been able to be considered. While the recommendations noted above are likely to significantly advance how the issue of contamination in organic waste is addressed in New Zealand, there is likely to be additional benefit in further research in certain areas. This could include the following:

- Undertake further research to gather data to more fully understand the flows of materials and the quantities involved in different waste streams, and levels of contamination reported. In particular kerbside food scraps and garden waste. This would provide a stronger basis for determining the potential cost-benefit of recommended actions by providing additional clarity on the quantities of material that may be impacted by each action.
- Undertake a Life Cycle Assessment or Cost-Benefit Analysis on the different pathways and interventions for particular organic waste streams. This would help illuminate the potential environmental costs and benefits of diverting organic waste from disposal and how these balance against the risks presented by introducing contamination from those waste streams into the receiving environments.
- Undertake further engagement with food producers to understand in more detail how market requirements and market acceptance impacts on practice. As noted in this project, whatever standards are in place, the market will be the ultimate arbiter of what organic waste products actually get used, and for which applications. While current flows and practices are broadly understood, a more detailed understanding of market concerns and trends could be useful in informing best practice and ensuring optimum utilisation of organic wastes.
- In terms of long-term planning and investment, it may be worthwhile to further define the understandings of circular economy and circular bio-economy that form the basis of the framework for this study. In other words, if the ultimate aim is to achieve a circular system for organics so that efficiency and productivity are optimised, what will this actually look like? What are the pathways of organic wastes and potential contaminants that will be needed to build systems for going forward, and how might these differ to current systems and practice? It is important that the circular economy and bio economy policy platforms are clarified and aligned, and New Zealand achieves a holistic and synergetic, rather than siloed, approach in addressing (de)contamination in a future circular bio-economy.

6.0 Summary and Conclusions

This section provides a summary of the work undertaken on the project and offers some concluding observations.

6.1 Legislation and Regulation

There are a range of standards and guidelines which provide some coverage of the issue of contamination in the organic waste stream. These standards and guidelines have served to manage contamination in organic waste streams; however, they have been developed independently of each other over time and, while there is some broad alignment, they do not form a comprehensive approach. Some key shortcomings noted include:

- No standard definition of contamination
- No standard range of contaminants covered or agreement on contaminant thresholds
- No specific standards or controls for AD digestate, no specific standards for vermicast/vermicomposting, and no standards for use of manures or biochar
- Very little reference is made to the Treaty of Waitangi/ te tiriti o waitangi and mātauranga Māori, as well as what is acceptable when considering cultural, as well as environmental, human, and animal health
- No consistent framework or process for updating and integrating emerging new contaminants or processes

6.2 International Good Practice

Our research on international good practice found that, while there are more comprehensive controls in place internationally (notably Europe), these still fall short of taking an integrated approach that provides clear pathways for the consideration of new contaminants and how they are best managed through the value chain. International tools used can be broadly characterised into the following:

- Tackling contamination by defining product standards (for example compost classes)
- Tackling contamination via process controls (for example controlling temperature and process time)
- Tackling contamination through collection and other upstream controls (such as bin inspections and restrictions on use of plastic bags)

6.3 Conceptual Framework

The organic waste value chain encompasses a large number of different types of activities from the generation of organics waste and the potential contaminants, through their collection, processing, and potential end uses in different receiving environments. A key challenge of the project was therefore identifying the systems boundaries and where interventions are likely to be practical, efficient and effective. A value chain

mapping exercise helped to identify key potential actors, material streams, and points of intervention.

The proposed frame to address organic waste contamination that was developed was to conder organic contaminants in the context of a circular economy enriched by te ao Māori, as set out in Te rautaki para | Waste strategy. Removing organic waste from landfill and reducing emissions is central to this.

To achieve a circular bioeconomy for organic waste implies that progressive detoxification of organic waste will be required. This will in turn be dependent on broader moves towards a circular economy. This means that the implications of controlling contamination in organic waste streams extend beyond those directly involved in the organic waste value chain.

6.4 Māori Engagement

As part of the project, the team considered how Te Ao Māori worldviews might be considered into the project, how they would be identified, and at what point of the continuum that these might be considered. The output was a framework to support the consideration of contaminants from a Te Ao Māori lens through a whakapapa-centred analysis.

The resulting Whakapapa-centred Approach for understanding the views of Te Ao Māori on Contamination of Organic Waste (Whakapapa Centred Approach) is a framework to consider different contaminants and explore their impacts as it pertains to Te Ao Māori. This approach was developed as a separate workstream. The decision not to integrate the approach into technical thresholds work, was an intentional one. The report should be read as a standalone piece of work and considered as part of decision making in this space, where knowledge of Te Ao Māori views needs to increase.

The application of the Whakapapa Centred Approach can be used across the board to support increasing knowledge and understanding of the impacts of the sector for Te Ao Māori. It is recommended that the approach is always used in the following instances:

- Application in Culturally Significant Contexts
- Engagements under Te Tiriti with Iwi
- Defining Pollution Status of Contaminants
- Supporting Education within the Sector

6.5 Stakeholder Engagement

This project canvassed a wide variety of information and stakeholders. One of the distinguishing features of the project was that the issue of contamination in organic wastes cut across a very wide range of organisations and interests. These interest groups ranged from Tangata Whenua, wastewater organisations, soil, farming, plastic and packaging industry, waste management, standards, through to community organisations and contaminated land related organisations and individuals. Each of these interested parties brought a different perspective and often different sets of

concerns. This was reflected in a high level of, often pro-active, engagement through the stakeholder engagement process.

Many of the stakeholders engaged in the process expressed a willingness to remain involved in further development and progression of actions within the sector.

6.6 Material Management Framework and Thresholds

One of the key themes to emerge from the study has been that there are different levels of contamination risk depending on the feedstock, the level of process control, and what end uses the product made from organic waste is put to.

In broad terms different feedstocks present different levels of risk, which tends to provide an initial default pathway for use of those feedstocks – feedstocks with lower risk of contamination being preferred for higher sensitivity end uses and vice versa. However, this default pathway can be altered through a range of controls and management processes, that seek to prevent, remove and remediate the respective contaminants, so that the resulting products are suitable for application to higher sensitivity end uses. Overlaying this, there are various levels of standards, certification, and monitoring that can be applied to provide assurance of the quality of the product and its suitability for the intended end use.

The issue of establishing contaminant thresholds arguably generated the most engagement. It was beyond the scope of the current work to comprehensively review the science behind limit setting and to challenge limits that have been set. Instead, the current work aims to establish an overall framework by which contaminant thresholds can be used to manage the risk of exposure depending on end-use scenarios for organic waste products. This framework is described as the Contaminant Threshold Framework and is developed in this report. Specific attention has been paid to existing contaminant guidelines and regulations in New Zealand that consider the protection of both human health and ecological indicators.

A further theme to emerge from this stage of the project was that the science of determining thresholds is ongoing, and that there are a range of emerging contaminants, such as PFAS and micro and nano plastics, for which we do not yet have scientifically determined thresholds.

6.7 Recommendations

The outcomes from the stakeholder and Māori engagement were synthesised into a range of recommended actions. These recommendations reflect the outcomes of the research as well as the input from stakeholder engagement. The actions are divided into the following themes:

A. Clean up system inputs
B. Clean up feedstocks
C. Improve decontamination
D. Align standards and guidelines
E. Expand testing and compliance

F. Develop planning and oversight
G. Coordinate research and development

In total 35 specific actions were identified. If actions across the different themes identified above are implemented this would result in a comprehensive programme of actions. It was recognised that some of these actions will either be more urgent, easier, or quicker to implement, while others, while likely to be important will require a longer-term approach. The actions were therefore then further prioritised, taking account of input from the TAG and the project team, to identify a range of priority actions.

