Healthy Rivers PLAN FOR CHANGE | Wai Ora HE RAUTAKI WHAKAPAIPAI

Draft for discussion purposes

Report No. HR/TLG/2015-2016/6.2

Integrated Assessment One: Assessment of Scenarios from modelling round one

This report was commissioned by the Technical Leaders Group for the Healthy Rivers Wai Ora Project

The Technical Leaders Group approves the release of this report to Project Partners and the Collaborative Stakeholder Group for the Healthy Rivers Wai Ora Project.

Signed by: 

Date: 1 March 2016

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Liz Wedderburn and Antoine Coffin on behalf of the Technical Leaders Group

Preface

The Healthy Rivers Wai Ora plan change project (the project) aims to update the Waikato Regional Plan in order to help restore and protect the health and wellbeing of the Waikato and Waipa rivers. The plan change seeks to reduce, over time, the levels of sediment, bacteria and nutrients (nitrogen and phosphorus) entering water bodies (including groundwater). A key driver of the project is the Vision and Strategy for the Waikato River. The Vision and Strategy identifies the objective of the restoration of water quality within the Waikato River, so that it is safe for people to swim in and take food from over its entire length[1].

The Integrated Assessment (IA) is a key input into the project, providing an assessment of the environmental, social, cultural and economic impacts of the water quality scenarios modelled[2]. This work was led by Dr Liz Wedderburn (Portfolio Leader - Agri Policy & Principal Scientist, AgResearch) and Antoine Coffin (Te Onewa Consultants), from the Technical Leaders Group.

Development of Integrated Assessment Framework

An initial workshop was held on 1 December 2014[3] to discuss the prosperous communities and social impact assessment for the project. It was attended by IA leads Liz Wedderburn and Antoine Coffin, as well as Dr Bryce Cooper (General Manager – Strategy, NIWA) as Chair of the Technical Leaders Group, Julie Meade Rose (Social and Environmental Ltd, Bruce Small (AgResearch), and Jacqueline Henry and Emma Reed (Waikato Regional Council).

The outcome of this workshop was a preliminary assessment framework, and identification of data sources for the IA. The framework was based on the values identified by the Collaborative Stakeholder Group (CSG). The workshop also identified key elements of the IA including the need for baseline information, and that the outcomes of testing water quality scenarios using a set of indicators would be provided to the CSG for consideration.

Indicators

The draft environmental, social and economic indicators were developed through a series of workshops with the CSG[4] from February to April 2015, led by Liz Wedderburn. A sub-group of the CSG (Ruth Bartlett, Charlotte Rutherford, Gwyneth Verkerk and Sally Davis) met with Liz Wedderburn in May 2015 to further develop an Integrated Assessment framework that considered the Policy Selection Criteria, the indicators identified at CSG9, the Waikato Progress Indicators and the Waikato River Authority report card. At CSG13, CSG decided on the following list of indicators:

Environmental

- Regional Ecological Monitoring of (wadeable) Streams (REMS which includes MCI, clogginess (Macrophytes), stream habitat)
- Riparian (effective for land-use) - Pareparenga o te wai (Riparian margin – access and acceptability)

[1] Te Ture Whaimana o te Awa o Waikato – The Vision and Strategy for the Waikato River

[2] See Doole, G. et al (2015). Economic modelling report- first round scenarios DM#3483793 and 2nd round scenarios DM#3564910

[3] Prosperous communities workshop notes December 2014. DM#3237973

[4] Integrated Assessment CSG history (summary) DM#3499887

- Wetland (unique habitat protected)

Social

- Vibrant Resilient Communities
- Employment (with an emphasis on type, variety and diversity of jobs)
- Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)
- Recreation use (including access and safety)

Economic

- Net Value Add $m (Regional GDP with sector breakdown)
- Net International Exports $m (Waikato regional contribution to national exports)
- Net Employment (Modified Employee Count or MEC) (Total value of employment)

The Mātauranga Māori indicators were developed through a separate process, led by Antoine Coffin. The details of this process are contained in a separate report[5].

Mātauranga Māori (Cultural)

- Waitemata (water clarity)
- Te Rere (flow)
- Paemakariri (temperature)
- He kai pai (edible food)
- Te nui o nga kai i te wai (abundance of fish species – koura)
- Nga tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)
- Matauranga ki nga wai kaukau (Knowledge of swimming places)
- Au Putea (economic benefit of water)

Baseline

The baseline provides a reference from which to assess each of the indicators based on the scenario outputs. A baseline of quantitative and qualitative data and trends were prepared for each of the indicators. Both published and unpublished sources were used to provide the most up to date information. The ecological data were provided by Dr John Quinn (Chief Scientist - Freshwater and Estuaries, NIWA) from the Technical Leaders Group, the social indicators data by Beat Huser (Waikato Regional Council), Bruce Small and members of the CSG sectors[6], and the baseline economic data by Dr Garry McDonald (Economist, Market Economics Ltd).

[5] See Te Onewa Consultants (2015). Mātauranga Māori Knowledge Networks DM#3504062

[6] Relevant data was provided by representatives of the horticulture, tourism, and energy sectors.

Assessment process

An expert panel was used to carry out the assessment. The purpose of the expert panel workshops was to bring together a range of expertise and knowledge to evaluate the results of the scenario modelling against the baseline information. The panel would then produce a narrative for each indicator and a trend for any change showing direction (either positive, negative or no change) and magnitude (i.e. a minor or more significant effect/change). The requirement was for the panel to use data where possible but due to timeframe constraints, to generally provide best professional judgement. A report was prepared for each of round one and round two scenario modelling assessments.

Process

A panel was convened comprising Liz Wedderburn, Jacqueline Henry, John Quinn, Wendy Boyce (Consultant), Emma Reed and Antoine Coffin. The panel met on Friday 28 August 2015 to consider the first round of economic modelling outputs. Using the baseline information, the panel assessed the model outputs against each indicator, and a draft narrative and trends were recorded.

A sub-group of CSG members, formed at the CSG13 meeting and comprising Sally Davis, Trish Fordyce, Stephen Colson, Jason Sebestian, Gwyneth Verkerk, George Moss, Weo Maag, James Bailey, Alastair Calder, James Houghton, and Al Fleming7, met with the panel on 15 September 2015 to finalise the first round IA. At this workshop a new indicator 'Vibrant Resilient Communities' was developed, after CSG identified a gap at their meeting on 8 September 2015.

The panel re-convened on 23 September 2015 to assess the outputs of the second round of modelling, for the 10, 25, 50 and 100% steps for Scenario 1[8].

Outputs

This report sets out the Integrated Assessment of scenario modelling round one and should be read in conjunction with the two reports summarising the baseline information (Baseline Report) and scenario modelling round two (Integrated Assessment Two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of Scenario 1 steps 10%, 25% and 50% from case 1 modelling round two).

Introduction

This report contains information about the potential social, environmental, cultural and economic impacts if policy was put into place to restore and protect the Waikato and Waipa rivers for swimming, taking food and healthy biodiversity. Four scenarios are identified for achieving these goals:

Scenario 1: Achieving water quality for swimming, taking food and healthy biodiversity
Scenario 2: No further degradation and improving to at least minimum acceptable states for all attributes
Scenario 3: Some general improvement in water quality for swimming, taking food and healthy biodiversity
Scenario 4: No further degradation.

Structure

The report is divided up into four categories:

1. Social
2. Environmental
3. Economic
4. Mātauranga Māori.

[7] See Integrated Assessment CSG history (summary) DM#3499887

[8] Doole, G. et al (2015). Healthy Rivers Wai Ora Economic modelling report-2nd round scenarios DM#3564910

Each category has several key pieces of information to guide decisions about the Healthy Rivers Wai Ora (HRWO) project. These indicators are chosen because they provide a measurable snapshot of the current situation in the Waikato catchment and surrounds. Column 3 summarises the level of impact and direction of change in relation to the baseline.

Some important points about this report

The indicators were based on what people value about the Waikato catchment, as well as the ways they use the land and rivers (waikatoregion.govt.nz/csgdocs). They were also based on what the community said they wanted taken into account by the Collaborative Stakeholder Group (CSG) as the policy was designed. This is also known as the policy selection criteria. For example, the acceptability of the policy to the community will focus the policy designers on achieving sound principles of allocation, recognition of effort already made and ensuring those contributing to the problem contribute to the solution in the right proportions (waikatoregion.govt.nz/policyselectioncriteria).

NB:

The Integrated Assessment does not take into account timeframes for each scenario. Therefore the severity of effects on the indicators should be read not as intensity of change but as direction and degree of change. Any significant change required may be ameliorated by the policy instruments that are chosen and how they are implemented (i.e. over a longer timeframe).

The Integrated Assessment Panel acknowledge that the issue of climate change, and potential carbon trading or tax regimes will have a significant effect on the profitability of particular sectors. The risks and likely anticipated effects of climate change have been considered as part of this assessment. These events are recognised through the benefits such as greater diversity of employment, and environmental resilience achieved through enhanced biodiversity.

