Scoping report:

The Clean Waters of Tikapa Moana
Restoring the Hauraki Gulf

Produced by

The Sustainable Business Network

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Executive Summary

This scoping report was funded by Foundation North as part of its Gulf Innovation Fund Together (GIFT) programme. The fund's purpose is to "significantly improve the environmental health of the Hauraki Gulf by seeking and enabling innovation", through supporting "projects that will deliver intergenerational benefit and wide impact".[1]

The Hauraki Gulf Marine Park (Tikapa Moana) is an important natural taonga for New Zealand. The work of the Hauraki Gulf Forum in the *Marine Spatial Plan* as well as the *State of our Gulf 2017* report highlights the incredible richness of this marine area. But it has also raised awareness of the dramatic degradation of this marine environment over the last century as well as the ongoing and increasing pressures it faces. This is the context for action under the GIFT programme.

The pressures on the Hauraki Gulf are both direct, in the marine environment, such as over-fishing and dredging, and indirect, from land-based activities. These land-based activities occur across the Hauraki Gulf catchment, including rural and urban areas. The rural activities causing impacts are primarily from land use, especially pastoral agriculture, but also forestry (felling operations). The main contaminants from these activities are sediment and nutrients. The urban activities causing impacts are wide-ranging, resulting in pollution from sediment, heavy metals (especially copper and zinc), nutrients and rubbish (including plastics).

Sediment is the main water quality issue affecting the Hauraki Gulf. The Marine Spatial Plan highlights poor water quality as one of the biggest concerns for the health of the Hauraki Gulf. The number one contributor to poor water quality in the Gulf is sediment from the land. Excess sediment in estuaries can smother habitats and have a detrimental effect on water clarity. This reduces the ability of phytoplankton and plants to photosynthesise, affecting the whole marine ecosystem.

Heavy metals, particularly copper and zinc, are another significant contaminant in the Gulf and its harbours and estuaries. They result from a range of human activities. They are discharged into the waterways, estuaries, and harbours from the stormwater system, especially at times of heavy rain. Heavy metals are toxic to both animals and humans, even at low concentrations.

Under the GIFT programme, the Sustainable Business Network (SBN) was funded to scope out projects and associated plans covering two specific areas:

- Reducing sediment load in rural areas through strategic expansion of SBN's Million Metres Streams riparian planting project[2] in the Hauraki Gulf catchments
- Reducing sediment and heavy metal loads in urban Auckland through engagement with the business sector

SBN[3] bases its transformational project work on a systems-based approach called the 'Big Shift', developed in the UK. The Big Shift process starts with experiencing the need for change and diagnosing the current system and its problems. It then creates and scales pioneering solutions. The Big Shift principles were used as a basis for this scoping study.

[1] https://www.giftofthegulf.org.nz/

[2] SBN's project Million Metres is an established riparian planting programme, using a crowd-funding based model, working across New Zealand with a range of stakeholders and partners.

[3] SBN is a network of 500 businesses and organisations. The network seeks to empower business so people and nature prosper through a range of activities, including collaboration on system change projects.

Reducing sediment load in rural areas through strategic expansion of Million Metres

The Hauraki Gulf Marine Spatial Plan recommends a suite of actions to tackle the sediment issue. Our scoping study highlights the scale of the sediment issue in the Hauraki Gulf, and the need for high level, high profile leadership to tackle this issue.

The work of SBN, through its Million Metres project, is able to support sediment reduction by increasing investment in waterway restoration. Waterway restoration is one of the key work areas for sediment reduction prioritised by the Hauraki Gulf Marine Spatial Plan.

This scoping study found that there are eight fundamental inputs required to achieve successful waterway restoration at any scale: an enabling political environment, land and landowners, capital, good quality restoration plans, skilled project coordination, labour, plants, and impact monitoring. As well as this, we found that collaborative partnerships will become a critical enabler to scale waterway restoration for the Hauraki Gulf.

We identified the following bottlenecks limiting scale for waterway restoration: lack of partnerships between key stakeholders; high costs associated with nursery and planting processes ; lack of large-scale engagement with landowners; limited capital to deliver restoration; and the lack of incentives to do restoration on private land.

We found that there is a significant opportunity to restore wetlands and native vegetation to waterways to reduce sediment reaching the Hauraki Gulf. We estimate this to be in the range of 900-1,800 kilometres, for the Auckland region, with a potential cost of $34 - $67.5 million just for planting. This is based on 5m wide plantings. It represents a planting aspiration of approximately 4.5 – 9 million plants. This analysis was conservative, and does not include wetland restoration. Data was not available for the Waikato region catchment for this analysis, we recommend analysis for Waikato is completed.

There is a significant opportunity to scale-up waterway restoration for the Hauraki Gulf through co-ordinated catchment planting projects based on collaboration. Collaboration with key stakeholders provides an opportunity for innovation that can overcome some of the key barriers to achieving scale in the existing waterway restoration 'eco-system'[4].

Through the work for this scoping report SBN identified a number of collaboration opportunities to test the removal of barriers to scale. In particular, a collaboration with farmer-led catchment groups (made up of hundreds of farmers), Te Whangai Trust nursery, Fonterra, iwi and others.

Our key recommendation is a three-year pilot. This would test out collaboration for scaling waterway restoration between Million Metres, Te Whangai Trust, five catchment groups on the Western Firth of Thames, regional councils and others.

- **Year 1: Create planting plans and a strategy for investment –** develop planting plans, investment strategy and launch the first fundraising campaign
- **Year 2: Full scale fundraising campaign and activation** by business, young people, and rural communities to achieve the investment needed
- **Year 3: Focus on leveraging Million Metres funding for corporate match funding** for the Western Firth of Thames

Lessons from this collaboration will be used to build upon and scale up collaboration for large scale waterway restoration around the Hauraki Gulf over the next decade.

[4] In this scoping study we use the term waterway restoration 'eco-system' to describe the social and economic processes and activities associated with restoring waterways with native vegetation.

Reducing pollution loads in urban Auckland through business engagement

A comprehensive desktop review, including stakeholder engagement, was undertaken. This enabled an understanding of the current situation by identifying and analysing the key pollution source issues and opportunities. This included an analysis of SBN membership and its relation to water quality issues in the Gulf. Options were then evaluated and recommendations formulated, including an implementation plan.

The key man-made pollution sources identified were: vehicle brake pads, anti-fouling marine paints and metal works (for copper); road vehicle tyres and unpainted corrugated steel/iron roofing (for zinc); and earthworks/construction sites (for sediment). These sources are primarily non-point. The most affected catchments are those in the more populous areas of central Auckland.

Although the data quality and quantity is variable, it is better in the central areas of Auckland (Waitamatā and Tamaki). The overall trend is worsening across most contaminants and most catchments. For some problem activities there are lower impact alternatives (e.g. low copper brake pads, painted roofs, construction site control), but for others (e.g. zinc in tyres, anti-foul paints) there are no alternatives. Where alternatives exist there are various barriers, including supply into New Zealand, performance, cost, consumer preference, limited knowledge, as well as lack of regulation.

The collective impact from these activities is very significant. But awareness among the general public and the business sector is low. These pollution sources are not experienced by the public as they are generally invisible and not directly sensed. Combining this low awareness and the disparate nature of the source activities, it is difficult to achieve connection and interest to address the issues.

Despite these challenges, several options were identified and an integrated set of recommendations are presented:

1. **An overarching communications campaign** targeted at the business sector and their people to raise awareness and understanding and create the motivation for action.
2. **A business engagement programme** to develop the framework, appetite and capacity for action to enable businesses to engage in the targeted action programmes.
3. **Targeted action programmes** energising and enabling businesses to take specific actions, as outlined below, in the four focus areas.
    - Focus area 1 – Reducing zinc loss from galvanised roofs in key Gulf catchments
    - Focus area 2 – Accelerating the introduction of very low copper brake pads
    - Focus area 3 – A design challenge for non-toxic anti-foul solutions
    - Focus area 4 – Engagement with SBN's Circular Economy Accelerator's plastics innovation programme

A successful campaign needs 'emotional' connection. Therefore we have included a recommendation that plastic pollution is included in scope. This is an issue which people experience first hand. They see it in floating bottles in the harbour, beach debris and dying marine animals. By including plastics within our scope we introduce a 'gateway' issue, leading to improved awareness of the other land-based sources of marine pollution.

We recommend a three-year programme, based on the three components above (estimated cost $200,000 per year):

- Year 1 (18/19) - Awareness-raising (through the campaign), building partnerships, and creating solutions for plastics (include design challenges)
- Year 2 (19/20) - (Begin to) introduce plastics solutions and develop solutions for other contaminants (include design challenges, e.g. anti-foul paint)
- Year 3 (20/21) - Accelerate deployment of solutions

1. Introduction

The Hauraki Gulf Marine Park/Tikapa Moana is an important natural taonga for New Zealand. The work of the Hauraki Gulf Forum in the *Marine Spatial Plan*[5] as well as the *State of our Gulf 2017*[6] report highlights the incredible richness of this marine area. But it has also raised awareness of the dramatic degradation of this marine environment over the last century as well as the ongoing and increasing pressures it faces.

Sediment, copper and zinc are polluting the Hauraki Gulf. Earthworks, construction and agricultural activities drive sediment into our waterways and out to sea. Heavy rainfall, driven by climate change, makes this worse. Metal working, vehicle brake pads and anti-fouling boat paints shed copper into the water. Tyres and unprotected corrugated steel/iron roofing cause zinc pollution.

The catchments most badly affected by heavy metals pollution are in the more populous areas of central Auckland. These are Waitamatā and Tamaki, and to a lesser extent Hibiscus Coast. The information we have on this pollution varies, and lessens the further from central Auckland we look.

The highest inputs of sediment are coming from rural catchments, and to a lesser degree urban catchments where development is occurring.

Fish stocks and biodiversity are of course important areas of concern. They currently receive a lot of attention. But as anybody who keeps fish knows, you don't really keep fish, you keep water.

So it's fitting that water quality has been highlighted in the *State of Our Gulf 2017* as a very high priority issue. It is also the area that appears to be one of the most challenging. The report notes that freshwater issues are long-term, cross-cutting, complex, inter-generational and require innovation to address them.

In this scoping study we apply the Big Shift[7] model to thinking about water quality for the Hauraki Gulf, with a focus on key contaminants off the land. The Big Shift is the model used by the Sustainable Business Network (SBN) to drive positive and effective collaboration. The Big Shift outlines a framework for creating change for a more sustainable future. The underlying premise of the Big Shift is that a systems-based approach is needed to create change and scale impact.

Water quality issues are systemic. Water can be viewed as two interrelated systems[8]:

- **The hydrological system.** This includes ecosystems (plants, animals and non-living elements). In this system water is finite and cycles through numerous states. These are driven by solar energy as well as biological and metabolic processes
- **New Zealand's socio-economic system.** Water is a key input to human health, food production, industry, and economic productivity. This system's use of water tends to degrade water quality. The political and regulatory systems are sub-systems of the socio-economic system

Our initial diagnosis of the system highlights key areas of influence over water quality in the Gulf.

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[5] http://www.seachange.org.nz/read-the-plan/

[6] https://www.aucklandcouncil.govt.nz/about-auckland-council/how-auckland-council-works/harbour-forums/docsstateofgulf/state-gulf-full-report.pdf

[7] Draper S. Creating the big shift: System innovation for sustainability. http://www.forumforthefuture.org/sites/default/files/images/Forum/Documents/SI%20document%20v4.2%20web%20spreads_1.pdf

[8] Eppel E. 2014. Governance of a comlex issue: Water. VUW Institute of Policy Studies. https://www.victoria.ac.nz/__data/assets/pdf_file/0003/1175250/WP14-01-Governance-of-a-Complex-System.pdf

Governance and policy

More comprehensive and effective overarching governance is required to achieve excellent water quality in the Gulf. Work has begun on this with the Hauraki Gulf Forum as well as an increased focus on water quality in the Auckland and Waikato regional councils. However, there is still an opportunity for a high profile Gulf Sediment Initiative as indicated in *The Hauraki Gulf Marine Spatial Plan*. This would bring all the separate parties together to tackle the issues.

The Healthy Waters (Wai Ora) team at Auckland Council is in the middle of a three year programme - Integrated Watershed Planning. This includes in-depth research and analysis of land-based contamination of the Gulf from 10 catchments as well as the development of an action programme, using a consultative process. The research stage is expected to complete mid-2018, with options identification completing in early 2019 and then an action plan, including limits and targets, from 2020. This comprehensive work should provide much greater clarity on these issues.

Catchment level decision making and planning

It is widely acknowledged that Integrated Catchment Management[9] is the appropriate planning approach for achieving water management. Integrated catchment management is a process that recognises the catchment as the appropriate organising unit for understanding and managing biophysical processes. This places the catchment in a context that includes social, economic and political considerations. It guides communities towards an agreed vision of sustainable resource management. This reflects the approach being taken by the two councils in catchments around the Gulf. It is also the aspiration for a greater scale of co-ordination in the conservation and restoration efforts of local volunteers, non-government organisations and others.

In the meantime, it is widely acknowledged that governance for water quality must be collaborative. It must also address both the hydrological and socio-economic systems. But achieving successful collaborative processes is not easy. In New Zealand we still have a lot to learn about collaboration. Establishing collaboration as our normal mode of operation takes time. New Zealand agencies and communities are just at the beginning of that journey[10].

Business and property scale action

There are clearly changes in the way businesses and households operate that can have a significant positive impact on water quality in the Gulf. Some of these changes, along with ideas on how they might be incentivised, are included in the recommendations of this report.

