Operating Level Scenarios for Key Storages in South East Queensland

Project Meeting

9 February 2011

3-4 pm

Draft Agenda

1. Introduction
2. Strategic Issues – feedback from other agencies etc
3. Review of draft Report by John Collins
4. Draft Report Ver 4
5. Other business – review by Anita Sweet

D/11/002657

INFORMATION MATERIAL ONLY

Impacts on SEQ Water Strategy of Various Operating Scenarios for Wivenhoe Dam

9 February 2011

Version 4

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1 Purpose

The purpose of this report is to outline the results of the assessment, from a water supply security perspective for South East Queensland (SEQ) over the short and long term, of possible scenarios for lowering of Wivenhoe Dam below the deemed full operating supply level (i.e. 100 percent dam level for water supply purposes). The effects of temporarily lowering the full supply level of Baroon Pocket and Hinze Dams were also assessed.

For the purpose of this report, the short term is defined as the period over the next 5 years where the supply security may be impacted by any proposed temporary lowering of the dam operating level over the 2011 wet season. Long term is defined as permanent measures that may impact water security over the next 50 years.

It is emphasised that these are only scenarios and are meant to provide information for the consideration of any temporary measure over the 2011 wet season.

This assessment does not deal with the environmental, social and economic impacts of the dam operating levels in relation to flood mitigation to downstream properties and infrastructure.

2 Background

Major flooding occurred in the Brisbane River catchment on 13 January 2011.

This resulted in the Brisbane River peaking at 4.46m at the Port Office in Brisbane City and causing extensive damage to properties and businesses throughout the catchment. The 2011 flood was about 1m lower than the 1974 Flood event of 5.45m at Port Office, Brisbane City. However, the social and economic impacts are much more significant given the building and business developments in the catchment over the last 37 years. Flood rebuilding is currently estimated to cost about $5B.

The Minister for Natural Resources, Mines and Energy and the Minister for Trade has written to the Commissioner on 20 January 2011, requesting the Queensland Water Commission provide all necessary assistance to Seqwater in their review of the operation of Wivenhoe and Somerset Dams.

3 Role of Queensland Water Commission

3.1 Background/Context

The Queensland Water Commission (the Commission) is responsible for providing advice to the Minister on matters relating to water supply and demand management for water for SEQ. A key function of the Commission is to provide advice on the desired Levels of Service (LOS) for water supplied to SEQ.

The SEQ Water Strategy defines the LOS objectives as relating to the expected frequency, duration and severity of restrictions during future droughts. The LOS

4 Short Term Impacts

4.1 Determine the volume of release (or dam level) which may be accommodated within the Brisbane River system LOS yield

QWC RESPONSIBLE FOR LOS YIELD BUT OTHER OFF IS "A GRAIN OF SAND"

The SEQ Water Strategy notes that the Brisbane River system (Wivenhoe, Somerset and Gold Creek dams, Lake Manchester and Mt Crosby Weir) provides an average contribution of 256,300 ML/annum to the LOS Yield. This represents about 47% of the total LOS system yield for SEQ.

The metered demand from the Brisbane River system from 1 July 2010 to 31 December 2010 is about 51,400ML. This equates to about 102,800 ML/annum.

Thus, there may be potential to release about 150,000 ML/a or about 13% capacity of the full supply volume (FSV) of Wivenhoe Dam based on the Storage Capacity data provided in Appendix A. These calculations and conclusion are premised on the current high volumes of water in the remaining SEQ water storages, and the assumption that this stored water could be readily accessed to meet the region's demands.

4.2 Determine the volume of release (or dam level) which can be accommodated in accordance with the SOP for the SEQ region as a whole (for discussion)

Figure 1 shows the daily production rate of water for all of SEQ, since January 2009. As expected, there are some daily variations due to factors such as climatic conditions but over these two years the volume of production was about 680 megalitres per day (ML/day) or about 250,000 ML/annum.

4.3 Use the SEQ Regional Water Balance Model (Wathnet Model) to assess the SOP risk criteria

The modelling conducted for this report was carried out using the Wathnet Model[1] which assesses the likelihood of reaching particular water storage volumes. Under the current operating arrangements and policies, the volumes` of interest are:

- 60% of the Grid 12 volume, when full desalination production is triggered; and
- 40% of the Grid 12 volume, when full production of purified recycled water from the Western Corridor Recycled Water Project is triggered, to augment water supplies in Wivenhoe Dam and medium level restrictions would be introduced.

