CLUES Pro: Beta Release

Modelling the impacts of land-use change and farm practices on catchment water quality

The Catchment Land Use for Environmental Sustainability (CLUES) model is being transferred from the ArcMap GIS environment to ArcGIS Pro and we are looking for volunteers to help us test the new model interface with a limited Beta release of the model.

Predicting loads and concentrations

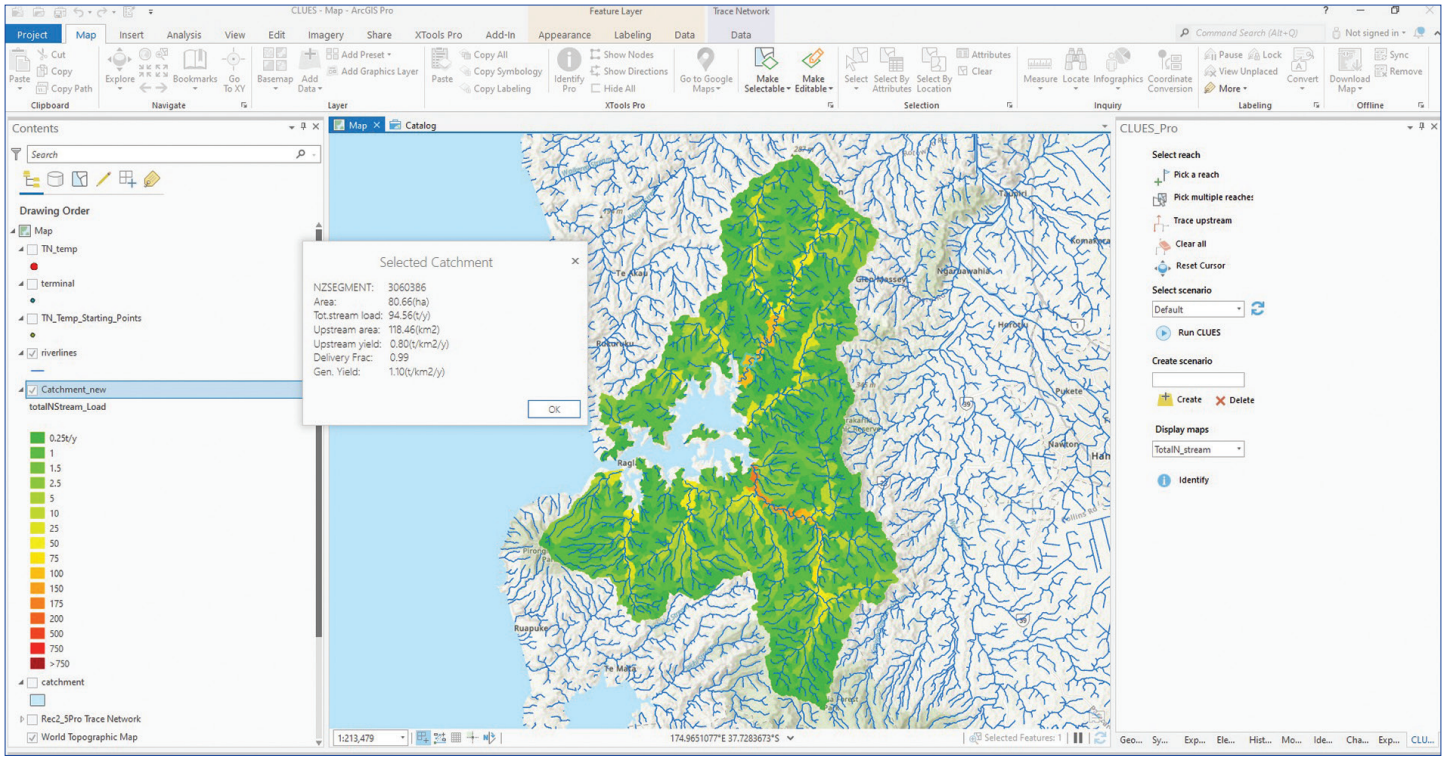
CLUES (Elliott et al. 2016) is a catchment scale, steady-state model that predicts generated and instream loads of total nitrogen (TN), total phosphorus, suspended sediment and *E. coli* for every reach in the River Environments Classification drainage network. CLUES was first released in 2006 and has become a staple tool in New Zealand for national and regional water quality modelling to inform catchment planning and policy development. CLUES is provided with a geodatabase holding all the data required for current-state water quality modelling and has tools for creating land use change and land management scenarios quickly and simply.

