2   SUMMARY OF JANUARY 2011 FLOOD EVENT

The following summary must be read in conjunction with the Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam (Revision 7) ("the Manual"). It provides a detailed summary of the operation of Wivenhoe and Somerset Dams during the January 2011 Flood Event that impacted Brisbane. Each table covers a period of the event during which one of the following occurred:

- There was a transition or change to the flood operation strategy used as defined by the Manual.
- There was a period of stability during which no gate operations from either Wivenhoe Dam or Somerset Dam was directed.
- There was a period of sustained gate operations (either opening or closing) at either Wivenhoe Dam or Somerset Dam.

Each table also provides a summary of relevant background information and a summary of the information that was used to make decisions during the period covered by the table. This information includes:

- Details of the time period.
- Relevant background information from the period leading up to and during the period.
- Changes in dam conditions during the period.
- Rainfall information (including forecast rainfall) and model results available during the period.
- The strategy used and/or adopted during the period.

It should be noted that the forecast rainfall model results apply the full 24 hour catchment average rainfall forecast from the Bureau of Meteorology (BoM) Quantitative Precipitation Forecasts (QPF) to the model run. It does not take into account the model run time in relation to the issue time of the forecast or the rainfall since the forecast was issued. In effect, this provides a "worst case" 24 hour scenario. Full details of the modeling results are shown in the tables contained in Appendix A.   Other tools used to support decisions that were examined and considered in conjunction with the modeling results and the 24 hour QPF included:

- The BoM weather radar available through the BoM website.
- BoM SILO Meteograms Forecast Rainfall (based on BoM ACCESS Model).
- BoM Interactive Weather and Wave Forecast Rainfall Maps (based on BoM ACCESS Model).
- BoM Water and the Land Forecast Rainfall (based on an ensemble of several numerical weather prediction models).
- Severe Weather Warnings issued by BoM.

QPF are considered the primary forecast tool as they are provided by BoM to give specific forecast information in relation to the dam catchment areas.

A significant quantitative variation from BoM model results presenting three day and five day rainfall forecasts can be expected in relation to other available rainfall forecast information. This is demonstrated in the following table that contains translated rainfall forecasting results using ACCESS model result data provided by BoM during the critical period of the event between 6 and 11 January 2011. The original BoM data has been translated to forecast catchment

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average rainfall results, based on a derived catchment centroid rainfall estimated by using Seqwater's Flood Early Warning Modeling System.

COMPARISON OF ACTUAL AND FORECAST RAINFALL FROM BOM ACCESS MODEL								
Forecast Date and Time	Somerset Dam Catchment Average Rainfall				Wivenhoe Dam Catchment Average Rainfall (excluding Somerset Dam Catchment)			
	3 Days from		5 Days from		3 Days from		5 Days from	
	Actual Rainfall (mm)	Forecast Rainfall (mm)	Actual Rainfall (mm)	Forecast Rainfall (mm)	Actual Rainfall (mm)	Forecast Rainfall (mm)	Actual Rainfall (mm)	Forecast Rainfall (mm)
06/01/2011 00:00	90	73	403	115	79	90	275	114
06/01/2011 12:00	150	85	515	133	87	51	335	78
07/01/2011 00:00	298	189	568	206	180	133	347	144
07/01/2011 12:00	321	123	536	137	183	79	322	89
08/01/2011 00:00	332	191	527	206	205	207	309	218
08/01/2011 12:00	447	165	527	169	284	136	309	139
09/01/2011 00:00	500	230	510	231	298	267	301	268
09/01/2011 12:00	441	140	446	141	271	170	273	171
10/01/2011 00:00	278	463	280	465	169	171	170	171
10/01/2011 12:00	218	59	219	60	140	389	141	390
11/01/2011 00:00	196	19	197	19	105	231	105	231

The table above shows:

- There are variations in excess of 700% between successive three day catchment average rainfall forecasts made 12 hours apart.
- There are variations in excess of 700% between successive five day catchment average rainfall forecasts made 12 hours apart.
- There are eight instances in which actual rainfall recorded is greater than 200% (highest is more than 1,000%) of the three day forecast rainfall.
- There are three instances in which the three day forecast rainfall is greater than 150% (highest is 280%) of the actual rainfall recorded.
- There are nine instances in which actual rainfall recorded is greater than 300% (highest is over 1,000%) of the five day forecast rainfall.
- There are two instances in which the five day forecast actual rainfall is greater than 200% (highest is 280%) of the actual rainfall recorded.

These results clearly show three day and five day forecasts only provide an indication of future rainfall and these forecasts cannot be used as a basis of flood operations decision making where public safety in both rural and urban areas is directly impacted. This forecasting information uses the most up-to-date scientific information available at the present time. Future improvements in this area will be examined with interest in order to maximise the flood mitigation benefits of the dams. This issue is discussed further in Section 6.0.

The source data for the information shown in the tables below is contained in the following Appendices of this report:

- Appendix A – Model results
- Appendix B – Flood volume summary
- Appendix C – Quantitative Precipitation Forecasts (QPF)

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- Appendix D – Catchment rainfall
- Appendix E – Situation reports
- Appendix G – Severe weather warnings
- Appendix H – Flood event notification email
- Appendix L – Flood operations directives
- Appendix M – Flood event log

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JANUARY 2011 FLOOD EVENT - PERIOD 1 OF 20

DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Thursday 06 Jan 2011 07:42
 	
Completed Friday 07 Jan 2011 02:00
	Strategy W1A and Strategy W1B; and Strategy S2
	
	• Catchment conditions prior to the event are as described in Section 6.0. The event was considered a continuation of the ongoing wet period that commenced in October 2010.
	
	• No significant rainfall occurred in the 24 hours to 09:00 on 5 Jan 2011.
	
	• Catchment average rainfalls in the 24 hours to 08:00 on 6 Jan 2011 were:
	  ○ Wivenhoe Dam 25mm;
	  ○ Somerset Dam 21mm;
	  ○ Lockyer Creek 23mm;
	  ○ Bremer River 23mm.
	
	• Event mobilisation occurred at 07:42 on 6 Jan 2011, using Strategies W1A and S2.
	
	• Once mobilisation occurs, 24/7 staffing of the Flood Operations Centre and dams continues until official de-mobilisation is announced. This occurred at 12:00 on 19 Jan 2011.
	
	• Duty Engineer called back early from holidays to assist with the management of the Event.
	
	• Transition from Strategy W1A to W1B once the Wivenhoe Lake level exceeded 67.50.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		○ Wivenhoe Dam 53mm;
		○ Somerset Dam 44mm;
		○ Lockyer Creek 53mm;
		○ Bremer River 54mm.
		
		Wivenhoe Dam level rose from 67.31 to 67.52 over the 18 hour period.
		
		Somerset Dam level rose from 99.34 to 99.55 over the 18 hour period.
			• Catchment average rainfalls during this period were:
			  ○ Wivenhoe Dam 28mm;
			  ○ Somerset Dam 23mm;
			  ○ Lockyer Creek 30mm;
			  ○ Bremer River 31mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 6/11 was 25mm.
			
			• Estimated peak Wivenhoe Dam level: 68.2 (excluding forecast); 68.7 (including forecast).
			
			• Estimated peak Somerset Dam level: 99.7 (excluding forecast); 100.1 (including forecast).
			
			• Estimated total dam inflow: 204,000ML (excluding forecast); 343,000ML (including forecast).
			
			• Estimated peak flow at Lowood excluding Wivenhoe Dam releases: 470m^3/s (excluding forecast); 720m^3/s (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 550m^3/s (excluding forecast); 960m^3/s (including forecast). These peaks were not expected to occur for more than 24 hours beyond period end. College's Crossing remained open in the short term.
			
			• Estimated peak Wivenhoe Dam outflow: 1220m^3/s (excluding forecast); 1260m^3/s (including forecast).
				Strategy W1A and Strategy W1B; and Strategy S2
				(Lake level greater than 67.25, maximum release 110m^3/s)
				
				• Peak inflows into the Brisbane River from Lockyer Creek were estimated to be in the order of 400m^3/s. These flows would not inundate Colleges Crossing until the morning of 7 Jan 2011.
				
				• Lake level was not expected to reach 67.50 (Strategy W1B) until 7 Jan 2011. Lake level may not exceed 68.5.
				
