

APP203974 Hydrogen cyanamide (plant growth regulator)

Māori Impact Assessment (MIA)

for Reassessment Hazardous Substance Application

KEY DETAILS

Applicant	<i>Environmental Protection Authority</i>
Active ingredient(s)	<i>Hydrogen cyanamide</i>
Purpose	<i>Plant growth regulator for stimulating bud-break in various horticultural crops especially kiwifruit</i>
End-user	<i>Commercial growers, commercial operators (contractors)</i>
Use method	<i>Ground-based boom spray, air blast</i>
Environment	<i>Commercial orchards</i>
Hazard classifications	<i>Acute toxicity (oral) Category 3 Acute toxicity (dermal) Category 4 Acute toxicity (inhalation) Category 4 Skin corrosion / irritation Category 1C Serious eye damage / eye irritation Category 1 Skin sensitisation Category 1 Carcinogenicity Category 2 Reproductive toxicity Category 2 Specific target organ toxicity – repeated exposure Category 2 Aquatic toxicity – Chronic Category 3 Soil toxicity Hazardous Terrestrial vertebrate ecotoxicity Hazardous Terrestrial invertebrate ecotoxicity Hazardous</i>

This report is prepared by Kaupapa Kura Taiao on behalf of the Environmental Protection Authority (EPA) as the applicant for this reassessment. As the applicant, we are mindful of the responsibilities of the EPA as the regulator under s 58(1)(a) of the Hazardous Substances and New Organisms Act 1996 (“the Act / HSNO”).

Executive Summary

Kaupapa Kura Taiao (the EPA’s Māori Policy and Operations team) has undertaken an assessment to consider potential impacts of Hydrogen cyanamide on the economic, social, and cultural well-being of Māori, and the relationship of Māori with the environment, pursuant to sections 5(b), 6(d) and 8 of the HSNO Act.

Hydrogen cyanamide (HC) is likely to adversely affect the relationship of Māori and their culture and traditions with their environment and taonga, including culturally significant species, resources, and places, and the customary values, practices and uses associated with these taonga.

Use of HC is likely to support the ability and capacity of Māori to enhance their economic and social development well-being in terms of prosperity, livelihoods, and lifestyles, but is likely to adversely affect their cultural and social well-being in terms of protecting cultural values, health and welfare, and environmental quality.

Ngā Mātāpono o Te Tiriti o Waitangi (the Principles of the Treaty of Waitangi) have been considered in relation to this application – no issues arise in this regard.

1. Purpose and scope of this MIA

The purpose of this MIA is to inform the decision maker on the potential impacts on the relationship of Māori and their culture and traditions with their environment and taonga, and any issues that arise under the principles of The Treaty of Waitangi (Te Tiriti o Waitangi) from the application for reassessment of HC. The MIA also provides advice to the decision maker on any potential impact on the capacity of Māori to maintain and enhance economic, social and cultural wellbeing.

The MIA is an assessment under s 6(d) and 8 of the Act. Advice is also provided on any implications arising under s 5(b) of the Act. To provide context to the findings in this assessment, a description of the Māori world view and the relationship of Māori with their environment is included as Appendix A.

2. Ngā here ture (Statutory obligations)

Section 5(b) provides that to achieve the purpose of the Act, the decision maker must recognise and provide for the maintenance and enhancement of the capacity of people and communities to provide for their own economic, social, and cultural wellbeing and for the reasonably foreseeable needs of future generations.

Section 6(d) of the Act requires all persons exercising functions, powers, and duties under the Act, to achieve the purpose of the Act, to take into account the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, valued flora and fauna, and other taonga.

In accordance with section 8, the decision maker is required to take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

The Treaty principles most relevant to assessing and deciding this application are:

- The principle of active protection of Māori interests.
- The principle of partnership.

3. Assessment of impacts on cultural receptors

3.1. Impact on Papatūānuku (Land and soils)

Overall, HC is not likely to have a significant long term impact on Papatūānuku (land and soils). There is some potential for HC to harm Te Aitanga a Punga (soil dwelling organisms) including noke/toke (earthworms). While noke in commercial orchards are typically exotic species, they are important for maintaining soil health and productivity of the whenua.

The controls proposed to be assigned to Hydrogen cyanamide should be sufficient for managing potential adverse effects on these receptors. See section 3 in Appendix A for more information regarding Papatūānuku.

3.2. Impact on Ngā otaota (Plants)

HC has potential to harm or contaminate culturally important species of otaota (plants) within target areas and around their perimeters. Māori will be concerned about protecting taonga in adjoining land and waterways from spray drift and overland run-off. This includes otaota growing in publicly

accessible places such as road reserves, parks and the margins of watercourses where valued species may be gathered. Potentially vulnerable otaota include iconic species such as pūhā (smooth sowthistle), kawakawa (NZ pepper tree), harakeke (NZ flax), and other species used in kai (food), rongoā (medicine and healing), raranga (weaving), and mahi toi (arts and crafts).

The controls proposed to be assigned to HC should be sufficient for managing potential adverse effects on these receptors. Furthermore, regarding the gathering of otaota within orchards, HC is used on private properties where access to spray areas is controlled and HC users have the opportunity to advise others of their intentions to spray or where spraying has been undertaken. See section 4 in Appendix A for more information regarding ngā otaota.

