CENTRAL BRISBANE BENEFITS STUDY

Technical Modelling Report

Prepared for:

Seqwater
117 Brisbane Rd, Ipswich QLD

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale, limited modelled data and resources allocated to it by agreement with Seqwater in liaison with the Mid Brisbane River Irrigators (the Clients). Information reported herein is based on the interpretation of data collated, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

Study Question

SLR Consulting has been engaged by Seqwater to undertake an independent Technical Study to determine the extent of hydrologic benefit, if any, that the irrigators in the Central Brisbane River Zone (between Wivenhoe Dam and Mt Crosby Weir) derive from the existence and operation of Seqwater's headworks storage (Wivenhoe and Somerset dams), using the existing Integrated water Quantity and Quality simulation Model (IQQM) for the study area. The Technical Study aims to answer the following question to provide appropriate input into the revised Headworks Utilisation Factor (HUF) for the Central Brisbane River Water Supply Scheme:

Has the effect of the dams (and their associated operations and entitlements) been an increase or decrease – or have no significant change to – the hydrologic performance of the irrigators in the Mid-Brisbane River zone compared with how they might have performed in the no-dams scenarios?

The conclusion of this study is that, using the department's existing IQQM model (including its key assumptions, limitations and extended to include the recent driest period of record), Wivenhoe and Somerset Dams (and the associated operational and entitlements) provide Central Brisbane Irrigators with no significant change to modelled hydrologic benefit, when compared to the predicted access under a hypothetical scenario where irrigators were able to take water from natural river flows and where there were no dams and system regulation for urban purposes. The effect of the dams – coupled with the operational and access rules that are applied to irrigators within this supplemented system – effectively quarantine the flows in the river primarily for urban water supply in critically dry periods. This results in less water being available to the irrigators in a very dry period than is predicted to have been available under the natural flow regime in the river in the hypothetical no-dam no-urban water supply scenario.

Background

The Brisbane River has its headwaters in the Great Dividing Range approximately 140 km north west of Brisbane. The river has several creek and river tributaries including Lockyer Creek, Stanley River and Bremer River which combine together to through Brisbane city and discharging into Moreton Bay. The total catchment area draining from the Brisbane River is 13,500 km^2. The Wivenhoe and Somerset Dams, operated by Seqwater, are the significant dam infrastructure in the Central section of the Brisbane River. The Central Brisbane River is a pool and riffle system, with numerous pools in the system. These pools represent a significant volume of stored water that is below the cease to flow level in the Brisbane River.

The Water Plan (Moreton) 2007 provides the legislative framework for sustainably managing water and the taking of water. The Moreton Resource Operations Plan (ROP) 2009 (Amended 2014) sets out how the Water Plan (Moreton) 2007 is to be implemented. Under the Moreton ROP 2009, the water allocation is categorised into

- High priority group water allocation nominal volume is 279,000 ML
- Medium priority group nominal volume for the Mid-Brisbane 7,376 ML

The IQQM Modelling

The IQQM model, as developed for the Water Plan (Moreton) 2007, has a simulation period from 01/01/1889 to 30/06/2000. The IQQM model has recently undergone an extension process by DNRM and DES to extend the simulation period to 30/06/2011. The IQQM model as extended from 2000 to 2011 covers the significant drought period experienced in the early to mid 2000's and the flood experienced in early 2011. The IQQM model was extended over this period with the use of recorded information, which was then infilled, in areas of

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missing data, with parameterisation consistent with the previously calibrated IQQM model. No further calibration for additional years (2000 onwards) was undertaken as part of the IQQM model extension.

In review of the IQQM model (sb343a.sys) for this Technical Study purpose, there were some limitations in the IQQM model that relate specifically to the assessment of the access to water for the Central Brisbane Irrigators as part of this study:

- Representation of Irrigators
- Limited Representation of River Pools
- Groundwater systems Representation
- Low Confidence in Low Flow Condition

With the limitations noted the IQQM model is deemed to be suitable for use for this study as:

- No creditable operational modelling substitute exists for Moreton Study area
- The IQQM model is the legislative tool for water resource planning and as such should be adopted
- The assessment to be undertaken in a relative assessment where the assumptions/limitations are present in all assessment cases

There were three cases to be assessed, these were:

- Existing Case – Current Full Entitlements model
- Without Wivenhoe Dam (Somerset Dam only) – Current Full Entitlements model with Wivenhoe Dam and some high priority water supply removed
- Without Wivenhoe and Somerset Dams – Current Full Entitlements model with Wivenhoe and Somerset Dams and high priority water supply removed

Due to a lack of available reliable data relating to the operation of Somerset Dam pre-Wivenhoe Dam, the second case was not able to be modelled with confidence. In order to fulfil the objectives of study, the following statistics have been used:

- Mean Annual Diversion Volume (ML)
- Mean Annual Diversion Volume (%) = Mean Annual Diversion Volume / Nominal Volume
- Number of Diversion Days (%) = Total Diversion Days[#]/Total Days
- Annual and Monthly Diversion Volumes (ML)

- a day where water is diverted it may be less than the full demand

These statistics have been presented for a different period including:

- Full simulation period
- Lowest diversion periods*

* - the lowest period is defined in this report as the lowest volume of total diversion supplied in a 15-year period

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Results – Long Term Modelling

The results of the assessment are presented in **Table 1** and **Table 2** for the long term average and lowest diversion period respectively.

Table 1 Comparison Mean Annual Diversion (MAD) and Diversion Days (DD)– Long Term Average

IQQM Node	Description	Existing	Without Dams	Existing	Without Dams
		MAD/NV (%)	MAD/NV (%)	DD (%)	DD (%)
145	Reg LB1	95.3	97.7	96.1	100
163	Reg LB3	95.3	93.9	96.1	98.1
175	Reg LB5	95.2	90.6	96.1	96.3
194	Reg LB9	95.2	89.3	96.1	95.9
TOTAL		**95.3**	**93.6**	**96.1**	**97.6**

The results show that on a long term basis the irrigators are predicted to receive no significant change to the hydrologic benefit from Wivenhoe and Somerset Dams (with the associated operations and entitlements) when assessing long term averages. On a comparison of the annual simulated diversion (**Figure 1**), the irrigators receive no hydrologic benefit or no significant change to the hydrologic benefit for 80 % of the modelled years. The irrigators were predicted to receive a hydrologic benefit for 15 % of years and predicted to receive a detriment to the hydrologic performance in 5 % of years.

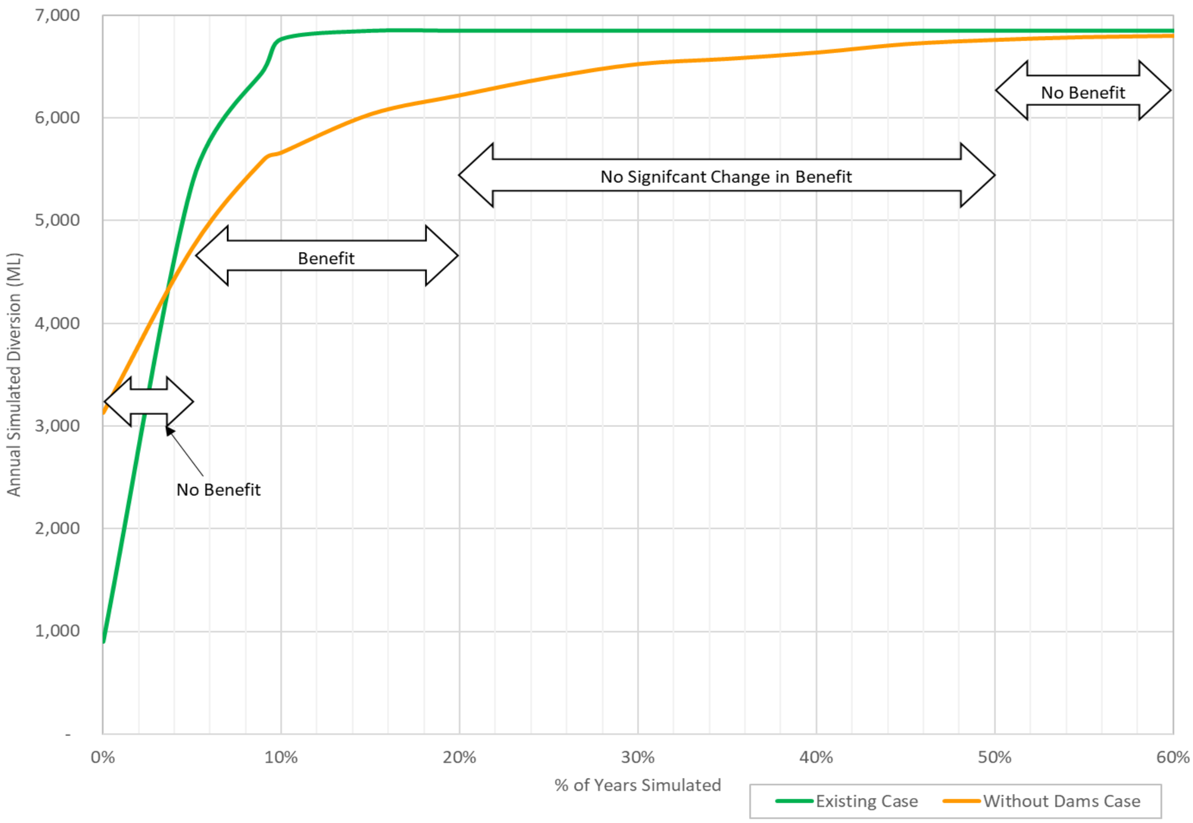

Figure 1 Annual Simulated Volume % of Year Simulated – Zoomed

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The hydrologic benefit predicted by the IQQM model, does not consider the river pools in the Central Brisbane River system that will hold water below the cease to flow measured level in the River. Therefore, the majority of this benefit is expected to be negated by the access of the irrigators to these river pools.

Results – Headwork Utilisation Factors

Headworks Utilisation Factors (HUFs) are used to apportion bulk water capital costs in accordance with the benefit attributable to each water entitlement priority group. The HUF methodology (detailed in the *Headworks Utilisation Factors, Technical Paper April 2018*) is based on a storage analysis for the lowest diversion period which relates to the modelled driest period of record for the dam infrastructure. For the Central Brisbane system, the lowest diversion period for supply for the dam infrastructure was determined to be 1997 to 2011. For the purposes of the HUF assessment, the hydrologic performance of the Existing Case and the Without Wivenhoe and Somerset Dams Case was compared using this lowest diversion period.

Table 2 presents the average statistics over the lowest diversion period in the Existing Case which is 1997 – 2011.

Table 2 Comparison Lowest Diversion Period Diversion and Diversion Days – Lowest Diversion Period (1997 – 2011)

IQQM Node	Description	Existing	Without Dams	Existing	Without Dams
		LDPD*/NV (%)	LDPD*/NV (%)	DD (%)	DD (%)
145	Reg LB1	74.4	96.4	77.6	100
163	Reg LB3	74.2	90.8	77.6	95.8
175	Reg LB5	73.8	87.0	77.6	93.4
194	Reg LB9	74.1	85.9	77.6	92.9
TOTAL		**74.2**	**90.0**	**77.6**	**95.5**

* Lowest Diversion Period Diversion Volume

To further assess the hydrologic benefit a further analysis of the lowest diversion periods was undertaken to assess the diversions on a monthly basis. Supply of water in certain months may be more important than the total supply in the period, as seasonal irrigation water demands are typically linked to critical stages in crop development.

Figure 2 shows a comparison of the monthly simulated demand versus the simulated diversions in the Existing Case and Without Wivenhoe and Somerset Dams Case for the lowest diversion period of 1997 to 2011.

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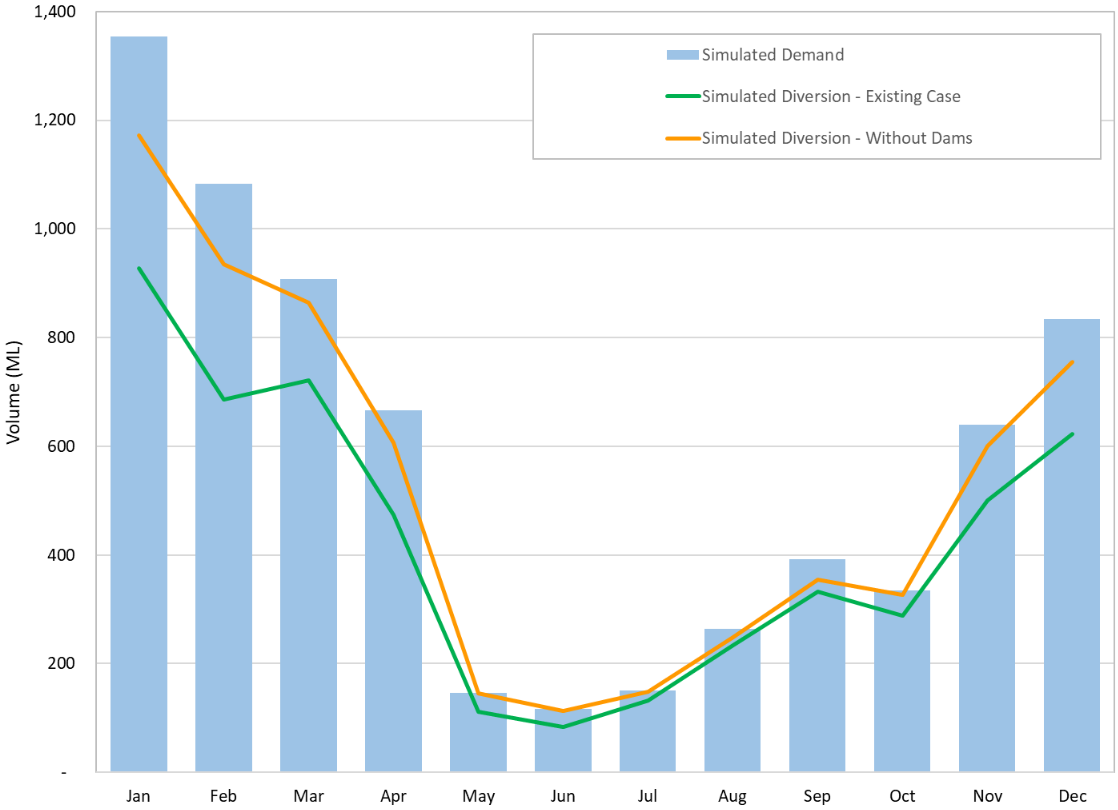

Figure 2 HUF Methodology Comparison for Existing Case Lowest Diversion Period 1996 to 2010

Table 3 and **Figure 2** shows that irrigators simulated diversion volumes and diversion days for the Existing Case (using the extended period of record) are less than the Without Wivenhoe and Somerset Dams for the total period and for all months (with monthly differences ranging from 15 to 249 ML less in diversion volume).

The modelling assessment undertaken as part of this study aimed to determine the hydrologic benefit of the Wivenhoe and Somerset Dams (and the associated operational and entitlements) to the irrigators in the Central Brisbane River. For the lowest diversion 15-year period (1997 – 2011) for the Wivenhoe and Somerset Dam, the results mean that the irrigators modelled hydrologic benefit from the Wivenhoe and Somerset Dams (and the associated operation and entitlements) was less than that under the Without Wivenhoe and Somerset Dams Case.