Contents

Scenario 1: Achieving water quality for swimming, taking food and healthy biodiversity

Social Indicators

Indicator	Narrative	Trend (scale 1 – 5)
Vibrant Resilient Communities	The loss of MEC is reported as a loss relative to the baseline, so each absolute number of job losses needs to be considered as a proportion of the existing number of jobs. The Middle FMU has a much larger base MEC than the other FMUs, so a decrease in jobs for the Upper, Lower and Waipa FMUs will mean those communities are likely to be more impacted than a similar number of jobs lost from the Middle FMU. Scenario 1 has the greatest impact in terms of community vibrancy and resilience because it implies a larger change and is also the biggest change in terms of size and speed. From a social perspective time and support reduces the negative social impacts and assists people to make a transition. Support could be, for example, research and development grants, land purchases, funding, extension, advice, business development grants, education and training initiatives or infrastructure subsidies. Support measures become critical to assist the change and reduce unintended negative consequences. Communities who are already in decline, will be more affected by a decrease in jobs, which influence on population decline and can have a flow on effect to a loss of key services such as schools, healthcare, stores and shops. Providing levels of service and infrastructure relies on having a large enough rateable population base. Working age population brings employment and children to an area. The dairy industry is the most affected by the number of job losses in scenario 1, and people 18-40 years are an important part of the on-farm workforce. So a loss in this sector will impact on the working age population. This is especially so in the Upper FMU. How close a community gets to a tipping point will depend on how close it is now. Some communities may experience increased vibrancy associated with recreation and related business opportunities, for example Karāpiro or Ngāruawahia.	↓4
Employment (with an emphasis on type, variety and diversity of jobs)	Employment in non-forestry primary industries, particularly dairy farming, would decrease substantially under this scenario. This would affect the type and number of jobs in these sectors, with many of the job losses affecting low-skilled workers who may be less likely to find work elsewhere without retraining. The magnitude of the change for the dairy industry means there would be a flow-on effect for the primary service sectors and other services within the economy. There would be a large regional loss of jobs in these sectors, and this would be spread across the FMUs equally. Depending on the policy approach, this may have a large negative effect on these sectors, which may in turn lead to migration out of the region and force people to look for work elsewhere. However, balancing this is the possibility that adaptation and mitigation within industries could lead to innovation and opportunities for new types of employment.	↓4.5

	The model shows a major shift towards forestry in this, and the other, scenarios. An increase in employment in forestry, and wood and paper manufacturing, would result in an increase in the numbers of people working in these industries. It is possible that this will balance migration out of the region, and provide some jobs for people from industries that have been adversely affected. The transition to forestry would take place over 60 to 70 years – taking into account successive waves of forestry planting, as dairy is gradually replaced, and the lag time as trees are planted and mature. The central FMU would experience different effects to the other FMUs, due to its predominantly urban population and focus on manufacturing and processing jobs. There may be little overall change in the diversity of jobs in the region. The model shows a large predicted loss of jobs, however it doesn't predict where jobs could shift to. It also doesn't account for innovation and change over time. It is anticipated that phased land use changes will buffer the impact of changes in employment for people and communities, and allow innovation. It is possible that the impact from the loss of dairy jobs will be minimal over time, as people are re-employed in other sectors. Existing and ongoing land use changes in the northern part of the catchment, primarily due to urbanisation, are already having an impact on employment patterns, which will possibly be hastened by this scenario. Under this scenario the model suggests that current horticulture areas will disappear, due to the contribution of horticulture to nitrogen loads. However as horticulture in the lower Waikato plays a crucial role in national food production and is essentially irreplaceable, this is unlikely to occur.	
Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)	Costs to the urban centres and the rural areas would be more equitable under this scenario, because mitigations would be required for both point source, municipal and commercial, and diffuse source rural contaminants. Urban municipal point sources would have to take into account the constraints of council planning timeframes, such as those set by the 10 year long-term plans. The current expense to water treatment plants (for town supply) from contaminants in the water would decrease, which may alleviate some of the expense of wastewater treatment plant upgrades. Affordability for communities would decrease, as job losses combine with increased costs. Upgrades required to wastewater treatment and stormwater infrastructure will create particular affordability issues for some communities. The upgrades to infrastructure are managed through the resource consent process. Costs for these upgrades are passed on to consumers and rate payers. In the case of public infrastructural upgrades, the level and allocation of funding is decided through council long term planning processes, involving assessment of benefits, costs and affordability. Land-use changes under this scenario are likely to affect hydroelectricity generation negatively, by reducing flows and affecting reliability. There is a possibility that this scenario will impact on the industry's international competitiveness. Flood protection on the other hand, will benefit from these same changes to flows.	↓2

	Measures to address municipal wastewater discharges are predominantly about tackling nitrogen and P. There is also a need to focus on and target sources of E.coli.	
Recreation use (including access and safety)	A key outcome of this scenario is making the water safe for use. Buffers and fencing will provide access to the river margins, but access will also depend on how these riparian areas are managed. Riparian planting increases bank stability, which increases safety for recreational and other users. Overall, there may not be much inherent change to access, but there are opportunities to increase the accessibility of the rivers' margins. This will require explicit policy and agency by local government and landowners to enable access, and possibly some investment. Access to forestry may depend on the landowner; for example, at present, crown forestry land is wander at will, whereas other privately-owned forests tend to have more restricted access. It will be important to plan for and factor into any mitigations, such as shifts in land use, the requirement for access and the need to enable it, for example by providing gates, stiles, boat ramps etc. One possible mechanism, which is already used, is to place covenants on access to the land. There are also different rules relating to riparian margins for rivers with differing bed depths, and there is a need to understand the distribution of rivers with bed widths of greater than 3 metres throughout the region. These broader rivers are government owned and generally have esplanade strips. Access is not just about infrastructure, and the reductions in pest weeds that will flow from this scenario should also make the rivers more accessible for fishing, swimming and boating.	↑2

Environmental Indicators

Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)	The suggested result of this scenario is for an increased MCI and decreased 'clogginess' caused by macrophytes. There would be an increase in stream habitat. Depending on the timeframes to achieve the scenario, not much change in eel population will occur short term, as habitat will only increase slowly as vegetation grows. This scenario may affect sediment as banks change from grass to vegetation. The factors affecting this indicator represent ecological health for iwi, which is expressed in terms of increasing mauri of water bodies.	↑5
Pareparenga o te wai/riparian margins (effective for land-use)	Effective riparian management is an important consideration for all land based sectors and is required to achieve the attribute targets for this scenario. This scenario requires significant fencing but may need to include different management options, suitable to the land and farm types. This means omitting sheep from stock exclusion requirements may happen as part of the policy options. Riparian buffers provide benefits for biodiversity, aesthetics and ecological corridors as well as increasing customary resources. The fencing of waterways with large buffers may increase the public perception of accessible space adjacent to waterways. Model includes fencing and grass buffers but not planting. The riparian margin plays an important role in the acceptability of a place to swim. This indicator assumes that bank stability, safe water access and native vegetation including customary resources will enhance this indicator.	↑4
Wetland (unique habitat protected)	The total area of constructed wetlands is 2390 ha (compared to existing wetland of 15,500 ha and historic 202,600 ha area). So the created wetland area would represent a 15% increase on the low baseline but only 1.2% of the historic level. This scenario would require significant collaboration between farmers, and include restoration of previously drained areas. Forestry can dry out small wetlands but the increase in wetland area would be effective for contaminants, particularly nitrogen (and its 'load to come'). Increase in base flow and more even base flow as a result of more wetlands would have significant benefits through increased biodiversity, increased customary resources, increased sense of identity and increased food sources.	↑2

Economic Indicators

Value Add (proxy for Regional GDP with sector breakdown)

Value added for the Waikato region decreases by $529m (3.0%), with a significant impact on Horticulture of 40.5% ($45m). Value added for Waikato dairy farming decreases by $241m (15.1%) and for sheep and beef by $66m (16.2%). These impacts are felt throughout all the FMUs. The large reduction in Horticulture will be mostly felt in the lower Waikato, and will have flow on impacts for local domestic supply of, in particular, leafy greens.

With such decreases in the agricultural sectors, the declines in smaller rural towns may accelerate as people move away to seek other opportunities. If other external forces are apparent, for example a global financial crises, then towns will be less resilient.

Industry	Impacts ($m) (relative to baseline)	% change (relative to baseline)
Horticulture	-45	-40.5
Sheep, beef, and grain	-66	-16.2
Dairy farming	-241	-15.1
Forestry	10	5.3
Other primary	1	0.2
Agriculture and forestry support	-8	-3.5
Meat and meat product manufacturing	-6	-1.3
Dairy product manufacturing	-83	-11.9
Wood and paper manufacturing	9	1.8
Other manufacturing	-5	-0.5
Utilities	3	0.2
Construction	-3	-0.3
Wholesale and retail trade	-14	-0.9
Transport	-5	-0.8
Professional/administrative services	7	0.7
Local and central government	-4	-1.8
Other services	-79	-1.3
Total relative to baseline	**-529**	**-3.0**

↓5

International Exports (proxy for Waikato regional contribution to national exports)	This scenario would have a large impact across dairy, meat, meat manufacturing in all the FMUS, but less in the lower FMU. Processing is located in the central FMU. Total loss of $406m of international exports, the largest portion of which comes from a $370m decrease in dairy product manufacturing, with the next largest losses occurring in horticulture and meat and meat product manufacturing. The largest gain is an $18m increase in net international exports from wood and paper manufacturing.	↓5

Employment (Modified Employee Count)
(proxy for Total value of employment)

Total employment count for the Waikato region decreases by 2.3%, including a 12.2% decrease in horticulture, 11.4% in dairy farming and 9.9% in dairy product manufacturing. The impacts are felt throughout all the FMUs; unskilled labour will be most affected. The impacts are felt throughout all the FMUs; unskilled labour will be most affected. There will be rural population decrease and job losses. Population changes (in both number and age structure) in smaller towns will have a significant impact on rates and ability to pay, and impact on community services.

Industry	% change in employment (Modified Employee Counts) (relative to baseline)
Horticulture	-12.2
Sheep, beef, and grain	-6.3
Dairy farming	-11.4
Forestry	5.1
Other primary	0.2
Agriculture and forestry support	-3.2
Meat and meat product manufacturing	-1.2
Dairy product manufacturing	-9.9
Wood and paper manufacturing	2.5
Other manufacturing	-0.5
Utilities	0.4
Construction	-0.2
Wholesale and retail trade	-1.1
Transport	-0.8
Professional/administrative services	0.4
Local and central government	-1.9
Other services	-1.2
Total relative to baseline	**-2.3**