The priority actions are as follows:

Table 3: Priority Actions

Action Type	Action
Clean up system inputs	1. Promote and enforce existing requirements around application of picolinic acid herbicides (including clopyralid, aminopyralid and picloram)
	2. Require all compostable packaging to be certified as home compostable to a recognised standard
Clean up feedstocks	7. Invest in standard messaging for education of households and key user groups, including community and marae.
	8. Support targeted education
	9. Promote kerbside best practice
	11. Restrict discharge of problematic contaminants into wastewater systems
Improve decontamination	12. Encourage the organics management sector to invest in decontamination equipment
	13. Promote best practice decontamination in processing
Align Standards and Guidelines	15. Agree a framework for identifying priority contaminants and thresholds
	16. Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines
	17. Establish definitions for the 'end of waste' – where material has been sufficiently processed or remediated to be regarded as no longer a waste product
	18. Finalise the current 2017 Draft "Guidelines for the Beneficial Use of Organic Materials on Productive Land"
	19. Review and update NZS 4454:2005
	20. Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar

Action Type	Action
	21. Align standards, guidelines and certification with international standards and market requirements/expectations
	22. Develop culturally focused standards or incorporate cultural considerations into existing standards
Expand Testing and Compliance	23. Develop and commission a national testing programme for organic waste soil amendment products and where they are applied
Develop planning and oversight	26. Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management
	27. Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development
Coordinate Research & Development	29. Identify research priorities as part of the sector plan in the context of a circular bioeconomy
	30. Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants and their impacts in Aotearoa

Appendices

A.1.0 Analysis of Actions by Priority and Waste Stream

This table below aims to prioritise and sequence the long list actions identified in section 3.0. The actions are prioritised and arranged to provide a cohesive programme to address organic waste contamination in an ongoing manner.

There are essentially three types of actions identified:

- Specific actions that directly address contamination through the value chain. These are further divided into:
    - Cleaning up system inputs
    - Cleaning up feedstocks
    - Improving decontamination
- Actions that address issues of quality control, assurance and monitoring. This includes rules and guidelines on how organic products are applied to the environment and how the impacts of this are measured. These actions are further divided into:
    - Aligning standards and guidelines
    - Expanding testing and compliance
- The final type of action relates to responsibilities for taking action in the sector and making sure that required initiatives are appropriately managed and resourced. These actions are subdivided into:
    - Developing planning and oversight
    - Coordinating research and development

As well as having priority levels assigned, actions are divided into a number of key action areas, which are intended to reflect the key concerns identified through the background research and stakeholder consultation. In particular, a key theme to emerge from the stakeholder engagement was that the areas of most concern in terms of contamination were household organics, biosolids, compostable packaging, and emerging contaminants. This is reflected in the table below by specifically identifying actions that address these areas.

For the purposes of this exercise, and in line with the three phase approach outline in in Te rautaki para | Waste strategy, actions have been split into the following priority levels:

High priority actions. These are important actions to implement and are also actions that could be progressed in the short term.

Medium priority. These actions are vital to delivering the desired outcomes for the sector but tend to require a higher degree of change including system change or the establishment of new processes and protocols.

Longer term actions. These actions will be important to deliver the longer-term change required for the sector, but are require less immediate action and/or are likely to be complex and time consuming to implement.

Prioritisation of Recommended Actions

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
Clean up System Inputs						
Highest priority	1. Promote and enforce existing requirements around application of picolinic acid herbicides (including clopyralid, aminopyralid and picloram)		2. Require all compostable packaging to be certified as home compostable to a recognised standard			
Medium priority				5. Support and implement the global plastics pollution treaty		
Longer term actions			6. Ban compostable packaging except where a product stewardship scheme is in place that provides full chain of custody		4. Ban or restrict problematic contaminants including clopyralid, PFAS, and CCA treated timber	3. Product Stewardship. Develop product stewardship schemes that pass on the cost of contaminant removal to producers, and/or require full chain of custody
Clean up Feedstocks						

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
Highest priority	7. Invest in standard messaging for education of households and key user groups, including community and marae					
	9. Promote kerbside best practice				8. Support targeted education	
Medium priority	10. Develop standardised contract clauses for contracts between collectors and processors to establish feedstock standards	11. Restrict discharge of problematic contaminants into wastewater systems. This could include requirements for on-site treatment of wastewater from industrial sites before discharge to sewer				
Longer term actions						
Improve Decontamination						
Highest priority	12. Make provision through the Waste Minimisation Fund					

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
	(WMF) for decontamination equipment to be funded					
Highest priority					13. Promote best practice. There are examples of best practice, globally and in Aotearoa that can be referenced to lift the overall level of practice	
Medium priority						
Longer term actions					14. Fund weighbridges at organic waste processing sites to improve data capture	
Align Standards and Guidelines						
Highest priority		17. Establish definitions for the 'end of waste' – where material has been sufficiently processed or remediated to be regarded as no			17. Establish definitions for the 'end of waste' – where material has been sufficiently processed or remediated to be regarded as no	15. Agree a framework for identifying priority contaminants and thresholds

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
		longer a waste product			longer a waste product	
Highest priority		18. Finalise the current 2017 Draft "Guidelines for the Beneficial Use of Organic Materials on Productive Land"			19. Review and update NZS 4454:2005	16. Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines
Medium priority					20. Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar	
					22. Develop culturally focused standards or	23. Revise the National Environmental

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
					incorporate cultural considerations into existing standards	Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS)
Longer term actions					21. Align standards, guidelines and certification with international standards and market requirements/expectations	
Expand Testing and Compliance						
Highest priority						24. Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.
Medium priority						26. Establish an anonymised database of compost/organic

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
						waste derived product test results.
Longer term actions	25. Provide additional resource for enforcement of existing standards and rules					27. Reduce barriers to access to testing
Develop Planning and Oversight						
Highest priority						28. Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management
						29. Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment,

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
						research, behaviour change, and market development
Medium priority						30. Establish an entity or role(s) within an organisation that has responsibility for oversight and delivery of the sector plan
Coordinate Research & Development						
Highest priority						31. Identify research priorities as part of the sector plan in the context of a circular bioeconomy
Highest priority						32. Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants

	Household Organics	Biosolids	Compostable Packaging	Emerging Contaminants	Multiple Waste Streams	General
						and their impacts in Aotearoa
Medium priority						33. Secure appropriate funding sources for the research priorities identified in the sector plan
						34. Ongoing delivery, monitoring and development of the research plan
Longer term action						35. Market development. Establish a sector-wide body to promote standards, product certification and markets to create an end-to-end system that give confidence to consumers

A.2.0 Prioritisation from Technical Advisory Group

The TAG was surveyed to ascertain the priorities perceived by the members of the group. Of the 13 members 7 responses were received.

Google Forms was used to administer the survey. Members were provided with a link via e-mail and given a week to complete the survey. An e-mail reminder was also sent on the day before the survey was closed.

Respondents were asked to rate the priority of each recommendation on a scale of 1 to 5, with 1 being lowest priority and 5 being highest priority.

