

Changes to ETI Tool 3

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11 January 2024

This document outlines updates and changes that have been made to *ETI Tool 3: Assessing Estuary Trophic State using a Bayesian Belief Network*. Please read the documentation below carefully to understand the implications that these changes may have on the calculated results of the tool. For further clarification, please email the ETI Team at eti-tools@niwa.co.nz.

Version 2.2.0

Release Date: 11 January 2024

The following changes have been made to the structure of the BBN and will affect the calculated results.

- The Macroalgae EQR node banding has been changed, using an updated relationship between Potential TN and Macroalgae EQR, derived from an enlarged EQR dataset from Salt Consulting.
- The Seagrass node, which was formerly linked to the Potential TN and % Mud nodes, is instead now linked to Macroalgae EQR and Sediment accumulation rate nodes.
- The ETI secondary score node is now calculated without input from the Seagrass node if the Salinity node value is < 5 .

The following change has been made to the structure of the BBN and will not affect the calculated results.

- The Sediment deposition node has been renamed to the Sediment accumulation rate node.
- Updated references section to reflect the literature supporting the revised tool

Version 2.1.1

Release Date: 28 June 2022

Added the following reference that summarises the BBN (v31). This change will not affect the calculated results.

- Zeldis, J. and D. Plew. (2022) Predicting and scoring estuary ecological health using a Bayesian Belief Network. *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2022.898992>

Version 2.1.0

Release Date: 28 June 2021

The following changes have been made to the structure of the BBN and will affect the calculated results.

- DSDEs have been removed from the BBN.