The Grid 12 storages and their corresponding capacities are provided in Appendix B.

Table 1 presents the scenarios modelled. Five scenarios were considered involving a reduction in water level at Wivenhoe Dam. The fifth scenario includes a reduction at Hinze and Baroon Pocket Dams. This allows an assessment of the sensitivity to the security of supply should there be a need to also reduce the full operating levels in the Sunshine Coast (Baroon Pocket Dam) and Gold Coast (Hinze Dam).

The key assumptions adopted for these runs were:

- Simulations start in January 2011
- Reduced initial levels of Wivenhoe Dam to 87%, 75%, 70% and 50% capacity (Scenarios 1-4) and all other storages were set at 100% initially.
- Reduced levels of Wivenhoe Dam, Baroon Pocket and Hinze Dams to 50% capacity and all other storages were set at 100% initially (Scenario 5)
- Northern Pipeline Interconnector Stage 2 excluded
- Demand used corresponds to permanent water conservation measures, in particular, 200 litres per person per day for residential use (November 2010 Bulk Price Review)
- Medium series population growth consistent with SEQ population forecasts
- No desalination above 60% Key Grid 12 Storages
- Full desalination below 60% Key Grid 12 Storages

The scenarios do not consider day-to-day operational matters.

[1] Wathnet Model refers to the Generalised Water Supply Headworks Simulation using Network Linear Programming Model.

Table 2: Results of risk criteria

Period	SOP Criteria	Scenarios (Wivenhoe/Baroon Pocket/Hinze capacities)				
		1 (87/100/100)	2 (75/100/100)	3 (70/100/100)	4 (50/100/100)	5 (50/50/50)
Probability of reaching 40% Grid 12 Storage Volume						
1 year	<0.2%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
5 year	<5%	0.09%	0.15%	0.20%	0.31%	0.49%
Probability of reaching 30% Grid 12 Storage Volume						
3 year	<0.5%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%
5 year	<1%	<0.01%	<0.01%	<0.01%	<0.01%	0.03%

From the above analysis, all scenarios 1 to 5 in Table 2 pass the SOP risk criteria. While this means that risk associated with the short term security of supply is acceptable, the consequences of each scenario with respect to other factors would need to be examined – see Section 4.3.

4.4 Implications of each scenario

Table 3 provides a general framework for the assessment of the consequences of each scenario based on the following criteria for the short, intermediate and long term periods:

- Security of supply - involves examining the sufficiency, LOS yield, and demand and supply balance
- Levers – these are some of the factors that could be reviewed to optimise the security of supply such as Levels of Service specification, government policies and assumptions
- Inputs – these are some of the input factors which could be impacted e.g. allocation, demand and supply
- Pricing – some of the scenarios may impact upon the current Price Path 2010-12 that has been established.

The following observations are made and this is reflected in Table 3:

Table 3: Preliminary Framework for Consideration of the Impact on SEQ Water Strategy of Various Operating Levels for Wivenhoe Dam

Description	Base Case (status quo)	Short Term/Temporary Options (Wivenhoe Dam drawdown)			Intermediate Option	Long Term/Permanent Options (Wivenhoe Dam drawdown)	
		13%	25%	50%	Review	#10%	25%
Security of supply							
• Sufficiency	✓	✓	✓	✓	Review	✓	✗
• LOS Yield	✓	✓	✓	✓		✓	✗
• Demand/ Supply Balance	✓	✓	✓	✓		✓	✗
• Desalination	✓	✓	✗ (potentially triggered ~~within 3 years~~ if 2001-2006 inflows ~~occur within~~ next 6 years)	✗ (potentially triggered within 3 years if 2001-2006 inflows occur within next 6 years)		✓	✗
Levers							
• Levels of Service					Review		
• Policies							
• Assumptions							
Input							
• Allocation/Yield	✓	✓	✗ (Brisbane river system allocation of 285,545 ML are impacted)	✗ (Brisbane river system allocation of 285,545 ML are impacted)	Review	✗ (impacted)	✗