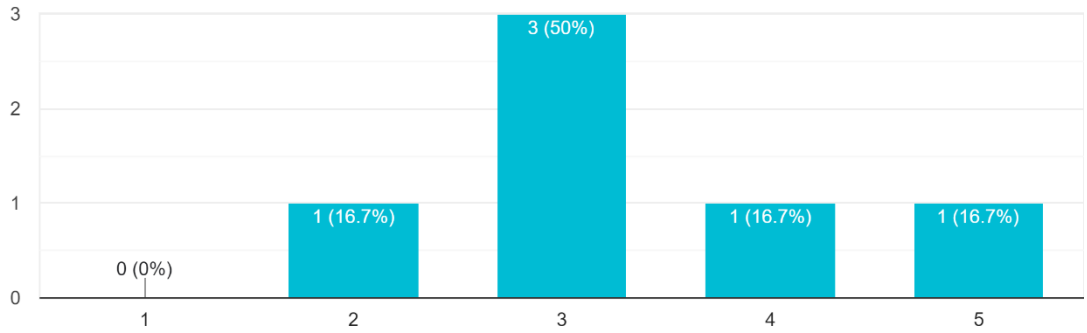
The results are presented below by question and summarised at the end.

Raw Results

Clean up System Inputs

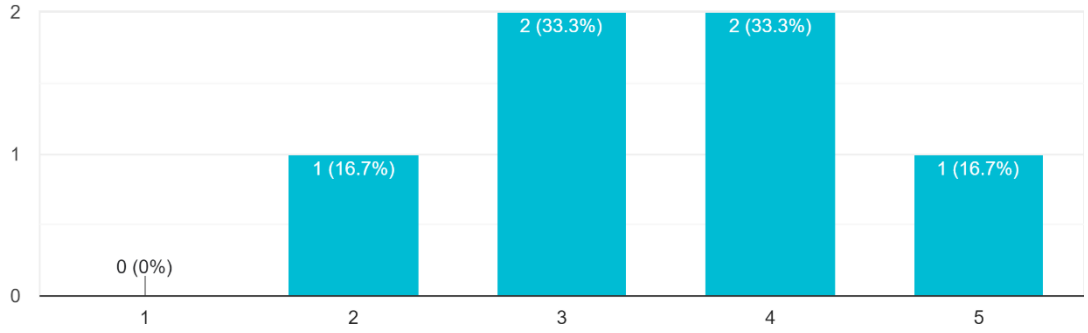
Promote and enforce existing requirements around application of Picolinic acid herbicides (including clopyralid, aminopyralid and picloram)

6 responses



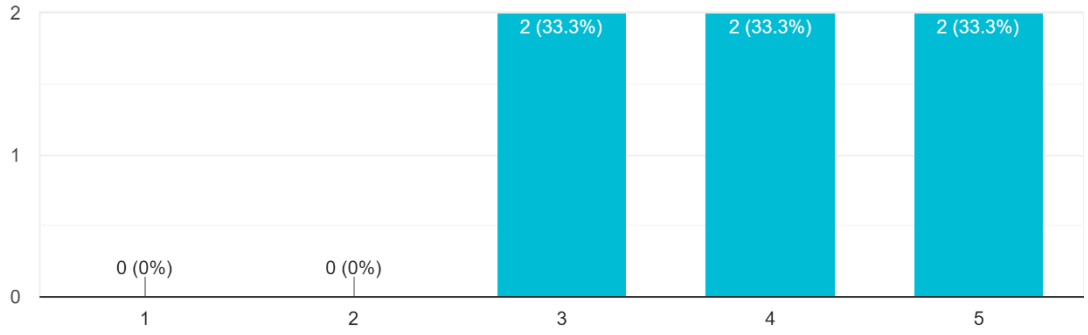
Product Stewardship. Develop product stewardship schemes that pass on the cost of contaminant removal to producers, and/or require full chain of custody.

6 responses



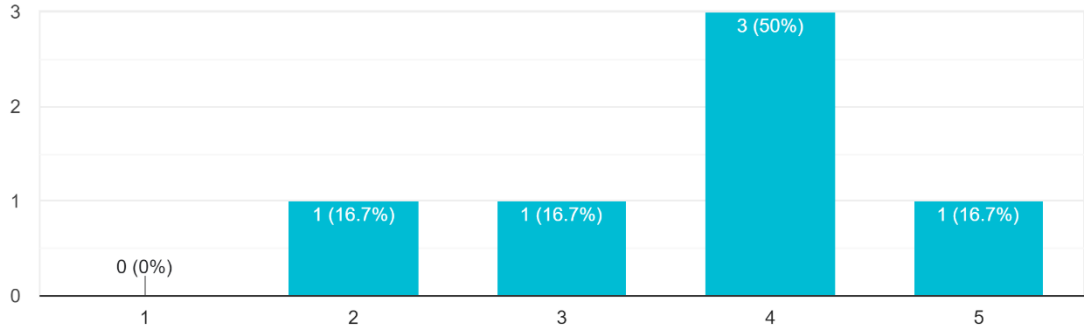
Ban or restrict problematic contaminants including clopyralid, PFAS, and CCA treated timber.

6 responses



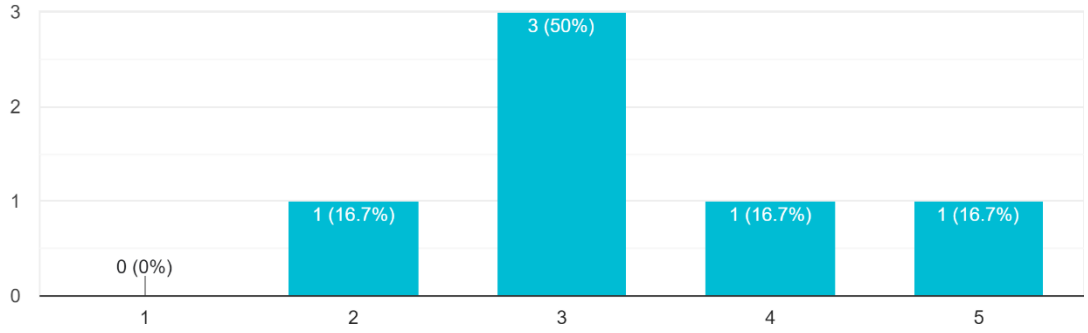
Support and implement the global plastics pollution treaty.

6 responses



Ban compostable packaging except where a product stewardship scheme is in place that provides full chain of custody.