CLUES has been developed as a GIS application to allow geo-visualisation of the model's inputs and outputs. Over the years there have been numerous releases of CLUES for different versions of ArcMap, the last was in 2018. Planning ahead for the imminent retirement of ArcMap, we asked users in 2019 for their preferred platform options with ArcGIS Pro overwhelmingly chosen. Since then we have been working to produce a new version of the model. Now we need your help to ensure that the final release of the model is intuitive to use, and provides and displays the model outputs in a way that meets the needs of our users.

What's new in CLUES Pro Beta?

Transition to ArcGIS Pro has required a rebuild of the model which means some of the functionality of CLUES is not yet available or is being replaced by new features. Modules have been coded for TN, TP and *E. coli* with a new sediment module based on NIWA's sediment yield estimator planned for 2023. Changes that have been made include the following:

- A new-look dockable interface that is compatible with ArcGIS pro.
- A national rather than regional database that allows simulations to be run in multiple regions at once.
- Updated and streamline geo-database, including the latest version of the REC (v. 2.5) drainage network, and a new LCDB5 land use layer for the baseline year 2017.
- Development of catchment selection and tracing tools compatible with REC 2.5 that offer greater flexibility than those built into ArcGIS Pro. Like the original version of CLUES, the selection tools allow users to select single or multiple stream segments at any location and single or multiple catchments by terminal/coastal segment.
- Estimates of attenuated loads from each REC subcatchment that are delivered to coast.



A screen shot of the ArcGIS Pro CLUES project showing the map display and model interface. The display is showing estimated instream TN loads for the streams draining to Raglan Harbour. The streams were selected by terminal reach using the multiple catchment selection tool.

Planned further development

Ahead of the full model release in 2024, we plan to undertake the following tasks:

- Re-calibrate the model by region or regional group to: a) improve regional fit; b) make use of updated water quality monitoring data sets; c) be compatible with updated land use; and d) offer an alternative to the Overseer component of CLUES.
- Integration of the NZ Sediment Yield Estimator (Hicks et al. 2019) into the CLUES framework.
- Re-integrate the CLUES Estuary model (Plew et al. 2015) into CLUES Pro. This tool estimates nitrogen and phosphorus concentrations for 370 estuaries around the country.
- Translation of CLUES load estimates into changed National Objective Framework attribute states for selected attributes.
- Integrate and improve the currently stand-alone CLUES yield modification tool into CLUES Pro. This tool allows users to build land management scenarios that take into account spatial variability of land management practices within REC subcatchments. This tool will be developed with research into the effectiveness of edge-of-field mitigations being undertaken by NIWA.
- Model documentation including a new user manual.

To become a beta user contact:

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To learn more about CLUES visit:

https://niwa.co.nz/clues

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Hicks, M.; Semadeni-Davies, A.; Haddadchi, A.; Shankar, U. and Plew, D. (2019) Updated sediment load estimator for New Zealand, NIWA client report prepared for Ministry for the Environment, report: 2018341CH. https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/updated-sediment-load-estimator-for-nz.pdf

Plew, D.R.; Zeldis, J.R.; Shankar, U. and Elliott, S. (2015) CLUES Estuary - a tool for predicting estuary water quality. *Australasian Coasts & Ports Conference*, Auckland, New Zealand, 15-18 September 2015.