Focus on sediment and heavy metals

In this report we conduct a scoping study on two key areas of interest from within the broader water system. We consider sedimentation in the Hauraki Gulf and the scope for addressing it by scaling waterway restoration. We consider heavy metals pollution[11] in the Hauraki Gulf and the scope for engaging businesses to reduce it. For each, we outline the challenge we face in addressing them, the options for addressing the challenge and our recommendations.

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[9] https://www.landcareresearch.co.nz/science/soils-and-landscapes/hydrology-and-soil-physics/icm

[10] https://www.landcareresearch.co.nz/science/portfolios/enhancing-policy-effectiveness/vmo/planning-and-decision-making/collaborative-processes

[11] The heavy metals within the agreed scope for this study were copper and zinc. Others, such as lead and mercury, were not considered.

The Sustainable Business Network and the Gulf

SBN connects nearly 500 businesses, collaborating to energise business so that people and nature prosper.

SBN created Million Metres[12], New Zealand's first crowdfunding platform for restoration conservation projects along waterways. Million Metres improves water quality through stream riparian planting.

Million Metres currently partners with tens of organisations from Northland to Southland to deliver waterway restoration projects. This includes a 5% levy on all SBN membership fees that is donated to Million Metres.

In the Hauraki Gulf catchment, Million Metres partners with Auckland Council, Waikato Regional Council, Queen Elizabeth II National Trust (QEII), the Whau River Catchment Trust, Friends of Te Wairoa Catchment, the Ōtara Waterways and Lake Trust, as well as numerous farmers, businesses and local community members.

Since 2015 Million Metres has funded and is delivering 30 waterway restoration projects across the country. It has raised more than $650,000 and funded riparian planting along more than 25km of waterway.

Million Metres operational expenses are funded by the Department of Conservation, philanthropic donations, business sponsors and 15% of all donations on the Million Metres fundraising platform.

[12] https://millionmetres.org.nz/

2. Methodology

The Big Shift

The Big Shift is the model used by SBN to drive positive and effective collaboration.

It was developed by the UK-based sustainability organisation Forum for the Future. The Big Shift[13] outlines a framework for creating change for a more sustainable future (Figure 1). The underlying premise of the Big Shift is that a systems-based approach is needed to create change and scale impact.

In this scoping study we apply the Big Shift model to thinking about water quality for the Hauraki Gulf, with a focus on key contaminants from the land.

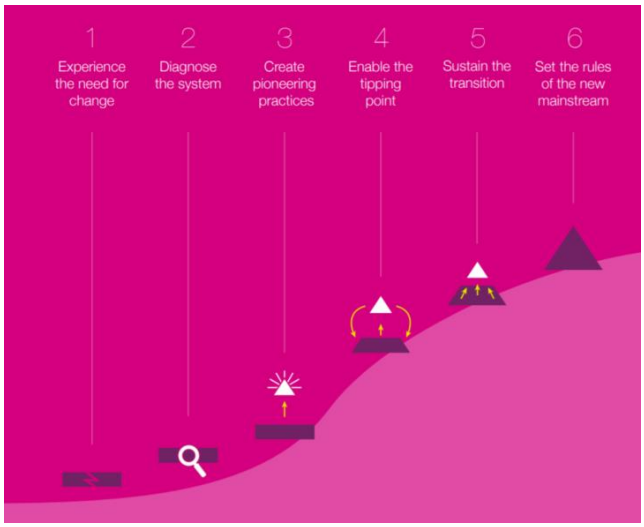

Figure 1: The Big Shift system transformation process

The framework diagnoses the system and identifies:

- the changes needed
- the leverage points where change can happen
- the key stakeholders needed to be engaged to achieve change

Waterway restoration to address sedimentation

The elements of this report dealing with waterway restoration in rural areas had the following objectives:

- identify key sources of sediment in the Hauraki Gulf and the catchments where sedimentation is worst
- identify the scale and cost of planting that could be achieved in the Hauraki Gulf
- identify potential options for achieving waterway restoration at scale in the Hauraki Gulf, including lessons learnt through Million Metres
- conduct stakeholder analysis for scaling waterway restoration around the Hauraki Gulf
- identify how SBN could contribute to the facilitation and delivery of restoration at scale for the Gulf

Desktop analysis was conducted to identify the current situation regarding sedimentation in the Hauraki Gulf. This included a review and comparison of all sediment monitoring data available for Hauraki Gulf catchments. This data is readily available for the Auckland region, but was not comprehensive or readily available for Waikato Region catchments.

A high level GIS analysis was completed by Morphum to estimate the length of waterway in Auckland region with less than 0.5 metres width of vegetation. This intersected Overland Flow Path[14] data with

[13] Draper S. Creating the big shift: System innovation for sustainability
http://www.forumforthefuture.org/sites/default/files/images/Forum/Documents/SI%20document%20v4.2%20web%20spreads_1.pdf

[14] Overland flow path refers to the places that water flows in the landscape (excluding the manmade stormwater network).

vegetation cover. There are a number of limitations associated with this high level analysis detailed in the report. Waterway restoration costs were estimated based on average costs from 30 projects delivered by Million Metres.

A strengths and limitations assessment and stakeholder analysis were conducted to develop an understanding of the limitations to and opportunities for scaling waterway restoration.

Informal interviews with council staff, Hauraki Gulf Forum members, sediment scientists and waterway restoration professionals also contributed to the findings of this report.

Business engagement on water pollution issues

The elements of the report focusing on business engagement in urban areas had the following objectives:

- Gain an understanding of the key sources (activity types and locations) of sediment and heavy metals (copper and zinc) pollution of the Hauraki Gulf catchment
- Establish how business activity is contributing to this pollution and the measures in place to control and reduce it
- Identify opportunities for further action by the general business community
- Make recommendations for further action

This was approached in three stages:

1. Understand the current situation
2. Identify and analyse issues and opportunities
3. Develop and evaluate outline options and make recommendations

Stage 1: Understand the current situation

This stage involved desktop research and implementing a stakeholder engagement plan.

Initially, the desktop work focused on the key comprehensive reports, including *State of our Gulf 2017* and the *Hauraki Gulf Marine Spatial Plan*. These were used to strengthen understanding of the overall context of pollution of the Hauraki Gulf. The research then developed into a wide-ranging search for more in-depth information relevant to the target contaminants (sediment, copper, zinc).

The stakeholder engagement plan consisted of identifying the key stakeholder groups and establishing the key organisations and individuals within those groups. Meetings and/or remote connections were then held with key individuals.

The meetings and discussions were based on a structured approach to better understand pollution sources; regulatory control; actions taken and planned; parties with influence and control; and gaps, barriers and opportunities (Appendix D).

Stage 2: Identify and analyse issues and opportunities

The information and understanding gathered in Stage 1 was then evaluated in a structured way to deepen understanding of the issues and the potential opportunities.

For each of the main sources of the target contaminants, we identified and assessed:

- **the problem scenario(s)**, including key locations, trends and rationale
- **the existing control and mitigation measures**, including regulatory controls and voluntary action
- **further action area opportunities**, through an assessment of key barriers and an understanding of leverage points and the parties with influence and control, including businesses

This stage also involved checking in with key stakeholders to confirm information and test understanding.

Running in parallel to stages 1 and 2, a thorough review of all SBN members operating in the Auckland region was undertaken. The review identified those likely to be significant contributors to the pollution problems, and those involved in pollution prevention or mitigation as producers or consumers. It also recorded location, in terms of the catchment and micro catchment within which the member site is located, and identified those sited in areas with significant pollution issues, using Auckland Council's detailed monitoring data for reference.

Stage 3: Develop outline options and make recommendations

Based on the output from Stage 2, the opportunities were assessed and options for action were identified for each of the target contaminants and source types.

At a broad level, the action option types were either producer-based (supply-side) or consumer-based (demand-side), and based on specific action or raising awareness and information provision.

The options were evaluated using a range of criteria including:

- relative priority
- ease of implementation
- indicative cost
- breadth and depth of potential engagement and leverage, including using SBN membership
- breadth and depth of potential impact
- connection with influencers

As input into the evaluation, an analysis of the SBN membership in February 2018 was undertaken. This review identified

- those based in Auckland
- those with main sites in one of the Gulf catchments, including proximity to high pollution sub-catchments
- those based outside but with (or connections with) activities within the catchment.

It assessed whether the member undertook activities which either contributed to, or addressed, the problems of sediment or heavy metals, and/or had a potential role in advocacy or communications.

Note: We were mindful of the relative priority of these options within the context of other Gulf issues/opportunities, and more broadly environmental priorities (e.g. climate change). Where possible, action options have been linked to other priority issues and actions (e.g. limiting car use and/or more efficient driving to reduce carbon emissions and reduce zinc and copper discharges).

3. The Key Challenges

Challenge 1: Sediment

Sediment is the main water quality issue affecting the Hauraki Gulf[15]. *The Hauraki Gulf Marine Spatial Plan* highlights poor water quality as one of the biggest concerns for the health of the Hauraki Gulf. The number one contributor to poor water quality in the Gulf is sediment from the land[16].

Sediment is loose soil. Sediment is most often generated on the land when it rains. It then moves across the landscape in freshwater runoff and eventually washes into streams and out to the marine environment.

Our activities on the land have increased the volumes of sediment entering streams and marine environments. Sediment flow arising from land use change has been a serious contaminant for many decades. It has resulted in significant sediment accumulation in the inner Hauraki Gulf and Firth of Thames.

The Hauraki Gulf Marine Spatial Plan notes that "excessive sediment runoff from the land is the main cause of degraded marine habitats, estuaries, habours and the Inner Hauraki Gulf." (p.130)

The State of Our Gulf 2017 report provides a summary of the current monitoring of sediment in Auckland and Waikato regions by Auckland Council and Waikato Regional Council. It is monitored at several points around the Gulf by each council.

Key points on sedimentation from *The State of Our Gulf 2017:*

- Sedimentation varies from catchment to catchment and in the marine environment.
- Modern sedimentation rates are far greater than pre-European sediment rates.
- The Waihou, Piako, Mahurangi and Wairoa rivers are contributing the greatest sediment loads to the Hauraki Gulf. These are all rural catchments with predominantly pastoral agriculture land use, although the Wairoa catchment also has a high proportion of forestry.
- The Hauraki Plains were once largely wetlands but are now nearly completely drained for pastoral agriculture.
- Many sites in Auckland have unchanging sedimentation levels, indicating that high levels of sediment experienced historically may not be reducing over time.
- Many sites around Auckland had higher than recommended sediment levels either in streams or the marine environment.
- The amount of Total Suspended Sediment has been increasing at three of 21 monitored sites in Auckland. These are: two sites in the Upper Waitematā and the Tūranga estuary at Whitford embayment.
- The amount of Total Suspended Sediment has been decreasing at four of the 21 monitored sites in the Auckland region. These are: Goat Island, Ti Point, Orewa, and Tāmaki Inlet.
- In the marine environment, Mangamangaroa, Tūranga and Waikopua estuaries (all part of the Whitford embayment), Okura estuary, and Miranda coastal environment all have increasing levels of deposited sediment.

[15] 2018. State of our Gulf 2017. https://aucklandcouncil.maps.arcgis.com/apps/MapJournal/index.html?appid=13c6b96541884d8099da216a2206a2d0

[16] 2017. Sea Change: Tai Timu Tai Pari Hauraki Gulf Marine Spatial Plan. http://www.seachange.org.nz/read-the-plan/

Five year mean suspended sediment levels do not meet standard guidelines for ecosystem health in the following catchments monitored by Auckland Council: Waiheke Island, North East, Mahurangi, Hibiscus Coast, Tāmaki, and Wairoa.

Waikato Regional Council reports differently on sediment. However, suspended sediment levels are reported as high in the Waihou and Piako rivers. Sedimentation in the marine environment is increasing in the Miranda area. It is widely reported that the Southern Firth of Thames marine environment has changed dramatically due to high volumes of sediment entering the Firth from the Waihou and Piako rivers.

Excessive levels of suspended sediment and sediment that has settled to the stream bed or sea floor adversely affect ecosystem health.

Agricultural and urban runoff may contain toxic materials, which can damage or even kill the organisms within an ecosystem. The runoff can also include sediment from pesticide and fertiliser applications as well as animal waste and bacteria.

Some animal species are especially sensitive to the effects of sediment, with contamination quickly accumulating in animal tissues. Filter feeders such as mussels and clams get food by filtering water through their bodies, making them especially vulnerable to the presence of sediment. High levels of suspended sediment can also interfere with predatory behaviour, risking the health of the ecosystem by disrupting prey-predator relationships.

Sediments inhibit photosynthesis and other ecosystem functions, smother marine habitats and can be toxic to freshwater and marine species. In some instances, entire species have been eradicated where sediment deposition is high. Sediment has also been found to change the physical development of some species.

The main ways that sediment is generated in the Hauraki Catchment are via:

- land disturbance (earthworks) when we develop for urban growth
- existing urban land use, when water runs off impervious surface areas and into the stormwater network
- stream bank and stream bed erosion in urban and rural streams
- rural land-use practices, including: agriculture, forestry and horticulture, particularly where slopes are unforested/deforested and/or soils are exposed and streams are unvegetated
- in-stream sediment mobilisation, most likely to occur in large storm events

The Hauraki Gulf Marine Spatial Plan outlines the eight priority actions for achieving sediment input reductions. These are: integrated catchment management plans and setting sediment load limits for all catchments, sediment traps (e.g. wetlands), waterway management, good sediment management practices (i.e. when harvesting forest), reducing the impacts of forestry on sediment, protecting highly erodible land, and addressing existing sediment in the coastal marine area.