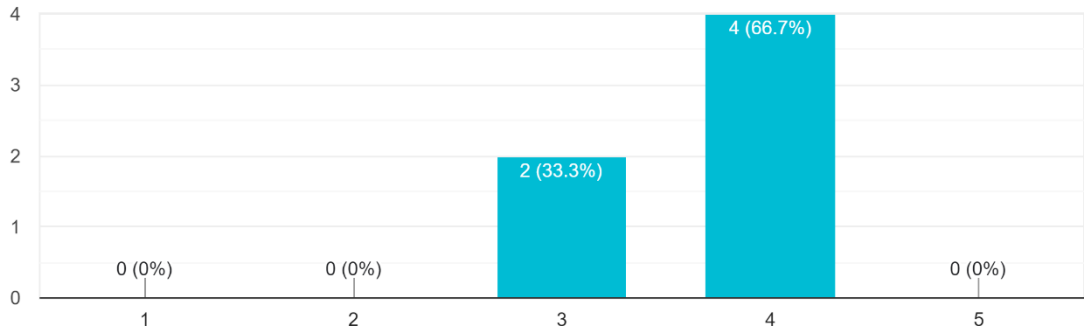
6 responses



Clean up Feedstocks

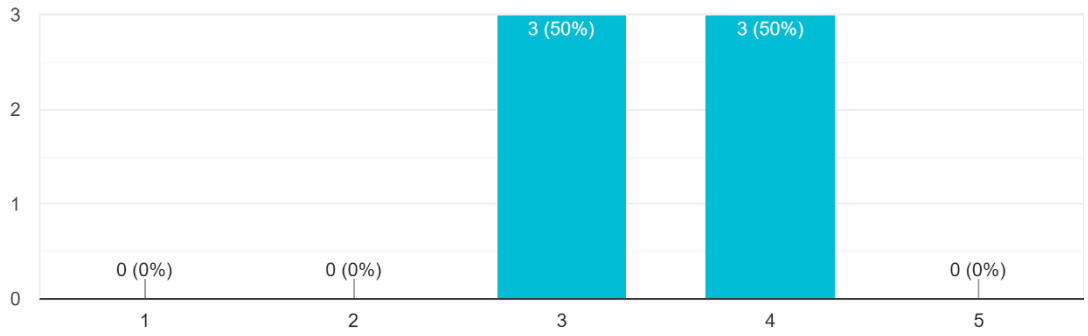
Invest in standard messaging for education of households and key user groups, including community and marae.

6 responses



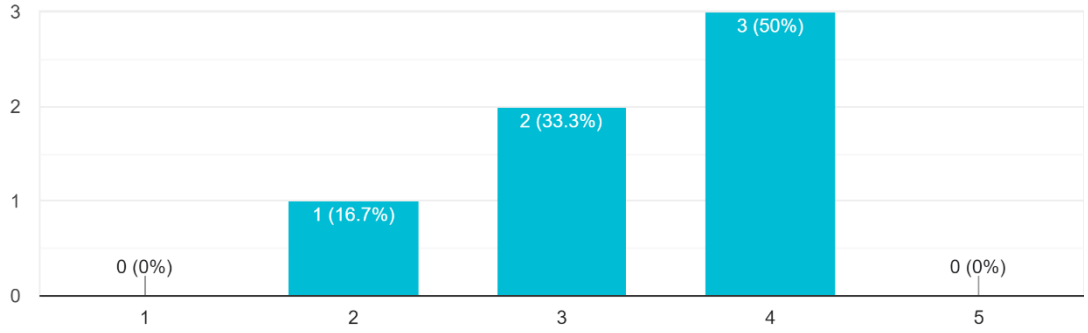
Support targeted education.

6 responses



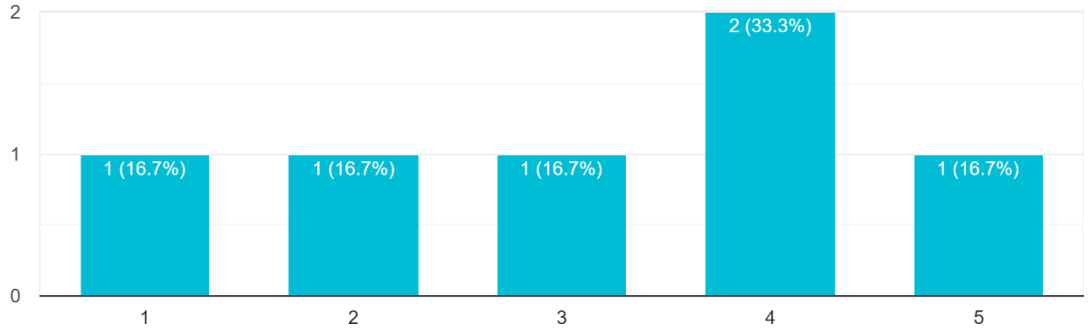
Promote kerbside best practice.

6 responses



Develop standardised contract clauses for contracts between collectors and processors to establish feedstock standards.

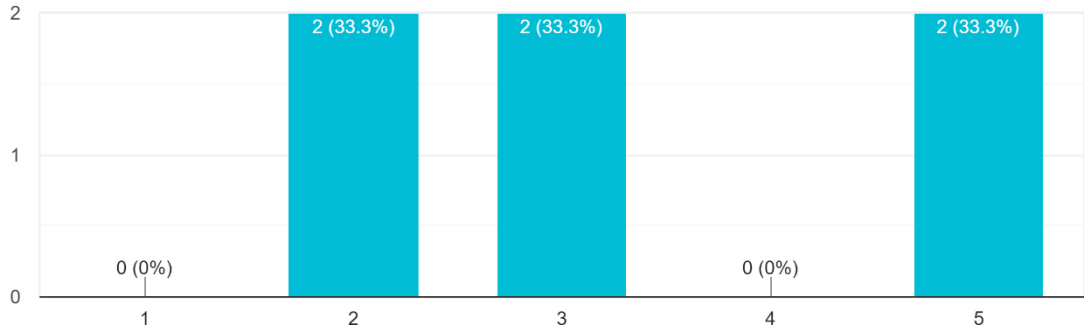
6 responses



Improve Decontamination

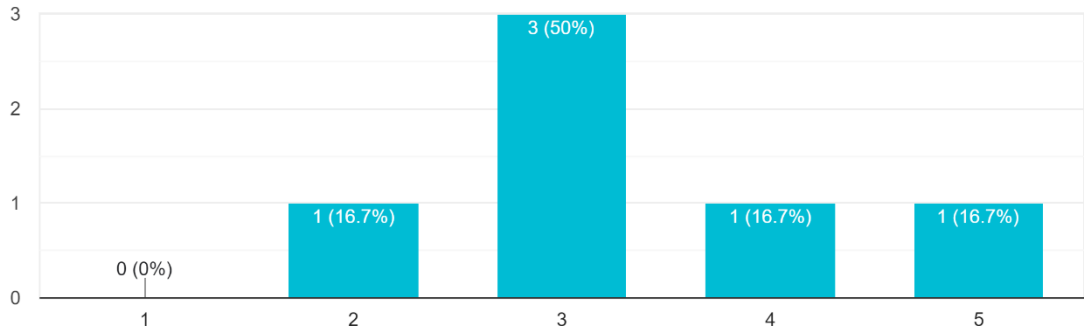
Make provision through the Waste Minimisation Fund (WMF) for decontamination equipment to be funded.

6 responses



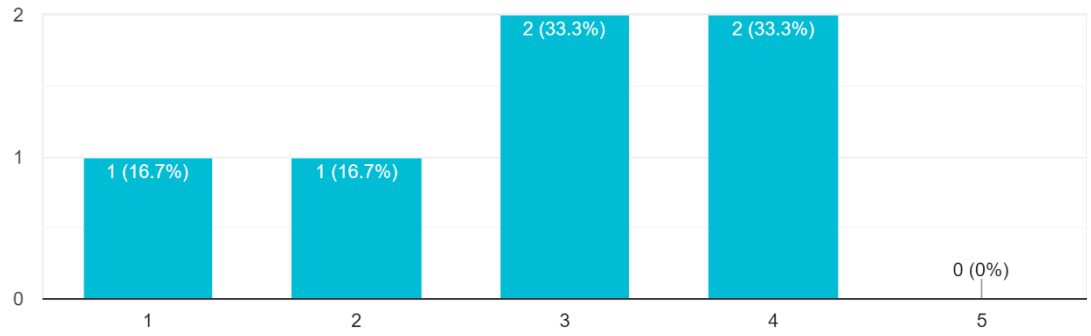
Promote best practice. There are examples of best practice, globally and in Aotearoa that can be referenced to lift the overall level of practice.

6 responses



Fund weighbridges at organic waste processing sites to improve data capture.

