Updated Draft of Wivenhoe and Somerset Flood Manual- Enterprise Vault Archived Item - Windows Internet Explorer

http://seq-vaultsite.seqwater.com.au/EnterpriseVault/ViewMessage.asp?VaultId=1E0A83DB889ABE54B8D382570652368391110000SEQ-VaultSite&SavesetId=201003240000000~200909240414000000~Z~504A91D18A800806EA98A75391CE9661

Updated Draft of Flood Man... | Flood Manual Revision Deadl... | Updated Draft of Wivenh...

Updated Draft of Flood Manual for meeting on 14 September.- Enterprise Vault Archived Item
http://seq-vaultsite.seqwater.com.au/EnterpriseVault/ViewMessage.asp?VaultId=1E0A83DB889ABE54B8D382570652368391110000SEQ-VaultSite&SavesetId=201003080000000~200909070038000000~Z~5012584AC8554782436E5DADB148561

From John Tibaldi **Date** Thursday, 24 September 2009 2:14:00 PM
To 'Allen Peter'; 'Ayre, Rob'; Terry Malone; 'Ruffini John'; 'Guppy Ron'
Cc Rob Drury; Jim Pruss; Barton Maher
Bcc Peter Borrows
Subject Updated Draft of Wivenhoe and Somerset Flood Manual

image001.png (7 KB HTML) Microsoft Word - WD-SD-Rev 7 -04 JT for distribution .pdf (1.1 MB HTML) Wiv Outflow Table comparison.xls (44 KB HTML)

All

A complete updated draft is attached that I believe addresses all issues raided to date. Terry will call a meeting next week (I am on leave for the week) to discuss the draft, so that any other outstanding issues can be brought forward and addressed prior to the Manual being finalised.

Please note that I have simplified the Loss Of Communications gate opening chart for Wivenhoe. The chart is now easier for the operators to follow and ensures that all gates are fully open prior to the first fuse plug initiating (EL 75.5). I believe the existing chart was also in error in that it contained dam outflows in excess of 4000 cumecs at dam levels less than EL 74.0 (not consistent with Strategy W3). The attached spreadsheet shows a comparison of the current and proposed tables.

I have also modified both the Operating Target Line and gate opening intervals for Somerset, in accordance with recent modelling results for both the normal and Loss of Communications cases.

John Tibaldi
Dam Safety Manager
Queensland Bulk Water Supply Authority *trading as* Seqwater

cid:image001.png@01C8F22C.8A7

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QFCI

Date: 15/4/11

Exhibit Number: 59

Local intranet | 100%

Start | Calendar - Microsoft Outl... | 2 Reminders | FW: Flood Manual Revie... | Manual Review | Updated Draft of Wiv... | Adobe Reader | Microsoft Word | Meeting to discuss Flood ...

Meeting to discuss Flood Manual Updates - Meeting

Meeting | Insert | Format Text

Cancel Meeting | Calendar | Forward | Appointment | Scheduling Assistant | Tracking | Add or Remove Attendees | Message to Attendees | Meeting Workspace | Address Book | Check Names | Responses | Show As: Busy | Reminder: None | Recurrence | Time Zones | Categorize | Private | High Importance | Low Importance | Spelling

Actions | Show | Attendees | Options | Proofing

3 attendees accepted, 0 tentatively accepted, 0 declined.
This appointment occurs in the past.

Send Update

To... Terry Malone; 'Ayre, Rob' [redacted] 'Peter Allen' [redacted] Barton Maher; 'Allen Peter' [redacted]

Subject: Meeting to discuss Flood Manual Updates

Location: Peter Allen's Office (Mineral House) Rooms...

Start time: Wed 7/10/2009 3:00 PM ☐ All day event

End time: Wed 7/10/2009 3:30 PM

In Shared Folder: Calendar

Last modified by John Tibaldi on 7/10/2009

Start | Calendar - Microsoft Outl... | 2 Reminders | FW: Flood Manual Revie... | Manual Review | Updated Draft of Wiven... | Adobe Reader | Notice of forth Meeting o... | Meeting to discuss Fl...

MANUAL

OF

OPERATIONAL PROCEDURES

FOR FLOOD EVENTS

AT

WIVENHOE DAM

AND SOMERSET DAM

Revision No.	Date	Amendment Details
0	27 October 1968	Original Issue
1	6 October 1992	Complete revision and re-issue
2	13 November 1997	Complete revision and re-issue
3	24 August 1998	Change to page 23
4	6 September 2002	Complete revision and re-issue
5	4 October 2004	Complete revision
6	20 December 2004	Miscellaneous amendments and re-issue
7	September 2009	Complete Revision

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Preface

Given their potential significant impact on downstream populations, it is imperative that Wivenhoe and Somerset Dams be operated during flood events in accordance with clearly defined procedures to minimise impacts to life and property. This manual outlines these procedures and is an approved Flood Mitigation Manual under Water Supply Act 2008.

The Manual in its current form was developed in 1992 and the basis of this document was a manual written in 1968 covering flood operations at Somerset Dam (Wivenhoe Dam was completed in 1984). Six revisions of the Manual have occurred since 1992 to account for updates to the Flood Alert Network and the Real Time Flood Models, the construction of an Auxiliary Spillway at Wivenhoe Dam in 2005 and to account for institutional and legislative changes.

The primary objectives of the procedures contained in this Manual are essentially the same as those contained in previous Manual versions. These objectives in order of importance are:

- Ensure the structural safety of the dams;
- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise Impacts to riparian flora and fauna during the drain down phase of the Flood Event.

In meeting these objectives, the dams must be operated to account for the potential effects of closely spaced Flood Events. Accordingly, normal procedures require stored floodwaters to be emptied from the dams within seven days of the flood event peak passing through the dams.

Wivenhoe Dam and Somerset Dam are operated in conjunction so as to maximise the overall flood mitigation capabilities of the two dams. The procedures outlined in this Manual are based on the operation of the dams in tandem.

1.2 Meaning of Terms

In this Manual, save where a contrary definition appears -

"Act"
means the *Water Supply (Safety and Reliability) Act 2008*;

"AEP"
means annual exceedance probability, the probability of a specified event being exceeded in any year.

"Agency"
includes a person, a local government and a department of state government within the meaning of the Acts Interpretation Act 1954;

"AHD"
means Australian Height Datum;

"Chairperson"
means the Chairperson of Seqwater;

"Chief Executive"
means the Director General of the Department of Environment and Resource Management or nominated delegate;

"Controlled Document"
means a document subject to managerial control over its contents, distribution and storage. It may have legal and contractual implications;

"Dams"
means dams to which this Manual applies, that is Wivenhoe Dam and Somerset Dam;

"Dam Supervisor"
means the senior on-site officer at Wivenhoe or Somerset Dam as the case may be;

"Duty Flood Operations Engineer"
means the Senior Flood Operations Engineer or Flood Operations Engineer rostered on duty to be in charge of Flood Operations at the dams;

"EL"
means elevation in metres from Australian Height Datum;

"Flood Event"
Situations where the Duty Flood Operations Engineer expects the water level in either of the Dams to exceed the Full Supply Level;

"Flood Operations Engineer"
means a person designated to direct flood operations at the dams in accordance with Section 2.3 of this Manual;

"FSL" or "Full Supply Level"
means the level of the water surface when the reservoir is at maximum operating level, excluding periods of flood discharge;

"Gauge"
when referred to in (m) means river level referenced to AHD, and
when referred to in (m^3/sec) means flow rate in cubic metres per second;

"Manual" or "Manual of Operational Procedures for Flood Events at Wivenhoe Dam and Somerset Dam"
means the current version of this Manual;

"Power Station"
means the Wivenhoe pumped storage hydro-electric power station associated with Wivenhoe Dam and Split-Yard Creek Dam;

"Senior Flood Operations Engineer"
means a person designated in accordance with Section 2.2 of this Manual under whose general direction the procedures in this Manual must be carried out;

"Seqwater"
means the Queensland Bulk Water Supply Authority trading as Seqwater

1.3 Purpose of Manual

The purpose of this Manual is to define procedures for the operation of Wivenhoe Dam and Somerset Dam to reduce, so far as practicable, the effects of flooding associated with the dams. This is achieved by the proper control and regulation in time of the flood release infrastructure at the dams, with due regard to the safety of the dam structures.

The procedures in this Manual have been developed on the basis that the community is to be protected to the maximum extent practical against flood hazards recognising the limitations on being able to:

- Obtain accurate forecasts of rainfall during flood events;
- Accurately estimate flood run-off within the dam catchments;
- Identify all potential flood hazards and their likelihood;
- Remove or reduce community vulnerability to flood hazards;
- Effectively respond to flooding;
- Provide resources in a cost effective manner.

1.4 Legal Authority

This manual has been prepared as a Flood Mitigation Manual in accordance with Chapter 4 Part 2 of the Act.

1.5 Application and Effect

The procedures in this Manual apply to the operation of Wivenhoe Dam and Somerset Dam for the purpose of flood mitigation, and operation in accordance with the manual shall give the protection from liability provided by Section 374 of the Act.

1.6 Date of Effect

The procedures in this Manual shall have effect on and from the date on which this version of the Manual is approved by gazette notice.

The Manual shall remain in force for the period of approval as determined by the Chief Executive. This approval may be for a period of up to five years.

Before the approval of the Manual expires, Seqwater must review and if necessary update the Manual and submit a copy to the chief executive for approval.

1.7 Observance of Manual

This Manual contains the operational procedures for Wivenhoe Dam and Somerset Dam for the purposes of flood mitigation and must be used for the operation of the dams during flood events.

1.8 Provision for Variations to Manual

If Seqwater is of the opinion that this Manual should be amended, altered or varied, it must submit for approval as soon as practical, an appropriate request to the Chief Executive, setting out the circumstances and the exact nature of the amendment, alteration or variation sought. The Chief Executive may accept, reject or modify the request prior to approval.

1.9 Distribution of Manual

Seqwater must regard the manual as a Controlled Document and ensure that only controlled manuals are used in the direction of flood mitigation activities. Agencies having copies of controlled hardcopies of the Manual are listed in Appendix B. Seqwater must maintain a Register of Contact Persons for issued controlled hardcopies of the Manual and must ensure that each issued document is updated whenever amendments or changes are approved.

2 DIRECTION OF OPERATIONS

2.1 Statutory Operation

Pursuant to the provisions of the Act, Seqwater is responsible for operating and maintaining the dams in accordance with this Manual in order to retain the protection from liability afforded by the Act. Operators, employees, agents, and contractors working for Seqwater must also comply with this Manual to obtain the protection of the Act.

2.2 Operational Arrangements

For the purposes of operation of the dams during Flood Events, Seqwater must ensure that:

- Sufficient numbers of suitably qualified personnel are available to operate the dams if a Flood Event occurs.