				• Endeavoured to keep Colleges Crossing trafficable by limiting combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 175m^3/s.
				
				• Water held in Wivenhoe Dam in an attempt to keep Colleges Crossing trafficable in accordance with Strategy W1A. Low level releases continued from the Mini-Hydro at this time and at various stages during the event. However, these releases (in the order of 13m^3/s) have low relative significance and are not referred to specifically in the remainder of this summary document.
				
				• In accordance with Strategy S2, the crest gates at Somerset Dam were raised to enable uncontrolled discharge. The low level sluices were kept closed. Some regulator releases continued from XX December as part of previous event drain down, (in the order of 35m^3/s). These were shut down at 18:00.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Friday 07 Jan 2011 02:00
 	
Completed Friday 07 Jan 2011 09:00
	Strategy W1B and Strategy S2
	
	• Transition from Strategy W1A to W1B due to the Wivenhoe Lake level exceeding 67.50.
	
	• Transition from Strategy W1B to W1C once the Wivenhoe Lake level exceeds 67.75.
	
	• Colleges Crossing was inundated by natural river flows during this period.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 64mm; Somerset Dam 60mm; Lockyer Creek 57mm; Bremer River 60mm.
		
		Wivenhoe Dam level rose from 67.52 to 67.75 over the seven hour period.
		
		Somerset Dam level rose from 99.55 to 99.65 over the seven hour period.
			• Catchment average rainfalls during this period were:
			   o Wivenhoe Dam 11mm;
			   o Somerset Dam 15mm;
			   o Lockyer Creek 4mm;
			   o Bremer River 5mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 6/11 was 25mm.
			
			• Estimated peak Wivenhoe Dam leve: 68.2 (excluding forecast); 68.5 (including forecast).
			
			• Estimated peak Somerset Dam level: 99.7 (excluding forecast); 100.2 (including forecast).
			
			• Estimated total Dam inflow: 242,000ML (excluding forecast); 380,000ML (including forecast).
			
			• Estimated peak flow at Lowood excluding Wivenhoe Dam releases: 470m^3/s (excluding forecast); 670m^3/s (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 570m^3/s (excluding forecast); 970m^3/s (including forecast).
			
			• Estimated peak Wivenhoe Dam outflow: 1,220m^3/s (excluding forecast); 1,250m^3/s (including forecast).
				Strategy W1B and Strategy S2 (Lake level greater than 67.50, maximum release 110m^3/s)
				
				• Endeavoured to keep Burtons Bridge trafficable by limiting combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 430m^3/s.
				
				• Peak inflows into the Brisbane River from Lockyer Creek were estimated to be in the order of 470m^3/s. These flows may not be sufficient to inundate Burtons Bridge.
				
				• Lake level was not expected to reach 67.75 (Strategy W1C) for at least six hours. Lake level may not exceed 68.5.
				
				• Water was held in Wivenhoe Dam in an attempt to keep Burtons Bridge trafficable in accordance with Strategy W1B.
				
				• In accordance with Strategy S2, the crest gates at Somerset Dam were raised to enable uncontrolled discharge and the low level regulators and sluices at Somerset Dam were kept closed.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Friday 07 Jan 2011 09:00
 	
Completed Friday 07 Jan 2011 15:00
	Strategy W1C and Strategy S2
	
	• At around 09:00 it became apparent flows from Lockyer Creek into the Brisbane River, combined with local Brisbane River inflows downstream of Wivenhoe Dam, would be sufficient to inundate all bridges below the Dam, with the exception of Mt Crosby Weir Bridge and Fernvale Bridge. Burtons Bridge which were inundated by natural river flows near the end of this period.
	
	• All impacted Councils were notified of the situation and that releases would commence from Wivenhoe Dam. Releases were timed to occur at 15:00 to allow bridges to be closed and arrangements to be made to cater for rural community isolation. The impacted rural communities had been isolated over the Christmas period and time was needed for suitable arrangements to be made to allow these communities to prepare for another potentially extended period of isolation. Releases were timed to start in accordance with the Manual requirements of keeping Burtons Bridge and Kholo Bridge open to traffic when operating under Strategy W1C
	• Transitioned from Strategy W1C to Strategy W1D once the Wivenhoe Dam Lake level exceeded 68.0
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 89mm;
		Somerset Dam 90mm;
		Lockyer Creek 71mm;
		Bremer River 71mm.
		
		Wivenhoe Dam level rose from 67.75 to 68.03 over the six hour period.
		
		Somerset Dam level rose from 99.65 to 99.94 over the six hour period.
			• Catchment average rainfalls during this period were:
			  ○ Wivenhoe Dam 24mm;
			  ○ Somerset Dam 30mm;
			  ○ Lockyer Creek 14mm;
			  ○ Bremer River 12mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 7/11 was 25mm.
			
			• Estimated peak Wivenhoe Dam level:
			68.4 (excluding forecast);
			68.9 (including forecast).
			
			• Estimated peak Somerset Dam level:
			100.3 (excluding forecast);
			100.6 (including forecast).
			
			• Estimated total dam inflow:
			346,000ML (excluding forecast);
			483,000ML (including forecast).
			
			• Estimated peak flow at Lowood excluding Wivenhoe Dam releases:
			530m³/s (excluding forecast);
			710m³/s (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases:
			660m³/s (excluding forecast);
			1,040m³/s (including forecast).
			
			• Estimated peak Wivenhoe Dam outflow:
			1,240m³/s (excluding forecast);
			1,270m³/s (including forecast).
				Strategy W1C
				(Lake Level greater than 68.00, maximum release 1,900m³/s)
				
				• Due to the further rain and observed stream rises, it became apparent flows from Lockyer Creek into the Brisbane River, combined with local Brisbane River inflows downstream of Wivenhoe Dam, would be sufficient to inundate all bridges downstream of the Dam, with the exception of the Mt Crosby Weir Bridge and Fernvale Bridge.
				
				• Releases from Wivenhoe Dam were managed in an attempt to ensure Mt Crosby Weir Bridge and Fernvale Bridge remained trafficable in accordance with Strategies W1D and W1E.
				
				• In accordance with Strategy S2, the crest gates at Somerset Dam were raised to enable uncontrolled discharge, and the low level regulators and sluices at Somerset Dam were kept closed.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Friday 07 Jan 2011 15:00 Completed Saturday 08 Jan 2011 14:00	**Transition from Strategy W1D to W1E to W3; and Strategy S2 Wivenhoe Directives #1 to #4. Somerset Directives #1 to #3.** • Gates opened continuously at Wivenhoe Dam for 23 hours, in accordance with standard gate opening sequence at a rate or 0.5 metres of opening per hour. • Transitioned from Strategy W1D to W1E when the Wivenhoe Dam level exceeded 68.25 (22:00 on 7 Jan 2011). • Transitioned from Strategy W1E to W3 as it becames apparent Wivenhoe Dam level would exceed 68.50 (08:00 on 8 Jan 2011). Strategy W2 was by-passed as it was not possible to achieve this Strategy by limiting the flow in the Brisbane River to less than the naturally occurring peaks at Lowood and Moggill. This is because the calculated naturally occurring peaks at Lowood and Moggill were 530m³/s and 800m³/s respectively, whereas the release rate from the Dam was already 940m³/s. Limiting releases to these naturally occurring peak flows would also have compromised the Dam drain down requirements. • At 14:00 on 08 Jan 2011, Wivenhoe Dam discharge was 1,239m³/s. All rural bridges below the Dam, with the exception of Mt Crosby Weir Bridge and Fernvale Bridge, were flooded.	Total rainfall from 0800 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 92mm; Somerset Dam 95mm; Lockyer Creek 72mm; Bremer River 72mm. Wivenhoe Dam level rose from 68.03 to 68.61 over the 23 hour period. Somerset Dam level rose from 99.94 to 100.44 over the 23 hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 3mm; o Somerset Dam 5mm; o Lockyer Creek 1mm; o Bremer River 1mm. • Forecast 24 hour catchment average rainfall at 10:00 on 8/11 was 40mm. • Estimated peak Wivenhoe Dam level: 68.7 (excluding forecast); 69.1 (including forecast). • Estimated peak Somerset Dam level: 100.5 (excluding forecast); 100.6 (including forecast). • Estimated total Dam inflow: 420,000ML (excluding forecast); 662,000ML (including forecast). • Estimated peak flow at Lowood excluding Wivenhoe Dam releases: 530m³/s (excluding forecast); 530m³/s (including forecast). • Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 550m³/s (excluding forecast); 960m³/s (including forecast). This peak is estimated to have occurred at 05:00 on 8 Jan 2011. • Estimated peak Wivenhoe Dam outflow: 1,480m³/s (excluding forecast); 1,540m³/s (including forecast). This flow was significantly greater than the calculated natural peak that excluded Wivenhoe Dam releases.	**Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)** • Inflows from Lockyer Creek into the Brisbane River have inundated all bridges downstream of the Dam, with the exception of the Mt Crosby Weir Bridge and Fernvale Bridge. • The Strategy transitioned from W1 to W3 as it becames apparent Wivenhoe Dam level was likely to exceed 68.5 and Strategy W2 could not be applied. • Strategy W3 required the flow at Moggill to be lowered to 4,000m³/s as soon as possible after the naturally occurring peak at Moggill (excluding Wivenhoe Dam releases). This was already achieved. • Strategy W3 also required lower level Manual objectives to be considered. Therefore consideration was given to minimising disruption to downstream rural life and endeavouring to keep Mt Crosby Weir Bridge and Fernvale Bridge trafficable. • Due to rainfall on the ground, it was apparent the Somerset Dam level would exceed 100.45. Accordingly, two sluice gates were opened during this period to allow Dam levels to move towards the Wivenhoe/Somerset Operating Target Line in accordance with Strategy S2.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Saturday 08 Jan 2011 14:00