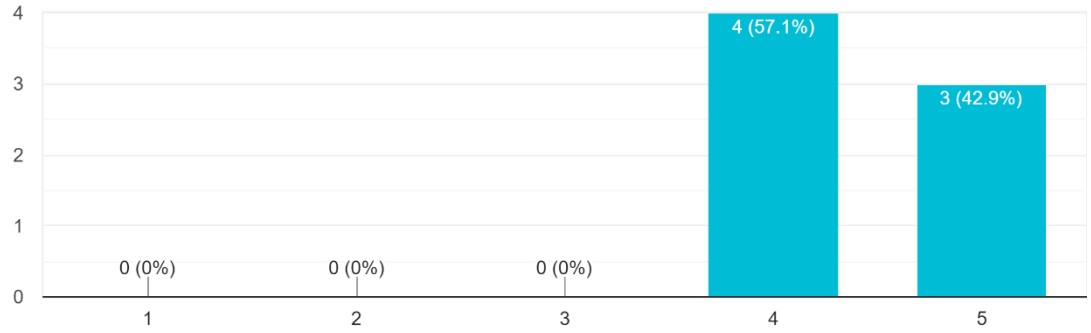
6 responses



Align standards and guidelines

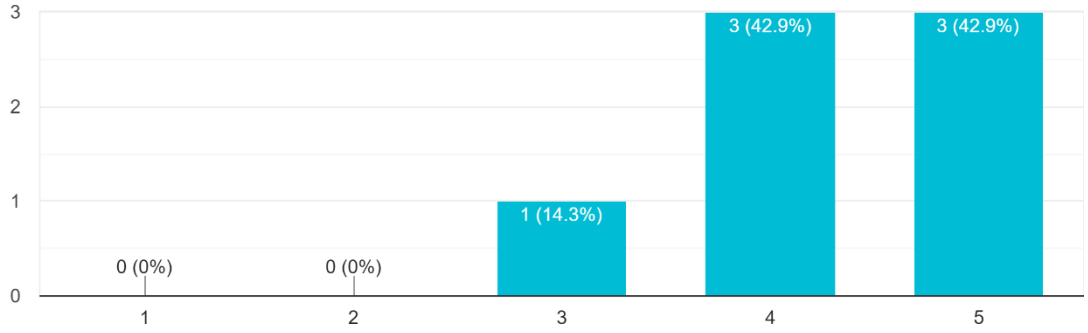
Agree a framework for identifying priority contaminants and thresholds.

7 responses



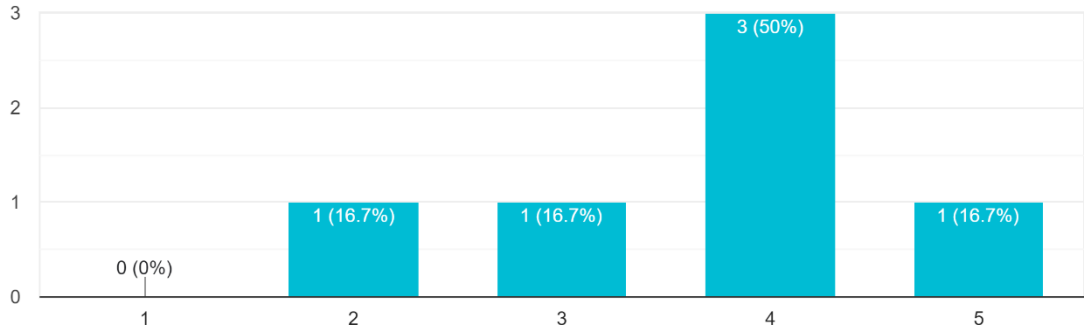
Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines.

7 responses



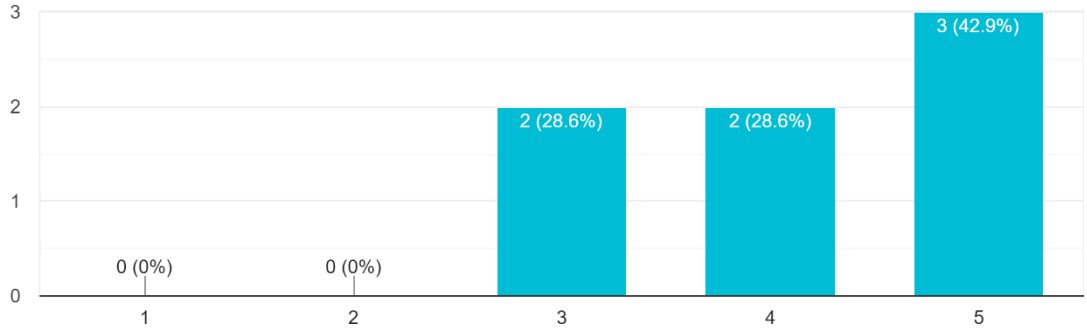
Establish definitions for the ‘end of waste’ – where material has been sufficiently processed or remediated to be regarded as no longer a waste product.

6 responses



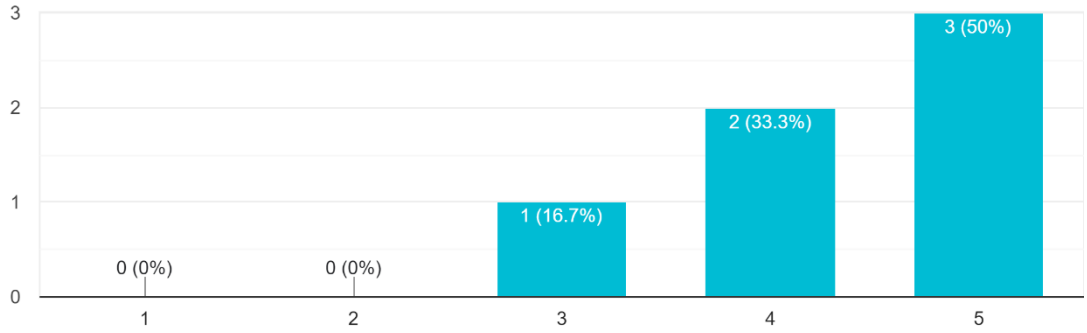
Finalise the current 2017 Draft “Guidelines for the Beneficial Use of Organic Materials on Productive Land”.

7 responses



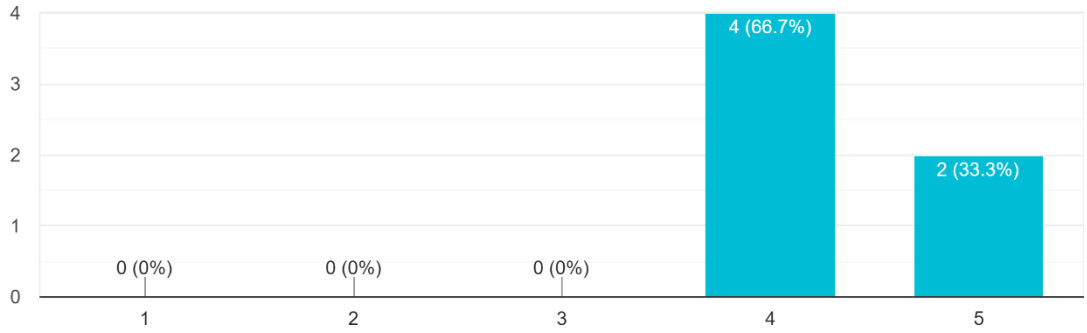
Review and update NZS 4454:2005.

