

Consequence Screening Tool for Small Dams

Water and Natural Resources

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This guideline and accompanying spreadsheet replace the original 'Screening Tool for Small Hazardous Dams, 2011'.

The Department of Environment and Primary Industries intends to review the screening tool spreadsheet and guideline periodically. Please forward any comments to Siraj Perera, Rural Water Programs Division, Water and Natural Resources Group, Department of Environment and Primary Industries, PO Box 500, East Melbourne VIC 3002 or email: siraj.perera@depi.vic.gov.au.

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1. Introduction to the Screening Tool

1.1. Purpose

The Screening Tool has been developed to provide a simplified method for assigning Consequence Categories to small dams and consists of this guideline and an accompanying spreadsheet. The tool is broadly consistent with the Initial Consequence Assessment level of the Australian National Committee on Large Dams (ANCOLD) *Guidelines on the Consequence Categories for Dams 2012*.

The Consequence Category obtained using the Screening Tool is intended to provide a basis for identifying the dam safety management requirements of small dams that require a licence under section 67 of the *Water Act 1989* but are of low hazard. Where the Screening Tool assesses that a dam may potentially pose a risk to downstream communities, the owner of the dam will be required to engage a suitably qualified engineer to undertake a more detailed Consequence Category assessment of the dam, and to assist with developing and implementing a dam safety management program.

While primarily developed for use by the five Victorian licensing authorities (Appendix A), the Screening Tool may also assist owners of small dams.

Throughout this document, a small dam refers to a dam that does not meet the ANCOLD definition of a large dam (Glossary) and has a volume of less than 500 ML.

1.2. Australian National Committee on Large Dams (ANCOLD) and Dam Safety

ANCOLD is an incorporated voluntary association of organisations and individual professionals with a common interest in encouraging improvements in the safety and operation of dams in Australia. Formed in 1937, it is a member of the international body ICOLD (International Commission on Large Dams). ICOLD's membership consists of 92 countries containing most of the world's significant dams. The Department of Environment and Primary Industries (DEPI) has actively participated as a member of ANCOLD for many years through the ANCOLD Regulators Forum. The forum includes representation from all states and meets annually.

ANCOLD has produced a series of guidelines (Appendix B) that are recognised by DEPI as representing the current industry position for dam safety management and are referenced by regulations in both Victoria and other jurisdictions across Australia.

The Consequence Category is used throughout the ANCOLD guidelines, such as in the *Guidelines on Dam Safety Management* (ANCOLD, 2003), in making recommendations about the appropriate level of dam safety practice for a particular dam.

1.3. Application of the Screening Tool

ANCOLD (2012) defines the consequences of dam failure as *'the outcome or result of a dam failure in terms of loss of life and damage to property and/or services, as well as environmental damage'*. The Screening Tool can be used to assign the following Consequence Categories (Table 1-1):

- Very Low or Low;
- Significant; and
- High C or above.

The Consequence Category provides a preliminary basis for determining dam safety management requirements. These cover aspects such as:

- Surveillance and monitoring;

- Emergency preparedness and response;
- Operational procedures;
- Skills and training of personnel involved in undertaking dam safety activities;
- Identification and prioritisation of further dam safety investigations and consequence assessment, particularly for dams with a Consequence Category of High C or above; and
- Dam safety improvement works.

However, irrespective of the Consequence Category assessed using the Screening Tool, dam owners who are required to have a licence under Section 67 of the *Water Act 1989*, must confirm their responsibilities with the relevant licensing authority (Appendix A) and comply with the conditions of their licences.

1.4. ANCOLD Consequence Categories

The ANCOLD *Guidelines on the Consequence Categories for Dams* (ANCOLD, 2012) provides a method to assess dams on the basis of the potential severity of damage and loss, in conjunction with the risk to human life which may result from a dam failure. The risk to human life can be expressed in terms of the Population at Risk (PAR) or the Potential Loss of Life (PLL). The Initial Consequence Assessment level described in the ANCOLD Guidelines recommends assessment using the Total PAR which is defined as 'the total population determined within the total flood zone'.

The risk associated with potential dam failure is expressed using seven Consequence Categories:

- Very low – where consequences from dam failure would be considered negligible;
- Low, Significant, High A, High B and High C; and
- Extreme – where consequences from dam failure would be considered severe.

Each category is defined by a severity of damage and loss and PAR threshold shown in Table 1-1. The guidelines also provide thresholds considering PLL, however the initial level primarily considers Total PAR.

In relation to the assignment of consequence categories, it is important to take note of this reference from the ANCOLD Consequence Guidelines – *“However the complexity of determining the various parameters that make up each Consequence Category means that only experienced dam engineering professionals should interpret and use these Guidelines when making these decisions that could impact on community safety, community cost and services, infrastructure, natural environment, heritage, and the owner’s and other businesses.”* In undertaking a consequence category assessment the information provided in the below tables should not be used without taking into account the full guidance provided in the Guidelines.

Table 1-1 ANCOLD Consequence Categories based on Population at Risk (PAR); Source: ANCOLD (2012)

Population at Risk (PAR)	Severity of damage and loss			
	Minor	Medium	Major	Catastrophic
<1	Very Low	Low	Significant	High C
≥1 to 10	Significant*	Significant*	High C	High B
>10 to 100	High C	High C	High B	High A
>100 to 1,000		High B	High A	Extreme
>1,000			Extreme	Extreme

*Change to “High C” where there is the potential of one or more lives being lost.

The ANCOLD guidelines provide guidance on the definition of the severity of damage and loss in relation to a number of assets. It is anticipated that damage and loss caused by the failure of a small dam will most likely fit the definition of Minor to Medium for most asset types as specified in Appendix B of the Consequence Category Guidelines (ANCOLD, 2012).

Thresholds of PAR for each category are similar for a Minor to Medium severity. These are summarised in Table 1-2 for the categories which are identified by the Screening Tool.

Table 1-2 Screening Tool Consequence Category definition for Severity of Damage and Loss

Consequence Category	Severity of Damage and Loss	Total PAR
Very Low to Low	Minor to Medium	<1
Significant*	Minor to Medium	≥1 to 10
High C or above	Minor to Medium	>10

* Change to High C or above where there is the potential for one or more lives being lost

Further details on the framework applied by the Screening Tool to assess the Consequence Category, is provided in Section 2 of this document.

1.5. Data Assembly and Key Inputs to the Screening Tool

The Screening Tool has been developed to perform an initial level assessment using information which can be readily obtained.

A summary of key inputs to the Screening Tool and potential sources of information are shown in Table 1-3. A complete list of information which can be entered and stored in the Screening Tool can be found in Appendix C.

Table 1-3 Summary of key inputs into the Screening Tool and possible sources of information

Key Screening Tool inputs	Examples of where information can be sourced
Dam volume	<ul style="list-style-type: none"> • Owner knowledge • Site inspection
Downstream topography	<ul style="list-style-type: none"> • Licence renewal pre-application questionnaire (for licensing authorities)
Extent of downstream impact	<ul style="list-style-type: none"> • Engineering reports • Works plans
Population at Risk (PAR)	<ul style="list-style-type: none"> • Records
Location of PAR	<ul style="list-style-type: none"> • Aerial photography • Contour/Topographic maps

1.6. Screening Tool Limitations

It is the user's responsibility to ensure that the Screening Tool is applied correctly and that the results are reasonable. ANCOLD (2003) provides a description of the knowledge required for personnel involved in dam safety programs. As a minimum, users of the tool should have the level of dam safety knowledge and expertise of 'Inspector and Other Field Personnel' as described in the guidelines.