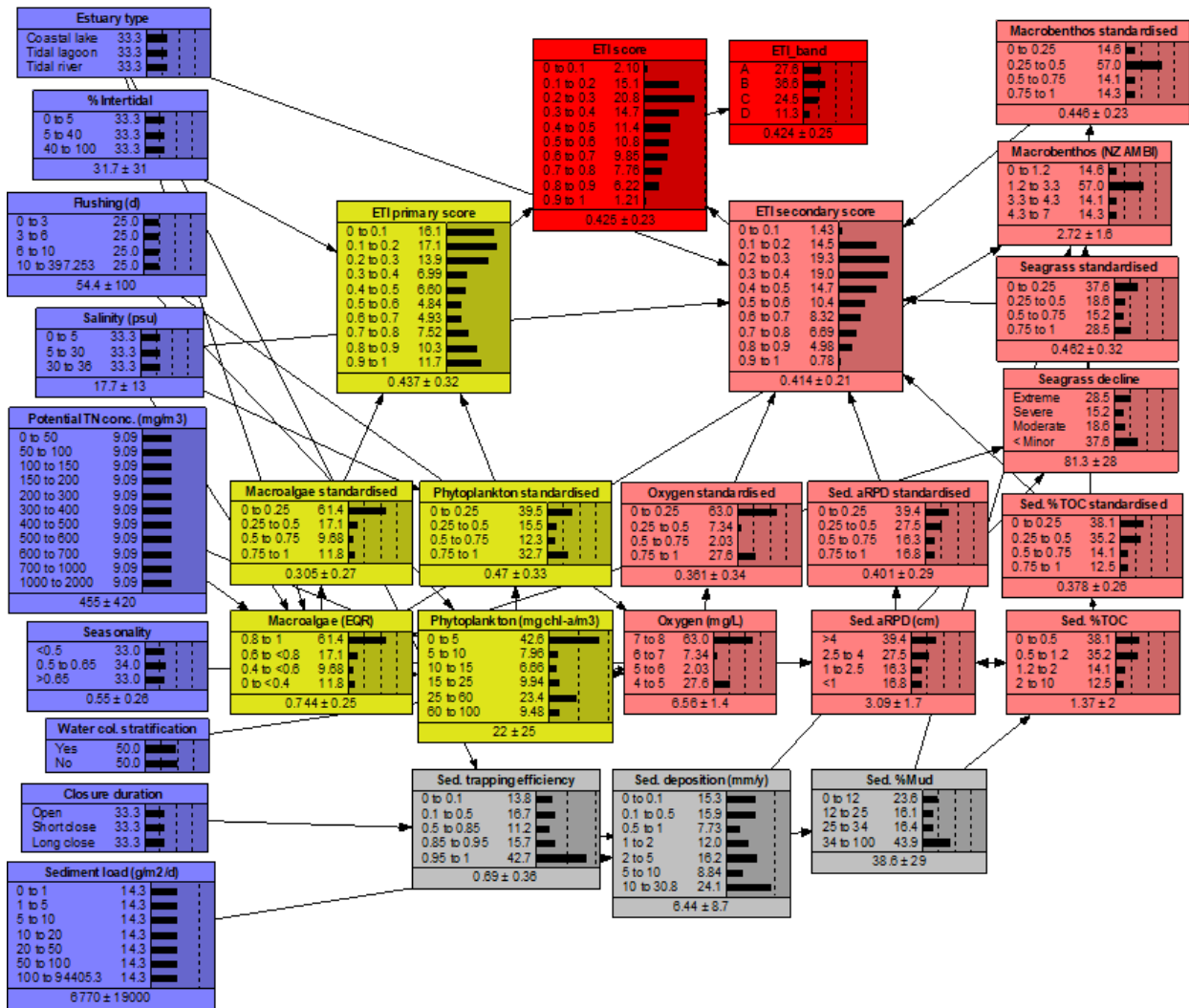


Figure 1: The Bayesian Belief Network (v36) released in Version 2.2.0 of ETI Tool 3.

- The ETI Primary and Secondary Scores now have 10 states rather than 16.
- The Final ETI score also has 10 states, which are then used to calculate the ETI band which has 4 states.
- Oxygen concentration is not included in the ETI secondary score for SIDs, as this indicator is seldom measured in SIDs.