6 responses



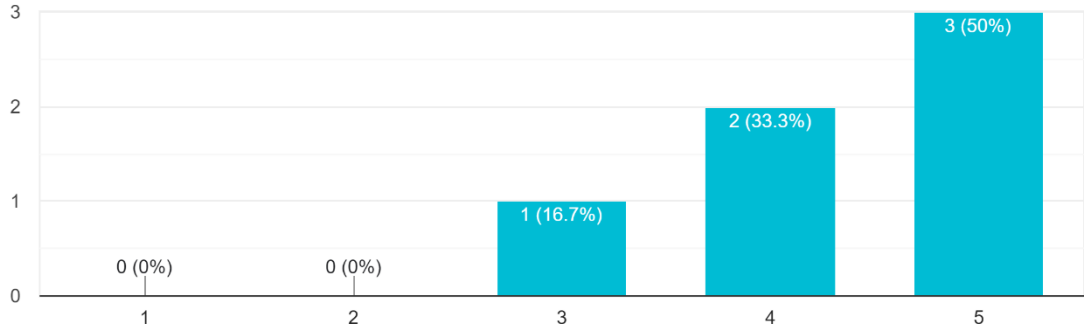
Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example:...olids, vermicompost, digestate, manures, biochar.

6 responses



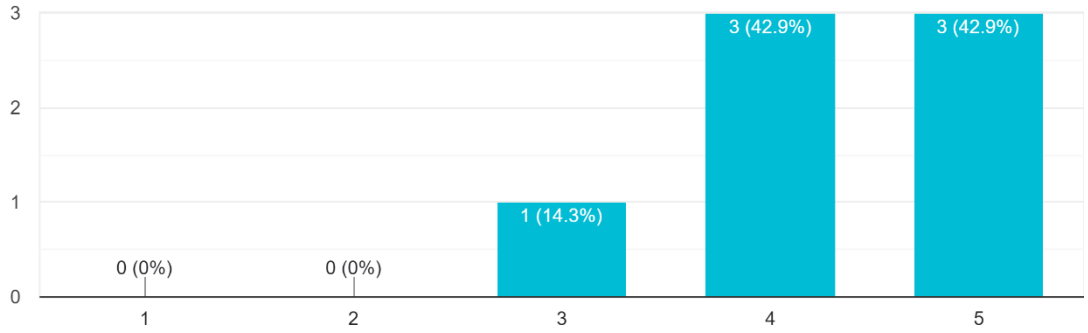
Align standards, guidelines and certification with international standards and market requirements/expectations.

6 responses



Develop culturally focused standards or incorporate cultural considerations into existing standards.

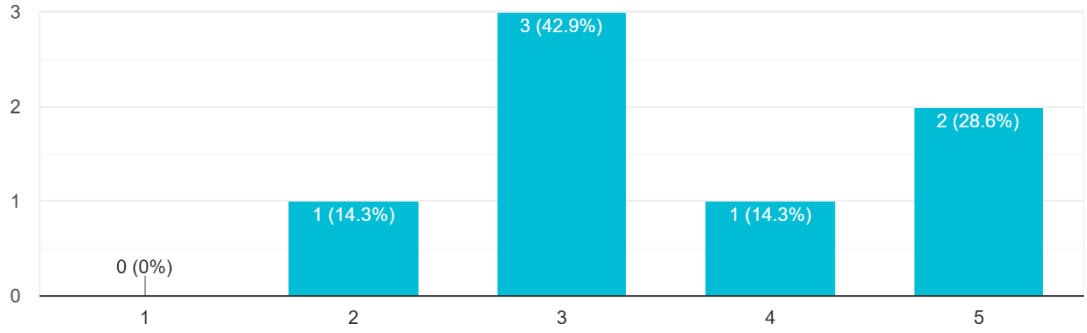
7 responses



Expand Testing and Compliance

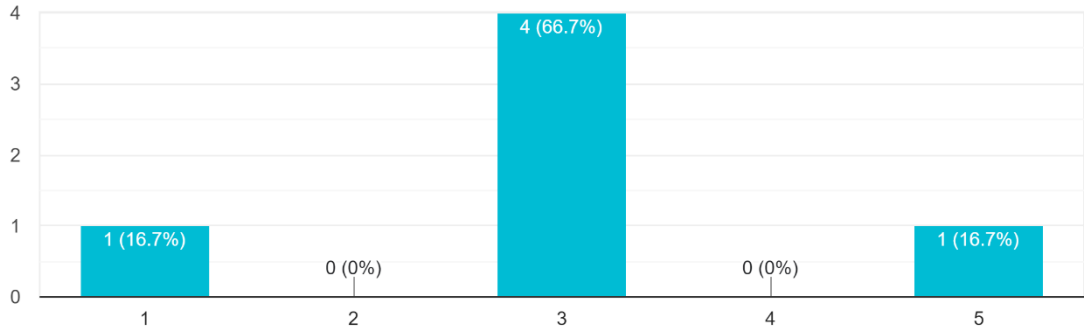
Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.

7 responses



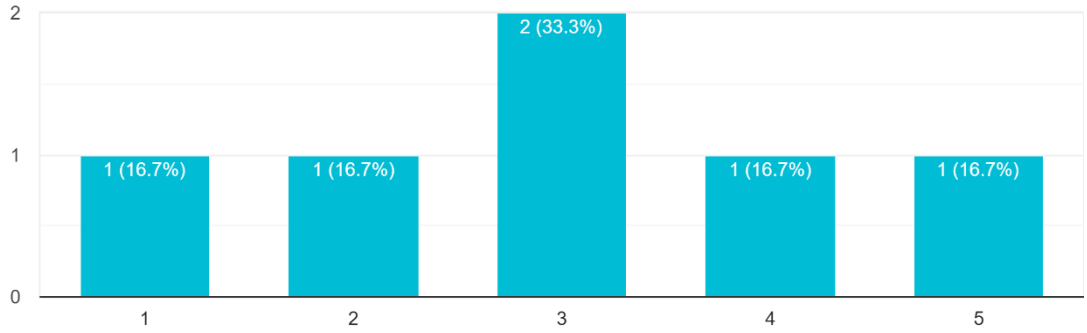
Establish an anonymised database of compost/organic waste derived product test results.

6 responses



Reduce barriers to access to testing.

