24th July 2015: CSG modeling working group meeting

Present: Graeme Doole, Bryce Cooper, Rick Pridmore, Sally Miller, Phil Journeaux, Trish Fordyce, Al Fleming, Gwyneth Verkerk, James Bailey, Weo Maag, Michelle Archer, Graeme Gleeson, Billy Brough. WRC observers: Jonathan Cowie, Ruth Lowry, Will Collin

Graeme Doole outlined the various modeling work components. In principle, the modeling should be seen as a tool to guide conversation when comparing scenarios.

The model component that GD is developing is focused at catchment level and the effects of land use and farm management practices on water leaving the catchment. This component will use information about total N and P, median chlorA, N and coliforms, 95% coliforms and NO3, and black disc (in relation to clarity). The model will describe the amount of contaminants in the water in relation to land use. It will then endeavour to identify 'least-cost changes in land-use and management' to meet the scenario targets.

Modeling will be at sub-catchment level where monitoring data is available. Current land-use areas are being estimated based on land-use being blocked in farm types (dairy: 27 'typical farm-types'; sheep and beef: 6; horticulture: 3; and forestry 74) by virtue of use of Scion Forest Investment Finder Tool. These 'typical farm-types' will also be used in the future land-use change section of work.

Commented [G1]: This is itself a modeling tool and not based on actual representative sites in any of the catchments. Trish

Two key input relationships are farm profit vs N and P loss. These relationships are usually curves and in general there is a point where the curve changes that represents the level of nutrient discharge associated with most profit. A key assumption is that these curves are the same for all farms, although it must be acknowledged that this is not reality. Using representative farms in this way is the most pragmatic approach, and CSG will need to decide the extent to which this will influence the accuracy of the result.

The model is the run as an 'optimisation model'. A target is set for each site/tributary and as the model iterates, it searches for the least-cost solutions by finding those farm-types where changes can be made most cheaply and that move towards meeting the target. Potential mitigation options have been pre-built into the definitions for farm-type.

Other layers of the model (hydrology etc) are being developed elsewhere and will then be incorporated into the land-use model, while a further component will take the catchment level outputs to predict effects on regional economy. These outputs will be used to predict social impacts of scenario changes.

Data limitations for this component of the model are:

- Data for economic relationships is sparse
- The model output only represents a single year, i.e. there is no opportunity to assess timeframes for change, apart from the total cost of achieving a scenario. i.e. the model assumes that all change will occur in a single year
- Also because representation is for a single year, the model assumes "immediate and 100% adoption" of land-use change or a mitigation activity

- Price assumptions – always going to be dodgy – can only look at some form of long-term average as a predictor, so will not be able to reflect 'good' or 'bad' years for producers
- Specific effectiveness of different mitigation technologies – these also alter the shape of profit vs N and P loss curves in a manner that differs for individual farms, but the model has no capacity to deal with this variation. This situation is aggravated for sheep and beef farms since the relationships vary, in general outputs are low, and mitigation opportunities for nitrogen may be rare.

Questions raised:

1) Is there any opportunity to address the seasonality of water flows? No – there is lack of data at this level. Model outputs will be presented as an accumulated annual total for the year relative to the model run. Concerns were raised as to whether this approach will produce results that are a conservative estimation. Flood flows will have an impact on the total outputs.

2) What level is GD's model focused at? It will use data from those sub-catchments where there is data (i.e. the 74 monitoring sites). This lead to further discussion as to how this can influence the level of uncertainty about the model outcomes.

3) Given that no parameters are defined as yet for attributes of TN and TP on tributaries, but that these may be calculated and set once outputs from the models to calculate total N and P loading have been developed further, will the model be able to inform CSG at that stage? Yes

4) Does the model enable understanding of the range of farm managements/mitigations, and how each contributes to the various discharges? Possibly but in a limited way, because 'best management' can still have a wide range of outcomes. This will be a further factor contributing to the reliability of the outputs, and should also be assessed to ensure that CSG understands the sources and likely factors where the model results may deviate from reality.

5) Will the TLG be able to provide the CSG with some parameters about the statistical variance of the model inputs and their consequential effects on reliability of the outputs? Given that the model is based on 'averages' there is no in-built variability estimations. The components of the model are peer reviewed within the TLG and the reports will examine strengths and weaknesses of model results and there will be some sensitivity analyses to provide an estimation of level of confidence that the CSG might have about the results. In the end the CSG will need to work this out and decide for themselves the extent to which they will trust the model to predict outcomes.

6) What happens if, after the modeling has been done, the predicted results do not eventuate? There should be a capacity the future to refine and improve the model, and in time it could even be developed as a monitoring tool. It should be possible to revisit model inputs/parameters in future years.

7) How will the model deal with background contributions e.g. contribution of 'yellow substance' to clarity? These components have been built into the hydrology model.

8) How will the clarity parameters be assessed? GD explained that clarity is calculated from three parts – yellow substance, farm sediment contributions and chlorA as a function of TN and TP. TN and TP themselves are calculated from outputs from farms and point-sources. Sediment is not considered by the TLG to be at a level that it would influence light through water, so indirectly influence chlorA. Any other sediment contributions eg Tunawaea slip, need to be included as background levels. This part of the model input is currently being reviewed by a TLG group.

9) Does the model provide any opportunity for examining where point-source contributions might be managed in a way that contributes to the targets? No – these are assumed to be constant. These are viewed as being of lesser contribution. There was discussion that this problem belongs to the whole community, and all should contribute where possible. The farming community should not be expected to cover all the costs of change.

10) Can you describe what the model output will look like? For example can the CSG be provided with a sub-catchment level output component? Not at this stage – there are some 30 technical studies to support this work and they are still in various stages of completion e.g. there is one group that is looking at land-use change over time and its association with water quality attributes. The CSG needs to see the process as a sum of many parts, and the model is a check on how those come together. TLG assurance that if something is vastly wrong, it will be noticed!

11) Can the model incorporate spatial diversity in land use alongside the least-cost mitigation approach? The model can be set to force either mitigation or land-use change. The CSG will need to provide some input as to how they want to balance these two approaches as they work towards policy development. One limitation to this interpretation is the absence of time-frame, since the forced changes are returned in the model output as occurring in a single year.

12) Does the model have the capacity to incorporate a policy approach that would require individual farms to have a farm management plan? That capacity is very limited, since the relationships between best management practices as they would be applied on individual farms, and the quality of discharges from that individual farm are understood in principle, but are not well enough quantified to be able to be modeled. This is another source of significant variation between farms i.e. implementing the same BMP on different farms will have different outcomes on discharges to water. There may be some opportunity to look at this at sub-catchment level for N and P, but the model outputs will be constrained by the need to also achieve clarity and coliform attributes.

13) How could the CSG use the model outputs in a way that includes a time-line? Reality is that change will take time. Timeframe influences costs, and the extent of the work to be done will require at least 20 years. Furthermore the economic outputs from the model do not account for the costs of rehabilitation activities, i.e. mitigations to stop inflows within the farm-types do not represent the total cost of the changes that might occur. This led to a brief discussion on policy options to incentivise change such as targeted rate relief where work has been done, and whether there are opportunities to consider this in the economic assessment. This needs to be discussed further by CSG.