Application of the Screening Tool should be limited to dams that do not meet the ANCOLD definition of a large dam (Glossary), are up to 500 ML, and where the predicted severity of damage and loss is not expected to exceed medium as defined in ANCOLD (2012). If a dam does not meet the above criteria, then the Consequence Category assessment should be undertaken by a suitably qualified engineer (DSE, 2007) using the methods described in ANCOLD (2012). Furthermore, the Screening Tool is not intended for use in assessing the Consequence Category of tailings storage facilities.

Where there is uncertainty in the Consequence Category assessed using the tool, for example as to whether to assign a Significant or High C or above Consequence Category to a dam, the dam owner or licensing authority should seek further engineering confirmation.

The Screening Tool was developed using Microsoft Excel 2007 and may not be compatible with versions of Microsoft Excel pre Excel-97. Note that macros must be enabled for the Screening Tool to operate.

1.7. Structure of the Screening Tool Guideline

This document has been developed to assist in the operation of the Screening Tool spreadsheet and to provide background information to the concepts on which the Screening Tool initial level assessment method is based.

Section 2 of this document describes the concepts behind the framework which is applied by the Screening Tool.

Section 3 of this document provides instruction on the operation of the Screening Tool.

2. Screening Tool Framework

2.1. Framework Overview

The Screening Tool Framework (Figure 2-1) applies a decision process based on the Initial Consequence Assessment method for assigning a Consequence Category to a dam, as outlined in ANCOLD (2012). The Initial assessment is described as a conservative assessment used to 'identify Consequence Categories that are obvious from existing knowledge' based on Total PAR.

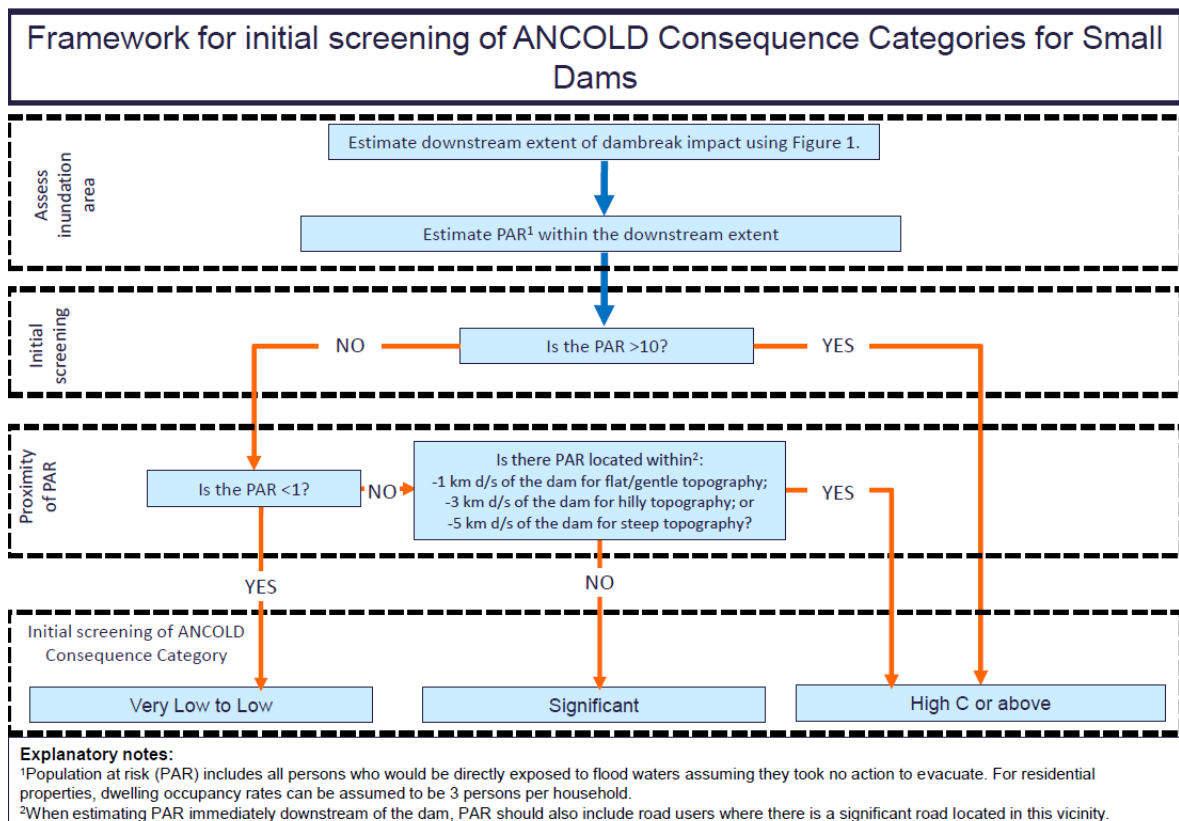
Assigning a Consequence Category using the Initial Consequence Assessment involves the estimation of the following parameters:

- Estimate of inundation area;
- Estimate of Total damage/loss; and
- Estimate of Total PAR.

The process which the Screening Tool framework uses to assign a Consequence Category incorporates the estimation of the above listed parameters and uses this information to categorise the dams based on the criteria summarised Table 1-2.

Each component of the framework is further described in the following sections.

Figure 2-1 Framework for initial screening of ANCOLD Consequence Categories for small dams as specified in the spreadsheet tool (larger version in Appendix D)



2.2. Estimate of Downstream Extent of Dambreak Impact

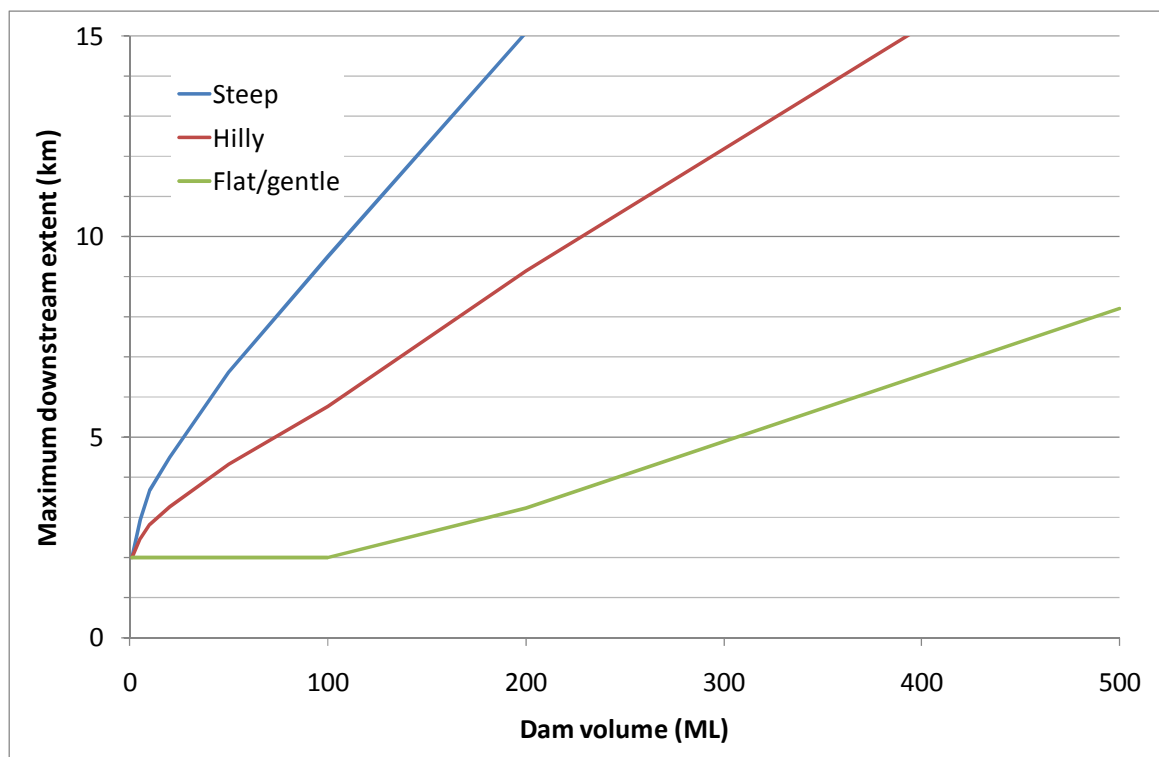
The downstream extent of dambreak impact referred to in Figure 2-1 relates to the estimation of inundation area in the Initial Consequence Assessment (ANCOLD, 2012). The inundation area which should be considered will depend on:

- The peak outflow from the dam breach;
- Routing and attenuation of the flood wave; and
- Depth and velocity at the location of the PAR.

The assessment should generally continue downstream until the dambreak flood would enter a river or downstream storage which has a sufficient storage volume to ensure that there are no further downstream impacts.

The maximum downstream extent is estimated by the Screening Tool using a series of indicative curves which provide guidance on the distance downstream where the flood wave could potentially result in significant consequences. The curves, shown in Figure 2-2 are employed by the Screening Tool to provide an estimate of downstream extent for a given dam volume and downstream terrain.

Figure 2-2 Indicative maximum downstream extent of dambreak impact



The maximum downstream extents in Figure 2-2 represent where the depth times velocity of the attenuated flood peak is no longer considered to provide a risk to human stability as defined by Cox (2010). The curves were derived using a combination of generalised methods for estimating peak flow from a dam failure (Froehlich, 1995) and generalised methods for estimating inundation areas (Schaefer, 1992). These curves are broadly consistent with the distances recommended in ANCOLD (2012) for the total distance downstream relative to dam volume which should be considered when developing a hydraulic model.

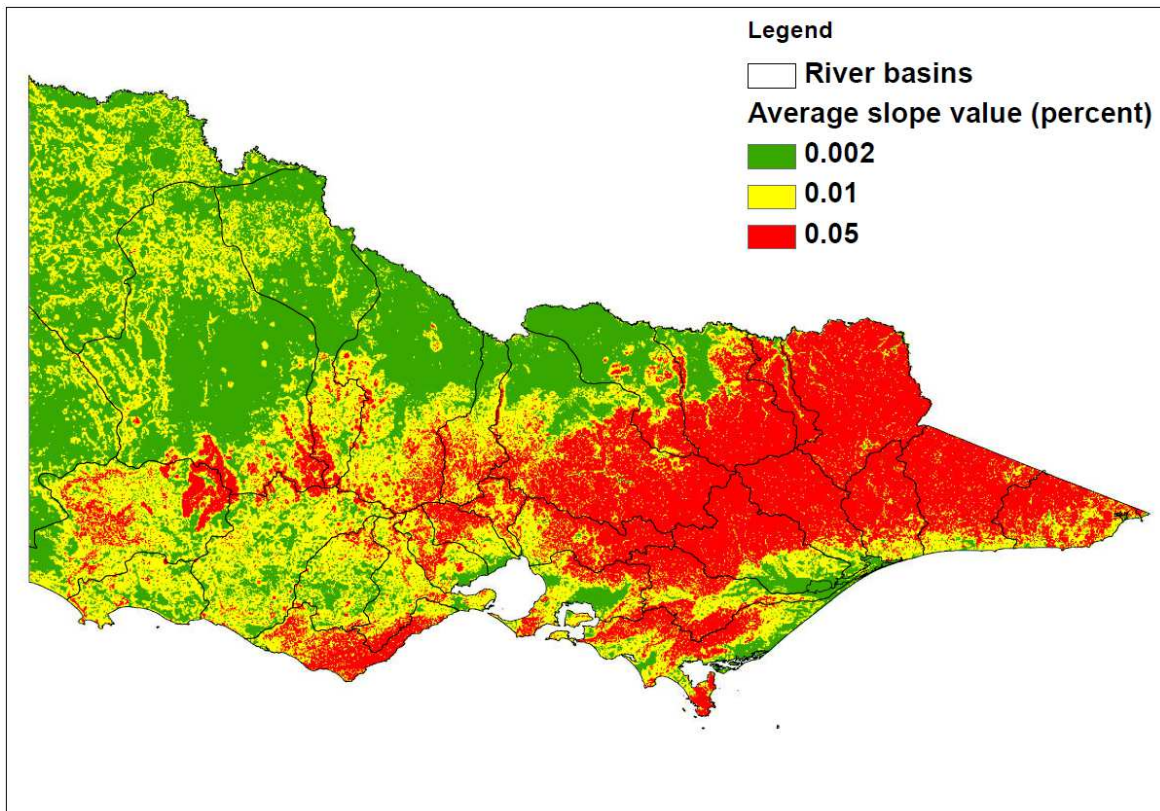
Three variations in terrain related to the slope of the downstream valley were considered in developing the extent curves: 'Steep', 'Hilly', 'Flat/gentle'. The curves were derived assuming slopes of up to 0.002% for the lower limiting 'Flat/gentle' curve and 0.02% for the upper limiting 'Steep' curve. To aid the selection of the appropriate slope

category a map of Victoria is provided in Figure 2-3 showing average terrain slopes in different regions. Roughness of the downstream terrain was assumed to be similar to grass or pasture.

Figure 2-2 was derived assuming rural settings with minimal obstructions and can be considered conservative for dams located in more urbanised environments.

Use of topographic maps could also be used to determine the downstream extent which should be considered in the assessment.

Figure 2-3 Victoria statewide slope map



2.3. Estimate of PAR within the Downstream Extent

As noted in Section 1.4, the assigned Consequence Category is dependent on the Total PAR. An estimate of PAR located within the downstream extent, as identified from Figure 2-2 or from site-specific knowledge, should include all persons who may be caught in the path of the flood wave at the time of dam failure. The PAR assessment should consider all locations where people assemble including houses, schools, hospitals, commercial and retail areas, roads, and community and recreational facilities.

The user should also consider PAR within the downstream extent based on elevation. This can be informed by aerial photography, contour or topographic maps and site inspections. ANCOLD (2012) suggest considering a height above the stream bed of between one third (1/3) and one half (1/2) of the dam height when assessing flood level. As a rule of thumb, it can be assumed that the flood height would be about one half of the maximum downstream height of the dam wall immediately downstream of the dam, tapering to zero at the maximum downstream extent of the flood. This approach requires a degree of judgement in taking variations in local topography and terrain into account.

2.4. Assessment of Consequence Category

The initial screening portion of the framework assesses whether the PAR meets the criteria of a High C or above Consequence Category dam (PAR greater than 10 – described in Section 1.4). Dams which do not meet the criteria for this category are further assessed.