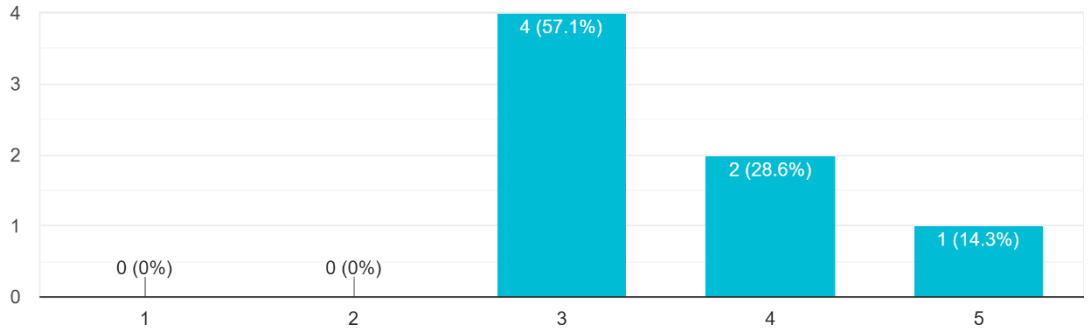
6 responses



Develop Planning and Oversight

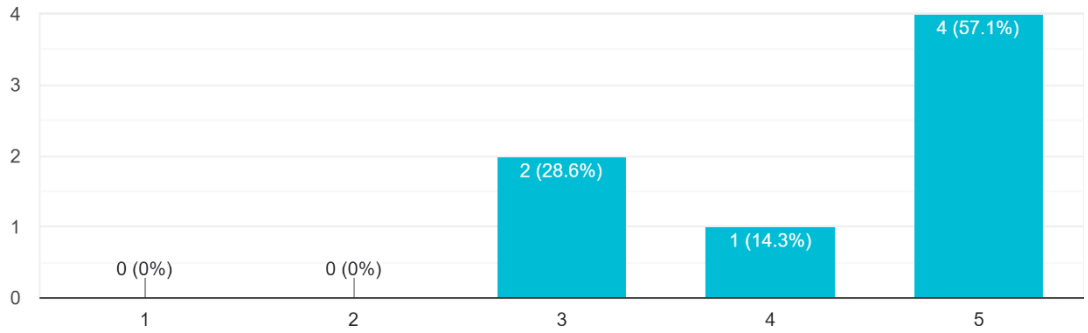
Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasin...ty for contribution in organic waste management.

7 responses



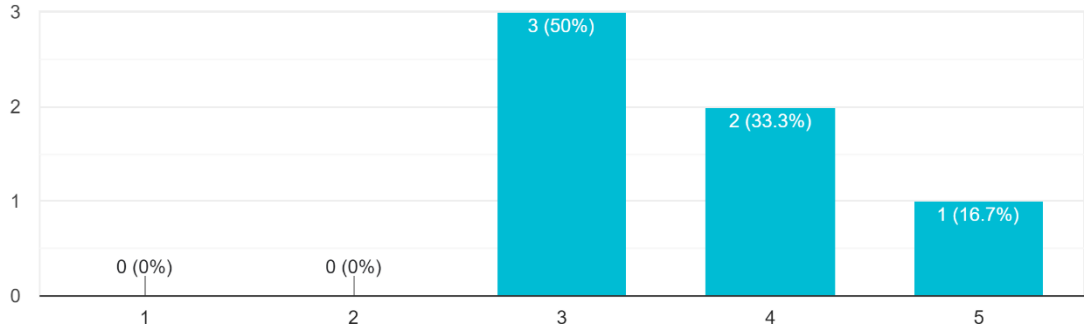
Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development.

7 responses



Establish an entity or role(s) within an organisation that has responsibility for oversight and delivery of the sector plan.

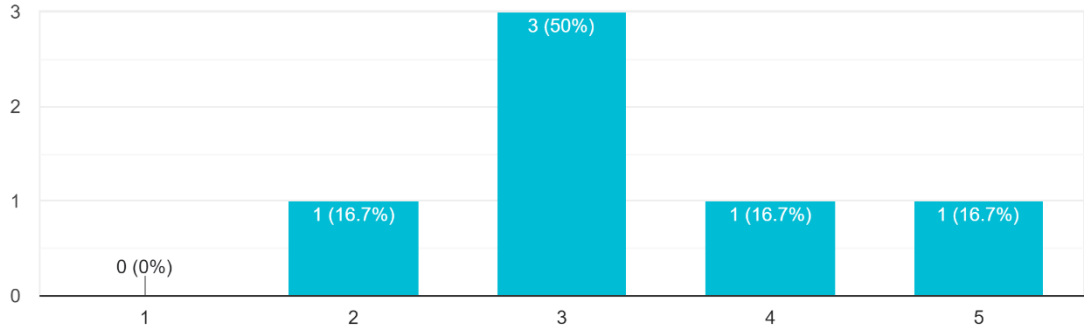
6 responses



Coordinate Research & Development

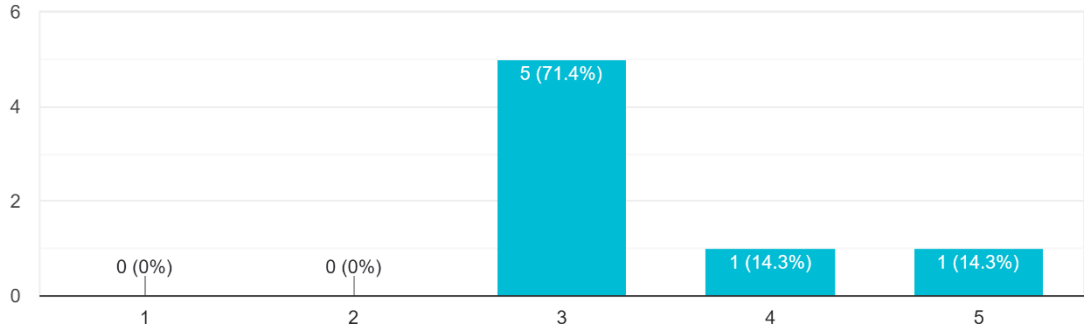
Identify research priorities as part of the sector plan in the context of a circular bioeconomy.

6 responses



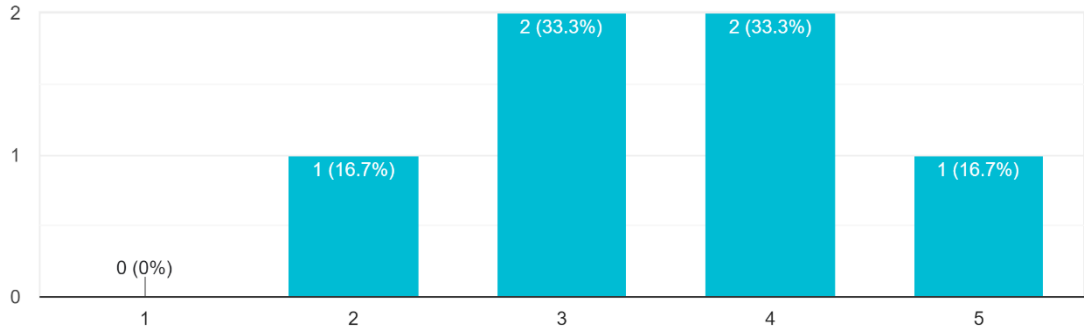
Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and in...ing of contaminants and their impacts in Aotearoa.

7 responses



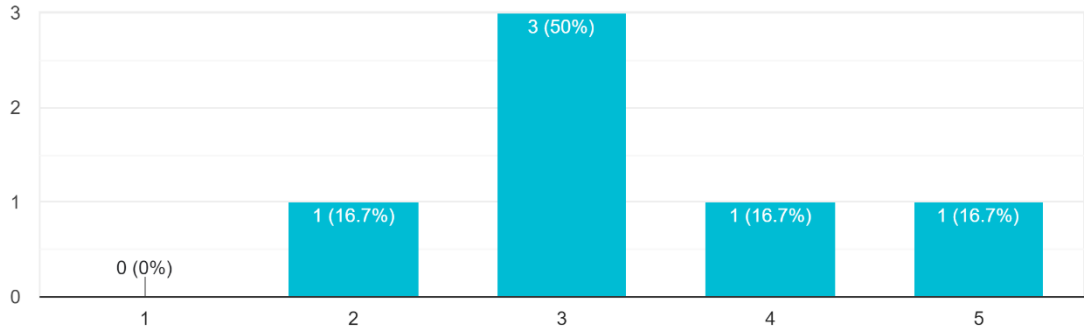
Secure appropriate funding sources for the research priorities identified in the sector plan.