3.3. Impact on Ngā manu, me ngā ngārara (Birds and reptiles)

The EPA has identified that HC is likely to pose risk to manu (birds), primarily in relation to reproductive effects in small ground-feeding species that consume seeds and invertebrates such as insects and worms. The potentially affected manu are predominantly introduced species such as sparrow, finches, and thrush.

However, HC is not likely to pose a significant threat to culturally important species of manu. There are not many small seed-eating native species that are likely to frequent environments where HC is used. Although HC has some potential to harm small insect eating taonga like pīwakawaka (fantails), tauhou (waxeye) and kotare (kingfishers) feeding on pepeke (arthropods), these 'perching' species spend very little time foraging on the ground. The number of these manu present and the quantity of pepeke consumed in orchards during the spray season is not expected to be a concern.

Valued manu such as pūkeko (swamp hen), rakiraki (various ducks), and other manu huahua (game birds) may venture into orchards to graze on vegetative matter and/or forage for pepeke (insects), noke (worms), ngata (snails) and putoko (slugs). However, HC is not likely to have a significant effect on these large manu.

There is an information gap in relation to ngārara (reptiles), particularly moko (lizards), therefore effects on these taonga cannot be assessed.

Notwithstanding the minimal harm to taonga species, it is acknowledged that risks to manu in general cannot be addressed with controls. See section 5 in Appendix A for more information regarding manu and ngārara.

3.4. Impact on Te Aitanga Pepeke (Arthropods)

HC has potential to harm species of pepeke (arthropods) that are culturally or economically important to Māori. These include pūngāwerewere (spiders), ngaro wīwī (hunting wasps), wētā, as well as various pāpapa (beetles), pepe (moths and butterflies), and ngarongaro (flies). HC also poses a threat to the pollinators pī honi (honey bees), pī rorohū (bumble bees) and ngaro tamumu (hoverflies) which may be attracted to flowering plants within or around orchards such as dandelions, sowthistle, daisies, and onion weed during the spray season.

The controls proposed to be assigned to HC should be sufficient for managing potential adverse effects on pollinators but not for other taonga pepeke. However, only relatively small numbers of in-field pepeke would be potentially affected, and the overall impact on local pepeke populations is not likely to be significant. See section 6 in Appendix A for more information regarding Te Aitanga Pepeke.

3.5. Impact on Ngā wai koiora (Aquatic habitats)

If HC enters waterways it has potential to harm culturally significant species of ika (fish), mawhiti (crustaceans), kaiwhao (molluscs), pūkohu wai (algae), and otaota wai (aquatic plants) including the food species tuna (freshwater eels), īnanga (whitebait), kōura (freshwater crayfish), kākahi (freshwater mussels), and kowhitiwhiti (watercress). HC may have potential to harm kekakeka (common duckweed), a food source of waterfowl and fish valued by Māori.

The controls proposed to be assigned to HC should be sufficient for managing potential adverse effects on these receptors. See section 7 in Appendix A for more information regarding ngā wai koiora.

3.6. Impact on Taha hauora (Human health and well-being)

HC is acutely toxic to humans when ingested, inhaled or absorbed dermally. It is classified as a skin and eye corrosive, a skin sensitiser, and is toxic to human organs and systems. HC is also a suspected carcinogen and human reproductive toxicant. There is a risk that HC may compromise the ability of people to protect themselves or others where it is used.

HC therefore poses a threat to taha hauora (human health) including the four dimensions of: Taha tinana – physical health and well-being; Taha hinengaro – mental and emotional well-being; Taha wairua – spiritual health and well-being obtained through the maintenance of a balance with nature and the protection of mauri, and; Taha whānaunga – the responsibility to ensure the collective welfare and foster a sense of well-being, safety, and belonging for all involved.

Some of the issues Māori may be concerned about include:

- Interference with whakapapa (genealogical connections and identity) and whanaungatanga (family relationships).
- Te whakaira tangata – issues concerning fertility.
- Oranga pai me te toiora – potential quality of life and enjoyment of healthy life styles.
- Reduction of mauri (vitality, life force viability) and manawaroa (resilience) of individuals.
- Hauātanga – impairment of functions and potential to participate fully at work, home or in society.

According to the Māori cosmogony, human beings are the progeny of Tāne-mahuta (kaitiaki of forests, plants, birds, insects and forest dwelling species) and Hineahuone (Earth-formed woman), as such we are said to have ira atua (supernatural life) and ira tangata (human life). Traditional narratives say Hine-ahu-one was the first human, who Tāne fashioned out of earth and came to life with a sneeze when he breathed life into her nostrils. That breath, which is shared by all humans and links everyone back through all preceding generations to Hine-ahu-one, is acknowledged in the ritual of the hongī (pressing of noses).

As all humans possess ira atua, it is said we are partly divine and should not be interfered with, especially in respect of human reproduction. This is due to the Māori belief that only atua have the right to change what is created by atua.

The potential for reproductive impairment and its implications for whakapapa (genealogical connections and identity) and whanaungatanga (family relationships) is a serious matter for Māori. Whakapapa is sacrosanct; it is pervasive in Māori art, architecture, carving, rituals and literature, and is the fundamental basis of the Māori cosmogony.