DERM ALLOCATION

4.5 Forecast the probability of key Grid 12 storages level over the next 5 years

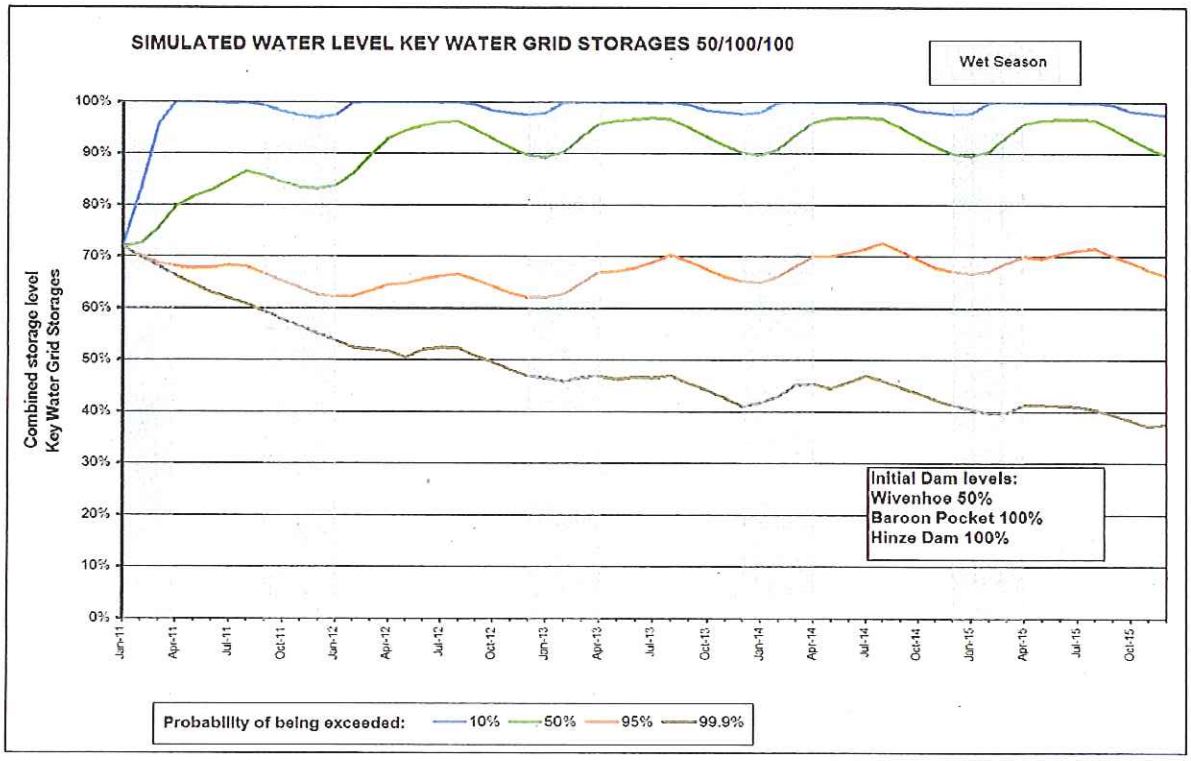
To forecast the probability of the Grid 12 storages reaching a certain level, the Wathnet Model was used, based on stochastic data generation for 117 years of historical information.

Figure 2 shows the forecast storage level for the Grid 12 (key water grid storages) for Scenario 4 (as described in Section 4.2) with Wivenhoe drawn down to 50% and the rest of the storages at 100% at the start of the simulation in January 2011. (Note: The plots for Scenarios 1 – 3 would show higher storage levels than those shown in Figure 2).

In this scenario:

- there is a 95% probability that the combined Grid 12 dam levels remain above 60% over the next 5 years;
- there is a 99.9% probability that the Grid 12 level remains over 40% for the next 4 years; and
- there is a 50% probability that the combined Grid 12 dam levels will climb back to 90% and remain at this level for the remainder of the 5 year period.

Figure 2: Scenario 4 with Wivenhoe Dam drawn down to 50% - forecast combined dam level Grid 12 showing probabilities of exceedance



4.6 Simulated storage behaviour of Grid 12 storages over the next 6 years using three inflow scenarios (using Waspp Model[2])

The purpose of these simulations was to assess the potential behaviour of the Grid 12 storages over the next 6 years using three inflow scenarios (or cases) based on probability of combined inflows into the storages. For all inflow scenarios, Wivenhoe Dam was assumed to be initially at 75% capacity.