The Hauraki Gulf Marine Spatial Plan notes that the Gulf catchment has steep slopes, erodible soils and frequent storms. This means that good land management practices alone will not reduce excess sediment reaching the Gulf. For this reason, the importance of sediment traps is highlighted to solve the sediment issue.

This scoping study focuses on how to implement just one of these solutions at scale - waterway management. However, we would expect the restoration of wetlands (sediment traps) to be an important part of waterway management as well. Waterway management was chosen as a focus point based on SBN's existing capacity to deliver widespread impact for the Hauraki Gulf in this area via its Million Metres project. We acknowledge that the other priority solutions to reduce sediment inputs to the Hauraki Gulf will all be necessary to reduce sedimentation inputs to a satisfactory level.

Waterway management to reduce sediment inputs in the Hauraki Gulf Marine Spatial Plan

Goal: Significantly improve waterway management to reduce sediment reaching marine environment (industry, mana whenua, and agencies will need to work together to achieve this goal).

1) Continue and significantly increase the extent of stock exclusion, and riparian planting programmes along waterways
2) Each catchment management plan to include target for % waterway planting needed (goal should be to achieve this within 10 years of the plan being completed)
3) Apply 'active and pragmatic' management of waterways and drains to reduce sediment loss, stream bank erosion and bankside collapse

The challenge that we consider in depth in this scoping report is the significant increasing of riparian planting programmes along waterways.

Challenge 2: Heavy metals

Copper

Copper is one of the major heavy metal contaminants from the Hauraki Gulf catchments, especially those including urban areas (Waitamatā and Tamaki). Copper is toxic to freshwater and marine life at elevated levels. Copper levels are monitored at a small number of rivers (as dissolved copper) and at many beach sites (sediment deposits) in the harbour and estuaries.

The *State of our Gulf 2017* report notes that sediment quality guidelines[17] are frequently exceeded for copper in the urban estuaries, although overall the situation is slightly improving. Long-term trend analyses[18] of 51 Auckland sites showed significant reductions in copper in 31% of sites, while significant increases occurred at 14% of sites (p. 149).

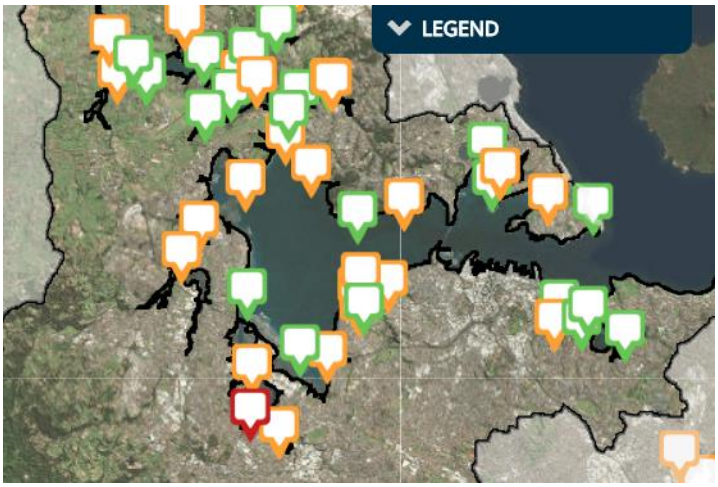

Figure 2: Copper levels at monitoring sites (Waitamatā catchment)

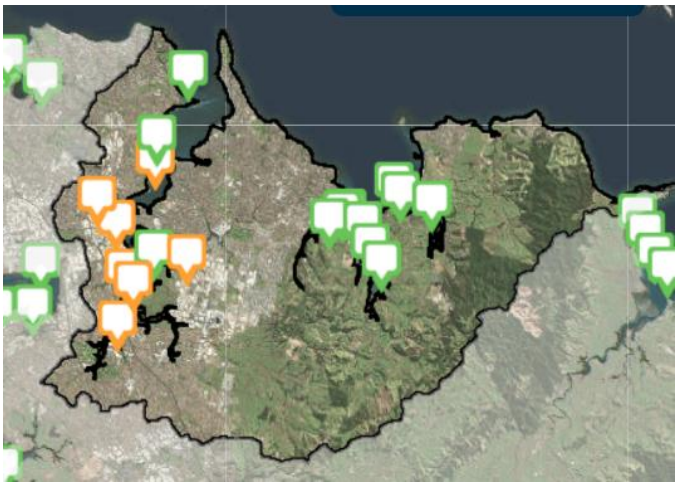

Figure 3: Copper levels at monitoring sites (Tamaki catchment)

Unsurprisingly, it is the more populous areas, and those which have significant industrial activity that have higher levels of copper pollution. Within the Waitamatā catchment, the areas with elevated levels (Red and Amber) include Henderson and Whau. The latter contains Whau Wairau, the only site with a Red rating. All the monitoring sites in the creeks flowing into the Tamaki Estuary show elevated Amber levels (Figure 2 and Figure 3).

[17] Refer to Table 6.4 of the State of our Gulf report for the sediment quality guidelines (Threshold Effect Levels).

[18] The State of our Gulf 2017 report was based on monitoring data comparison between 2004 and 2016.

Dissolved soluble copper levels at all river monitoring sites in the Waitamatā Harbour watershed are meeting the ANZECC guideline[19] for 90% species protection, with levels at most sites reaching the 95% species protection standard[20].

A 2013 study[21] (NIWA) estimated that copper leaching from boats at the Auckland marinas was more than double that flowing from the stormwater network and into the Waitamatā harbour (Figure 4).

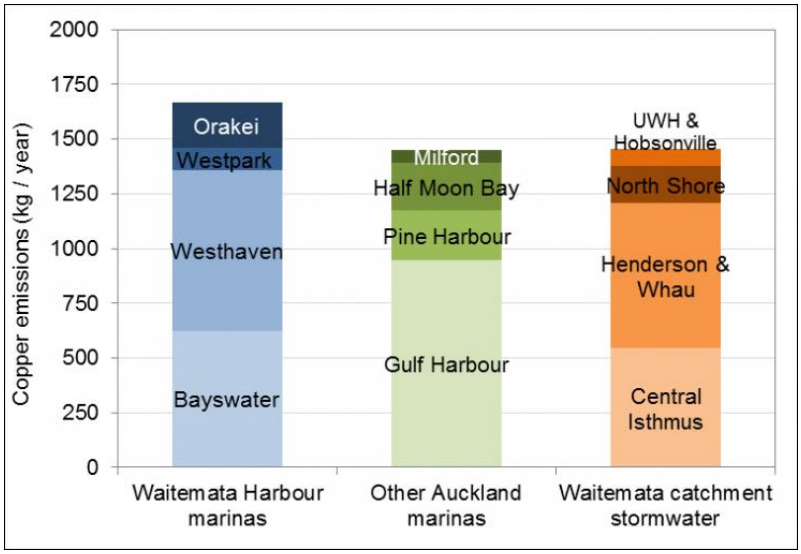

Figure 4: Copper levels from marinas and stormwater network (Waitamatā catchment)

Zinc

Zinc is the other major heavy metal contaminant from the Hauraki Gulf catchments, especially those including urban areas (Waitamatā and Tamaki). Zinc is toxic to freshwater and marine life at elevated levels. Zinc levels are monitored at a small number of rivers as dissolved zinc and at many beach sites as sediment deposits in the harbour and estuaries.

The latest *State of our Gulf 2017* notes that sediment quality guidelines are frequently exceeded for zinc in the urban estuaries. Long-term trend analyses of 51 Auckland sites showed significant reductions in zinc at only 8% of sites, while significant increases occurred at 14% of sites, leaving the vast majority at a similar level in 2004 and 2016 (p. 149).

[19] The Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines are the water quality guidelines used extensively throughout New Zealand in managing water quality and potential effects of discharges. The species protection level means that the levels of the contaminant (copper or zinc) in the monitoring sample are non-toxic to, at least, the percentage value of the species in the species reference group (e.g. 95% protection level assessment for a monitoring sample means that 95% of the species in the group are not affected by the pollution level). For more information, click here.

[20] The data on monitoring sites has been taken from the Auckland Council watershed current state story maps – refer to the Current State Overview for the Waitamatā watershed, here.

[21] https://www.niwa.co.nz/news/are-antifouling-paints-harming-our-sealife

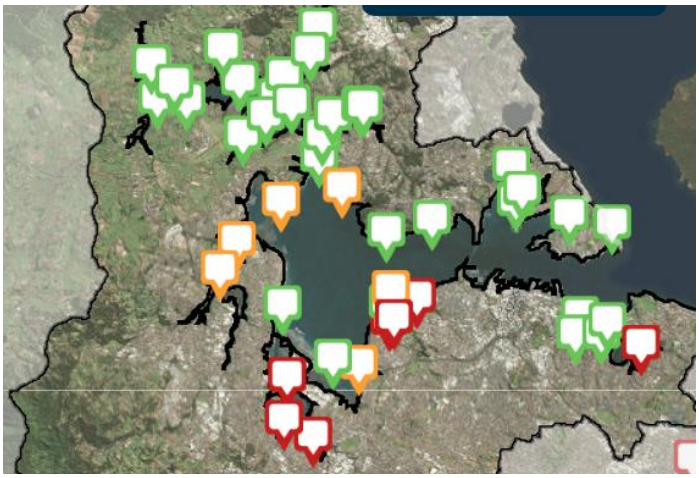

Figure 5: Zinc levels at monitoring sites (Waitamatā catchment)

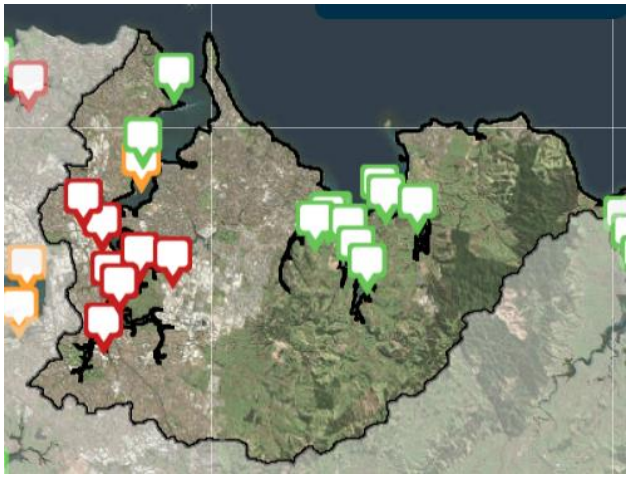

Figure 6: Zinc levels at monitoring sites (Tamaki catchment)

As with copper it is the more populous areas and those which have significant industrial activity that have higher levels of zinc pollution. Compared with copper, there are many more monitoring sites where zinc levels are classified Red (14 in total). The areas with very elevated levels (Red) within the Waitamatā catchment include Whau, Cox's Bay, and Motions. All seven monitoring sites within the Tamaki catchment in the upper Tamaki Estuary show very elevated levels (Red).

Similarly, the situation for dissolved soluble zinc levels is worse than those for copper. Half of the river monitoring sites in Waitamatā Harbour watershed are failing to meet the ANZECC guideline for 90% species protection.

4. Analysing the challenge – scaling waterway restoration to address rural water pollution

To understand the challenge and opportunity of reducing water pollution from rural areas by scaling waterway restoration we looked at:

- the current stream restoration 'eco-system'[22] strengths and limitations
- the key inputs to waterway restoration and how these could be scaled, including examples of innovative new models
- stakeholders in waterway restoration and their interest and influence on achieving scaled planting

Lessons from working in the current stream restoration 'eco-system'

There is an existing 'eco-system' for stream care and waterway restoration in the catchments of the Hauraki Gulf and more broadly across New Zealand.

This 'eco-system' is made up of:

- organisations and individuals driving restoration projects
- land management and ecology professionals
- restoration professionals
- land owners
- nurseries
- scientists and researchers
- funding organisations/sources.

There are many aspects of this system that are well developed, working well and that provide an excellent starting point for scaling planting around the Hauraki Gulf. There are also numerous aspects of this ecosystem that could be developed further and/or improved upon to better enable stream care and waterway restoration, particularly at scale. In this section we consider the strengths and limitations in our 'eco-system' of interest based on desktop review and Million Metres' on the ground experience.

[22] In this scoping study we refer to the waterway restoration 'eco-system' to describe the social and economic processes and activities people are in engaged in to achieve waterway restoration.

Table 1: Strengths & weaknesses of the waterway restoration 'eco-system'

Strengths	Limitations
Dis-aggregated system that enables local community-led restoration. This ensures local community-based 'ownership' of projects and better guarantees their long term maintenance.	There is rarely knowledge of how much work is needed to achieve the sediment reductions required to restore water quality and freshwater and marine ecosystems, or even if this can be achieved.
Well established ecological knowledge for restoration, although learning site by site continues to occur and contribute to a growing body of knowledge for native restoration in New Zealand.	Councils tend to be the organisations undertaking larger scale work, particularly via consents for large developments. Little information is currently available about the scale or impact of this work.
Well established local knowledge of what works and what doesn't work.	Little is known about the scale of the work being completed by individuals and community groups. Individual projects tend to be small scale and over long periods of time to make work plans manageable.
Well established community nurseries and planting techniques.	Restoration often occurs ad hoc, particularly with the willing and motivated, or where access to land can be gained.
Limited resourcing drives a culture of innovation and creative problem solving to achieve goals.	Restoration tends to be at a small scale on many disaggregated sites with limited strategic oversight to enable economies of scale to bring costs down.
A highly committed community of individuals and organisations.	Councils are under resourced to deliver support to landowners about waterway restoration.
	Waterway restoration lacks financial incentives making it harder to get uptake at scale.
	Contestable funding pools are available for waterway restoration; however, these are small relative to the costs of restoration. Existing funding models also put restoration projects in competition with each other.
	Much of the hands-on knowledge about restoration is held by an older generation of conservation enthusiasts. Ways of passing on this knowledge are needed.
	Many of the people working on waterway restoration are volunteers, time poor, and lack digital and/or social media skills.