Human reproduction and transmission of 'ira tangata' (human life) from one generation to the next is hugely important to Māori in a symbolic as well as ordinary sense. To interfere with reproductive capability is to disrespect the unbroken human and spiritual thread that stretches back to Hineahuone and Tāne-mahuta.

Māori will be worried that even if operators use full personal protection equipment (PPE) including a respirator, the risk to taha hauora is still above the level of concern. If the use of HC were allowed to continue, Māori would favour use patterns and controls that provide the highest level of protection for users given the potential effects it can have on taha hauora.

Since HC is not available for home use, it is unlikely to pose a threat to vulnerable groups such as tamariki (children), kaumātua (the elderly), ngā tūroro (the sick or disabled), me ngā kūware (the unknowing or unaware) unless they are present where it is being used.

It is noted Māori have significantly higher registration rates than non-Māori for cancer-related diseases, and medical conditions associated with organ and body system failure, and are more likely to be hospitalised than non-Māori for these afflictions. Māori working with crops where HC is used may potentially be a vulnerable group in view of the classifications associated with this substance. As such, Māori may be disproportionately affected by HC as a demographic group.

HC is likely to have a significant impact on taha hauora. The controls proposed to be assigned to HC may not be sufficient for managing potential adverse effects on taha hauora. See section 8 in Appendix A for more information regarding taha hauora.

3.7. Impact on kaitiakitanga and manaakitanga (environmental guardianship and due care)

HC may adversely affect the ability of Māori to exercise kaitiakitanga and manaakitanga (environmental guardianship and due care). The controls proposed to be assigned to HC may not be sufficient for managing potential adverse effects on these practices. See section 9 in Appendix A for more information regarding kaitiakitanga and manaakitanga, as well as section 2 (Ngā taonga tuku iho / Cultural legacies) for further context.

4. Engagement with Māori

As part of preparing this reassessment application, the EPA wanted to hear Māori perspectives on the benefits, risks, and operational aspects of using HC. In October 2020, a call for information on the use of HC was circulated to Te Herenga, the EPA's national network of Māori environmental practitioners and kaitiaki (environmental guardians), various iwi, Māori growers, and Māori sector groups.

The EPA held three hui with Māori communities in major kiwifruit growing areas at Kerikeri (31 May 2021), Ōpōtiki (3 June 2021), and Tauranga (10 June 2021) to discuss these matters. The hui provided an opportunity for whānau to hear about the reassessment process for HC, discuss the risks and benefits of using HC, and to contribute kōrero that will inform the EPA's reassessment application. The EPA also met with Māori Kiwifruit Growers Incorporated (MKGI) on 15 July 2021 to provide an overview of the proposed application and receive feedback from MKGI. After this hui EPA staff visited a Māori-owned kiwifruit operation to have a first hand look at the equipment used for spraying HC and how a kiwifruit orchard operates.

Feedback from the call for information and hui highlighted the following key themes:

- Māori have invested substantially in the kiwifruit industry especially in Te Tai Tokerau, (Northland), Te Moana a Toi (Bay of Plenty), and Tūranganui a Kiwa (Poverty Bay). Many Māori whānau and households depend on this industry for their livelihood and well-being.
- There is a tension between economic benefits, including the opportunity for economic resources to support cultural and social objectives, human health and well-being, and the environmental impacts associated with HC.
- There is a strong desire in Māori communities to participate in the regulatory process and know more about how HC affects Māori interests.
- Capacity and capability issues prevent Māori groups from participating in the reassessment process due to insufficient resources, expertise or time. Apart from their paid day jobs, many Māori have other unpaid jobs working for their iwi, hapū, and marae.
- Information being fed into the reassessment process needs to come from a Māori perspective. This is all part of rangatiratanga and is a way to exercise kaitiakitanga.
- Kaitiakitanga needs to be at the centre of discussions about HC and it is important for the EPA to internalise this.
- Protection of taonga species is important. There is concern about effects of HC on mahinga kai (food gathering resources) and rongoā (medicine). At-risk places for foraging include along road frontages and other publicly accessible areas adjoining orchards such as the margins of waterways where people gather taonga species.
- Concern about effects on the recovering population of weka in the Ōpōtiki area. There are only three significant populations of weka left in the North Island – Ōpōtiki is one of them.
- Local areas in kiwifruit heartlands are subject to high levels of HC spraying. Many people live close to kiwifruit orchards where HC is sprayed.
- While HC spraying occurs over a relatively short period of time each year, it occurs over large areas, and the accumulative effects of this need to be clearly understood.
- Concern about potential impacts on waterways, aquatic ecosystems, groundwater, harbours, and coastal environments, as well as contamination of domestic water supply for those on tank and/or bore water in the vicinity of kiwifruit orchards.
- Individuals linked a range of health ailments to HC spraying including migraines, allergies, asthma and breathing complaints, epilepsy and cancer. People would welcome confirmation whether or not there are any linkages between HC and these or other health issues.
- Some people would be supportive of HC use continuing if risks to human health and the environment can be managed adequately.
- The increasing number of new kiwifruit orchards is putting the environment under pressure – conversions to kiwifruit are increasing the spray load on the environment.