- Sufficient numbers of suitably qualified personnel are available to operate the Flood Operations Centre if a Flood Event occurs

- A Duty Flood Operations Engineer is on call at all times. The Duty Flood Operations Engineer must constantly review weather forecasts and catchment rainfall and must declare a Flood Event if the water level of either Wivenhoe or Somerset Dam is expected to exceed Full Supply Level as a result of prevailing or predicted weather conditions.

- A Senior Flood Operations Engineer is designated to be in the charge of Flood Operations at all times during a Flood Event.

- Release of water at the dams during Flood Events is carried out under the direction of the Duty Flood Operations Engineer.

- All practical attempts are made to liaise with the Chairperson and the Chief Executive if the release of water from the Dams during a Flood Event is likely to endanger life or property.

2.3 Designation and Responsibilities of Senior Flood Operations Engineer

Seqwater must nominate one or more suitably qualified and experienced persons to undertake the role of Senior Flood Operations Engineer. If approved by the Chief Executive, these persons can be authorised in the Schedule of Authorities (see Section 2.6). When rostered on duty during a Flood Event, the responsibilities of the Senior Flood Engineer are as follows:

- Set the overall strategy for management of the Flood Event in accordance with the objectives of this Manual.
- Provide instructions to site staff to make releases of water from the Dams during Flood Events that are in accordance with this Manual.
- Apply reasonable discretion in managing a Flood Event as described in Section 2.8.

Seqwater must ensure that an adequate number of Senior Flood Operations Engineers are available to manage all Flood Events.

2.4 Designation and Responsibilities of Flood Operations Engineer

Seqwater must nominate one or more suitably qualified and experienced persons to undertake the role of Flood Operations Engineer. If approved by the Chief Executive, these persons can be authorised in the Schedule of Authorities (see Section 2.6). When rostered on duty during a Flood Event, the responsibilities of the Flood Engineer are as follows:

- Direct the operation of the dams during a flood event in accordance with the general strategy determined by the Senior Flood Operations Engineer.

- Follow any direction from the Senior Flood Operations Engineer in relation to applying reasonable discretion in managing a Flood Event as described in Section 2.6. Unless otherwise directed, a Flood Operations Engineer is to follow this Manual in managing Flood Events and is not to apply reasonable discretion unless directed by the Senior Flood Operations Engineer or the Chief Executive.

- Provide instructions to site staff to make releases of water from the Dams during Flood Events that are in accordance with this Manual.

Seqwater must ensure that an adequate number of Flood Operations Engineers are available to manage all Flood Events. Seqwater must also ensure that and adequate number of suitably qualified and experienced persons are available to assist the Flood Operations Engineers during all Floods Events.

2.5 Qualifications and Experience of Engineers

Qualifications

All engineers referred to in Sections 2.2 and 2.3 must hold a Certificate of Registration as a Registered Professional Engineer of Queensland and must hold appropriate engineering qualifications to the satisfaction of the Chief Executive.

Experience

All engineers referred to in Sections 2.2 and 2.3 must, to the satisfaction of the Chief Executive, have:

(1) Knowledge of design principles related to the structural, geotechnical and hydraulic design of large dams, and

(2) At least a total of five years of suitable experience and demonstrated expertise in at least two of the following areas:

- Investigation, design or construction of major dams;
- Operation and maintenance of major dams;

- Hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology;
- Applied hydrology with particular reference to flood forecasting and/or flood forecasting systems.

2.6 Schedule of Authorities

Seqwater must maintain a Schedule of Authorities containing a list of the Senior Flood Operations Engineers and Flood Operations Engineers approved by the Chief Executive to direct flood operations at the dams during floods. A copy of the Schedule of Authority must be provided to the Chief Executive by 30 September of each year.

Seqwater shall nominate suitably qualified and experienced engineers for registration in the Schedule of Authorities as the need arises. Each new nomination must include a validated statement of qualifications and experience as required by the Chief Executive. Seqwater must obtain the approval for all nominations from the Chief Executive prior to their inclusion in the Schedule of Authorities.

If, in the event of unforseen and emergency situations, no Senior Flood Operations Engineer or no Flood Operations Engineer is available from the Schedule of Authorities to manage a Flood Event, Seqwater must temporarily appoint a suitable person or persons and immediately seek ratification from the Chief Executive.

2.7 Training

Seqwater must ensure that operational personnel required for flood operations activities receive adequate training in the various activities involved in flood control operation as required by the Chief Executive.

2.8 Reasonable Discretion

If in the opinion of the Senior Flood Operations Engineer, it is necessary to depart from the procedures set out in this Manual to meet the flood mitigation objectives set out in Section 3, the Senior Flood Operations Engineer is authorised to adopt such other procedures as considered necessary subject to the following:

- Before exercising discretion under this Section of the Manual with respect to flood mitigation operations, the Senior Flood Operations Engineer must make a reasonable attempt to consult with both the Chairperson and Chief Executive.

- The Chief Executive would normally authorise any departures from the Manual. However if the Chief Executive cannot be contacted within a reasonable time, departures from the Manual can be authorised by the Chairperson.

- If both the Chairperson and the Chief Executive cannot be contacted within a reasonable time, the Senior Flood Operations Engineer may proceed with the procedures considered necessary and report such action at the earliest opportunity to the Chairperson and Chief Executive.

2.9 Report

Seqwater must prepare a report after each Flood Event. The report must contain details of the procedures used, the reasons therefore and other pertinent information. Seqwater must forward the report to the Chief Executive within six weeks of the completion of the Flood Event.

3 FLOOD MITIGATION OBJECTIVES

3.1 General

To meet the purpose of the flood operational procedures in this Manual, the following objectives, listed in descending order of importance, are as follows:

- Ensure the structural safety of the dams;
- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise Impacts to riparian flora and fauna during the drain down phase of the Flood Event.

In meeting these objectives, the dams must be operated to account for the potential effects of closely spaced Flood Events. Accordingly, normal procedures require stored floodwaters to be emptied from the dams within seven days of the flood event peak passing through the dams.

Additionally, the auxiliary spillway constructed at Wivenhoe Dam in 2005 incorporates fuse plugs. Triggering of a fuse plug will increase floods levels downstream. Where possible, gate operations at both Wivenhoe and Somerset dams should be formulated to prevent operation of the fuse plug. This potential scenario is possible only when the forecast peak water level for Wivenhoe Dam just exceeds the trigger level for the fuse plug and sufficient time is available to alter releases.

3.2 Structural Safety of Dams

The structural safety of the dams must be the first consideration in the operation of the dams for the purpose of flood mitigation.

Wivenhoe Dam

The structural safety of Wivenhoe Dam is of paramount importance. Structural failure of Wivenhoe Dam would have catastrophic consequences. Wivenhoe Dam is predominantly a central core rockfill dam. Such dams are not resistant to overtopping and are susceptible to breaching should such an event occur. Overtopping is considered a major threat to the security of Wivenhoe Dam. Wivenhoe Dam is overtopped by a 1 in 100000 year Annual Exceedance Probability event.

Somerset Dam

The structural safety of Somerset Dam also is of paramount importance. Failure of Somerset Dam could have catastrophic consequences. Whilst Wivenhoe Dam has the capacity to mitigate the flood effects of such a failure in the absence of any other flooding, if the failure were to occur during major flooding, Wivenhoe Dam could be overtopped and destroyed also.

Somerset Dam is a mass concrete dam. Such dams can withstand limited overtopping without damage. Failure of such structures is rare but when they do occur, they occur suddenly without warning, creating very severe and destructive flood waves. Although Somerset Dam is overtopped by a 1 in 10000 year Annual Exceedance Probability event, it is expected that the dam could withstand at least 1.5 metres of overtopping without failure. This equates to a 1 in 100000 year Annual Exceedance Probability event.

3.3 Extreme Floods and Closely Spaced Large Floods

As indicated in the previous section, techniques for estimating extreme floods show that floods are possible which would overtop both dams. In the case of Wivenhoe Dam such an overtopping would most likely result in the destruction of the dam. Such events however require several days of intense rainfall to produce the necessary runoff.

Historical records show that there is a significant probability of two or more flood producing storms occurring in the Brisbane River system within a short time of each other. Therefore, unless determined otherwise by the Senior Flood Operations Engineer in accordance with Section 2.6, the aim during a Flood Event should be to empty stored floodwaters within seven days after the flood peak has passed through the dams. In a very large flood, this time frame may not be achievable because of downstream flood conditions and it may be necessary to extend the emptying period by several days.

The discharges from the dams should be regulated so as to have little impact on the urban reaches of the Brisbane River, taking into account inflows into the river downstream of the dams. However the seven day drainage requirement may result in submergence of some bridges. Regardless, the level of flooding as a result of emptying stored floodwaters after the peak has passed is to be less than the flood peak unless accelerated release is necessary to reduce the risk of overtopping.

3.4 Inundation of Urban Areas

The prime purpose of incorporating flood mitigation measures into Wivenhoe Dam and Somerset Dam is to reduce flooding in the urban areas of the flood plains below Wivenhoe Dam. The peak flows of floods emanating from the upper catchments of Brisbane and Stanley Rivers can be reduced by controlling flood releases from the dams, while taking into account flooding derived from the lower Brisbane River catchments.

3.5 Disruption to Rural Areas

While the dams are being used for flood mitigation purposes, bridges and areas upstream of the dams may be temporarily inundated. Downstream of the dam, bridges and lower river terraces will be submerged. The operation of the dams should not prolong this inundation unnecessarily.

Disruption to navigation in the Brisbane River is also a consideration when considering disruption to rural areas downstream of the dam. This consideration is secondary however to considerations associated with reducing bridge inundation.

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3.6 Minimising Impacts to Riparian Flora and Fauna

During the drain down phase, consideration is to be given to minimising the impacts on riparian flora and fauna. In particular, strategies aimed at reducing fish deaths in the vicinity of the dam walls are to be instigated, provided such procedures do not adversely impact on other flood mitigation objectives.

Additionally, when determining the time interval between successive gate closures consideration should also be given to reducing potential bank slumping. Rapid draw down of stream levels where banks are saturated should be avoided if this can be managed within the other flood mitigation objectives.

4 FLOOD CLASSIFICATION

For the reference purposes of this Manual, four magnitudes of flooding are classified as follows:

Minor Flooding
Causes inconvenience. Low-lying areas next to watercourses are inundated which may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged.

Moderate Flooding
In addition to the impacts experienced during Minor Flooding, the evacuation of some houses may be required. Main traffic routes may be impacted. The area of inundation is substantial in rural areas requiring the removal of stock.

Major Flooding
In addition to the impacts experienced during Moderate Flooding, extensive rural areas and/or urban areas are inundated. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood affected areas may be required. The 1974 flood that impacted on the Ipswich and Brisbane areas is classified as a major flood.

Extreme Flooding
This causes flooding impacts equal to or in excess of levels previously experienced. In addition to the impacts experienced during Major Floods, the general evacuation of people from significant populated areas is likely to be required.