Completed Sunday 09 Jan 2011 01:00 | **Strategy W3 and Strategy S2**

• Releases maintained from both Wivenhoe and Somerset dams to ensure Mt Crosby Weir Bridge and Fernvale Bridge remained trafficable.

• No change to gate settings over this period. Wivenhoe Dam discharge was 1,240m³/s. All rural bridges below the Dam, with the exception of the Mt Crosby Weir Bridge and Fernvale Bridge, were flooded. | Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 100mm; Somerset Dam 111mm; Lockyer Creek 75mm; Bremer River 75mm.

Wivenhoe Dam level rose very slightly from 68.61 to 68.63 over the 13 hour period.

Somerset Dam level fell from 100.44 to 100.32 over the 13 hour period. | • Catchment average rainfalls during this period were:
    o Wivenhoe Dam 8mm;
    o Somerset Dam 16mm;
    o Lockyer Creel 3mm;
    o Bremer River 2mm.

• Forecast 24 hour catchment average rainfall at 16:00 on 8/11 was 40mm.

• Estimated peak Wivenhoe Dam level: 68.7 (excluding forecast); 69.9 (including forecast).

• Estimated peak Somerset Dam level: 100.5 (excluding forecast); 100.6 (including forecast).

• Estimated total Dam inflow: 457,000ML (excluding forecast); 697,000ML (including forecast).

• Estimated peak flow at Lowood excluding Wivenhoe Dam releases: 530m³/s (excluding forecast); 530m³/s (including forecast).

• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 770m³/s (excluding forecast); 840m³/s (including forecast). This peak is estimated to have occurred at 05:00 on 8 Jan 2011.

• Estimated peak Wivenhoe Dam outflow: 1,480m³/s (excluding forecast); 1,520m³/s (including forecast). This flow was significantly greater than the calculated natural peak that excluded Wivenhoe Dam releases. | **Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)**

• Strategy W3 required the flow at Moggill to be lowered to 4,000m³/s as soon as possible after the naturally occurring peak at Moggill (excluding Wivenhoe Dam releases). This was already achieved.

• Strategy W3 also required lower level Manual objectives to be considered. Therefore, with Lake levels rising slightly (Wivenhoe Dam) and falling (Somerset Dam) consideration during this period remained on minimising disruption to downstream rural life and endeavouring to keep Mt Crosby Weir Bridge and Fernvale Bridge trafficable.

• With the Somerset Lake Dam level still expected to exceed 100.45, and the level in Wivenhoe Dam remaining relatively static, releases from Somerset Dam continued. Closing of the sluices would have resulted in Dam levels quickly moving under the Wivenhoe/Somerset Operating Target Line requiring sluice re-opening within a short period. |

8

DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Sunday 09 Jan 2011 01:00
 	
Completed Sunday 09 Jan 2011 08:00
	Strategy W3 and Strategy S2 Wivenhoe Directives #5 to #7.
	
	• Releases increased marginally from Wivenhoe Dam to account for the passing of the Lockyer Creek peak while ensuring Mt Crosby Weir Bridge and Fernvale Bridge remained trafficable.
	
	• Wivenhoe Dam discharge increased from 1,240m^3/s to 1,334m^3/s.
	
	• There were no change to Somerset Dam gate settings over this period.
	
	• All rural bridges below the Dam, with the exception of the Mt Crosby Weir Bridge and Fernvale Bridge, were flooded.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 112mm;
		Somerset Dam 146mm;
		Lockyer Creel 76mm;
		Bremer River 75mm.
		
		Wivenhoe Dam level fell from 68.63 to 68.56 over the seven hour period.
		
		Somerset Dam level fell from 100.32 to 100.28 over the seven hour period.
			• Catchment average rainfalls during this period were:
			   o Wivenhoe Dam 12mm;
			   o Somerset Dam 36mm;
			   o Lockyer Creek 1mm;
			   o Bremer River 0mm.
			
			• Forecast 24 hour catchment average rainfall at 16:00 on 8/11 was 40mm.
			
			• Estimated peak Wivenhoe Dam level:
			68.7 (excluding forecast);
			69.3 (including forecast).
			
			• Estimated peak Somerset Dam level:
			100.5 (excluding forecast);
			101.0 (including forecast).
			
			• Estimated total Dam inflow:
			569,000ML (excluding forecast);
			814,000ML (including forecast).
			
			• Estimated peak flow at Lowood excluding Wivenhoe Dam releases:
			530m^3/s (excluding forecast);
			530m^3/s (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases:
			770m^3/s (excluding forecast);
			780m^3/s (including forecast).
			This peak is estimated to have occurred at 05:00 on 8 Jan 2011.
			
			• Estimated peak Wivenhoe Dam outflow:
			1,500m^3/s (excluding forecast);
			1,550m^3/s (including forecast).
			This flow is significantly greater than the calculated natural peak that excluded Wivenhoe Dam releases.
				Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m^3/s)
				
				• Strategy W3 required the flow at Moggill to be lowered to 4,000m^3/s as soon as possible after the naturally occurring peak at Moggill (excluding Wivenhoe Dam releases). This was already achieved.
				
				• Strategy W3 also required lower level Manual objectives to be considered. Therefore, with Lake levels falling at both dams, consideration during this period remained on minimising disruption to downstream rural life and endeavouring to keep Mt Crosby Weir Bridge and Fernvale Bridge trafficable.
				
				• With the Somerset Lake Dam level still expected to exceed 100.45, and the level in Wivenhoe Dam falling, releases from Somerset Dam continued. Closing of the sluices would have resulted in dam levels quickly moving under the Wivenhoe/Somerset Operating Target Line requiring sluice re-opening within a short period, particularly given the rainfall that occurred in the Somerset Dam catchment during this period.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Sunday 09 Jan 2011 08:00
 	
Completed Sunday 09 Jan 2011 14:00
	Strategy W3 and Strategy S2 Wivenhoe Directives #7. Somerset Directives #4 to #5.
	
	• Releases increased marginally from Wivenhoe Dam to account for the passing of the Lockyer Creek peak while ensuring Mt Crosby Weir Bridge and Fernvale Bridge remained trafficable.
	
	• Wivenhoe Dam discharge increased from $1,334\text{m}^3/\text{s}$ to $1,386\text{m}^3/\text{s}$.
	
	• Somerset Dam sluice gates opened progressively over this period to allow Dam levels to move towards the Wivenhoe/Somerset Operating Target Line in accordance with Strategy S2.
	
	• All rural bridges below the Dam, with the exception of the Mt Crosby Weir Bridge and Fernvale Bridge, were flooded.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 146mm;
		Somerset Dam 199mm;
		Lockyer Creek 94mm;
		Bremer River 90mm.
		
		Wivenhoe Dam level rose very slightly from 68.56 to 68.58 over the six hour period.
		