There are various methodologies that could be used for the selection of inflow sequences. For the purpose of this work, it is considered necessary to test scenarios covering a period of relative wet, average inflow and the driest years. The annual inflows for the Grid 12 storages from 1890 to 2007 were used in the analysis. Table 5 provides the scenarios corresponding to the 30% (wet), 50% (average) and 100% (dry) exceedance probabilities[3] based on 6 years of cumulative inflow sequence.

The worst 6 years of inflows (100% exceedance probability) was found to correspond to the most recent drought on record from 2001 to 2006 shown in Case 3 (Table 5).

Table 5: inflow scenarios assessed

Scenarios (Case)	Exceedance Probability of Inflows	Continuous Sequence (6 years)	Total Inflow Volume Grid 12 (ML)
1	30%	Jan 1985 – Dec 1990	10,193,300
2	50%	Jan 1995 – Dec 2000	7,243,300
3	100%	Jan 2001 – Dec 2006	2,752,000

The assumptions adopted in the modelling were:

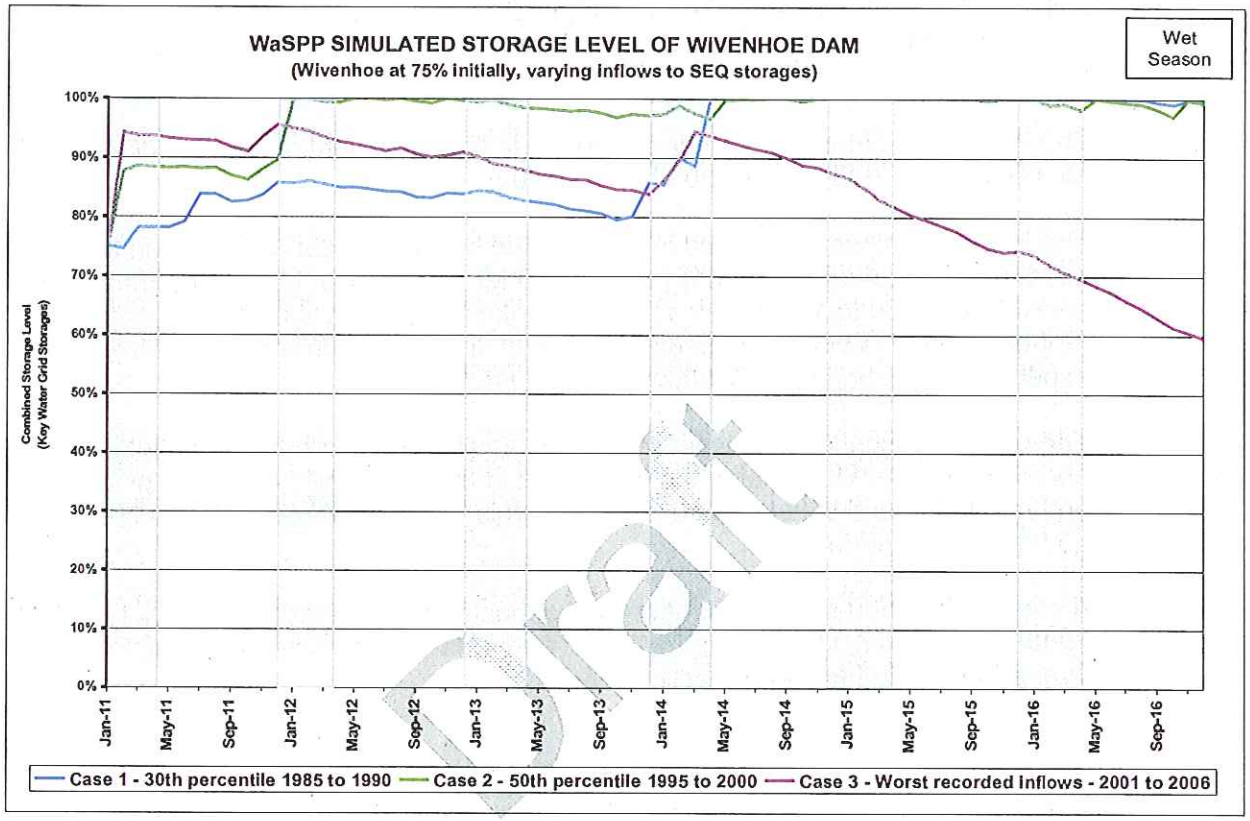
- 75% initial storage volume at Wivenhoe Dam (all other storages at 100% full) - or Grid 12 storages at 86% capacity
- Demands based on November 2010 Bulk Price Path – commences with current consumption and increases to a residential 200 litres/person/day by 2018

[2] Waspp Model refers to Water Supply Predictive Planning Model, QWC.