It should be noted that a flood may not cause the same category of flooding along its entire length and the relevant agencies shall have regard to this when flooding is predicted. The classifications of minor, moderate and major flooding are based on the Bureau of Meteorology Standard Flood Classifications for Australia.

5 FLOOD MONITORING AND FORECASTING SYSTEM

5.1 General

A real time flood monitoring and forecasting system has been established in the dam catchments. This system employs radio telemetry to collect, transmit and receive rainfall and streamflow information. The system consists of more than 100 field stations that automatically record rainfall and/or river heights at selected locations in the dam catchments. Some of the field stations are owned by Seqwater with the remainder belonging to other agencies.

The rainfall and river height data is transmitted to Seqwater's Flood Operations Centre in real time. Once received in the Flood Operations Centre, the data is processed using a Real Time Flood Model (RTFM) to estimate likely dam inflows and evaluate a range of possible inflow scenarios based on forecast and potential rainfall in the dam catchments. The RTFM is a suite of hydrologic and hydraulic computer programs that utilise the real time data to assist in the operation of the dams during flood events. Seqwater is responsible for providing and maintaining the RTFM and for ensuring that sufficient data is available to allow proper operation of the RTFM during a Flood Event.

5.2 Operation

The Senior Flood Operations and Flood Operations Engineers use the RTFM for flood monitoring and forecasting during flood events to operate the dams in accordance with this Manual. This is done by optimising releases of water from the dams to minimise the impacts of flooding in accordance with the objectives and procedures contained in this Manual.

Seqwater is responsible for improving the operation of the RTFM over time by using the following processes:

- Implementing improvements based on Flood Event audits and reviews.
- Improving RTFM calibration as further data becomes available.
- Updating software in line with modern day standards.
- Improving the coverage and reliability of the data collection network to optimise data availability during Flood Events.
- Recommendations by Senior Flood Operations Engineers.

A regular process of internal audit and management review must be maintained by Seqwater to achieve these improvements.

Seqwater must also maintain a log of the performance of the data collection network. The log must include all revised field calibrations and changes to the number, type and locations of gauges. Senior Flood Operations and Flood Operations Engineers are to be notified of all significant changes to the Log.

Seqwater must also maintain a log of the performance of the RTFM. Any faults to the computer hardware or software are to be noted and promptly and appropriately attend to.

5.3 Storage of Documentation

The performance of any flood monitoring and forecasting system is reliant on accurate historical data over a long period of time. Seqwater must ensure that all available data and other documentation is appropriately collected and catalogued for future use.

5.4 Key Reference Gauges

Key field station locations have been identified for reference purposes when flood information is exchanged between authorities or given to the public. Should it be deemed desirable to relocate field stations from these locations or vary flood classification levels, agreement must first be obtained between Seqwater, Bureau of Meteorology and the Local Government within whose boundaries the locations are situated.

Gauge boards that can be read manually must be maintained by Seqwater as part of the equipment of each key field station. Where possible and practical during Flood events, Seqwater is to have procedures in place for manual reading of these gauge boards in the event of failure of field stations.

5.5 Reference Gauge Values

Other agencies such as the Bureau of Meteorology, Brisbane City Council and Ipswich City Council have direct access to the information from field stations for flood assessment purposes. The consultation between agencies is a very important part of the assessment and prediction of flood flows and heights.

Seqwater must ensure that information relevant to the calibration of its field stations is shared with these agencies.

6 COMMUNICATIONS

6.1 Communications between Staff

Seqwater is responsible for providing and maintaining equipment to allow adequate channels of communication to exist at all times between the Seqwater Flood Operations Centre and site staff at Wivenhoe and Somerset Dams.

6.2 Dissemination of Information

Agencies other than Seqwater have responsibilities for formal flood predictions, the interpretation of flood information and advice to the public associated with Flood Events. Adequate and timely information is to be supplied to agencies responsible for the operation of facilities affected by flooding and for providing warnings and information to the public. Agency information requirements are generally as shown in Table 6.1.

The Senior Flood Operations and Flood Operations Engineers must supply information to each of these agencies during Flood Events. The contact information for these Agencies and communication procedures is contained in the Emergency Action Plans for the dams and each agency is to receive updated controlled copies of these documents .

Seqwater must liaise and consult with these agencies with a view to ensuring all information relative to the flood event is consistent and used in accordance with agreed responsibilities.

TABLE 6.1 - AGENCY INFORMATION REQUIREMENTS

Agency	Activity	Information Requirement from SEQWC Flood Centre	Trigger
Bureau of Meteorology	Issue of flood warnings for Brisbane River basin	Actual and projected discharges from Wivenhoe Dam Actual and projected discharges from Somerset Dam	Initial gate operations and thereafter at intervals to suit forecasting requirements.
Department of Environment and Resource Management	Review of flood operations and discretionary powers.	Actual and predicted lake levels and discharges	
Somerset Regional Council	Flood level information upstream of Somerset Dam and upstream and downstream of Wivenhoe Dam	Actual and predicted lake levels, Somerset Dam and actual and predicted lake levels and discharges, Wivenhoe Dam	Somerset Dam water level predicted to exceed EL 102 and initial Wivenhoe Dam gate operation.
Ipswich City Council	Flood level information for Ipswich City area	Nil (information obtained from BOM)	
Brisbane City Council	Flood level information for Brisbane City area	Nil (information obtained from BOM)	

6.3 Release of Information to the Public

Seqwater is responsible for the issue of information regarding storage conditions and current and proposed releases from the dams to the public and the media.

The Bureau of Meteorology has responsibility for issuing flood warnings.

The Emergency Services Response Authorities, under the Disaster Management Act 2003, have responsibility for the preparation of a local counter disaster plan and the interpretation of flood forecast information for inclusion in their local flood warnings prepared under the flood sub plan of the counter disaster plan.

7 REVIEW

7.1 Introduction

With the passage of time neither the technical assumptions nor the physical conditions on which this Manual is based may remain unchanged. It is also recognised that the relevance of the Manual may change with changing circumstances. It is important therefore, that the Manual contain operational procedures which cause the assumptions and conditions upon which they are based, to be checked and reviewed regularly.

This process must involve all personnel involved in the management of Flood Events, to ensure that changes of personnel do not result in a diminished understanding of the basic principles upon which the operational procedures are based. Variations to the Manual may be made in accordance with provisions in Section 1.8.

7.2 Personnel Training

Seqwater must report to the Chief Executive by 30 September each year on the training and state of preparedness of operations personnel.

7.3 Monitoring and Forecasting System and Communication Networks

Seqwater must provide a report to the Chief Executive by 30 September each year on the state of the Flood Monitoring and Forecasting System and Communication Networks. The report must assess following in terms of hardware, software and personnel:

- Adequacy of the communication and data gathering facilities.
- Reliability of the system over the previous period.
- Reliability of the system under prolonged flood conditions.
- Accuracy of forecasting flood flows and heights.
- The overall state of preparedness of the system.

Seqwater must take any action considered necessary for the proper functioning and improvement of this system.

7.4 Operational Review

After each significant flood event, Seqwater must report to the Chief Executive on the effectiveness of the operational procedures contained in this manual. This report must be submitted within six weeks of any flood event that requires mobilisation of the Flood Operations Centre.

7.5 Five Yearly Review

Prior to the expiry of the approval period, Seqwater must review the Manual pursuant to provisions of the Act. The review is to take into account the continued suitability of the communication network and the flood monitoring and forecasting system, as well as hydrological and hydraulic engineering assessments of the operational procedures.

8 WIVENHOE DAM FLOOD OPERATIONS

8.1 Introduction

Wivenhoe Dam is capable of being operated in a number of ways to reduce flooding in the Brisbane River downstream of the dam, depending on the origin, magnitude and spatial extent of the flood. Maximum overall flood mitigation effect will be achieved by operating Wivenhoe Dam in conjunction with Somerset Dam.

The reservoir volume above FSL of EL 67.0 is available as temporary flood storage. How much of the available flood storage compartment is utilised, will depend on the initial reservoir level below FSL, the magnitude of the flood being regulated and the procedures adopted.

Spiltyard Creek Dam is part of the overall Wivenhoe Area Project and it forms the upper pumped storage for hydro power generation. Splityard Creek Dam impounds a volume of 28 700 ML at FSL (EL 166.5). This volume can be emptied into Lake Wivenhoe within 12 hours and this water can affect the level in Wivenhoe Dam by up to 300mm when Wivenhoe Dam is close to FSL. Operation of the power station and release of water from Splityard Creek Dam to Lake Wivenhoe is outside the control of Seqwater, but should be considered when assessing the various trigger levels of Wivenhoe Dam.

8.2 Flood Release Infrastructure

Radial Gates and an Auxiliary Spillway are the primary infrastructure used to release water during flood events at Wivenhoe Dam. The arrangement of the Radial Gates is shown in the diagram below:

In addition to the five radial gates, the auxiliary spillway was constructed in 2005 as part of an upgrade to improve flood adequacy of this storage. The auxiliary spillway consists of a three bay fuse plug spillway at the right abutment. In association with other works constructed at the dam, this gives the dam crest flood an annual exceedance probability (AEP) of approximately 1 in 100,000. Another one bay fuse plug spillway may be constructed at Saddle Dam two in the future.

Pertinent information about the auxiliary spillway, including the initiation level for the specific bays is given in the following table.

AUXILIARY SPILLWAY - FUSE PLUG DETAILS

[redacted]

* Lake Water Level is as per that measured at the Headwater Gauge.
Initiation of Fuse Plug is expected to occur when the Lake Water Level exceeds the Lake Level at Fuse Plug Pilot Channel by 0.10 - 0.15 m

\+ Includes 0.03m of drawdown from the Fuse Plug Pilot Channel Invert to the Lake Water Level

++ Includes 0.08m of drawdown from the Fuse Plug Pilot Channel Invert to the Lake Water Level

The arrangement of the Auxiliary Spillway is shown in the diagram below:

[redacted]

8.3 Initial Flood Control Action

Once a Flood Event is declared, an assessment is to be made of the magnitude of the Flood Event, including:

- A prediction of the maximum storage levels in Wivenhoe and Somerset Dams.
- A prediction of the peak flow rate at the Lowood Gauge excluding Wivenhoe Dam releases.
- A prediction of the peak flow rate at the Moggill Gauge excluding Wivenhoe Dam releases.

The spillway gates are not to be opened for flood control purposes prior to the reservoir level exceeding EL 67.25.

