

# Guidelines to select scenario models for assessing compliance to long-term average annual extraction limits

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## Analysis

Assessing compliance of current levels of extractions with Long-term Average Annual Extraction Limits (LTAAELs) for the 2020-21 water year requires us to compare long term average annual extractions for the full historic climate period (1895-2021) from two scenario models of the same river system.

One is the LTAAEL reference scenario model and the other is the current conditions scenario model. As we may have more than one version of each scenario model, we firstly need to select the most appropriate combination of these for a valid assessment. This document provides guidelines for selecting the most appropriate scenario model.

While the older scenario model versions have been independently reviewed, our approach to continually improve our models would suggest more recent scenario models produce better estimates. Hydrological consistency between scenario models is also important.

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## Background and purpose

The water sharing plans for inland regulated river systems and the Barwon-Darling unregulated river system requires the NSW Department of Planning and Environment to annually assess whether current levels of water extractions comply with the long-term average annual extraction limit (LTAAEL). The assessment is intended initially to determine whether long term average extractions in the river system exceed the LTAAEL.

The LTAAEL is estimated using our river system models. These models are calibrated to various forms of water volume related data across different time periods, then extended in time to include long term modelled climate and inflows as inputs. The calibrated and extended model is then configured to conditions conforming with definitions of development levels, rules for water sharing and use, and operational behaviours.

For current levels of extractions, the same model is then modified based on updated data. If current levels of long-term average extractions exceed LTAAEL by exceedance criteria specified in the water sharing plan, then there is non-compliance and a course of action specified in the water sharing plan is then required to reduce this growth in extractions.

This assessment depends on comparison of the results of modelled extraction estimates from the two model scenarios; the first a reference scenario model representing LTAAEL conditions as defined in the governing water sharing plan, the second representing the corresponding conditions as they currently exist.

These scenario models are henceforth labelled as the LTAAEL scenario model and the current conditions scenario model respectively.

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## Issue

The department has developed several scenario models with its river system models in both the IQQM and the Source river system modelling software platforms. These scenario models include variants of LTAAEL and current condition scenario models. These variants are almost certain to produce different results, although in most cases we would only expect minor differences.

Selecting which is the most appropriate LTAAEL and current conditions scenario models in each of our river systems is an important initial step to completing the LTAAEL assessment. Deciding on LTAAEL scenario models for the 2020-2021 water year needs to account for past revisions, as well as which of these is most appropriate, considering key technical and model review factors.

This selection will be re-done each year as we continually improve our scenario models. Deciding on the scenario models in future years will be guided by what we selected in 2020-2021, as well as outcomes of any internal review of model results.

The following guidelines describe the key variants in scenario models and what should be considered in recommending most appropriate scenario models for LTAAEL compliance. The guidelines set out principles for consideration, list categories of candidate models and describes factors to consider in recommending scenario models for the LTAAEL compliance assessment.

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## Model candidacy - principles

1. Three scenario models are required: Cap scenario model, water sharing plan scenario model and current conditions scenario model. The LTAAEL scenario model is whichever of the Cap scenario model and water sharing plan scenario model results in lowest average annual extractions. If the Cap scenario model produces higher extractions, it may still be used to assess LTAAEL compliance. This is because some non-compliance triggers in some water sharing plans explicitly reference the Cap scenario.
2. Selecting scenario models for Cap, water sharing plan and current conditions acknowledges that there may be several variants that have evolved over time that would be consistent with the governing definition. Differences between these variants may be because of software bug fixes, model error correction, better representation of operational management, additional data and improved water balance calibration.
3. Notwithstanding that the later scenario models are likely to produce a better estimate because of these factors, the default scenario models selected for the assessment should be those that have published status or approved, especially those accredited by the Cap independent review and adoption process and/or referenced in the water sharing plan.
4. Evidence should be provided to justify choosing Cap and water sharing plan scenario models which differ from the accredited Cap scenario model and the scenario model noted in the water sharing plan. The evidence to support this selection includes the scenario model needs to be documented and independently reviewed.
5. The best available scenario models should perform best as a suite of scenarios to inform compliance conclusions, rather than choosing best individual scenarios.

6. As we transition to new Source models, there will be cases where we have updated current condition scenario models, but not the Cap or water sharing plan scenario models. In these cases, it might not be appropriate to use a combination of Source and IQQM models if there are different standards which affect the compliance outcome.
7. If an updated Cap scenario model is used, this does not mean that we have changed the scenario model used for Cap accreditation and audit purposes, or that we need MDBA approval. This is because LTAAEL compliance is an NSW instrument.

