FWMT ADVANCES IN WATER QUALITY MANAGEMENT: FUTURE & OPTIMISED SCENARIO MODELLING

H. Judd (Morphum Environmental), J. Wells (Morphum Environmental), S. Ira (Koru Environmental), C. Muller (Perrin Ag), T. Stephens (Healthy Waters), C. Clarke (Morphum Environmental)

ABSTRACT

Auckland Council is responsible for the management of freshwater quality and quantity in Auckland region. A Freshwater Management Tool (FWMT) is being developed to predict future water quality outcomes in Auckland through continuous, process-based modelling of altered development, climate and/or management.

The FWMT simulates water quality effects and life-cycle costs (LCC) for structural and non-structural interventions across urban and rural land uses. The FWMT includes sub-catchment and integrated (to coast) optimization for a range of hydrological and/or contaminant outcomes (e.g., faecal bacteria, nutrients, heavy metals, sediment; timeseries of concentration, loading, grading). By simulating instream and downstream water quality, for various mixes of interventions (differing type, location and size), the FWMT can generate valuable evidence for Resource Management Act and Local Government Act decision-making by Auckland Council.

To ensure accuracy of scenario and optimized scenario modelling, the FWMT requires robust data inputs and accurate configuration for Auckland's future.

Note the FWMT can deliver evidence both of projected changes in water quality from development and/or altered climate, and guidance on how management strategies to best maintain or improve water quality ("optimized scenario" modelling).

Our presentation will share novel outputs for the FWMT of broader national and regional relevance to water quality managers, including:

- **Future land use layer (FLUL)**. A new geospatial layer representing changes in land use (Hydrological Response Unit - HRU) expected for maximum permitted development (MPD) of Auckland. The MPD scenario enables water quality scenario and optimized scenario modelling of growth envisaged in current planning frameworks. This layer is developed from Auckland Unitary Plan zoning data using rules for maximum imperviousness to determine maximum development. FLUL models have been trialed in Tamaki for regionwide extension.
- **Menu of structural & source control interventions**. Database of water quality interventions on HRU's within the FWMT: detailed structural intervention design (e.g., rain tanks, permeable pavement, proprietary devices, raingardens, constructed and regional wetlands) and source controls (e.g., street sweeping, waste-water overflow reduction, brake pad material replacement, inert roofing, retiring land into native cover, adoption of good management practice on-farm, education and incentivization). Combined, structural and source controls enable optimization scenario modelling to maintain or improve water quality for optimal lifecycle cost integrated across rural and urban environments.

- **Lifecycle costing of structural & source control interventions**. New models for 50-year LCC across urban and rural, structural and source control options. Using operational and literature knowledge to identify total acquisition, outlay and maintenance (ongoing and renewal) costs. Derived for low/medium/high cost intervention variants over 2%, 4% and 6% discount rates. Reported with estimates of benefits to contaminant treatment. User-friendly LCC models and reports are now available (contact: tom.stephens@aucklandcouncil.govt.nz).
- **Retrofit potential opportunity**. An automated screening process uses geospatial models to rapidly and explicitly map structural intervention opportunities (e.g., location, extent and type of device and corresponding treated catchment). Device opportunities are screened for site suitability, access to existing networks, feasibility of flow diversion, and upstream catchment area. Trialed in the Tamaki watershed but regionally scalable. Retrofit opportunities identified by automated screening have potential to support implementation (e.g., integrated catchment management plans, stormwater management plans, targeted investment).

For new development and redevelopment areas in Auckland, treatment trains complying with Auckland Unitary Plan and Guidance Document 01 have been developed and costed as interventions. In regionwide modelling, all structural and source control interventions are assigned maximum opportunities by HRU for each sub-catchment. The approach enables multi-tiered optimization within the FWMT, for targeted improvements in water quality both within sub-catchment and across broader watershed (e.g., to critical concentration, load or grading of sediment, nutrients, metals and faecal bacteria instream). The approach also enables assessment of whether existing regulation will ensure maintenance of water quality during Auckland's growth to maximum permitted development. If not, identifying optimal management strategies for *total* lifecycle costs and permitting assessment of cost-fairness (e.g., distribution across stakeholders – developer, landholder and Auckland Council).

The FWMT enables improvement in water quality decision-making through: (1) determination of changing water quality under projected development throughout Auckland; (2) assessment of existing regulation to maintain and improve water quality (on the 2013-17 baseline outputs now available); (3) lifecycle costing models for a wide diversity of urban and rural interventions; (4) geospatial opportunity models for structural interventions; and (5) optimal intervention strategies for integrated (multi-tiered) water quality outcomes.

Note FWMT baseline capability has been completed; peer review is ongoing. Development of FWMT scenario and optimized scenario capability is expected to be completed in 2021.

Keywords

water quality, modelling, treatment devices, source controls, national policy statement for freshwater management, Freshwater Management Tool