8.4 Flood Operations Strategies

There are four strategies used when operating Wivenhoe Dam during a flood event as outlined below. These strategies are based on the Flood Objectives of this manual. The strategy chosen at any point in time will depend on the following predictions which are to be made using the best forecast rainfall and streamflow information available at the time:

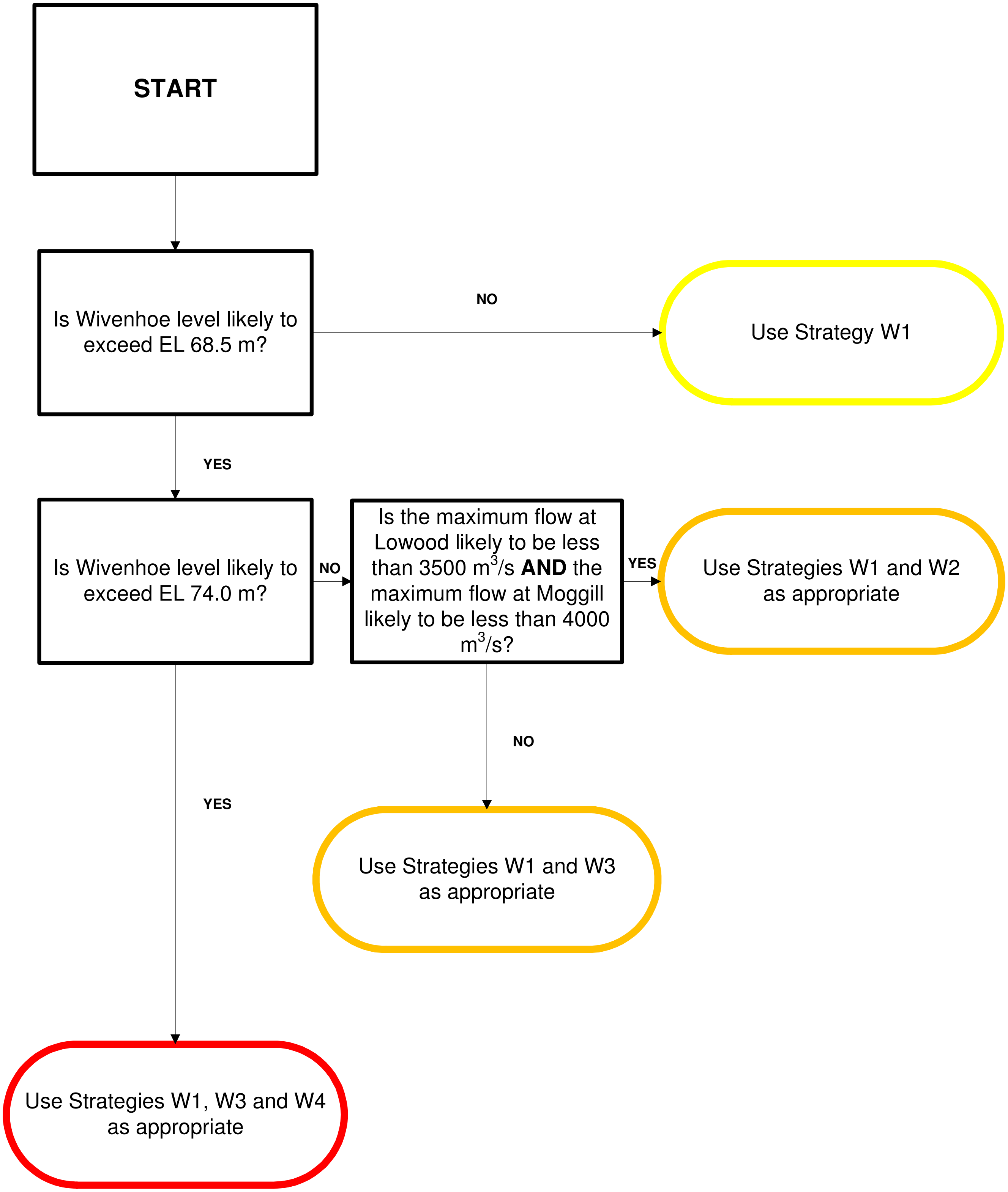
- Maximum storage levels in Wivenhoe and Somerset Dams.
- Peak flow rate at the Lowood Gauge (excluding Wivenhoe Dam releases).
- Peak flow rate at the Moggill Gauge (excluding Wivenhoe Dam releases).

Strategies are likely to change during a flood event as forecasts change and rain is received in the catchments. It is not possible to predict the range of strategies that will be used during the course of a flood event at the commencement of the event. Strategies are changed in response to changing rainfall forecasts and streamflow conditions to maximise the flood mitigation benefits of the dams.

When calculating the impacts of flood releases from Wivenhoe Dam, the gate opening sequences outlined in Section 8.6 should be used to determine likely outflow rates from the dam.

A flowchart showing how best to select the appropriate strategy to use at any point in time is shown below:

WIVENHOE FLOOD STRATEGY FLOW CHART

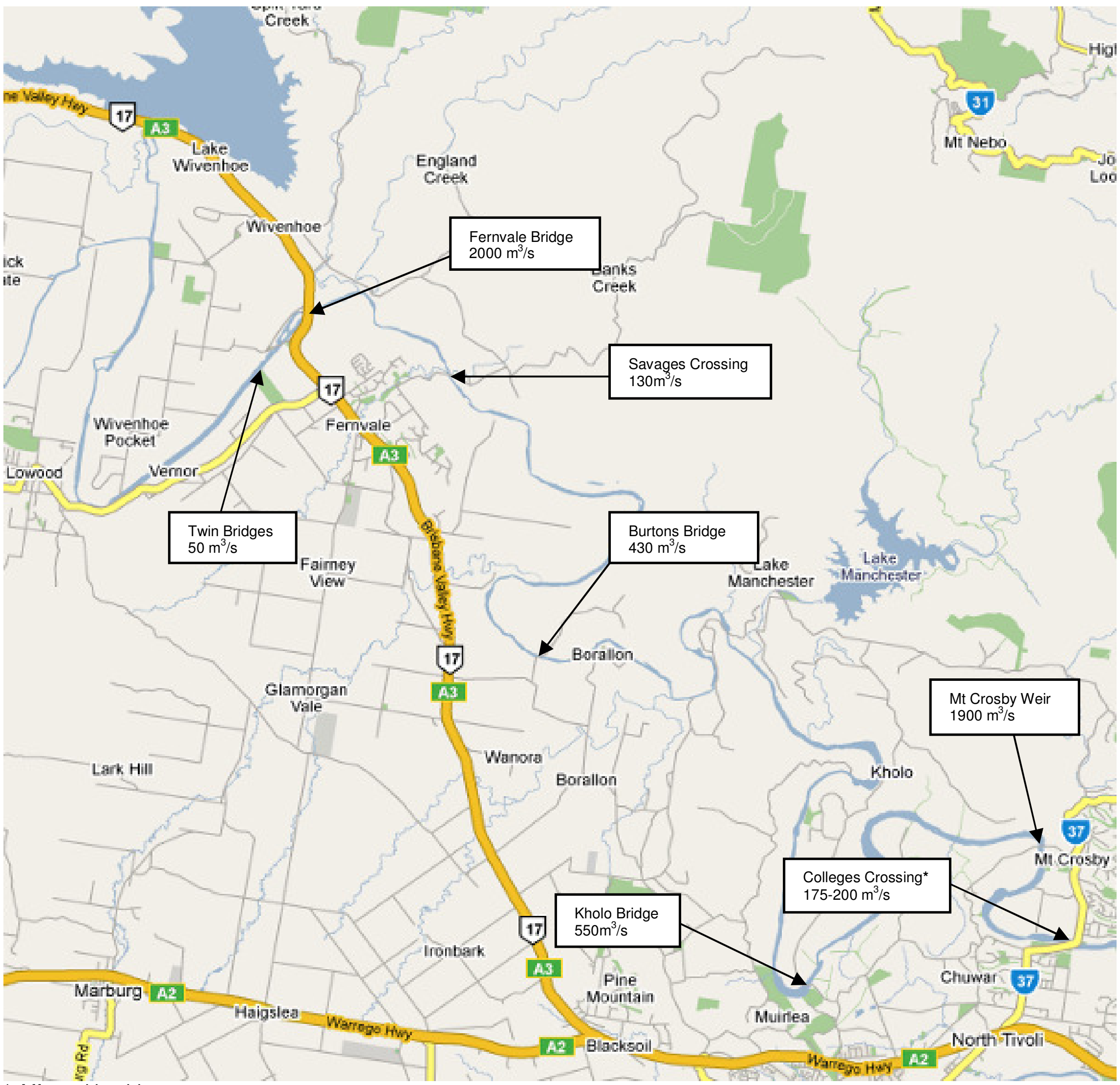


Strategy W1- Minimising Impact On Rural Life Downstream

Conditions	• **Wivenhoe Lake Level predicted to be less than 68.50 m AHD.** • **Maximum Release 1 900 m^3/sec.** • **The primary consideration is minimising disruption to downstream rural life.**

The intent of Strategy W1 is to not to submerge the bridges downstream of the dam prematurely. The limiting condition for Strategy W1 is the submergence of Mt Crosby Weir Bridge that occurs at approximately 1 900 m^3/sec.

Submergence Flows for Bridges



* Affected by tides

For situations where flood rains are occurring on the catchment upstream of Wivenhoe Dam and only minor rainfall is occurring downstream of the dam, releases are to be regulated to limit, as much as appropriate in the circumstances, downstream flooding.

The following strategies require a great deal of control over releases and knowledge of discharges from Lockyer Creek. In general, the releases from Wivenhoe Dam are controlled such that the combined flow from Lockyer Creek and Wivenhoe Dam is less than the limiting values to delay the submergence of particular bridges. The diagram above shows the location of the impacted bridges and the approximate river flow rate at which they are closed to traffic.

<u>Strategy W1A</u> Twin Bridges, Savages Crossing and Colleges Crossing

Lake level between 67.25 and 67.5 m AHD
[Maximum Release 110 m^3/sec]

Firstly, endeavour to maintain Twin Bridges trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 50 m^3/s.

Once Twin Bridges is closed to traffic, endeavour to maintain Savages Crossing trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 110 m^3/s.

Once Savages Crossing is closed to traffic, endeavour to maintain College’s Crossing trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 175 m^3/s. Note that College’s Crossing can be impacted by tidal influences.

When the flood event subsides, all gates are to be closed when the dam achieves FSL in accordance with Section 8.5.

<u>Strategy W1B</u> College’s Crossing and Burtons Bridge

Lake level between 67.50 and 67.75 m AHD
[Maximum Release 380 m^3/sec]

No consideration is given to maintaining Twin Bridges or Savages Crossing open.

Endeavour to maintain College’s Crossing trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 175 m^3/s.

Once College’s Crossing is closed to traffic, endeavour to maintain Burtons Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 430 m^3/s.

Strategy W1C Burtons Bridge and Kholo Bridge

Lake level between 67.75 and 68.00 m AHD
[Maximum Release 500 m^3/sec]

No consideration is given to maintaining College's Crossing open.

Endeavour to maintain Burtons Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 430 m^3/s.

Once Burtons Bridge is closed to traffic, endeavour to maintain Kholo Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 550 m^3/s.

Strategy W1D Kholo Bridge and Mt Crosby Weir Bridge

Lake level between 68.00 and 68.25 m AHD
[Maximum Release 1900 m^3/sec]

No consideration is given to maintaining Burtons Bridge open.