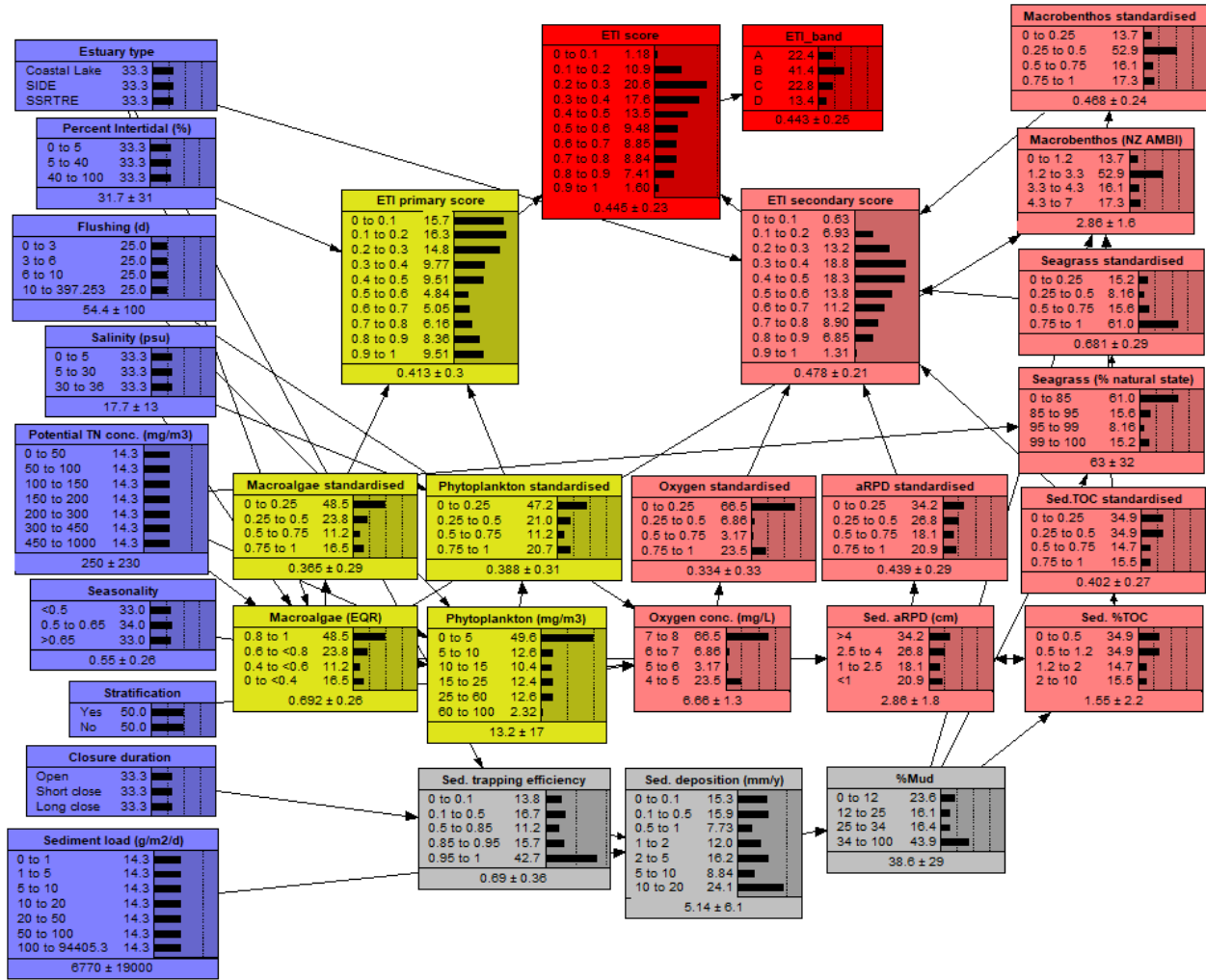


Figure 2: The Bayesian Belief Network (v31) released in Version 2.1.0 of ETI Tool 3.

Version 2.0.3

Release Date: 25 January 2021

- Added additional explanatory information to the *Using Tool 3* page. This change will not affect the calculated results.

Version 2.0.2

Release Date: 17 December 2020

- The overall structure of the BBN remains the same as version 18, however, minor changes were made to the conditional probability table that underpins the sediment TOC node. This change may affect the calculated results.

Version 2.0.1

Release Date: 10 December 2020

- The oxygen depletion node in the BBN has been renamed to better reflect its meaning. This change is cosmetic only and will not affect the results.