What are the key inputs and enablers for scaling waterway restoration?

We found that there are eight fundamental inputs required to achieve successful waterway restoration at any scale: an enabling political environment, land (landowners), capital, good quality restoration plans, skilled project coordination, labour, plants, and impact monitoring.

Political environment

The political environment for waterway restoration for the Hauraki Gulf appears to be increasingly open and enabling of planting at scale. Rules to require waterway restoration in some contexts are being introduced; however, landowners are going to lag behind in implementing those rules if insufficient support is provided.

Land availability

In theory, many landowners recognise the desirability of restoring forest to the riparian margins of their streams, and of restoring wetlands on their land. However, not enough farmers have restored their waterways. Engaging large numbers of landowners in more than 40 catchments (hundreds of sub-catchments) will be a critical enabler to scaling planting for the Hauraki Gulf.

Partnerships with key sector organisations (e.g. Fonterra and Beef & Lamb NZ) are one way in which engagement with private landowners could be achieved at the scale required. An engagement campaign targeting landowners to engage in waterway restoration on their land may be another feasible option.

Capital

Access to capital has been identified as one of the key barriers to achieving higher levels of afforestation in New Zealand, including planting for waterway restoration[23]. As a result, New Zealand's conservation restoration sector is going through something of a revolution in terms of its approach to accessing capital[24]. Innovation to access new capital is being called for across New Zealand from organisations and individuals working at all scales.

Numerous new approaches are being discussed, developed or are emergent: a tourist levy; high level business investment; impact investment; crowdfunding (e.g. Million Metres) and other digital fundraising approaches (e.g. Trees That Count); forest bonds[25]; payment for ecosystem services; and social enterprise for restoration outcomes. For example, Million Metres facilitates connections between land, labour, and capital.

The government has recognised both the urgent need for afforestation and for capital to achieve this by announcing its Billion Trees goal and programme. The Billion Trees programme is still under development; however, it is likely to involve a mix of funding opportunities for afforestation. The review of the Emissions Trading Scheme (ETS) may see new streams of capital become available for waterway restoration if riparian areas and wetland areas are brought into the scheme.

Traditional streams of capital will remain critical and will need to be boosted. It seems likely that a mix of sources of capital will be used across and within waterway restoration projects. The more we are able to coordinate sources of capital and projects, the more readily we will be able to realise cost efficiencies across these numerous funding sources.

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[23] Hall D 2016. Our Forest Future. Pure Advantage. http://pureadvantage.org/news/2016/04/22/our-forest-future/

[24] Brown M 2018. Transforming Community Conservation Funding in New Zealand. Catalyst Group. http://j6tf91d0ueo2tdwbl2hqjjle-wpengine.netdna-ssl.com/wp-content/uploads/2018/05/PFNZ-Trust-Transforming-Community-Conservation-Funding-in-NZ-May-2018-compressed.pdf

[25] Hall et al 2017. Permanent Forest Bonds: A pioneering environmental impact bond for Aotearoa New Zealand. https://www.victoria.ac.nz/__data/assets/pdf_file/0009/1175247/WP17-01-Permanent-forest-bondsv2.pdf

Another important consideration is how to reduce the costs of waterway restoration so that more can be achieved with the same or less capital investment. For nearly every input listed cost savings are needed to bring down the cost of waterway restoration. In some cases, for example plant supply, efficiencies of scale are likely to be achievable. And automation, in the form of the Riparian Planner web-based tool for planting plans, may help reduce direct project costs. Efficiency is discussed in more detail in each relevant section.

Restoration plans

There are numerous options a landowner or community organisation can use to generate a restoration plan for their property or project site. These include: regional council farm advisors, an independent ecological consultant, a nursery consultant, riparian planner, or a Dairy NZ, Fonterra or Beef & Lamb NZ advisor.

Where this service is provided free there is far too little resourcing of the service to enable scale. There are too few farm advisors from council and Fonterra/Beef & Lamb to get around enough farms. And where the service is not free it is prohibitively expensive for many landowners and community organisations.

If engaging landowners around the Hauraki Gulf at scale was achieved, this next input would be a major barrier to progressing restoration works. One solution to removing the barrier to scaling waterway restoration plans would, of course, be a larger stream of capital being made available for this work.

Innovation to reduce the cost and increase efficiency for restoration plans is occurring. For example, Riparian Planner – as it develops and improves – may become a much simpler, cheaper, and equally effective approach for developing waterway restoration projects[26].

Additional innovation may still be necessary. For example, could peer to peer mentoring work as an option to enable farmers to all have a waterway restoration plan for their farm at a lower cost?

Project coordination and labour

Project coordination and labour is one of the highest costs in waterway restoration. It can, in the simplest sense, be hired in with sufficient capital investment. However, there is the potential for exciting innovation for this input to enable scale. For example, social enterprises formed around achieving waterway restoration goals are popping up around New Zealand.

Can we bring down the costs of project coordination and planting labour via scaling and increasing efficiencies around both tasks and travel? One way to achieve this is to introduce a conservation restoration qualification that covers all of the tasks required in the waterway restoration area. These include: project management, planting plans, seed collection, seedling propagation, fencing, planting, volunteer coordination, maintenance, pest management, and monitoring.

Increasing the trained labour available for waterway restoration would also drive a number of positive social outcomes – increasing job readiness and decreasing unemployment.

Alternatively, could large scale coordination of volunteers help to reduce the cost of labour? Volunteer labour can typically be just as expensive as paid labour because of the high coordination cost and because it can be less effective due to the low quality of planting achieved.

Plants

The high cost of plants for waterway restoration has been attributed to the small, boutique nature of many native nurseries, as opposed to large scale commercial exotic nurseries that achieve significant economies of scale[27]. Reducing the costs associated with supplying plants for waterway restoration is critical.

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[26] Dairy NZ Riparian Planner. https://riparian-planner.dairynz.co.nz/

[27] Hall D 2016. Our Forest Future. Pure Advantage. http://pureadvantage.org/news/2016/04/22/our-forest-future/

At present a number of initiatives are underway that have started to trial new approaches. Sustainable Coastlines has been working with The Corrections Department to access low cost seedlings (grown in Corrections nurseries) as well as low cost labour[28]. Te Arai Nursery was set up to grow a large number of commercial seedlings. The profit from the sale of those plants is invested in the nursery to allow it to give away 350,000 free conservation seedlings every year[29].

Impact monitoring

Monitoring the impacts of waterway restoration currently lacks coordination. It tends to be up to the individual or community group leading their project. It can also depend on whether or not they have any connections to the research institute or individual. Monitoring can be costly and time consuming.

A number of research programmes are underway around New Zealand to demonstrate the impact of waterway restoration on water quality and other metrics like biodiversity. Many community groups are engaged in citizen science to monitor and report on the impact of their work.

Collaboration and leveraging of existing research funding is seen as critical enabler for implementing robust impact monitoring waterway restoration for the Hauraki Gulf. For example, WAINZ Ltd, recently funded by Foundation North to conduct water quality monitoring in the Hauraki Gulf, could be a key partner in delivering waterway restoration.

Stakeholder Analysis

The Sustainable Business Network currently partners with tens of organisations from Northland to Southland to deliver waterway restoration projects via its project Million Metres. In the Hauraki Gulf catchment, Million Metres partners with Auckland Council, Waikato Regional Council, Queen Elizabeth II National Trust (QEII), the Whau River Catchment Trust, Friends of Te Wairoa Catchment, the Ōtara Waterways and Lake Trust, as well as numerous farmers, businesses and local community members.

To scale waterway restoration for sediment reductions in the Hauraki Gulf key stakeholders will need to work together. In this section we identify key stakeholders, their interests and the degree of influence they have in relation to achieving waterway restoration at scale for the Hauraki Gulf (Table 2).

Table 2: Stakeholder analysis for scaling waterway restoration for sediment reductions

Organisation	Interests	Interest & Influence levels
Ministry for the Environment (MfE)	MfE develops national policy on freshwater and influences land use policy and rules in relation to air, land, water, and marine. MfE administers various funds for freshwater projects. Has the potential to play a key leadership role in a Gulf Sediment Initiative.	Interest: High Influence: High
Ministry for Primary Industries (MPI)	MPI has a direct influence on land use, the activities of rural landowners and agricultural practices. MPI administers various funds for sustainable land management and afforestation (e.g. The Billion Trees programme).	Interest: Medium Influence: High
Department of Conservation (DOC)	DOC has a key interest in the achievement of waterway restoration for both its terrestrial and marine biodiversity impacts. DOC has a critical role to play in the strategic oversight of terrestrial restoration, and in terms of holding specific ecological expertise for restoration projects. DOC is a large scale landowner in the Coromandel Waikato region and thus could be a key supply of land for waterway restoration. DOC is limited as to what it can achieve on privately owned land, thus partnerships to achieve restoration on private land are attractive to DOC in a general sense. DOC administers various funds that support waterway restoration.	Interest: Medium Influence: High
Mana whenua iwi of the	Mana whenua have a direct and strong interest in the restoration of strong mauri to the	Interest: High

[28] Pers comm. Sam Judd. 2017. Sustainable Coastlines.

[29] Pers comm. Peter Wilson. 2018. Te Arai Nursery.

Hauraki Gulf	Hauraki Gulf. Mana whenua iwi often have an iwi management plan with details of the goals and aspirations. Mana whenua iwi are major landowners and may be interested in crowdfunding for waterway restoration with Million Metres. Mana whenua hold significant levels of influence in their communities.	Influence: Medium
Auckland Council and Waikato Regional Council	Regional councils are responsible for the implementation of the Resource Management Act 1991 (RMA) and the National Policy Statement Freshwater. They develop regional plans to manage the way we use land, air and water. Regional councils also have biodiversity, pest management, parks, land management and waterway programmes that intersect with and influence waterway restoration for Hauraki Gulf. Auckland Council and Waikato Regional Council have a high level of interest, influence and investment in the Hauraki Gulf Marine Spatial Plan and the achievement of its goals. Regional Councils have several sediment specific roles: regional monitoring and research, policy development and implementation of sediment management approaches.	Interest: High Influence: High
Hauraki, Matamata-Piako, Thames-Coromandel, and Waikato District Councils.	These District Councils sit on the Hauraki Gulf Forum. They have had a direct interest in the development of the Hauraki Gulf Marine Spatial Plan. While there is significant interest and engagement of district councils in the Hauraki Gulf process, this is not their core focus and thus interest is not high. Key leaders within district councils do, however, have the potential to significantly influence outcomes of any initiative aimed at scaling waterway restoration for Hauraki Gulf.	Interest: Medium Influence: High
The Hauraki Gulf Forum	The Hauraki Gulf Forum (HGF) is a key stakeholder to any waterway restoration initiative in the Hauraki Gulf. The HGF oversaw the development of the Marine Spatial Plan. The Hauraki Gulf Forum has the potential to drive a high-profile Gulf Sediment Initiative.	Interest: High Influence: High
Funding organisations (eg. MfE, DOC, Regional Councils, Foundation North, Million Metres, WWF, Trees That Count)	Funding organisations play a critical role investing capital into waterway restoration. They also have a key role to play in connecting the dots between the various inputs to waterway restoration, including: land, resources, labour, and research.	Interest: Medium/High Influence: High
Fonterra, Beef & Lamb and other similar sector organisations (e.g. Dairy NZ)	Fonterra, Beef & Lamb NZ, Dairy NZ (etc.) each have a critical role to play in engaging landowners for waterway restoration. Fonterra has also completed several projects to develop sustainable farming models that can inform waterway restoration for the Hauraki Gulf. These organisations have a high level of influence, in that if they do not work on engaging farmers for waterway restoration the work will be significantly slower to implement.	Interest: Medium Influence: High
Landowners/farmers	Landowners, in particular DOC, councils and farmers provide the land input required to waterway restoration. This stakeholder group has a high level of influence, and if not adequately engaged will severely limit progress.	Interest: Medium Influence: High
Te Whangai Trust (and other nurseries)	Te Whangai Trust and other nursery operations (both commercial and community) around the Hauraki Gulf catchment will provide the plants and trees needed to achieve waterway restoration. As such this group of stakeholders has a high level of influence on the ability to scale waterway restoration. Nurseries have the potential to help reduce the costs of waterway restoration via cost reductions and/or social enterprise models of operation.	Interest: High Influence: High
Environmental NGOs	Some environmental NGOs are engaged in waterway restoration as part of their core operations. For example, Forest & Bird, Mountains to Sea, Whitebait Connection and The Nature Conservancy. Environmental NGOs have a number of potential roles that could usefully augment current activities and help to support scale. The support of environmental NGOs will help deliver scale for waterway restoration; however, these relationships are not critical to the same degree as those highlighted above.	Interest: Medium Influence: Medium
Community Groups – landcare and streamcare	Community groups are currently driving waterway restoration in their communities to a large degree. These groups are motivated to achieve great water quality outcomes;	Interest: High

groups	often have built up local knowledge and years of experience; and well developed networks in their communities. These groups have the potential to be key delivery partners for scaled up waterway restoration, as well as the influence to either enable or hinder local scale restoration.	Influence: High
Volunteer organisations (e.g. Conservation Volunteers NZ)	Volunteer organisations have the potential to support waterway restoration with labour. Waterway restoration is not typically their only function or core function. Their support would be beneficial, but is not essential.	Interest: Medium Influence: Low
The Corrections Department	As above, The Corrections Department has the potential to supply both native plants and labour for waterway restoration. This source of plants and labour could significantly boost capacity to scale this work. Corrections has expressed interest in supplying plants and labour for waterway restoration; however, this is far from its core function. Its engagement is not critical.	Interest: Medium Influence: Low
Research organisations (eg. Landcare Research, NIWA, Auckland University)	Partnership with at least one research organisation is required to develop adequate monitoring and reporting on the impacts of waterway restoration. This relationship is seen as high priority; however, their interest could be comparatively low. Their influence on the delivery of waterway restoration itself is not considered high.	Interest: Medium Influence: Medium
Citizen science initiatives (e.g. Waicare, SCHMAK by NIWA)	There are opportunities to engage with citizen science programmes and connect them with landowners, and/or develop a citizen science component to the scaling of waterway restoration. This could be developed as part of a partnership with a research organisation. This set of stakeholders are not considering critical.	Interest: Medium Influence: Low
Predator Free New Zealand	Engagement with Predator Free New Zealand and/or other pest management expertise to assess the needs of ongoing pest management of established native forest/scrub/wetland beside waterways. Developing a robust ongoing pest management strategy for large scale areas of restored native vegetation will be needed. If this component of the work is not completed there will be a considerable risk of poor quality plantings that will struggle to provide ecosystem services to their full potential.	Interest: Medium Influence: Low

5. Analysing the challenge – urban water pollution

There are other potential business collaborations beyond Million Metres and supporting riparian planting, particularly in urban areas.

