DSC2G

June 2010
(updated August 2015)

EMERGENCY MANAGEMENT FOR DAMS

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1. INTRODUCTION

The *normal requirements* of the NSW Dams Safety Committee (DSC) are set out in its guidance sheets with its principal guidance sheet, *DSC Background, Functions and Operations (DSC1A),* outlining the DSC's general operations and authority.

The NSW Dams Safety Committee (DSC) considers that a vital part of a dam owner's dam safety management program is the provision of effective emergency management plans for a dam to maximise the continued viability and safety of the dam and minimise consequences in the unlikely event of its failure. Dam owners, and their professional advisers, have full responsibility to determine, and put in place appropriate emergency management actions to ensure the ongoing safety of their dams. The purpose of this guidance sheet is to provide the owners of prescribed, or proposed, dams with general advice on good dam emergency management practice, along with specific advice on their responsibilities and the requirements of the DSC in this area.

The DSC Emergency Management Goal and Key Requirements (Section 2) at the start of the sheet are a summary - the whole sheet is to be read for a proper understanding of DSC considerations on emergency management for dams.

2. DSC EMERGENCY MANAGEMENT GOAL & KEY REQUIREMENTS

2.1 DSC Emergency Management Goal

The goal of the DSC for prescribed dams is to ensure that dam owners apply appropriate standards and planning for emergency management in order to achieve and/or maintain tolerable risks to community interests.

It is for the dam owner to determine how the goal will be achieved and to demonstrate to the DSC that the goal is achieved or will be achieved following appropriate action(s). The following sections of this sheet aim to provide guidance and direction to assist the owner in the achievement of the DSC's goal.

2.2 DSC Key Requirements

This highlighted section summarises the DSC requirements outlined in this sheet (under relevant section headings).

3. BACKGROUND

Dam owners should comply with the ANCOLD *Guidelines on Dam Safety Management*.

4. DAM SAFETY EMERGENCY PLANS

The DSC requires a quality controlled DSEP to be prepared for prescribed dams where persons may be at risk downstream if the dam failed. Dam owners must consult the SES State Headquarters during the preparation of draft DSEPs (see Figure 1 for process and Appendix B for helpful checklist to be completed and submitted with each DSEP).

A "Summary Information Sheet for Emergency Agencies" is to be included in conjunction with the emergency Notification Flowchart in each DSEP (refer Section 6 and Appendix A).

Table 1 briefly outlines some defining conditions and likely SES responses for each dam failure alert level (ie white, amber or red).

DSEP distribution arrangements are set out in Section 4.3.

DSEPs are to include provisions for prompt notification to the DSC's Executive Engineer of any actual or potential emergency which may have implications for dam safety.

Owners of Extreme and High Consequence Category dams (excluding retarding basins) are to have in place automatic telemetered monitoring of the storage level in their dams (and preferably rainfall and seepage as well). Owners of Extreme and High Consequence Category retarding basins are to have in place automatic telemetered monitoring of rainfall at a location near the basin in lieu of, or in addition to, monitoring of basin storage level.

The DSC also requires the owners of remotely located Extreme and High Consequence Category embankment dams to consider the practicalities of installing telemetered tailwater/seepage monitoring devices to maximise warning times of potential piping incidents at these dams. The installation of these devices is mandatory for all new Extreme and High Consequence Category embankment dams.

The DSC requires DSEPs to be updated annually, and to be reviewed and tested at least every 5 years.

6. EMERGENCY MANAGEMENT CONTACT PROCEDURES

The SES, DSC and the NSW State Emergency Operations Controller (SEOCON) have agreed to a protocol to assist owners and operators of prescribed dams when determining the emergency management contact procedures for inclusion in a DSEP. The SES 24-hour contact number is to be stressed (contact the SES State Headquarters to obtain the appropriate emergency contact number). The arrangements are in the generic flow chart, and notes on its use, in Appendix A to this sheet.

7. DAMBREAK STUDIES

The DSC requires that dambreak studies, using appropriate methods and parameters, are arranged by prescribed dam owners for any existing or proposed prescribed dam where loss of life, or other significant threat to the community's interests could result from dam failure. This dambreak information is to be provided to the SES State Headquarters to assist with emergency planning.

8.0 RECORDS TO BE KEPT BY DAM OWNERS

The DSC requires that dam owners maintain appropriate records of their emergency planning for their dams.

