**Sub-project timeline, tasks and responsibilities**

End of March for full delivery

Mike: App development

Ton: Methodology and documentation/write up

Olivier: project management, project coordination, comms, website and write up

**Quick glossary**

NPS-FM: National Policy Statement for Freshwater management, 2020 updated February 2023

Attribute: As in NPS-FM Appendix 2A

Attribute state: aka “band”

# Key objectives / audience

The key objective of this scenario builder is to allow users to:

* Access available information on their catchment
* Understand current state of water quality (key attributes)
* Access estimates of natural state to provide an estimate of “best achievable state”
* Understand the size of improvements required to achieve better NPS-FM attribute state(s)
* Explore simple on-land mitigation scenarios involving (1) application of mitigation actions to existing land use and (2) changes in land use

Audience / users: typically multi-party catchment groups or stakeholders (including farmers, iwi, NGOs, council catchment management staff) their advisors, and/or any of these parties individually. The Scenario Builder will be designed to provide a simple tool a freely and publicly available “scenario builder” enabling end-users to explore mixes of land mitigations and land use changes for defined areas (e.g., group of farms of similar freshwater farm plans) and see the effect these have towards improving water quality towards meeting NPS-FM targets

This document identifies elements of work the team feels comfortable delivering within budget / timeframes and those that are be considered to be unlikely to be able to be delivered as part of this project due to the amount of work / complexities involved. They are identified as “tier 2” elements, as potential further /future work (e.g. subject to potential future funding applications)

# Key components

It is anticipated the Scenario Builder will be composed of three main components / modules:

* Current state: To access and visualise existing data and information
* On-farm mitigations: To estimate and visualise the potential improvements brought by on-farm mitigations applied to existing land use
* Land Use Changes: To estimate and visualise potential water quality improvements brought by changes to existing land use mix in the catchment

[Names to be confirmed. Level of interaction between modules also TBC - It is possible the three modules will be rolled into one or two?]

# In-river current state component

**Purpose:** To enable users to visualise the current state of key water quality attributes at existing monitoring sites and how large an improvement would be required to achieve higher/better attribute states (e.g. meet national bottom line, improve on or two bands up). Estimates of natural state will provide an estimate of “best achievable state”.

For each attribute, the user will be able to visualise

**Inputs and outputs**

Steps:

User selects monitoring site (existing monitoring sites only)

App displays monitoring site name and catchment above site

Use selects Attribute of interest (from drop-down menu)

App displays a simple plot (and table?) showing

Attribute Bands A, B, C, D, etc.

Current median

Estimate of natural state

% improvement to reach each of the higher bands (in a small table?)

**Method and data sources**

The analysis of “current state” and “size of improvement” required to achieve better attribute states will be limited to measures of central tendency (median / average) (95th percentiles and maxima are out of scope / tier 2).

Attributes covered will be limited to the following Appendix 2A River Attributes:

* Periphyton (92nd percentile)
* TN and TP (median, as nutrient criteria to achieve periphyton
* Visual clarity
* *E.coli* (median only)
* Nitrate-nitrogen (toxicity attribute, median only)

Current state information at existing monitoring sites to be obtained from LAWA

Natural state information from: McDowell (Year + reference needed) Because of uncertainties in the current estimates of natural state, these will be displayed as a measure of central tendency ± 95%confidence interval

% improvement will be calculated between the current median and the “bottom” of the next band up (the threshold between this band and the next band up), e.g. if “current” median is 3.1 mg/L, % improvement to get to :

* NBL (2.4mg/L) is (3.1-2.4)/3.1=-22.6%,
* Band A (1.0mg/L) is (3.1-1)/3.1= -67.7%

Notes:

[It would be useful to also show FMUs as base map – from Ton?]

[Attribute state based on median only will often be different from the full/true attribute state. Median may be in, say band B, but 95th percentile may be in, say, Band D. The % improvement required to get to a higher attribute state may thus be very different – we will need to carefully communicate this. Ton, how did you deal with this in your pressure maps, did you calculate % improvement based on 95th %iles?]]