Conclusion

The conclusion of this study is that, using the existing department's IQQM model (including its key assumptions, limitations and extended to include the recent driest period of record), Wivenhoe and Somerset Dams (and the associated operational and entitlements) provide Central Brisbane Irrigators with no significant change to modelled hydrologic benefit, when compared to the predicted access under a hypothetical scenario where irrigators were able to take water from natural river flows and where there were no dams and system regulation for urban purposes. The effect of the dams – coupled with the operational and access rules that are applied to irrigators within this supplemented system – effectively quarantine the flows in the river primarily for urban water supply in critically dry periods. This results in less water being available to the irrigators in a very dry period than is predicted to be been available under the natural flow regime in the river in the hypothetical no-dam no-urban water supply scenario.

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1 Introduction

SLR Consulting has been engaged by Seqwater to undertake an independent Technical Study to determine the extent of hydrologic benefit, if any, that the irrigators in the Central Brisbane River Zone (between Wivenhoe Dam and Mt Crosby Weir) derive from the existence and operation of Seqwater's headworks storage (Wivenhoe and Somerset dams) using the existing Integrated water Quantity and Quality simulation Model (IQQM) for the study area.

2 Purpose

The Technical Study aims to answer the following question to provide appropriate input into the revised Headworks Utilisation Factor (HUF) for the Central Brisbane River Water Supply Scheme:

Has the effect of the dams (and their associated operations and entitlements) been an increase or decrease – or have no significant change to – the hydrologic performance of the irrigators in the Mid-Brisbane River zone compared with how they might have performed in the no-dams scenarios?

3 Glossary

Table 3-1 Glossary

Term	Description
Department of Environment and Science (DES)	The current custodians of the IQQM model
Department of Natural Environment and Resource Management (DNRM)	The previously named department that developed the IQQM model
Diversion Days (DD)	A day water is diverted to the irrigation demand
Headworks Utilisation Factor (HUF)	A factor to apportion capital costs to a water supply scheme based on the headworks storage volumetric capacity
Mean Annual Diversion (MAD)	The average annual volume of water diverted to the irrigator
Mid Brisbane River Irrigators (MBRI)	A community based, volunteer organisation that represents the interests of the irrigators that hold the 6,771 ML of entitlements in the Mid Brisbane River
Nominal Volume (NV)	The volume of the allocation entitlement
SEQ Water Grid	South East Queensland Water Grid
Water Year	The calculation of annual statistics based on water year which is from 1st July to the 30th June

4 Background

4.1 Catchment

The Brisbane River has it headwaters in the Great Dividing Range approximately 140 km north west of Brisbane. The river has several creek and river tributaries including Lockyer Creek, Stanley River and Bremer River which combine together to flow through Brisbane city and discharging into Moreton Bay. The total catchment area draining from the Brisbane River is 13,500 km^2.

Agriculture predominates in the upper reaches; high density urban regions are found in the middle reaches and industrial and port developments dominate the lower reaches and the river mouth.

The catchments areas at key locations are presented in **Table 4-1**.

Table 4-1 Catchment Area

Water Infrastructure	Reaches	Catchment Area (km^2)
Somerset Dam	Stanley River	1,340
Wivenhoe Dam	Central Brisbane	7,020
Savage's Crossing Fernvale	Central Brisbane	10,170
Mt Crosby Weir	Central Brisbane	10,550
Brisbane River Mouth	Lower Brisbane	13,500

4.2 Dams

The Wivenhoe and Somerset Dams, operated by Seqwater, are the significant dam infrastructure in the Central section of the Brisbane River. The attributes of these dams are described in the **Table 4-2**.

Table 4-2 Dam Key Details

Features	Somerset Dam	Wivenhoe Dam
Construction Completed	1959	1984
Dam Purpose	Water Supply and Flood Mitigation	Water Supply and Flood Mitigation
Watercourse	Stanley River	Brisbane River
Catchment Area (km^2)	1,340	7,020
Full Supply Capacity (ML)	379,859	1,165,238
Flood Mitigation (ML)	601,000	2,080,000

Source: Seqwater Website www.seqwater.com.au/water-supply/dam-operations/somerset-dam and www.seqwater.com.au/water-supply/dam-operations/wivenhoe-dam

4.3 Water Plan and the Resource Operations Plan

The Water Plan (Moreton) 2007 provides the legislative framework for sustainably managing water and the taking of water in the study area. The Moreton Resource Operations Plan (ROP) 2009 (Amended 2014) sets out how the Water Plan (Moreton) 2007 is to be implemented. Under the Moreton ROP 2009, the water allocation is categorised into:

- High priority group water allocation nominal volume is 279,000 ML
- Medium priority group nominal volume for the Mid-Brisbane 7,376 ML

4.4 Water Supply

The Brisbane River is the primary water supply for the city of Brisbane. This water supply is extracted at the Mount Crosby Weir, located in the Central Brisbane River and it is treated at the Mount Crosby water treatment plant. Releases are made from Wivenhoe and Somerset Dams to supplement the flow in the Brisbane River to supply Mount Crosby Weir.

4.5 Irrigators

Irrigation in the Central Brisbane River area has been undertaken for more than 100 years. There are approximated 130 irrigators with water allocations in the Central Brisbane River. The licenses were area-based licences issued by the DNRM prior to the construction of Wivenhoe Dam. In 1981, the irrigators could elect to have either area based or volumetric allocation limited to 7,000 ML per year. In November 1988 a cabinet decision (No. 55604) stated the Water Commissioner was authorised to issue water licences on a volumetric basis under the provisions of the Water Act to allow the diversion of up to 7,000 ML of water from the Brisbane River.

The development of the Water Plan (Moreton) 2007 and Moreton ROP 2009 the irrigators licenses were converted to water allocations with a separate title to the land title. These irrigator water allocations are classed as Medium Priority entitlement. The nominal volume of water entitlements for the Mid-Brisbane River Irrigators (MBRI) is 6,771 ML. The MBRI account for the majority of the medium priority demand (6,771 ML from the total 7,376 ML) in the Mid-Brisbane River.

As these entitlements are part of a regulated system that includes high priority allocations including town water supplies, they are subjected to announced allocations limits in times of low storage levels in Wivenhoe and Somerset Dams to ensure water is quarantined for the high priority water supplies.

4.6 Pool and Riffle System

The Central Brisbane River is a pool and riffle system, with numerous pools in the system. These pools represent a significant volume of stored water that are below the cease to flow level in the Brisbane River.

Figure 4-1 shows the cross section from the Savages Crossing flow gauge located in Central Brisbane River. This figure shows that there is a significant depth between 1 – 3 m below the lowest recorded value over the period from 1958 to 2018.

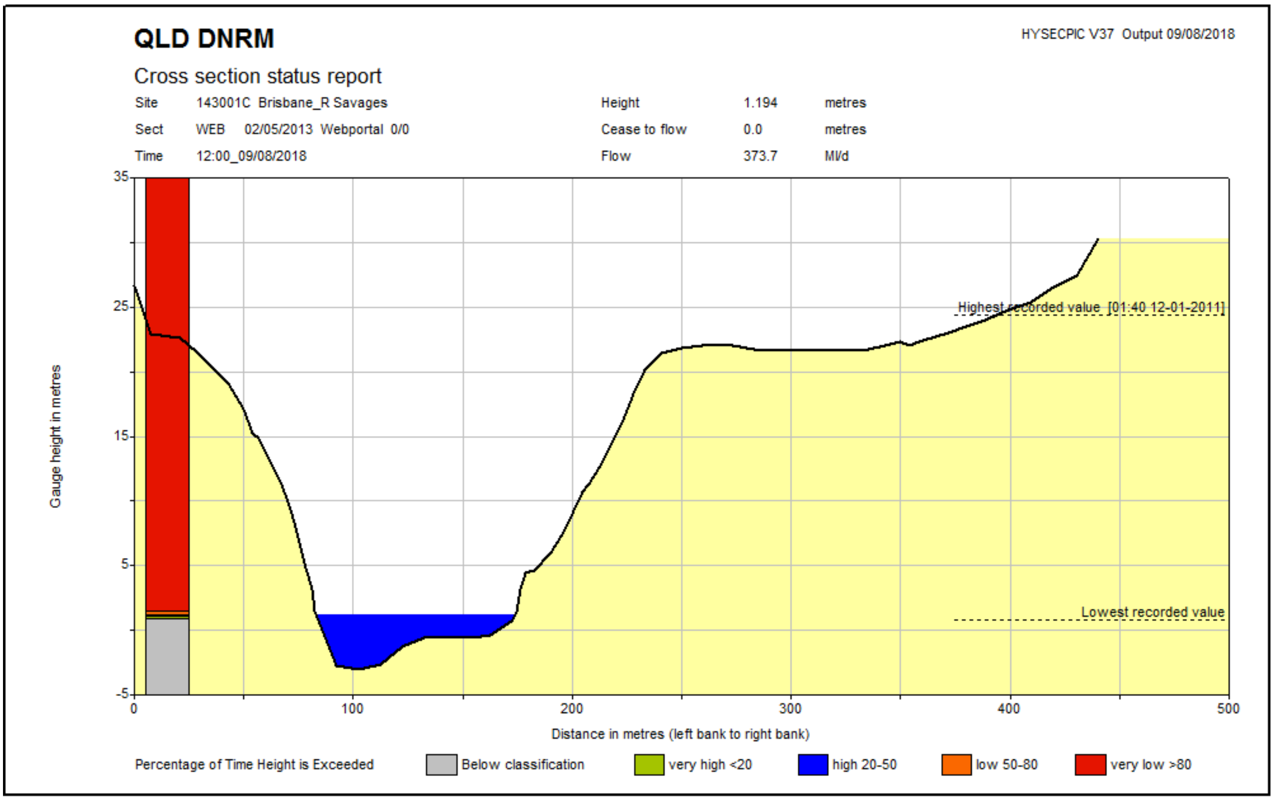


Figure 4-1 Gauge Cross Section from Savage's Crossing (143001C)

A visual inspection of aerial photography (from to 2002 to 2018) was undertaken to identify the pools and riffles in the system. **Figure 4-2**, shows there is a significant number of pools and riffles through the Central Brisbane River between Wivenhoe Dam and Mount Crosby Weir. **Figure 4-3** and **Figure 4-4** show two examples of the river pools with the estimated dimensions. The depth is unknown, however the examples of the pools in these locations are over 1 km long and more than 60 m wide, which have the potential to amount to a significant amount of storage in the system.

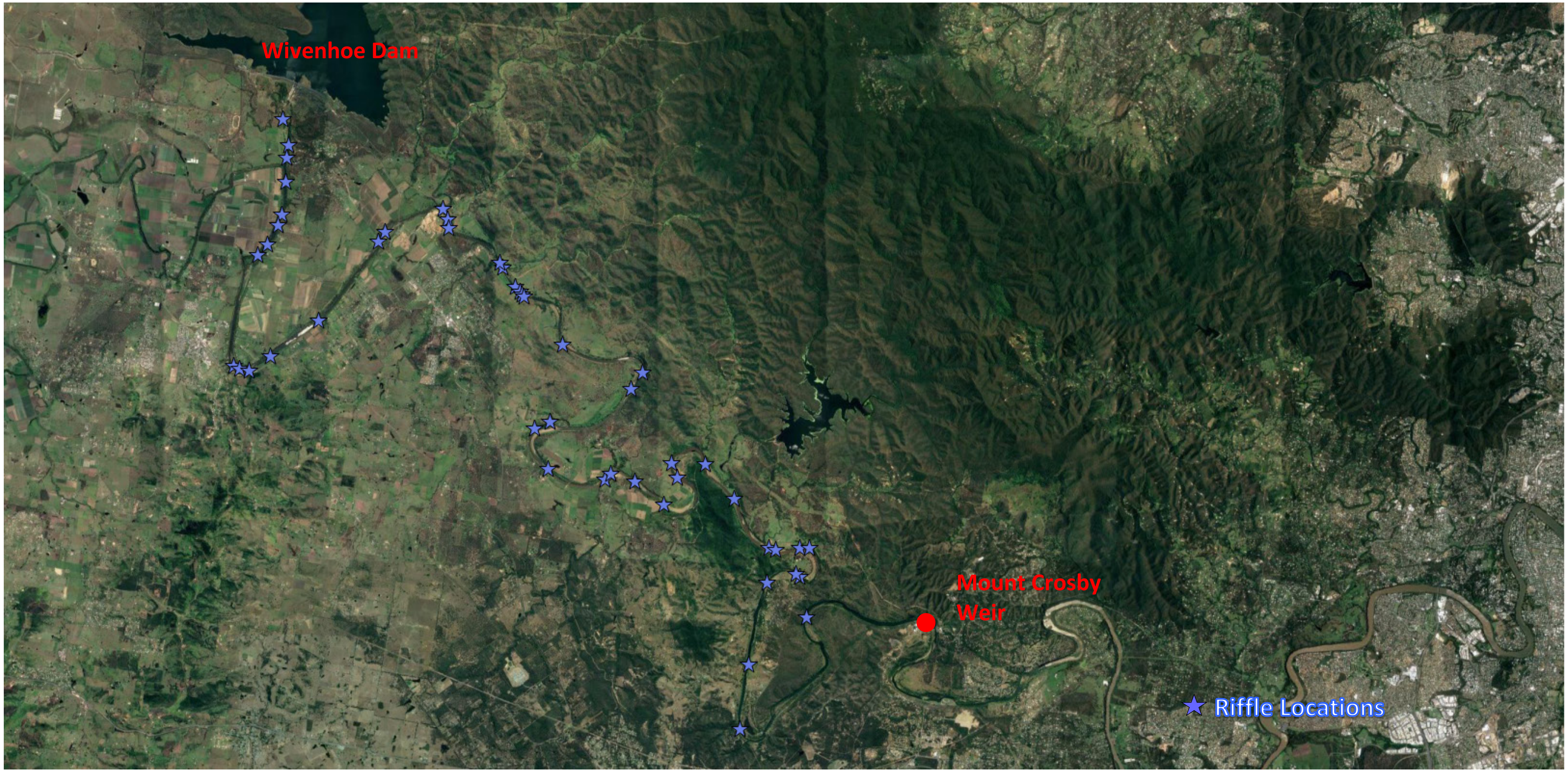


Figure 4-2 Central Brisbane River Pools and Riffles

Figure 4-3 Central Brisbane River Pools Example 1 – Location England Creek Rd, England Creek