To assign a Consequence Category of Very Low or Low, a PAR of less than one must be satisfied. Where a dam does not meet the Very Low or Low criteria, the framework considers the proximity of the PAR to the location of the dam and topography in order to assess the potential for loss of life. Referring to Table 1-1, dams which fall into the Significant Category based on PAR may be upgraded to High C or above where there is the potential for loss of life. The “potential for loss of life” will depend upon the location and vulnerability of the PAR which will be influenced by the warning time, depth and velocity of floodwaters and associated understanding the PAR has of the impending flooding.

In lieu of detailed hydraulic modelling, proximity to the dam and downstream topography has been adopted within the Screening Tool as a surrogate for vulnerability of the PAR. Therefore, the potential for loss of life is assumed to be more likely where the PAR is located within:

- one kilometre downstream of the dam in flat/gentle topography; or
- three kilometres downstream of the dam for hilly topography; or
- five kilometres downstream of the dam for steep topography.

It is assumed that the PAR located in these areas will have little warning time available and the flood depth and velocity will also be most severe in such areas. Hence, if the PAR is between 1 and 10 and is located within the above areas, the Screening Tool classifies the dam as within the High C or above Consequence Category. If the PAR is between 1 and 10 and is located downstream of the above areas, the Screening Tool classifies the dam as within the Significant Consequence Category.

2.5. Consequence Category and Dam Safety Management Approach

As outlined in ANCOLD (2003) the level of dam safety practice should be consistent with the Consequence Category of the dam. The initial level Consequence Category obtained from the Screening Tool indicates whether a simplified approach to dam safety management can be used, or whether a failure of the dam could cause significant impacts to public safety and should be subject to a more detailed management approach and engineering input.

Table 2-4 outlines some typical dam safety requirements for small dams of different Consequence Categories. A Consequence Category of High C or above is a threshold for a higher level of dam safety practice including a safety review of the dam by a suitably qualified engineer (see Glossary). For a licensed dam, an owner must ensure compliance with the requirements set out in the ‘Works Plan’ and ‘Works Licence’ of the dam.

Where downstream development increases the potential impact of the dam may correspondingly increase. Owners are responsible for regularly reviewing the Consequence Category to ensure that they continue to manage their dams to a safe level.

Table 2-4 Typical dam safety requirements for owners of small dams based on Consequence Category

Initial Assessment Consequence Category using Screening Tool	Typical dam safety requirement for small dam owner
Low or Very Low	<ul style="list-style-type: none"> • Uses a simplified surveillance and monitoring plan (available from licensing authorities or DEPI) and dam safety emergency plan (e.g. template provided in DSE 2007). • Refers to guidance provided in the document 'Your Dam Your Responsibility'.
Significant	<ul style="list-style-type: none"> • If there is uncertainty about potential for loss of life, commissions a suitably qualified engineer to undertake Consequence Category Assessment as per ANCOLD (2012). • Uses a simplified surveillance and monitoring plan (available from licensing authorities or DEPI) and dam safety emergency plan (e.g. template provided in DSE 2007) endorsed by a suitably qualified engineer. • Refers to guidance provided in the document 'Your Dam Your Responsibility' and ANCOLD guidelines.
High C or above	<ul style="list-style-type: none"> • Commissions a suitably qualified engineer to undertake a full Consequence Category Assessment as per ANCOLD (2012). • Commissions a suitably qualified engineer to undertake a safety review and preparation of surveillance and monitoring plans and dam safety emergency plans. • Refers to and ensures compliance with ANCOLD dam safety guidelines. • Lodges the DSEP to the relevant municipal Council. • Where applicable, commissions a risk assessment.
All Consequence Categories	<ul style="list-style-type: none"> • Notifies the licensing authority or DEPI in an emergency or where a significant deficiency in a dam is detected. • Works to rectify a significant deficiency in a dam are devised by a suitably qualified engineer and completed as soon as practicable. • Notifies relevant emergency agencies (e.g. SES and Victoria Police), stakeholders and community in the event of an emergency. For a licensed dam, contact details should be set out in the DSEP. • Reviews Consequence Category every five years or sooner if significant downstream development occurs.

3. Using the Consequence Category Screening Tool

3.1. General Information

The Screening Tool is comprised of a series of sheets within a Microsoft Excel workbook. Sheets available for viewing are listed in Table 3-1. These are navigated to using the command buttons located at the top of each sheet. Note that command buttons vary depending on the sheet which is currently selected.

Table 3-1 Excel sheets within the Screening Tool workbook

Sheet	Description
Home	Introduction to the Screening Tool. Automatically loaded when the tool is opened.
Help	Provides a description of the functions available within the Screening Tool and a description of the input fields.
Add New Record	Input sheet for new dam assessments. White cells indicate where inputs can be entered.
Retrieve Record	Sheet on which records which have been previously stored in the database are retrieved and displayed. Previously stored assessments can be edited on this sheet. White cells indicate where inputs can be entered or edited.
View Record Database*	Sheet shows all information which has been stored within the Screening Tool.

*Only available on the 'Home' and 'Help' sheets

Sheets which are used to add or edit assessment records also have additional command buttons located at the top of the sheet. These include command buttons for: save, delete, clear sheet and print.

3.2. Entering a New Dam for Assessment

A new dam can be entered into the Screening Tool for assessment using the '**Add New Record**' command.

The '**Add New Record**' input sheet is broken up into the following sections:

- General Information;
- Dam Information;
- Downstream extent of dambreak impact;
- Initial Screening and Proximity of PAR; and
- Assessment of Consequence Category.

White cells on the '**Add New Record**' sheet indicate where inputs can be entered. Grey cells are protected and cannot be altered.

The following sections provide descriptions of each input field available in the '**Add New Record**' sheet and some guidance in populating these fields.

A summary of all input fields available on the sheet are listed with a description of the data to be entered in Appendix C.

An example of an assessment sheet populated with dummy information is shown in Appendix E.

3.2.1. General information

Description of input fields

Section	Fields	Optional or Compulsory	Description
General Information	Dam No./Service ID	Compulsory	Dam identifier. Cannot be changed once saved into the Screening Tool. Only numerical values can be entered.
	Dam Name/Works ID	Compulsory	Secondary dam identifier. Cannot be changed once saved into the Screening Tool.

The 'Dam No. /Service ID' and 'Dam Name/Works ID' refer to unique identifiers for easy identification or reference of the dam. An entry into both fields is required to save the assessment. Both fields are also required to retrieve and edit any previously entered assessments.

Note:

- Only numeric values can be entered into the 'Dam No./Service ID' field; and
- Once the assessment is saved these two fields cannot be edited if the assessment is retrieved from the database.

3.2.2. Dam information

Description of input fields

Section	Fields	Optional or Compulsory	Description
Dam Information	Dam Volume	Compulsory	Storage capacity of the dam. Where there are multiple dams on a waterway the effects of cascade failure should be taken into account as described in Section 3.2.3, Cannot be changed once saved into the Screening Tool.

The dam volume entered is used in assessing the downstream extent of the dambreak impact.

Note:

- Once the assessment is saved, the dam volume cannot be edited if the assessment is retrieved from the database.