[3] The exceedance probability is the percentage probabilty of a 6 years of cumulative inflows being equalled or exceeded. For example, the exceedance probability of the Jan 2001-2006 inflows is 100% - as this volume of inflow is always exceeded (100%) based on the previous record.

The simulated storage level behaviour of Wivenhoe Dam for the three inflow scenarios is indicated in Figure 5. As expected the simulated level for Wivenhoe Dam reduces significantly due to the worst inflow sequence (drought). With the other two inflow scenarios, Wivenhoe Dam recovers within about 3 years.

Figure 5: Simulated Wivenhoe Dam storage levels for 3 inflow scenarios/cases



5 Long Term Impacts - assessment of the potential impact on the LOS Yield (using Wathnet Model)

To assess the impact on the LOS yield if Wivenhoe Dam was operated at a reduced water supply capacity, over a long term or permanently, two scenarios involving a 10% and 25% reduction from full supply level were investigated.

This assessment is carried out for completeness only and does not suggest that the dams be operated permanently with a reduced full supply level.

The Regional Water Security Program for SEQ establishes the desired LOS objectives which form a basis for the SEQ Water Strategy and are implemented through the System Operating Plan. These objectives provide a long term security of water supply and are defined as the:

- desirable maximum frequency, duration and severity of water restrictions
- the average amount of water per person that must be supplied in normal times.

These objectives are used to determine the Level of Service (LOS) Yield. The LOS Yield is used, along with the projected demands, to ensure that adequate initiatives are in place to meet demand in the future.

The LOS Yield for the 2010 Infrastructure (capacity to deliver) is assessed to be 485,000 ML/a. This assumes that the desalination plant is providing 125 ML/day and PRW at 142 ML/day.

To assess the impact on the long term LOS Yield, the Wathnet Model was used.

This assessment was based on the following assumptions[4]:

- 2010 infrastructure, prior to the full operation of Wyaralong Dam and Hinze Dam Stage 3
- PRW production at 52,000 ML/a (142 ML/day) and supplies 34,950 ML/a (96 ML/day) to industry
- Desalination production at 46,000 ML/a (125 ML/day)

5.1 Results – 10% reduction on Full Supply Volume for Wivenhoe Dam

The LOS Yield for the 2010 Infrastructure (capacity to deliver) is assessed to be 485,000 ML/a.

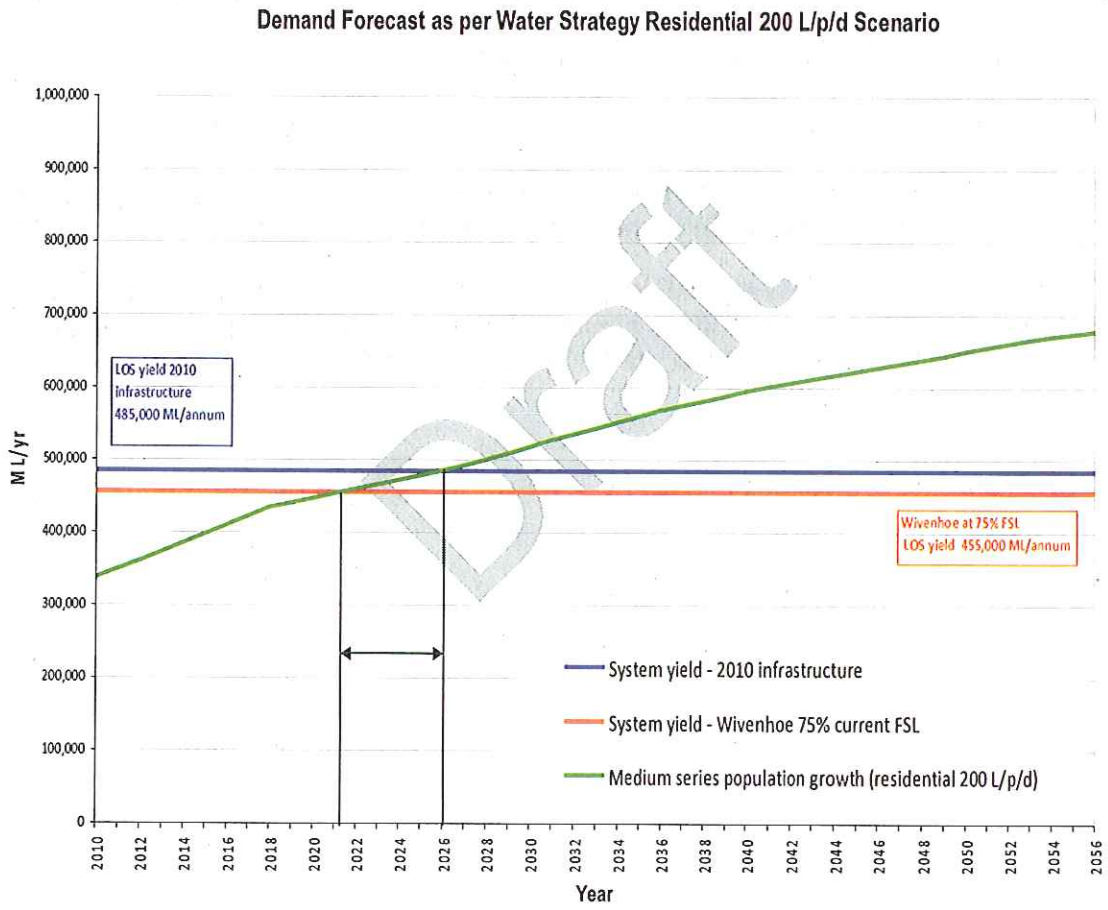
[4] The Wathnet modelling scenarios were based on the model set up used in the preparation of the SEQ Water Strategy.