Endeavour to maintain Kholo Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 550 m^3/s.

Once Kholo Bridge is closed to traffic, endeavour to maintain Mt Crosby Weir Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 1900 m^3/s.

Strategy W1E Mt Crosby Weir Bridge and Fernvale Bridge

Lake level between 68.25 and 68.50 m AHD
[Maximum Release 1900 m^3/sec]

No consideration is given to maintaining Kholo Bridge open.

Endeavour to maintain Mt Crosby Weir Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 1900 m^3/s.

Once Mt Crosby Weir Bridge is closed to traffic, endeavour to maintain Fernvale Bridge trafficable by limiting the combined flows from Wivenhoe Dam and Lockyer Creek to a maximum of 2000 m^3/s.

If the level reaches EL 68.5 m AHD in Wivenhoe Dam, operations switch to Strategy 2 or 3 as appropriate.

Strategy W2 - Transition Strategy from W1 to W3

Conditions	• **Wivenhoe Lake Level predicted to be between 68.50 and 74.00 m AHD.** • **Maximum Release 3 500 m^3/s.** • **This is a transition strategy in which the primary consideration changes from minimising disruption to downstream rural life to protecting urban areas from inundation.**

The intent of Strategy W2 is limit the flow in the Brisbane River to less than the naturally occurring peaks at Lowood and Moggill, while remaining within the upper limit of non-damaging floods at Lowood (3500 m^3/s). In these instances, the combined peak river flows should not exceed those shown in the following table:

LOCATION	**TARGET MAXIMUM FLOW IN THE BRISBANE RIVER**
Lowood	The lesser of: • the natural peak flow at Lowood excluding Wivenhoe Dam releases, and; • 3500m^3/s.
Moggill	The lesser of: • the natural peak flow at Moggill excluding Wivenhoe Dam releases, and; • 4000m^3/s.

Strategy W3 – Protect Urban Areas from Inundation

Conditions	• **Wivenhoe Lake Level predicted to be between 68.50 and 74.00 m AHD.** • **Maximum Release 4 000 m^3/s.** • **The primary consideration is protecting urban areas from inundation.**

The intent of Strategy W3 is to limit the flow in the Brisbane River at Moggill to less than 4000 m^3/s, noting that 4000 m^3/s at Moggill is the upper limit of non-damaging floods downstream. The combined peak river flow targets for Strategy W3 are shown in the following table. In relation to these targets, it should be noted that depending on natural flows from the Lockyer and Bremer catchments, it may not be possible to limit the flow at Moggill to below 4000 m^3/s. In these instances, the flow at Moggill is to be kept as low as possible.

TIMING	**TARGET MAXIMUM FLOW IN THE BRISBANE RIVER**
Prior to the naturally occurring peak at Moggill (excluding Wivenhoe Dam releases).	The flow at Moggill is to be minimised.
After the naturally occurring peak at Moggill (excluding Wivenhoe Dam releases).	The flow at Moggill is to be lowered to 4000m^3/s as soon as possible.

Strategy W4 – Protect the Structural Safety of the Dam.

Conditions	• **Wivenhoe Lake Level predicted to exceed 74.00m AHD.** • **No limit on Maximum Release rate.** • **The primary consideration is protecting the structural safety of the dam.**

The intent of Strategy W4 is to ensure the safety of the dam while limiting downstream impacts as much as possible.

This strategy normally comes into effect when the water level in Wivenhoe Dam reaches EL 74. However the Senior Flood Operations Engineer may seek to invoke the discretionary powers of Section 2.8 if earlier commencement is able to prevent triggering of a fuse plug.

Under Strategy W4 the release rate is increased as the safety of the dam becomes the priority. Opening of the gates is to occur until the storage level of Wivenhoe Dam begins to fall.

If required, the minimum time interval between gate openings can be reduced or successive gate openings of the same gate may be used in this procedure as considered appropriate. In addition to dam safety issues, the impact of rapidly increasing discharge from Wivenhoe Dam on downstream reaches should be considered in determining these intervals

Strategy 4A – No Fuse Plug Initiation Expected

Lake level between 74.0 and 75.5 m AHD
[No Maximum Release]

Strategy 4A applies while all indications of the peak flood level in Wivenhoe Dam are that it will be insufficient to trigger operation of the first bay of the fuse plug by reaching EL 75.5.

Gate openings are to occur at the minimum intervals and sequences as specified in Section 8.4 until the storage level of Wivenhoe Dam begins to fall. Generally, this requires gates to be raised at a rate of one metre per ten minutes in the sequence of Gate 3, Gate 2, Gate 4, Gate 1, Gate 5. In these circumstances, to protect the safety of the dam, minimum opening intervals can be reduced and gate opening sequences can be modified.

Strategy 4B – Fuse Plug Initiation Possible

Lake level greater than 75.5 m AHD
[No Maximum Release]

Strategy 4B applies once indications are the peak flood level in Wivenhoe Dam may exceed EL75.5 and trigger the fuse plug under normal operations. Two scenarios are possible under this strategy. The first scenario is where it may be possible to prevent fuse plug initiation by early opening of the gates. The second scenario is where fuse plug initiation cannot be avoided. The actions associated with these scenarios are contained in the following table:

[redacted]

The effect of varying the operational procedures at Somerset Dam in keeping the peak flood level at Wivenhoe Dam below EL 75.7 may also be investigated using the real time flood model.

8.5 Gate Closing Strategies

In general, gate closing commences when the level in Wivenhoe Dam begins to fall and is generally to occur in the reverse order to opening. The final gate closure should occur when the lake level has returned to Full Supply Level. The following requirements must be considered when determining gate closure sequences:

- Unless determined otherwise by the Senior Flood Operations Engineer in accordance with Section 2.6, the aim should be to empty stored floodwaters stored above EL 67.5m within seven days after the flood peak has passed through the dams.

- The maximum discharge from the dam during closure should generally be less than the peak inflow into Wivenhoe Dam experienced during the event. The discharge from Wivenhoe Dam includes discharge from triggered fuse plugs, gates, regulator cone dispersion valve and hydro release.

- Where possible, total releases during closure should not produce greater flood levels downstream than occurred during the flood event.

- If, at the time the lake level in Wivenhoe Dam begins to fall, the combined flow at Lowood is in excess of 3500 m^3/s then the combined flow at Lowood is to be reduced to 3500 m^3/s as quickly as practicable.

- If the flood storage compartments of Wivenhoe Dam and Somerset Dam can be emptied within seven days, the maximum flow in the Brisbane River at Lowood should not exceed 3500 m^3/sec.

- To minimise the stranding of fish downstream of the dam, final closure sequences should consider Seqwater policies relating to fish protection at the dam.

There may be a need to take into account base flow when determining final gate closure. This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.

8.6 Gate Operation Sequences

Intervals Between Operations

Rapid opening of dam outlets (spillway gates and regulators) can cause hydraulic surges and other effects in the Brisbane River that could endanger life and property and may have other adverse effects. Additionally, rapid closure of outlets can affect river-bank stability Therefore, under normal operations during Flood Events, the gates and regulators are to be operated one at a time at intervals that will minimise adverse impacts on the river system as outlined in the table below. However it should be noted that these gate opening constraints are to be overridden if the gates will be overtopped during normal operation.

MINIMUM INTERVALS FOR NORMAL GATE OPERATIONS	
OPERATION	TIME INTERVAL BETWEEN SUCCESSIVE OPERATIONS (minutes)
Radial Gate opening of 500 millimetres.	10
Radial Gate closure of 500 millimetres.	20
Full regulator opening or closures	30

Rapid closure of more than one gate at a time should only be used when time is critical and there is a requirement to correct a malfunction to preserve storage or to reduce downstream flooding rapidly.

More rapid gate opening intervals are permitted at any time to protect the structural safety of the dam.

During the initial opening or final closure sequences of gate operations it is permissible to replace the discharge through a gate by the immediate opening of a regulator valve (or the reverse operation). This allows for greater control of low flows.

Protection of the Spillway Walls

The flip bucket spillway is designed to control the discharge from the reservoir and to dissipate the energy of the discharge. The flip throws the discharge clear of the concrete spillway structures and into a plunge pool where the energy is dissipated by turbulence. Under non-symmetric flow conditions or when Gates 1 and 5 are not operating, the discharge jet may impinge on the walls of the plunge pool. As these walls have been excavated into erodible sandstone rock, this impingement may cause non-predictable erosion. Upstream migration of this erosion is to be avoided. This can be achieved by operating Gates 1 and 5 to deflect the discharge away from the walls of the plunge pool.

Therefore in operating the spillway, the principles to be observed in order of priority are:

(i) The discharge jet into the plunge pool is not to impinge on the right or left walls of the plunge pool.

(ii) The flow in the spillway is to be symmetrical.

Normal Gate Operation Sequences

Under normal operation, only one gate is to be opened at any one time and the sequences shown in the table below are to be adopted. Variations are allowed at any time to protect the structural safety of the dam.

RADIAL GATE OPENING SEQUENCES[1]

[redacted]

1 Gates are numbered 1 to 5 from the left bank looking downstream.
2 Gate movements are to normally occur in 500 mm increments.
3 When the accelerated opening rate applies, gate opening increments of 1.0 metres may be used.

Gate Failure or Malfunction Procedures

Gate operating procedures in the event of equipment failure are contained in Appendix G. If one or more gates are inoperable during the course of the flood event, the gate openings of the remaining gates are to be adjusted to compensate. These adjustments should ensure that:

- The impact of the flow on the sidewalls of the plunge pool should be minimised, and
- The flow in the spillway is as symmetrical as practicable.

Radial Gate Turbulence Considerations

Unless in the process of lifting the gates clear of the flow, the bottom edge of the radial gates must always be at least 500 millimetres below the release flow surface. Having the bottom edge of the gates closer to the release flow surface than 500 millimetres may cause unusual turbulence that could adversely impact on the gates. This procedure has never been undertaken in practice and should be observed closely when being undertaken. Variations to the procedure are allowed to protect the structural safety of the dam.

Lowering Radial Gates that have been lifted Clear of the Release Flow

When lowering radial gates that have been lifted clear of the release flow, the bottom edge of the gates must be lowered at least 500 millimetres into the flow. Lowering gates into the release flow less than this amount may cause unusual turbulence that could adversely impact on the gates. This procedure has never been undertaken in practice and should be observed closely when being undertaken. Variations to the procedure are allowed to protect the structural safety of the dam.

8.7 Modification to Flood Operating Procedures if a Fuse Plug Triggers

Where the operation of a fuse plug spillway bay has been triggered, the flood operation procedures are to be modified such that:

- The discharge from the triggered fuse plug is to be taken into account when determining total flood releases from the dam;
- The gates are to be operated, to the extent possible, so that the same discharge restrictions apply as would have if the fuse plug embankment was intact.