3.2.3. Cascade Dams

Where multiple dams are located on the same waterway there is a potential for cascade failure. This is where the failure of a dam on a waterway could result in the failure of dams located downstream. In this circumstance, ANCOLD (2012) recommends that '*the Consequence Category of the upstream dam should be based upon the combined effects of multiple dam breaks*'. In using the Screening Tool, this can be addressed by entering a volume for the upstream dam which is the combined volume of that dam and any downstream dams.

3.2.4. Downstream extent of dambreak impact

Description of input fields

Section	Fields	Optional or Compulsory	Description
Downstream extent of dambreak impact	Downstream topography	Optional	Topography downstream of the dam. Required to estimate the downstream extent of the dambreak impact. Three options are available: -Flat/gentle; -Hilly; and -Steep.
	Downstream extent of dambreak impact	Optional	Automatically calculated from Figure 2-2. This provides an estimate of the maximum distance downstream of the dam where the Population at Risk (PAR) should be considered in making an initial assessment of

Section	Fields	Optional or Compulsory	Description
			Consequence Category.
	Adopted extent	Optional	A downstream extent can be entered by the user to overwrite the downstream extent above where more specific information is known about where the flood wave from a dambreak event would travel. E.g. The user may enter a distance downstream of the dam in which to consider the PAR which is less than that which is estimated using Figure 2-2 as there is a creek located downstream of the dam which would capture the dambreak flood.
	Comments relating to dambreak extent	Optional	The user should record any comments relating to the estimate of the downstream extent of dambreak impact for future reference.

The downstream extent of dambreak impact provides guidance on the area in which the Total PAR should be considered downstream of a dam. To assess the downstream extent, the user is required to select a downstream topography from the drop down list.

The downstream extent is calculated by the Screening Tool as a function of the dam volume and the downstream topography from Figure 2-2.

The extents estimated from Figure 2-2 and reported in the Screening Tool are conservative and are intended to be used as a guide to the maximum distance downstream for which the PAR should be considered. These extents should be overwritten in the 'Adopted extent' field where further site-specific information is available.

A comments field is available in this section of the assessment form for the user to record any comments which may provide further understanding of downstream extent adopted when the record is retrieved in future.

It should be noted that the assessment can be saved into the database even if no fields in this section have been populated.

3.2.5. Initial Screening and Proximity of PAR

Description of input fields

Section	Fields	Optional or Compulsory	Description
Initial Screening and Proximity of PAR	Estimate of Total PAR within downstream extent	Compulsory	The estimate of the Total Population at Risk (PAR) located within the downstream extent described above. The PAR includes all persons who would be directly exposed to flood waters assuming they took no action to evacuate. For residential properties, dwelling occupancy rates can be assumed to be 3 persons per household. When estimating PAR immediately downstream of the dam, PAR should also include road users where there is a significant road located in this vicinity. The ANCOLD guidelines suggest considering a height above the stream bed of between one third (1/3) and one half (1/2) of the dam height when assessing flood level.
	PAR located within: 1 km d/s of the dam for flat/gentle topography, 3 km d/s for hilly topography or 5 km d/s for steep topography	Compulsory if PAR <=10	Identify if there is PAR located within: <ul style="list-style-type: none"> • 1 km d/s of the dam for flat/gentle topography; • 3 km d/s for hilly topography; or • 5 km d/s for steep topography. This input is only required if the Total PAR estimate is less than or equal to 10 and the permanent PAR is not less than one (refer figure 2-1).

Section	Fields	Optional or Compulsory	Description
	Source of estimate of Total PAR	Optional	The method/s for estimating the initial PAR can be selected from the check list. Six customisable check list labels are available. One check box labelled 'Other' is also available. If this option is selected the user should enter the other method into the adjacent comment box.
	Comments relating to PAR	Optional	The user should record any comments relating to the estimate of the PAR.

The estimate of PAR within the downstream extent entered in this section should consider all persons who may be caught in the path of the flood wave within a distance downstream of the dam informed by the downstream extent from the Screening Tool. This number should include any road users who are at risk. Some guidance for estimating PAR for residential dwellings is provided in the table above.

Information to assist in estimating the Total PAR can be obtained from a number of sources. The user should select the relevant sources of information using the check lists (see Figure 3-1). This data is stored for future reference.

Depending on the estimated number of PAR, the user may be prompted to identify if PAR is located within:

- one kilometre downstream of the dam in flat/gentle topography; or
- three kilometres downstream of the dam for hilly topography; or
- five kilometres downstream of the dam for steep topography.

This question will only appear if the total PAR is less than or equal to 10.

A comments field is available in this section of the assessment form for the user to record any comments which may provide further understanding of the PAR adopted when the record is retrieved in future.

Figure 3-1 Initial Screening section of the assessment form

Initial estimate of PAR within downstream extent	
Initial estimate of PAR:	<input type="text" value="2"/>
Source of initial PAR estimate:	<input type="checkbox"/> Aerial imagery <input type="checkbox"/> Formal site inspection <input checked="" type="checkbox"/> Dam engineer's report <input type="checkbox"/> Licence application <input type="checkbox"/> Works plans <input type="checkbox"/> Owner knowledge <input type="checkbox"/> Other <input type="text"/>

Note:

- Only numeric values can be entered into the estimate of PAR within downstream extent field.
- When the Screening Tool is opened on its first application, the check box labels will be generic (Option 1, Option 2, etc.). These labels should be customised before the Screening Tool's first use with relevant options for estimating the PAR (see Figure 3-1). This can be done through the "Help" menu under 'Source of estimate of Total PAR' in the Description of Inputs table. Check box labels should NOT be changed following the first application as this may alter existing records.

3.2.6. Assessment of Consequence Category

Section	Fields	Description
Assessment of Consequence Category	Initial assessment of ANCOLD Consequence Category	Automatically calculated. The Consequence Category is estimated using the Framework for Initial Screening of ANCOLD Consequence Categories for Small Dams.

Following entry of the required data the populated assessment sheet will display the initial assessment of the ANCOLD Consequence Category as one of the following:

- Very Low or Low;
- Significant; or
- High C or above.

The Consequence Category is estimated using the framework described in Section 2.4 of this document.

3.2.7. Saving a new record

In order for the data entered into the assessment sheet to be saved to the Screening Tool database, the **'Save New Record'** command button (located at the top of the sheet) must be used. Selecting this command will write the assessment information into the database and save the whole workbook. **Selecting save from the Excel menu will not record the assessment details to the Screening Tool database.**

3.3. Retrieving/Editing an Existing Record

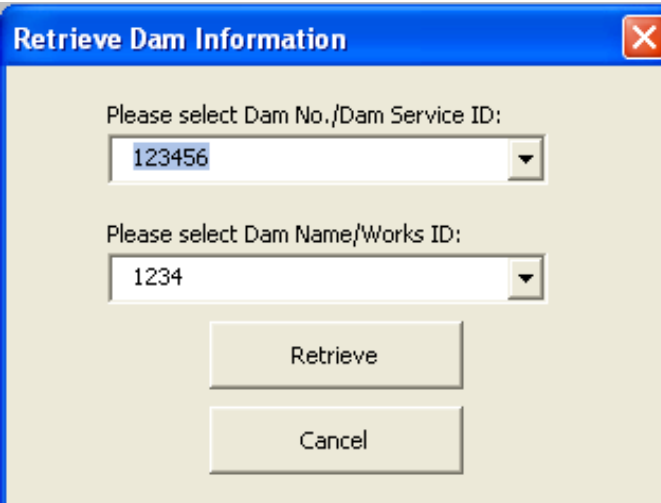
3.3.1. Retrieving a record

Records which have been previously entered and saved into the Screening Tool can be retrieved for viewing or editing by using the **'Retrieve Record'** command button. When selected, the user will be prompted for the 'Dam No./Service ID' and 'Dam Name/Works ID' relating to the record to be retrieved. Dam details can be entered either by typing in the 'Dam No./Service ID' and 'Dam Name/Works ID' or selecting the two identifiers from the drop down list of the pop up user form (Figure 3-2). When using the drop down lists, the 'Dam No./Service ID' list will show all 'Dam No./Service IDs' stored in the database. When a 'Dam No./Service ID' has been selected, the 'Dam Name/Works ID' drop down list will show all 'Dam Name/Works IDs' stored in the database which have the selected 'Dam No./Service ID'. Once 'Retrieve' is selected from the pop up screen, the 'Retrieve Record' sheet will be populated with the data.