- Māori growers see HC as an unfortunate necessity – they would prefer not to use it but say there are no satisfactory alternatives.
- Growers say that alternatives to HC are not as effective, more expensive, and are more difficult to use. More research and development is needed for alternative sprays.
- It was indicated that green kiwifruit might not be economic to produce without HC; up to around 50% of these vines would likely need to be removed in the Ōpōtiki region if HC was no longer available.
- HC offers kiwifruit growers the following benefits:
 - Highly efficacious and reliable bud-break
 - Increases quantity and quality of fruit
 - Shortened flowering periods
 - Reduces harvest costs
 - Maintain crop viability under climate change
- The number of organic kiwifruit operations is increasing, however, these orchards do not produce as heavy crops as those using HC.
- Many operators are responsible and courteous with their HC spraying operations. For example, neighbours are given advanced notice so they can stay away or inside, protect pets, close windows and doors, and not have laundry on clothes lines. However, some operators are very poor at communicating.
- Growers have to meet the protocols from Zespri and New Zealand Kiwifruit Growers Inc, so there is already a high standard of practice with spraying.
- Māori kiwifruit growers are not only involved in kiwifruit for economic reasons. Their operations are also cultural entities based around iwi, hapū, and whānau with a purpose of supporting the growth and development of these groups. Thus, kiwifruit operations are seen as business and community enterprises.

5. Ngā hua (Benefits)

Using HC as a plant growth regulator for stimulating bud-break in various horticultural crops, especially kiwifruit but also apples, will produce economic and operational benefits for those working with these crops, many of whom are Māori, in terms of yield, quality, and profitability of their crops.

As previously stated, these benefits include: Highly efficacious and reliable bud-break; increased quantity and quality of fruit; shortened flowering periods (e.g. over one week, rather than four); reduced harvest costs, and; the ability to maintain crop viability under climate change i.e. warmer temperatures and milder frosts.

Māori are heavily invested in kiwifruit production. In 2017 Māori-owned businesses accounted for 10% of New Zealand's kiwifruit production. In the near future it is envisaged that figure could grow to 20%. Māori are involved in all parts of the kiwifruit supply chain as orchard owners, contractors, employers and employees engaged in land development, technical services, planting, harvesting, packing, marketing, and transportation. Banning the use of HC would have major economic and social implications for Māori.

Māori growers and operators most likely to benefit from the ongoing use of HC are those in Te Tai Tokerau (Northland), Tāmaki Makaurau (Auckland), Te Moana a Toi (Bay of Plenty), Tūrangānui a Kiwa (Poverty Bay), Te Matau a Māui (Hawkes Bay), Te Tai o Aorere (Tasman), Whakatū (Nelson), and Ōtākou (Otago) as these are the main production areas in New Zealand for kiwifruit and apples.

Allowing use of HC for an interim period while a more suitable alternative bud-break regulator is found would help to protect substantial Māori investment in kiwifruit, and support the economic and social development of iwi, hapū, and whānau.

6. Analysis of impact

It is not clear whether the benefits to Māori associated with the ongoing use of HC are likely to outweigh any detrimental impacts to Māori. By and large Māori communities and growers acknowledge the harmful attributes of HC. They do not view HC as a long term option for stimulating bud-break i.e. growers would cease using it if a suitable, less harmful, and cost-effective alternative became available.

The controls proposed to be assigned to HC may not be sufficient for managing the impact of adverse effects on Māori.

The overall impact on the relationship Māori have with their environment and taonga may be significant, and may adversely affect the ability of Māori to exercise kaitiakitanga.

The overall impact on Māori economic wellbeing (arising from the impact on the environment and taonga) may be significant.

The overall impact on Māori social wellbeing (arising from the impact on the environment and taonga) may be significant. This includes impacts on Māori ways of life and taha hauora (human health and well-being).

The overall impact on Māori cultural wellbeing (arising from the impact on the environment and taonga) may be significant. This includes potential impacts Māori may experience in relation to their customary practices, traditions, beliefs, institutions, and lore.

7. Te Tiriti o Waitangi (Treaty of Waitangi)

The EPA, as the applicant for this reassessment, has considered the Principles of the Treaty of Waitangi in relation to this application and is of the view that no concerns arise under the Treaty Principles, as summarised below.

The EPA actively seeks to provide information that will enable Māori interests in relation to this application to be protected.

The information in this MIA will assist the decision makers on this application to be making a decision informed by a Māori perspective.

The EPA considers it is acting in good faith, and is acting reasonably and fairly, in respect of this application. Mātauranga Māori and tikanga Māori are being respected.

8. Kupu whakatepe (Conclusion)

8.1. Impact on the maintenance and enhancement of the capacity of people and communities to provide for their own economic, social and cultural well-being

Use of HC is likely to support the ability and capacity of Māori to enhance their economic and social development in terms of prosperity, livelihoods, lifestyles and the potential to achieve some cultural objectives, but is likely to adversely affect their cultural and social well-being in terms of protecting cultural values, health and welfare, and environmental quality.