		Somerset Dam level rose from 100.28 to 100.47 over the six hour period.
			• Catchment average rainfalls during this period were:
			  o Wivenhoe Dam 34mm;
			  o Somerset Dam 53mm;
			  o Lockyer Creek 18mm;
			  o Bremer River 15mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 9/11 was 50mm.
			
			• Estimated peak Wivenhoe Dam level: 70.0 (excluding forecast); 71.3 (including forecast).
			
			• Estimated peak Somerset Dam level: 100.7 (excluding forecast); 101.1 (including forecast).
			
			• Estimated total Dam inflow: 804,000ML (excluding forecast); 1,108,000ML (including forecast).
			
			• Estimated peak flow at Lowood excluding Wivenhoe Dam releases: $530\text{m}^3/\text{s}$ (excluding forecast); $690\text{m}^3/\text{s}$ (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: $770\text{m}^3/\text{s}$ (excluding forecast); $1,210\text{m}^3/\text{s}$ (including forecast). This peak was estimated to have occurred at 05:00 on 8 Jan 2011.
			
			• Estimated peak Wivenhoe Dam outflow: $1,490\text{m}^3/\text{s}$ (excluding forecast); $1,560\text{m}^3/\text{s}$ (including forecast). This flow was significantly greater than the calculated natural peak that excluded Wivenhoe Dam releases.
				Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release $4,000\text{m}^3/\text{s}$)
				
				• With Lake levels rising at both Dams and heavy rain being experienced in the Dam catchments, consideration was given to transitioning from minimising disruption to downstream rural life to protecting urban areas from inundation.
				
				• However, using the BoM rainfall forecasts, a three day assessment showed the lower limit of three day forecast inflow to be similar to the October 2010 Flood Event, with the upper limit similar to the February 1999 Flood Event. Therefore, during this period, consideration remained on minimising disruption to downstream rural life and endeavouring to keep Mt Crosby Weir Bridge and Fernvale Bridge trafficable.
				
				• With Dam levels under the Wivenhoe/Somerset Operating Target Line at the end of this period, releases continued from Somerset Dam.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Sunday 09 Jan 2011 14:00 Completed Sunday 09 Jan 2011 19:00	**Strategy W3 and Strategy S2** • During this period, releases continued from both Dams at a level that ensured Mt Crosby Weir Bridge and Fernvale Bridge remained trafficable. Gate settings were unchanged and the Wivenhoe Dam discharge was 1,411m^3/s. • Due to rainfall on the ground and the modelled rapid Lake level rises, a decision was made to focus on protecting urban areas from inundation at 19:00. • Councils, the Dam Safety Regulator and Seqwater's CEO were notified of the decision soon after 19:00. The ramifications of the decision were that the new estimated peak flow at Moggill of 3,300m^3/s would impact properties and begin to damage urban areas below Moggill. Brisbane City Council damage tables indicated at flows of 3,000m^3/s, damage costs would exceed $5.0 million and 2,600 properties would be impacted in some way. The level of impact would increase significantly as flows increased and therefore the focus was on minimising the flow at Moggill. • A decision was made at 19:00, to staff the Flood Operations Centre with at least two Duty Engineers at all times until the peak of the Event had occurred.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 208mm; Somerset Dam 305mm; Lockyer Creek 116mm; Bremer River 96mm. Wivenhoe Dam level rose from 68.58 to 68.97 over the five hour period. Somerset Dam level rose from 100.47 to 101.43 over the five hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 62mm; o Somerset Dam 106mm; o Lockyer Creek 22mm; o Bremer River 6mm. • Forecast 24 hour catchment average rainfall at 16:00 on 9/11 was 65mm. • Estimated peak Wivenhoe Dam level: 72.1 (excluding forecast); 73.9 (including forecast). • Estimated peak Somerset Dam level: 102.3 (excluding forecast); 103.0 (including forecast). • Estimated total Dam inflow: 1,272,000ML (excluding forecast); 1,712,000ML (including forecast). • Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 770m^3/s (excluding forecast); 1,940m^3/s (including forecast). This peak was estimated to have occurred at 05:00 on 8 Jan 2011. • Estimated peak flow at Moggill including Wivenhoe Dam releases: 3,300m^3/s (excluding forecast); 4,400m^3/s (including forecast).	**Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m^3/s)** • Lake levels continuing to rise at both dams, and combined with heavy rain in the Dam catchments during this period, it was decided at the end of the period to no longer consider minimising disruption to downstream rural life and to focus only on protecting urban areas from inundation. • Towards the end of this period, it became apparent Moggill was likely to experience a second naturally occurring peak on 10 Jan 2011 or later. The Manual required the flow at Moggill to be minimised prior to this peak occurring. This requirement competed with the need to protect urban areas by not allowing the Wivenhoe Dam to reach a level that invoked Strategy W4. It was decided the best course of action was to increase releases as quickly as possible to the limit of non-damaging flows at Moggill. However, before this could occur, Councils needed to be advised, bridges needed to be closed and actions needed to be taken to prepare rural communities for isolation and urban areas below Moggill for river flows approaching 3,500m^3/s. • With Dam levels under the Wivenhoe/Somerset Operating Target Line during this period, releases continued from Somerset Dam.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Sunday 09 Jan 2011 19:00 Completed Monday 10 Jan 2011 01:00	**Strategy W3 and Strategy S2** • Agency notifications commenced at 07:00. Brisbane City Council, the Dam Safety Regulator and Seqwater's CEO were advised the likely peak flow at Moggill would exceed 3,000 m³/s • Brisbane City Council damage tables indicated, at flows of 3,000m³/s, damage costs would exceed $5.0 million and 2,600 properties would be impacted in some way. The level of impact would increase significantly as flows increased, and therefore the focus was on minimising the flow at Moggill. • Fernvale Bridge was closed by police at around 01:00 on 10 Jan 2011. A directive was issued to increases releases from Wivenhoe Dam. • Gate settings did not change over this period due to the potential danger to the public associated with inundating Fernvale Bridge from Wivenhoe Dam outflows prior to the bridge being closed to traffic. Councils also required time to prepare for the isolation of rural communities, the onset of urban damage below Moggill and to undertake any necessary evacuations. Wivenhoe Dam discharge was 1,473m³/s. All rural bridges below the Dam, with the exception of Mt Crosby Weir Bridge and Fernvale Bridge, were flooded.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 232mm; Somerset Dam 343mm; Lockyer Creek 131mm; Bremer River 102mm. Wivenhoe Dam level rose from 68.97 to 69.97 over the six hour period. Somerset Dam level rose from 101.43 to 102.54 over the six hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 24mm; o Somerset Dam 38mm; o Lockyer Creek 14mm; o Bremer River 6mm. • Forecast 24 hour catchment average rainfall at 16:00 on 9/11 was 65mm. • Estimated peak Wivenhoe Dam level: 72.9 (excluding forecast); 74.7 (including forecast). • Estimated peak Somerset Dam level: 102.9 (excluding forecast); 103.4 (including forecast). • Estimated total Dam inflow: 1,468,000ML (excluding forecast); 1,922,000ML (including forecast). • Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 820m³/s (excluding forecast); 2,000m³/s (including forecast). This peak was estimated to occur at 16:00 on 10 Jan 2011. • Estimated peak flow at Moggill including Wivenhoe Dam releases: 3,240m³/s (excluding forecast); 4,480m³/s (including forecast).	**Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)** • Consideration now focused on protecting urban areas from inundation. However, before releases were increased to and above the limit of non-damaging floods at Moggill, Councils and other impacted agencies were notified so appropriate actions could be taken, including any necessary evacuations and the closure of the Mt Crosby Weir Bridge and Fernvale Bridge. • The Manual requires the flow at Moggill to be minimised prior to its naturally occurring peak. This requirement was balanced against the need to protect urban areas by releasing water from the Dams in an attempt to keep the Wivenhoe Dam Lake below a level that would invoke Strategy W4. Based on an estimated 16 hour travel time between the Dam and Moggill, this did occur. • With Dam levels under the Wivenhoe/Somerset Operating Target Line during this period, releases continued from Somerset Dam. • Although there was a full awareness of the rainfall forecasts and associated potential flood impacts, the strategy was not to release flows that would cause high level urban inundation until it was certain it could not be avoided. Model results continued to indicate this may be possible.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Monday 10 Jan 2011 01:00
 	
Completed Monday 10 Jan 2011 09:00
	Strategy W3 and Strategy S2 Wivenhoe Directives #8 to #10.
	