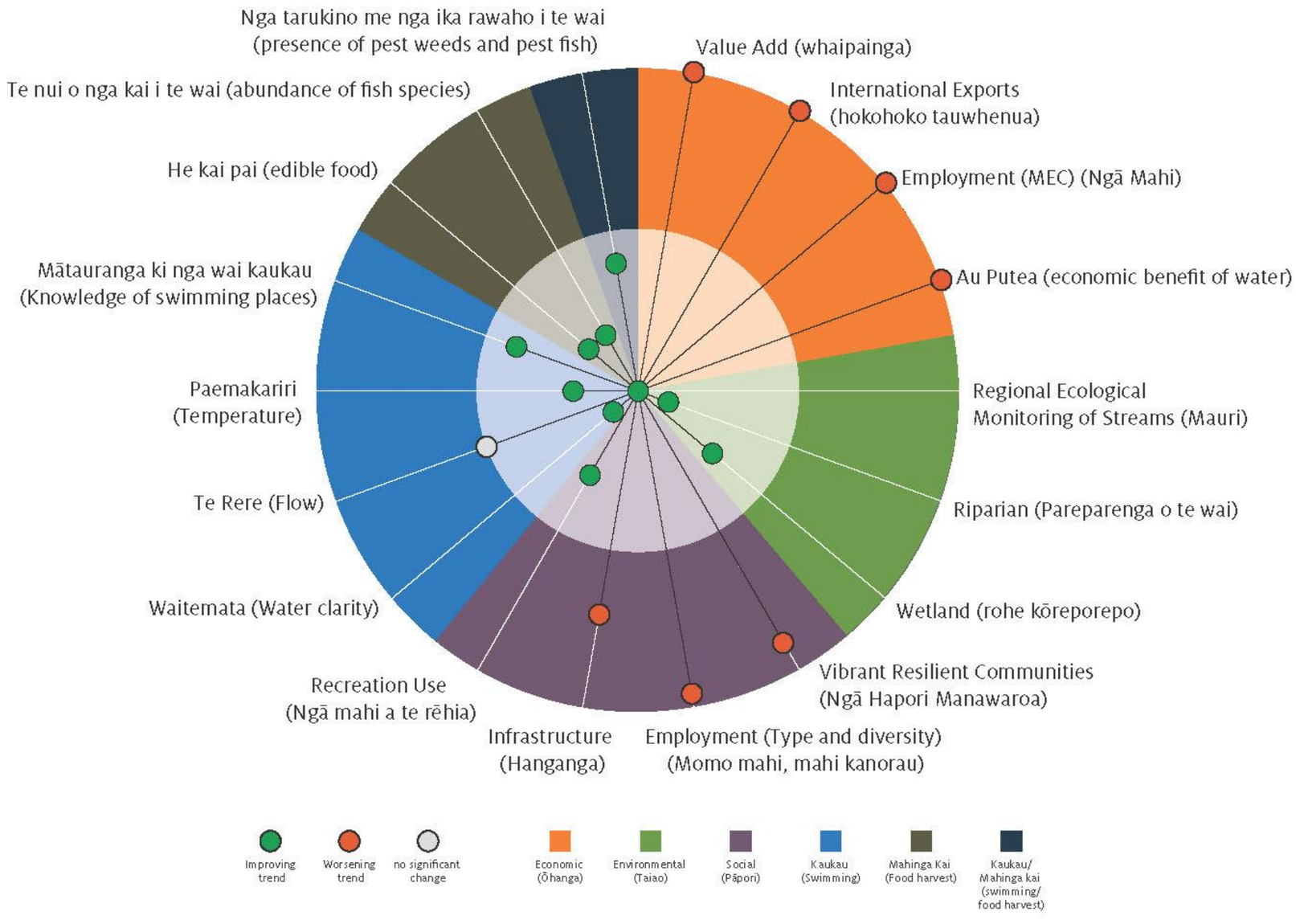
↓5

Mātauranga Māori Indicators

Waitematā (water clarity) – currently an attribute	Clarity in this scenario will improve however modelling indicates potentially 11 breaches of the scenario limits. These are predominantly in the Waipa River catchment and lower Waikato. It is expected that water clarity would achieve the B band in most places. The number of breaches generally increases where mitigation options are limited.	↑4
Te Rere (flow)	Flow is expected to remain static and not be affected by the reductions of the contaminants themselves. It is expected afforestation will decrease the variability of flow, particularly during small to medium sized storm events. This scenario modelling suggests conversion to forestry of approximately 17,000ha. The construction of wetlands of approximately 360,000ha as a mitigation would result in less variability and an increase in base flow. There will be an impact on swimming in low and very high flows.	—
Paemakariri (temperature)	The temperature of water is affected by exposure to sunlight. Shading of water bodies, particularly tributary streams will see a small decrease in temperature. This scenario includes land use change (conversion to forestry, and riparian management) that will result in a reduction in water temperature at those places. Temperature is also a stressor of native fauna, therefore lower temperatures are an improvement in ecosystem health. Generally, the expectation is that water will be colder in tributaries and that afforestation will reduce temperature.	↑3
He kai pai (edible food) – E.coli measured but food standards not reported	In this scenario E.coli levels reduce. However, there are 37 breaches of the limits or swimmable at 95th percentile for E. coli (whereas for wadeable limit of median E. coli no breaches at all) (Upper Waikato remains A, Tributaries min B, Middle Waikato Main stem B, lower stem C, Lower Waikato C). While the limits for E.coli in this scenario have 37 breaches of the swimmable limit in the model, there is still likely to be an improvement or decrease in E.coli levels through de-intensification, afforestation, and mitigations. E.coli monitoring and modelling involves significant uncertainty. Kai currently collected from the waterways in the catchments is cooked, reducing risk of human health risk from E.coli and other pathogens. Therefore the improvements in E.coli will likely improve perceptions of risk to human health. This indicator does not include or consider effects of heavy metals such as arsenic, mercury, zinc and copper that may come from both natural (geothermal) and industrial/urban waste sources. Heavy metals, particularly concentrated in sediment (Ohakuri) and reduced nutrients may reduce the release of heavy metals in anoxic stratified water.	↑3

Te nui o ngā kai i te wai (abundance of fish species – koura). Monitored as part of Regional Ecological Monitoring Survey (in tributaries).	In this scenario fish species have the potential to increase in number. There are a number of factors that affect the abundance of fish, including predation, food, barriers to migration, and water quality attributes (dissolved oxygen, pH, turbidity, ammonia, temperature). Reductions in the 4 contaminants may have varying impacts on particular species. Tuna are a very resilient species and can live in degraded environments but like piharau and inanga are sensitive to barriers to migration. Koura are particularly sensitive to sediment, and inanga are quite sensitive to a range of factors. For this indicator koura has been focussed on as an indicator species. They have a wide distribution in water body types (lakes, river, and streams) and are sensitive to sediment, and thrive in natural riparian margins. It is expected that numbers and distribution of koura may increase as a result this scenario. Koura, short finned Tuna, Inanga and Piharau (picked up in the REMS indicator). Increase in natural riparian margin will increase koura and increased koura means an increase in food source for trout, tuna, catfish.	↑3
Ngā tarukino me ngā ika rawaho i te wai (presence of pest weeds and fish)	This negative indicator assumes that the presence of pest plants and fish are an indicator of poor water health, from a cultural perspective. This scenario will have minimal impacts on the presence of pest weeds and fish (i.e. won't significantly reduce their numbers). There is expected to be some reduction of pest weeds that are affected by shading from afforestation and riparian management (that includes planting). Pest fish such as carp, catfish, gambusia and rudd are very resilient to a range of water quality characteristics. This scenario is not expected to see reductions in their number. Shading will control exotic plants in streams and shading also favours native fish. There are pros and cons in terms of this scenario but no significant effect on pests.	↑1
Mātauranga ki nga wai kaukau (Knowledge of swimming places) – information currently held by River Iwi	The assessment of changes in knowledge requires detail of personal, whānau, hapū, Iwi and collective knowledge, therefore assessment within the timeframe and scope of this project is unable to be achieved. The knowledge of swimming places can potentially be improved and increased as a result of improved water quality, particularly as these places are more accessible for swimming. In particular, by improving clarity (safety) and reducing E.coli (perceptions of safety) this will improve the opportunity to go to swimming places and therefore sharing of knowledge can occur. The higher frequency of swimming will facilitate the improvements in knowledge and the passing of knowledge. It is also expected that the awareness generated from the focus on swimmability will facilitate discussion and research.	↑1
Au Putea (economic benefit of water) – can measure effects in employment and profit from sectors and industries and on farm cost in economic model	For this scenario there would be land-use change (afforestation) and decreases in land-use intensity The economic effects of changes in land-use, particularly on Māori landholdings that significantly rely on agriculture, forestry, horticulture and future geothermal energy production are significant. While there is expected to be some increases in forestry (which has low labour force requirements) and value added industries such as pulp and paper, there will be significant reductions in other primary sectors; horticulture and fruit growing, sheep and beef, and dairy. There does not appear to be significant increases in tourism, however there may be niche market potential.	↓5

Trends Wheel Scenario 1



Scenario 2: No further degradation and improving to at least minimum acceptable states for all attributes

Social Indicators

Indicator	Narrative	Trend (scale 1 – 5)
Vibrant Resilient Communities	Significant job loss still occurs, with greater numbers for the upper Waikato FMU. Less of a step change in this scenario, with lower impact but still significant. Affordability of infrastructure is a concern, for example historically in Waitomo District debt per capita has been high.	↓3
Employment (with an emphasis on type, variety and diversity of jobs)	The impact on employment will be approximately 2000 jobs lost across the region. The impact on dairy farming is around 65 per cent of the total job losses, along with the related dairy support and manufacturing sectors. There is a large impact on horticultural jobs with a shift in land use away from horticulture. There is some question around the feasibility and likelihood of this shift happening, to the degree envisaged by the model, given the lower Waikato's crucial role in providing food nationally. Some jobs losses would be mitigated by new jobs being created within the region, particularly in forestry, and professional and administrative services. Professional and administrative services are already strong employers for the region, and it is likely some employment increase will come from people retraining and shifting into these fields. Peoples' and communities' resilience in the face of challenges also needs to reflected, and it is likely new and innovative ways of making a living will emerge, enabling people to remain employed within their local communities. The extent to which this may happen is hard to predict, but it seems likely that some secondary employment opportunities, related to the growth in forestry, are likely: for example, craft or trade-based uses of wood. It is also anticipated that there will be an increase in tourism, and as a result tourism jobs. This may particularly be the case in more remote rural areas where residents will be forced to consider what else they can do. However, it is unlikely the job increases flowing from international tourism will be significant: New Zealand already has a clean green image, and improvements in the rivers' water quality are unlikely to have a significant impact on this. Domestic tourism promises greater gains, both in terms of jobs and the economy. The spread of job losses and shifts is not constant across the region. The upper Waikato will experience more significant dairy-related job losses than the other FMUs, while (as is to be expected) the lower Waikato FMU carries the brunt of the horticulture (other primary) related job losses. Waipa is the least affected FMU. Similarly, gains in certain employment areas (construction; professional and administrative) are greater in some FMUs than others, although again it is unclear form the model what is driving these. Overall, in the context of total regional employment, the job losses for scenarios 2 and 3 are relatively minimal. In addition, in terms of numbers, the industries where the most jobs will be lost are not major employers. However, it is likely that smaller rural communities, where to date there has been less scope for diversity, will be hardest hit. This is likely to exacerbate existing trends where younger people are moving away from rural areas to find work.	↓3

Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)	Costs to the urban centres and the rural areas would be more equitable under this scenario, because mitigations would be required for both point source municipal and commercial, and diffuse source rural contaminants. Urban municipal point sources would have to take into account the constraints of council planning timeframes, such as those set by the 10 year long-term plans. Affordability for communities would decrease, as job losses combine with increased costs. Upgrades required to wastewater treatment and stormwater infrastructure will create particular affordability issues for some communities. The costs for industry to address new requirements for point source discharges will be largely covered by resource consents. Any further upgrades required as a result of this scenario will be an added cost, which will need to be measured against the benefits of the upgrades to assess if they are worthwhile. Land-use changes under this scenario are likely to affect hydroelectricity generation negatively, by reducing flows and affecting reliability. There is a possibility that this scenario will impact on the industry's international competitiveness. Flood protection on the other hand, will benefit from these same changes to flows. There would also be some reduction in the reliability and affordability of the various water infrastructure for consumers and communities. It is important to distinguish which of the infrastructure types is being discussed, as the costs, impacts and affordability of each varies hugely. The main infrastructures that need to be considered are: • electricity generation – there will be little impact under any of the scenarios at this stage. Whether this situation continues depends upon whether flow becomes a factor • flood protection – wherever there's a major land use shift to forestry, you would expect to see some improvements in the performance of flooding infrastructure. Wherever flood protection schemes are considered an issue, there will be a major capital cost in changing them • industrial point discharges and municipal wastewater treatment plants – measures to address these will create rates increases and funding issues, especially around who should pay. If ratepayers end up footing the bill, this will create flow-on issues for how other important aspects of water quality management (such as riparian planting) will be funded. The effect will be detrimental for communities either way, although spreading the costs over time will lessen the impact. Impacts will be very localised, based on the locations of towns and industries • stormwater (diffuse discharge) – this is not featuring sufficiently at present, and it is not clear if it has been accounted for in the model. This is predominantly an urban issue, but it is unclear what impact, if any, measures to treat or divert urban sediments and contaminants will have on overall water quality • community water supply – it is assumed that the more the river water quality improves the less treatment is required. This is more an issue for smaller communities, as the treatment plants for urban areas are very sophisticated. Assessing the impact of the scenarios on infrastructure is difficult (when assigning an overall grade), because we need to consider a wide range of impacts collectively. Specific points relevant to this scenario are: • electricity generation – no change • flood protection – slight improvement (↑1) • industrial point discharges and municipal wastewater treatment plants – some decline (↓2) • stormwater (diffuse discharge) – unknown • community water supply – slight improvement (↑1).	↓2

Recreation use (including access and safety)	It is possible that, because New Zealand already has a well-established clean green image, the main impact of improved water quality will be to ensure this is not tarnished or lost. The improvements in this scenario will enable the country, over time, to live up to its reputation. Where there is more likely to be recreational gains is with respect to domestic visitors, who are likely to be more drawn to the rivers if they are known to be clean. This anticipated trend needs to be limited to actual on-water users: swimmers, paddlers, boaters, water skiers. The actual quality of the water will be more important to them than to those recreational users who are walking or cycling alongside the rivers (these people are currently the main recreational users of the river). Those fishing will also be increasingly drawn to the rivers if they are cleaner, and as a result support more, and more edible, fish and other aquatic life. For all these recreational users, but especially fisher people, the nature and quality of access will be paramount, and factors influencing the riparian indicator need to be considered alongside this indicator. It doesn't matter how clean the water is if people can't access it. Any desire to increase recreational use will need to be supported by policy, management practices and targeted initiatives. The nature of the access required will vary. People using boats and other water craft will require specific infrastructure for launching (such as ramps and jetties), but Those fishing will require easy access to favoured riverbank spots. Issues around access to land that is privately owned, or subject to health and safety restrictions (for example, some forestry land) will need to be considered and negotiated. How riparian strips are managed will also have an impact for fisher people, as some species prefer overhanging vegetation, while others require grassy mats and banks.	↑2

Environmental Indicators

Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)	Some improvement in MCI and decrease in 'clogginess' caused by macrophytes. The Waipa FMU could benefit more as it is moving from D band to C for clarity. Middle FMU moving to C for clarity. This indicator is influenced by changes at harvest time for forestry. Eels increase in this scenario. Less suited for short fin eel, they are less suited to forested catchments and have more food in sheltered pastoral streams. Increased forestry may mean increased wood in streams for habitat.	↑2
Riparian/Pareparenga o te wai (effective for land-use)	More length of fenced riparian margins doesn't mean guarantee that biodiversity or water quality outcomes are better. Effective riparian management is an important consideration for all land based sectors and is required to achieve the attribute targets for this scenario. This scenario requires significant fencing but may need to include different management options, suitable to the land and farm types. This means omitting sheep from stock exclusion requirements may happen as part of the policy options. Riparian buffers provide benefits for biodiversity, aesthetics and ecological corridors as well as increasing customary resources. The fencing of waterways with large buffers may increase the public perception of accessible space adjacent to waterways. The model includes fencing and grass buffers but not planting. The riparian margin plays an important role in the acceptability of a place to swim. This indicator assumes that bank stability, safe water access and native vegetation including customary resources will enhance this indicator.	↑3
Wetland (unique habitat protected)	This scenario would require significant collaboration between farmers, and include restoration of previously drained areas. A substantial area would serviced by constructed wetlands. Forestry can dry out small wetlands but the increase in wetland area would be effective for nitrogen and load to come. This mitigation would have greater effect if focussed on Waipa, Lower Waikato and lakes FMUs for sediment.	↑1

Economic Indicators

Value Add (proxy for Regional GDP with sector breakdown)

For the areas affected land values may decrease due to reduced opportunities. With such decreases in the agricultural sectors, the declines in smaller rural towns will accelerate as people move away to seek other opportunities. If other external forces are apparent, for example a global financial crises, then towns will be less resilient. **Table 1**: Value Added for the Waikato Region decreases by $310m (1.7%).

Industry	Impacts ($m) (relative to baseline)	% change (relative to baseline)
Horticulture[9]		
Sheep, beef, and grain	-60	-14.7
Dairy farming	-174	-10.9
Forestry	9	4.8
Other primary	3	0.5
Agriculture and forestry support	-1	-0.4
Meat and meat product manufacturing	-5	-1.1
Dairy product manufacturing	-38	-5.4
Wood and paper manufacturing	10	2.0
Other manufacturing	-1	-0.1
Utilities	5	0.4
Construction	1	0.1
Wholesale and retail trade	-8	-0.5
Transport	-2	-0.3
Professional/administrative services	10	1.0
Local and central government	-3	-1.4
Other services	-56	-0.9
Total relative to baseline	**-310**	**-1.7**

With such decreases in the agricultural sectors, smaller rural towns will start to decline as people move away to seek other opportunities. If other external forces are apparent, for example a global financial crises, then towns will be less resilient. Biggest impacts (compared to maintaining current water quality in Scenario 4) start to be felt in the Waipa FMU and in the Lower Waikato.

The affordability of capital investment into mitigation options will be compromised for highly leveraged businesses if the pay-out remains low for sustained time. Land values may decrease due to reduced opportunities.

↓3

[9] No change provided for horticulture number, just baseline provided from same time as round 2 of modelling

<table>
<tr><td>International Exports (proxy for Waikato regional contribution to national exports)</td><td>Total loss of $177m of international exports, $168m of which is from dairy product manufacturing, and $16m from meat and meat product manufacturing.</td><td>↓1</td></tr>
<tr><td>Employment (Modified Employee Count) (proxy for Total value of employment)</td><td>Total employment count decrease of 0.9%, a large number of which is from dairy farming, and significant amount from ‘other services’. Biggest impacts being felt in the lower and mid Waikato FMUs compared to scenario 4, Waipa had the most impact in the ‘other services’ sector. There will be rural population decrease and job losses. Population changes (in both number and age structure) in smaller towns will have a significant impact on rates and ability to pay, and impact on community services.
<table>
<tr><th>Industry</th><th>% change in employment (Modified Employee Counts) (relative to baseline)</th></tr>
<tr><td>Horticulture[10]</td><td></td></tr>
<tr><td>Sheep, beef, and grain</td><td>-0.2</td></tr>
<tr><td>Dairy farming</td><td>-5.9</td></tr>
<tr><td>Forestry</td><td>4.7</td></tr>
<tr><td>Other primary</td><td>-0.0</td></tr>
<tr><td>Agriculture and forestry support</td><td>-0.5</td></tr>
<tr><td>Meat and meat product manufacturing</td><td>-0.9</td></tr>
<tr><td>Dairy product manufacturing</td><td>-4.5</td></tr>
<tr><td>Wood and paper manufacturing</td><td>2.3</td></tr>
<tr><td>Other manufacturing</td><td>-0.1</td></tr>
<tr><td>Utilities</td><td>0.6</td></tr>
<tr><td>Construction</td><td>0.2</td></tr>
<tr><td>Wholesale and retail trade</td><td>-0.7</td></tr>
<tr><td>Transport</td><td>-0.3</td></tr>
<tr><td>Professional/administrative services</td><td>0.7</td></tr>
<tr><td>Local and central government</td><td>-1.4</td></tr>
<tr><td>Other services</td><td>-0.8</td></tr>
<tr><td>Total relative to baseline</td><td>-0.9</td></tr>
</table></td><td>↓2</td></tr>
</table>

[10] No change provided for horticulture number, just baseline provided from same time as round 2 of modelling