8.8 Modification to Flood Operating Procedures if a subsequent flood event occurs prior to the reconstruction of Triggered Fuse Plugs

Where the operation of any or all of the fuse plug spillway bays has been triggered and a flood event occurs before the fuse plug can be reinstated, the flood operation procedures are to be modified such that:

- The discharge from the triggered fuse plug is to be taken into account when determining total flood releases from the dam;

- The gates are to be operated, to the extent possible, so that the same discharge restrictions apply as would have if the fuse plug embankment was intact.

- Discharge from the Auxiliary Spillway will occur before the Gate Trigger Level of EL 67.25 m AHD. This flow should be taken into account when applying the flood operation strategies relevant to the low level bridge crossings.

9 SOMERSET DAM OPERATIONAL PROCEDURES

9.1 Introduction

Somerset Dam is capable of being operated in a number of ways to regulate Stanley River floods. Somerset Dam and Wivenhoe Dam are to be operated in conjunction to optimise the flood mitigation benefits downstream of Wivenhoe Dam. The arrangement of the Somerset Dam Radial Gates, Sluice Gates and Regulator Valves is shown in the diagram below:

9.2 Initial Flood Control Action

Once a Flood Event is declared, all radial gates are to be fully opened and all sluice gates and regulator valves are to be fully closed. An assessment is to be made of the magnitude of the Flood Event, including a prediction of the maximum storage levels in Wivenhoe and Somerset Dams.

9.3 Flood Operations Strategies

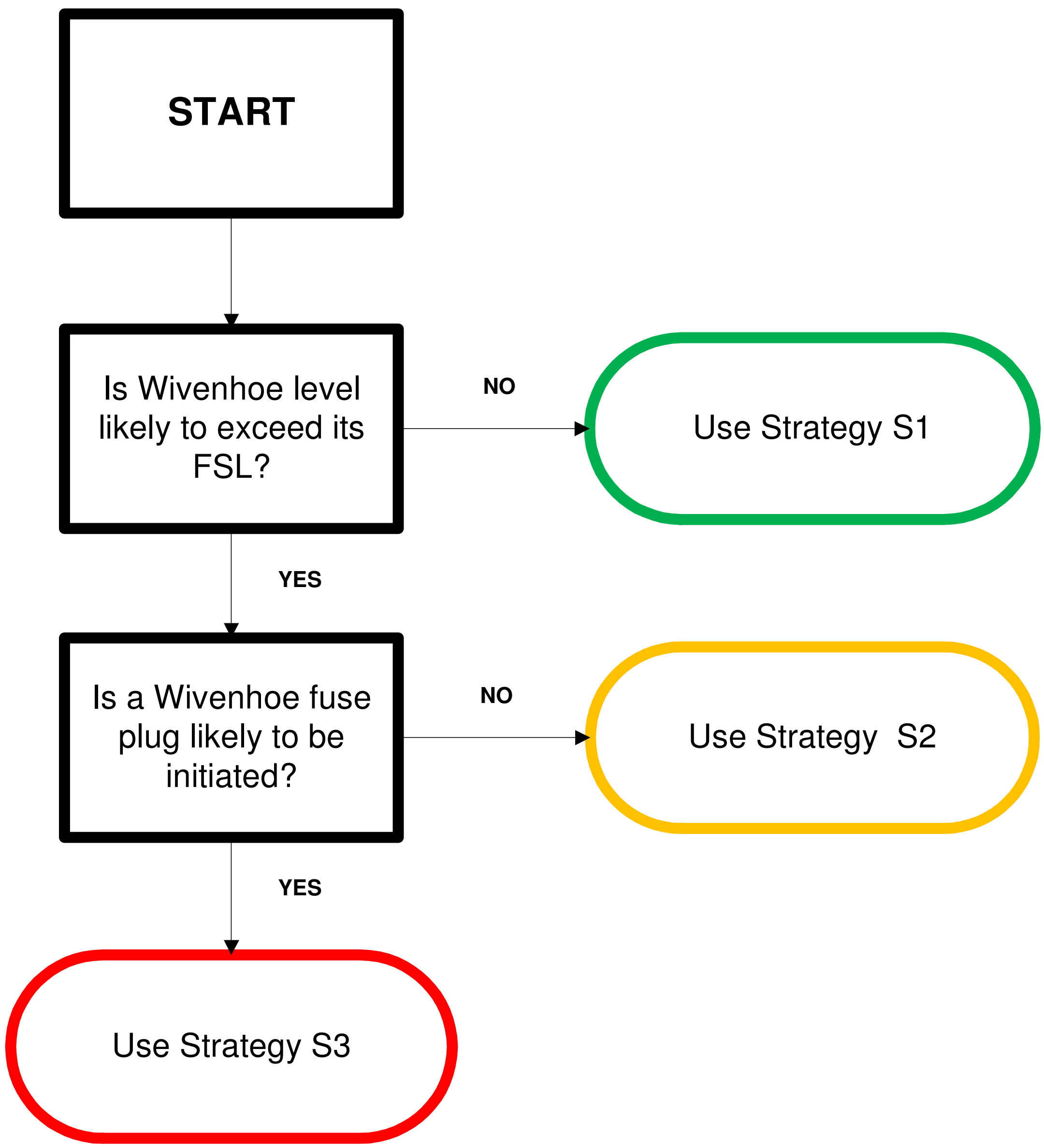
There are three strategies used when operating Somerset Dam during a flood event as outlined below. These strategies are based on the Flood Objectives of this manual. The strategy chosen at any point in time will depend on predictions of the maximum storage levels in Wivenhoe and Somerset Dams which are to be made using the best forecast rainfall and streamflow information available at the time.

Strategies are likely to change during a flood event as forecasts change and rain is received in the catchments. It is not possible to predict the range of strategies that will be used during the course of a flood event at the commencement of the event. Strategies are changed in response to changing rainfall forecasts and streamflow conditions to maximise the flood mitigation benefits of the dams.

When calculating the impacts of flood releases from Somerset Dam, the gate opening sequences outlined in Section 9.5 should be used to determine likely outflow rates from the dam.

A flowchart showing how best to select the appropriate strategy to use at any point in time is shown below:

SOMERSET FLOOD STRATEGY FLOW CHART



Strategy S1 – Minimising Impact on Rural Life Upstream

Conditions	• **Somerset Dam Level expected to exceed EL 99.0 and Wivenhoe Dam not expected to reach EL 67.0 (FSL) during the course of the Flood Event.**

The intent of this strategy is to return the dam to full supply level while minimising the impact on rural life upstream of the dam. Consideration is also given to minimising the downstream environmental impacts from the release.

The crest gates at Somerset Dam are raised to enable uncontrolled discharge. The Regulator Valves and Sluice gates are to be used to maintain the level in Somerset dam below EL 102.0 (deck level of Mary Smokes Bridge). The release rate from Somerset dam is not to exceed the peak inflow into the dam.

Strategy S2 – Minimise Impacts Below Wivenhoe Dam

Conditions	• **Somerset Dam Level expected to exceed EL 99.0 and Wivenhoe Dam level expected to exceed EL 67.0 (FSL) but not exceed EL 75.5 (fuse plug initiation) during the course of the Flood Event.**

The intent of this strategy is to maximise the benefits of the flood storage capabilities of the dam while protecting the structural safety of both dams. The table below contains the operating conditions and actions for Strategy S2.

CONDITION	**ACTION**
Wivenhoe rising and Somerset level below EL 102.25.	The crest gates are raised to enable uncontrolled discharge. The low level regulators and sluices are generally kept closed.
Wivenhoe rising and Somerset level above EL 102.25.	The crest gates are raised to enable uncontrolled discharge. Operations are to target a correlation of water levels in Somerset Dam and Wivenhoe Dam as set out in the graph below. The operations target line shown on this graph is to generally be followed as the flood event progresses. The release rate from Somerset Dam is generally not to exceed the peak inflow into the dam.

Wivenhoe falling and Somerset level above EL 102.25.	The opening of the regulators and sluices generally should not cause Wivenhoe Dam to rise significantly. The release rate from Somerset Dam is generally not to exceed the peak inflow into the dam.
The Flood Event has emanated mainly from the Stanley River catchment without significant runoff in the Upper Brisbane River catchment	The crest gates at Somerset Dam are raised to enable uncontrolled discharge. The Regulator Valves and Sluice gates are to be used to maintain the level in Somerset dam below EL 102.0 (deck level of Mary Smokes Bridge). The release rate from Somerset Dam is generally not to exceed the peak inflow into the dam.

[redacted]

Notes:

- The target point on the operating target line at any point in time is based on the maximum storage levels in Wivenhoe and Somerset Dams using the best forecast rainfall and streamflow information available at the time.

- Gate operations will enable the movement of the duty point towards the target line in a progressive manner. It will not necessarily be possible to adjust the duty point directly towards the target line in a single gate operation.

Strategy S3 - Protect the Structural Safety of the Dam.

Conditions	• **Somerset Dam Level expected to exceed EL 99.0 and Wivenhoe Dam level expected to exceed EL 75.5 (fuse plug initiation) during the course of the Flood Event.**

The intent of this strategy is to maximise the benefits of the flood storage capabilities of the dam while protecting the structural safety of both dams.

In addition to the operating protocols used in Strategy S2, to prevent fuse plug initiation, consideration can be given to temporary departure from the operating protocols contained in this strategy under the following conditions:

- The safety of Somerset Dam is the primary consideration and cannot be compromised.
- The peak level in Somerset dam cannot exceed EL 107.5.

9.4 Gate Closing Strategies

In general, gate closing commences when the level in Somerset Dam begins to fall and is generally to occur in the reverse order to opening. The final gate closure should occur when the lake level has returned to Full Supply Level. The following requirements must be considered when determining gate closure sequences:

- Unless determined otherwise by the Senior Flood Operations Engineer in accordance with Section 2.6, the aim should be to empty stored floodwaters within seven days after the flood peak has passed through the dams.

- To minimise the stranding of fish downstream of the dam, final closure sequences should consider Seqwater policies relating to fish protection at the dam.

There may be a need to take into account base flow when determining final gate closure. This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.

9.5 Gate Operation Sequences

Intervals Between Operations

The following minimum intervals must generally be observed whilst opening and closing regulators, sluices and crest gates at Somerset Dam for flood mitigation purposes.

MINIMUM INTERVALS FOR NORMAL GATE OPERATIONS		
DAM COMPONENT	OPENING	CLOSING
Regulator Valves	30 minutes	60 minutes
Sluice Gates (Dam level < EL 102.25)	120 minutes	180 minutes
Sluice Gates (Dam level > EL 102.25)	60 minutes	60 minutes
Crest Gates	Gates are normally open	-

Regulator Valve Considerations

During the initial opening or final closure sequences of gate operations it is permissible to replace the discharge through a sluice gate by the immediate opening of one or more regulator valves (or the reverse operation). This allows for greater control of low flows and enables a smooth transition on opening and closing sequences.

It must also be noted that the Regulator Valves are not to be operated when the tail water level below Somerset Dam is above the invert of the valves. Operating the valves under these circumstances can damage the valves. This requirement can be ignored if the structural safety of the dam is at risk.