Note:

The same 'Dam No./Service ID' may appear more than once in the drop list, this means that there are a number of records with the same 'Dam No. Service ID'. However, there should only be one record with the same combination of 'Dam No./Service ID' and 'Dam Name/Works ID'.

Figure 3-2 'Retrieve Record' user prompt



The image shows a dialog box titled "Retrieve Dam Information" with a close button in the top right corner. The dialog contains two dropdown menus. The first dropdown is labeled "Please select Dam No./Dam Service ID:" and has the value "123456" selected. The second dropdown is labeled "Please select Dam Name/Works ID:" and has the value "1234" selected. Below the dropdowns are two buttons: "Retrieve" and "Cancel".

3.3.2. Editing a record

When editing an existing record, the record must first be retrieved as described in Section 3.3.1. The retrieved record will appear in the same format as the 'Add New Record' assessment sheet. However, the following fields will be shaded in grey and locked from editing:

- Date of assessment – the date displayed will be the date on which the record was originally entered;
- User – the user displayed will be the user who originally entered the record;
- Dam No/Service ID;
- Dam Name/Works ID;
- Dam volume.

All other cells coloured in white are available for editing.

To maintain the integrity of the assessment record, it is suggested that any changes made to the assessment are recorded by the user in the available comment fields (see Figure 3-3) for an example). Six rows are available for comments under the 'Downstream extent of dambreak impact' and 'Confirm PAR location' sections. When a comment is entered, the date on which it was made is automatically recorded. Comments entered are saved into the database when the edited sheet is saved and will be shown when the record is retrieved in future.

Note:

There is no need to continue a single comment on the next row if the width of the text is wider than the width of the comment cell. The rows on which the comments are entered will adjust automatically in height to accommodate the text entered in the field.

Figure 3-3 Example of entering comments when editing a record

Downstream extent of dambreak impact	
Downstream topography:	Hilly
Downstream extent of dambreak impact:	4 km
	(calculated from Figure 1)
Adopted extent:	1.5 km
Date of comment:	Comments:
14/6/2012	Creek located 1.5 km downstream of dam. Flood wave from dam failure will flow directly into the creek.

3.3.3. Saving an edited record

When saving a record which has been edited, the record which was previously saved for that particular dam will be overwritten with the edited data. The '**Save Edits**' command button must be used to register changes in the database.

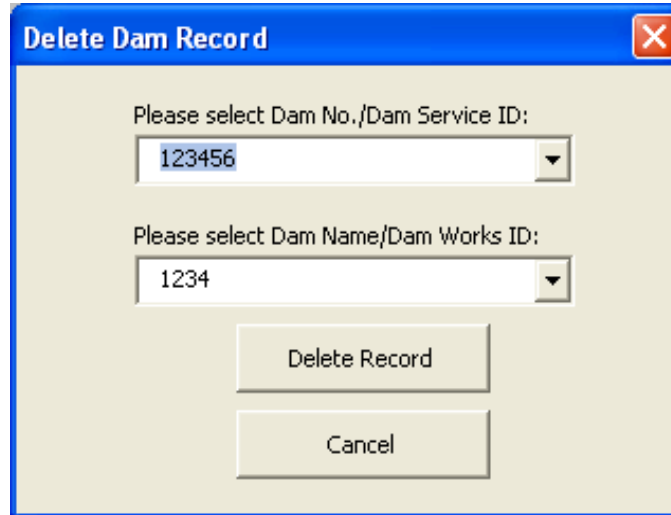
3.3.4. Deleting an existing record

Records which have been previously entered and saved into the Screening Tool can be removed from the database by using the '**Delete Record**' command button (Figure 3-4). The user will be prompted to enter the 'Dam No. /Dam Service ID' and 'Dam Name/Dam Works ID' – both are required to continue.

Note:

Once a record has been deleted the data for that particular dam is removed permanently from the database and cannot be retrieved.

Figure 3-4'Delete Record' user prompt



3.4. Record Database

The record database can be displayed by selecting the '**View Record Database**' button. This option is only available on the "Home" and "Help" screens. The database stores all information which has been entered and saved into the Screening Tool.

Note:

Records cannot be added, edited or deleted in the database sheet. These functions can only be performed by using the respective command buttons.

3.5. Printing the Record

By using the '**Print Current Sheet**' command button the current assessment record is first saved to the database. The print area is automatically set to print the full area of the assessment sheet on a single A4 page and the print dialogue box will be displayed so the user can select the appropriate printer settings.

Note:

Selecting print from the Excel menu will not guarantee the print area settings. These settings should be checked prior to selecting print from the Excel menu.

4. References

Australian National Committee on Large Dams (ANCOLD, 2003). *Guidelines on Dam Safety Management* (www.ancold.org.au).

ANCOLD (2012). *Guidelines on the Consequence Categories for Dams*. (www.ancold.org.au).

Cox, R.J, T.D. Shand, M.J. Blacka (2010). *Australian Rainfall and Runoff Revision Projects, Project 10, Appropriate Safety Criteria for People, Stage 1 Report*, Institution of Engineers, Australia, Barton ACT, 2010.

Departments of Sustainability and Environment (DSE, 2007). *Your Dam Your Responsibility*. State Government of Victoria (www.water.vic.gov.au).

Froehlich, D.C. (1995). *Peak Outflow From Breached Embankment Dam*. Journal of Water Resources Planning and Management, vol. 121, no. 1, p. 90-97.

Schaefer, Melvin G. (1992). *'Dam Safety Guidelines – Technical Note 1: Dam Break Inundation Analysis and Downstream Hazard Classification'* Washington State Department of Ecology, July 1992 (Revised October 2007).