The pollution sources investigated were informed by authoritative sources, such as the *State of our Gulf* reports. They were: sediment from construction sites (large and small scale); copper from road vehicle brake pads and anti-foul boat paints; and zinc from road vehicle tyres and unpainted galvanized metal roofing.

Key sources of urban water pollution into the Hauraki Gulf

In the tables below we outline the problem scenario for each source, the existing measures to tackle them and what barriers and opportunities exist for further intervention options.

Earthworks/construction sites (large)	
1. Problem scenario	There are many large-scale construction projects within the Hauraki Gulf catchments in urban Auckland and greenfield sites. Each has the potential to be a significant source of sediment flow from earthworks and poor site management.
2. Existing measures	Earthworks on larger scale sites (greater than 500m^2) require specific resource consents, and typically have detailed, site-specific control requirements. The works are generally carried out by the larger construction operators that use best practice erosion and sediment control measures and implement self-monitoring plans. These are backed up by proactive monitoring and enforcement programmes, carried out by the regulator, Auckland Council, and its agents.
3. Barriers and Opportunities	Given the level of regulatory control in place for these large sites, and the capabilities of the main contractors, there is limited opportunity for additional action. However, there is a need for ongoing vigilance to ensure there is continual performance improvement as best practices are enhanced. At strategic sites, the use of stormwater filtration devices would supplement the on-site control measures.

Earthworks / construction sites (small/medium)	
1. Problem scenario	Over recent years, the level of residential construction activity in Auckland has increased. This is expected to accelerate markedly over the next decade, both in the current urban area and greenfield sites. Whilst at an individual site level the effect from sediment flow is quite limited, collectively the potential impact is very significant, especially during heavy rainfall events.
2. Existing measures	Earthworks on smaller sites (less than 500m^2) do not require specific resource consents. Although site managers are required to use best practice erosion and sediment control measures, there is quite variable conformance and use of such measures. Given the volume of sites the regulator (Auckland Council) is unable to proactively monitor each site. However, Auckland Council has developed a useful set of tools and resources (videos, online guide and hard copy guide) with best practice guidance for site management, targeted at those involved with smaller sites[30]. The hard copy guide (in English and Mandarin) is available on request, although it cannot be provided routinely to all sites, for various reasons (including cost

[30] https://www.aucklandcouncil.govt.nz/building-and-consents/understanding-building-consents-process/starting-building-renovation-work/Pages/building-site-management.aspx

	constraints).
3. Barriers and Opportunities	The key barriers for these smaller sites are the general lack of knowledge of best practice control measures among site workers and the limited enforcement capacity of the regulator. The knowledge deficit is accentuated by the number of new entrants into the industry, including those from overseas. There is a good opportunity to address this by improving awareness of best practice through wider circulation of the existing guide and resources, and potentially additional resources. This could be achieved in many ways, through different stakeholder/industry group and across multiple channels.

Road vehicle brake pads	
1. Problem scenario	Copper is used in most vehicle brake pads. It is currently the most cost effective way to provide smooth braking, transfer heat efficiently and help braking effectiveness in cold weather. During braking tiny copper fragments detach and flow into the stormwater system. With more than 1.2 million cars and vans registered in Auckland, plus trucks and buses, the collective impact from these non-point sources is significant.
2. Existing measures	Currently, there is no control over the levels of copper in brake pads in New Zealand. With almost no production of vehicles or after-market parts in New Zealand, we are reliant on reduction initiatives overseas. The European Union (EU) and certain states of the US have introduced legislation to control the levels of copper. For example, California requires levels to be below 5% by 2021 and 0.5% by 2025[31]. These regulations are incentivising manufacturers to accelerate the development of low copper brake pads. The US after-market parts industry has developed a reference standard, the 'Leaf Mark', to indicate whether brake pads meet these standards (refer Appendix E).
3. Barriers and Opportunities	The key barrier at present is supply of brake pads, although potentially cost and consumer preferences could emerge. In response to specific requests, representatives from the NZ motor industry have indicated that some lower copper formulations are expected to be available later in 2018. But the extent of availability, relative cost and performance attributes are not clear. The risk is that as other markets require lower copper pads then the NZ market will be used to absorb legacy production of the higher copper pads. However, there is an opportunity to build up awareness of the issue within the business community to generate interest and demand for low copper pads. Alongside fuel efficiency this is another argument for using smoother driving technique with less acceleration and braking, or even reducing vehicle use.

Anti-foul paints (boat hulls)	
1. Problem scenario	Copper is the main biocide used in most anti-foul paints around the world. It is used in all formulations available in New Zealand. The paint is applied to boat hulls to prevent the build-up of shellfish and other marine life. This action improves the fuel efficiency of boats. There is the risk of paint spilling into uncontained areas during application and getting washed into the sea. This risk is relatively low. The activity is regulated and there are good controls in professional operations. But the paint also degrades over time, releasing copper fragments into the marine environment. This cannot be contained. There are well over 5,000 berths, mostly occupied in the main Auckland marinas serving the

[31] https://www.epa.gov/npdes/copper-free-brake-initiative

	Hauraki Gulf. In addition, there are boats anchored in the harbour and tens of thousands of smaller vessels housed on land. A 2013 NIWA study[32] estimated the copper discharge at the main Auckland marinas as more than double that flowing in stormwater from the Waitamatā catchment.
2. Existing measures	The anti-foul paint market is controlled in New Zealand by the Environmental Protection Agency (EPA). A comprehensive 2013 EPA study[33] into the use of copper in paints concluded that "banning copper would be infeasible given the lack of substitute paints currently available" and that "approved substances in antifouling paints all contain copper and co-biocides and are toxic, they have to be or they would not serve their purpose." However, the EPA did decline some applications for licenses, including those with higher copper concentrations. The New Zealand market mirrors those overseas, which are dominated by copper formulations. However, there are efforts being made to develop alternatives, including non-biocidal alternatives. These include paints containing silicone coatings or ultrasound and biomimetic coatings such as those which imitate shark skin to stop the attachment of organisms. Regulatory control is beginning to be introduced overseas, for example in Washington State in the US. This bans copper paints on recreational boats from 2020, and is primarily to avoid impact on the important salmon fishery, although the implementation has recently been deferred[34]. It is understood that none of these alternatives is available in New Zealand.
3. Barriers and Opportunities	As mentioned above, the key barrier is technology and the lack of supply. Some sectors of the recreational boating industry are aware of the issues with copper in anti-foul paints, and other environmental issues. For example, the NZ Marina Operators Association operates the Clean Marina Programme[35]. There is an opportunity to raise awareness of the impacts of copper in anti-foul paint, through such programmes and engaging with other stakeholder groups.

Unpainted galvanized roofing	
1. Problem scenario	Zinc is used in the manufacturing process of galvanised metal (corrugated) roofing sheets. These have been one of the main materials used on houses and industrial buildings over many decades. This roofing material was typically not painted on older buildings. Over time this has led to zinc particles decaying from the roofing material and into the downpipes and the stormwater system. This is accepted by most as a significant ongoing source of zinc.
2. Existing measures	There is now a much wider range of roofing options, including painted galvanized metal sheets. Therefore, this is generally considered a legacy issue. It will reduce over time as buildings or roofing are upgraded or replaced. An interim option is to paint the unpainted roofs. However, despite the availability of many roofing alternatives, current Auckland regulations in the Unitary Plan do not explicitly control their use, although there were control provisions in an early draft of the Plan. In terms of mitigation measures, there are also stormwater treatment devices, which can be connected at the base of down-pipes to filter some contaminants.
3. Barriers and Opportunities	The key barrier to the installation, replacement or upgrading of roofing would seem to be cost. Auckland Council's Healthy Waters (Wai Ora) team is undertaking detailed research into the profile of discharge of contaminants in certain industrial areas (including Whau area). This research should help to identify mitigation options, enabling action to be targeted at the most significant source scenarios.

[32] https://www.niwa.co.nz/news/are-antifouling-paints-harming-our-sealife

[33] https://epa.govt.nz/everyday-environment/painting-your-boat/

[34] http://www.marinadockage.com/washington-state-halts-ban-antifouling-copper-paints/

[35] http://www.cleanmarinas.org.nz/

Road vehicle tyres	
1. Problem scenario	Zinc oxide is a key ingredient in the manufacture of tyres, aiding the rubber vulcanisation process. While in use tiny zinc particles detach from the tyres and flow into the stormwater system. There are more than 1.2 million light vehicles (cars and vans) registered in Auckland, plus trucks and buses. The collective impact from these non-point[36] sources is significant. The impact will be greatest in areas of high vehicle use.
2. Existing measures	There are no alternatives to zinc in tyres. Research has been done overseas into alternatives, but it is unlikely that any will be commercially available in the near future. Therefore, the prime means of control is to try and reduce contaminants from the roading network entering streams and the harbour via the stormwater system. There are stormwater management design techniques (like wetlands) and devices available in New Zealand that filter out contaminants, including zinc and copper. For example, in 2017 Auckland Transport installed two such filters under Te Atatu Road as part of a roading improvement project. But there are various constraints, including cost, which limit the use of such devices.
3. Barriers and Opportunities	As mentioned the key barriers are technology (there is no alternative to zinc) and the cost of filtration devices. So, opportunities are limited.

Analysis of SBN members and impacts on Hauraki Gulf

We looked at how the network of SBN member businesses impacts the key catchments feeding the Gulf. We identified those based in Auckland and sited in one of the Gulf catchments (including proximity to high pollution sub-catchments), and also those based outside but with (or connections with) activities within the catchment.

We assessed whether the member undertook activities that contributed to or addressed the problems of sediment or heavy metals, and/or had a potential role in advocacy/communications.

The analysis identified 70 different SBN members meeting at least one of the criteria, with the following relevance:

- 14 members have association with the sediment problem
- 51 members have association with heavy metals problem related (mainly related to vehicle fleets)
- 21 members have some association with providing solutions for sediment and/or heavy metals
- 24 members have a potential role in advocacy

This suggests a powerful point of leverage to build wider collaboration on water quality in the Gulf.

[36] Non-point source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters. Compare with point source pollution which is any single identifiable source of pollution from which pollutants are discharged, such as a pipe.

6. Options for scaling waterway restoration to reduce rural water pollution

What is the Hauraki Gulf planting opportunity?

We estimate that the Auckland region has 3,667 kilometres of stream that is un-vegetated (i.e. has vegetation cover/width of 0.5m or less)[37] that flows into the Hauraki Gulf. This is approximately 41% of the total stream length of 9,000 kilometres[38] (see Appendix B). Data was not available for the Waikato region, so this initial assessment only considers the Auckland region. However, we know that Waikato rivers flowing into the Hauraki Gulf are in the order of four times the scale of those in Auckland region.

The following estimates are high-level only. They are outlined here to provide an indication of the scale of the planting opportunity for the Hauraki Gulf.

Option One provides cost estimates for planting 25% of all un-vegetated waterway in Auckland region at 3, 5 10 and 20 metres planting width, with one metre spacing between seedlings.

Option Two provides estimates for planting 50% of all un-vegetated waterway in Hauraki catchments with 3, 5, 10, and 20 metres planting width, with one metre spacing between seedlings.

One quarter and one half of all un-vegetated stream were chosen as two plausible scenarios of planting need. Some areas cannot be planted (e.g. urban paved areas). In some areas planting will not be the appropriate sediment control measure (e.g. where engineering work is considered the most appropriate option).

The estimates include the costs associated with: site preparation, seedlings, labour, and maintenance for three seasons. These estimates do not include administration costs, project planning or coordination costs; costs associated with collaboration and/or partnerships and travel; and monitoring for impacts of the planting. This analysis does not include wetland restoration opportunities and costs.

Based on this initial analysis we estimate the planting opportunity in the Auckland catchments draining to the Hauraki Gulf to be in the range of $34 - $67.5 million, based on the goal of achieving an average of 5m wide plantings (Table 3). This represents a planting opportunity or aspiration of approximately 4.5 - 9 million plants and trees.