3. BACKGROUND

The DSC has statutory functions to ensure that all prescribed dams do not impose an intolerable level of danger to the community's interests. In regard to proper dam emergency management practices, the DSC produced its Information Sheet DSC12 in 2001 giving guidance and direction to prescribed dam owners in this area.

However, there have been significant changes to emergency management approaches and practices in recent years and the DSC has produced this guidance sheet to supersede DSC12. It has been prepared to outline and clarify the procedures and processes the DSC considers necessary to ensure proper emergency management planning is in place for NSW dams. In this regard, the DSC has had significant input to, and has adopted in principle, the 2003 Australian National Committee on Large Dam's (ANCOLD) '*Guidelines on Dam Safety Management*' as its requirements for dam owners. Consequently, it is the DSC's policy that dam owners should normally comply with these ANCOLD guidelines unless otherwise indicated in this or other guidance sheets.

4. DAM SAFETY EMERGENCY PLANS

4.1 Introduction

Dam Safety Emergency Plans (DSEPs) outline the required procedures to:

- Protect a dam in the event of an emergency which may threaten its security;
- Notify the State Emergency Service (SES) during potential dam failure emergencies; and
- Provide relevant information to assist the SES in its emergency planning for areas affected by dam flooding.

A DSEP outlines the required actions of owners and their personnel at dams in response to a range of possible emergency situations. The DSC considers that trained and experienced dam operators are a valuable "dam safety" resource, particularly in emergencies, and their value is enhanced when they are readily available to attend the dam site for emergency actions. The DSEP, and on-call trained staff, have particular importance for those dams with controlled spillways (i.e. gates, fuseplugs). Accordingly, owners of significant, and higher consequence category, dams should carefully consider the appropriateness of their staffing arrangements, particularly for emergency situations.

The DSC requires, as distinct from ANCOLD's suggestion, that the DSEP forms an important, yet separate, adjunct to the O&M Manual for a dam and should be rigorously implemented by dam owners in conjunction with the O&M Manual.