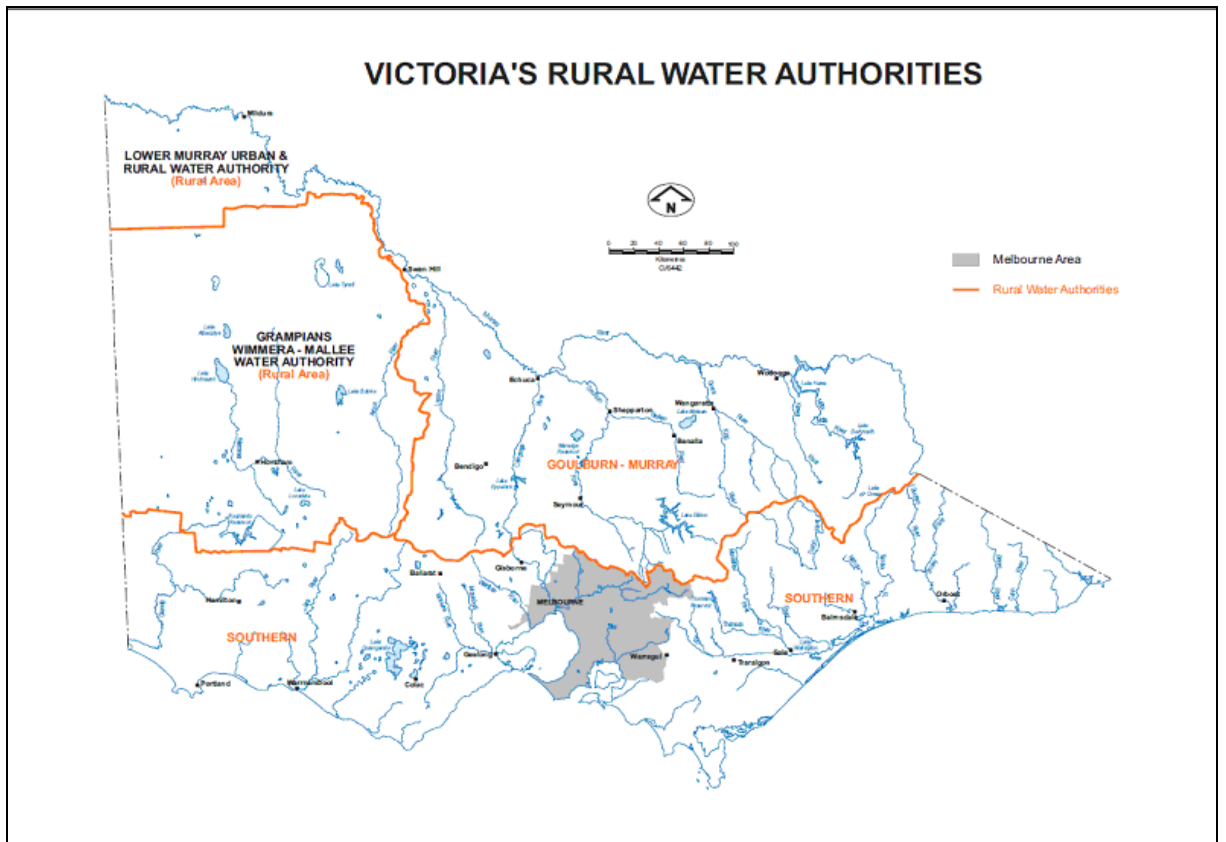
5. Glossary

TERM	DEFINITION
Large Dam (ANCOLD)	<p>A large dam is defined as one which is:</p> <p>(a) more than 15 metres in height measured from the lowest point of the general foundations to the 'crest' of the dam; or</p> <p>(b) more than 10 metres in height measured as in (a) provided they comply with at least one of the following conditions:</p> <ul style="list-style-type: none"> (i) the crest is not less than 500 metres in length; (ii) the capacity of the reservoir formed by the dam is not less than one million cubic metres; (iii) the maximum flood discharge dealt with by the dam is not less than 2000 cubic metres per second (approximately 170,000 ML/d); and (iv) the dam is of unusual design. <p>No dam less than 10 metres in height is included.</p>
Population at Risk (PAR)	<p>The PAR includes all people who would be directly exposed to flood waters assuming they took no action to evacuate. The PAR should be assessed using demographic data including dwelling occupancy rates, school populations, work sites and other places where people assemble (eg. Industrial, hospital, commercial and retail areas). The PAR may vary according to time of day, day of week and season.</p>
Potential Loss of Life (PLL)	<p>The PLL is synonymous with the term Loss of Life (LOL) as described in the ANCOLD <i>Guidelines in Risk Assessment</i> (2003b). PLL may be used where:</p> <ul style="list-style-type: none"> • a risk assessment has already been undertaken consistent with ANCOLD <i>Guidelines in Risk Assessment</i>; or • a loss of life assessment is undertaken in accordance with the recommendations of ANCOLD's <i>Guidelines on the Consequence Categories for Dams</i> (October 2012). <p>PLL estimates resulting from a potential dam failure can be influenced by factors including:</p> <ul style="list-style-type: none"> • warning time for people exposed to the life threatening flood waters; • severity of the flood event and types of failure scenarios used in the evaluation; • time of failure, including day, night, season; and • inability to precisely determine the fatality rate.
Suitably Qualified Engineer (DSE, 2007)	<p>A professional engineer who:</p> <ul style="list-style-type: none"> a) has qualifications sufficient for eligibility for membership of Engineers Australia; b) is recognized by the engineering profession as experienced in the engineering of dams; c) is competent to undertake the investigation, design, construction supervision, repair and remedial work, operational, surveillance, maintenance and decommissioning activities associated with farm dams; and d) has an appropriate amount of professional indemnity insurance.

Appendix A: Licensing Authorities

The licensing authority function under the *Water Act 1989* is delegated to the following water corporations:

- Goulburn Murray Water;
- Grampians Wimmera Mallee Water;
- Lower Murray Water;
- Melbourne Water; and
- Southern Rural Water.



Appendix B: ANCOLD Guidelines

Guidelines for Design of Dams for Earthquake, 1998.

Guidelines on Selection of Acceptable Flood Capacity for Dams, 2000.

Guidelines on the Environmental Management of Dams, 2001.

Guidelines on Dam Safety Management, 2003(a).

Guidelines on Risk Assessment, 2003(b).

Guidelines on the Consequences Categories for Dams 2012.