Table 3: Estimated riparian planting costs for un-vegetated stream: Auckland region

Planting width	Planting Length Option 1: 915 kilometres	Planting length Option 2: 1,800 kilometres
3 metres	$20,587,500	$40,500,000
5 metres	$34,312,500	$67,500,000
10 metres	$68,625,000	$135,000,000
20 metres	$137,250,000	$270,000,000

[37] This rapid GIS analysis has been completed by Morphum in the process of developing this scoping report and a proposal to complete comprehensive analysis for Auckland region. These rapid investigations should only be considered a high-level estimate of riparian cover. Limitations include: riparian cover not being measured because of inaccuracies in some channel centre lines versus actual channel width; some riparian cover not being included because of map discrepancies; and some areas being measured as not having riparian cover, but having no restoration opportunity (ie. uban areas with impervious surface cover).

[38] Based on overland flow paths with a catchment of >2 hectares intersected with vegetation >0.5m.

Based on the above estimate for Auckland region, we suggest that the opportunity in Waikato catchments draining to the Hauraki Gulf could be in the order of $80-$160 million. However, additional analysis is necessary to estimate this.

The full costs associated with planting are expected to be considerably higher than this initial assessment, because this assessment does not incorporate all the costs associated with planting, and because the length and width of planting required may be greater than the conservative parameters chosen here. We recommend a thorough economic and business analysis is undertaken to understand in full the business opportunity for waterway restoration in the Hauraki Gulf. This analysis should include wetland opportunities and costs.

Where should we focus planting efforts?

We identified 10 key areas comprising approximately 30 catchments where planting effort could be focused to maximise sediment reduction results.

We considered available information on sediment and identified the following catchments as priority areas for effort to reduce sedimentation rates in the Auckland region:

- Waiheke Island (Gulf Islands)
- North East
- Mahurangi catchment
- Hibiscus Coast
- Tāmaki
- Wairoa.[39]

We considered available information on sediment and identified the following catchments as priority areas for effort to reduce sedimentation rates in the Waikato region:

- Miranda catchments (15 small catchments that run into the western Firth of Thames)
- Piako
- Waihou
- The Coromandel catchments with Catchment Management Plans: Wharekawa, Tairua, Whangapoua, Whitianga, Whangamata, and Coromandel)[40].

Collaboration to scale waterway restoration for the Hauraki Gulf

There is a significant opportunity to scale up waterway restoration for the Hauraki Gulf through coordinated collaborative catchment planting projects.

Collaboration with key stakeholders outlined in the above Stakeholder Analysis provides an opportunity for innovation. This can overcome some of the key barriers to scale in the existing waterway restoration 'eco-system'. Here we propose a three-year collaborative pilot to test scaling waterway restoration. This would be a partnership between Million Metres, Te Whangai Trust, five catchment groups on the Western Firth of Thames, regional councils and others. Lessons from this collaboration will be used to build upon and scale up collaboration for large scale waterway restoration around the Hauraki Gulf over the next decade.

[39] This assessment is based on available sediment data collated on Auckland Council's watershed web platform: Auckland's Watersheds: Current State Story Maps and the recommendations of the *Hauraki Gulf Marine Spatial Plan*.

[40] This assessment is based on the recommendations of the *Hauraki Gulf Marine Spatial Plan*, Swates et al. 2016, and Catchment and Harbour Management Plans developed around Coromandel.

SBN's Million Metres project provides an innovative process for accessing capital for planting. This scoping study has identified a number of key limitations to Million Metres' ability to scale, including access to willing landowners and to low cost plants.

Te Whangai Trust is a native nursery set up using a social enterprise model. Based at Miranda, Te Whangai Trust works across the Waikato and Auckland regions with recently released prison inmates. It takes them through a job readiness programme and helps them find employment.

Te Whangai Trust provides plants and labour for waterway restoration. It has access to hundreds of farmers engaged in planting the 15 short catchments running north from Miranda along the Western Firth of Thames coast. Te Whangai Trust and the farmer catchment groups are limited by lack of capital to develop riparian planting plans and deliver the planting.

Te Whangai Trust and Million Metres are collaborating to scale planting for the Hauraki Gulf, beginning with a pilot in the Miranda area, where Million Metres can support the farmer catchment groups to find capital investment and achieve their planting goals. Million Metres and Te Whangai Trust see that working together can overcome some of the barriers for scaled-up planting.

In the Western Firth of Thames farming communities have come together through the Incubate[41] process to take the pressure off individual farmers and implement waterway restoration as a community. The groups of farmers have come a long way in their process of working together and setting priorities for waterway restoration. Te Whangai Trust has identified capital as the key input required to increase progress across the catchments. Capital investment is needed to support the farmers to create high quality restoration plans, and to deliver those plans.

Million Metres will work with the Western Firth of Thames catchment groups to pilot the scaling up of investment in waterway restoration via a mix of funding sources. For example, by using Million Metres crowdfunded investment to leverage significant corporate match funding.

Coordinating planting projects at catchment scale and across catchments will enable significant efficiencies of scale. It will provide a peer learning environment for landowners. Landowners will not be working alone and in isolation, but are a part of a much larger group in their catchment.

This work will be delivered over three years, with the plan to scale the approach around the Hauraki Gulf in the subsequent years. The following is an indicative approach. It is expected that new collaboration partners will come on board and priorities may be identified throughout the process with the farmer catchment groups. This would develop the work programme over time.

Year 1: Create planting plans and a strategy for investment

- Te Whangai Trust will work with the farmer-led catchment groups to develop riparian planting plans
- Million Metres will work with the farmer-led catchment groups to develop a strategy for raising capital (including experimentation with a range of novel funding opportunities and ways to reduce the costs of planting)
- Million Metres will support the catchment group's launch of their first small scale fundraising campaign
- Million Metres will connect Auckland businesses with the Western Firth of Thames restoration efforts. Businesses will be educated about the State of the Hauraki Gulf and engaged in the effort to scale up waterway restoration to reduce sediment and clean up the waters of the Hauraki Gulf
- Te Whangai Trust will deliver waterway restoration planting

[41] Incubate is a facilitated collaborative process through which groups can agree to shared goals and work towards achieving them.

Year 2: Full scale fundraising campaign and activation by business, young people, and rural communities

- Te Whangai Trust will continue to develop riparian planting plans and deliver planting
- Million Metres will work with the farmer-led catchment groups to develop a full scale fundraising campaign to implement the investment strategy developed
- Million Metres will support the full scale fundraising campaign to achieve success, including story-telling, promotion, and growing youth and business engagement
- Te Whangai Trust will deliver waterway restoration planting

Year 3: Corporate match investment for the Western Firth of Thames

- Te Whangai Trust will continue to develop riparian planting plans and deliver planting
- Million Metres will work with the farmer catchment groups to deliver the second stage of fundraising, including growing investment by focusing on leveraging Million Metres' investment in planting with corporate match

Continued work to scale impact around the Hauraki Gulf

Million Metres will also continue its existing work in the Hauraki Gulf.

Million Metres currently partners with numerous organisations, in particular Auckland Council, to deliver six waterway restoration projects around the Hauraki Gulf (Table 4), and has an additional seven Hauraki Gulf projects in its pipeline for the remainder of 2018.

Table 4: Current Million Metres Hauraki Gulf catchment waterway restoration

Project	Macro-catchment	Community Organisation	Fundraising goal	Project scale
Rosebank Peninsula	Waitamatā	Whau River Catchment Trust	$50,000	500 metres 12,000 plants
Rangihoua Wetland	Waiheke	Waiheke Resources Trust	$43,000	1,500 metres 1,020 plants
Otara Creek	Tamaki	Otara Waterways & Lake Trust	$32,000	630 metres 3,100 plants
Mill Stream, Warkworth	Rodney	Private landowner	$25,000	510 metres 6000 plants
Wairoa River	Wairoa	Friends of Te Wairoa	$22,000	314 metres 2,000 plants
Kaipatiki Project, North Shore	Waitamatā	Kaipatiki Project	Approx. $30,000	To be determined
Total	**5 macro-catchments**	**5+ community organisations** **1 landowner**	**$202,000**	**>3454 metres** **>25,000 plants**

As a result of the work carried out for this scoping study, Million Metres is also developing a collaboration with Waikato Regional Council for the Coromandel, Waihou and Piako areas that would see Million Metres begin to support rural landowners in those catchments.

Foundation North partnership

We propose a three-year partnership between Foundation North and Million Metres to achieve this work. The work programme will continue beyond this time period. Million Metres will continue beyond the three-year timeframe to scale up waterway restoration around the Gulf.

The costs will be incorporated into the operational expenses of Million Metres. Million Metres is seeking $350,000 annually to secure its operational costs over the next three years. Securing this funding is the most effective way to accelerate and scale Million Metres' investment in waterway restoration.

Te Whangai Trust covers the expenses associated with its components of the collaboration.

The impact

We are confident this will enable Million Metres to deliver a 200% return on this investment in increased business and personal donations to our projects.

This would increase new/additional investment in waterway restoration to $700,000 a year.

This will be achieved by:

- using the additional resources to leverage the existing network of support for Million Metres
- engaging with a larger group of stakeholders, landowners, businesses (including SBN's Now Crowd[42]) and organisations
- develop key collaborators specifically to engage farmers (and manage sediment) at scale including:
    - Auckland Council
    - Te Whangai Trust
    - Iwi
    - Waikato Regional Council
    - Beef and Lamb
    - Fonterra
    - Hauraki Gulf Forum
    - Crown Research Institutes

This work will also provide numerous environmental benefits to assist in the protection and restoration of the Hauraki Gulf ecosystem as a whole.

In addition, fundraising work and planting days provide powerful and practical ways for the business community, and the wider community, to directly engage in work to help restore the Gulf.

[42] See https://www.nowcrowd.org.nz/

7. Options for intervention in urban water pollution

Following on from our analysis we assessed potential intervention options to tackle the main sources of pollution in the Gulf. The options have been initially evaluated using a range of criteria, including:

- relative priority
- ease of implementation
- indicative cost
- breadth and depth of potential engagement (including using SBN membership)
- breadth and depth of potential impact,
- connection with influencers and ability to apply leverage (including using SBN membership)

The following broad option types have been identified:

1. Targeted action programmes on specific issues
2. A general programme of business engagement
3. An over-arching Gulf campaign

Targeted action programmes for urban areas

These options involve working directly with the industry sectors and businesses on the supply-side and are (for want of a lighter phrase) 'part of the problem'.

Targeted action: Brake pads and the NZ motor industry	
Summary of option	**Develop an engagement programme with interested stakeholders in the NZ automotive industry (e.g. industry bodies, automotive suppliers, servicing operators, importers) to accelerate the introduction of low/no copper brake pads into the NZ market.** The content of the programme would depend on those willing to participate, but could include: providing information to vehicle owners; generating demand through fleet providers; collective industry action to secure supply from overseas; 'aftermarket' supply by key retailers.
Initial evaluation	Based on preliminary discussions with some industry supplier representatives, there is awareness and interest in supplying the low copper brake pads, and some products are expected in New Zealand later in 2018. But, as noted above, there is limited awareness among buyers, and no indications of a regulatory change. Overall the issue has poor visibility and any potential action project may struggle to compete with other environmental initiatives. However, if there is a well-designed campaign to raise awareness (leading to demand) and collaboration with willing industry suppliers (to provide the supply), then there are reasonable prospects for an accelerated introduction of low copper brake pads.
Overall assessment	Given some interest in the sector and the likely availability of product in the near future, then there seem reasonable prospects to accelerate the uptake of low copper brake pads through a well-designed initiative. It is also a product type which is used by all businesses, so we can engage with the whole SBN membership.

Targeted action: Key sites in priority industrial areas	
Summary of option	**Develop a highly targeted engagement programme with relevant businesses in the**

	key commercial/industrial areas within priority catchments (such as Whau and upper Tamaki). This could focus on two aspects: unpainted galvanized roofs (zinc), and metal works/welders (copper). A painting programme could be developed to facilitate voluntary action to re-paint or replace unpainted roofs. It would provide information and develop a process, to connect site owners with service providers. A best practice site management package could be developed for metal work operations, building on existing material. This work could build on the work by Auckland Council and its contractors with similar models of engagement (for other environmental issues), involving direct approaches to high priority sites and buildings.
Initial evaluation	Highly targeted programmes of this type have been shown to have some success, especially if carried out by non-regulatory agents. Auckland Council is already undertaking some detailed site-specific analysis which could be used as a basis for this targeting. As well, the available monitoring site data indicates likely 'hotspot' sites. There will be costs involved for the site owners (for roof painting/replacement) so unless this initiative is coordinated with regulatory enforcement it relies on the goodwill of site owners.
Overall assessment	This is a significant issue and a targeted approach has the potential to be successful. The challenge of engaging with, and gaining support from, the necessary decision-makers (for the roofing issue) should not be under-estimated. Despite this, the significance of the issue suggests that an appropriate initiative should be developed.

Targeted action: Anti-foul paints and the NZ marine industry	
Summary of option	**Develop an engagement programme with interested players in the NZ marine industry (e.g. marina operators, industry bodies, boat painters, retailers) to minimise the impacts of copper in anti-foul.** The content of the programme would depend on those willing to participate. It could include: • use of low copper paint formulations by paint operators • application of paints in a highly controlled manner (beyond compliance) • providing information to boat owners • a 'design challenge' for the local marine and tertiary education sectors, to develop a non-copper (toxic) anti-foul solution • collective industry action to secure alternative supply from overseas; and then supply by key retailers The issue could also be part of a more wide-ranging campaign to address land-based contaminants.
Initial evaluation	The problem of copper in anti-foul paints is relatively concentrated, being centred around the larger marinas. The direct connection with the marine environment can be leveraged to encourage change. The need for Auckland to showcase a clean marine environment during the 2021 America's Cup provides added impetus for action. There is an existing sector initiative (the Clean Marinas Programme) which indicates willingness of the sector, although the programme's scope is limited and doesn't address anti-foul specifically. So overall there could be reasonable levels of motivation. Unfortunately, there are no anti-foul solutions commercially available in New Zealand, and very few overseas, which don't use toxic ingredients like copper. The EPA stated in its 2013 report that "…the approved substances in anti-fouling paints all contain copper and co-biocides and are toxic, they have to be or they would not serve their purpose." Clean boat hulls are critical to avoid drag and so provide optimal fuel efficiency. Some estimates suggest heavily fouled hulls can result in up to a 40% loss of efficiency. However, the same EPS report also recommended that authorities should "undertake or encourage further research on safer alternatives to the current antifouling paints." The 2021 America's Cup provides a prime opportunity to encourage further research into alternatives, as well as other actions to minimise the leaching of copper from boat hulls.