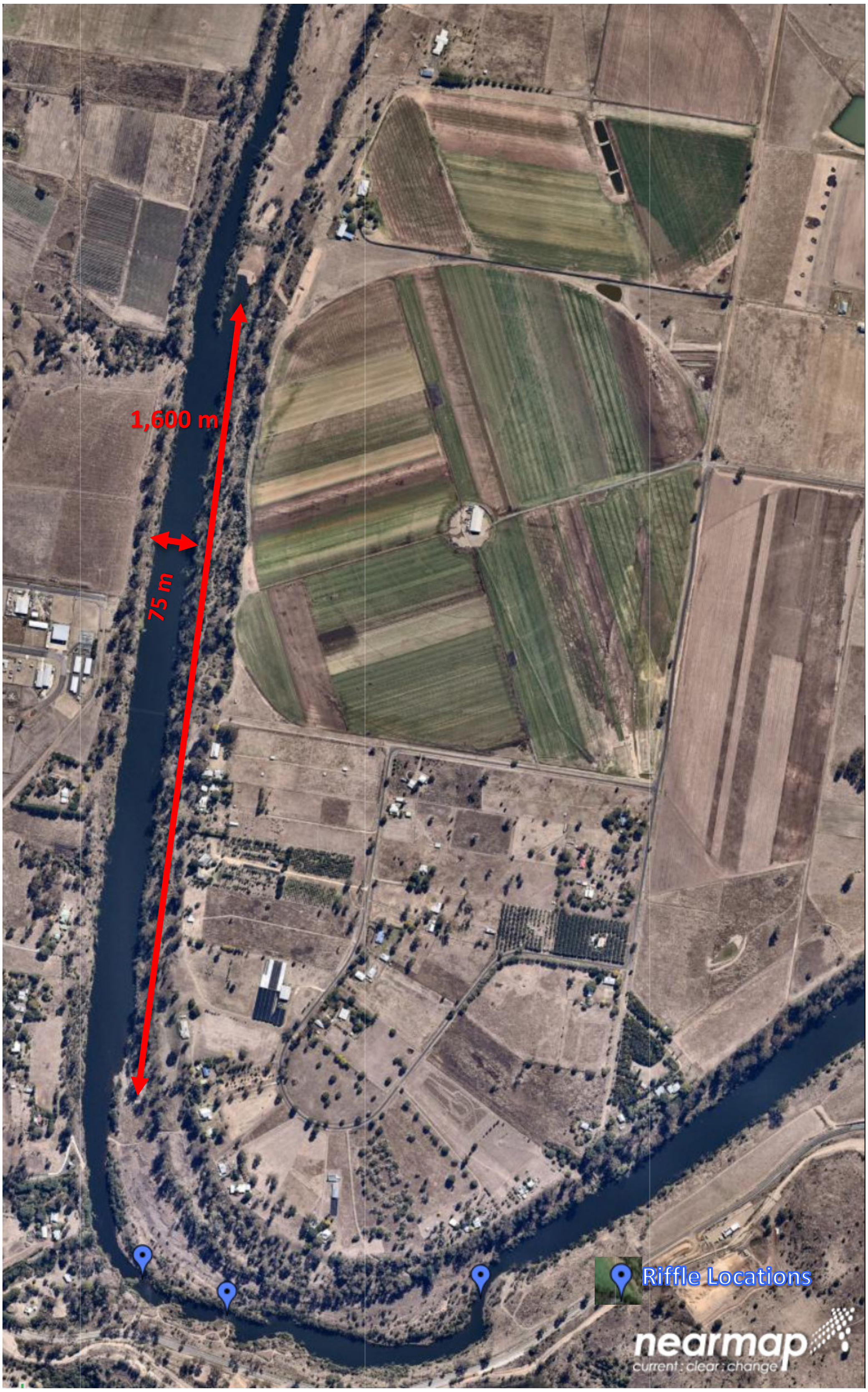


Figure 4-4 Central Brisbane River Pools Example 2 – Location Fernvale Rd, Lowood

5 Modelling Review

5.1 IQQM

The IQQM model developed by the Department of Natural Environment and Resource Management (DNRM) to support the Water Plan (Moreton) 2007. The model was developed in version 6.43 and 6.75 of IQQM. The IQQM model is a hydrologic model that operates on a daily timestep.

The current IQQM model (version 6.75.29) was supplied by the Department of Environment and Science (the file name is sb343a.sys). The IQQM model is the full entitlements model, which means that all entitlements under the Water Plan (Moreton) 2007 are being fully utilised in the assessment. This represented the maximum allowable extraction of water from the river.

5.2 Calibration

The IQQM model calibration was documented in the Calibration Report, Brisbane River IQQM Calibration Report: 143000.PR/107 (2011) from DNRM. The IQQM model was calibrated for the flow sequences for each reach using available recorded information and a Sacramento Rainfall/Runoff Model. There were different calibration periods for each reach based on the available data.

The key calibration statistics from the Calibration Report are presented in **Table 5-1**. This table shows calibration results ranged from excellent to very poor for the relevant area of this Study. In general, the low flow predictions are considered to be of lower quality.

Table 5-1 Key Calibration Statistics

River Section	Number of Reaches	Performance Indicator	Result Classification for River Reaches				
			Excellent	Good	Fair	Poor	Very Poor
Upper Brisbane	9	Whole Range Flow Volume		5	3	1	
		Low Flow Volume	1	2		5	1
		Zero Flow Days			4	4	1
Stanley River	2	Whole Range Flow Volume	1	1			
		Low Flow Volume	1			1	
		Zero Flow Days	1				1
Central Brisbane	3	Whole Range Flow Volume		2	1		
		Low Flow Volume	2				1
		Zero Flow Days	2			1	
Lockyer	12	Whole Range Flow Volume	3	4	5		
		Low Flow Volume	2	2	1	1	6
		Zero Flow Days		3	3	4	2
Lower Brisbane	3	Whole Range Flow Volume		1		1	1
		Low Flow Volume		1		1	1
		Zero Flow Days		1	1		1

Figure 5-1 to **Figure 5-3** shows the calibration achieved for Somerset Dam, Wivenhoe Dam and Savages Crossing. These figures show that a reasonable calibration was achieved at the key locations in the Central Brisbane River.

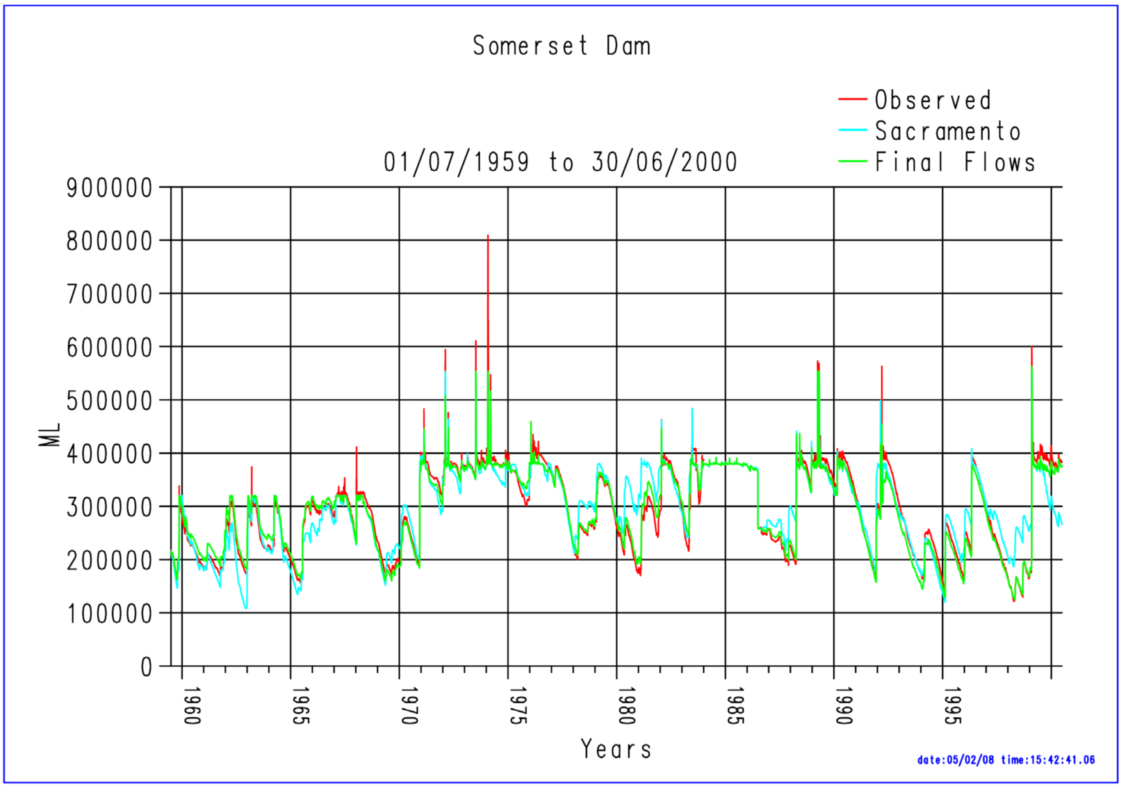


Figure 5-1 Somerset Dam IQQM Calibration (Source DNRM Calibration Report)

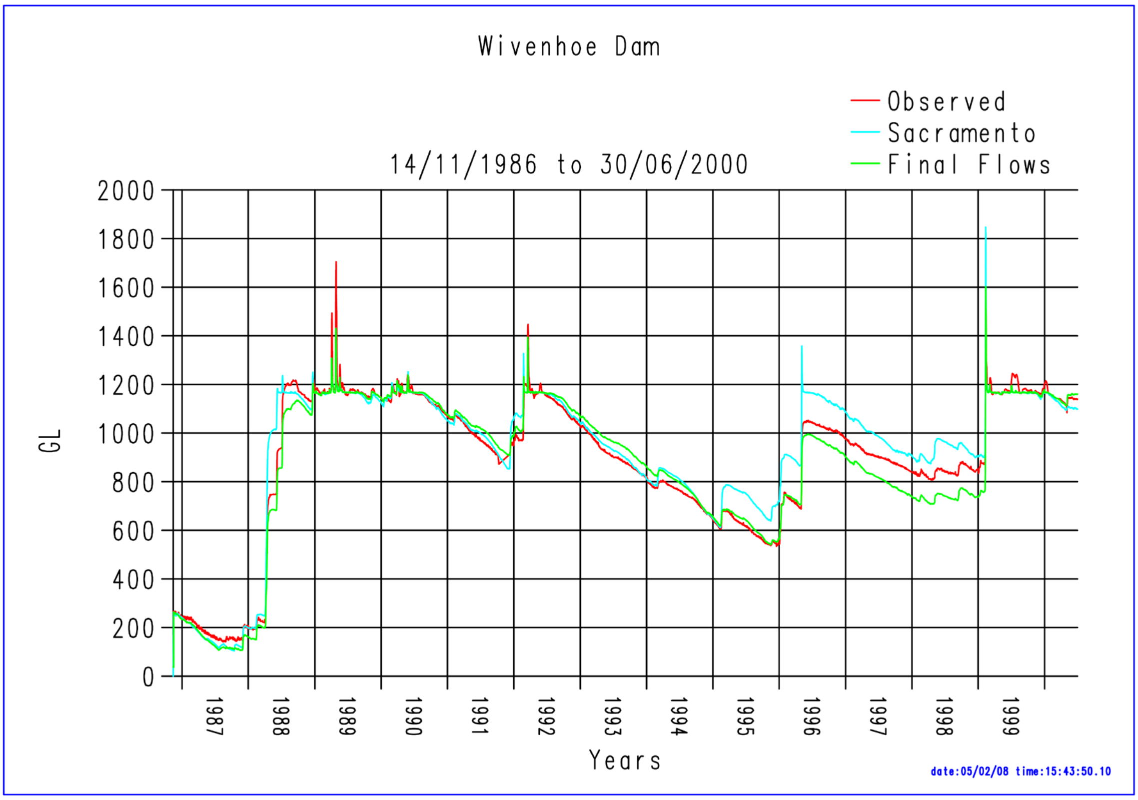


Figure 5-2 Wivenhoe Dam IQQM Calibration (Source DNRM Calibration Report)

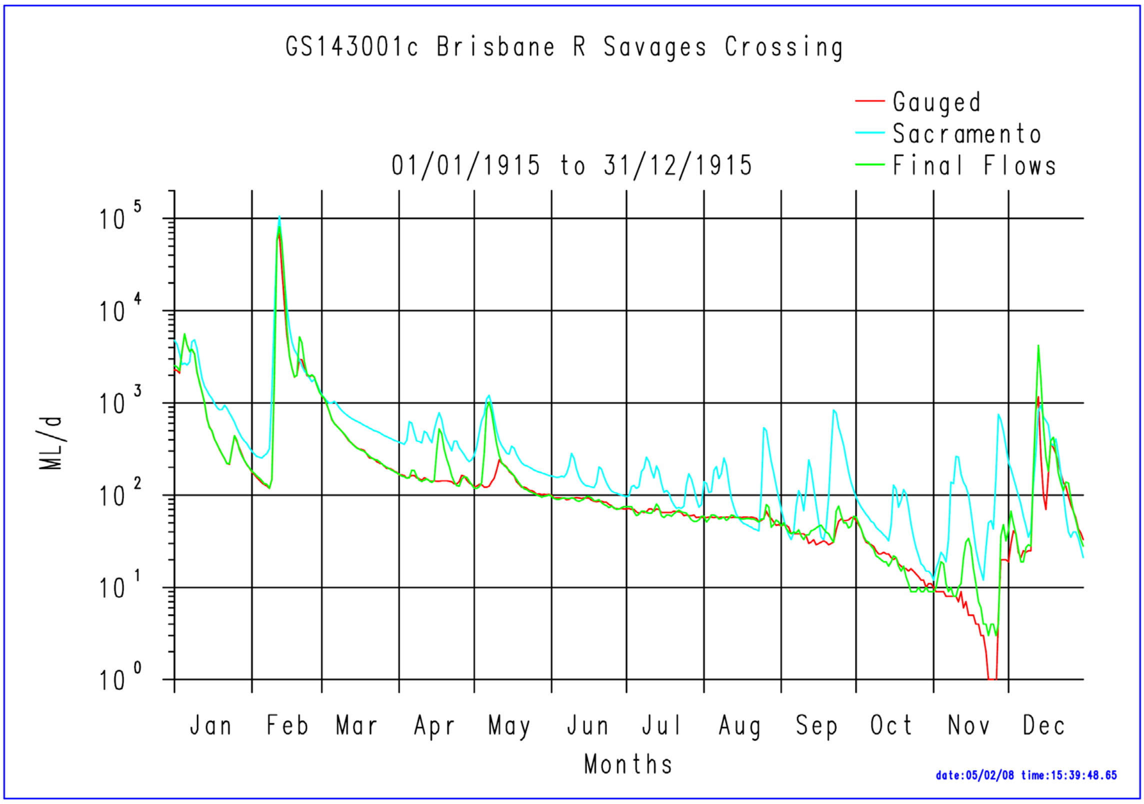


Figure 5-3 Savages Crossing IQQM Calibration (Source DNRM Calibration Report)

With the representation of low flows considered to be poor in the IQQM model, the use of the IQQM model for the extended simulation period will be important as the more recent low flow period will have better recorded information. However, this assumption still needs to be validated with updated IQQM model calibration for the extended period (2000-2011).

5.3 Simulation Period

The IQQM model, as developed for the Water Plan (Moreton) 2007, has a simulation period from 01/01/1889 to 30/06/2000. The IQQM model has recently undergone an extension process by the DNRM to extend the simulation period to 30/06/2011. Utilisation of the IQQM model as extended from 2000 to 2011 is considered important as it covers the significant drought period experienced in the first decade of the 2000's as well as the flood experienced in early 2011. The IQQM model was extended over this period with the use of recorded information, which was then infilled, in areas of missing data, with parameterisation consistent with the previously calibrated IQQM model. No further calibration was undertaken as part of the IQQM model extension.