8.2. Impact on the relationship of Māori and their culture and traditions with their environment and taonga

Use of HC is likely to adversely affect the relationship of Māori and their culture and traditions with their environment and taonga, including culturally significant species, resources, and places, and the customary values, practices and uses associated with these taonga.

8.3. Ngā Matapono o Te Tiriti o Waitangi (Treaty of Waitangi principles)

The active protection principle: the Crown has a duty to actively protect Māori interests.

No issues arise. The EPA prepared this MIA to assess potential impacts on Māori interests and help protect these.

The informed decision making principle: the Crown has a duty to make informed decisions.

No issues arise. The EPA held hui with Māori groups to discuss HC as part of the reassessment preparations and incorporated their views in the application.

The partnership principle: to act fairly, reasonably, and in good faith.

No issues arise. The EPA engaged with Māori and shared information early in the reassessment process to ensure proper consideration of the environmental, economic, social, and cultural implications for Māori.

Dated: 2/9/21

Appendix A

1) Ngā here whakapapa (Genealogical obligations)

Māori have a holistic and intergenerational view of the environment based around whakapapa (genealogies) and whanaungatanga (relationships) connecting people and all things in the world, living and non-living, animate and inanimate. Māori cultural beliefs and environmental frameworks use kinship, personification and metaphor to explain the origins of, and interrelationships between, all things. These beliefs and frameworks are maintained and transmitted to successive generations through kōrero o mua (traditional narratives), mātauranga (knowledge systems) and tikanga (customary values and practices).

According to Māori creation traditions, Tāne-mahuta (deity of humans, forests and forest-dwelling species) procreated birds, insects, trees, plants and humans. As progeny of Tāne, all of these organisms share whakapapa (genealogy) with one another and are closely related. Since birds, insects, trees and plants were created before humans, the former have tuākana (senior sibling) status in relation to humans who are teina (junior siblings). This tuākana – teina relationship dictates that careful consideration be given to potential risks and impacts on plants and animals and places a responsibility on people to exercise tiakitanga (guardianship, due care and diligence).

Fish and other aquatic species are descendants of Tangaroa (deity of the sea and water-dwelling species). Many of Tangaroa's descendants live in the domain of Maru (tutelary guardian of fresh water). Again, whakapapa obliges us to ensure that the best interests of these related and interconnected elements are taken care of.

Any use of, or effects on, organisms and natural resources need to be contemplated within this fundamental construct. Compelling justification is required for any detrimental impacts.

2) Ngā tikanga tuku iho (Cultural legacies)

Any substance that poses risk to the web of life, and the plants and creatures within it, is an issue for Māori. The importance to Māori of ensuring that valued species flourish cannot be overstated historically or contemporarily. In former times, mahinga kai (food resources), rongoā (medicine) and pūeru (textiles) were critical for sustaining Māori communities and whānau. Wild plants and animals formed a critical part of the food supply. Valued native and introduced species are essential for continuing customary practices and meeting cultural obligations, especially in respect of showing manaaki (hospitality) to guests on the marae, providing whānau with traditional kai, healing people using age-old remedies, and performing rituals in accordance with proper method and material.

Hazardous substances that may potentially harm or adversely interfere with culturally significant receptors are not favoured by Māori. Any level of contamination of cultural receptors by hazardous substances is undesirable – irrespective of the quantity of contaminants coming into contact with the receptors, period of exposure, and the nature, scale and intensity of adverse effects.

Hazardous substances can engender both direct and indirect impacts on Māori interests. Direct impacts are positive or adverse effects that are directly imparted to culturally significant receptors such as taonga species. Indirect impacts are the consequential effects of cultural receptors being impacted, that is, how such impacts affect the ability of Māori to express their culture, in particular customary practices and usages associated with the affected culturally significant species.

3) Papatūānuku (Land and soils)

Hazardous substances have potential to adversely affect soils, minerals and lifeforms in the earth's lithosphere, which is personified in Papatūānuku (earth mother), the wife of Ranginui (sky father), from whom all living things originate. This is concerning to Māori due the potential for directly poisoning or defiling Papatūānuku. Affected lifeforms could include culturally significant earth-dwelling creatures belonging to a realm known as Te Aitanga a Punga (the progeny of Punga) e.g. noke / toke

(earthworms), iroiro (nematodes), ngūharu (greasy cutworm), tūtaeruru (grass grub), pihareinga (crickets), and huakita (bacteria).

Papatūānuku is central to Māori creation stories and represents many things to Māori. Whenua (land) and soils (one), which provide a basis for life, are personified in Papatūānuku and are fundamentally important to Māori identity. The inextricable link between Māori and whenua is reflected in the term 'tangata whenua' meaning people of the land. Whenua provides a tūrangawaewae – a place where a person can stand and feel they belong. Whenua also means placenta. Humans are born of Papatūānuku, are sustained by her placenta (the land) and return to her upon death. Similarly, it is Māori tradition following childbirth to return the placenta to Papatūānuku by burying it in a significant place. Māori are concerned to protect these cultural associations in relation to hazardous substances.