4.2 Preparation

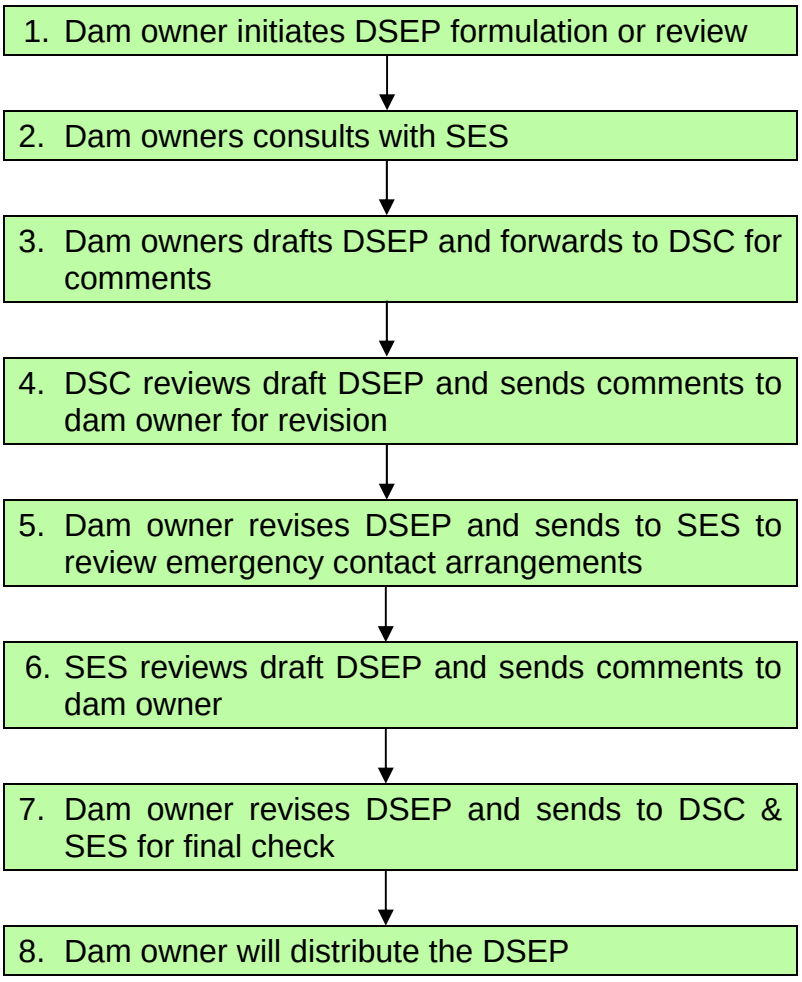
4.2.1 General Requirements

The DSC requires a quality controlled DSEP, with associated dambreak warning procedures, to be prepared for prescribed dams where persons may be at risk downstream if the dam failed. Appendix B provides a helpful checklist of items to be undertaken to complete an effective DSEP. This checklist is to be completed and attached to the final DSEP submitted to the DSC.

General procedures for preparing appropriate DSEPs are outlined in Section 8 of the ANCOLD '*Guidelines on Dam Safety Management*', while DSC requirements for associated dambreak analysis studies are outlined in Section 7 of this sheet.

The DSC considers the key steps outlined in Figure 1 are required to ensure a proper quality control process of review, external consultation and approval for the provision of effective DSEPs for dams.

Figure 1 - Key Steps in DSEP Formulation and Review



The extent and content of DSEPs will vary between dams depending on local conditions. Dam owners must consult the SES, through its State Headquarters at Wollongong, at an early stage during the preparation of draft DSEPs to:

- Jointly determine dam failure alert levels (i.e. white, amber and red)
- Jointly determine appropriate warning protocols for downstream populations at risk (particularly warning arrangements for non-itinerant persons immediately downstream of dams); and
- Confirm notification arrangements.

If the SES is unable to warn downstream populations due to time/resource constraints, then the dam owner will be required to establish alternate appropriate measures such as improved warning systems, including gauges, sensors and associated telemetry and notification systems. In particular, several owners of dams with significant deficiencies have installed Dam Failure Warning Systems in order to provide advance notice of conditions under which failure could occur.

For prescribed dams, where non-itinerant persons could be at risk (i.e. all Extreme and High Consequence Category dams), the DSEP is required to include dambreak inundation information (e.g. mapping, depths, timing) and emergency authority notification arrangements. In the context of this sheet non-itinerant persons include:

- residents in dwellings, hotels, motels, boarding houses, hospitals, caravan parks, established camping grounds and the like; and
- persons occupying places of work, schools, day care centres and the like, including workplaces of limited duration such as mines or construction sites.

DSEP requirements for dry flood retarding basins will mainly reflect responses to flood threats only.

For prescribed dams, where only itinerant persons (e.g. campers, bushwalkers, fishermen etc) may be at risk (i.e. Significant Consequence Category dams), the DSC requires that owners also prepare a DSEP to minimise risk to itinerant persons and to be in line with prudent dam operation practice to maximise the safety of their dam, having regard to the consequences of dam failure and value of the dam as an asset. However, these DSEPs may not need to include such aspects as dambreak analysis, inundation mapping or emergency authority warning but will need procedures to maximise the safety of itinerant persons. Where it is practicable to warn and evacuate itinerant persons, appropriate provisions are to be included in the DSEP.

4.2.2 Summary Information Sheet

A "Summary Information Sheet for Emergency Agencies" is to be included in conjunction with the Notification Flowchart in each DSEP. This sheet is to contain short summaries of the following topics:

- Background Information (e.g. dam owner, location, dam type & size, availability of dam data, Consequence Categories, safety status and nature of deficiency);
- Alert Levels Background (e.g. defining conditions and reasoning for alert levels of white, amber, and red - see Table 1);
- Notification Protocols (e.g. owner's actions, notifier's advice, content and quality of warning messages, availability of relevant Bureau of Meteorology warnings and stream gauges, emergency response requirements);
- Consequences of dam failure (including number of dwellings and depth and timing of flooding in the dambreak inundation area); and
- Flood Plan name.

4.2.3 Emergency Service Notifications

An emergency service notification flowchart is to be included in each DSEP (refer Section 6 and Appendix A).

The primary contact in the event of alerting emergency services for dam failure is the SES State Operations Communications Centre (OCC). The alerts must be provided by telephone, preferably by an actual person relaying a message (rather than an automated message). The SES cannot receive SMS, and considers it an unreliable technology for life threatening situations.