## Candidate models

Table 1 and Table 2 describe the categories of candidate scenario model options

Table 1. Candidate model options for long term average annual extraction limit scenario model

Option	Description	Comments
1a	Cap scenario model (accredited)	As supplied for independent review for Cap scenario model accreditation and/or referenced in the water sharing plan. Also used in annual Cap compliance runs.
1b	Cap scenario model (improved)	Most valleys have evolved versions of the accredited Cap model, including converting to the Windows version of IQQM, inclusive of corrections made over time. Not formally reaccredited for Cap. These scenario models may be in use for annual Cap compliance runs.
1c	Cap scenario model (updated for floodplain harvesting)	Updated for the floodplain harvesting program. Often derived from an improved edition of the Cap model (1b) rather than the accredited version (1a).
2a	Water sharing plan scenario model	Referenced in the governing water sharing plan. Note - this is only a candidate scenario model if there has been a direct conversion to Windows IQQM if applicable.
2b	Baseline diversion limit scenario model used in Basin Plan development	That version supplied to MDBA in 2009 as used in their Basin Plan development.
2c	Candidate baseline diversion limit scenario model updated for water resource plan	Typically, changes made to the baseline diversion limit model (2b) for the water resource plan and submitted as part of Basin Plan. These models are under review as part of accreditation of the water resource plan.
2d	Candidate water sharing plan scenario model updated for floodplain harvesting	Changes made to the baseline diversion limit model updated as part of the floodplain harvesting.

Table 2. Current conditions

Option	Description	Comments
3a	Annual permitted take scenario model	Based on Pre-Basin Plan conditions. – submitted as part of water resource plan.
3b	Current conditions	Updated as part of FPH process.

## Instructions to select best available suite of scenario models

A range of criteria have been proposed to assess which scenario models to use to assess compliance with LTAAEL. These criteria are set out in Table 3, along with guidance to assign a qualitative grading against each of these criteria. Lead valley modellers will identify the candidate models and associated documentation, and then provide that grading along with relevant comments.

A supplemental decision process in Table 4 will largely decide suite of scenario models for those water sources where floodplain harvesting modelling has been completed, documented and independently reviewed.

Then, based on this grading, recommend a suite of scenario models. The recommendations should not be simply score based, for example most 'A's. Some criteria are more important, especially documentation, independent review and flow calibration.

Table 3. Criteria to guide selection of scenario models

Description	Questions	Grading
Documentation	How well are scenario model versions documented.	A = Complete B = Partial C = Low discoverability
Independent Review	Has there been an independent external review? If not, what level of review has there been?	A= complete B= partial C= none
Conformance with rules	Have all relevant rules been explicitly included? Have differences in implementation been documented and internally reviewed?	A = complete B = most C = some
Conformance with development levels	Are these sources consistent between scenario models?	A= Best estimate – consistent data source across scenarios B= Good estimate C= Unknown
Behavioural assumptions	Are these based on data at point in time?	A= Calibrated to valid reference period B= Transposed from prior period C= Not yet known
Provenance	Do we have good records of data used and calibration results, and evolution to alternate modelled scenarios.	A= Comprehensive internal documentation B= Discoverable with suitable effort C= Not evident
Model performance	Have scenario results been compared to metered extractions over relevant periods? Is there reasonable fit or explanations for fit?	A= Fully B= Partially C= No
Flow calibration	Do all scenarios use the same flow calibration? Please include in comments which scenarios have consistent flow calibration.	A= Consistent for all scenarios B= Consistent at least 2 scenarios C= no consistency
Calibration reference period	If separate reference periods have been used to separately calibrate scenarios, have clear justifications been provided? Has sensitivity to period selection been tested.	A= Yes B= Partially C= Unknown

Table 4. Selecting Cap scenario model to estimate LTAEL

Step	Test	Answer	Final choice
a	Has Cap been updated for floodplain harvesting and scenario models 2d and 3b exist?  and  Is there sufficient evidence and reporting to support re-accreditation of the updated Cap scenario model.	N	1a/b – Use accredited or improved Cap scenario model
		Y	Go to step b.
b	Can we demonstrate that scenario models 2d and 3b are best available estimates based on assessment of other criteria.	N	1a/b - Accredited or improved Cap scenario model
		Y	1c – Use Cap scenario model updated for floodplain harvesting