6 responses



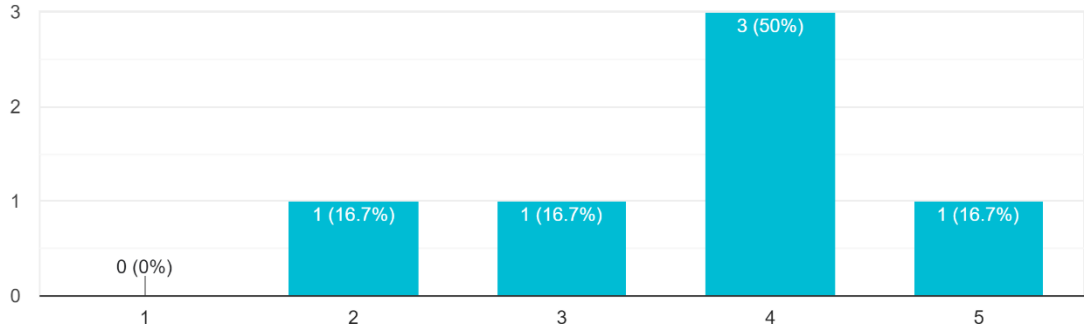
Ongoing delivery, monitoring and development of the research plan.

6 responses



Market development. Establish a sector-wide body to promote standards, product certification and markets to create an end-to-end system that give confidence to consumers.

6 responses



Summary of Results

Results Ranked by Section

Section	ID	Action	Overall rank:
Section 1: Clean Up System Inputs	2	Require all compostable packaging to be certified as home compostable to a recognised standard.	10
	4	Ban or restrict problematic contaminants including clopyralid, PFAS, and CCA treated timber.	13
	5	Support and implement the global plastics pollution treaty.	15
	3	Product Stewardship. Develop product stewardship schemes that pass on the cost of contaminant removal to producers, and/or require full chain of custody.	20
	6	Ban compostable packaging except where a product stewardship scheme is in place that provides full chain of custody.	23
	1	Promote and enforce existing requirements around application of Picolinic acid herbicides (including clopyralid, aminopyralid and picloram).	23
Section 2: Clean Up Feedstocks	11	Restrict discharge of problematic contaminants into wastewater systems. This could include requirements for on-site treatment of wastewater from industrial sites before discharge to sewer.	6
	7	Invest in standard messaging for education of households and key user groups, including community and marae.	15
	8	Support targeted education.	20
	9	Promote kerbside best practice.	23

Section	ID	Action	Overall rank:
	10	Develop standardised contract clauses for contracts between collectors and processors to establish feedstock standards.	30
Section 3: Improve Decontamination	12	Make provision through the Waste Minimisation Fund (WMF) for decontamination equipment to be funded.	23
	13	Promote best practice. There are examples of best practice, globally and in Aotearoa that can be referenced to lift the overall level of practice.	23
	14	Fund weighbridges at organic waste processing sites to improve data capture.	33
Section 4: Align Standards and Guidelines	15	Agree a framework for identifying priority contaminants and thresholds.	1
	16	Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines.	2
	22	Develop culturally focused standards or incorporate cultural considerations into existing standards.	2
	18	Finalise the current 2017 Draft “Guidelines for the Beneficial Use of Organic Materials on Productive Land”.	5
	19	Review and update NZS 4454:2005.	7
	20	Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar.	7
	21	Align standards, guidelines and certification with international standards and market requirements/expectations.	7
	17	Establish definitions for the ‘end of waste’ – where material has been sufficiently processed or remediated to be regarded as no longer a waste product.	15
Section 5: Expand Testing and Compliance	23	Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.	10
	24	Establish an anonymised database of compost/organic waste derived product test results.	31
	25	Reduce barriers to access to testing.	31
Section 6: Develop Planning and Oversight	27	Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development.	2
	26	Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management.	10
	28	Establish an entity or role(s) within an organisation that has responsibility for oversight and delivery of the sector plan.	15

Section	ID	Action	Overall rank:
Section 7: Coordinate Research and Development	30	Identify areas of further research for Te Ao Māori views, mātauranga Māori and knowledge to remain visible in this space, and to enhance and inform our understanding of contaminants and their impacts in Aotearoa.	13
	33	Market development. Establish a sector-wide body to promote standards, product certification and markets to create an end-to-end system that give confidence to consumers.	15
	31	Secure appropriate funding sources for the research priorities identified in the sector plan.	20
	29	Identify research priorities as part of the sector plan in the context of a circular bioeconomy.	23
	32	Ongoing delivery, monitoring and development of the research plan.	23

Top 12 Ranked Actions

Ref	Action	Overall rank:
15	Agree a framework for identifying priority contaminants and thresholds.	1
16	Establish a panel/working group to review contaminants and thresholds and establish a reference list for application to various standards and guidelines.	2
22	Develop culturally focused standards or incorporate cultural considerations into existing standards.	2
27	Develop a sector plan that establishes priorities for standards and guidelines, regulation, investment, research, behaviour change, and market development.	2
18	Finalise the current 2017 Draft “Guidelines for the Beneficial Use of Organic Materials on Productive Land”.	5
11	Restrict discharge of problematic contaminants into wastewater systems. This could include requirements for on-site treatment of wastewater from industrial sites before discharge to sewer.	6
19	Review and update NZS 4454:2005.	7
20	Work with sector bodies to establish appropriate standards and certification pathways for all organic waste products and materials, for example: biosolids, vermicompost, digestate, manures, biochar.	7
21	Align standards, guidelines and certification with international standards and market requirements/expectations.	7
2	Require all compostable packaging to be certified as home compostable to a recognised standard.	10
23	Develop and commission a national testing programme for organic waste soil amendment products and where they are applied.	10
26	Support the establishment of a collective iwi/Māori voice to address the need for ongoing inclusion of iwi and Te Ao Māori views and support increasing Māori capacity for contribution in organic waste management.	10

A.3.0 Technical Advisory Group (TAG) Feedback and Priorities.

Key themes from the TAG are noted below

Framework

Update to acknowledge the value in engaging further with food producers to understand in more detail how market requirements and acceptance impacts on practice.

Te Ao Māori

Include discussion of the potential to integrate science with the concepts of Tapu and Noa by identifying that there are certain levels of contaminants that are either clearly acceptable or clearly unacceptable, and that in the middle is where the local and cultural context makes the difference in deciding what is and is not acceptable

Thresholds

Include a context-setting overview of how contamination is managed in New Zealand which would include a brief synopsis of the interconnection of various guidelines. This overview would describe the requirement for soil testing as part of consenting to apply contaminated material to land.

Recommendations

1. Consider how we can structure the recommendations to acknowledge the distinction between actions that address system challenges and those that address operational challenges. Ideally there will be a balance of both.
2. Include a 'further work' section which acknowledges the constraints of the current study and identifies where additional research would be beneficial. This could include the following:
    a. A recommendation to gather data to more fully understand the flows of materials and the quantities involved in different waste streams, and levels of contamination reported. In particular kerbside food scraps and garden waste.
    b. A recommendation to undertake Life Cycle Assessment or Cost-Benefit Analysis
    c. A recommendation to engage more fully with food producers understand in more detail how market requirements and acceptance impacts on practice.
3. Include a recommendation for ongoing funding for education on waste prevention and reducing contamination
4. Identify potential owners or key parties are for each of the recommended actions
5. Consider how resource can be directed towards compliance and enforcement of existing standards and rules. A commonly held view amongst the TAG was that enforcing existing standards and rules was a foundational starting point.

6. Make adjustments to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS) to enable the use of soil replacements that are appropriate to intended use.