



Engineering

Technical Standard

TS 0601 - Design, Assessment and Retrofitting of SA Water Assets in Bushfire-Prone Areas

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Only the current revision of this Standard should be used which is available for download from the SA Water website.

Significant/Major Changes Incorporated in This Edition

Nil.

This is the first issue of this Technical Standard.

Document Controls

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1 Introduction

SA Water is responsible for operation and maintenance of an extensive amount of engineering infrastructure within state-wide Bushfire Prone Areas.

This standard has been developed to assist designers develop new assets and for assessment and retrofitting of existing assets to be more resilient to the damaging impacts of bushfires.

Existing Australian Standards and South Australian legislation provides guidance to the design and construction of residential properties within Bushfire Prone Areas. However, these documents do not consider the unique built form and criticality of SA Water assets.

This Technical Standard builds on these existing Australian Standards and legislation to appropriately identify and mitigate the risk of bushfires on SA Water assets.

It shall be considered that the primary objective of this technical Standard is to improve design, construction, operation and maintenance, and thus minimize risk of damage from the effects of bushfire attacks.

However, due to the unpredictable nature and behaviour of fire and the associated extreme weather conditions, it is acknowledged that it will not guarantee that the asset will survive a bushfire on every occasion. In such cases, and depending on asset criticalities, an expert advice shall be sought, and additional measures implemented, when deemed necessary.

1.1 Purpose

The purpose of this standard is to detail SA Water's minimum requirements to ensure that assets covered by the scope of this standard are designed, constructed and maintained to consistent standards and attain the required asset life with minimum risk of service interruptions and damage from the effects of bushfire attacks.

1.2 Glossary

The following glossary items are used in this document:

| Term | Description |
|----------|-----------------------------------------------|
| APZ | Asset Protection Zone |
| BAL | Bushfire Attack Level |
| BMAP | Bushfire Management Area Plan |
| CFS | South Australian Country Fire Service |
| FDI | Fire Danger Index |
| FRL | Fire Resistance Level |
| NCC | National Construction Code |
| NERAG | National Emergency Risk Assessment Guidelines |
| SAPPA | South Australia Property Planning Atlas |
| SA Water | South Australian Water Corporation |
| TG | SA Water Technical Guideline |
| TS | SA Water Technical Standard |

1.3 References

1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

| Number | Title |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AS/NZS ISO 31000 | Risk Management – Principles and Guidelines |
| AS 1530.1 | Combustibility Test for Materials. |
| AS 1530.8.1 | Methods for fire tests on building materials, components, and structures: Part 8.1 Tests on elements of construction for buildings exposed to simulated bushfire attack – Radiant heat and small flaming sources. |
| AS 1530.8.2 | Methods for fire tests on building materials, components, and structures: Part 8.2: Tests on elements of construction for buildings exposed to simulated bushfire attack – Large flaming sources. |
| AS 3959 | Construction of buildings in bushfire prone areas. |
| AS 5414 | Bushfire water spray systems |

1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

| Number | Title |
|-------------------------------|-----------------------------------------------------------------------------------|
| SAWS-LM-0003 | Bushfire Prevention Standard ¹ |
| SAWL-OPS-0013 | Bushfire Preparedness Checklist ¹ |
| SAWD-EMS-0017 | Native Vegetation Standard Operating Procedure ¹ |
| SAWS-ENG-0245 | Design Requirements for Ventilation and Cooling Systems (<i>when published</i>) |
| SAW IP&S BCI List | Business Critical Infrastructure (BCI) October 2021 Report |

1) Available on request from Manager Environment, Land and Heritage Expertise

1.3.3 Other References

The following table identifies other documents referenced within this document which have been prepared by other governing bodies:

| Title | Web Address |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| South Australia Property Planning Atlas | https://sappa.plan.sa.gov.au/ |
| Adelaide and Mount Lofty Ranges BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=19107228eda348d69471e280d37a06c0 |
| Fleurieu BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=c8392b87647146d89a81bad4361c05d7 |
| Flinders Mid-North Yorke BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=a26972fffc624f888e0e9e6b99906c77 |
| Limestone Coast BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=1fbeace168b14c1f8760772edf777d3e |
| Kangaroo Island BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=5598c493e87a46fd97184c32d861c39a |
| Lower Eyre Peninsula BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/MapSeries/index.html?appid=edc3f6d6e02a4a24b5825a569d844444 |
| Murray Mallee BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=2edab976d4ba40399a798986b53db9e7 |
| Outback Bushfire Management Area Plan | https://cfs.geohub.sa.gov.au/portal/apps/MapSeries/index.html?appid=e615d9b95a2048ab84f2fa3b686e43c2 |
| Upper Eyre Peninsula BMAP Online Map | https://cfs.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=872619ba8745460794a9f8781554da59 |
| SA Country Fire Service's: <i>Rural Fire Hazard State Risk Assessment Report</i> | https://safecom-files-v8.s3.amazonaws.com/current/docs/rural fire hazard state risk assessment report%20%281%29.pdf |
| Department for Environment and Water's: <i>Overall Fuel Hazard Guide for South Australia</i> | https://www.environment.sa.gov.au/files/sharedassets/public/fire_management/fire-fuel-hazard-assessment-sheet-gen.pdf |
| SA State Bushfire Coordination Committee's: <i>Fire Management Zone Standard and Guidance for Use 2.0</i> | https://safecom-files-v8.s3.amazonaws.com/current/docs/2020%20Bushfire%20Management%20Zone%20Standard%20and%20Guidance%20for%20Use%20%20Final%20v2.pdf |

1.4 Definitions

The following definitions are applicable to this document:

| Term | Description |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accepted | Determined to be satisfactory by SA Water's Representative |
| Active Bushfire Protection | Equipment which is activated in the event of a bushfire to protect the asset. Examples include bushfire sprinkler systems. |
| Bushfire Attack Level | Refers to the bushfire attack levels as determined in AS 3959. The bushfire attack level indicates the level of radiant heat in kW/m ² . |
| Bushfire Management Plan | Refers to a document which outlines all of the sites bushfire protection measures which have been implemented. This includes the site criticality, BAL (contour map), details bushfire protection measures, details of ongoing vegetation management (frequencies) and other maintenance activities. Document is to be finalised by constructor prior to handover to SA Water. |
| Constructor | The organisation responsible for constructing and installing infrastructure for SA Water whether it be a third party under contract to SA Water or an in-house entity. |
| Contract Documents | A set of documents supplied to Constructor as the basis for construction; these documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes |
| Designer | The organisation responsible for designing infrastructure for SA Water whether it be a third party under contract to SA Water or a Constructor, or an in-house entity |
| Firebreak | A firebreak is an area or strip of land where vegetation has been removed or modified to reduce the risk of fires starting and reduce the intensity and rate of spread of fires that may occur. A firebreak should incorporate a track used for fire access where practicable. Other purposes for firebreaks are to: (a) Provide protection for personnel, equipment and property from fire (b) Provide an edge from which fire crews can undertake fire suppression or prescribed burning. |
| Fuel | Fuel in the context of bushfires are living and dead vegetation that influence the speed and intensity of a bushfire. |
| Passive Bushfire Protection | Refers to the provision of passive systems which reduce the risk of bushfire on the asset. Examples include the use of non-flammable construction materials. |
| Responsible Discipline Lead | The engineering discipline expert responsible for TS 0601 as defined on page 3 (via SA Water's Representative). |
| SA Water's Representative | The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): <ul style="list-style-type: none"> • Superintendent's Representative (e.g. AS 4300 & AS 2124 etc.) • SA Water Project Manager • SA Water nominated contact person |
| 'Shall' and 'Should' | In this Standard the word 'shall' indicates a requirement that is to be adopted in order to comply with the Standard. The word 'should' indicates practices which are advised or recommended. |
| TDRF | Technical Dispensation Request Form. This form is part of SA Water's Technical Dispensation Request Procedure which details the process by which those required to comply, or ensure compliance, with SA Water's technical requirements may seek dispensation from those requirements. |

| Term | Description |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terminology | <ul style="list-style-type: none"> ● Where an obligation is given and it is not stated who is to undertake these obligations, they are to be undertaken by the Constructor. ● Directions, instructions and the like, whether or not they include the expression 'the Constructor shall' or equivalent, shall be directions to the Constructor, unless otherwise specifically stated. ● Where a submission, request, proposal is required and it is not stated who the recipient should be, it is to be provided to SA Water's Representative for review. ● Each word imparting the plural shall be construed as if the said word were preceded by the word "all". ● Each word implying persons shall, where appropriate, also be construed as including corporations. ● "Authorised", "approval", "approved", "selected", "directed" and similar words shall be construed as referring to the authorisation, approval, selection or direction of SA Water's Representative in writing. ● "Allow" shall mean that the cost of the item referred to is the responsibility of the Constructor. ● "Provide" shall mean "supply and install". ● "Submit" shall mean "submit to SA Water's Representative or his nominated delegate". ● Submissions, requests, proposals are to be provided at least 7 working days prior to work commencing or material ordering (unless noted otherwise). ● "Informative" shall mean "provided for information and guidance" |
| Understorey Plants | Understorey vegetation includes small trees, shrubs, herbs, grasses, mosses, and lichens that occupy the vegetation layers below the canopy of taller trees. |
| Works | Elements of a project which require design and/or construction |