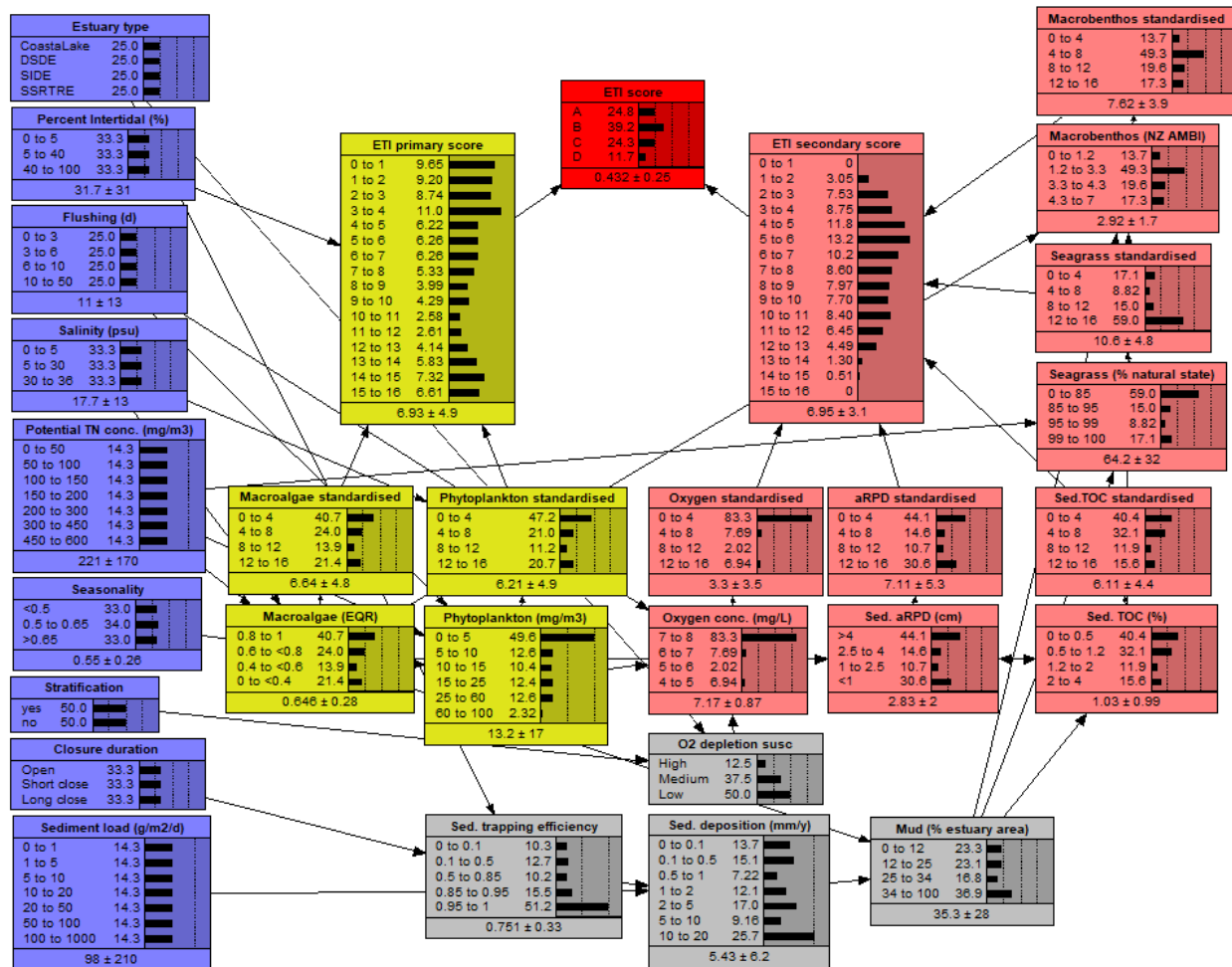


Figure 3: The Bayesian Belief Network (v18) released in Version 2.0.1 of ETI Tool 3.

Version 2.0.0

Release Date: 25 November 2020

- This release represents a major update to the Bayesian belief network (BBN), with the addition of several situation and intermediate nodes and substantial changes to the underlying conditional probability

tables (Figure 1). Please see Zeldis & Plew (2020) for a detailed description of the new BBN. These changes were undertaken to improve the realism of the BBN, incorporating a better representation of the estuarine environment based on empirical relationships sourced from the literature. They also allow the calculation of ETI scores for coastal lakes, a feature that was not possible in the previous version. These changes may affect the calculated results.