[We’ll need to think about how we will display the periphyton and TN /TP information. The attribute is periphyton and TN/TP are criteria to control periphyton, not NPS-FM attributes per se. So the user should be able to visualise the current state of periphyton, TN and TP, then the % improvement in median [TN] and [TP] required to meet higher periphyton attribute states. Unsure how we then take the next steps (mitigation / land use) when we have two attributes to consider simultaneously?]

# Mitigation scenario builder

**Purpose:** The purpose of the mitigation scenario builder is to enable the user to estimate / visualise

* the potential improvements at the selected monitoring site brought by on-farm mitigations applied to existing land use in the surface catchment above the selected monitoring site
* how these improvements compare with the relative improvements required to “shift” to a higher band

[We could run this two ways:

the app enables the user to “play” with various levels of mitigation and visualise how far this changes WQ

The user nominates an improvement and the App calculates the level of mitigation (as a proportion of full 2035 improvement) required to get to the target. If full mitigation does not get you there, the App simply displays that

First option provides more flexibility and options, but could also be a bit more confusing for the user. Second option is more rigid but is also easier to implement; although some flexibility could be built in by allowing the user to enter any water quality target they want. Assuming both options are doable, I think this should be decided with end users]

**Inputs and outputs**

Steps (option 1):

User selects monitoring site (existing monitoring sites only)

App displays current land mitigation layer

(*layer not downloadable, but option for the user to modify the %reductions of contaminant losses at source?)*

*Option to display a table showing the proportion of each main land use and average “full mitigation” % reduction in contaminant losses at source*

User selects a contaminant

User selects level of mitigation from “no mitigation” to “full mitigation” (equivalent to existing cursor)

*Option to provide a cursor for each type of main land use (dairy, drystock, arable, forestry, native forest, urban and others)*

App displays in-river improvement at the monitoring site, using a similar plot to the “current state” plot to show progress towards nominated “target”

Steps (option 2):

User selects monitoring site (existing monitoring sites only)

User selects water quality “target”. *Option to allow the user to nominate any target they want, as long as it is better than current state (i.e. not necessarily the threshold between bands)*

App calculates the level of mitigation required to get to the target. If full mitigation is insufficient, then app displays estimated “mitigated” state on a similar plot to the “current state” plot to show progress towards nominated “target”

**Method and data sources**

Based on / repackaging of the existing “mitigation” and river catchment modules. Same data sources etc.

In particular, the relative reductions of contaminant losses at source remain as per the Monhagan 2035 work

Routing also remains the same

Display in-river improvements only at selected monitoring site (not in all river reaches, although this could be offered since it is already built in?)

# Land use change scenario builder

**Purpose:** The purpose of the mitigation scenario builder is to enable the user to estimate / visualise potential water quality improvements brought by changes to existing land use mix in the catchment

Outputs will only be provided at the “control” site (i.e. the monitoring site selected by the user). Changes in land use mixes will be done at the catchment scale, and will not be spatially explicit. This is to avoid too much downscaling and pre-determination of where different land uses should / could go.

**Inputs and outputs**

Steps:

User selects monitoring site (existing monitoring sites only)

App displays monitoring site name and catchment above site

App displays current state, attribute bands and potential improvements from full land mitigation

App displays the proportion of each main land use. Potentially as a bar (full bar representing 100% of the catchment area), with each land use type represented by a colour / texture and / or a simple table

User changes mix of land use in catchment, potentially by moving cursors within the “bar” described above. A small table would be useful to keep track of actual numbers

*Option to also let the user define a “level of mitigation”, which would provide more options (too many?)*

App displays the estimated resulting state of the attribute at the monitoring site, using the same simple plots as before

[same as before we need to decide if user will select a “target” and the app provides solutions, or if the app simply enables the user to “play” with multiple / incremental scenarios and visualise outcome]

In the option where the user selects a “target”, if the land use mix selected by the user results in better water quality than the “target”, then the app could automatically adjust the required level of mitigation to achieve the minimum improvement required to reach the attribute state.