2 Objectives, Scope and Application

2.1 Objectives of this Standard

The main objectives of this standard are:

1. Consideration for bushfire design requirements, at very early stage of the project development, as bushfires have significant financial and environmental impacts.
2. Outline the process of identifying whether a new, or existing asset is located within a Bushfire Prone Area.
3. Reduce the assets Bushfire Attack Level (BAL) in accordance with the criticality of the asset.
4. Development of appropriate passive and active systems to protect the assets.
5. Specify minimum construction standards for SA Water assets proposed in bushfire-prone areas noting that building regulations do not adequately cover the construction of non-residential buildings.
6. Improve design, construction, operation and maintenance, and thus minimize risk of damage from the effects of bushfire attacks and risk of service interruptions during a bushfire.
7. Provide a robust system to protect SA Water assets including establishment of Asset Protection Zones, safe access for firefighting services and taking into consideration their response time.
8. Assessment of existing assets against bushfire risks and make recommendations on land and fuel management and building controls to minimise or reduce bushfire risks.
9. Emphasise the need for continued maintenance works to ensure the standards that applied at the time of construction are maintained throughout the life cycle of an asset (via Maintenance PM Task Reports).
10. Engagement with Country Fire Service (CFS) personnel to ensure on-site firefighting strategies align with their requirements.
11. Engagement with key internal/external stakeholders.

This standard considers that in the event of a bushfire the site is un-attended and all SA Water personnel have safely egressed the site prior to the approach of a fire front.

2.2 Scope of this Standard

This standard specifies minimum SA Water requirements for the design of new assets and assessment and retrofitting of existing assets in Bushfire Prone Areas.

It applies to all assets in the following Bushfire Attack Levels as defined in Section 3.2:

- BAL-LOW
- BAL-12.5
- BAL-19
- BAL-29
- BAL-40

This standard does not apply to SA Water assets which are identified to have BAL-FZ. Such assets shall require business risk assessment to verify that this risk is acceptable. Development of alternative design solutions for BAL-FZ assets are outside the scope of this Technical Standard.

2.2.1 Technical Dispensation

Departure from any requirement of this Technical Standard shall require the submission of Technical Dispensation Request Form (TDRF) for the review and approval (or otherwise) of SA Water Principal Engineer listed in Page 3, on a case-by-case basis.

The Designer shall not proceed to document/incorporate the non-conforming work before the Principal Engineer has approved of the proposed action in writing via the Technical Dispensation Request Form (TDRF).

SA Water requires sufficient information to assess dispensation requests and their potential impact. The onus is therefore on the proponent to justify dispensation request submissions and provide suitable evidence to support them.

Design works that are carried out without being appropriately sanctioned by SA Water shall be liable to rejection by SA Water and retrospective rectification by the designer/constructor.

2.3 Bushfire Design and Project Development Phases

The process of identifying, designing, and operating and maintaining assets within Bushfire Prone Areas is provided within Table 1.

| Design Phase | Bushfire Design Tasks |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition Phase | <ol style="list-style-type: none"> 1. Determine if the site is within a bushfire Prone Areas using SAPPA. |
| Concept Design Phase | <ol style="list-style-type: none"> 1. Review the bushfire history and requirements of the region Bushfire Management Area Plan (BMAP). 2. Liaise with the SA Water Environmental and Heritage, Land and Fire Management teams, CFS and local council to understand the local requirements. 3. Define a project-specific criticality rating. 4. Undertake a site visit (with appropriate subject matter experts such as SA Water Environment and Heritage team) to familiarise yourself with the site(s) and its surrounding including vegetation classification, fuel loads and vegetation height, effective slope, etc. 5. Capture aerial point cloud of the current site and nearby vegetation. 6. Develop a site-specific BAL in accordance with AS 3959 Simplified Procedure (Method 1), based on a Fire Danger Index (FDI) of 100 for SA. 7. Where possible, consider the use of alternative sites which have a reduced BAL. 8. Undertake a bushfire risk assessment in accordance with the National Emergency Risk Assessment Guidelines (NERAG) (2020) – Refer Section 5. 9. Design a protection strategy. 10. Document in the Concept Design Report. |
| Detailed Design Phase | <ol style="list-style-type: none"> 1. Engage a specialist fire consultant (refer to Section 3.3 for qualifications). 2. Undertake due diligence review of Concept Design works, listed above, and update, as required, including: <ul style="list-style-type: none"> • Update the site-specific Bushfire Attack Level (BAL) in accordance with AS 3959 Appendix B Detailed Method (Method 2), based on a Fire Danger Index (FDI) of 100 for SA. 3. Design a protection strategy based on the hierarchy of protection. 4. Engage with CFS to seek approval of proposed mitigation strategies. 5. Develop a site-specific Bushfire Management Plan that covers the lifecycle of the assets from design to construction and operation. 6. Document in the detailed design drawings, report and in the Safety in Design documentation. |