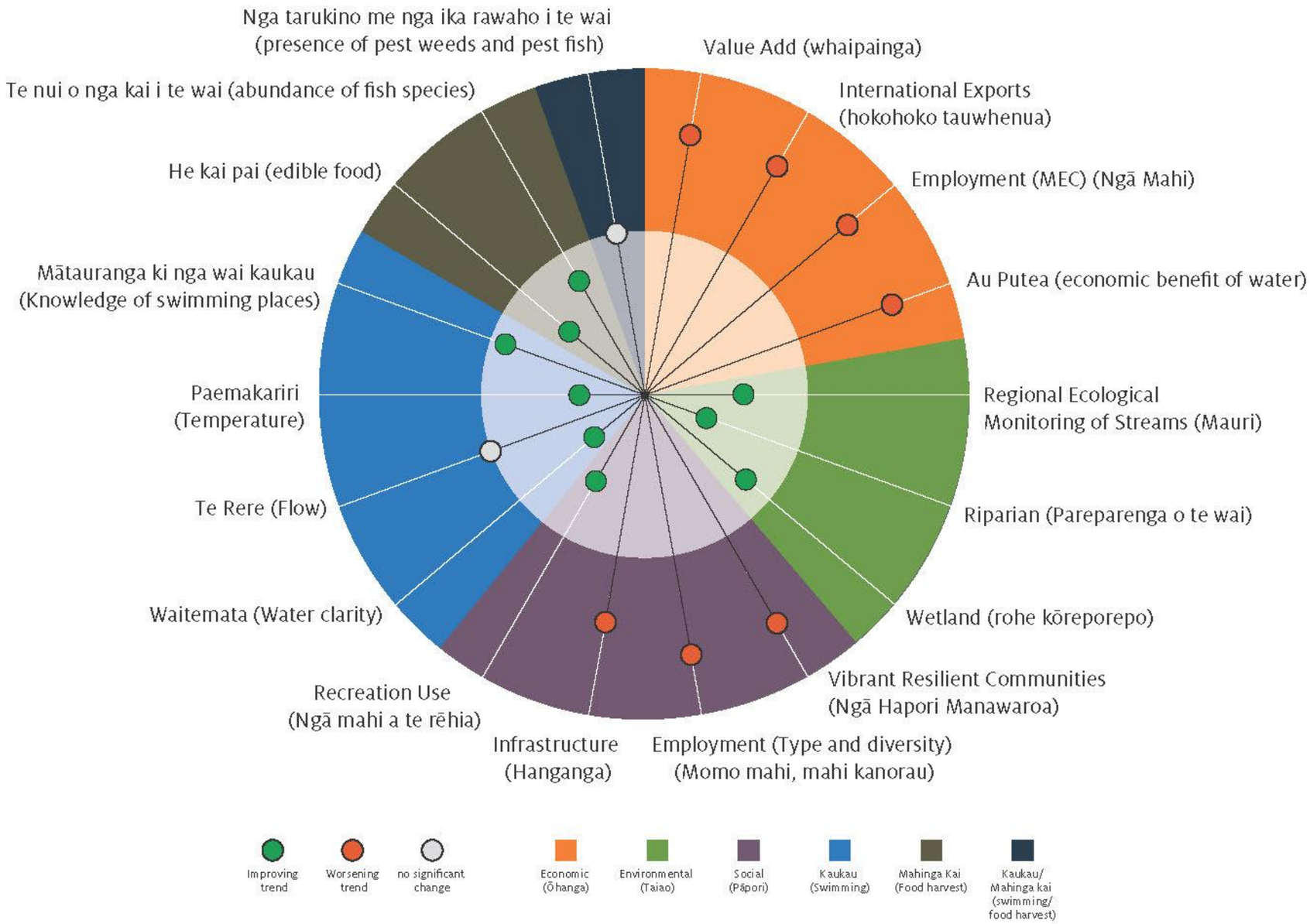
Mātauranga Māori Indicators

Waitematā (water clarity) – currently an attribute	Clarity in this scenario will improve however modelling indicates potentially 7 breaches of the scenario limits. These are predominantly in the lower parts of the Waipa and Lower Waikato. This scenario meets iwi swimming expectations of 155cm clarity (B Band) but below the A band (representing Vision and Strategy). The number of breaches generally increases where mitigation options are limited.	↑3
Te Rere (flow) – measures in cumecs at monitoring stations / effects from expert panel	Flow is expected to remain static and not be affected by the reductions of the contaminants themselves. It is expected afforestation will decrease the variability of flow, particularly during small to medium sized storm events. This scenario modelling suggests conversion to forestry of approximately 17,000ha. The introduction of wetlands as a mitigation to attenuate flows from approximately 360,000ha of land would result in less variability and an increase in base flow. There will be an impact on swimming in low and very high flows.	–
Paemakariri (temperature)	The temperature of water is affected by exposure to sunlight. Shading of water bodies, particularly tributary streams will see a small decrease in temperature. This scenario includes afforestation (forestry and riparian management) that will result in lower water temperatures at those places. Temperature is also a stressor of native fauna, therefore lower temperatures are an improvement in ecosystem health. Generally, the expectation is that water will be colder in tributaries and afforestation and riparian planting will reduce temperature.	↑3
He kai pai (edible food) – E.coli measured but food standards not reported	E.coli levels reduce by 25% to 75% across all FMUs. However, there are 37 breaches of the swimmable limits at 95th percentile for E. coli (whereas for wadeable median E. coli no breaches at all). While the swimmable limits for E.coli in this scenario experience 37 breaches in the model there will still be an improvement or decrease in E.coli levels through de-intensification, afforestation, and mitigations. E.coli monitoring and modelling involves significant uncertainty. Kai collected in the present day from the catchments is cooked, reducing risk of human health risk from E.coli and other pathogens. Therefore the improvements in E.coli will likely improve perceptions of risk to human health. This indicator does not include or consider effects of heavy metals such as arsenic, mercury, zinc and copper that may come from both natural (geothermal) and industrial/urban waste sources. Heavy metals, particularly concentrated in sediment (Ohakuri) and reduced nutrients may reduce the release of heavy metals in anoxic stratified water.	↑2

Te nui o ngā kai i te wai (abundance of fish species – kōura) – monitored as part of Regional Ecological Monitoring Survey (in tributaries)	In this scenario fish species have the potential to increase in number. There are a number of factors that affect the abundance of fish, including predation, food, barriers to migration, and water quality attributes (dissolved oxygen, pH, turbidity, ammonia, temperature). Reductions in the 4 contaminants and their attributes may have varying impacts on particular species. Tuna are a very resilient species and can live in degraded environments but like piharau and inanga are sensitive to barriers to migration. Kōura are particularly sensitive to sediment, and inanga are quite sensitive to a range of factors. For this indicator koura has been focussed on as an indicator species. They have a wide distribution in water body types (lakes, river, and streams) and are sensitive to sediment, and thrive in natural riparian margins. It is expected that numbers and distribution of koura may increase as a result of this scenario. The Middle and Lower FMUs and small area in Waipa breaches of water clarity limit for scenario. This may have some effects on improved ecological health. Kōura, short finned tuna, inanga and piharau (picked up in the REMS indicator). Increase in natural riparian margin will increase kōura – some improvement however, increased koura means an increase in food source for humans, trout, tuna, catfish.	↑1
Ngā tarukino me ngā ika rawaho i te wai (presence of pest weeds and fish)	This negative indicator assumes that the presence of pest plants and fish are an indicator of poor water health, from a cultural perspective. This scenario will have minimal impacts on the presence of pest weeds and fish (i.e. won't reduce their numbers). Pest fish such as carp, catfish, gambusia and rudd are very resilient to a range of water quality characteristics. This scenario is not expected to see reductions in their number. There are pros and cons in terms of this scenario but not significant effect on pests.	—
Mātauranga ki ngā wai kaukau (Knowledge of swimming places) – information currently held by River Iwi	The assessment of changes in knowledge requires detail of personal, whanau, hapū, Iwi and collective knowledge, therefore assessment within the timeframe and scope of this project is unlikely to be achieved. The knowledge of swimming places can potentially be improved and increased as a result of improved water quality, particularly as these places are more accessible for swimming. In particular, by improving clarity (safety) and reducing E.coli (perceptions of safety) this will improve the opportunity to go to swimming places and therefore sharing of knowledge can occur. The higher frequency of swimming will facilitate the improvements in knowledge and the passing of knowledge. It is also expected that the awareness generated from the focus on swimmability will facilitate discussion and research.	↑0.5

Au Putea (economic benefit of water) – can measure effects in employment and profit from sectors and industries and on farm cost in economic model	For this scenario there would be land-use change (afforestation) and decreases in land-use intensity The economic effects of changes in land-use, particularly on Maori landholdings that significantly rely on agriculture, forestry, horticulture and future geothermal energy production are significant. While there is expected to be some increases in forestry (which has low labour force requirements) and value added industries such as pulp and paper, there will be significant reductions in other primary sectors; horticulture and fruit growing, sheep and beef, dairy. This scenario has some 40% less reduction in value and 50% reduction in employment (dairy and sheep/beef) with smaller impact on horticulture and fruit growing. There will be some reductions in energy production but it is unclear the scale of effect on geothermal energy production. There does not appear to be significant increases in tourism, however there may be niche market potential.	↓3

Trends Wheel Scenario 2



Scenario 3: Some general improvement in water quality for swimming, taking food and healthy biodiversity

Social Indicators

Indicator	Narrative	Trend (scale 1 – 5)
Vibrant Resilient Communities	Significant job loss still occurs, with greater numbers for the upper Waikato FMU. Less of a step change in this scenario, with lower impact but still significant. Affordability of infrastructure is a concern.	↓3
Employment (with an emphasis on type, variety and diversity of jobs)	The impact on employment will be approximately 2000 jobs lost across the region. The impact on dairy farming is around 65 per cent of the total job losses, along with the related dairy support and manufacturing sectors. There is a large impact on horticultural jobs with the shift in land use for horticultural land. There is some question around the feasibility and likelihood of this shift happening, given the lower Waikato's crucial role in supplying food nationally. Some of these jobs losses are mitigated by new jobs created within the region, particularly in forestry, and construction (larger gains in construction but these gains are minimal). Professional and administrative services are already strong employers for the region, and it is likely some employment increase will come from people retraining and shifting into these fields. People's and communities' resilience in the face of challenge also needs to reflected, and it is likely new and innovative ways of making a living will emerge, enabling people to remain employed within their local communities. The extent to which this may happen is hard to predict, but it seems likely that some secondary employment opportunities, related to the growth in forestry, are likely: for example, craft or trade-based uses of wood. It is also anticipated that there will be an increase in tourism, and as a result tourism jobs. This may particularly be the case in more remote rural areas where residents will be forced to consider what else they can do. However, it is unlikely the job increases flowing from international tourism will be significant: New Zealand already has a clean green image, and improvements in the rivers' water quality are unlikely to have a significant impact on this. Domestic tourism promises greater gains, both in terms of jobs and the economy. The spread of job losses and shifts is not constant across the region. The upper Waikato will experience more significant dairy-related job losses than the other FMUs, while (as is to be expected) the lower Waikato FMU carries the brunt of the horticulture (other primary) related job losses. Waipa is the least affected FMU. Similarly, gains in certain employment areas (construction; professional and administrative) are greater in some FMUs than others, although again it is unclear form the model what is driving these. Overall, in the context of total regional employment, the job losses for scenarios 2 and 3 are relatively minimal. In addition, in terms of numbers, the industries where the most jobs will be lost are not major employers. However, it is likely that smaller rural communities, where to date there has been less scope for diversity, will be hardest hit. This is likely to exacerbate existing trends where younger people are moving away from rural areas to find work.	↓3

Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - covers energy, waste and water)	The impact expected for this scenario is some reduction in the reliability and affordability of the various water infrastructure for consumers and communities. It is important for this scenario to distinguish which of the infrastructure types is being discussed, as the costs, impacts and affordability of each varies hugely. The main infrastructures that need to be considered are: • electricity generation – there will be little impact under any of the scenarios at this stage. Whether this situation continues depends upon whether flow becomes a factor • flood protection – wherever there's a major land use shift to forestry, you would expect to see some improvements in the performance of flooding infrastructure. Wherever flood protection schemes are considered an issue, there will be a major capital cost in changing them • industrial point discharges and municipal wastewater treatment plants – measures to address these will create rates increases and funding issues, especially around who should pay. If ratepayers end up footing the bill, this will create flow-on issues for how other important aspects of water quality management (such as riparian planting) will be funded. The effect will be detrimental for communities either way, although spreading the costs over time will lessen the impact. Impacts will be very localised, based on the locations of towns and industries • stormwater (diffuse discharge) – this is not featuring sufficiently at present, and it is not clear if it has been accounted for in the model. This is predominantly an urban issue, but it is unclear what impact, if any, measures to treat or divert urban sediments and contaminants will have on overall water quality • community water supply – it is assumed that the more the river water quality improves the less treatment is required. This is more an issue for smaller communities, as the treatment plants for urban areas are very sophisticated. Discussions about the impact of the scenarios on this infrastructure is too difficult (in terms of allocating an overall grade), when considered collectively, as each area needs to be dealt with separately. Specific points relevant to this scenario are: • electricity generation – no change • flood protection – slight improvement (↑1) • industrial point discharges and municipal wastewater treatment plants – slight decline (↓1) • stormwater (diffuse discharge) – unknown • community water supply – slight improvement (↑1).	↓1

Recreation use (including access and safety)	There is an assumption in this scenario that improved water quality will increase the rivers' tourism appeal, but this will have to be verified. It is possible that, because New Zealand already has a well-established clean green image, the main impact of improved water quality will be to ensure this is not tarnished or lost. The improvements in Scenario 2 will enable the country, over time, to live up to its reputation. Where there is more likely to be recreational gains is with respect to domestic visitors, who are likely to be more drawn to the rivers if they are known to be clean. This anticipated trend needs to be limited to actual on-water users: swimmers, paddlers, boaters, water skiers. The actual quality of the water will be more important to them than to those recreational users who are walking or cycling alongside the rivers (these people are currently the main recreational users of the river). Those fishing will also be increasingly drawn to the rivers if they are cleaner, and as a result support more, and more edible, fish and other aquatic life. For all these recreational users, but especially those who fish, the nature and quality of access will be paramount, and factors influencing the riparian indicator need to be considered alongside this indicator. It doesn't matter how clean the water is if people can't access it. Any desire to increase recreational use will need to be supported by policy, management practices and targeted initiatives. The nature of the access required will vary. People using boats and other water craft will require specific infrastructure for launching (such as ramps and jetties), but those fishing will require easy access to favoured riverbank spots. Issues around access to land that are privately owned, or subject to health and safety restrictions (for example, some forestry land) will need to be considered and negotiated. How riparian strips are managed will also have an impact for fisher people, as some species prefer overhanging vegetation, while others require grassy mats and banks. Management conflicts between recreational user will have to be managed, if usage levels rise, especially around access points. Note that the data* shows that increased recreational usage will not be spread evenly across the FMUs. The lower Waikato is expected to see the greatest increases, while the middle Waikato will experience a slight decline in recreation trips. Greater increase are anticipated in the middle and lower Waikato river, than the other two FMUs, with the Waipa region expected to experience a slight dip. There will be a greater increase in the number of trips made for recreational purposes to the rivers under this scenario.	↑2

Environmental Indicators

Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)	Improvement in MCI and decrease in 'clogginess' caused by macrophytes. Improvement, middle FMU clarity to B. This indicator is influenced by changes at harvest time for forestry. Eels increase in this scenario. Less suited for short fin eel, they are less suited to forested catchments and have more food in sheltered pastoral streams. Increased forestry may mean increased wood in streams for habitat.	↑3
Riparian/Pareparenga o te wai (effective for land-use)	More length of fenced riparian margins doesn't guarantee that biodiversity or water quality outcomes are better. Effective riparian management is an important consideration for all land based sectors and is required to achieve the attribute targets for this scenario. This scenario requires significant fencing but may need to include different management options, suitable to the land and farm types. This means omitting sheep from stock exclusion requirements may happen as part of the policy options. Riparian buffers provide benefits for biodiversity, aesthetics and ecological corridors as well as increasing customary resources. The fencing of waterways with large buffers may increase the public perception of accessible space adjacent to waterways. The model includes fencing and grass buffers but not planting. The riparian margin plays an important role in the acceptability of a place to swim. This indicator assumes that bank stability, safe water access and native vegetation including customary resources will enhance this indicator.	↑3
Wetland (unique habitat protected)	This scenario would require significant collaboration between farmers, and include restoration of previously drained areas. Substantial area serviced by constructed wetlands. This mitigation would have greatest effect if focussed on Waipa, Lower Waikato and lakes FMUs for sediment.	↑1

Economic Indicators

Value Add (proxy for Regional GDP with sector breakdown)

For the areas affected land values may decrease due to reduced opportunities. With such decreases in the agricultural sectors, the declines in smaller rural towns will accelerate as people move away to seek other opportunities. If other external forces are apparent, for example a global financial crisis, then towns will be less resilient. Value Added for the Waikato Region decreases by $311m (1.7%)

Industry	Impacts ($m) (relative to baseline)	% change (relative to baseline)
Horticulture[11]		
Sheep, beef, and grain	-62	-15.2
Dairy farming	-164	-10.2
Forestry	9	4.8
Other primary	-5	-0.8
Agriculture and forestry support	-2	-0.9
Meat and meat product manufacturing	-5	-1.1
Dairy product manufacturing	-36	-5.1
Wood and paper manufacturing	11	2.2
Other manufacturing	0	0.0
Utilities	-1	-0.1
Construction	8	0.7
Wholesale and retail trade	-7	-0.5
Transport	-2	-0.3
Professional/administrative services	3	0.3
Local and central government	-3	-1.4
Other services	-55	-0.9
Total relative to baseline	**-311**	**-1.7**

With such decreases in the agricultural sectors, smaller rural towns will start to decline as people move away to seek other opportunities. If other external forces are apparent, for example a global financial crisis, then towns will be less resilient. Biggest impacts (compared to maintaining current water quality in Scenario 4) start to be felt in the Waipa FMU and in the Lower Waikato. The affordability of capital investment into mitigation options will be compromised for highly leveraged businesses if the pay-out remains low for a sustained time. Land values may decrease due to reduced opportunities.

↓3

International Exports (proxy for Waikato regional contribution to national exports)

Total net loss of $167m of international exports, $161m from dairy product manufacturing, and $14m from meat and meat product manufacturing.

↓2

[11] No change provided for horticulture number, just baseline provided from same time as round 2 of modelling

Employment (Modified Employee Count) (proxy for Total value of employment)

Total employment count decrease of 0.9%, a large number of which is from dairy farming, and significant amount from ‘other services’. Effects felt throughout all the FMUs. There will be rural population decrease and job losses. Population changes (in both number and age structure) in smaller towns will have a significant impact on rates and ability to pay, and impact on community services.

Industry	**% change in employment (Modified Employee Counts) (relative to baseline)**
Horticulture[12]	
Sheep, beef, and grain	-0.4
Dairy farming	-5.7
Forestry	4.9
Other primary	-1.5
Agriculture and forestry support	-0.6
Meat and meat product manufacturing	-0.9
Dairy product manufacturing	-4.3
Wood and paper manufacturing	2.4
Other manufacturing	0.0
Utilities	-0.1
Construction	0.8
Wholesale and retail trade	-0.6
Transport	-0.3
Professional/administrative services	0.2
Local and central government	-1.4
Other services	-0.8
Total relative to baseline	**-0.9**

↓2

[12] No change provided for horticulture number, just baseline provided from same time as round 2 of modelling