10 EMERGENCY FLOOD OPERATIONS

10.1 Introduction

While every care has been exercised in the design and construction of the dams, there still remains a low risk that the dams may develop an emergency condition either through flood events or other causes. Vigilance is required to recognise emergency flood conditions such as:

- Occurrence of a much larger flood than the discharge capacity of the dam;
- Occurrence of a series of large storms in a short period;
- Failure of one or more gates during a flood.
- Development of a piping failure through the embankment of Wivenhoe Dam;
- Damage to the dams by earthquake;
- Damage to the dams as an act of war or terrorism;

Responses to these conditions are included in Emergency Action Plans for the dams.

10.2 Overtopping of Dams

Whatever the circumstances, every endeavour must be made to prevent overtopping of Wivenhoe Dam by the progressive opening of operative spillway gates. The Auxiliary Spillway constructed at the dam in 2005 gives the dam crest flood an annual exceedance probability (AEP) of approximately 1 in 100,000. Another one bay fuse plug spillway may be constructed at Saddle Dam two in the future, thereby increasing this immunity.

Somerset Dam should not be overtopped by flood water, but if Wivenhoe Dam is threatened by overtopping, the release of water from Somerset Dam is to be reduced at the risk of overtopping Somerset Dam in order to prevent the overtopping of Wivenhoe Dam.

10.3 Communications Failure

If communications are lost between the Flood Operations Centre and either dam, the officers in charge at each dam are to adopt the procedures set out below.

Wivenhoe Dam Emergency Procedure

In the event of communications loss with the Flood Operations Centre, the officer in charge at Wivenhoe Dam is to assume responsibility for flood releases from the Dam. Once it has been established that communications have been lost, the officer in charge at Wivenhoe Dam is to:-

- Take all practicable measures to restore communications and periodically check the lines of communication for any change;
- Follow the procedures set out below to determine the relevant magnitude and duration of releases from Somerset Dam;
- Log all actions in the Event Log;
- Ensure the dam is at full supply level at the end of the event;

- Remain in the general vicinity of the dam while on duty.

Minimum Gate openings are to be as set in the following table:

[redacted]

[redacted]

The minimum intervals between the opening and closing of the radial gates are shown in the table below. This requirement can be ignored to achieve the minimum openings in the table above when the dam level is greater than EL 74.0 or to protect the structural safety of the dam.

ITEM	MINIMUM OPENING INTERVAL	MINIMUM CLOSING INTERVAL
Radial Gates Dam Level < EL 74.0	10 minutes	20 minutes
Radial Gates Dam Level > EL 74.0	No Minimum	No Minimum

In the event of a gate becoming jammed shut the remaining gates are to be operated to provide the required release. In the event of one or more gates becoming jammed in the partially or fully open position, the remaining gates are to be operated to provide the remaining required release. The gate rating table shown below along with the discharges contained in the tables above are to be used in these calculations.

The bulkhead gate is not to be used without the specific direction of the Duty Engineer. Under loss of communication circumstances, it is only to be used to prevent a situation occurring which could endanger the safety of the dam.

At the end of the event, the full supply level of the storage is to be achieved.

Somerset Dam Emergency Procedure

In the event of communications loss with the Flood Operations Centre, the officer in charge at Somerset Dam is to assume responsibility for flood releases from the Dam. Once it has been established that communications have been lost, the officer in charge at Somerset Dam is to:-

- Take all practicable measures to restore communications and periodically check the lines of communication for any change;
- Follow the procedures set out below to determine the relevant magnitude and duration of releases from Somerset Dam;
- Log all actions in the Event Log;
- Ensure the dam is at full supply level at the end of the event;
- Remain in the general vicinity of the dam while on duty.

The actions to be undertaken are:

- The radial gates are to be kept raised to allow uncontrolled discharge.
- The regulators are not to be used if the tail water level exceeds EL 68.60 and are generally kept closed. The only exception to this is if the regulators are used to prevent overtopping of the dam.
- The sluice gates are also to be kept closed until either:
    - **Case 1 -** the level in Somerset Dam is below EL 102.25 **and** the level in Wivenhoe Dam is below EL 71.75 and falling at a rate greater than 10 millimetres per hour; or
    - **Case 2 -** the level in Somerset Dam is above EL 102.25.

Case 1 Procedure (the level in Somerset Dam is below EL 102.25 and the level in Wivenhoe Dam is below EL 71.75 and falling at a rate greater than 10 millimetres per hour)

If communications with Wivenhoe Dam are lost, the level in Wivenhoe Dam is to be assumed as the level shown on gauge boards located downstream of Somerset Dam.

The opening of sluice gates is allowed, provided such opening does not cause the water level in Wivenhoe Dam to rise significantly. The timing of sluice gate movements is to be in accordance with the following table.

LOSS OF COMMUNICATIONS CASE 1 PROCEDURE - TIMING GATE MOVEMENTS		
GATE	**OPENING INTERVAL**	**CLOSING INTERVAL**
Regulators	Generally kept closed	Generally kept closed
Sluice Gate	120 minutes	180 minutes
Radial Gate	Gates to remain open	Gates to remain open

At the end of the event, Sluice Gates are to be closed in accordance with the following table to achieve FSL.

LOSS OF COMMUNICATIONS CASE 1 PROCEDURE – SLUICE GATE CLOSURE LEVELS	
NUMBER OF SLUICE GATES OPEN	**LEVEL AT WHICH A SLUICE GATE IS TO BE CLOSED**
1	EL 99.00
2	EL 99.05
3	EL 99.15
4	EL 99.31
5	EL 99.51
6	EL 99.75
7	EL 100.04
8	EL 100.37

<u>Case 2 Procedure (the level in Somerset Dam is above EL 102.25)</u>

If communications with Wivenhoe Dam are lost, the level in Wivenhoe Dam is to be assumed as the level shown on the gauge boards located downstream of Somerset Dam.

The sluices gates are to be operated in accordance with the following graph:

[redacted]

Sluices are progressively closed at one hour intervals if operating above the Operating Target Line and progressively opened at one hour intervals if operating below the Operating Target Line. The aim is always to follow the Operating Target Line as closely as possible.

10.4 Equipment Failure

In the event of equipment failure the action to be taken is indicated in Appendix E for Wivenhoe Dam and Appendix F for Somerset Dam.

APPENDIX A
AGENCIES HOLDING CONTROLLED COPIES OF THIS MANUAL

Agency	Responsible Person within Agency	Location
Seqwater	Dam Safety and Source Operations Manager	Brisbane
Seqwater	Principal Engineer Dam Safety	Ipswich
Seqwater	Storage Supervisor	Wivenhoe Dam
Seqwater	Storage Supervisor	Somerset Dam
Seqwater	Operations Coordinator	Central
Seqwater	Senior Flood Operations Engineer	Flood Operations Centre, Brisbane
NRW	Director Dam Safety	Brisbane
Department of Emergency Services	Duty Officer – Disaster Management Service	Brisbane
Somerset Regional Council	Local Disaster Response Coordinator	Esk
Ipswich City Council	Local Disaster Response Coordinator	Ipswich
Brisbane City Council	Local Disaster Response Coordinator	Brisbane
Emergency Management Queensland	Regional Director, Brisbane District	Brisbane

APPENDIX B
KEY REFERENCE GAUGES

<table>
<tr><th colspan="9">KEY REFERENCE GAUGES</th></tr>
<tr><th rowspan="3">Location</th><th rowspan="3">GZ</th><th rowspan="3">1974 Gauge Height</th><th colspan="2">Minor Flood</th><th colspan="2">Moderate Flood</th><th colspan="2">Major Flood</th></tr>
<tr><th>Gauge Height</th><th>Flow</th><th>Gauge Height</th><th>Flow</th><th>Gauge Height</th><th>Flow</th></tr>
<tr><th>m</th><th>m^3/s</th><th>m</th><th>m^3/s</th><th>m</th><th>m^3/s</th></tr>
<tr><td>Stanley River at Somerset Dam</td><td>0.00 AHD</td><td>-</td><td>103.0</td><td></td><td>105.0</td><td></td><td>106.0</td><td></td></tr>
<tr><td>Brisbane River at Lowood</td><td>23.68 AHD</td><td>22.02</td><td>8.0</td><td rowspan="4">1000</td><td>15.0</td><td rowspan="4">3300</td><td>20.0</td><td rowspan="4">6000</td></tr>
<tr><td>Brisbane River at Lowood</td><td>22.74 SD</td><td>-</td><td>8.6</td><td>15.9</td><td>21.2</td></tr>
<tr><td>Brisbane River at Savages Crossing</td><td>18.43 AHD</td><td>23.79</td><td>9.0</td><td>16.0</td><td>21.0</td></tr>
<tr><td>Brisbane River at Mt Crosby</td><td>0.00 AHD</td><td>26.74</td><td>11.0</td><td>13.0</td><td>21.0</td></tr>
<tr><td>Bremer River at Ipswich</td><td>0.00 AHD</td><td>20.70</td><td>7.0</td><td></td><td>9.0</td><td></td><td>11.7</td><td></td></tr>
<tr><td>Brisbane River at Moggill</td><td>0.00 AHD</td><td>19.95</td><td>10.0</td><td rowspan="3">4000</td><td>13.0</td><td rowspan="3">5000</td><td>15.5</td><td rowspan="3">6500</td></tr>
<tr><td>Brisbane River at Jindalee Bridge</td><td>0.00 AHD</td><td>14.10</td><td>6.0</td><td>8.0</td><td>10.0</td></tr>
<tr><td>Brisbane River at City Gauge</td><td>0.00 AHD</td><td>5.45</td><td>1.7</td><td>2.6</td><td>3.5</td></tr>
</table>

Flows are approximate only and gauge heights are tide dependent in the lower reaches.

APPENDIX C
WIVENHOE DAM TECHNICAL DATA

[redacted]

* This is the maximum discharge of an individual spillway bay or regulator. Total discharge is calculated by adding the contributions of each gate or regulator. There are two (2) regulators to five (5) spillway bays.

** This assumes that all gates and sluices are closed. Discharges through the spillway have to be added to the above figures to calculate the actual inflow into the reservoir.

*** The temporary storage above normal Full Supply Level of EL 67.0.

**** The first fuse plug is designed to trigger at EL75.7. Above this level, fuse plug flows from Table E.3 need to be added to give the full outflow.

CONTROLLED GATE DISCHARGES

[redacted]

CONTROLLED GATE DISCHARGES (CONTINUED)

[redacted]

[redacted]

APPENDIX D
SOMERSET DAM TECHNICAL DATA

[redacted]

* This is the maximum discharge of an individual gate or regulator. Total discharge is calculated by adding the contributions of each gate or regulator.

APPENDIX E
WIVENHOE DAM GATE OPERATION CONSIDERATIONS

SPILLWAY OPERATION PRINCIPLES

The radial gates are sequentially numbered from 1 to 5 from left to right looking in the downstream direction. Plans of the dam and spillway are contained in Appendix H.