Any adverse impacts on soil environments, including potential effects on life forms such as worms and naturally occurring bacteria, would be regarded as culturally undesirable. This is particularly the case in respect of noke / toke (earthworms) which are taonga species. Noke / toke are important to Māori because they:

- Are a source of food for culturally significant species e.g. tarāponga (red billed gull), kōtare (kingfisher) and pūtangitangi (paradise shelduck)
- Are used in traditional fishing methods e.g. toitoi tuna (eel bobbing)
- Are a part of the Māori cosmogeny e.g. stories concerning Māui and the mortality of humans
- Have geographical significance through incorporation into place names e.g. Te Tai Tokerau (Northland)

4) Ngā otaota (Plants)

Māori value plants in a multifaceted way that recognises their tangible and intangible uses as well as historical and contemporary importance. Some plants retain special significance even when their uses change or they are no longer used but have 'remembered' cultural value. This worldview respects past and evolving relationships between people and plants, and connects Māori with their culture and history. There is hardly a facet of classical Māori culture that did not somehow connect with plants.

With respect to Te Marae o Tāne (terrestrial ecosystems), hazardous substances may potentially harm culturally significant plants used for food, medicine, weaving, building materials and other end-uses, for example, pūhā (sow thistle), kawakawa (pepper tree), harakeke (flax), toetoe (toetoe grass), poroporo (kangaroo apple), koromiko (NZ willow), kohukohu (chickweed), kopakopa (NZ plantain) and paewhenua (common dock).

The importance of harakeke to Māori contemporarily and historically in terms of textiles, equipment, art, ornamentation, medicine, symbolic value and other associations cannot be overstated. Pūhā is an iconic Māori vegetable and has a variety of medicinal uses.

The multifaceted value of plants is exemplified in rarauhe (bracken fern). In pre-contact times, rarauhe was the most important wild vegetable – its starchy underground stems and tender young shoots were a staple food. Survival of Māori in Aotearoa depended on rarauhe when cultivated crops of kūmara (sweet potato), taro (arum) and uwhi (yam) failed, so remains respected today.

Rarauhe is tied into bundles for catching kōura / kēwai (freshwater crayfish), and is used to line and insulate crop storage facilities to keep kūmara and other root crops dry. It is also used to treat a range of medical complaints including burns, headache, colds, influenza, diarrhoea, constipation and seasickness. In former times, it was used as a soil binder in the construction of ramparts for defensive fortifications.

Rarauhe is also very symbolic. Along with other fern species it is used as a metaphor for leadership, succession, natural life cycles and intergenerational sustainability. For example, the whakataukī or proverbial saying 'Mate atu he tētēkura, ara mai he tētēkura' (As one fern frond dies another rises to take its place) encompasses these notions. Similarly, the young curled shoots of rarauhe emerging from the ground are sometimes generically referred to as 'pikopiko' (not to confuse with pikopiko the shield fern), a term commonly used as a metaphor for the younger or next generation of people. Such idioms are often used to embellish whaikōrero (speeches) and literature.

5) Ngā manu me ngā ngārara (Birds and reptiles)

Manu (birds) have always had a prominent place in Te Ao Māori as a food resource, skins and feathers for clothing and personal ornamentation, environmental and seasonal indicators, spiritual guardians and many other tangible and intangible uses.

Hazardous substances have the potential to harm culturally significant manu (birds) that might come into contact with the substance either directly or indirectly. At-risk species may include pīwakawaka (fantail), tauhou (waxeye), pīhoihoi (pipit), kotare (kingfisher), karoro (black-backed gull), tarāpunga (red-billed gull), weka (woodhen), ruru (morepork), kererū (NZ pigeon), tūī (parson bird), korimako (bellbird), pūkeko (swamp hen), pūtangitangi (paradise shelduck), pērera (grey duck) and rakiraki (mallard duck) feeding on foliage, seeds, buds, flowers, insects, spiders and other prey exposed to the substance. The last five listed above are currently game birds, while the kererū was formerly an iconic food species and highly valued for its attractive plummage.

Pīwakawaka have deep symbolic meaning in kōrero o mua (traditional narratives) and Māori lore. Pīwakawaka are associated with death; Māori regard them as a harbinger of death when seen inside a house. According to some traditions it was the fantail that caused Maui's death which resulted in the mortality of humans.

Kererū was the most important food bird for Māori and its feathers were used to beautify cloaks. It was highly valued as a seed distributor and forest regenerator because it was the only bird big enough to swallow and disperse the largest seeds of native species e.g. taraire and karaka trees.

Great orators and singers are compared with the melodious tūī, as in the kīwaha (saying) 'me he korokoro tūī' (just like the throat of a tūī). Tūī are also highly regarded for their ability to mimic the sounds of other creatures and humans.

Māori admire the kōtare for being an alert sharp-sighted sentry. This bird perches motionless, then attacks its prey in a sudden blur. The word kōtare sometimes referred to elevated platforms in pā from which sentries watched out for enemies.

The kawau is a metaphor for imminent action and people who are primed for action or ready to implement a plan. This is evident in the saying 'Kua mārō te kakī o te kawau' (The shag's neck has stiffened), referring to the rigid out-stretched neck of the kawau prior to launching into flight. Its alternative name 'koau' (a word play on 'ko au', literally 'it is me') is used in the proverb 'ko te koau anake e whakahua i tana ingoa, ko au, ko au, ko au' (Only the black shag proclaims its own name, it's me, it's me, it's me) in reference to conceited or egotistic people. Kupe, one of the first explorers of New Zealand, had a pet shag that was said to be the 'eye of the ancestor', a special bird with insights into ancient knowledge.