For this study it was considered to be very important to use the IQQM model that covered the extended period to assess the performance of the system in the most recent and very significance drought period.

5.4 Central Brisbane Irrigators

The Central Brisbane Irrigators are represented in the IQQM model as outlined in **Table 5-2** and **Table 5-3**. The description of the irrigator is the sub-reach as shown in the map in **Appendix B**.

Table 5-2 Central Brisbane IQQM Representation of Irrigators – Nominal Volumes

Description	IQQM Node	Location	Nominal Volume (ML)
Reg LB1	145	Wivenhoe Dam to Brisbane River Gauge at Vernor	1,955
Reg LB3	163	Brisbane River Gauge at Vernor to Brisbane River Gauge at Savages Crossing	2,694
Reg LB5	175	Brisbane River Gauge at Savages Crossing to Black Snake Creek	560
Reg LB9	194	Black Snake Creek to Mt Crosby Weir	1,682
		TOTAL	**6,891***

* this varies slightly from the 6,771 ML as outlined in the WRP.

Table 5-3 Central Brisbane IQQM Representation of Irrigators – Model Parameters

IQQM Node	Node Type	Crop Type	Nominal Area (ha)	Nominal Volume (ML)	Pump Capacity (ML/d)	Flow Threshold (ML/d)
145	8.0 – Regulated Irrigator	Wiv7000	195.5	1,955	1,000	0
163	8.0 – Regulated Irrigator	Wiv7000	269.4	2,694	1,000	0
175	8.0 – Regulated Irrigator	Wiv7000	56.0	560	1,000	0
194	8.0 – Regulated Irrigator	Wiv7000	168.2	1,682	1,000	0

The irrigators are represented as regulated irrigators, with no limit in pumping capacity or river flow thresholds. As regulated irrigators, the diversion demand is not limited by rainfall as is the case with unregulated irrigators. The irrigators have no lower or upper limit on the flows in the river that would limit their ability to divert water.

The irrigators have advised that they are unable to access water in higher flow events due to infrastructure limitations. If the flow in the Brisbane River exceeds the Twin Bridges, approximately 50 m^3/s, the irrigators infrastructure is not able to extract water. This IQQM model is an entitlements model and at times of high flows the irrigators are entitled to extract water; whether the infrastructure allows it or not is a separate issue.

5.4.1 Diversion Demand Pattern

The diversion demand pattern that has been attributed to all the irrigators in the Central Brisbane River is presented in **Figure 5-4**. This pattern shows the most significant demands is from November through to April, predominantly the summer months.

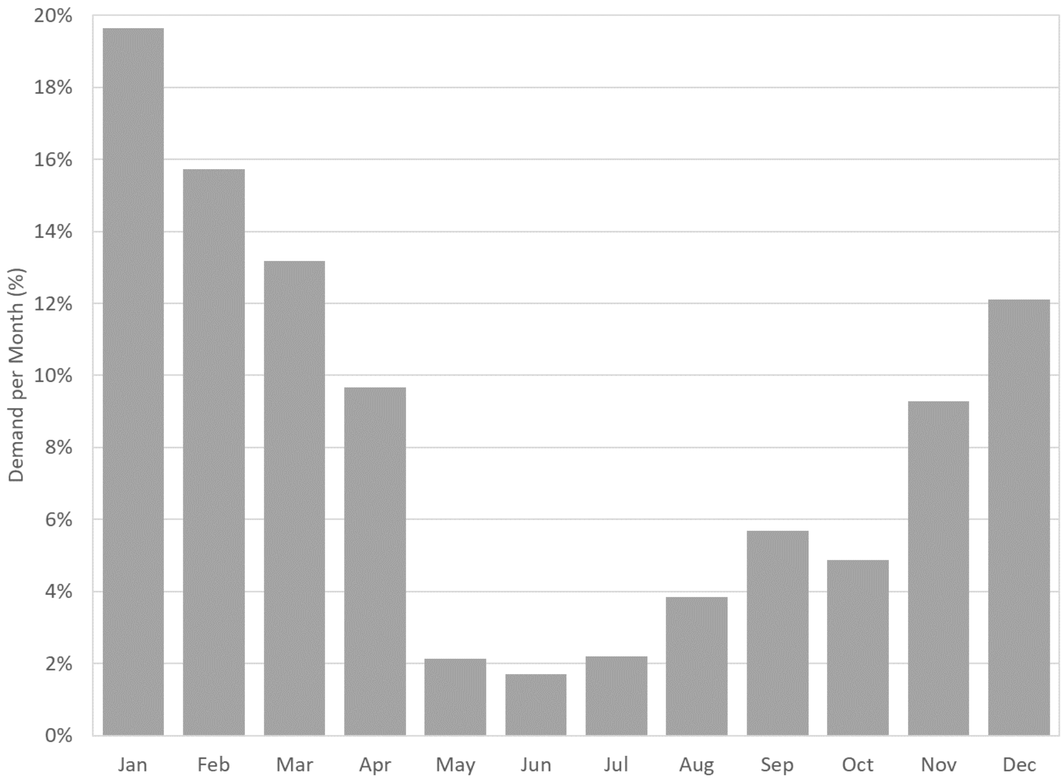


Figure 5-4 'Wiv7000' Crop Pattern from IQQM

5.4.2 High Flow Conditions – Irrigator Infrastructure Limitation

The IQQM model does not have any flow threshold limits on diverting water to the irrigators in the Central Brisbane River. Through discussion with the MBRI, pump infrastructure cannot extract water in high flow conditions. This limit was advised to be similar to when the Twin Bridges infrastructure is flooded which from the flood operations manual is designated at 50 m^3/s. The IQQM model will divert flows to the irrigators with no upper limit flow threshold which is appropriate for entitlement modelling, as there is no limit on the entitlement for the irrigators to cease extracting water at times of high flows. The high flows may be a result of the natural flooding regime in the river or releases from Wivenhoe Dam.

5.4.3 Announced Water Allocations

The IQQM model represents the announced water allocation process to be applied to the medium priority water allocations of the irrigators. **Figure 5-5** presents the announced water allocation levels as represented in the IQQM model based on the combined stored volume of Wivenhoe and Somerset Dams.

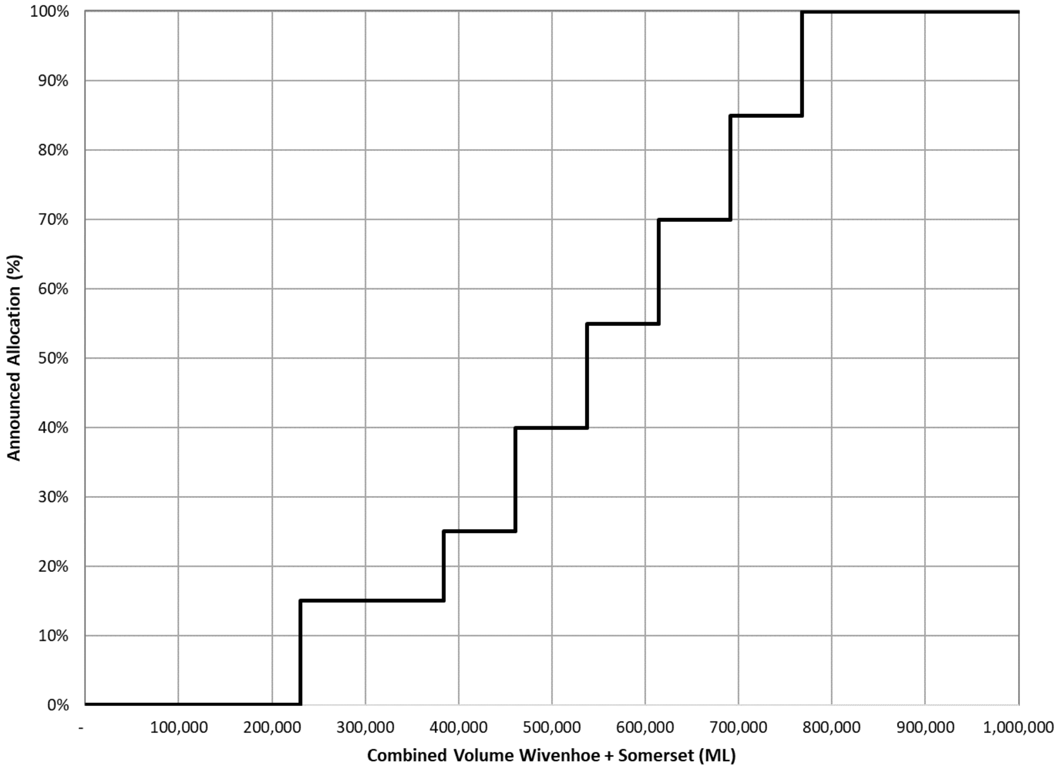


Figure 5-5 Announced Allocations from IQQM

5.5 Limitations

The IQQM model has been developed for the catchment wide water resource planning. This model has been developed with a very significant level of rigour by DNRM and has been third party independently reviewed. The IQQM model has a specific purpose; this study aims to utilise the IQQM model developed for the purpose of catchment wide system modelling and apply it to a similar but slightly different purpose of only focussing on one particular section of the catchment wide model. When using any model for a different purpose than it was developed for, there is the potential for some of the assumptions to become limitations. A discussion below highlights the limitations in using the IQQM model for this study.

There were some limitations in the IQQM model that relate specifically to the assessment of the access to water for the Central Brisbane Irrigators as part of this study:

Representation of Irrigators: The irrigators are set as a single lumped node in the IQQM model for each river reach, with the same associated irrigation demand pattern. This configuration has the potential to misrepresent the demand pattern required by the irrigators by simplifying all irrigators to the same demand pattern. There is a diverse range of irrigators with different irrigation demand patterns in the Central Brisbane River.

Limited Representation of River Pools: The Central Brisbane River has a series of pools and riffles, which in terms of access to water for irrigation, these pools will provide water in the low flow and zero flow conditions in the river. As the IQQM model does not represent these pools in the Central Brisbane River reaches of the model, the results have the potential to underestimate the irrigators access to water in low and zero flow conditions in the river.

Groundwater Systems Representation: Groundwater systems are only represented for the Lockyer and Cressbrook Creek in the model. There are no groundwater systems specifically represented in the Central Brisbane River reaches in the model. Therefore, there is the potential for the model to underestimate the water availability in the Central Brisbane River reaches for irrigation. This is likely to be countered to some degree in the calibration process, by the determination of flows in low flow conditions in which recorded flows are likely to have a groundwater inflow component.

Low Confidence in Low Flow Condition: As discussed in **Section 5.2**, the calibration report identified there is lower confidence in the low flows. This was also identified in the third party review of the IQQM model. The low flow periods are of most concern to this study in terms of access to water. This is primarily due to the lack of available data when the model was calibrated for the modelling period up to 2000. This is the case in both the Existing Case and the Without Dams Cases. The use of the extended IQQM model is important as the most recent low flow periods have better recorded information.

5.6 Possible Improvements

Based on the review of the IQQM model specifically for the purpose of this study, there is a potential for technical improvements that could be made to the IQQM model to lessen the uncertainty due to the limitations as identified above, these include:

- Detailed discretisation of each irrigator with a specific individual demand pattern
- Further calibration of the IQQM model to cover the extended period from 2000 to 2011
- Further assessment and representation of river pools in the Central Brisbane River reaches
- Further assessment and representation of the groundwater interactions in the Central Brisbane River reaches

These technical improvements are outside of the scope of this study. These technical improvements have to potential to have cost implications and there may not be the relevant data available.

5.7 Other Considerations

Seqwater operates the SEQ water grid, an interconnected system of water sources, treatment plants and bulk water transfer pipelines, to most efficiently produce and transfer water across our system for urban water supply. With regard to the storages in the Central Brisbane region (Wivenhoe and Somerset Dams), using the grid to transport water from other areas of the network into the central region is able to supplement the total water demand for the area. Further, operation of the Western Corridor Recycled Water Scheme (WCRWS) will supply purified recycled water into Wivenhoe Dam. Seqwater has not yet used this scheme for this purpose to date.

This study seeks to assess the hydrologic benefit to the Mid-Brisbane irrigators from the Central Brisbane River Water Supply Scheme (Central Brisbane). As such the study has used the IQQM for this scheme, and therefore does not capture modelling of Seqwater’s operation of the SEQ water grid which includes operations across South East Queensland, not just this scheme.

However, the operation of the water grid is optimised for urban water supply and does not seek to also supplement irrigation users. In principle Seqwater would seek to operate the WCRWS for the purpose of maintaining urban water supplies under drought conditions, not to supplement the Mid-Brisbane irrigators' supply, or any other medium priority users in the scheme. Therefore, while the operation of the water grid may create benefit for the Central Brisbane storages under certain scenarios it may also be equally used to supplement northern and southern region supplies from the Central Brisbane storages. Seqwater operates the Grid for the benefit of urban water supplies and it is proposed not to supplement irrigation users and is therefore considered irrelevant for this study.

6 Modelling Strategy

6.1 Suitability for Use

The IQQM model is the tool used to inform the legislative process of the Water Plan. The IQQM model is a complex hydrological simulation model and has to make a number of assumptions to represent aspects of the systems including the Central Brisbane irrigators. In order to carry out the modelling for the specific purposes of assessing the performance of the Central Brisbane Irrigators, a number of technical limitations have been identified. With the limitations noted the IQQM model is deemed to be suitable for use for this study as:

- No creditable operational modelling substitute exists for Moreton Study area
- The IQQM model is the legislative tool for water resource planning and as such should be adopted
- The assessment to be undertaken in a relative assessment where the assumptions/limitations are present in all assessment cases

The IQQM model for the Brisbane River Catchment was adopted using IQQM version 6.75.29 for the simulation period of 01/01/1889 to 30/06/2011. The calibrated IQQM model, as discussed in **Section 5.2**, has been used to assess the performance of the system in the climatic conditions over the simulation period.

6.2 Cases to be Assessed

As outlined in the Request for Quote (RFQ) from Seqwater, there were three cases to be assessed. These cases as described in the RQF are:

1. *Current development (Moreton Water Plan) case under full utilisation of existing entitlements, existing instream water infrastructure and current storage operational strategies (the "Existing Case")*
2. *Pre-Wivenhoe dam development case under full utilisation of pre-Wivenhoe dam water entitlements, water infrastructure and conditions of water access (the "Pre-Wivenhoe Dam Case").*
3. *Pre-Wivenhoe Dam Case to further removing Somerset Dam and associated water entitlements (the "Pre-Wivenhoe and Somerset Dam Case").*

The Pre-Wivenhoe and Pre-Somerset Dams case as described above have been developed to determine the hydrologic benefit as a result of the water entitlements, water infrastructure and conditions of access. The modelled cases for the "Pre-Dam" cases represent the current development from the WRP with the Wivenhoe and Somerset Dams and their associated operations and entitlements in relation to the Central Brisbane Irrigators removed. This aims to quantify the effect of the Wivenhoe and Somerset Dams, their associated operations and water entitlements, on the Central Brisbane Irrigators when compared to the without the dams and associated operations and entitlements.