Overall assessment	The 2021 America's Cup provides a 'rallying point' for action to clean up the Gulf. The anti-foul paint issue is a prime opportunity with a direct connection. But there is a lack of alternatives to provide the required anti-foul performance. Despite this there is potential to raise awareness and some willingness from parts of the sector to engage. The best opportunity may be to include the issue within an overall campaign, and investigate the potential for a design challenge (see separate commentary below).

Targeted action: Sediment control and smaller-scale construction sites	
Summary of option	**Develop an engagement programme for the residential building industry to improve understanding of, and action on, sediment control on smaller construction sites.** Although there are statutory requirements around such control, compliance is variable. This programme would include: • working with industry bodies, regulatory agencies, and builders to develop more effective training • optimise use of the tools and resources already available (such as Auckland Council's best practice guidance package) • introduce innovative ways to improve performance, including targeted approaches in high priority areas and among certain industry groups (e.g. those inexperienced in New Zealand standards and practices).
Initial evaluation	The advantages of such an engagement programme is the availability of existing resources, and knowledge that direct targeted engagement has been shown to work with similar environmental issues. There is already a regulatory requirement for sites so the programme could also be linked to enforcement action to take a 'carrot and stick' approach. Given the quantity and geographical spread of the construction sites, there is a clear need for appropriate targeting of the high priority areas. Even with appropriate targeting the costs could be significant. Given the existing role in this issue by the regulatory authorities, any action programme would require strong collaboration.
Overall assessment	There is potential for an effective action programme to be developed. But it would be preferable that this is well aligned with the activities of Auckland Council. At this stage we haven't been able to confirm how that might work. So, although the issue can form part of an overall awareness-raising campaign, no specific action programme is suggested at this time.

Targeted action: Design Challenge – non-biocidal anti-foul paint	
Summary of option	**The 2021 America's Cup creates an opportunity for NZ's marine and academic communities to collaborate on the development of a low-impact, effective, and cost efficient alternative to copper in anti-foul solutions.** Globally there is research into the development of anti-foul solutions for boat hulls that avoid the need for toxic paints and covering. Alternatives like biomimetic coverings and ultrasound have been investigated, but toxic copper paints dominate. As shown in Figure 4 above, marinas are a major source of copper pollution in the Hauraki Gulf. This could involve a design challenge approach – a call to the local marine industry and tertiary institutions and students to help 'clean up the Gulf'.
Initial evaluation	New Zealand's marine boat design expertise, combined with the 'rallying point' of the 2021 America's Cup creates the potential to energise designers in the industry and academia. The challenge will be to gain sufficient stakeholder support and the funds to incentivise involvement. The challenge could utilise and potentially build on some of the related research undertaken by research organisations (such as the Cawthron Institute).

Overall assessment	There is a lack of alternatives to toxic anti-foul paints. The best opportunity may be to include the issue within an overall campaign, and investigate the use of a design challenge.

Packaged engagement and action scheme

Summary of option	**This option is based on a general business engagement programme.** Willing businesses will be encouraged to commit to actions tackling water pollution issues. A suite of action options will be developed, with supporting information and resources. For example, the action options could include: those covered in the targeted action programme ideas (above) and existing SBN initiatives (e.g. Million Metres Streams). They could also broadened to include other priority contaminants (e.g. plastics). The programme will initially target SBN members, but could be extended to other businesses and organisations, as well as partnerships with other business groups. A highly engaging and dynamic publicity and marketing would be developed. *A variant to this option is using SBN's Now Crowd initiative as an additional mechanism for influencing within organisations. The Now Crowd is SBN's programme to empower young people within larger organisations to drive internal change in sustainability. It is based on a 'Sprint' model, where SBN rapidly gathers people and resources for action on key sustainable business issues. SBN is currently developing a 'Water' sprint. This will incorporate some of the concepts of the packaged engagement option (above). With further investment it could be developed into a comprehensive engagement approach, using an organisation's most energised and committed people to drive good change.*
Initial evaluation	A coordinated and over-arching business engagement programme provides a suitable way for the disparate nature of the in-scope pollution sources to be connected. By initially targeting the more aware and committed businesses and organisations (e.g. SBN members) the programme can be tested and refined with a motivated group, before broadening the target groups. Whilst each business will most likely not be in a position to take action in all the specific action areas (for reasons of relevance and relative priority), providing a 'menu of options' improves the likelihood that at least one is suitable.
Overall assessment	As indicated above, an over-arching business engagement programme will provide an essential way to connect the different pollution source activities. It seems clear that it should be a part of any programme of action. The Now Crowd model provides an additional approach to engagement, but further consideration on the specifics needs to be undertaken.

Over-arching Gulf campaign

Summary of option	The above-mentioned options cover specific action programmes in which businesses can participate. But, as stated, the problem areas are disparate and there is low awareness of the issues. The pollution is not experienced by the general public or businesses (it is generally invisible and not sensed). Combining this low awareness and the disparate nature of the source activities, it is difficult to achieve connection and interest. The 'Big Shift' model for systemic change identifies the need to 'experience the need for change' before meaningful engagement can take place. To enable this, we need to develop awareness and a motivation to act through a campaign. The campaign would primarily be online, with unique branding and a set of dedicated channels (e.g. website, social media presence). It would use a range of engagement methods, including infographics and videos.

	To provide greater 'emotional' connection with the campaign, we recommend that plastic pollution is included in scope. This is an issue people experience at first hand. They see floating bottles in the harbour, debris on our beaches, marine life dying from ingestion or entanglement. By including plastics within our scope we introduce a 'gateway' issue leading to improved awareness of other land-based sources of marine pollution (as described in this report).
Initial evaluation	A campaign would need to be well-scoped, designed and resourced to produce the desired outcome. It would need to appropriately consider related initiatives to avoid confusion or overlap, and ensure complementarity where beneficial. Clarity of message will be needed. Including the high profile and emotionally connecting issue of marine plastic contamination seems essential.
Overall assessment	Awareness of these land-based contamination sources is very limited. Before an effective action programme can be implemented the need for change (action) needs to be experienced and then a motivation to act needs to be developed. An integrated campaign seems essential to deliver these outcomes.

8. Summary & Recommendations

Poor water quality in the Gulf is an issue of ecological, economic and cultural significance that must be addressed. Because of the scale of the problem, and the diffuse nature of the causes, collaboration will be the key to creating long-lasting effective solutions.

This report has highlighted a number of practical options to begin this work. It is hoped that the right partners and resources can be found to pursue these options, while also seeking additional resources to enable additional scale.

Reducing sediment load in rural areas through strategic expansion of the Million Metres Streams

Sediment is the main water quality issue affecting the Hauraki Gulf. *The Hauraki Gulf Marine Spatial Plan* highlights poor water quality as one of the biggest concerns for the health of the Hauraki Gulf. The number one contributor to poor water quality in the Gulf is sediment from the land.

The Hauraki Gulf Marine Spatial Plan recommends a suite of actions to tackle the sediment issue. Our scoping study highlighted the scale of the sediment issue and the need to high level, high profile leadership to really start to tackle this issue.

The Million Metres project gives SBN the ability to support efforts to tackle the sediment issue, by investing capital into waterway restoration. Waterway restoration is one of the key work areas for sediment prioritised by *The Hauraki Gulf Marine Spatial Plan*.

We found that the recommendations of *The Hauraki Gulf Marine Spatial Plan* are influencing decision making and action all around the Gulf catchment. Auckland Council and Waikato Regional Council are funding programmes of work in response to the Plan, although more investment is needed.

We found that there is a significant opportunity to restore wetlands and native vegetation to waterways to reduce sediment reaching the Hauraki Gulf. We estimate this to be in the range of 900-1,800 kilometres with a potential cost of $34 - $67.5 million (just for planting). This is based on 5m wide plantings and represents a planting aspiration of approximately 4.5 – 9 million plants. This analysis was conservative, and does not include wetland restoration. Data was not available for the Waikato region catchment for this analysis, but it would be beneficial to also undertake for Waikato.

This scoping study identified key barriers or bottlenecks in the current ‘eco-system’ for waterway restoration that are limiting scale. In particular we highlighted the need to reduce costs of native restoration, engage landowners, incentivise planting, and increase investment. We propose the development of strategic collaborations to overcome these barriers and innovate for scale in waterway restoration.

Through the work for this scoping report SBN has identified a number of these collaboration opportunities. Specifically, Million Metres proposes to partner with Te Whangai Trust to pilot collaboration for scaling waterway restoration in the Western Firth of Thames.

We recommend:

- a three-year programme of work to develop scale in waterway restoration through the collaboration between Million Metres and Te Whangai Trust for the Western Firth of Thames

- additional funding is sought for a thorough economic and business opportunities analysis to understand in the full the planting opportunity for the Hauraki Gulf. This analysis should also include wetland restoration opportunities.

Reducing pollution loads in urban Auckland through business engagement

Land-based human activity in urban Auckland is resulting in various pollution issues in the Hauraki Gulf. The pollution sources are quite disparate, including vehicle brake pads, anti-fouling marine paints and metal works (for copper); road vehicle tyres and unpainted corrugated steel/iron roofing (for zinc); and earthworks/construction sites (for sediment). Based on the data available from monitoring the overall trend is worsening, across most contaminants and most catchments.

For some problem activities there are lower impact alternatives (e.g. low copper brake pads, painted roofs, construction site control), but for others (e.g. zinc in tyres, anti-foul paints) there are no alternatives. Where alternatives exist there are various barriers, including supply (into NZ), performance (efficacy), cost, consumer preference, limited knowledge, as well as lack of regulation.

Collectively the impact from these activities is very significant. But there is low awareness. These pollution sources are not experienced by the public. Combining this low awareness and the disparate nature of the source activities, it is difficult to achieve connection and interest to address the issues.

Despite these challenges, several options were identified and an integrated set of recommendations are presented which collectively seek to mobilise the business sector:

1. **An overarching communications campaign** – to raise awareness and understanding (targeted at business sector and their people) and create the motivation for action.
2. **A business engagement programme** – to develop the framework, appetite and capacity for action to enable businesses to engage in the targeted action programmes
3. **Targeted action programmes** – to energise and enable businesses to take specific actions, as outlined below in the four focus areas.
    - Focus area 1 – Reducing zinc loss from galvanised roofs in key Gulf catchments
    - Focus area 2 – Accelerating the introduction of very low copper brake pads
    - Focus area 3 – A design challenge for non-toxic anti-foul solutions
    - Focus area 4 – Involvement in SBN's Circular Economy Accelerator's plastics innovation programme

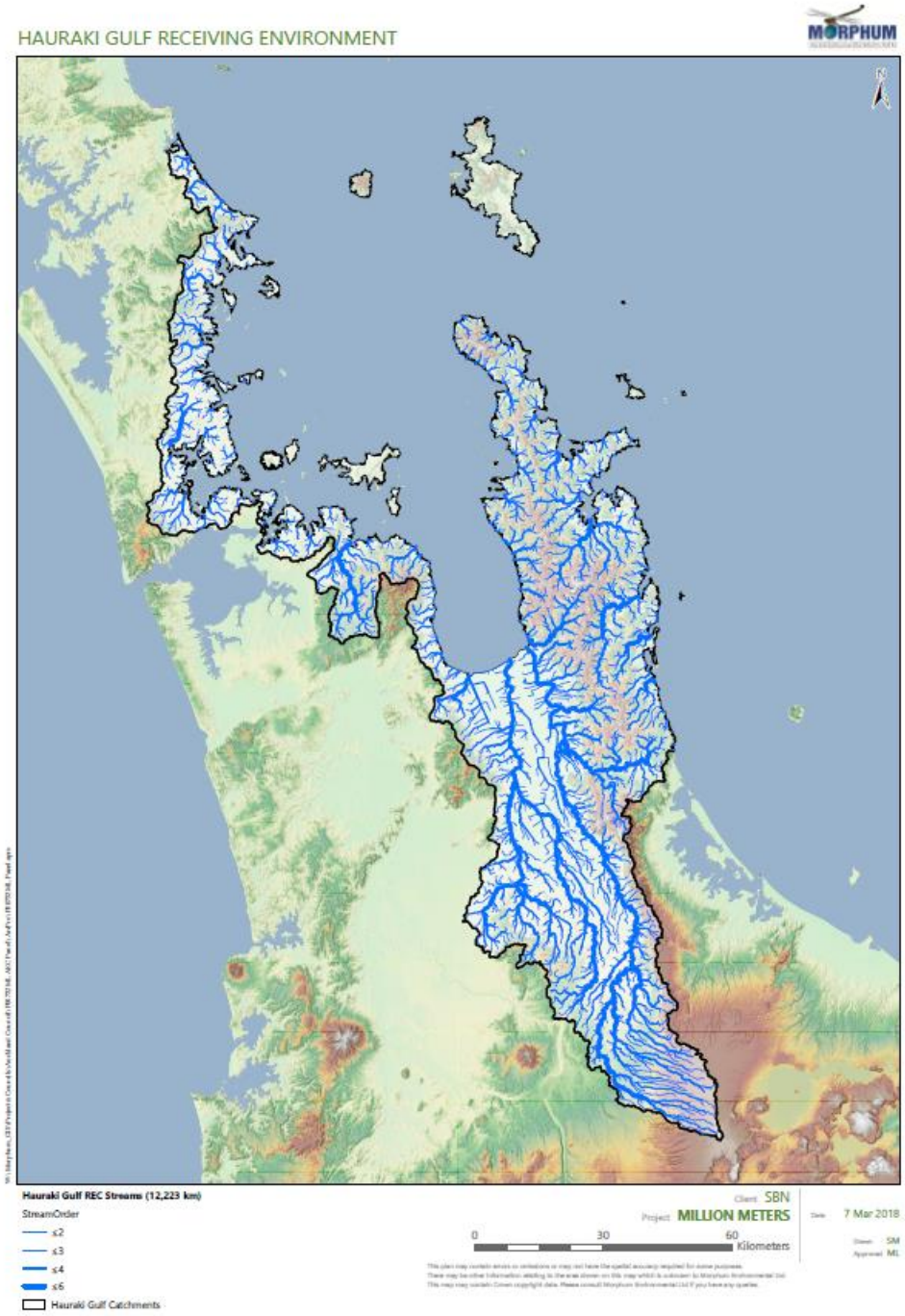
A successful campaign needs 'emotional' connection. Therefore we have included a recommendation that plastic pollution is included in scope. This is an issue which people experience at first hand (floating bottles in the harbour, debris on our beaches, marine life dying from ingestion or entanglement, etc.). By including plastics within our scope we introduce a 'gateway' issue leading to improved awareness of the other land-based sources of marine pollution.