It is essential that each alert is communicated to the SES through its OCC. However, subsequent liaison between the dam owner and an appropriate SES Operations Controller, at an SES Region or Local Headquarters (to be advised by the SES during DSEP preparation), will be established to ensure effective communication during an emergency situation.

Dam failure alerts (i.e. white, amber and red) are used to trigger emergency response actions. The conditions that define each of the alert levels are listed in each DSEP. Consequences and responses escalate as the alert level migrates from white to red. Table 1 briefly outlines some of the possible defining conditions and likely SES responses associated with each alert.

Table 1 - Typical Dam Failure Alert Protocols

Alert Level	Typical Defining Conditions	SES Response	SES Warning Product
White	Structural defect detected (e.g. crack, piping) or heavy rainfall event.	Notification of support agencies. Monitoring at-risk areas downstream. Check operational readiness.	This is a preliminary alert to assist the SES in its preparations and is not a public alert.
Amber	Failure possible if storage continues rising or structural defect not fixed.	Warn downstream population at risk to prepare to evacuate.	SES Evacuation Warning.
Red	Failure imminent or occurred.	Evacuation of downstream population.	SES Evacuation Order.

These alert levels relate specifically to the warning and evacuation tasks to be performed by emergency managers with respect to communities at risk downstream. As far as possible, these alert levels should be set to maximise the amount of warning time available. When preparing DSEPs dam owners should liaise closely with the SES to ascertain the warning requirements for its flood operating procedures which is dependent, amongst other things, on the population at risk and emergency services resources.

Some DSEPs will require alert levels that proceed directly from White to Red if adequate time does not exist between the three alert levels to both warn and evacuate the downstream population at risk. The decision to omit the Amber Alert Level in these cases, and the general setting of Alert Levels, must be undertaken in consultation with the SES.

It is also essential that dam owners notify all appropriate personnel, including the SES, when the dam failure emergency is over, or if the dam failure alert was a false alarm. The SES will issue the "All Clear" to the community at risk where appropriate.

4.3 Distribution

DSEP distribution arrangements are to be as follows:

- One controlled copy to the DSC;
- Controlled copies to SES headquarters at Wollongong for internal distribution (Number of copies to be advised by the SES State Headquarters which retains one and distributes others to relevant SES Regions and local Units);
- Controlled copies to State Emergency Operations Centre for internal distribution (Number to be advised by SEOC related to number of Regional Emergency Management Offices involved); and
- DSEPs and their annual updates are to be distributed in both paper and electronic format (i.e. CD in flap of paper copy).

4.4 Monitoring and Alert Systems

It is to be noted that, pursuant to Sections 18, 21 and 22 of the Dams Safety Act, 1978, the DSC has functions in relation to potential or actual emergencies at prescribed dams. Consequently DSEPs are to include provisions for prompt notification to the DSC's Executive Engineer of any actual or potential emergency, which may have implications for the safety of the particular dam or its storage.

The DSC's policy is that the owners of Extreme and High Consequence Category dams (excluding retarding basins) have in place automatic telemetered monitoring of the storage level in their dams (and preferably rainfall and seepage as well) to:

- Keep dam owner personnel apprised of this key surveillance information;
- Assist in the early detection of incidents at dams;
- Provide maximum warning times for any emergency response required in relation to these incidents.

This policy has been varied for owners of Extreme and High Consequence Category retarding basins, who are to have in place automatic telemetered monitoring of rainfall *at a location near the basin in lieu of, or in addition to, monitoring of basin storage level.*

The DSC also requires the owners of remotely located Extreme and High Consequence Category embankment dams to consider the practicalities of installing telemetered tailwater/seepage monitoring devices to maximise warning times of potential piping incidents at these dams. The installation of these devices is mandatory for all new Extreme and High Consequence Category embankment dams.

4.5 Testing

For DSEPs to remain effective it is imperative that they be regularly updated and tested. In this regard, the DSC requires DSEPs to be updated annually, and to be reviewed and tested at least every 5 years with actions in this regard to be reported in Surveillance Reports for each dam (see DSC2C). When dam owners plan any DSEP testing they must contact the SES early to arrange appropriate SES involvement.