- Updated to new NIWA branding

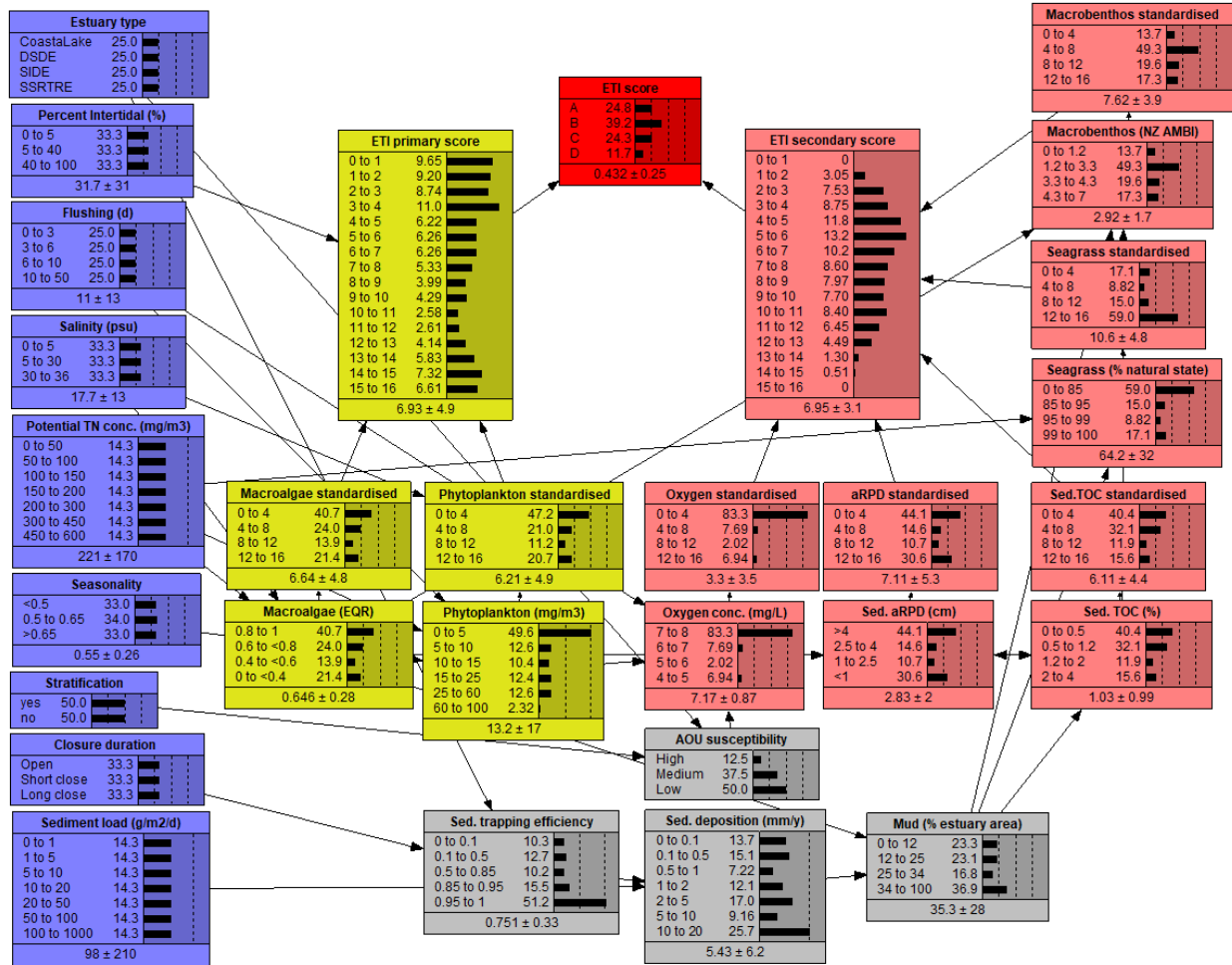


Figure 4: The Bayesian Belief Network (v17) released in Version 2.0.0 of ETI Tool 3.

Version 1.1.2

Release Date: 17 October 2018

- Added updated Hume (2018) reference and link to pdf.

Version 1.1.1

Release Date: 12 June 2018

- Corrected units in metadata table for *Macroalgae* from *OMBT EQR (dry wt/m²)* to *OMBT EQR (dimensionless)*. This change may affect the calculated results if users were using the *Macroalgae* node with the wrong units.

Version 1.1.0

Release Date: 3 November 2017

- Added a new Situation Node (*Percent Intertidal*) to the BBN (Figure 2). This change may affect the calculated results. This change was made to match changes in ETI Tool 1. Banding is provided for both macroalgae and phytoplankton eutrophication potentials in the BBN. However, the main effects of phytoplankton eutrophication are oxygen depletion and high light attenuation in deeper and often stratified estuarine systems, which typically do not occur in New Zealand SIDes when they are permanently open. Phytoplankton effects are more likely in SSRTEs, particularly those with longer flushing times. Using the Tool 1 database, we have found that the great majority of estuaries with intertidal areas less than 20% are SSRTEs, while the great majority of SIDes have intertidal areas greater than 40%. To prevent the phytoplankton primary indicator having effect when operating the BBN for estuaries with intertidal areas greater than 40% (i.e., for SIDes), the BBN selects the macroalgal primary indicator as the driver of the ETI primary node. For estuaries with intertidal areas less than 20% the BBN selects the phytoplankton primary indicator as the driver of the ETI primary node. If the intertidal area is between 20% and 40%, the BBN considers both macroalgal and phytoplankton indicators, and the ETI primary node is determined by the greater of these two indicators. Although the percent intertidal setting affects whether the ETI primary node is driven by macroalgae or phytoplankton, it does not affect how the nutrient and flushing decision nodes affect the macroalgae and phytoplankton nodes. Therefore, if the estuary is a SIDE, but is known to have areas that have deep holes with high nutrients and low flushing, the user may wish to consider the results of phytoplankton primary indicator in decision-making. Conversely, if the estuary is an SSRTE, but is known to have small but important intertidal areas, the user may wish to consider results of the macroalgae node.
- The phytoplankton half saturation coefficient and net growth rates were altered from 35 mg/m³ and 0.43 day⁻¹ to 45mg/m³ and 0.4 day⁻¹. These changes bring the coefficients in line with accepted values for NZ (see references below), slowing the rate of phytoplankton growth and reducing the potential susceptibility to phytoplankton.
 - Gibbs, M.M., and W.N. Vant. 1997. Seasonal changes in factors controlling phytoplankton growth in Beatrix Bay, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 31: 237-248.
 - Vant, W.N., and R.G. Budd. 1993. Phytoplankton photosynthesis and growth in contrasting regions of Manukau Harbour, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 27: 295-307.
- The TN thresholds for banding macroalgae have been recalculated based on updated dilution models for the estuaries. This has resulted in lower A/B and B/c thresholds and a higher C/D threshold as shown in the table below. This may change an estuary’s banding for macroalgae.