As the current water supply scheme for the Central Brisbane River includes both the water infrastructure (Wivenhoe and Somerset Dams) and associated operations and entitlements (the system regulation), the modelling approach is to remove both of these aspects of the assessment as they are currently inherently linked. Further assessment could be undertaken to assess the benefit of the dams and system regulation separately by changing the associated operations of the dams in terms of the conditions of access for the Central Brisbane Irrigators. This is outside the scope of this study.

A description of each of the modelling cases and aim is outlined in **Table 6-1**. To reduce the potential for confusion, the modelling case have been titled "without" cases rather than "pre" cases, as not all aspects of the model have been updated to be "pre" Wivenhoe or Somerset Dams. These without dams cases represent the removal of both the dams and the regulated system for the Central Brisbane irrigators.

Table 6-1 Modelling Cases

Case	Description	Aim
Existing	The full entitlements model with the current dam infrastructure	To determine the existing access to water for the irrigators
Without Wivenhoe Dam	The full entitlements model removing Wivenhoe Dam and retaining Somerset Dam and some of the Mt Crosby town water supply	To determine the access to water for the irrigators as if Wivenhoe Dam (and its current associated operation and entitlements) was not in the system (but Somerset was in the system) and compare to the Existing Case
Without Wivenhoe and Somerset Dam	The full entitlements model removing Wivenhoe and Somerset Dams, the associated operations and entitlements, and all of the Mt Crosby and Glamorgonvale town water supply	To determine the access to water for the irrigators if Wivenhoe and Somerset Dams (with the current associated operations and entitlements) were not in the system and compare to the Existing Case

The access to water for the irrigators in the Existing Case will be determined by the regulation in the system and the releases from Wivenhoe Dam. The access to water in the Without Wivenhoe and Somerset Dams is determined by the natural climatic variability in the catchment.

It is important to understand that the IQQM model is run for the simulation period of 1889 to 2011, this is not aiming to show how the system would perform in a certain historically year and compare to that actual years observations. That is the calibration process. The IQQM model is showing how the system would perform, for the scenarios above, if the same climatic conditions that have been experienced historically between 1889 and 2011 were experienced.

6.3 Statistics

In order to fulfil the objectives of study, this study used the following statistics for the assessment period:

- Mean Annual Diversion Volume (ML)
- Mean Annual Diversion Volume (%) = Mean Annual Diversion Volume / Nominal Volume
- Number of Diversion Days (%) = Total Diversion Days#/Total Days
- Annual and Monthly Diversion Volumes (ML)

- a day where water is diverted it may be less than the full demand
These statistics have been presented for a different period including:

- Full simulation period
- Lowest diversion periods*

* - the lowest period is defined in this report as the lowest volume of total diversion supplied in a 15-year period

The diversion days is considered to be an important statistic as is develops a picture of the frequency that some if not all of the diversion demand can be extracted.

It is important to note that this assessment does not calculate any environmental flow objectives (EFOs) or water allocation security objectives (WASOs) as neither of these calculations were considered to be relevant for this study.

7 Modelling

7.1 Existing Case

The Existing Case was run as supplied by DES for the full entitlements model for the period 01/01/1889 to 30/06/2011.

7.2 Without Wivenhoe and Somerset Dams Case

As discussed on **Section 6.2**, the scenario assessment aims to characterise the performance of the Central Brisbane Irrigators based on the natural climatic variability with Wivenhoe and Somerset Dams and the associated operations and entitlements. The Without Wivenhoe and Somerset Dams case was created by making the following modifications to the Existing Case, all other aspects remained as per the Existing Case:

1. Changed the 4 irrigator nodes from Node Type 8.0 (regulated irrigator) to Node Type 8.3 (unregulated irrigators)
2. Applying a rainfall pattern of 0 to the irrigator nodes
3. Reducing the Soil Moisture Depletion to 0.1 to the irrigator nodes
4. Set the Town Water Supply of Mt Crosby Weir and Glamorgonvale to 0
5. Reduced the volume of Wivenhoe and Somerset Dams to 2 ML with infinite spillway capacity for overflow at 2 ML

Wivenhoe and Somerset Dams nodes were left in the IQQM model as there is a significant number of complex rules in the model regarding flood operations and water supply. These operating rules are linked the volume in the dams, as the volume of the dams never reaches these levels therefore these rules are not activated in the modified Wivenhoe and Somerset Dams. To ensure that this was an appropriate methodology, a comparison was undertaken on the flows upstream and downstream of Wivenhoe Dam, as shown in **Figure 7-1**. This figure shows that the flow is passed appropriately through the dam with the changes as outlined above.

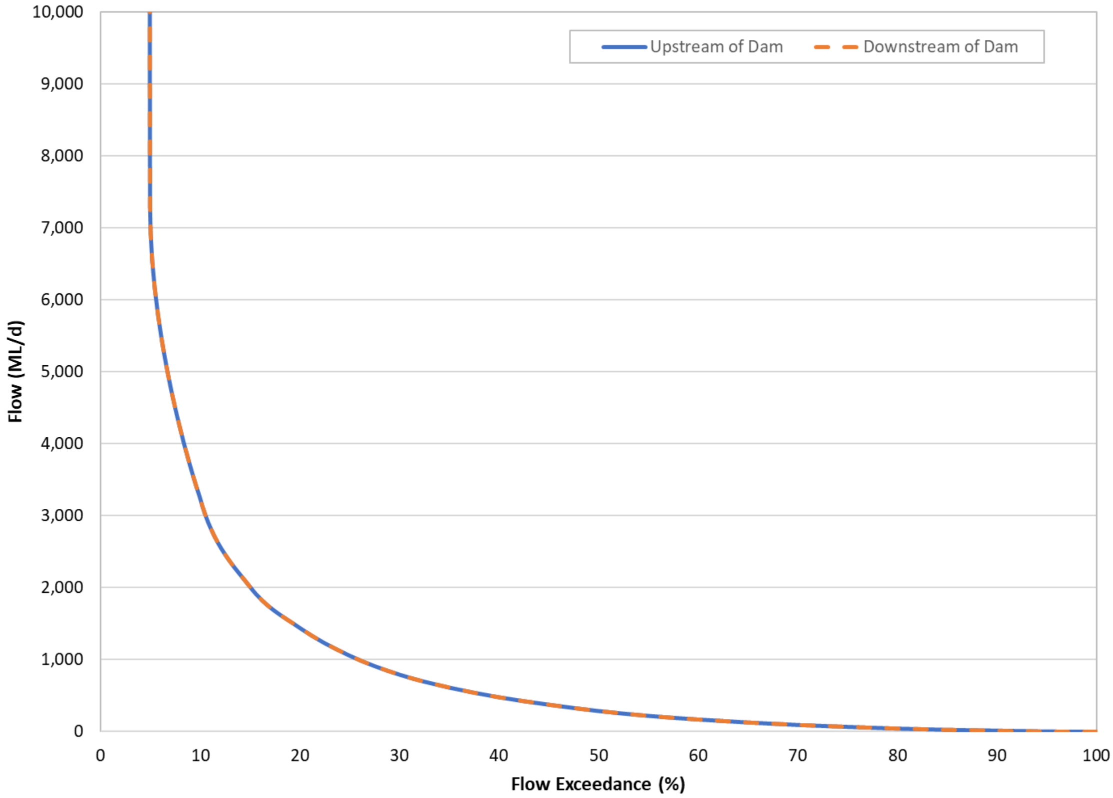


Figure 7-1 Daily Flow Exceedance Curve Upstream and Downstream of Wivenhoe Dam

The irrigators are represented as regulated irrigators Node Type 8.0 in the Existing Case, the regulated irrigator node does not include a reduction in the diversion demand due to rainfall. To remove the regulation from the irrigators and allow them to access the water based only on the flow in the river, as access would have been prior to the construction of Wivenhoe and Somerset Dams, the Nodes were converted to Node Type 8.3, which are unregulated irrigators. These unregulated irrigator nodes used calculations of crop, soil moisture, evaporation and rainfall to reduce the diversion demand based on the climatic conditions. To represent the irrigators in the same manner as the Existing Case, without the system regulation, the rainfall pattern was set to zero and the soil moisture depletion was set to 0.1. A sensitivity assessment was undertaken to confirm the appropriate application of this soil moisture depletion parameter. An assessment of the diversion demand showed it was the same as the Existing Case.

7.3 Without Wivenhoe Dam Case

The Without Wivenhoe Case (i.e. retaining Somerset Dam only) was designed to be an interim case, between the Existing Case and the Without Wivenhoe and Somerset Dams. Somerset Dam operated for 25 years, from 1959 to 1984, prior to the construction of Wivenhoe Dam. Unfortunately, there is limited records available for this period on the operational procedures for the dam and recorded information on dam releases.

The inputs required for this case were the operation of Somerset Dam in relation to the releases for town water supply and irrigation. Without records, it is difficult to determine the operational regime and the releases from the dam. At this stage, this scenario was not explicitly modelled in IQQM, however a qualitative discussion is presented in the **Section 8.3** based on the conclusions that can be drawn from Without Wivenhoe and Somerset Dams Case.

8 Results

8.1 Existing Case

The MAD and the MAD percentage of NV is presented in **Table 8-1** for the full simulation period (1889 - 2011) for the Existing Case. This table presents the individual reach diversions statistics and the total for the irrigator group.

Table 8-1 Existing Case Mean Annual Diversion – Long Term Average

IQQM Node	Description	NV (ML)	MAD (ML)	MAD/NV (%)
145	Reg LB1	1,955	1,862	95.3
163	Reg LB3	2,694	2,566	95.3
175	Reg LB5	560	533	95.2
194	Reg LB9	1,682	1,602	95.2
TOTAL		**6,891**	**6,564**	**95.3**

Table 8-2 presents the diversion days for the full simulation period. This table presents the statistics for the individual reaches and for the average for the irrigator group.

Table 8-2 Existing Case Diversion Days – Long Term

IQQM Node	Description	DD (%)
145	Reg LB1	96.1
163	Reg LB3	96.1
175	Reg LB5	96.1
194	Reg LB9	96.1
AVERAGE		**96.1**

In the Existing Case the system is regulated, water is provided equally to the irrigators in the system and therefore each irrigator group receives the same ratio of the volume of water supplied and access to water on the same number of days. The MAD is 95.3 % of the NV and access to water is 96.1 % of days over the full simulation period.

To determine the lowest diversion period, the annual diversions were summed on a 15-year rolling basis. The lowest diversion period is the continuous 15-year period with the lowest total diversion volume. This period was determined to be 1997 to 2011 in the Existing Case.

Figure 8-1 shows the annual simulated diversion volumes for the period 1997 to 2010. In this period the irrigators total NV demand was 103,365 ML and the simulated total diversion was 76,606 ML. The climatic period of 2006 to 2010 dominates the results for this period, with the diversion for the irrigators being significantly reduced in the period by the announced allocations for the Central Brisbane River, with the lowest annual diversion simulated to be 902 ML in 2009 water year.

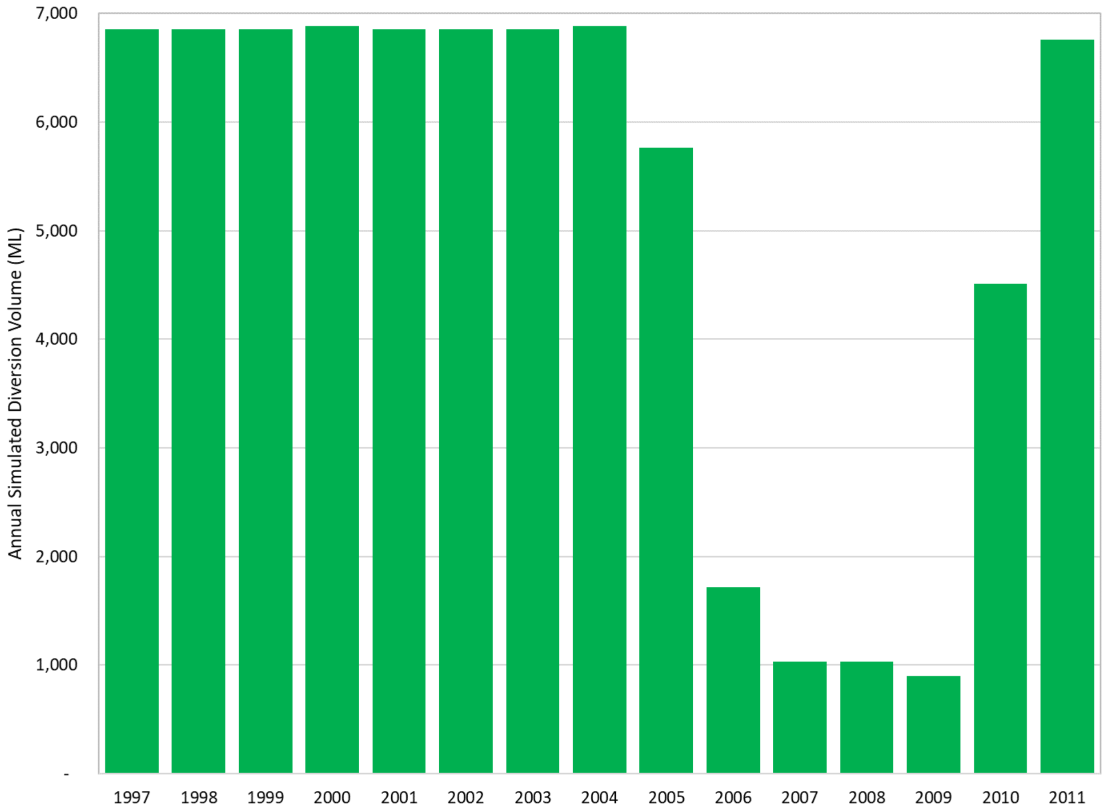


Figure 8-1 Existing Case Annual Simulated Diversion Volume – Lowest Diversion Period 1997 – 2011

Table 8-3 presents the diversion days, which shows the irrigators access to water in the lowest diversion period. The results predicted the irrigators had access to water for 75.6 % of days of 1997 to 2011 in the Existing Case.

Table 8-3 Existing Case Diversion Days – Lowest Diversion Period 1997 - 2011

IQQM Node	Description	DD (%)
145	Reg LB1	77.6
163	Reg LB3	77.6
175	Reg LB5	77.6
194	Reg LB9	77.6
AVERAGE		**77.6**

8.2 Without Wivenhoe and Somerset Dams Case

The MAD and the MAD percentage of NV are presented in **Table 8-4** for the full simulation period for the Without Wivenhoe and Somerset Dams Case. This table presents the individual reach diversions statistics and the total for the irrigator group.

Table 8-4 Without Wivenhoe and Somerset Dams Mean Annual Diversion – Long Term Average

IQQM Node	Description	NV (ML)	MAD (ML)	MAD/NV (%)
145	Reg LB1	1,955	1,910	97.7
163	Reg LB3	2,694	2,530	93.9
175	Reg LB5	560	507	90.6
194	Reg LB9	1,682	1,502	89.3
TOTAL		**6,891**	**6,449**	**93.6**

Table 8-5 presents the diversion days for the full simulation period. This table presents the statistics for the individual reaches and for the average for the irrigator group.