5. FLOOD EMERGENCY PLANS

Under the emergency management legislation in NSW (i.e. the State Emergency and Rescue Management Act, 1989 and the State Emergency Service Act, 1989) the SES is the combat agency for floods, including floods affected by dams. Within this role the SES's main responsibility, which relates to its interactions with dam owners and managers, is to plan for, and respond to, flood emergencies. SES planning is conducted at local, regional and State levels. Each flood plan prepared by the SES is a sub-plan to the Disaster Plan (DISPLAN) at the relevant level and is endorsed by the relevant Emergency Management Committee.

For Extreme and High Consequence Category prescribed dams having a significant deficiency in safety, the SES has agreed with the DSC that its local flood plans will contain specific arrangements for dealing with dam failure, usually in the form of a Dam Failure Annex in the Local Flood Plan. In this regard, the DSC regularly updates the SES on the deficiency status of prescribed dams in NSW through interaction on the DSC's Emergency Management Sub-Committee.

The implementation of Dam Failure Annexes in Local Flood Plans has proceeded for dams with significant deficiencies on a priority basis determined by the SES and the DSC. The priority is determined by the degree of deficiency and the consequences of failure. When a dam's deficiency is rectified, the SES will then review the appropriateness of the existing dam failure emergency response arrangements.

Dam owners have a responsibility to assist the SES in their task of flood emergency planning in order to protect the community as well as to minimise the owner's liability for damages from a dam failure.

Owners are to provide the SES with copies (both hard copy and electronic) of their DSEPs (including dambreak studies and associated relevant information) as they are implemented to provide necessary information for SES purposes, and also to provide any requested assistance to the SES to enable formulation of effective emergency response arrangements for the areas downstream of dams.

6. EMERGENCY MANAGEMENT CONTACT PROCEDURES

The SES, DSC and the NSW State Emergency Operations Controller (SEOCON) have agreed to a protocol to assist owners and operators of prescribed dams when determining the emergency management contact procedures for inclusion in a DSEP. The contact procedures are intended to be followed when the owner/operator of a dam needs to activate the State's emergency management arrangements due to a potential or imminent failure of the dam or one of its control structures that could result in flooding of downstream communities. In this regard the importance and priority for contacting the SES 24 hour contact number is to be stressed (contact the SES State Headquarters to obtain the appropriate emergency contact number). Note that this is a dedicated number for dam failure emergencies only.

The arrangements have been developed in consultation with the NSW SES, the Emergency Management Sub-Committee of the DSC, and the State Emergency Operations Controller (SEOCON) and are represented in the generic flow chart, and notes on its use, in Appendix A to this sheet.

It has been further agreed that the SES will review emergency management contact arrangements in each DSEP submitted to the DSC and will sign-off on the emergency management contact arrangements on behalf of the Emergency Management agencies involved.

7. DAMBREAK STUDIES

7.1 General

The DSC requires that dambreak studies, using appropriate methods and parameters, are arranged by prescribed dam owners.

The dambreak studies are required for any existing or proposed prescribed dam where loss of life, or other significant threat to the community's interests, including to the environment, could result from dam failure. Dambreak studies are to be undertaken for all Extreme, High and Significant Consequence Category dams (see DSC3A for definition of consequence categories). For new dams, the studies are to be undertaken in the design phase, to be completed six months prior to the commencement of construction or modification of a dam.

The cases to be examined in the study are, as a minimum, those set out in the DSC's guidance sheet on 'Consequence Categories for Dams' - DSC3A, for assessment of consequences (i.e. sunny day dambreak and flood dambreaks from acceptable flood capacity up to PMF).

Reports on these studies are to be submitted to the DSC setting out:

- Cases examined;
- The input data; and
- The methodology used and the results including;
    - the extent of flooding;
    - flood travel times; and
    - flood water velocities, downstream of the dam, as related to residences, properties, infrastructure and environmentally sensitive areas.

The dambreak study should examine effects to a point downstream where there is no longer a significant incremental threat to the interests of the community, including to the environment.

The study report needs to outline the basis of dam breach modelling. For example, with long embankment dams having large storage volumes, the potential for outflow discharges, much greater than those given by empirical formulae based on failure data, needs to be considered. For such dams, the possibility of multiple breach locations upon overtopping, especially if the crest surface is of uneven level, should also be considered.