| | |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction Phase | <ol style="list-style-type: none">1. Update the site-specific Bushfire Management Plan.2. Update drawings to As-Constructed.3. Submit as part of the Project Master Document Register (MDR). |
| Operations Phase | <ol style="list-style-type: none">1. Familiarise yourself with the requirements of the site-specific Bushfire Management Plan.2. Undertake routine planned maintenance works. |

Table 1 – Bushfire Design and Project Development Phases.

Depending on the complexity of the project, some of the design tasks listed under the Detailed Design Phase can be brought forward to the Concept Design Phase and vice versa. For instance, engagement of a specialist fire consultant, establishing a more accurate BAL assessment and development of a site-specific Bushfire Management Plan can be undertaken at the Concept Design Phase rather than the Detailed Design Phase.

3 Bushfire Attack Level Assessment

3.1 Determining if the Site is within a Bushfire Prone Area

The South Australian Property and Planning Atlas (SAPPA) is managed by the South Australian Government and is part of the Development Application process for residential properties in accordance with the Development Regulation (2008).

At the Project Definition Phase, SAPPA shall be used to identify whether the asset falls within a Bushfire Prone Area as determined by the Government. These equivalent BAL within these zones is defined within The South Australian Ministerial Building Standard MBS008.

SAPPA can be found online in the following website:

<https://sappa.plan.sa.gov.au/>The bushfire data can be accessed by selecting "Layers" -> "Planning and Building" -> "Planning and Design Code" -> "Overlays" -> "Hazard Overlays" -> "Hazards (Bushfire)".

The overlay identifies the bushfire prone areas throughout South Australia. Overlays which indicate that the asset is within a Bushfire Prone Area is as follows:

- Hazards (Bushfire – High Risk) - Requires an AS 3959 assessment (Refer Section 3.2)
- Hazards (Bushfire – Medium Risk) - Equivalent to BAL-12.5
- Hazards (Bushfire – General Risk) - Equivalent to BAL-LOW
- Hazards (Bushfire – Urban Interface): Urban Interface Zones within 500 m and no closer than 100 m of a Bushfire High Risk region is equivalent to BAL-LOW. Where assets are within 100 m from the High-Risk region, an AS 3959 assessment is required (Refer Section 3.2).

If the asset is within one of the hazard zones identified, then an assessment of the BAL is required in accordance with this standard and AS 3959. Refer Section 3.2 for details.

If the asset falls within an urban centre (such as the Adelaide metropolitan area or large regional towns) there will be no hazard overlay in the area. Therefore, the risk associated with bushfire is negligible and treatment of the bushfire risk is not required.

The outcome of this assessment is to be incorporated into the Master Planning reporting and the sites Bushfire Management Plan.

The South Australian government has also prepared a BMAP for each of the 9 major regions. This plan includes assessments from CFS to identify the risk within different localised areas. However, the data within the BMAP does not cover as much area as the SAPPA data, and as such is not preferred.

3.2 Bushfire Attack Level Assessment

A BAL assessment is the means of measuring the severity of a buildings' potential exposure to ember attack, radiant heat, and direct flame contact. This directly influences the required vegetation reduction and construction materials.

This is expressed in increments of radiant heat (kW/m²) and is detailed in Table 2.

| BAL | Description (As per AS 3959-2018) |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BAL-LOW | The risk is considered to be VERY LOW. There is insufficient risk to warrant any specific construction requirements but there is still some risk. |
| BAL-12.5 | The risk is considered to be LOW. There is a risk of ember attack. The construction elements are expected to be exposed to a heat flux of not greater than 12.5 kW/m ² . |

| BAL | Description (As per AS 3959-2018) |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BAL-19 | The risk is considered to be MODERATE. There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 19 kW/m ² . |
| BAL-29 | The risk is considered to be HIGH. There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 29 kW/m ² . |
| BAL-40 | The risk is considered to be VERY HIGH. There is a much increased risk of ember attack and burning debris ignited by windborne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux of not greater than 40 kW/m ² . |
| BAL-FZ | The risk is considered to be EXTREME. There is an extremely high risk of ember attack and burning debris ignited by windborne embers, and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux greater than 40 kW/m ² . |

Table 2 – Summary of the BAL as per AS 3959 (2018).