Table 8-5 Without Wivenhoe and Somerset Dams Diversion Days – Long Term

IQQM Node	Description	DD (%)
145	Reg LB1	100
163	Reg LB3	98.1
175	Reg LB5	96.3
194	Reg LB9	95.9
AVERAGE		**97.6**

As the irrigators are represented as unregulated irrigators, they take water when it is available without consideration for the downstream irrigators. The upstream irrigators have more access to water than the irrigators further downstream. The average MAD is 93.6 % of the NV access to water for the group is 97.6 % of days over the full simulation period.

To determine the lowest diversion period, the annual diversions were summed on a 15-year rolling basis. The lowest diversion period is the continuous 15-year period with the lowest total diversion volume. This period was determined to be 1902 to 1916 for the Without Wivenhoe and Somerset Dams Case.

Figure 8-2 shows the annual diversion volume for the period 1902 to 1916. In this period the irrigators total NV demand was 103,365 ML and the simulated total diversion was 88,123 ML. The climatic period of 1902 to 1903 and 1916 dominates the results for this period, with the lowest annual diversion simulated to be 3,132 ML in 1902 water year.

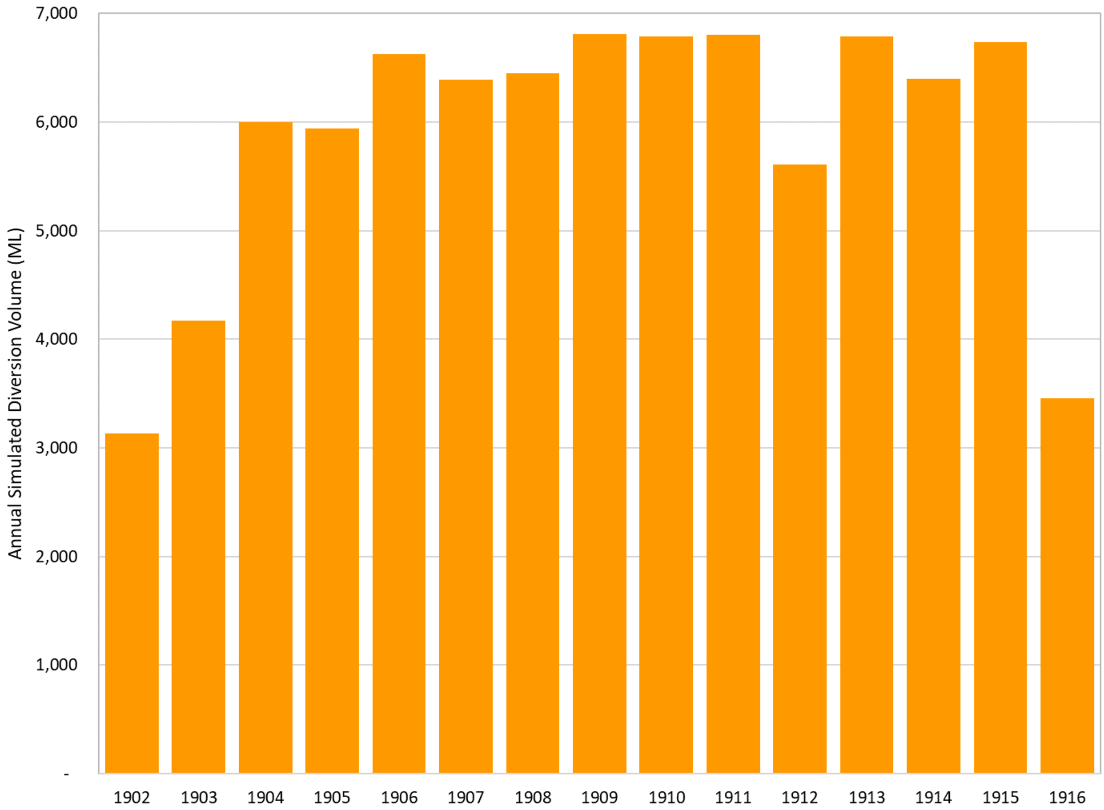


Figure 8-2 Without Wivenhoe and Somerset Dams Case Annual Diversion Volume – Lowest Diversion Period 1902 – 1916

Table 8-6 presents the diversion days, which shows the irrigators access to water in the lowest diversion period of 1902 to 1915. The results predicted the irrigators had access to water for 93.9 % of days for lowest diversion period of 1901 to 1915 in the Pre-Wivenhoe and Pre-Somerset Dam Case.

Table 8-6 Pre-Wivenhoe and Pre-Somerset Case Diversion Days – Lowest Diversion Period 1902 - 1916

IQQM Node	Description	DD (%)
145	Reg LB1	100
163	Reg LB3	95.1
175	Reg LB5	90.7
194	Reg LB9	89.7
AVERAGE		**93.9**

8.3 Without Wivenhoe Dam Case

As discussed above, the Without Wivenhoe Dam case was not explicitly modelled as there was not enough information on the operational regime of Somerset Dam to develop a credible modelling case. Somerset Dam is on the Stanley River and capture flows from approximately 13 % of the upstream catchment of the Central Brisbane River.

It is not clear whether releases from Somerset Dam historically would have been made for irrigation users as well as town water supply. The effect of Somerset Dam on the irrigators if no releases are made for irrigation, would have a reduction in the access to water due to the reduced flows in the river due to the Somerset Dam. Therefore, there would be expected to be some reduction in access to water in the Central Brisbane River from the results outlined in **Section 7.2** for the Without Wivenhoe and Somerset Dams Case.

8.4 Hydrologic Benefit

The hydrologic benefit has been assessed with the key aim of informing the Headworks Utilisation Factor (HUF) calculations. The results presented to assess hydrologic benefit are:

- Long term average annual diversion and diversion days
- Long term annual diversion
- Lowest diversion period including average annual diversion, annual diversion, diversion days and average monthly diversion

8.4.1 Long Term

Table 8-7 presents a comparison of the MAD and DD for the Existing Case and Without Wivenhoe and Somerset Dams Case for the full simulation period.

Table 8-7 Comparison Mean Annual Diversion and Diversion Days – Long Term Average

IQQM Node	Description	Existing	Without Dams	Existing	Without Dams
		MAD/NV (%)	MAD/NV (%)	DD (%)	DD (%)
145	Reg LB1	95.3	97.7	96.1	100
163	Reg LB3	95.3	93.9	96.1	98.1
175	Reg LB5	95.2	90.6	96.1	96.3
194	Reg LB9	95.2	89.3	96.1	95.9
TOTAL		**95.3**	**93.6**	**96.1**	**97.6**

These results show that on a long term basis, the diversion volume is 95.3 % in the Existing Case compared to 93.6 % in the Without Wivenhoe and Somerset Dams Case. The diversion days is 97.6 % in the Existing Case compared to 96.1 % in the Without Wivenhoe and Somerset Dams Case. The access to water is predicted to slightly decrease in the Existing Case for the irrigators. These results predict that the irrigators have a lesser number of days they can access water in the Existing Case, however they are able to access more water on those days therefore resulting in a slight increase in the MAD over the full simulation period. This table shows that the regulation of the system provides more equity in both diversion volumes and days of access to the irrigator group. The irrigators are predicted to have no significant change to the hydrologic benefit from Wivenhoe and Somerset Dams (with the associated operations and entitlements).

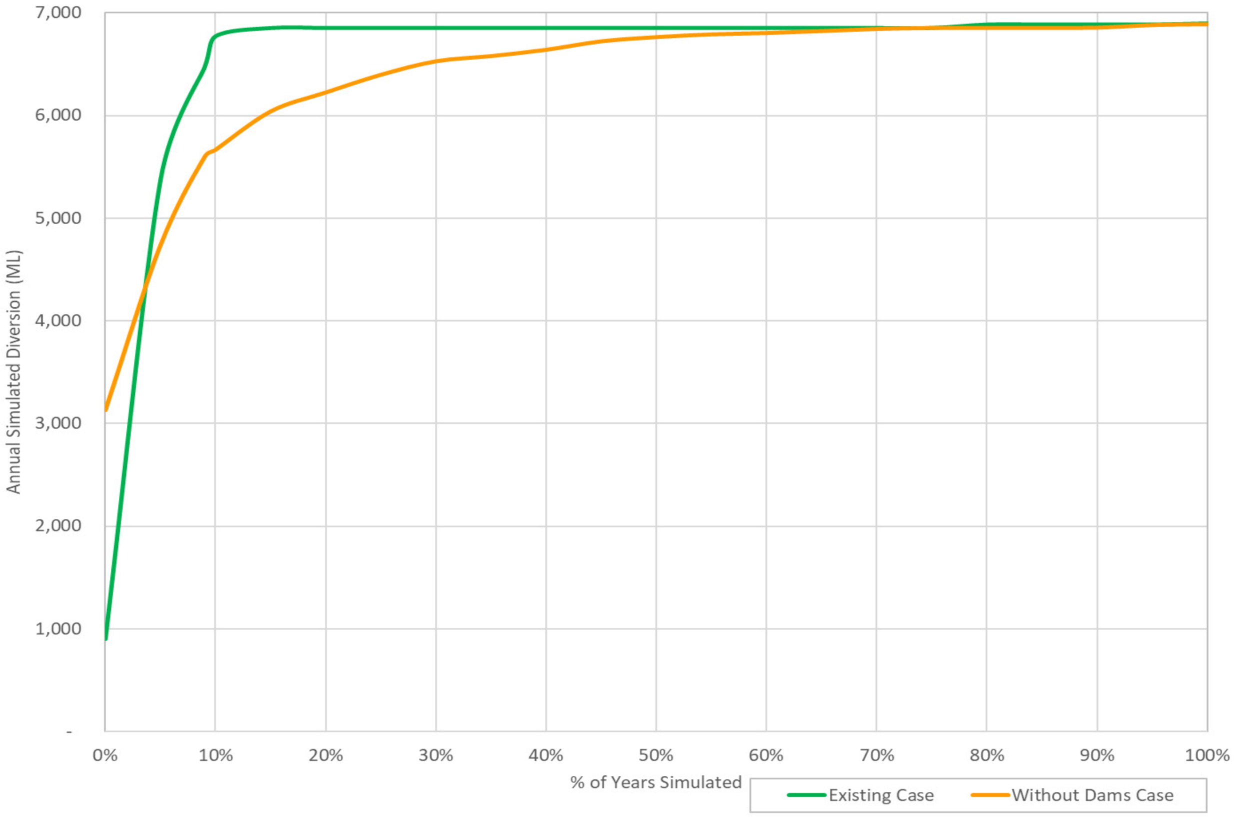


Figure 8-3 Annual Simulated Volume % of Year Simulated

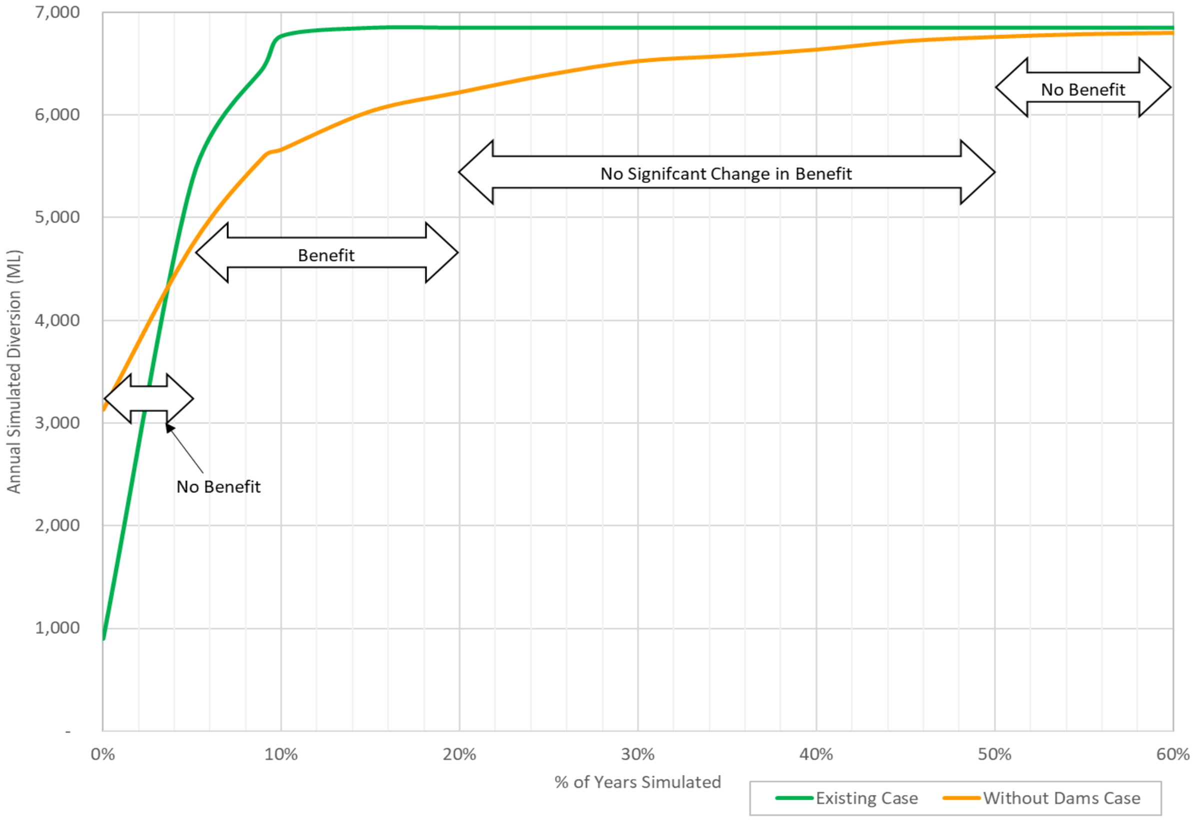


Figure 8-4 Annual Simulated Volume % of Year Simulated – Zoomed

Figure 8-3 presents the annual simulated diversion volume versus the percentage of years simulated. **Figure 8-4** shows a zoom in of the same graph for between 0 – 60 % of years simulated. This comparison shows that for 50 % of years, there is no change to the hydrologic performance in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case (between 50 – 100 % on the graph). There was no significant change in the hydrologic performance for 30 % of years (between 20 – 50 % on the figure) as the annual simulated diversion volume was at least 90 % of the NV. There was 15 % of years with a hydrologic performance improved (between 5 – 20 % in the figure) as the annual simulated diversion volume was higher in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case. There was a decrease in the hydrologic performance to the annual simulated diversion for 6 % of years (between 0 – 5 % on the figure).

As discussed in **Section 4.6**, the Central Brisbane River is a pool and riffle system. There is expected to be significant volumes of water available in these pools which would be available in zero flow conditions of the Without Wivenhoe and Somerset Dams Case. The access by the irrigators to these pools is not represented in the IQQM model. This access would be expected to increase the access to water by the irrigators and thus negate the majority of benefit predicted by the Existing Case in 15 % of years.

8.4.2 Lowest Diversion Period Without Wivenhoe and Somerset Dams Case – 1902 - 1916

The key analysis of the performance in the lowest diversion period which for the Without Wivenhoe and Somerset Dams Case is 1902 – 1916, this includes the “Federation Drought”. The assessment below presents the average of the 15-year period, a year by year comparison and an average monthly comparison.

Table 8-8 presents comparison of the simulated diversions in the lowest diversion period for Wivenhoe and Pre-Somerset Dams case.