For flood related failure cases, consideration is to be given to a feasible range of antecedent flooding conditions downstream immediately prior to dam failure. This can be a particularly significant aspect where a dam is located on a stream, which joins a main stream with a relatively much larger catchment, not far downstream. If the large stream is at normal stage, the dambreak flood may remain within the banks and not affect towns on the alluvial terraces. But, if the main stream is close to bank full stage, the dambreak flood may affect towns on the terraces. Careful attention needs to be given to the likelihood of such scenarios.

See also Sub-section 8.5 of Nathan, R.J. and Weinmann, P.E., Book VI, The Estimation of Large to Extreme Floods, NCWE (Eds), Australian Rainfall and Runoff - A Guide to Flood Estimation, Volume 1. The report of a dambreak study is to state what consideration has been given to antecedent flooding.

The scale and quality of inundation mapping needs to be appropriate to the potential severity of the flooding impacts. Where dwellings are at risk, base mapping would typically be at a scale of 1:10,000 with a contour interval of 2m or better accuracy. Ortho photomaps can be particularly valuable to the emergency authorities but flood extents displayed on any maps should be transparent so that essential details are not obscured.

The Dambreak Study provides essential information for downstream emergency planning and also provides a basis for a conclusive assessment of the dam's Flood and Sunny Day Consequence Categories.

7.2 Information Required by the SES to Assist in Emergency Planning

A complete copy of the Dambreak Study report is to be provided to the SES State Headquarters including the following information for emergency planning:

- The number of dwellings at risk for each scenario modelled (note that this is more useful to the SES than potential loss of life estimates);
- The access routes affected for each scenario modelled; and
- Travel time information and rate of rise (preferably to the start of the flood reaching the population rather than just the time to peak to enable consideration of timing for alert levels).

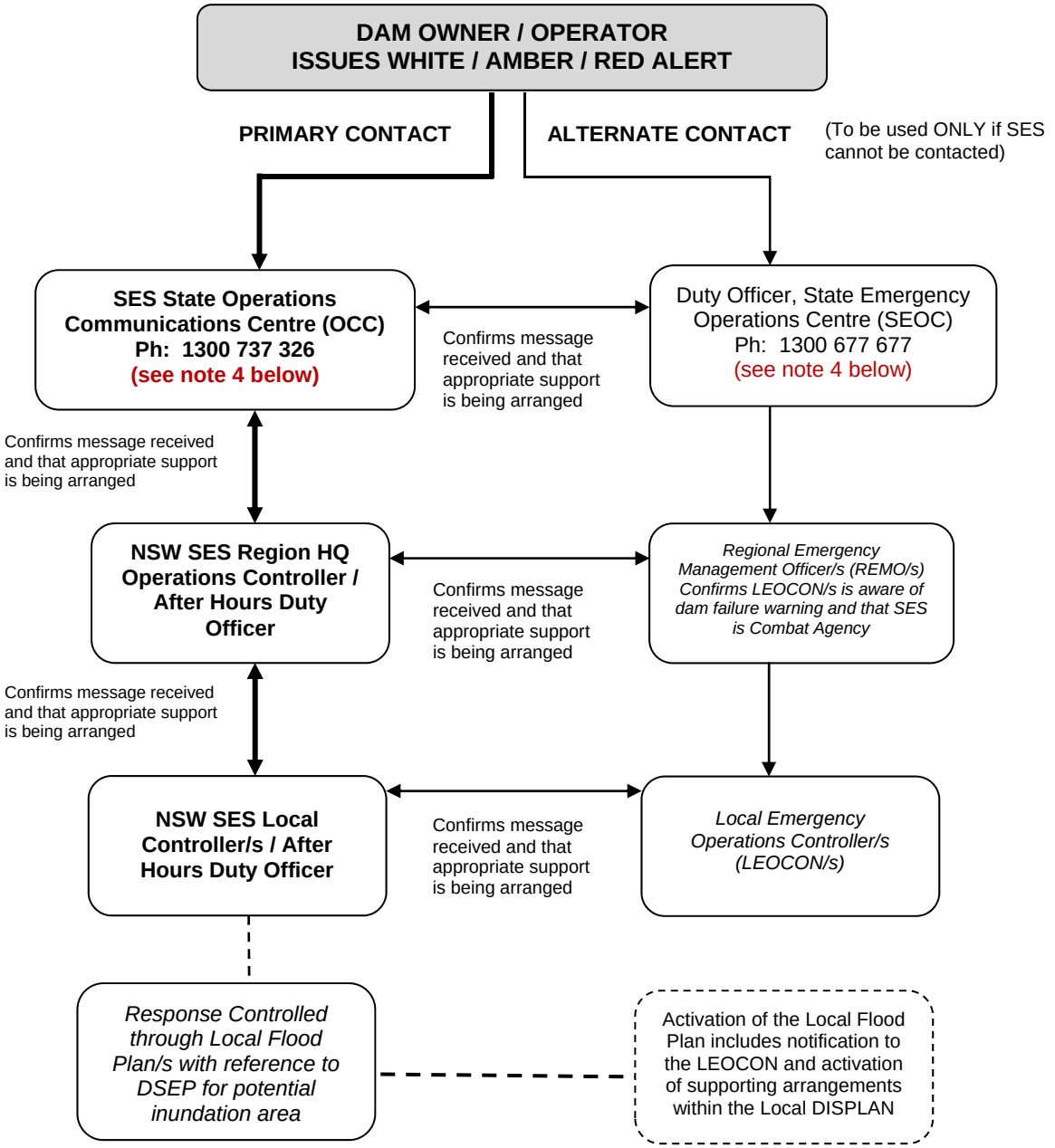
Where possible, the relevant GIS layers showing flood extents and other key information should also be provided. In addition it would be useful for emergency managers if flood cross-sections are provided at key locations such as flood gauges, bridges and major infrastructure (i.e. roads, railways, power facilities).