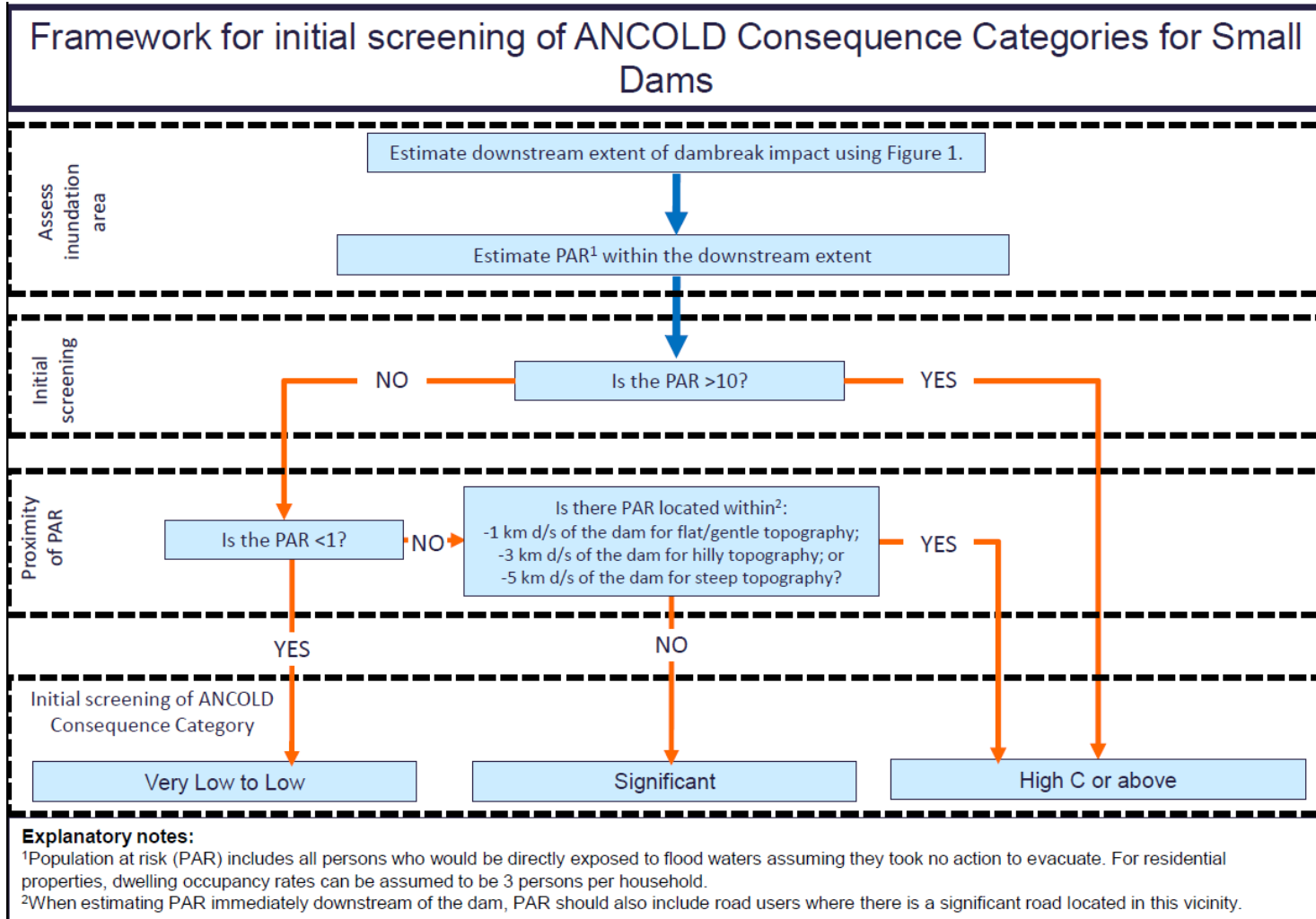
Appendix C: Screening Tool Input Fields

Table C-1 Input fields available when adding a new dam for assessment

Section	Fields	Optional or Compulsory	Description
	Date of assessment	Automatic	Date on which the dam was entered into the Screening Tool. Date is automatically generated.
	User	Optional	Identifier for the user whom entered the dam into the Screening Tool.
General Information	Dam No./Service ID	Compulsory	Dam identifier. Cannot be changed once saved into the Screening Tool.
	Dam Name/Works ID	Compulsory	Secondary dam identifier. Cannot be changed once saved into the Screening Tool.
Dam Information	Dam Volume	Compulsory	Storage capacity of the dam. Cannot be changed once saved into the Screening Tool.
Downstream extent of dambreak impact	Downstream topography	Optional	Topography downstream of the dam. Required to estimate the downstream extent of the dambreak impact. Three options are available: <ul style="list-style-type: none"> • Flat/gentle; • Hilly; or • Steep.
	Downstream extent of dambreak impact	Optional	Automatically calculated from Figure 2-2. This provides an estimate of the maximum distance downstream of the dam where the Population at Risk (PAR) should be considered in making an initial assessment of Consequence Category.
	Adopted extent	Optional	A downstream extent can be entered by the user to overwrite the downstream extent above where more detailed information is known about where the flood wave from a dambreak event would travel. E.g. The user may enter a distance downstream of the dam in which to consider the PAR which is less than that which is estimated using Figure 2-2 as there is a creek located downstream of the dam which would capture the dambreak flood.
	Comments relating to dambreak extent	Optional	The user should record any comments relating to the estimate of the downstream extent of dambreak impact for future reference.
Initial Screening and Proximity of PAR	Estimate of PAR within downstream extent	Compulsory	The initial estimate of the Population at Risk (PAR) located within the downstream extent described above. The PAR includes all persons who would be directly exposed to flood waters assuming they took no action to evacuate. For residential properties, dwelling occupancy rates can be assumed to be 3 persons per household. When estimating PAR immediately downstream of the dam, PAR should also include road users where there is a significant road located in this vicinity. The ANCOLD guidelines suggest considering a height above the stream bed of between one third (1/3) and one half (1/2) of the dam height when assessing flood level.

Section	Fields	Optional or Compulsory	Description
	PAR located within 1 km d/s of the dam for flat/gentle topography, 3 km d/s for hilly topography or 5 km d/s for steep topography?	Compulsory if PAR <=10	Identify if there is PAR located within: <ul style="list-style-type: none"> • 1 km d/s of the dam for flat/gentle topography; • 3 km d/s for hilly topography; or • 5 km d/s for steep topography. This input is only required if the Total PAR estimate is less than or equal to 10 and the permanent PAR is not less than one (refer figure 2-1).
	Source of estimate of Total PAR	Optional	The method/s for estimating the initial PAR can be selected from the check list. Six customisable check list labels are available. One check box labelled 'Other' is also available. If this option is selected the user should enter the other method into the adjacent comment box.
	Comments relating to PAR	Optional	The user should record any comments relating to the estimate of the PAR.
Assessment of Consequence Category	Initial assessment of ANCOLD Consequence Category	Automatic	Automatically calculated. The Consequence Category is estimated using the Framework for Initial Screening of ANCOLD Consequence Categories for Small Dams.

Appendix D: Framework for Screening of ANCOLD Consequence Categories for Small Dams as specified in the Screening Tool



Appendix E: Example of a Populated Assessment Sheet

Initial Assessment of ANCOLD Consequence Category for Small Dams	
Date of Assessment	9/11/2012
User	A. Smith
General Information	
Dam No./Service ID	12345
Dam Name/Works ID	ABC Dam
Dam Information	
Dam Volume (ML)	325
Downstream extent of dambreak impact	
Downstream topography:	Hilly
Downstream extent of dambreak impact:	12 km <i>(calculated from Figure 1)</i>
Adopted extent:	5 km
Comments:	River located 5 km downstream of dam would capture dambreak flood.
Initial estimate of PAR within downstream extent	
Initial estimate of PAR:	2
Source of initial PAR estimate:	<input type="checkbox"/> Aerial imagery <input type="checkbox"/> Formal site inspection <input checked="" type="checkbox"/> Dam engineer's report <input type="checkbox"/> Licence application <input type="checkbox"/> Works plans <input type="checkbox"/> Owner knowledge <input type="checkbox"/> Other
Confirm PAR Estimate and Proximity of PAR	
Confirmed estimate of PAR:	2
Is there PAR located within:	- 1 km d/s of the dam for flat/gentle topography; <input type="radio"/> Yes <input checked="" type="radio"/> No - 3 km d/s of the dam for hilly topography; or - 5 km d/s of the dam for steep topography?
Source of confirmed PAR estimate:	<input type="checkbox"/> Aerial imagery <input type="checkbox"/> Formal site inspection <input checked="" type="checkbox"/> Dam engineer's report <input type="checkbox"/> Licence application <input type="checkbox"/> Works plans <input type="checkbox"/> Owner knowledge <input type="checkbox"/> Other
Comments:	1 residential property located 3 km downstream of dam may become inundated. 2 residents estimated at property.
Assessment of Consequence Category	
Initial assessment of ANCOLD Consequence Category	Significant



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