ETI macroalgae susceptibility	New threshold (mg/m ³)	Old threshold (mg/m ³)
A	TN < 40	TN < 56
B	40 < TN ≤ 120	56 ≤ TN < 178
C	120 < TN ≤ 380	179 ≤ TN < 350
D	TN > 380	TN ≥ 351

- Updated text, figures and tables to reflect the changes to the BBN described above.

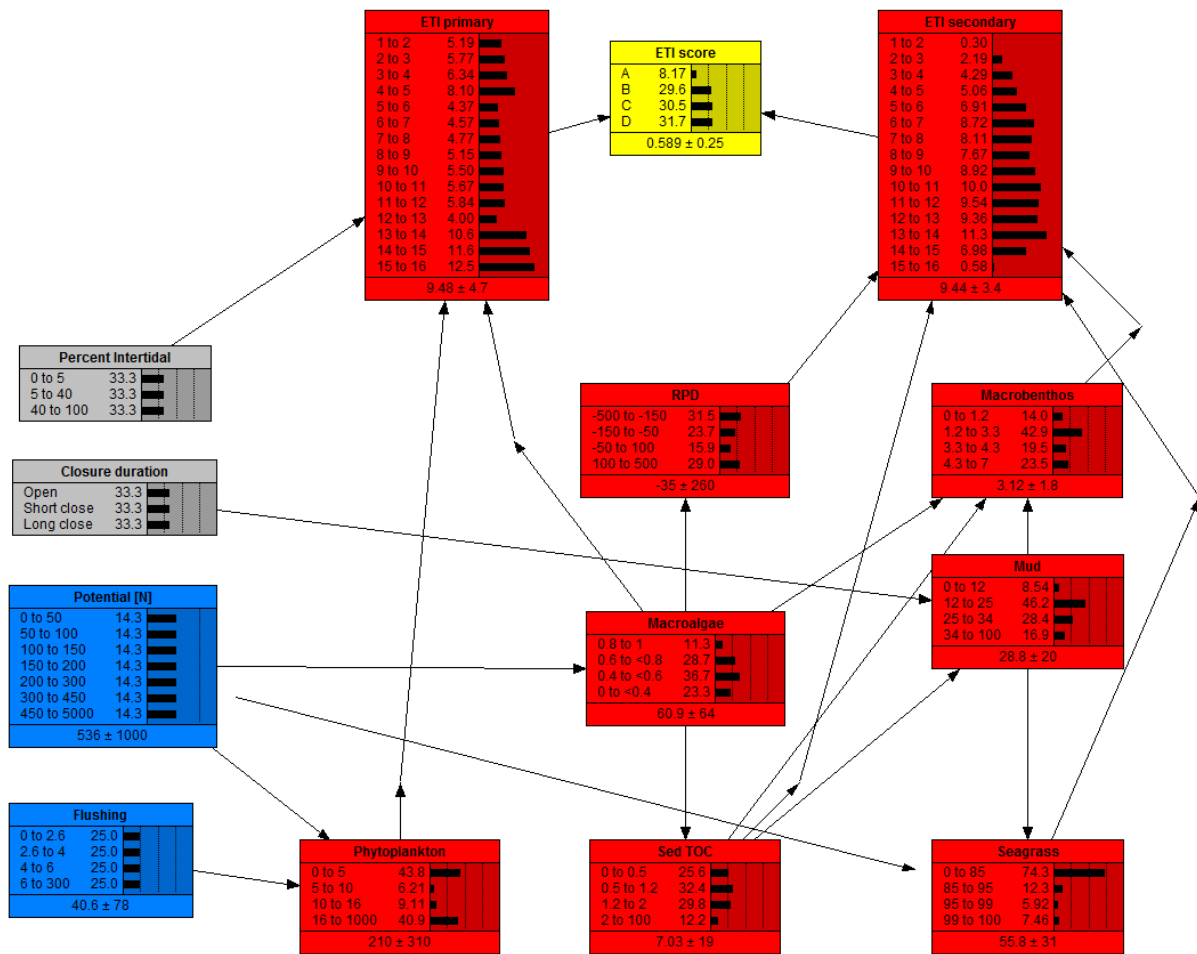


Figure 5: The Bayesian Belief Network (v6) released in Version 1.1.0 of ETI Tool 3.