Māori sometimes kept karoro (black-backed gulls) as pets – they trained them to eat the caterpillars that infested kumara crops. Some birds became tame enough to follow people around, while others had their wings clipped to stop them flying away. Tarāpunga (red-billed gulls) around Lake Rotorua are considered tapu by the Te Arawa people as the shrieking of gull colonies warned them of a pending attack by northern Ngāpuhi marauders led by Hongi Hika in 1823.

Māori associate matuku with nobility and grace. The kōtuku (white heron) in particular has mythical status for Māori because of their rarity and beauty. The epithet 'te kōtuku rerenga tahi' (the white heron of a single flight) is given to distinguished guests who seldom visit and people of rare ability or achievement. While the elegant matuku-moana (white-faced heron) is reasonably abundant, other herons are much less common as befits their status as special beings.

Even though pīhoihoi are small, they were sometimes used as food by Māori in former times. According to Te Ara: The Encyclopedia of New Zealand (2015), Māori warriors sometimes used a tactic known as manu kāwhaki (decoy bird) which mimicked the pīhoihoi's movement whereby they would pretend to retreat, and lure the enemy into an ambush.

Pūkeko were admired for their bold scheming and determination. In former times the tenacious and mischievous pūkeko raided gardens for kūmara and taro. Stubborn, annoying people are compared to the bird and said to have 'taringa pākura' or pūkeko ears (pākura is another name for pūkeko) i.e. headstrong people who ignore or don't listen to advice. Pūkeko feature in stories of how the kiwi lost its wings in which all forest birds refuse to come down from the trees to eat the bugs on the ground and save the forest, except the kiwi which was willing to give up its colours and the ability to fly. The pūkeko's excuse was that the forest floor was too damp and it didn't want to get wet feet, so was punished by having to live in swamps.

Hazardous substances can also pose risks to ngārara (reptiles), in particular moko (lizards) such as moko tāpiri (common gecko) and mokomoko (common skink). Moko are important in kōrero o mua (traditional narratives) and Māori lore. Moko are considered by Māori to be harbingers of bad luck and symbolise death. They are associated with Whiro - the deity of darkness, disease, evil and death. Māori generally feared moko and placed these in burial caves as guardians to watch over the dead.

6) Te Aitanga Pepeke (Arthropods)

Hazardous substances have the potential to harm culturally significant arthropods belonging to a domain within Te Marae o Tāne (terrestrial ecosystems) known to Māori as Te Aitanga Pepeke (insect world) and 'Te Tini o Hakuturi' (the multitude of bow-legged ones). These vulnerable species include wētā, rō (stick insects), pūngāwerewere (spiders), kēkerengū (cockroaches), pōpokorua (ants), hiore kakati (earwigs), ngaro iro (blowflies, houseflies), tūpanapana (click beetles), kurikuri (ground beetles), pāpaka nguturoa (weevils), mūmūtawa (ladybirds), mōwhitiwhiti (grasshoppers) and pepe (moths and butterflies).

Te Aitanga Pepeke, including ngarongaro (flies), pāpapa (beetles), pepe (moths and butterflies), pūngāwerewere (spiders) and wakapīhau (centipedes), are culturally significant due to the part they play in Māori cosmogeny and environmental lore. This is evident in kōrero o mua (traditional narratives) involving pepeke which contain lessons or, as Pākehā would have it, the 'moral of a story'. For example, according to kōrero o mua, the insects and birds saw a man named Rātā fell a large tree to make a waka without appropriate ritual or authority to do so. They were angry about this and twice re-erected the tree after he had felled it, resulting in great shame for Rātā. However, upon realising and making good his mistake, Rātā was assisted by the insects and birds to build his waka. This cautionary tale is a reminder that natural resources should be used wisely and with due care and diligence. It also signals that mistakes are acceptable if they are corrected and lessons are learnt from them.

Māori recognise the important role that pepeke play in the web of life as predators, scavengers and as a food source for other creatures. Several culturally significant pepeke are beneficial for humans. These include mūmūtawa (ladybirds), pūngāwerewere (spiders) and ngaro wīwī (hunting wasps) prey on a range of pest insects and mites, while ngaro huruhuru (native bees) and ngaro tamumu (hoverflies) are pollinators.

Additionally, pī rāwaho (introduced bees) including pī honi (honey bees) and pī rorohū (bumble bees) are economically important as pollinators and, in the case of honey bees, producers of honey. A significant number of Māori work with agricultural systems or ecosystems where pollination is essential to the healthy functioning of those systems. Also, an increasing number of apiarists are Māori. It is noted that some substances pose risks to bees and may have the potential to impact on Māori bee keeping activities.

This is important because beekeeping enables natural resources to be harvested without damaging ecosystems or needing to own the resources on which bees forage. It provides a source of employment and income that can support Māori wishing to live in their hau kāinga (traditional home communities) particularly in remote areas.