The flip bucket spillway is designed to control the discharge from the reservoir and to dissipate the energy of the discharge. The flip throws the discharge clear of the concrete structures into a plunge pool where the energy is dissipated by turbulence. Under non-symmetric flow conditions, or when gates 1 and 5 are not operating, the discharge jet may impinge on the walls of the plunge pool, which has been excavated into erodible sandstone rock, and cause non-predictable erosion. Upstream migration of this erosion is to be avoided. The wing walls adjacent to the flip bucket deflect the discharge away from the walls of the plunge pool when gates 1 and 5 are operated.

Therefore in operating the spillway, the principles to be observed are, in order of priority:

(i) The discharge jet into the plunge pool is not to impinge on the right or left walls of the plunge pool.

(ii) The flow in the spillway is to be generally symmetrical.

The main purpose of gating the spillway is to exercise maximum possible control over the flow in the Brisbane River insofar as river flows in excess of 4 000 m^3/sec cause damage to urban areas downstream. The gates also allow the routing of much larger floods with substantial flood mitigation being achieved.

RADIAL GATE OPERATION PRINCIPLES

Each radial gate consists of a cylindrical upstream skin-plate segment that is attached to the radial arms. The cylindrical axis is horizontal. Each gate rotates about two spherical trunnion bearings that are on this axis.

The position of the gate is controlled by hydraulically driven winches that are located on the piers beside the gates. Wire ropes are attached to the downstream face of the skin plate through a pulley system. The hydraulic motors work off a common pressure manifold and under perfectly matched conditions, will give an equal lifting force to each side of the gate. This system does not sense rope travel and will take up slack rope. It cannot prevent or correct skewing of the skin plate segment between the piers. If skewing occurs, skids will come into contact with the side seal plates to limit movement.

It is not possible to operate a winch independently of the other winch attached to the gate.

When the hydraulic motors are not energised, the gates are held in position by spring loaded friction brakes on the winches. There are two brake bands per winch and each band is capable of supporting half the weight of the gate. One winch can support the total weight of a gate on both its brake bands but not on one.

While the radial gates have been designed to withstand overtopping, it should be avoided if possible. The reservoir levels and the structural state of the radial gates when in the closed position are as follows:

Reservoir Level m AHD	**Radial Gate Stress Condition with Gate Closed**
73	Normal
77	33% Overstress
79	Critical

Once overtopped, the gates become inoperable when the lifting tackle is fouled by debris from the overflow. The gates remain structurally secure until the reservoir level exceeds EL 77. The ability to control floods however may be lost.

FREE FALL OF THE RADIAL GATES

Under no circumstances are the radial gates allowed to free fall. The lower skin plate sections are overstressed if a freefall of 60 mm is arrested by the seal plate on the spillway.

If a gate becomes stuck in an open position, attempts are to be made to free the gate by applying positive lifting forces. Under no circumstances are the winches to be unloaded and the direct weight of the gates used to yield the obstruction.

OPERATION IN HIGH WIND

Other than in periods of mitigation of medium and major floods, the gates are not to be raised or lowered when clear of water, during periods of high winds. The gates can however, be held on the brakes in any position in the presence of high wind.

The term "high wind" means any wind that causes twisting or movement of the gate. While a precise figure cannot be placed on these velocities, further experience over time may allow a figure to be determined.

This limitation is required to prevent the gate from twisting from skew on one side to skew on the other side. While the gate is being raised or lowered, skewing cannot be prevented by the hydraulic lifting system and any impact forces encountered may damage the gate.

MAINTENANCE CONSIDERATIONS

No more than one gate is to be inoperable at any one time for maintenance. The maintenance is to be scheduled so that the spillway bay can be cleared of obstructions in a reasonable time to allow its use in the event of major flooding.

BULKHEAD GATE OPERATING LIMITATIONS

The bulkhead gate can be used to control discharge in an emergency situation where a radial gate is inoperable. It is transported to, and lowered upstream of the inoperable radial gate by means of the gantry crane. The following conditions apply:

(a) The bulkhead gate can always be lowered with any type of underflow; and

(b) It is not possible to raise the bulkhead gate once it has been lowered past certain levels depending on upstream conditions without there being a pool of water between it and the radial gate.

It is thus possible to preserve storage by effectively closing the spillway even with one radial gate inoperable. It will not be possible to raise the bulkhead gate until the radial gate behind has been repaired and is again storing water between the bulkhead gate and itself.

The bulkhead gate is not to be used for flood regulation until the reservoir level is falling and not likely to rise within the period needed to repair the inoperable radial gate.

The spillway gantry crane is to be used to raise and lower the bulkhead gate. The crane operates at two speeds, 1.5 and 3.0 m/min. When within the bulkhead gate guides, the bulkhead gate is to be moved only at 1.5 m/min.

BULKHEAD GATE OVERTOPPING

In the event that the bulkhead gate is overtopped (reservoir level exceeds EL 69 when bulkhead gate is closed), it cannot be removed unless a pool of water fills the space between it and the radial gate behind. The closed bulkhead becomes critically stressed when the reservoir level overtops it to EL 71.4.

It is not possible to engage the lifting tackle while overtopping is occurring. While there is any risk that the bulkhead gate may be overtopped, the lifting gear is to be left engaged so that the gate can be raised once the downstream radial gate becomes operable.

BULKHEAD GATE DISCHARGE REGULATION

This procedure should only be used if the safety of the dam is at direct risk.

In the event that a radial gate is inoperable in a partially open position, the bulkhead gate can be used for flow regulation provided that the lower lip of the radial gate is clear of the underflow jet.

Where a pool exists between the bulkhead gate and a radial gate under flow conditions, the bulkhead gate will be subjected to additional pull-down and possibly subjected to vortex-induced vibrations. When this condition occurs, the bulkhead gate is to be lowered to dewater the pool. The bulkhead gate can then be adjusted to regulate the flow provided the underflow jet remains below the lower lip of the radial gate.

INOPERABLE RADIAL GATES

In the event of a major flood, where the full discharge capacity of the four operable radial gates is required, these gates are to be used to their full capacity to protect the embankment from overtopping. Under certain abnormal conditions, it may not be possible to operate one gate. The following guidelines are to be adopted.

(a) Gate 3 Inoperable

Gates 2 and 4 are to be used to regulate flood discharges, until the discharge impinges on the walls of the plunge pool. Gates 1 and 5 are then to be opened sufficiently to deflect the discharge into the plunge pool.

The bottoms of gates 1 and 5 are to be maintained at or below those of gates 2 and 4 respectively.

(b) Either Gate 2 or 4 Inoperable

Normal gate operating procedures are to be adopted, except that only the operable gate 2 or 4 is available for flood regulation beyond 500 m^3/sec and not both.

(c) Either Gate 1 or 5 Inoperable

Normal gate operating procedures are to be adopted until the discharge impinges on the walls of the plunge pool. Thereafter the operable gate 1 or 5 is to be used in lieu of using the radial gate adjacent to the inoperable gate. The other radial gates are to be used in the normal way to control discharge.

EQUIPMENT MALFUNCTION

Normal gate operation is by means of two electric hydraulic pumps supplied by external mains supply electric power, with pump number 1 connected to gates 1 and 2 and the penstock gate, while pump number 2 is connected to gates 3, 4 and 5.

Normal gate operation may not be possible in the event of equipment malfunctions during the passing of a flood. The procedures to be followed under various possible events are outlined below.

Failure of External Electric Power

A diesel electric generator is used to provide a power supply. The generator supplies sufficient power to operate the gates normally.

Failure of One Electric Hydraulic Pump

In the event that one electric hydraulic pump fails, the connecting valves between pumps are to be switched such that both sets of hydraulic lines are connected to the operable pump, thus permitting operation of all 5 gates, one gate at a time.

Failure of Two Electric Hydraulic Pumps

In the event that both electric hydraulic pumps fail, either the mobile or fixed emergency diesel hydraulic pump is to be used to operate the gates, one gate at a time.

Rupture of Hydraulic Lines

Depending on location and severity, a hydraulic line rupture may cause a radial gate to become inoperable. Accordingly any ruptures to the hydraulic lines are to be repaired as soon as practical. Depending on the location of the rupture, it may be possible to use the mobile emergency diesel hydraulic pump to operate the impacted gate.

Contamination of Winch Brakes

Oil contamination of the winch brakes will reduce their holding capacity and possibly allow the gate to fall. The brake bands are to be inspected regularly and cleaned immediately if any contamination is observed.

Fouling of Radial Gate Lifting Tackle

The lifting tackle consists of blocks, wire ropes and winch drums. If the gate is overtopped, debris may be collected on the wire ropes that may in turn foul the blocks or the winch drums. This may result in jamming of the wire rope or in uneven lifting, both of which may cause the gate to jam.

Fouling of Side Skids

The side skids have been designed to limit the side-sway and skew of the radial gates during operation. Under ideal conditions, the skids should not be in contact with the side seal plates.

If the winches are lifting the gates unevenly or in a skewed position, the lifting gear should be adjusted if possible.

APPENDIX F
SOMERSET DAM AUXILIARY EQUIPMENT

DISCHARGE REGULATION

The normal operating procedure for Somerset Dam in the event of a flood requires the spillway gates to be raised to provide an uncontrolled spillway followed by opening of the low level outlets some time later. Plans of the dam and spillway are contained in Appendix I.

EMERGENCY POWER SUPPLY

In the event of a power failure at Somerset Dam, both a fixed and a mobile diesel generator are available to operate the regulators, sluice gates and radial gates. The fixed generator can also power the crane. A mobile auxiliary generator is also available for emergency operation of the regulators and gates.

FAILURE OF SPILLWAY GATES MACHINERY

If a spillway gate cannot be raised due to failure of the lifting machinery, the gantry crane may be attached to the gate and the gate can be raised using the gantry crane.

FAILURE OF SLUICE GATE MACHINERY

In the event of a sluice gate being jammed in the open position or the lifting machinery failing, the coaster gate at the dam can be lowered over the inlet to the sluice to preserve the water supply storage.

APPENDIX G
HYDROLOGIC INVESTIGATIONS

The design hydrology for the Manual is based on the Hydrology Review for the dams undertaken in September 2005 in conjunction with the flood discharge capacity upgrade of Wivenhoe Dam. This work was undertaken by the Wivenhoe Alliance, the group responsible for undertaking the upgrade work.

Floods in the Brisbane River catchment above Wivenhoe Dam can originate in either the Stanley River or upper Brisbane River catchment or both. Both of the dams are capable of being operated in a number of ways, each of which will reduce the flow downstream. Indicative inflows for the dams for 48 hour storm events (the critical duration for Wivenhoe Dam) are shown in the graph below. Full results containing inflows for a range of storm events and durations are contained in the Alliance reports.

[redacted]

APPENDIX H
WIVENHOE DAM
PLANS, MAPS AND PHOTOGRAPHS

[redacted]