A three-year programme has been developed (estimated cost $200,000 per year – refer to Appendix C):

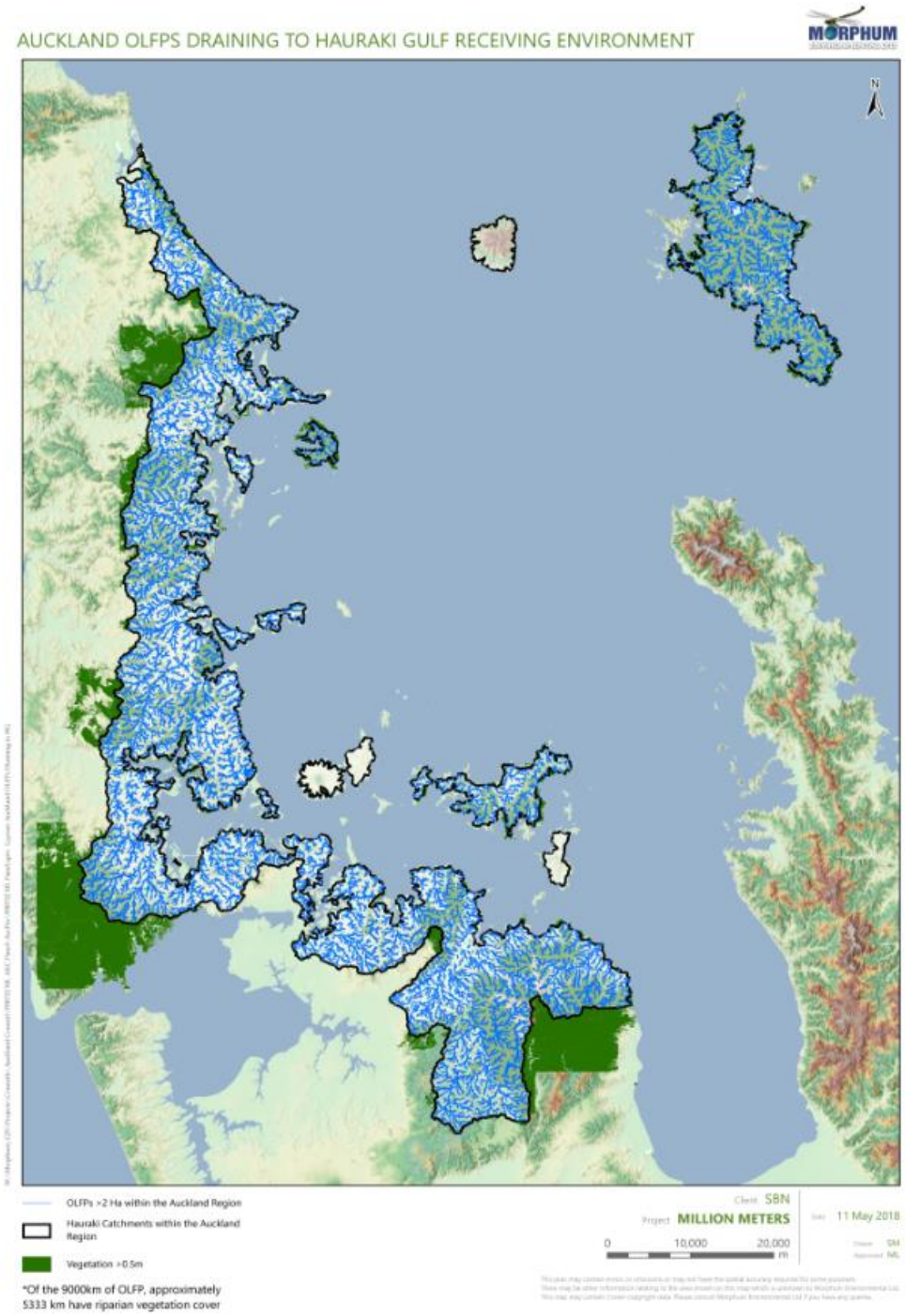
- Year 1 (18/19) - Awareness-raising (through the campaign), building partnerships, and creating solutions for plastics (include design challenges)
- Year 2 (19/20) - (Begin to) introduce plastics solutions and develop solutions for other contaminants (include design challenges, e.g. anti-foul paint)
- Year 3 (20/21) - Accelerate deployment of solutions

Appendices

Appendix A: Hauraki Gulf Receiving Environment (River Environment Classification)



Appendix B: Auckland Region Waterways (Overland Flow Path)



Appendix C: Business Engagement Schedule and Costs

This appendix includes the schedule and indicative costs for the three year programme of action recommended in the report.

Activity area	*Scope*	*Year 1 (18/19)*	*Year 2 (19/20)*	*Year 3 (20/21)*	*Total*
Campaign set-up (internal)	Messaging, website, social media, launch event, etc.	$ 20,000	$ -	$ -	$ 20,000
Campaign set-up & refresh (external)	Branding, design, specialised input (e.g. infographics), etc.	$ 10,000	$ 5,000	$ 5,000	$ 20,000
Campaign operation	Features, news, videos, engagement 'hooks', events, etc. Average 10 hours per week	$ 34,000	$ 46,000	$ 46,000	$ 126,000
Campaign refresh	Review the campaign and refine it as necessary to optimise its performance	$ -	$ 5,000	$ 5,000	$ 10,000
Business engagement set-up	Design & develop the programme (including pledge-type component), supporting materials, processes, etc.	$ 10,000	$ -	$ -	$ 10,000
Business engagement rollout	Targetted engagement with SBN members (year 1 = 50, 2 = 75, 3 = 75; - 8 hours per member)	$ 40,000	$ 60,000	$ 60,000	$ 160,000
Focus area 1 (Plastics) innovation	Linked with SBN CE work - focus on innovation of business activities connected to marine environment issue	$ 25,000	$ -	$ -	$ 25,000
Focus area 1 (Plastics) rollout	Targetted engagement with SBN members (year 1 = 20, 2 = 40, 3 = 40; - 8 hours per member)	$ 16,000	$ 32,000	$ 32,000	$ 80,000
Focus area 2 (roof painting) programme set-up	Design & develop the programme, supporting materials, processes (especially with service providers), etc.	$ 5,000	$ -	$ -	$ 5,000
Focus area 2 (roof painting) programme rollout	Targetted engagement with SBN members (year 1 = 10, 2 = 20, 3 = 20; - 4 hours per member)	$ 4,000	$ 8,000	$ 8,000	$ 20,000
Focus area 3 (Brake pads) programme set-up	Design & develop the programme, supporting materials, processes (especially with product and service providers), etc.	$ -	$ 7,500	$ -	$ 7,500
Focus area 3 (Brake pads) programme rollout	Targetted engagement with SBN members (year 1 = 10, 2 = 20, 3 = 20; - 4 hours per member)	$ -	$ 8,000	$ 16,000	$ 24,000
Focus area 4 (boat anti-foul) innovation	Run a design challenge (including prize), engaging with marine industry, tertiary education sector and others	$ -	$ 20,000	$ -	$ 20,000
Project oversight & management	SBN management - average 2 hours per week allocation	$ 9,200	$ 9,200	$ 9,200	$ 27,600
External relations	Liaising with external parties (e.g. government, agencies, industry groups, academia, conservation/environmental groups, etc.) - average 2 hours per week allocation	$ 9,200	$ 9,200	$ 9,200	$ 27,600
	Total - allocated	**$ 182,400**	**$ 209,900**	**$ 190,400**	**$ 582,700**

Appendix D: Business Engagement scoping project – additional information

Stakeholders/Experts

The following people were spoken to as part of this scoping project. Our thanks for their contributions.

Name	Organisation	Input provided
Jonathan Benge, Tim Hopley, Rhianna Drury	Healthy Waters team, Auckland Council	Council's integrated watershed planning programme and related matters
Gretel Roberts	Technical guidance (Environment), Auckland Council	Water quality issues and related research
Graham Jones	Senior Monitoring Officer (NW1), Licensing and Regulatory Compliance Auckland Council	Construction site monitoring and enforcement
Robyn Simcock	Landcare Research	Water quality issues and related research
Emma Comrie-Thomson	Senior Environmental Consultant, 4-Sight Consulting (ex-ARC)	Practical challenges relating to stormwater management and control
Simon Wilkinson	Wilkinson Environmental Limited (contracted to Auckland Council)	Targeted environmental programmes in the commercial and industrial sectors
Tristan Lavendar	Environmental Manager, Toyota	The role of an OEM in the supply chain (tyres and brake pads)
Garth Middleton	Technical team, Bridgestone Tyres	Confirmation that no known alternatives to zinc-based tyres
Warren Hislop	Brake pad supplier	Information on the brake pad market in NZ and likely introduction of low copper products
Chris Galbraith	Chair, NZ Marina Operators Association	Information on the Clean Marina Programme and the use of anti-foul in the industry
David Laurie	Director, Gloss Boats Marine Spraying	Perspective from a paint service provider
Mike Hannah	Director, Stormwater 360	Information on stormwater pollution control devices and their application
Kirk Clark	Technical team, Brake and Transmissions (BNT)	Information on the brake pad market in NZ and likely introduction of low copper products
Dr Matthew Allen Zach Miller	Senior Reassessments Advisor, EPA	Information on the EPA study into copper in anti-foul paints
Trevor Wallace	Westhaven Marina	Information on the marina operations

Analysis questions

A common set of questions was used as reference when engaging with stakeholders:

Area	Questions
Sources for sediment and heavy metals	What are the main sources? Are they point or non-point? Where are they? For non-point, are they from a common source type?
Action taken or underway	What types? By whom? With what level of success? Why are the successful, or not? (How) can they be enacted by individual organisations?
Action planned or aspirational	What types? By whom? (How) can they be enacted by individual organisations?
Regulatory Control	What are the regulatory tools? How effective are they? Why are they effective? How could they be enhanced?
Parties with influence or control	Which group types have influence and/or control? What is the scope and level of that influence/control? Which organisations (including businesses) have influence and/or control? What is the scope and level of that influence/control? Which of these do we/SBN have relationships with (as members or otherwise)? What are the opportunities to develop or enhance those relationships? Which SBN members have interest and/or influence (direct &/or indirect)

Appendix E: The ‘Leaf Mark’ brake pad campaign (US)

This Leaf Mark has been introduced by the US Automotive Aftermarket Suppliers Association as a pivotal reference to recent legislation in California and Washington. This has mandated the dramatic reduction of copper and other potentially hazardous substances in original equipment and replacement brake pads and shoes.

From 2014 in California and 2015 in Washington, all brake friction materials restricted to no more than 0.1% by weight of asbestiform fibers, chromium, lead and mercury and no more than 0.01% by weight of cadmium. By 2025, California law requires that copper must be less than 0.5% by weight. Washington will adopt a date for 0.5% by weight copper following a feasibility assessment.

To assist consumers and technicians, this new mark helps differentiate between all the new brake pads that comply with the new requirements.

Level A	Level B	Level N
Asbestiform fibers, less than 0.1% by weight	**Contains between 0.5% and 5% of copper by weight**	**Contains less than 0.5% of copper by weight**
Cadmium and its compounds, less than 0.01% by weight	Asbestiform fibers, less than 0.1% by weight	Asbestiform fibers, less than 0.1% by weight
Chromium (VI)-salts, less than 0.1% by weight	Cadmium and its compounds, less than 0.01% by weight	Cadmium and its compounds, less than 0.01% by weight
Lead and its compounds, less than 0.1% by weight	Chromium (VI)-salts, less than 0.1% by weight	Chromium (VI)-salts, less than 0.1% by weight
Mercury and its compounds, less than 0.1% by weight	**L**ead and its compounds, less than 0.1% by weight	Lead and its compounds, less than 0.1% by weight
	Mercury and its compounds, less than 0.1% by weight	Mercury and its compounds, less than 0.1% by weight