As indicated by the Māori term 'Te Tini o Hakuturi' (the multitude of bow-legged ones) – the word 'tini' meaning numerous, countless and prolific – the use of hazardous substance in some circumstances is not likely to compromise overall populations of impacted culturally significant arthropods, and locally affected numbers of pepeke can be expected to recover reasonably quickly.

7) Ngā wai koiora (Aquatic habitats)

Waterways and wetlands are extremely important to Māori as they provide food, medicine and raw materials for a wide range of uses and were stewarded carefully in former times to ensure they remained productive and sustainable. Aquatic species formed a staple element of Māori diets and these remain highly valued today. Māori developed sophisticated technologies for managing, harvesting and processing the bounty of aquatic systems. They also observe that otaota wai (aquatic plants) and pūkohu wai (algae) are valuable to waterways as they help to purify water by absorbing nutrients, and stabilising sediment from streams and rivers, and stabilising sediment – which is important for maintaining balance within and between Te Marae o Maru (freshwater ecosystems) and Te Marae o Tāne (terrestrial ecosystems). The relationship of Māori with, and dependence on, waterways and the resources within is encapsulated by the saying ‘Ko au te awa, ko te awa ko au’ (I am the river and the river is me).

In respect of Te Marae o Maru, hazardous substances entering waterways may have potential to adversely affect culturally significant ika (fish), mawhiti (crustaceans), kaiwhao (molluscs) and otaota wai (aquatic plants). This includes food species such as tuna (freshwater eels), inanga (whitebait), kōura / kēwai (freshwater crayfish), kākahi (freshwater mussels) and kowhitwhiti (watercress), and prey species that spend all or part of their lifecycle in waterbodies, for example kōuraura (shrimp), pūpū wai māori (water snails), piriwai (mayflies) kapowai (dragonflies), hoehoe (water boatman) and hoe tuarā (backswimmer). The importance of tuna (freshwater eels) to Māori is widely known and extends well beyond being a key traditional food source. Kowhitwhiti (watercress) is an iconic Māori vegetable.

Further in respect of Te Marae o Maru, some hazardous substances may adversely affect kekakeka (duckweed) and other aquatic plants including pūkohu wai (algae), which are a food source for culturally significant species and offer a habitat and protection for small fish and invertebrates in addition to other ecological functions.

8) Taha hauora (Human health and well-being)

Hazardous substances may adversely affect taha hauora (human health and well-being), including the dimensions of: *Taha tinana* – physical health and well-being; *Taha hinengaro* – mental and emotional well-being; *Taha wairua* – spiritual health and well-being obtained through the maintenance of a balance with nature and the protection of mauri, and; *Taha whānaunga* – the responsibility to care for and share in the collective, including relationships, co-workers and social cohesion, and be connected to, people and things that foster a sense of belonging, enjoyment, well-being and safety.

Hazardous substance may compromise the ability of people to protect themselves or others where it is used. Ensuring the collective welfare and fostering a sense of well-being and safety amongst all involved is important for maintaining taha hauora.

Māori are interested to know about how hazardous substances may potentially effect vulnerable or disadvantaged groups such as kaumātua (older persons), tamariki (children) in particular ngā kōhungahunga (toddlers), ngā tūroro (the sick and infirm), ngā kūware (the unknowing or innocent), me ngā ūmanga (particular occupations).

Hazardous substances may potentially raise concerns in relation to the following issues:

- Oranga pai me te toiora - quality of life and enjoyment of healthy life styles.
- Reduction of mauri (vital essence) and manawaroa (resilience) of individuals.
- Hauātanga - impairment of functions and potential to participate fully at work, home or in society.
- Mate ā ira (genetically linked diseases), or interference with ira tangata (human genes) and ira atua (divine elements) of which human beings are compromised.
- Interference with whakapapa (genealogy) and whanaungatanga (family relationships).
- Mate pukupuku - cancer related conditions.
- Te whānau tamariki - issues concerning fertility, pregnancy, birth and developmental defects.
- Ngā whakakino ki ngā pūnaha ā tinana - adverse effects on body organs and/or systems.

Māori may have higher registration rates than non-Māori for medical conditions associated with particular hazardous substances, and may be more likely to be hospitalised than non-Māori for these

afflictions. Furthermore, Māori may be increasingly or highly represented in occupations or activities where they may be potentially exposed to particular hazardous substances. As such, Māori may be disproportionately affected by a hazardous substance as a demographic group.

9) Kaitiakitanga and manaakitanga (environmental guardianship and due care)

Kaitiakitanga can be interpreted roughly as the environmental and cultural guardianship exercised by mana whenua enabling protection of resources for the current and future welfare of people and the environment. Kaitiakitanga seeks to maintain balance and harmony within the environment from a perspective of intergenerational sustainability. Manaakitanga is about valuing people, acting with goodwill and beneficial purpose, showing respect, caring for and protecting the well-being of people and the environment. Manaakitanga extends to physical, spiritual, social and economic well-being – which can manifest in dimensions of taha hauora (human health).

Keeping people safe and minimising environmental impacts is consistent with the practice of kaitiakitanga and manaakitanga. Protecting the economic well-being, social well-being and lifestyles of those who may potentially be affected by a hazardous substance aligns with the practice of manaakitanga.