Version 1.0.3

Release Date: 16 October 2017

- Corrected error in metadata units for potential Total Nitrogen from mg/L to mg/m³.
- Added downloadable citation that can be loaded into referencing software.

Version 1.0.2

Release Date: 3 August 2017

- Added suggested citation. This change will not affect the calculated results.

Version 1.0.1

Release Date: 20 June 2017

- Added the ETI email address eti-tools@niwa.co.nz to the app. This change will not affect the calculated results.
- Added link to change log and updated version control number. This change will not affect the calculated results.

Version 1.0.0

Release Date: 1 April 2017

- Initial release of ETI Tool 3 on NIWA's external shiny server (Figure 3).

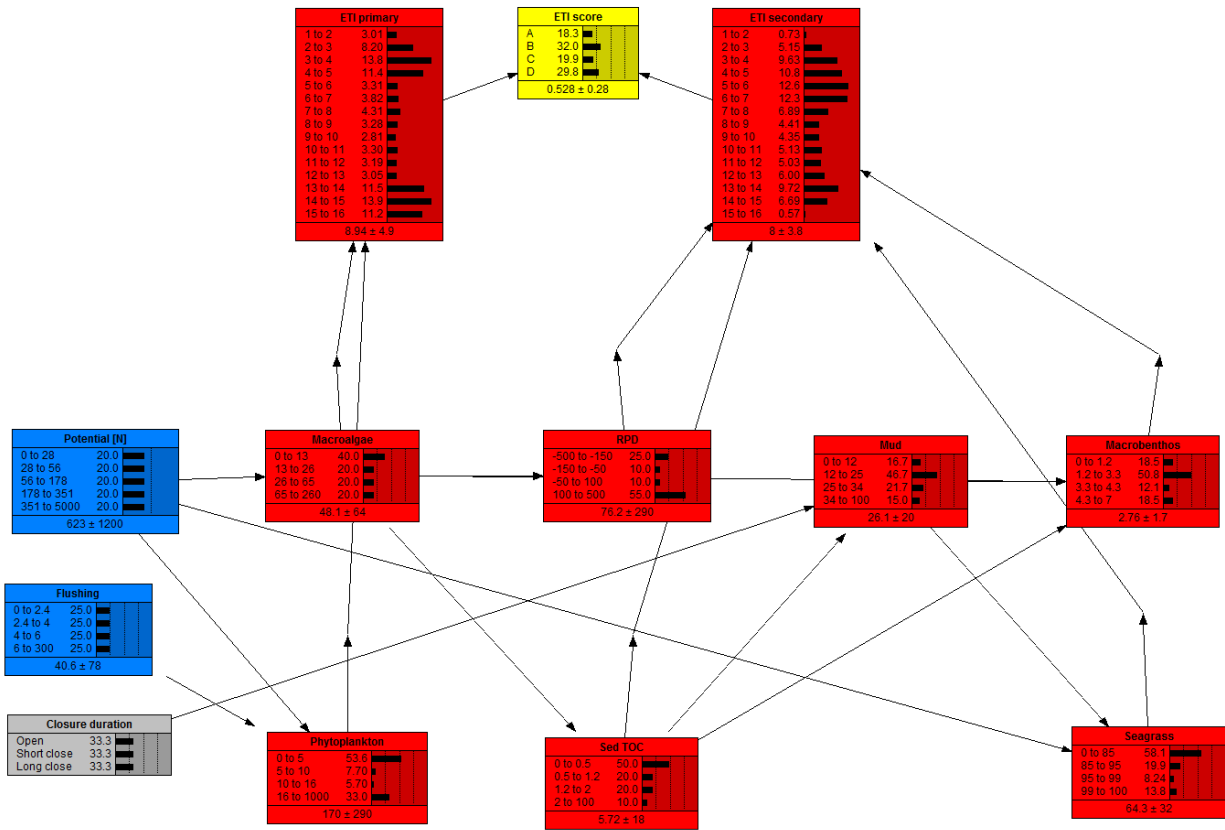


Figure 6: The original Bayesian Belief Network released in Version 1.0.0 of ETI Tool 3.