	• Gates opened continuously at Wivenhoe Dam for eight hours in accordance with standard gate opening sequence at a rate of 0.5 metres of opening per hour.
	
	• Wivenhoe Dam discharge increased from 1,473m^3/s to 2,015m^3/s. All rural bridges below the Dam were flooded.
	
	• Further gate openings at Wivenhoe Dam were paused at 09:00 in an attempt to allow the Lockyer Creek and Bremer River peaks to pass Moggill, and to restrict Brisbane River flows at Moggill to 3,500m^3/s. This was achieved following discussions with Brisbane City Council that advised a flow of 3,500m^3/s at Moggill would fully submerge 322 properties and impact 7,000 properties.
	
	• No gate movements occurred at Somerset Dam during this period, with Dam levels plotting under the Wivenhoe/Somerset Operating Target Line. This meant the only gate movements allowable at Somerset Dam under Strategy S2 would be openings and this did not happen to limit further rises in Wivenhoe Dam.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 244mm; Somerset Dam 373mm; Lockyer Creek 143mm; Bremer River 120mm.
		
		Wivenhoe Dam level rose from 69.97 to 71.56 over the eight hour period.
		
		Somerset Dam level rose from 102.54 to 103.08 over the eight hour period.
			• Catchment average rainfalls during this period were:
			   ○ Wivenhoe Dam 12mm;
			   ○ Somerset Dam 30mm;
			   ○ Lockyer Creek 12mm;
			   ○ Bremer River 18mm.
			
			• Forecast 24 hour catchment average rainfall at 16:00 on 9/11 was 65mm.
			
			• Estimated peak Wivenhoe Dam level: 72.9 (excluding forecast); 74.5 (including forecast).
			
			• Estimated peak Somerset Dam level: 103.1 (excluding forecast); 103.5 (including forecast).
			
			• Estimated total Dam inflow: 1,531,000ML (excluding forecast); 1,985,000ML (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 1,090m^3/s (excluding forecast); 2,090m^3/s (including forecast). This peak was estimated to occur at 16:00 on 10 Jan 2011.
			
			• Estimated peak flow at Moggill including Wivenhoe releases: 3,420m^3/s (excluding forecast); 4,680m^3/s (including forecast).
				Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m^3/s)
				
				• Consideration was given to protecting urban areas from inundation and minimising urban damage.
				
				• Due to advice received from Brisbane City Council that a flow of 3,500m^3/s at Moggill would fully submerge 322 properties and impact 7,000 properties, an attempt was made to remain below this flow level.
				
				• The approach in the Manual which states the intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4,000m^3/s was adopted. Advice received from Brisbane City Council that the upper limit of non-damaging floods was below the 4,000m^3/s stated in the Manual was noted and taken into account in the decision making processes.
				
				• With Dam levels under the Wivenhoe/Somerset Operating Target Line during this period, releases continued from Somerset Dam.
				
				• Although there was a full awareness of the rainfall forecasts and associated potential flood impacts, the strategy was not to release flows that would cause high level urban inundation until it was certain it could not be avoided. Model results continued to indicate this may be possible.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Monday 10 Jan 2011 09:00
 	
Completed Monday 10 Jan 2011 15:00
	Strategy W3 and Strategy S2
	
	• Gate settings at Wivenhoe Dam did not change over this period. Wivenhoe Dam discharge was 2,087m³/s. All rural bridges below the Dam were flooded.
	
	• At 15:00, the attempt to restrict Brisbane River flows at Moggill to 3,500m³/s was abandoned due to rainfall in the Dam catchments. A new target of 4,000m³/s was set in accordance with the Manual, on the basis that Strategy W3 intends to limit the flow in the Brisbane River at Moggill to less than 4,000m³/s and minimise urban damage.
	
	• Gate movements at Somerset Dam did not change during this period, with Dam levels plotting under the Wivenhoe/Somerset Operating Target Line. This meant the only gate movements allowable at Somerset Dam under Strategy S2 was openings and this was not done to limit further rises in Wivenhoe Dam.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 274mm;
		Somerset Dam 407mm;
		Lockyer Creek 169mm;
		Bremer River 149mm.
		
		Wivenhoe Dam level rose from 71.56 to 72.54 over the six hour period.
		
		Somerset Dam level rose from 103.08 to 103.43 over the six hour period.
			• Catchment average rainfalls during this period were:
			  o Wivenhoe Dam 34mm;
			  o Somerset Dam 31mm;
			  o Lockyer Creek 27mm;
			  o Bremer River 30mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 10/11 was 75mm.
			
			• Estimated peak Wivenhoe Dam level; 73.6 (excluding forecast); 75.2 (including forecast).
			
			• Estimated peak Somerset Dam level; 103.4 (excluding forecast); 103.7 (including forecast).
			
			• Estimated total Dam inflow; 1,708,000ML (excluding forecast); 2,162,000ML (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases; 1,500m³/s (excluding forecast); 2,570m³/s (including forecast). This peak was estimated to occur at 20:00 on 10 Jan 2011.
			
			• Estimated peak flow at Moggill including Wivenhoe Dam releases; 3,910m³/s (excluding forecast); 5,180m³/s (including forecast).
				Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)
				
				• Consideration focused on protecting urban areas from inundation and minimising urban damage.
				
				• It was decided at 15:00 to attempt to remain below a target flow of around 4,000m³/s at Moggill.
				
				• The approach in the Manual which states the intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4,000 m³/s, continued to be followed.
				
				• With Dam levels under the Wivenhoe/Somerset Operating Target Line during this period, releases continued from Somerset Dam.
				
				• Although there was a full awareness of the rainfall forecasts and associated potential flood impacts, the strategy was not to release flows that would cause high level urban inundation until it was certain it could not be avoided. Model results continued to indicate this may be possible.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Monday 10 Jan 2011 15:00 Completed Monday 10 Jan 2011 20:00	**Strategy W3 and Strategy S2 Wivenhoe Directive #11.** • Gates opened continuously at Wivenhoe Dam for five hours in line with standard gate opening sequence, at a rate or 1.0 metres of opening per hour. Wivenhoe Dam discharge increased from 2,087m³/s to 2,695m³/s. • In accordance with the Manual, a target of 4,000m³/s at Moggill was set, on the basis of the intent of Strategy W3 to limit the flow in the Brisbane River at Moggill to less than 4,000m³/s and minimise urban damage. • Further gate openings at Wivenhoe Dam were paused at 20:00 in an attempt to allow the Lockyer Creek and Bremer River peaks to pass Moggill and to restrict Brisbane River flows at Moggill to 4,000m³/s. • No gate movements occurred at Somerset Dam during this period, with Dam levels plotting under the Wivenhoe/Somerset Operating Target Line. This limited further rises in Wivenhoe. • Initial advice on a major flash flood originating in the Lockyer headwaters was received from BoM at 17:32. No volume or flow details were available and gauges in the area were not indicating a significant event. The event could not impact on the Brisbane River for 24 hours.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 279mm; Somerset Dam 415mm; Lockyer Creek 174mm; Bremer River 153mm. Wivenhoe Dam level rose from 72.53 to 73.06 over the five hour period. Somerset Dam level rose from 103.43 to 103.45 over the five hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 4mm; o Somerset Dam 8mm; o Lockyer Creel 5mm; o Bremer River 3mm. • Forecast 24 hour catchment average rainfall at 16:00 on 10/11 was 38mm. • Estimated peak Wivenhoe level: 73.6 (excluding forecast); 74.3 (including forecast). • Estimated peak Somerset level: 103.5 (excluding forecast); 103.5 (including forecast). • Estimated total dam inflow: 1,731,000ML (excluding forecast); 1,982,000ML (including forecast). • Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 1,500m³/s (excluding forecast); 1,840m³/s (including forecast). This peak was estimated to occur at 20:00 on 10 Jan 2011. • Estimated peak flow at Moggill including Wivenhoe Dam releases: 3,980m³/s (excluding forecast); 4,470m³/s (including forecast). • The extreme rainfall that occurred in Lockyer Creek catchment during this period was not recorded in the remotely accessible rain gauges in the catchment, and was not indicated on the BoM weather radar.	**Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)** • Consideration focused on protecting urban areas from inundation and minimising urban damage. • The target maximum flow at Moggill was now 4,000m³/s. The approach in the Manual which states the intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4,000m³/s, continued to be followed. • With dam levels under the Wivenhoe/Somerset Operating Target Line during this period, Somerset Dam releases continued. • The reduced rainfall forecast justified retaining the target of 4,000m³/s at Moggill, while the Wivenhoe Dam peak of 74.3 (including forecast) indicated it may be possible to keep urban damage within tolerable limits. A discussion was held with the Dam Safety Regulator to request permission to exceed a level of 74.0 in Wivenhoe Dam for a short period (maximum 12 hours) without invoking Strategy W4, if the safety of the Dam could be guaranteed and urban damage reduced. The Regulator agreed with this approach and provided permission. • The strategy continued to not release flows that would cause high level urban inundation until it was certain it could not be avoided. Model results continued to indicate this may be possible.

DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Monday 10 Jan 2011 20:00
 	
Completed Tuesday 11 Jan 2011 04:00
	Strategy W3 and Strategy S2
	
	• Gate openings at Wivenhoe Dam were paused at 20:00 in an attempt to restrict flows at Moggill to close to 4,000m³/s. There were no changes to gate settings at Wivenhoe Dam over this period. The Dam discharge was 2,726m³/s.
	
	• In accordance with the Manual, a target flow of 4,000m³/s at Moggill was set on the basis of Strategy W3 to limit the flow in the Brisbane River at Moggill to less than 4,000m³/s. However, Brisbane City Council damage tables indicated this would still impact 5,325 properties and cause damage exceeding $47.0 million.
	
	• At 17:32, initial advice was provided about a significant flash flood originating in the Lockyer Creek headwaters. Details were received at 20:00. The focus was on developing strategies to manage these potential flows, however, as any strategy would involve significantly reducing outflows from Wivenhoe Dam, the strategies were not adopted.
	
	• During this period the plotted dam levels drifted just above the Wivenhoe/Somerset Operating Target Line. This lead to a decision at 04:00 to start closing down releases from Somerset Dam to limit further rises in Wivenhoe Dam.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 323mm;
		Somerset Dam 437mm;
		Lockyer Creek 186mm;
		Bremer River 167mm.
		
		Wivenhoe Dam level rose from 73.06 to 73.40 over the eight hour period.
		
		Somerset Dam level fell from 103.45 to 103.23 over the eight hour period.
			• Catchment average rainfalls during this period were:
			    o Wivenhoe Dam 44mm;
			    o Somerset Dam 22mm;
			    o Lockyer Creek 12mm;
			    o Bremer River 14mm.
			
			• Forecast 24 hour catchment average rainfall at 16:00 on 10/11 was 38mm.
			
			• Estimated peak Wivenhoe level: 74.1 (excluding forecast); 74.9 (including forecast).
			
			• Estimated peak Somerset level: 103.5 (excluding forecast); 103.7 (including forecast).
			
			• Estimated total dam inflow: 2,016,000ML (excluding forecast); 2,267,000ML (including forecast).
			
			• Estimated peak flow at Moggill excluding Wivenhoe Dam releases: 1,500m³/s (excluding forecast); 1,810m³/s (including forecast). This peak was estimated to have occurred at 20:00 on 10 Jan 2011.
			
			• Estimated peak flow at Moggill including Wivenhoe Dam releases: 4,040m³/s (excluding forecast); 4,540m³/s (including forecast).
				Strategy W3 and Strategy S2 (Lake Level greater than 68.50, maximum release 4,000m³/s)
				
				• Consideration focused on protecting urban areas from inundation and minimising urban damage. The target maximum flow at Moggill remained 4,000m³/s. The approach in the Manual which states the intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4,000m³/s continued to be followed.
				
				• Model results showed a peak level in the Dam close to 74.0 was possible, but appeared increasing unlikely.
				
				• With Dam levels moving above the Wivenhoe/Somerset Operating Target Line during this period, it was decided to begin closing down releases from Somerset Dam to limit further rises in Wivenhoe Dam.
				
				• Although there was a full awareness of the rainfall forecasts and associated potential flood impacts, the strategy was not to release flows that would cause high level urban inundation until it was certain it could not be avoided. Model results continued to indicate that may be possible however, as rainfall continued, the strategy was reviewed each hour. At 21:00 the Dam Safety Regulator was asked for permission to exceed a level of 74.0 in Wivenhoe Dam for a short period (maximum 12 hours) without invoking Strategy W4, provided the safety of the Dam could be guaranteed. This was considered carefully during the period in view of the continued rainfall.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
Commenced Tuesday 11 Jan 2011 04:00 Completed Tuesday 11 Jan 2011 08:00	**Transition from Strategy W3 to Strategy W4; and Strategy S2 Wivenhoe Directive #12. Somerset Directive #6.** • Extreme intense rainfall (estimated after the event to exceed **1 in 500 year intensities**) commenced on and close to the Wivenhoe Dam lake area during this period. If the centroid of this rainfall was located further east or south, it may have been possible to avoid transition to Strategy W4. • Because the extreme intense rainfall was occurring on and close to the Dam rather than in the northern areas of the Dam catchment, response time was minimised and quick action had to be taken to protect the safety of the Dam. Accordingly, at 08:00 a decision was made to transition to Strategy W4. Significant urban damage was not to be avoided and the Dam Safety Regulator, Seqwater's CEO and the Councils were advised. • Gate settings were not changed at Wivenhoe Dam over this period. Wivenhoe Dam discharge was 2,832m³/s. • Sluice gate openings at Somerset Dam were reduced from five to two as the plotted dam levels had drifted just above the Wivenhoe/Somerset Operating Target Line.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 356mm; Somerset Dam 483mm; Lockyer Creek 240mm; Bremer River 183mm. Wivenhoe Dam level rose from 73.40 to 73.70 over the four hour period. Somerset Dam level rose from 103.23 to 103.46 over the four hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 33mm; o Wivenhoe Dam (local) 78mm; o Somerset Dam 46mm; o Lockyer Creek 54mm; o Bremer River 16mm. • Forecast 24 hour catchment average rainfall at 16:00 on 10/11 was 38mm. • Estimated peak Wivenhoe level: 74.5 (excluding forecast); 75.1 (including forecast). • Estimated peak Somerset Dam level: 103.9 (excluding forecast); 104.2 (including forecast). • Estimated total dam inflow: 2,210,000ML (excluding forecast); 2,460,000ML (including forecast). • Estimated peak flow at Moggill including Wivenhoe Dam releases: 5,870m³/s (excluding forecast).	**Strategy W4 and Strategy S2 (Lake level predicted to exceed 74.00, no maximum release rate)** • At 08:00, model results showed restricting the peak level in the Dam close to 74.0 was no longer possible due to the high intensity rainfall experienced over this period. • At 08:00 it was decided to transition to Strategy W4 and the Dam Safety Regulator, Seqwater's CEO and Councils were advised. It was now apparent significant urban damage resulting from releases from Wivenhoe Dam could not be avoided due to the extreme intense rainfall (estimated after the event to exceed **1 in 500 year intensities**) that commenced on and close to the Wivenhoe Dam lake area during this period. • As dam levels moved above the Wivenhoe/Somerset Operating Target Line during this period, releases from Somerset Dam were progressively closed down to limit further rises in Wivenhoe Dam (sluices were closed down at hourly intervals in accordance with the Manual).

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Tuesday 11 Jan 2011 08:00
 	
Completed Tuesday 11 Jan 2011 13:00
	Strategy W4 and Strategy S2 Wivenhoe Directive #12 to #14. Somerset Directive #7.
	
	• Extreme intense rainfall (estimated after the event to exceed **1 in 500 year intensities**) continued on and close to the Wivenhoe Dam lake area during this period. If the <mark>centroid</mark> of this rainfall was located further east or south, it may have been possible to avoid transition to Strategy W4.
	
	• Because the extreme intense rainfall was occurring on and close to the Dam rather than in the northern areas of the Dam catchment, response time was minimised and quick action had to be taken to protect the safety of the Dam. Once Strategy W4 is invoked, the Manual requires the opening of gates in accordance with standard sequences until the storage level of Wivenhoe Dam begins to fall. Accordingly gates were opened continuously at Wivenhoe Dam for five hours in accordance with the standard gate opening sequence at an average rate of 2.0 metres of opening per hour. This increased the Dam discharge from 2,753m^3/s to 4,250m^3/s. The threshold limit for urban damage had been exceeded and the Lake level continued to rise.
	