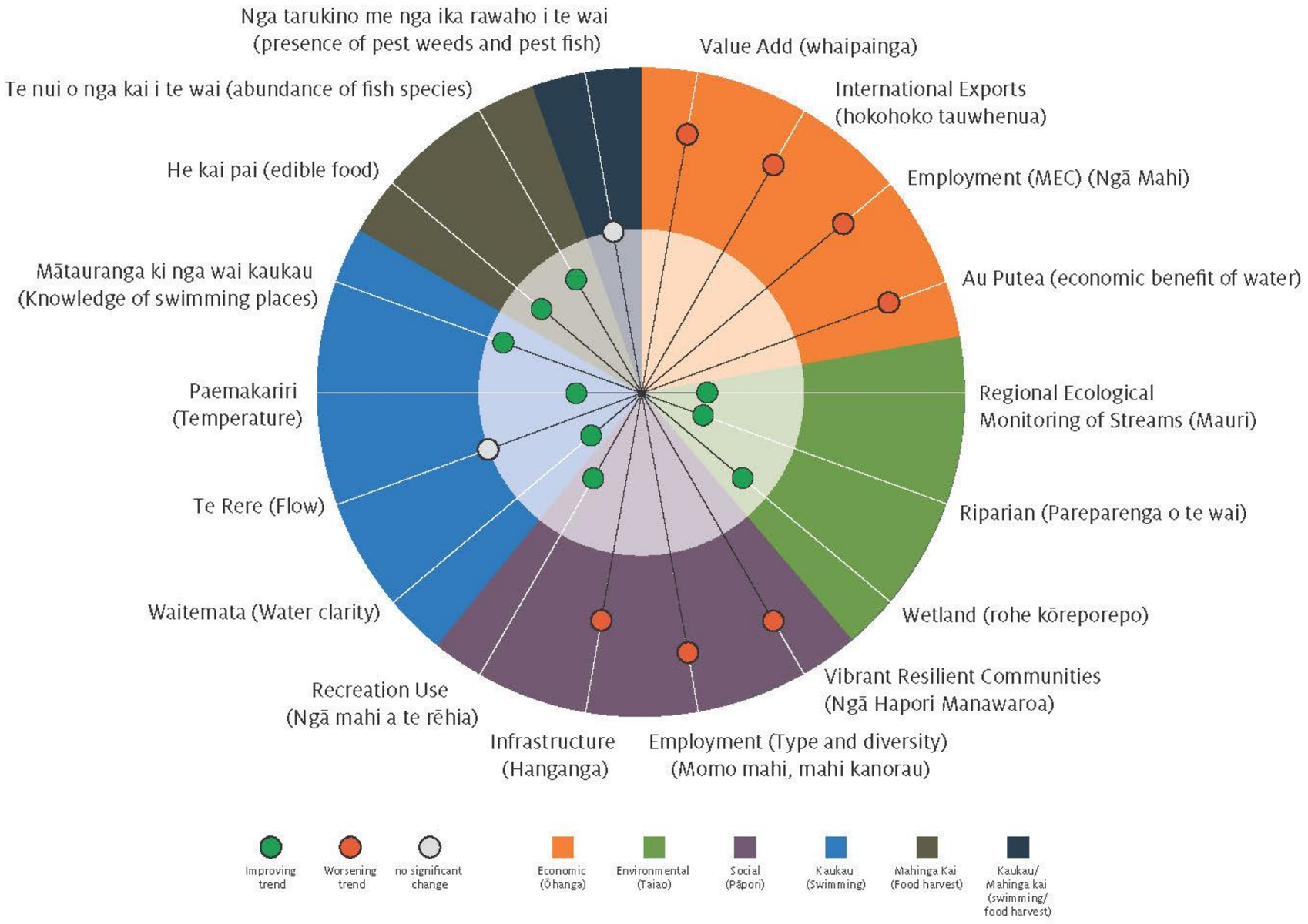
Mātauranga Māori Indicators

Waitematā (water clarity) – currently an attribute	Clarity in this scenario will improve, with all sites having a target of at least C band with B band in the upper and Middle Waikato Main stem, however modelling indicated potentially 7 breaches of the scenario limits. These are predominantly in the Waipa River catchment and lower Waikato. The number of breaches generally increases where mitigation options are limited.	↑3
Te Rere (flow) – measures in cumecs at monitoring stations	Flow is expected to remain static and not be affected by the reductions of the contaminants themselves. It is expected afforestation will decrease the variability of flow, particularly during small to medium sized storm events. This scenario modelling suggests conversion to forestry of approximately 17,000ha. The introduction of wetlands of approximately 360,000ha as a mitigation would result in less variability and an iincrease in base flow. There will be an impact on swimming in low and very high flows.	—
Paemakariri (temperature) – measured across the monitoring network	The temperature of water is affected by exposure to sunlight. Shading of water bodies, particularly tributary streams will see a small decrease in temperature. This scenario includes afforestation (forestry and riparian management) that will result in a reduction in water temperature at those places. The riparian mitigations do not currently include shading revegetation (only buffers and fencing). Temperature is also a stressor of native fauna, therefore lower temperatures are an improvement in ecosystem health. Generally, the expectation is that water will be colder in tributaries and that afforestation will reduce temperature.	↑3
He kai pai (edible food) – E.coli measured but food standards not reported	In this scenario E.coli levels reduce. However, there are 29 breaches of the limits set at 95th percentile for E. coli whereas for median E. coli no breaches at all (Upper Waikato remains A, Tributaries min B, Middle Waikato Main stem B, lower stem C, Lower Waikato C. While the limits for E.coli in this scenario experience 29 breaches in the model there is likely to be an improvement or decrease in E.coli through de-intensification, afforestation, and mitigations. E.coli monitoring and modelling involves significant uncertainty regarding resident times in hydro-lakes, urban point sources, and off the grid point discharge sources. Kai collected in the present day from the catchments is cooked, reducing risk of human health risk from E.coli and other pathogens. Therefore the improvements in E.coli will likely improve perceptions of risk to human health.	↑1

Te nui o ngā kai i te wai (abundance of fish species – kōura) – monitored as part of Regional Ecological Monitoring Survey (in tributaries)	In this scenario fish species have the potential to increase in number. There are a number of factors that affect the abundance of fish, including predation, food, barriers to migration, and water quality attributes (dissolved oxygen, pH, turbidity, ammonia, temperature). Reductions in the 4 contaminants may have varying impacts on particular species. Tuna are a very resilient species and can live in degraded environments but like piharau and inanga are sensitive to barriers to migration. Kōura are particularly sensitive to sediment, and inanga are quite sensitive to a range of factors. For this indicator koura has been focussed on as an indicator species. They have a wide distribution in water body types (lakes, river, and streams) and are sensitive to sediment, and thrive in natural riparian margins. It is expected that numbers and distribution of koura may increase as a result of Scenario 1. Kōura, short finned tuna, inanga and piharau (picked up in the REMS indicator). Increase in natural riparian margin will increase kōura – some improvement however, increased koura means an increase in food source for trout, tuna, catfish	↑1
Ngā tarukino me ngā ika rawaho i te wai (presence of pest weeds and fish)	This negative indicator assumes that the presence of pest plants and fish are an indicator of poor water health, from a cultural perspective. This scenario will have minimal impacts on the presence of pest weeds and fish i.e. won't reduce their numbers. Pest fish such as carp catfish, gambusia and rudd are very resilient to a range of water quality characteristics. This scenario is not expected to see reductions in their number. There are pros and cons in terms of scenarios but not significant effect on pests.	–
Mātauranga ki ngā wai kaukau (Knowledge of swimming places) – information currently held by River Iwi	The assessment of changes in knowledge requires detail of personal, whānau, hapū, Iwi and collective knowledge, therefore assessment within the timeframe and scope of this project is unlikely to be achieved. The knowledge of swimming places can potentially be improved and increased as a result of improved water quality, particularly as these places are more accessible for swimming. In particular, by improving clarity (safety) and reducing E.coli (perceptions of safety) this will improve the opportunity to go to swimming places and therefore sharing of knowledge can occur. The higher frequency of swimming will facilitate the improvements in knowledge and the passing of knowledge. It is also expected that the awareness generated from the focus on swimmability will facilitate discussion and research.	↑0.5

Au Putea (economic benefit of water) – can measure effects in employment and profit from sectors and industries and on farm cost in economic model	Under this scenario there would be land-use change (afforestation) and decreases in land-use intensity The economic effects of changes in land-use, particularly on Māori landholdings that significantly rely on agriculture, forestry, horticulture and future geothermal energy production are significant. While there is expected to be some increases in forestry (which has low labour force requirements) and value added industries such as pulp and paper, there will be significant reductions in other primary sectors; horticulture and fruit growing, sheep and beef, dairy. This scenario has about 25% less reduction in value and 33% reduction in employment (dairy and sheep/beef) but less than 50% of the Scenario 1 impact on horticulture and fruit growing. There will be some reductions in energy production but it is unclear the scale of effect on geothermal energy production. There does not appear to be significant increases in tourism, however there may be niche market potential.	↓3

Trends Wheel Scenario 3



Scenario 4: No further degradation

Social Indicators

Indicator	Narrative	Trend (scale 1 – 5)
Vibrant Resilient Communities	Significant job loss continues negative impact. More keenly felt in upper Waikato FMU (assessed by itself would have a ↓3).	↓2
Employment (with an emphasis on type, variety and diversity of jobs)	The employment situation is much as it currently is, with the mitigation measures suggested revolving around reducing the nitrogen load entering the rivers. This has a predictable impact on dairy, with the dairy and related industries, and the horticulture sector being the only areas where jobs are likely to be affected under this scenario. Under this scenario, there is more scope for exploring other options (including funding more expensive mitigation measures) to prevent dairy and horticulture job losses. Because the required shift is not so large, there is more room for innovation to have a meaningful role. The greatest impact will be felt by communities in the upper Waikato, as this is the area with the highest leaching rates, and accordingly the area most targeted for land use change. There will be some lesser impact on lower Waikato communities, with minimal effects in the central areas.	↓1
Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)	Overall, the impact of this scenario on the reliability and affordability of water and river-related infrastructure would be minimal. The biggest impact will be for industrial point source and municipal waste water treatment discharges.	–
Recreation use (including access and safety)	Not much change is anticipated in this scenario, as the water quality stays essentially the same.	↑1

Environmental Indicators

Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)	No change, as this scenario does not require change in clarity	—
Riparian/Pareparenga o te wai (effective for land-use)	Minor fencing required so no change expected. Afforestation in upper FMU so that area only affect. Little change to current condition of riparian margins.	—
Wetland (unique habitat protected)	Smaller area serviced by constructed wetlands, so less benefit. Would have greater effect if focussed on Waipa, Lower Waikato and lakes FMUs for sediment.	↑0.5

Economic Indicators

Value Add (proxy for Regional GDP with sector breakdown)

Value Added for the Waikato Region decreases by $97m (0.5%). Most of this decrease is from the Dairy farming and dairy product manufacturing sectors.

While there are some effects felt in the mid-Waikato FMU with a reduction in the value of dairy product manufacturing, most of the effects are felt in the Upper Waikato. To maintain the current levels of water quality, which this scenario requires, the upper Waikato has to do the most to account for lags in nitrogen. This is likely to affect smaller towns in particular in the Upper Waikato.

Industry **Impacts ($m) (relative to baseline)** **% change (relative to baseline)**		
Horticulture[13]	-	-
Sheep, beef, and grain	2	0.5
Dairy farming	-63	-3.9
Forestry	6	3.2
Other primary	-2	-0.3
Agriculture and forestry support	-3	-1.3
Meat and meat product manufacturing	-2	-15.5
Dairy product manufacturing	-26	-3.7
Wood and paper manufacturing	7	1.4
Other manufacturing	-1	-0.1
Utilities	-2	-0.2
Construction	1	0.1
Wholesale and retail trade	-2	-0.1
Transport	-1	-0.2
Professional/administrative services	-1	-0.1
Local and central government	0	0.0
Other services	-10	-0.2
Total relative to baseline	**-97**	**-0.5**

↓1

[13] No change provided for horticulture number, just baseline provided from same time as round 2 of modelling

International Exports (proxy for Waikato regional contribution to national exports)	Total loss of $116m of international exports, including a loss of $117m in the dairy product manufacturing, and small losses and gains in other primary and related industries. Therefore this is most strongly felt in the mid-Waikato FMU.	↓1
Employment (Modified Employee Count) (proxy for Total value of employment)	Total employment count decrease of 0.5%, a large number of which is from dairy farming. Biggest impacts being felt in the upper Waikato FMU, Region-wide this could be a similar impact to a sustained (3 years or more) low dairy pay-out., Most of the job losses will be to unskilled workers, who are less employable elsewhere.	↓1