5.2 Results – 25% reduction on Full Supply Volume for Wivenhoe Dam

There is a significant reduction in the LOS yield of 30,000 ML/annum with a scenario where Wivenhoe Dam was operated at 25% lower than the Full Supply. The LOS yield has reduced from 485,000 ML/annum to 455,000 ML/annum.

Figure 6 shows that new infrastructure would need to be brought forward by about 5 years to about 2021 from 2026 under the medium population growth series.

Figure 6: LOS Yield comparison



Appendix A – Wivenhoe Dam Storage Capacity Data

EL (M)	AREA (HA)	VOLUME (ML) TOTAL	CONV
82.00	22161	3555000	
81.75	21916	3499906	
81.50	21658	3445429	
81.25	21415	3391560	
81.00	21166	3338361	
80.75	20918	3285762	
80.50	20677	3233774	
80.25	20431	3182392	
80.00	20192	3131619	
79.75	19952	3081433	
79.50	19705	3031815	
79.25	19509	2982768	
79.00	19265	2934279	
78.75	19051	2885356	
78.50	18831	2839008	
78.25	18613	2792205	
78.00	18390	2745957	
77.75	18173	2700263	
77.50	17956	2655099	
77.25	17746	2610476	
77.00	17535	2566379	
76.75	17322	2522810	
76.50	17118	2479767	
76.25	16920	2437223	
76.00	16724	2395172	
75.75	16531	2353607	
75.50	16337	2312526	
75.25	16147	2271925	
75.00	15954	2231791	
74.75	15763	2192113	
74.50	15572	2152874	
74.25	15443	2114058	
74.00	15269	2075678	
73.75	15106	2037713	
73.50	14943	2000158	
73.25	14782	1963003	
73.00	14620	1926252	
72.75	14454	1889912	
72.50	14286	1853992	
72.25	14121	1818485	
72.00	13960	1783388	
71.75	13800	1748690	
71.50	13642	1714393	
71.25	13484	1680485	
71.00	13323	1645963	
70.75	13167	1613071	
70.50	13009	1581155	
70.25	12851	1549833	
70.00	12693	1518905	
69.75	12529	1488379	