Table 8-8 Comparison Lowest Diversion Period Diversion and Diversion Days – 1902 - 1916

IQQM Node	Description	Existing LDPD*/NV (%)	Without Dams LDPD*/NV (%)	Existing DD (%)	Without Dams DD (%)
145	Reg LB1	89.8	96.6	90.8	100
163	Reg LB3	89.5	85.3	90.8	95.1
175	Reg LB5	89.0	78.7	90.8	90.7
194	Reg LB9	89.4	76.8	90.8	89.7
TOTAL		**89.5**	**85.9**	**90.8**	**93.9**

* Lowest Diversion Period Diversion Volume

This table shows that comparison of the lowest diversion period in the Existing Case and Without Wivenhoe and Somerset Dams Case, the irrigators had slight improvement in the access to water in the Existing Case for the total irrigator group in terms of the volume of water access. However, there is a reduction in the number of days that water is accessed. This table shows that the regulation of the system provides more equity in both diversion volumes and days of access to the irrigator group.

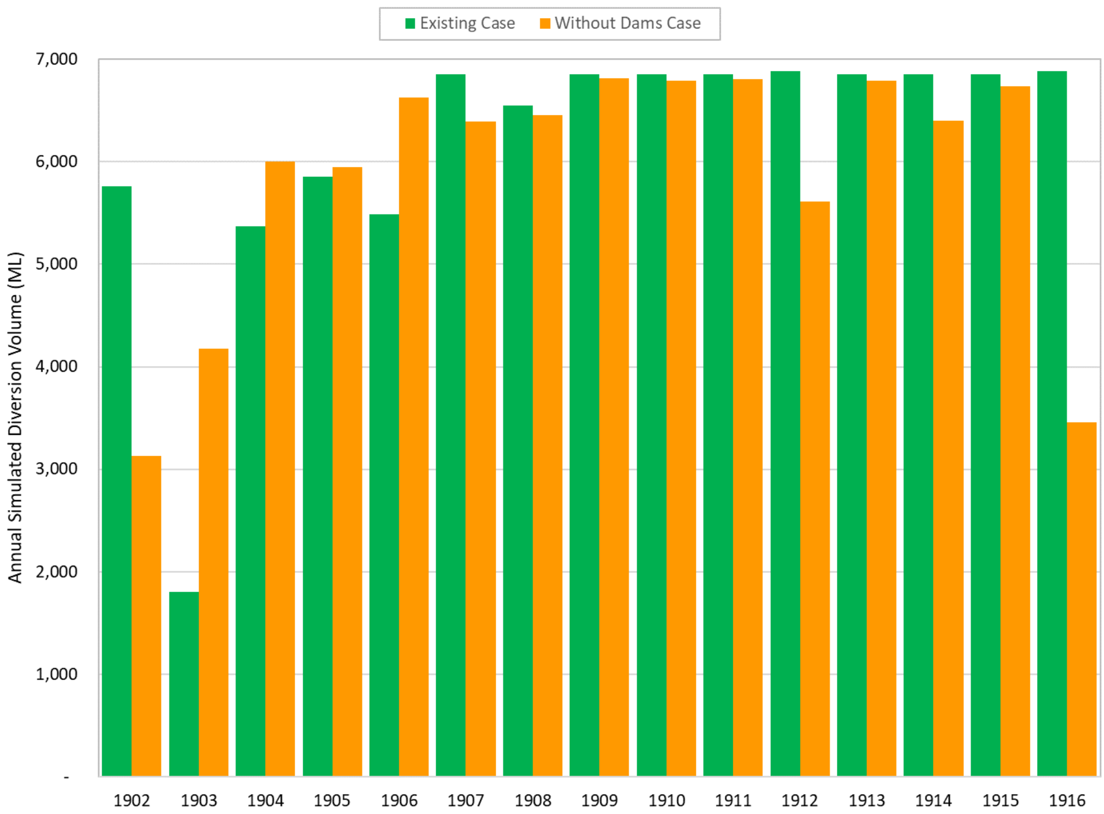


Figure 8-5 Year by Year Comparison of Annual Diversion Volume – Without Wivenhoe and Somerset Dams Case Lowest Diversion Period 1902 - 1916

Figure 8-5 shows a comparison of the annual simulated diversion volumes year by year in the 15-year lowest diversion period for the Without Wivenhoe and Somerset Dams from 1902 – 1916. This figure shows that in some years the irrigators have more access to water in the Existing Case and in some years they receive less access to water. For the 15-year period, the irrigators receive more access to water in 3 years, less access to water in 2 years and similar access to water in 10 years.

To further assess the hydrologic benefit, a further analysis of the lowest diversion period was undertaken to assess the diversions on a monthly basis. Supply of water in certain months may be more important than the total supply in the period as seasonal irrigation water demands are typically linked to critical stages in crop development. This assessment is presented in **Figure 8-6**.

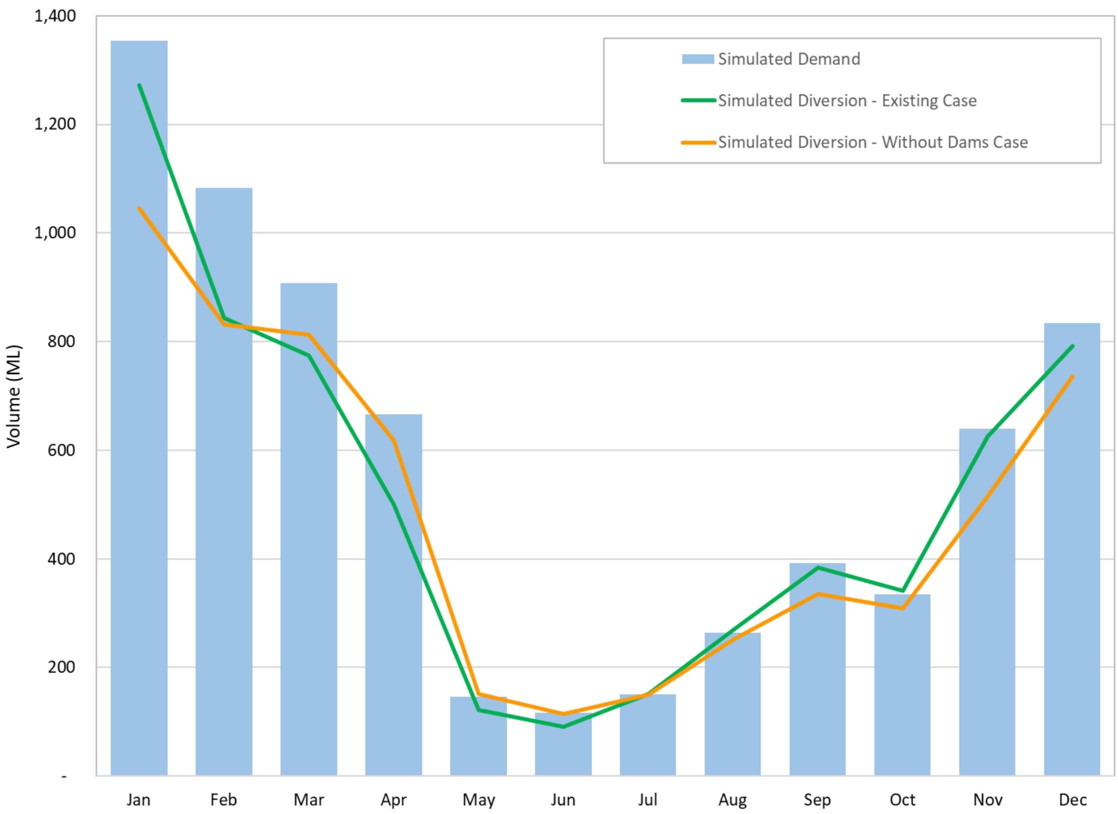


Figure 8-6 Monthly Comparison of Simulated Demand versus Simulated Diversions in the Lowest Diversion Period 1902 - 1916

This comparison shows that over the Without Wivenhoe and Somerset Dams Case lowest diversion period, the irrigators received less access to water for some months and more access to water in some months in the Existing Case than in the Without Wivenhoe and Somerset Dams Case.

For the Without Wivenhoe and Somerset Dams Case lowest diversion period 1902 – 1916, based on the average diversions, the year by year annual diversions and the monthly average diversion, the irrigators receive no significant change to the hydrologic benefit with the regulated system including Wivenhoe and Somerset Dams.

8.4.3 Lowest Diversion Period Existing Case – 1997 – 2011

The key analysis of the performance in the lowest diversion period which for the Existing Case is 1997 – 2011, this period includes the "Millennium Drought". The assessment below presents the average of the 15-year period, a year by year comparison and an average monthly comparison.

Table 8-9 presents comparison of the simulated diversions in the lowest diversion period for the Existing Case. This table shows that over the lowest diversion period, for the Existing Case, the irrigators had less access to water in the Existing Case than in the Without Wivenhoe and Somerset Dams Case.

Table 8-9 Comparison Lowest Diversion Period Diversion and Diversion Days – Lowest Diversion Period – 1997 – 2011

IQQM Node	Description	Existing	Without Dams	Existing	Without Dams
		LDPD*/NV (%)	LDPD*/NV (%)	DD (%)	DD (%)
145	Reg LB1	74.4	96.4	77.6	100
163	Reg LB3	74.2	90.8	77.6	95.8
175	Reg LB5	73.8	87.0	77.6	93.4
194	Reg LB9	74.1	85.9	77.6	92.9
TOTAL		**74.2**	**90.0**	**77.6**	**95.5**

* Lowest Diversion Period Diversion Volume

Figure 8-7 shows a comparison of the annual simulated diversion volumes year by year in the 15-year lowest diversion period for the Existing Case from 1997 – 2011. This figure shows that between 2006 - 2010 the irrigators received significantly less access to water in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case.

Figure 8-7 Year by Year Comparison of Annual Diversion Volume – Existing Case Lowest Diversion Period 1997 – 2011

To further assess the hydrologic benefit, additional analysis of the Existing Case lowest diversion period was undertaken to assess the diversions on a monthly basis. Supply of water in certain months may be more important than the total supply in the period as seasonal irrigation water demands are typically linked to critical stages in crop development. This assessment is presented in **Figure 8-8**.

This comparison shows that over the Existing Case lowest diversion period the irrigator received less access to water in the Existing Case than in the Without Wivenhoe and Somerset Dams Case. The simulated diversion to the irrigators is less in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case for each month.

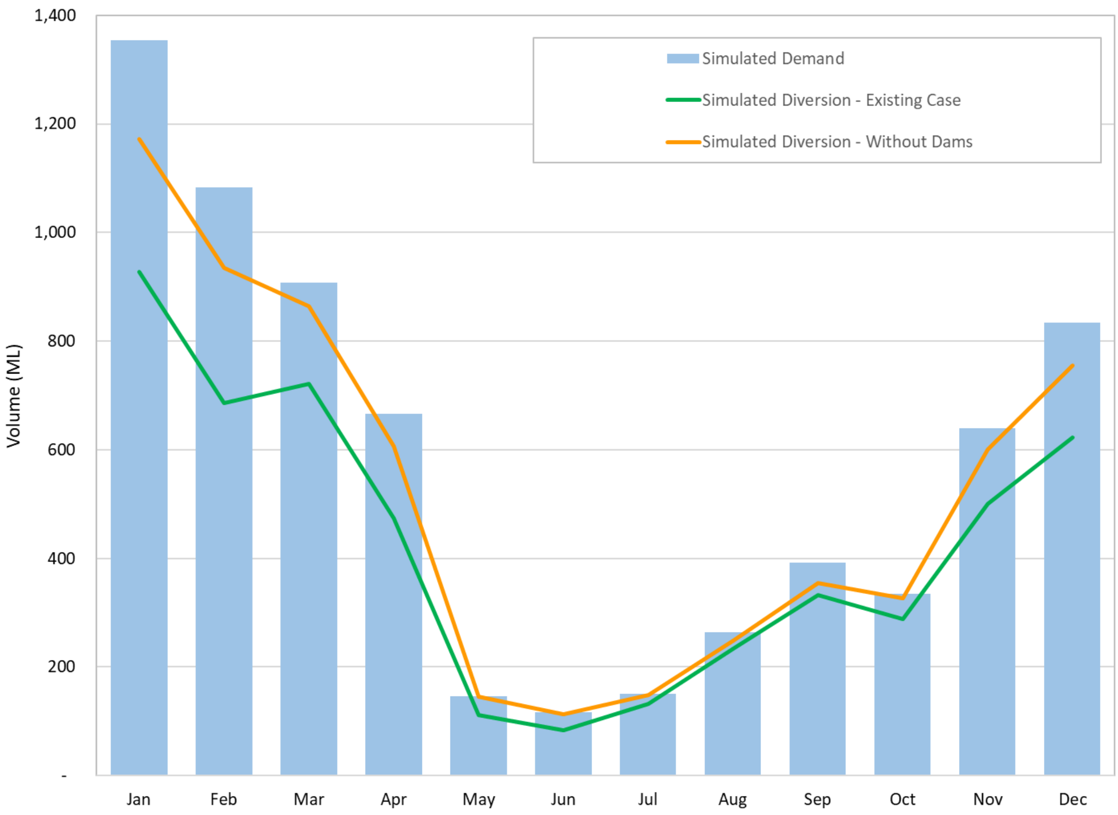


Figure 8-8 Monthly Comparison of Simulated Demand versus Simulated Diversions in the Lowest Diversion Period 1997 - 2011

The irrigators access to water in the lowest diversion period of the Existing Case is dictated by the system regulation, while the access to water in the Without Wivenhoe and Somerset Dams Case is based on the natural flow variability in the system. These results show that the natural flows in the river in the Without Wivenhoe and Somerset Dams Case would provide more access to water for the irrigators than is provided by the regulated system including the Wivenhoe and Somerset Dams in this critically dry period.

8.4.4 Headworks Utilisation Factor

The HUF methodology is based on a storage analysis for the lowest diversion period which relates to the modelled driest period of record for the dam infrastructure. For the Central Brisbane system, the lowest diversion period for supply for the dam infrastructure was determined to be 1997 to 2011. As discussed in **Section 8.4.3**, **Figure 8-7** and **Figure 8-8** presents hydrologic performance of the irrigators for the lowest diversion period.

Table 8-10 presents a comparison between the simulated performance of the system on a monthly basis comparing the simulated diversion and the diversion days in the lowest diversion period for the dam infrastructure.

Table 8-10 Monthly Comparison Lowest Diversion Period Diversion and Diversion Days – Lowest Diversion Period (1997-2011)

Month	Simulated Diversion (ML)			Diversion Days (%)		
	Existing (1)	Without Dams (2)	Difference (1) – (2)	Existing (3)	Without Dams (4)	Difference (3) – (4)
Jan	928	1,172	-244	67.3	89.6	-22.3
Feb	686	935	-249	68.3	95.2	-26.8
Mar	721	864	-143	78.1	95.4	-17.4
Apr	475	607	-133	72.2	95.6	-23.4
May	111	145	-34	73.3	96.8	-23.4
Jun	83	113	-29	73.3	99.1	-25.8
Jul	132	148	-16	86.7	98.3	-11.7
Aug	234	249	-15	86.7	93.8	-7.2
Sep	333	354	-21	86.7	94.5	-7.8
Oct	288	327	-39	84.5	98.5	-14.0
Nov	500	601	-101	79.6	98.5	-18.9
Dec	623	756	-133	73.3	92.6	-19.3

The HUF analysis relates to the stored volume in the dams in this period which is attributed to supply the benefit to the irrigators. These results show that in the lowest diversion period for the performance of the dam infrastructure (1997 to 2011), the irrigators received less diversion volume and less access to water in all months in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case.