**Method and data sources**

All outputs will only be provided at the “control” site (i.e. the user-selected monitoring site).

Broad land use “classes” will be assembled in the following broad categories:

* Dairy (D)
* S&B [should there be 2 categories, intensive / extensive?)
* Forestry (F)
* Native vegetation (NF)

Specific yields (kg/ha/yr) to be sourced from [did we land on Ton’s or Srivanasian??] for same broad LU classes. Importantly these correspond to “current” yields (i.e. non- fully mitigated)

Current load contribution from each LU class to be calculated from specific yields \* area /total

Mitigatable improvements to be calculated for each of the above broad LU class from the 2035 Monaghan reductions (full mitigation) as the area-weighted average of all “typologies” within each class.

For each combination of land use mix and level of mitigation, the App calculates the % reduction in load

* Load and % contribution from each LU class from the new mix
* Selected level of mitigation then applied to new LU mix (see above mitigatable improvement)

# Limitations and “Tier 2” components

* Scenario builder limited to river catchments. Extending to lakes and estuaries out of scope / tier 2
* Does not include mitigations on urban land use
* No consideration of groundwater pathways / interaction
* Extent analysis of “improvement required” and “mitigation effectiveness” to high percentile attribute metrics (95th percentiles / annual maxima)
* Analysis limited to attributes in NPS-FM (2020, updated 2023)
* Enable user to select improvements within a band (e.g. within current band, or middle of next band up)

**Sub-project 3 description (as in proposal):**

**Long description (as in proposal):**

Sub-project 1: This sub-project will use information derived from two other Challenge funded projects (1) Spatial patterns and uncertainties associated with catchment scale attenuation of nitrogen and phosphorus and (2) comparison of current state to national bottom lines for nitrogen, phosphorus, sediment, and Escherichia coli in New Zealand’s aquatic receiving environments ("pressure layers").

This extension Project will develop a freely and publicly available “scenario builder” enabling end-users to explore mixes of land mitigations for defined areas (e.g., group of farms of similar freshwater farm plans) and see the effect these have towards improving water quality towards meeting NPS-FM targets.

The current tool uses average mitigation effectiveness as driven by the Challenges typologies and has limited built-in interface facilities It is proposed to upgrade the existing tool to allow for integration of farm and location-specific mitigation mixes and more user interface flexibility with regards to inputs (land use scenario) and outputs (water quality outcomes).

This work will expand the number of organisations (e.g., councils) and groups (e.g., iwi, catchment groups) able to explore land management and use options for good water quality. This will improve communication between stakeholders, simplifying the scale of actions required to be taken on land to achieve NPS-FM water quality outcomes. Its application will be particularly relevant in regions where catchment-specific models are lacking and /or where groups or organisations want to independently test scenarios and ideas.

Sub-project 1: Firstly, the "pressure layers" for N, P, sediment, and E. coli will be presented comparing the current state to national bottom lines. Secondly, end-users will be provided with a mix of curated land mitigations for defined areas (e.g., group of farms of similar freshwater farm plans) and calculate the effect these mitigations will have towards meeting NPS-FM targets. Other tools like the FarmApt tool currently does this, but the Subcontractor will go further providing downstream effects (not just on farm) and linkages to monitoring regimes to prove the actions are working. The key outputs from this project will include:

* Added information and data that account for reference conditions (i.e., clarifying how much of the present load is mitigatable).
* Added flexibility in the definition of the spatial scale of interest (e.g., a group of farms in a sub-catchment to large catchment housing an FMU).
* Further options for the customisation of land-use inputs (land parcels and relative improvements).
* Options to include land use change in scenarios.
* Visualisation and export of modelled outputs
* Supporting user guides and documentation