EL (M)	AREA (HA)	VOLUME (ML) TOTAL	CONV
69.50	12365	1454287	
69.25	12205	1423557	
69.00	12046	1393246	
68.75	11889	1363332	
68.50	11723	1333815	
68.25	11561	1304714	
68.00	11401	1276013	
67.75	11240	1247714	
67.50	11080	1219815	
67.25	10916	1192321	
67.00	10751	1165238	
66.75	10572	1138550	
66.50	10389	1112378	
66.25	10197	1086624	
66.00	9990	1061414	
65.75	9797	1036687	
65.50	9598	1012440	
65.25	9412	988681	
65.00	9234	965378	
64.75	9058	942515	
64.50	8884	920080	
64.25	8712	898036	
64.00	8541	876532	
63.75	8371	855391	
63.50	8194	834561	
63.25	8027	814418	
63.00	7864	794567	
62.75	7710	775097	
62.50	7558	756014	
62.25	7402	737320	
62.00	7247	719011	
61.75	7115	701062	
61.50	6987	683435	
61.25	6865	666123	
61.00	6745	649112	
60.75	6629	632398	
60.50	6518	615966	
60.25	6409	599809	
60.00	6299	583927	
59.75	6190	568318	
59.50	6085	552976	
59.25	5975	537895	
59.00	5875	523082	
58.75	5775	508518	
58.50	5674	494208	
58.25	5573	480151	
58.00	5467	466339	
57.75	5371	452812	
57.50	5273	439507	
57.25	5175	426447	

EL (M)	AREA (HA)	VOLUME (ML) TOTAL	CONV
57.00	5078	413633	
56.75	4985	401056	
56.50	4897	388706	
56.25	4810	376573	
56.00	4721	364660	
55.75	4627	352973	
55.50	4537	341519	
55.25	4445	330291	
55.00	4348	319302	
54.75	4256	308561	
54.50	4144	298084	
54.25	4042	287851	
54.00	3942	277871	
53.75	3837	268147	
53.50	3735	258693	
53.25	3633	249474	
53.00	3524	240529	
52.75	3425	231845	
52.50	3329	223403	
52.25	3212	215250	
52.00	3121	207334	
51.75	3029	199651	
51.50	2932	192203	
51.25	2837	184993	
51.00	2744	178019	
50.75	2654	171275	
50.50	2576	164738	
50.25	2501	158392	
50.00	2427	152231	
49.75	2350	146259	
49.50	2264	140494	
49.25	2179	134939	
49.00	2100	129594	
48.75	2029	124434	
48.50	1957	119452	
48.25	1883	114644	
48.00	1820	110006	
47.75	1754	105542	
47.50	1693	101255	
47.25	1639	97073	
47.00	1590	93038	
46.75	1542	89123	
46.50	1488	85335	
46.25	1444	81670	
46.00	1399	78116	
45.75	1355	74673	
45.50	1312	71340	
45.25	1255	68139	
45.00	1214	65053	
44.75	1174	62068	

EL (M)	AREA (HA)	VOLUME (ML) TOTAL	CONV
44.50	1134	59185	
44.25	1095	56399	
44.00	1043	53727	
43.75	1008	51167	
43.50	977	48686	
43.25	944	46285	
43.00	911	43966	
42.75	879	41728	
42.50	828	39593	
42.25	801	37557	
42.00	774	35589	
41.75	744	33692	
41.50	716	31858	
41.25	685	30116	
41.00	659	28435	
40.75	635	26809	
40.50	593	25229	
40.25	575	23834	
40.00	554	22424	
39.75	533	21066	
39.50	512	19761	
39.25	494	18504	
39.00	476	17292	
38.75	456	16128	
38.50	433	15014	
38.00	393	12937	
37.50	339	11096	
37.00	309	9480	
36.50	279	8006	
36.00	202	6725	
35.50	184	5765	
35.00	168	4986	
34.50	153	4383	
34.00	132	3979	
33.50	104	2807	
33.00	95	2311	
32.50	84	1864	
32.00	60	1507	
31.50	55	1220	
31.00	51	955	
30.50	44	718	
30.00	39	510	
29.50	34	327	
29.00	30	167	
28.50	19	47	
28.00	3	12	
27.50	2	1	
27.00	0	0	
26.50	0	0	
26.00	0	0	

Level Datum AHD - PM 34781 EL 74.784 m
Computed using photogrammetric DTM produced in 1995 from 1971 photography
Survey records : 25727 FD
Full Supply Level: EL 67.000 m AHD [1,165,200 ML : 10,750 ha]
River outlet EL 33.200 m AHD [2,510 ML : 99 ha]
Catchment Area 7020 sq km
Latitude: 27 23 39 Longitude: 152 33 05

DEPARTMENT OF PRIMARY INDUSTRIES

BRISBANE RIVER - BASIN 143
WIVENHOE DAM 150.2 km

STORAGE DATA

A3-110405

19/09/95