Industry	% change in employment (Modified Employee Counts) (relative to baseline)
Horticulture	
Sheep, beef, and grain	1.1
Dairy farming	-4.3
Forestry	3.3
Other Primary	-1.0
Agriculture and forestry support	-1.3
Meat and meat product manufacturing	-0.3
Dairy product manufacturing	-3.1
Wood and paper manufacturing	1.6
Other manufacturing	-0.1
Utilities	-0.2
Construction	0.1
Wholesale and retail trade	-0.1
Transport	-0.2
Professional/administrative services	-0.2
Local and central government	-0.2
Other services	-0.1
Total relative to baseline	**-0.5**

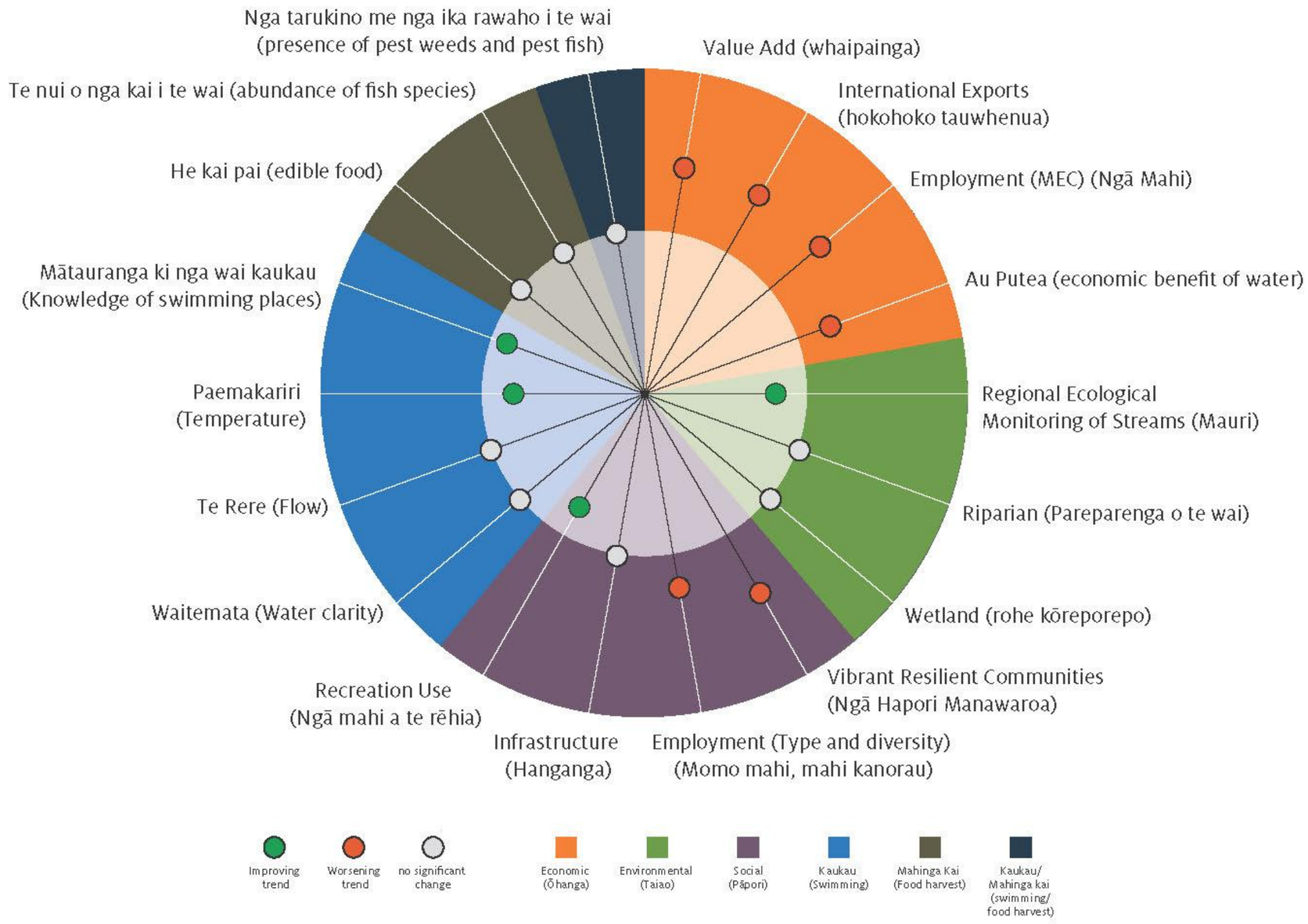
Mātauranga Māori Indicators

Waitematā (water clarity) – currently an attribute	Clarity in this scenario will not improve and there are no breaches of the scenario limits. This scenario doesn't meet the expectations for swimming for iwi where clarity is below C band.	—
Te Rere (flow) – measures in cumecs at monitoring stations / effects from expert panel	Flow in this scenario is expected to remain static and not be affected by the reductions of the contaminants themselves. It is expected afforestation will decrease the variability of flow, particularly during small to medium sized storm events. This scenario suggests 12,000ha of conversion to forestry in the catchment. The introduction of wetlands will not be significant.	—
Paemakariri (temperature) – measured across the monitoring network / effects from expert panel Survey (in tributaries)	Shading of water bodies, particularly tributary streams will see a small decrease in temperature. This scenario includes afforestation (forestry and riparian management) that will result in a reduction in water temperature at those places. The riparian mitigations do not currently include shading revegetation (only buffers and fencing). Temperature is also a stressor of native fauna, therefore lower temperatures are an improvement in ecosystem health. Generally, the expectation is that water will be colder in tributaries and that afforestation will reduce temperature.	↑1
He kai pai (edible food) – E.coli measured but food	There are no breaches of the limits set at median or 95th percentile for E. coli however there are no improvements.	—

Te nui o ngā kai i te wai (abundance of fish species – kōura) – monitored as part of Regional Ecological Monitoring Survey (in tributaries)	In this scenario fish species have the potential to increase modestly in number as a result of riparian management and some afforestation. There are a number of factors that affect the abundance of fish, including predation, food, barriers to migration, and water quality attributes (dissolved oxygen, pH, turbidity, ammonia, temperature). Reductions in the 4 contaminants may have varying impacts on particular species. Tuna are a very resilient species and can live in degraded environments but like piharau and inanga are sensitive to barriers to migration. Koura are particularly sensitive to sediment, and inanga are quite sensitive to a range of factors. For this indicator kōura has been focussed on as an indicator species. They have a wide distribution in water body types (lakes, river, and streams) and are sensitive to sediment, and thrive in natural riparian margins. It is expected that numbers and distribution of koura will not increase measurably as a result of this scenario. Kōura, short finned tuna, inanga and piharau (picked up in the REMS indicator). Increase in natural riparian margin will increase kōura – some improvement however, increased koura means an increase in food source for humans, tuna, catfish.	—
Ngā tarukino me ngā ika rawaho i te wai (presence of pest weeds and fish)	This scenario will have minimal impacts on the presence of pest weeds and fish. Pest fish such as carp, catfish, gambusia and rudd are very resilient to a range of water quality characteristics. This scenario is not expected to see reductions in their number.	—
Mātauranga ki ngā wai kaukau (Knowledge of swimming places) – information currently held by River Iwi	The assessment of changes in knowledge requires detail of personal, whānau, hapū, Iwi and collective knowledge, therefore assessment within the timeframe and scope of this project is unlikely to be achieved. The knowledge of swimming places can potentially be improved and increased as a result of improved water quality, particularly as these places are more accessible for swimming. In particular, by improving clarity (safety) and reducing E.coli (perceptions of safety) this will improve the opportunity to go to swimming places and therefore sharing of knowledge can occur. The higher frequency of swimming will facilitate the improvements in knowledge and the passing of knowledge. It is also expected that the awareness generated from the focus on swimmability will facilitate discussion and research.	↑0.5

Au Putea (economic benefit of water) – can measure effects in employment and profit from sectors and industries and on farm cost in economic model	Under this scenario there would be land-use change (afforestation) and decreases in land-use intensity The economic effects of changes in land-use, particularly on Māori landholdings that significantly rely on agriculture, forestry, horticulture and future geothermal energy production are significant. Whilst there is expected to be some increases in forestry (which has low labour force requirements) and value added industries such as pulp and paper, there will be significant reductions in other primary sectors; horticulture and fruit growing, sheep and beef, dairy. This scenario has a modest effect on value, however, still significant effect on employment in horticulture and fruit growing and dairy. There will be gains in employment in the sheep/beef sector. There does not appear to be significant increases in tourism, however there may be niche market potential.	↓1

Trends Wheel Scenario 4



Scenario Trend Summary: Indicators of the impact of activities to achieve the scenario attribute states

Key (scale 1 – 5) ↑ Improving ↓ Worsening — No change	Social				Environmental			Swimming/ Mahinga Kai
	Vibrant Resilient Communities	**Employment (with an emphasis on type, variety and diversity of jobs)**	**Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)**	**Recreation use (including access and safety)**	**Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)**	**Riparian (Pareparenga o te wai)**	**Wetland (unique habitat protected)**	**Nga tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)**
Direction of change in relation to Baseline	1. ↓4 2. ↓3 3. ↓3 4. ↓2	1. ↓4.5 2. ↓3 3. ↓3 4. ↓1	1. ↓2 2. ↓2 3. ↓1 4. —	1. ↑2 2. ↑2 3. ↑2 4. ↑1	1. ↑5 2. ↑2 3. ↑3 4. —	1. ↑4 2. ↑3 3. ↑3 4. —	1. ↑2 2. ↑1 3. ↑1 4. ↑0.5	1. ↑1 2. — 3. — 4. —

	Kaukau (Swimming)				Mahinga Kai		Economic			
	Waitemata (water clarity)	**Te Rere (flow)**	**Paemakariri (temperature)**	**Matauranga ki nga wai kaukau (Knowledge of swimming places)**	**Te nui o nga kai i te wai (abundance of fish species – koura)**	**He kai pai (edible food)**	**Au Putea (economic benefit of water)**	**Value Add**	**International Exports**	**Employment MEC**
Direction of change in relation to Baseline	1 ↑4 2. ↑3 3. ↑3 4. —	1. — 2. — 3. — 4. —	1. ↑3 2. ↑3 3. ↑3 4. ↑1	1. ↑1 2. ↑0.5 3. ↑0.5 4. ↑0.5	1. ↑3 2. ↑2 3. ↑1 4. —	1. ↑3 2. ↑1 3. ↑1 4. —	1. ↓5 2. ↓3 3. ↓3 4. ↓1	1. ↓5 2. ↓3 3. ↓3 4. ↓1	1. ↓5 2. ↓1 3. ↓2 4. ↓1	1. ↓5 2. . ↓2 3. ↓2 4. ↓1