	• During this period Somerset Dam sluice gate openings were closed to limit rises in Wivenhoe Dam in accordance with Strategy S2.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 382mm;
		Somerset Dam 570mm;
		Lockyer Creek 287mm;
		Bremer River 237mm.
		
		Wivenhoe Dam level rose from 73.70 to 74.39 over the five hour period.
		
		Somerset Dam level rose from 103.46 to 103.83 over the five hour period.
			• Catchment average rainfalls during this period were:
			    ○ Wivenhoe Dam 27mm;
			    ○ Wivenhoe Dam (local) 85mm;
			    ○ Somerset Dam 86mm;
			    ○ Lockyer Creek 47mm;
			    ○ Bremer River 55mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on <mark>11/11</mark> was 100mm.
			
			• A portion of the extreme intense rainfall in the Dam catchment fell in an un-gauged area (e.g. on the Dam lake area) which made it difficult for the model to accurately predict lake level rises. Accordingly, operations at Wivenhoe Dam commenced gauge board readings every 30 minutes during this period and relayed this information to the Flood Operations Centre by telephone.
			
			• Estimated peak Wivenhoe Dam level: 75.0 (excluding forecast); 76.2 (including forecast).
			
			• Estimated peak Somerset Dam level: 104.8 (excluding forecast); 105.7 (including forecast).
			
			• Estimated total Dam inflow is: 2,506,000ML (excluding forecast); 3,123,000ML (including forecast).
				Strategy W4 and Strategy S2 (Lake level predicted to exceed 74.00, no maximum release rate)
				
				• The strategy was to protect the structural safety of the Dam.
				
				• The Manual requires actions under Strategy W4 to ensure Wivenhoe Dam gate openings occur in accordance with standard sequences until the storage level of Wivenhoe Dam begins to fall.
				
				• The Dam level continued to rise at 13:00. During this period, a Dam Operator relayed Wivenhoe Dam gauge board readings to the Flood Operations Centre every 30 minutes. All four Duty Engineers were present in the Flood Operations Centre and flood operations decisions were made every half hour upon receipt of the gauge board readings.
				
				• With Dam levels above the Wivenhoe/Somerset Operating Target Line during this period, releases from Somerset Dam were closed down (all sluices closed at 10:00) to limit further rises in Wivenhoe Dam.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
	Strategy W4 and Strategy S2 Wivenhoe Directive #12 to #14.			**Strategy W4 and Strategy S2 (Lake level predicted to exceed 74.00, no maximum release rate)**
Commenced Tuesday 11 Jan 2011 13:00 Completed Tuesday 11 Jan 2011 19:00	• Extreme rapid lake level rises in Wivenhoe Dam continued during this period. The QPF issued at 16:00 was for a catchment average rainfall of 75mm over the next 24 hours. • Gates were opened continuously at Wivenhoe Dam for six hours in accordance with Strategy W4 and the standard gate opening sequence at an average rate of 4.5 metres of opening per hour. • Wivenhoe Dam discharge was increased from 4,250m³/s to 7,464m³/s. Significant damage to urban areas below Moggill could not be avoided. Estimated peak inflow during this period exceeded 12,000m³/s. • No releases were made from Somerset Dam to limit increases in Wivenhoe Dam in accordance with Strategy S2.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 397mm; Somerset Dam 610mm; Lockyer Creek 325mm; Bremer River 278mm. Wivenhoe Dam level rose from 74.39 to 74.97 over the six hour period. Somerset Dam level rose from 103.83 to 104.60 over the six hour period.	• Catchment average rainfalls during this period were: ○ Wivenhoe Dam 15mm; ○ Wivenhoe Dam (local) 35mm; ○ Somerset Dam 40mm; ○ Lockyer Creek 38mm; ○ Bremer River 40mm. • Forecast 24 hour catchment average rainfall at 16:00 on 11/11 was 75mm. However, catchment average rainfalls totals this period were: ○ Wivenhoe Dam 8mm; ○ Wivenhoe Dam (local) 13mm; ○ Somerset Dam 19mm; ○ Lockyer Creek 9mm; ○ Bremer River 8mm. • A portion of the extremely intense rainfall in the Dam catchment fell in an un-gauged area (e.g. on the dam lake area) which made it difficult for the model to accurately predict lake level rises. • Estimated peak Wivenhoe level: 75.0 (excluding forecast); 75.2 (including forecast). • Estimated peak Somerset Dam level: 105.2 (excluding forecast); 105.9 (including forecast). • Estimated total dam inflow: 2,659,000ML (excluding forecast); 3,289,000ML (including forecast).	• The strategy was to protect the structural safety of the Dam. • The Manual requires actions under Strategy W4 to ensure Wivenhoe Dam gate openings occur in accordance with standard sequences until the storage level of Wivenhoe Dam begins to fall. • The lake level in both Dams continued to rise during this period. A Dam operator relayed Wivenhoe Dam gauge board readings to the Flood Operations Centre every 30 minutes. All four Duty Engineers were present in the Flood Operations Centre and decisions were made every half hour upon receipt of the gauge board readings. • With Dam levels above the Wivenhoe/Somerset Operating Target Line during this period no releases were made from Somerset Dam to limit further rises in Wivenhoe Dam. • The water level in Wivenhoe Dam peaked at 19:00 on 11 Jan 2011 at 74.97m AHD.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY
	Strategy W4 and Strategy S2 Wivenhoe Directive #15 to #24.			**Strategy W4 and Strategy S2 (Lake level predicted to exceed 74.00, no maximum release rate)**
Commenced Tuesday 11 Jan 2011 19:00 Completed Tuesday 11 Jan 2011 21:00	• Gate settings at Wivenhoe Dam did not change over this period. Wivenhoe Dam discharge is 7,458m^3/s. • The lake level in Wivenhoe Dam stabilised and then fell slightly at 21:00. At the same time a decision was made to close down the gates as quickly as possible to reduce urban flood impacts. This decision require gate openings below minimum recommended settings however, it was made in an attempt to minimise urban damage below Moggill (an objective that has to be considered under Strategy W4). Gates would have been re-opened if further lake level rises were experienced. • In accordance with Strategy S2, there were no releases made from Somerset Dam	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 398mm; Somerset Dam 610mm; Lockyer Creek 326mm; Bremer River 278mm. During this two hour period, the lake level in Wivenhoe Dam stabilised at 74.97 and then fell slightly to 74.95 at 21:00. Somerset Dam level rose from 104.60 to 104.78 over the two hour period.	• Catchment average rainfalls during this period were: o Wivenhoe Dam 1mm; o Somerset Dam 1mm; o Lockyer Creek 1mm; o Bremer River 1mm. • Forecast 24 hour catchment average rainfall at 16:00 on 11/11 was 75mm. • A portion of the extreme intense rainfall in the Dam catchment fell in an un-gauged area (e.g. on the dam lake area) which made it difficult for the model to accurately predict lake level behaviour. • Estimated peak Wivenhoe Dam level: 75.0 (excluding forecast); 75.2 (including forecast). • Estimated peak Somerset Dam level: 105.2 (excluding forecast); 105.9 (including forecast). • Estimated total Dam inflow: 2,659,000ML (excluding forecast); 3,289,000ML (including forecast). • The water level in Wivenhoe Dam peaked at 19:00 on 11 Jan 2011 at 74.97m AHD.	• The strategy was to protect the structural safety of the Dam. • The Manual requires actions under Strategy W4 to ensure Wivenhoe Dam gate openings occur at the minimum intervals and sequences until the storage level of Wivenhoe Dam begins to fall. • The Dam level stabilised during this period and then fell slightly at 21:00. A Dam operator relayed Wivenhoe Dam gauge board readings to the Flood Operations Centre every 30 minutes. All four Duty Engineers were present in the Flood Operations Centre and decisions were made every half hour upon receipt of the gauge board readings. • With Dam levels above the Wivenhoe/Somerset Operating Target Line during this period, no releases were made from Somerset Dam to limit further rises in Wivenhoe Dam.