8.4.5 High Flow Conditions

As discussed in **Section 5.4.2**, the irrigators are limited by infrastructure constraints to extract water in high flow conditions, typically above 50 m^3/s at the Twin Bridges. In the Existing Case, flows at this location will be dictated by the releases from Wivenhoe Dam and in the Without Wivenhoe and Somerset Dams Case flows will be dictated by the natural flooding regime. An assessment was undertaken to compare the number of days in the simulation period estimated to have flows above 50 m^3/s at the Twin Bridges.

The Existing Case predicted 5.9 % of days were above 4,320 ML/d (50 m^3/s) compared to 8.9 % of days in the Without Wivenhoe and Somerset Dams Case. This is a result of the flood mitigation provided by Wivenhoe and Somerset Dams. Further assessment could be undertaken to assess when releases are made from Wivenhoe Dam and without significant rainfall in the Central Brisbane river area. This is outside the scope of this study.

8.5 Discussion

The results show that on a long term basis the irrigators are predicted to receive a slight benefit from Wivenhoe and Somerset Dams when assessing long term averages. On a comparison of the annual simulated diversion, the irrigators receive no hydrologic benefit or no significant change to the hydrologic benefit for 80 % of the modelled years. The irrigators were predicted to receive a hydrologic benefit for 15 % of years and predicted to receive a detriment to the hydrologic performance in 5 % of years.

The hydrologic benefit predicted by the IQQM model, does not consider the river pools in the Central Brisbane River system that will hold water below the cease to flow measured level in the River. Therefore, the majority of this benefit is expected to be negated by the access of the irrigators to these river pools.

A comparison of the simulated performance of the system in the lowest diversion periods for the Existing Case and Without Wivenhoe and Somerset Dams Case. In the Existing Case lowest diversion period of 1997 to 2011, the irrigators were predicted to receive less diversion volume and less access to water in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case. In the Without Wivenhoe and Somerset Dams lowest diversion period from 1902 to 1916, the irrigators received no significant change to the hydrologic benefit Existing Case of compared to the Without Wivenhoe and Somerset Dams Case.

For the introduction to the HUF calculations, a comparison of the simulated performance for the lowest diversion period for the dam infrastructure which is 1997 to 2011. This comparison was undertaken on an annual and monthly basis. The irrigators received less diversion volume and diversion days in the Existing Case compared to the Without Wivenhoe and Somerset Dams Case, for all months ranging from 15 to 249 ML less diversion volume and 7.2 to 25.8 % less diversion days.

9 Headworks Utilisation Factor

9.1 Background

In 2012 the state government directed that the Queensland Competition Authority (QCA) to recommend irrigation prices for the Central Brisbane Water Supply Scheme (CBRWSS), as there were no water prices being applied to the irrigators in this scheme. The methodology originally developed for other water supply schemes as developed by parson Brinkerhoff in 2012, was applied to the Central Brisbane Water Supply Scheme. The strict application of the methodology found that the irrigators would be assigned 69 % of the HUF, although the urban supply accounts for 98 % of the system entitlements. A revised methodology was suggested as a "adjusted HUF" calculation which represented the medium priority irrigator entitlements as a ratio to the high priority entitlements adjusted for the level of useable storage volume in the system. This resulted in an "adjusted HUF" of 2.1 % for the medium priority irrigators.

For the 2013-17 regulatory period, Seqwater proposed that renewals and maintenance costs for bulk water infrastructure be apportioned in accordance with HUFs calculated for each water supply scheme where both high priority (typically urban and industrial) and medium priority (typically irrigation) water entitlements coexist. The HUF represents a hydrological assessment of the percentage of utilisable storage dedicated to each priority group of water entitlements. Specifically, the HUF methodology considers water sharing rules, critical water sharing arrangements (CWSAs) and other operational requirements that typically give high priority (non-irrigation) water entitlement holders exclusive access to water stored in the lower levels of storage infrastructure.

After considering submissions from Seqwater, its consultants and stakeholders, the QCA developed and adopted its own approach – based on applying special adjustments to the standard HUF methodology – whereby 1.6% would be used (for the 2013-17 price path) as the basis for determining the proportion of CBRWSS's renewals, fixed repairs and maintenance costs, and all other fixed operating costs (including insurance premiums) to be allocated to medium priority (irrigation) water entitlement holders within the scheme.

A more robust methodology has been developed for the application of the HUF by the analysis through IQQM on the storages volumes in the critical 15-year period in the water supply scheme.

9.2 Determination of Benefit

HUFs are used to apportion bulk water capital costs in accordance with the benefit attributable to each water entitlement priority group.

The modelling assessment undertaken as part of this study aimed to determine the hydrologic benefit of the Wivenhoe and Somerset Dams (and the associated operational and entitlements), to the irrigators in the Central Brisbane River. **Table 8-10** and **Figure 8-8** the lowest diversion period 15-year period (1997 – 2011) for the water supply scheme. These results show that the irrigators received no modelled hydrologic benefit from the regulated water supply scheme including Wivenhoe and Somerset Dams. The irrigators were predicted to receive more access to water based on the natural flows in the system for the lowest diversion period of 1997 to 2011.

10 Conclusions

A technical study has been undertaken to determine the extent of hydrologic benefit, if any, that is provide to the irrigators of the Central Brisbane Water Supply Scheme from the Wivenhoe and Somerset Dams (and the associated operational and entitlements). This study utilised the Brisbane River IQQM model, which is the basis for the Water Plan (Moreton) 2007. The IQQM model has been extended by the DES to include the period from 30/06/2000 to 30/06/2011, which covers the most recent significant drought and flood periods experienced.

The modelling strategy was developed to model the Existing Case and the Without Wivenhoe and Somerset Dams Case. The assessment focused on the performance in terms of diversion volume and diversion days. The system performance was assessed on a long-term basis and for the lowest diversion period to determine hydrologic benefit. The IQQM model was identified to have a number of limitations, however it has been deemed suitable for use in this study. There are further technical improvements that could be undertaken (if relevant data was available) to reduce these limitations.

The conclusion of this study is that, using the existing department's IQQM model (including its key assumptions, limitations and extended to include the recent driest period of record), Wivenhoe and Somerset Dams (and the associated operational and entitlements) provide Central Brisbane Irrigators with no significant change to the modelled hydrologic benefit, when compared to the predicted access under a hypothetical scenario where irrigators were able to take water from natural river flows and where there were no dams and system regulation for urban purposes. The effect of the dams – coupled with the operational and access rules that are applied to irrigators within this supplemented system – effectively quarantine the flows in the river primarily for urban water supply in critically dry periods. This results in less water being available to the irrigators in a very dry period than is predicted to be been available under the natural flow regime in the river in the hypothetical no-dam no-urban water supply scenario.

APPENDIX A

References

References

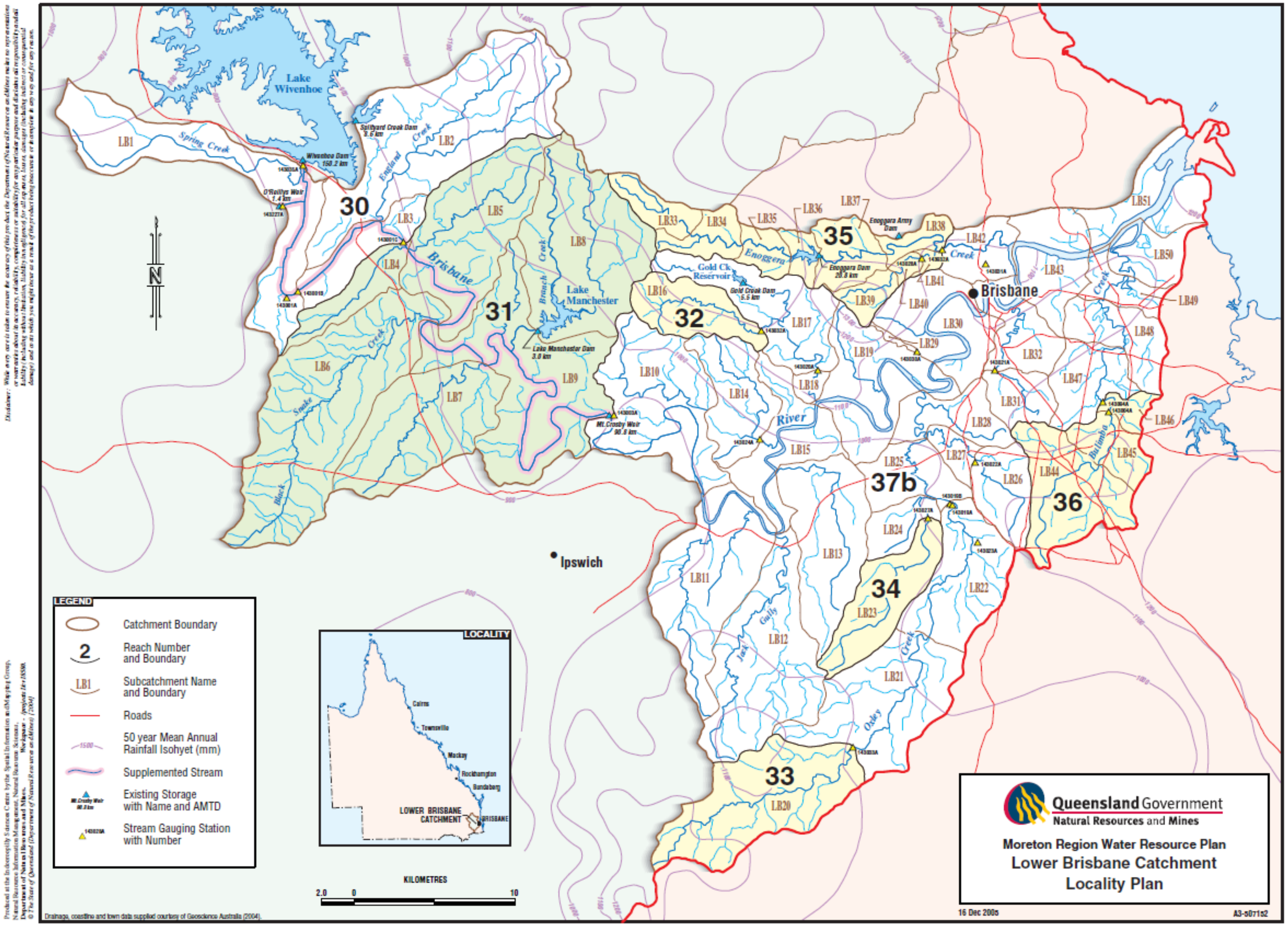
Headworks Utilisation Factors, Technical Paper, SunWater and Seqwater, 24th April 2018

Wivenhoe Dam and Somerset Dam, Manual of Operational Procedures for Flood Mitigation (Seqwater) Revision 14, October 2016.

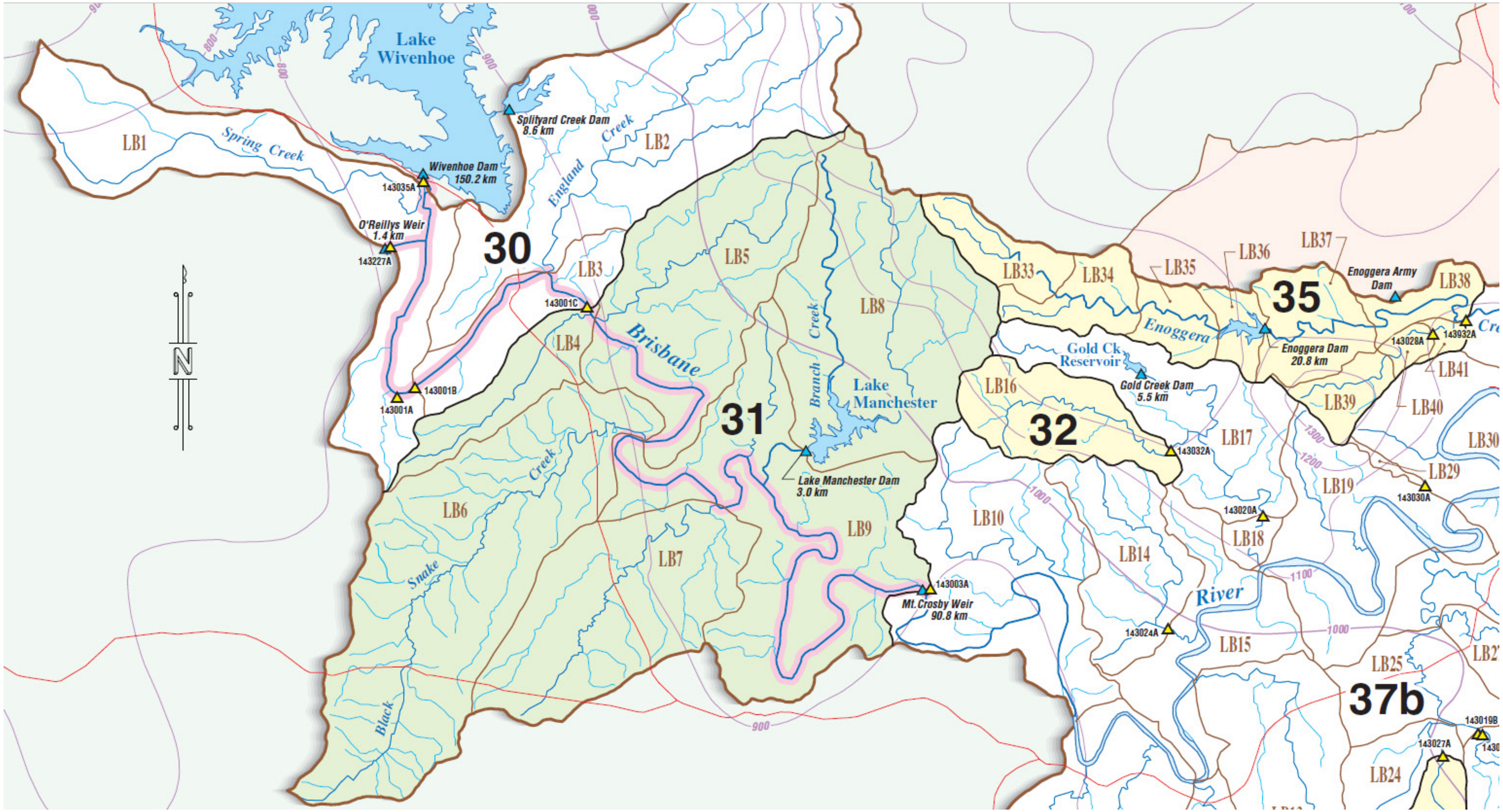
Brisbane River IQQM Calibration, Department of Environment and Resource Management, 21st March 2011

APPENDIX B

Moreton Region Water Resource Plan – Lower Catchment Locality Plan



Moreton Region Water Resource Plan – Lower Catchment Locality Plan



Zoom of Moreton Region Water Resource Plan – Lower Catchment Locality Plan

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