8. RECORDS TO BE KEPT BY DAM OWNERS

The DSC requires, in conjunction with the requirements of the State Records Act 1998, that dam owners maintain appropriate records of their emergency planning for their dams including the results of emergency exercises and any dam incidents, responses and subsequent actions by dam owners.

APPENDIX A

Notification Arrangements for Potential Dam Failure



Notes:

1. Dam owners should only contact the SEOC if the SES State Operations Communications Centre (OCC) cannot be contacted.
2. The first priority for notification is to contact the next SES HQ or the next level of EOC down the flowchart. The second notification should always be across the flow chart to confirm the message is received. If the first priority notification fails or is not picked up for any reason, the second priority notification should be made before any further attempts to contact the first priority (this is why an alternate or backup system of contracts is in place).
3. The triple zero (000) number for emergency services should not be used unless contact cannot be made with SES or the SEOC, as it is likely the triple zero (000) operators will have difficulty dealing with the very unusual case of potential or actual dam failure.
4. Dam owners must contact the SES State Headquarters during the preparation of the DSEP to check any changes in the appropriate emergency contact numbers.

APPENDIX B

CHECKLIST FOR FORMULATING DAM SAFETY EMERGENCY PLANS (DSEPs)

DSC Form D17

The following checklist covers the minimum items to be included in DSEPs submitted to the NSW Dams Safety Committee (DSC) by dam owners and their consultants. Please tick against each item to indicate completion of the item in, or in conjunction with, the DSEP, and enclose the signed form with the copy of the DSEP submitted to the DSC. Please note that DSEPs which do not address all relevant items may not be accepted.

- ❑ Owner to provide cover letter summarising actions to date.
- ❑ Coverage of each of the Sections outlined in Chapter 8.5 of ANCOLD Guidelines on Dam Safety Management.
- ❑ Summary Information Sheet including:
  - o Background dam information;
  - o Alert Levels background;
  - o Notification protocols; and
  - o Associated Flood Plan name.
- ❑ Emergency Services Notification Flowchart.
- ❑ Detailed information on monitoring and alert systems.
- ❑ Dambreak information including:
  - o Cases studied;
  - o Inundation mapping;
  - o Flood depths;
  - o Timing of flood events; and
  - o PAR and LOL.
- ❑ SES consultation
- ❑ Copy of dambreak information provided to SES
- ❑ An IBM compatible CD, or equivalent, containing a Microsoft Word format file of the text and a PDF of the entire report including drawings and photos.

***Checklist completed by**:* *Name and position* .....

Signature .....

This Guidance Sheet is one of a series available from our Website at:

http://www.damsafety.nsw.gov.au

In order to read this file you need a Portable Document Format (PDF) reader. A free PDF reader is available from http://www.adobe.com/

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