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DATE/TIME	BACKGROUND	DAM CONDITIONS	RAINFALL AND MODEL RESULTS	STRATEGY

Commenced Tuesday 11 Jan 2011 21:00
 	
Completed Wednesday 12 Jan 2011 08:00
	Strategy W4 and Strategy S2 Wivenhoe Directive #25 to #34.
	
	• During this period, Wivenhoe Dam gates were closed as quickly as possible without causing rises in the Lake level. This was done to reduce urban flood impacts downstream. This decision required gate openings below minimum recommended settings, and was made in an attempt to minimise urban damage below Moggill (an objective that must be considered under this Strategy).
	
	• Gates were closed continuously at Wivenhoe Dam for 11 hours in accordance with the standard gate closing sequence, at an average rate of just over 3.6 metres of opening per hour.
	
	• Wivenhoe Dam discharge was decreased from 7,464m³/s to 2,547m³/s. All rural bridges below the dam remained flooded and significant damage to urban areas below Moggill occurred.
	
	• No releases were made from Somerset Dam in accordance with Strategy S2.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 399mm;
		Somerset Dam 613mm;
		Lockyer Creek 328mm;
		Bremer River 279mm.
		
		Wivenhoe Dam level fell from 74.97 to 74.78 over the 11 hour period.
		
		Somerset Dam level rose from 104.78 to 105.11 over the 11 hour period.
			• Catchment average rainfalls during this period were:
			   o Wivenhoe Dam 1mm
			   o Somerset Dam 3mm;
			   o Lockyer Creek 3mm;
			   o Bremer River 1m;
			
			• Forecast 24 hour catchment average rainfall at 16:00 on 11/11 was 75mm.
			
			• Estimated peak Wivenhoe Dam level: 75.0 (excluding forecast); 75.0 (including forecast).
			
			• Estimated peak Somerset Dam level: 105.1 (excluding forecast); 105.1 (including forecast).
			
			• Estimated total Dam inflow: 2,650,000ML (excluding forecast); 2,650,000ML (including forecast).
				Strategy W4 and Strategy S2 (Lake level predicted to exceed 74.00, no maximum release rate)
				
				• The strategy was to protect the structural safety of the Dam.
				
				• The Manual requires actions under Strategy W4 to ensure Wivenhoe Dam gate openings occur at the minimum intervals and sequences until the storage level of Wivenhoe Dam begins to fall. As the lake level was falling slightly, a decision was made to quickly reduce releases from Wivenhoe Dam to as low a level as possible, to minimise urban damage below Moggill.
				
				• It was calculated that reducing to a discharge of 2,547m³/s from Wivenhoe Dam would:
				   o Not increase the downstream flood peak;
				   o Not cause the water level in Wivenhoe Dam to rise and;
				   o Allow the Dam to be drained back to FSL in seven days, in accordance with the Manual.
				
				• With Dam levels above the Wivenhoe/Somerset Operating Target Line during this period, no releases were made from Somerset Dam to limit further rises in Wivenhoe Dam.

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Commenced Wednesday 12 Jan 2011 08:00
 	
Completed Thursday 13 Jan 2011 12:00
	Transition from Strategy W4 to the Drain Down Phase Somerset Directives #8 to #9.
	
	• Wivenhoe Dam gate settings did not change over this period. Wivenhoe Dam discharge was 2,534m^3/s and all rural bridges below the Dam remained flooded.
	
	• Releases from Somerset Dam began during this period as the plotted Dam levels fell below the Wivenhoe/Somerset Operating Target Line. These actions were undertaken in accordance with Strategy S2 and to allow the D'Aguilar Highway to be re-opened as soon as possible. Releases from Somerset Dam continued even though plotted Dam levels later rose above the Wivenhoe/Somerset Operating Target Line during this period, to allow the Dam to be drained back to FSL in seven days, in accordance with the Manual.
		Total rainfall from 08:00 on 6 Jan 2011 to the end of this period:
		Wivenhoe Dam 401mm;
		Somerset Dam 619mm;
		Lockyer Creek 330mm;
		Bremer River 280mm.
		
		Wivenhoe Dam level fell from 74.78 to 74.61 over the 28 hour period.
		
		Somerset Dam level fell from 105.11 to 103.96 over the 28 hour period.
			• Catchment average rainfalls during this period were:
			   o Wivenhoe Dam 2mm;
			   o Somerset Dam 6mm;
			   o Lockyer Creek 6mm;
			   o Bremer River 6mm.
			
			• Forecast 24 hour catchment average rainfall at 10:00 on 12/11 was 10mm.
				Drain Down Phase (Stored floodwaters emptied from the dam in seven days)
				
				• During this period the strategy transitioned from Strategy W4. The target was to protect the structural safety of the dam to the Drain Down Phase of the Event.
				
				• Once the Drain Down Phase commenced, the target was to release stored floodwaters from the Dam within seven days of the flood peak passing through the dams, while controlling downstream impacts. Considerations impacting the duration and timing of the Drain Down Phase in this instance included:
				
				   o Causing no renewed increases in river levels below the Dam (except where they were unavoidable due to tidal influences);
				   o Maintaining an adequate release rate to ensure temporary pumps providing water supplies to the Lowood area could continue to operate;
				   o Minimising bank slumping impacts along the river, particularly in key areas such as Coronation Drive (as requested by Brisbane City Council);
				   o Re-opening Brisbane Valley Highway and key rural bridges as quickly as possible;
				   o Achieving Full Supply Levels in the Dams at the conclusion of the Event.

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Commenced Thursday 13 Jan 2011 12:00 Completed Wednesday 19 Jan 2011 12:00	**Drain Down Phase** **Wivenhoe Directives #35 to #62** **Somerset Directives #10 to #13.** • During this period, releases from Wivenhoe Dam were increased as the peaks from Lockyer Creek and Bremer River subside. Downstream impacts were controlled to ensure that, at no time during this phase, downstream water levels rose, except if impacted by tidal influences. • During this period, stored flood water in Somerset Dam was drained into Wivenhoe Dam in accordance with the drain down target of seven days. Importance was placed on opening the D'Aguilar Highway as soon as possible.	Total rainfall from 08:00 on 6 Jan 2011 to the end of this period: Wivenhoe Dam 415mm; Somerset Dam 626mm; Lockyer Creek 337mm; Bremer River 288mm. Wivenhoe Dam level fell from 74.61 to 66.89 over the six day period. Somerset Dam level fell from 103.96 to 99.00 over the six day period.	• Catchment average rainfalls during this six day period were: o Wivenhoe Dam 14mm; o Somerset Dam 7mm; o Lockyer Creek 7mm; o Bremer River 8mm.	**Drain Down Phase** • During this period the target was to release stored floodwaters from the Dam within seven days of the flood peak passing through the Dams, while controlling downstream impacts. Considerations impacting the duration and timing of the Drain Down Phase in this instance included: o Causing no renewed increases in river levels below the Dam (except where unavoidable due to tidal influences); o Maintaining an adequate release rate to ensure temporary pumps providing water supplies to the Lowood area could continue to operate; o Minimising bank slumping impacts along the river, particularly in key areas such as Coronation Drive (as requested by Brisbane City Council); o Re-opening Brisbane Valley Highway and key rural bridges as quickly as possible; o Achieving Full Supply Levels in the Dams at the conclusion of the Event.

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that because of the serious nature of the event,

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The likely peak flow at Moggill of over 3000 m^3/s was communicated to the

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Page 17: [115] Deleted	11/02/2011 12:23:00 PM

a decision is made to

Page 17: [115] Deleted	11/02/2011 12:24:00 PM

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Page 17: [115] Deleted	11/02/2011 12:23:00 PM

of this decision

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must be

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prevent a situation arising during which	

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rises	

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are	

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from Wivenhoe Dam were received

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and this

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resulted in difficulties in the

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being able to

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during this period dam

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taking

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are

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at Somerset Dam are

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off

Page 19: [130] Deleted	11/02/2011 3:06:00 PM

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is in excess of

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rises

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 in accordance with Strategy S2

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Page 21: [151] Deleted	11/02/2011 3:25:00 PM

These actions are taken

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; however it

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which is

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be that

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 are to

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Because

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as quickly and

Page 21: [153] Deleted	**11/02/2011 3:31:00 PM**

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has

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No change to gate settings occurred at

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, during which the

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