A site-specific BAL shall be established using the two methods stipulated in AS 3959 (2018); these are:

- Simplified Procedure (Method 1) – Simplified procedure that involves five steps to determine the BALs which is subject to limitations on the circumstances in which it can be used. To be used during Concept Design Phase.
- BAL Contour Map (Method 2) – An extended procedure which considers the different BAL across a large site with spread out structures. To be used during the Detailed Design Phase.

3.2.1 SA Water BAL Design Requirements

In order to reduce the risk to the SA Water assets the following shall be targeted for each site:

- Reduce the site BAL to BAL-12.5 or consider alternative sites which can achieve a BAL-12.5; or
- Design and construction of assets to minimise the bushfire risk based on their criticality.

BMPs are to be developed for existing sites detailing short- and long-term measures to be implemented. The BMP will need to consider the current environmental and heritage value of the site, site constraints and operation criticalities.

3.2.2 Simplified Procedure (Method 1)

The Simplified Procedure is as per AS 3959 (2018) and is provided below for information:

- Step 1 – Determine FDI (FDI = 100 for South Australia based on recommendations of the State Bushfire Committee).
- Step 2 – Determine the classified vegetation type (based on the information within AS 3959 (2018). Note any exclusions as per AS 3959 Section 2.2.3.2.

- Step 3 – Determine the distance of the site from the classified vegetations type. This can be done by satellite imagery (such as Google Maps) if there have been no significant changes to the on-site vegetation. If significant changes have occurred drones shall be utilised to develop current satellite imagery of the site.
- Step 4 – Determine the effective slope under the classified vegetation. This is to be calculated as an average based on a suitable form of measurement (such as a dumpy level) and verified as part of an engineering survey. Engineering surveys can be reused for existing sites where available.
- Step 5 – Determine the BAL from the tables within AS 3959 (2018).

The results are to be incorporated within the design reporting and in the site-specific Bushfire Management Plan.

3.2.3 BAL Contour Map (Method 2)

3.2.3.1 Introduction

A BAL Contour Map is a scale map of a development site including the proposed layout which identifies the indicative BAL ratings across the site.

The map illustrates potential BALs and radiant heat impacts in relation to classified vegetation that will remain within 100 m of the assessment. This enables designers to appropriately layout the site equipment and building envelopes to assist in mitigating the bushfire risk.

Examples of BAL Contour Maps and Vegetation Classification Maps are provided within Appendix C.

3.2.3.2 Contour Map Assessment Methodology

The BAL contour map shall be prepared in accordance with this Technical Standard and the principles of AS 3959 (2018).






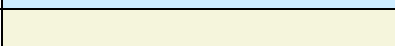
Step 1: Identify vegetation types and slope

- Using an appropriate aerial photo to define the vegetation assessment area that is to be the subject of the Vegetation Classification Map. The aerial photo shall clearly show the vegetation density and structure. The subject site (i.e. tank) and all the land within 150 m of the site's external boundary is to be included in the vegetation assessment area.
- Classify all vegetation within the vegetation assessment area through a site inspection and provide photos. The vegetation is to then be classified in accordance with AS 3959 (2018) and reviewed by SAW Environmental and Heritage team or qualified external consultant.
- Analyse the land contour information (via engineering survey) and define the slope for each assessment area.
- The Vegetation Classification Map shall form the base map for the Contour Map and shall at least include the following information:
 - Areas of vegetation and excluded vegetation (if any) in the form of plots.
 - Classification information of vegetation.
 - Photo points to indicate where images of vegetation have been taken.
 - Any other relevant features of the site that need to be considered.

Step 2: Map the BAL Contours

- Define the BAL Contour assessment area by indicating the area within 100 metres of the external boundary of the site.
- When determining the BAL rating for each assessment, identify the slope of the land underneath the classified vegetation.

- The contour measurements need to be done at the frequency and locations dictated by site conditions to present the worst-case scenario. This is typically where either the slope or vegetation changes.
- Where there are no changes to vegetation or slope, the contour measurements shall be at intervals to provide a worst-case scenario measurement of no more than 50 metres.
- The BAL contours will be formed by combining the BAL assessment at each of the assessment transects.
- Where multiple BAL ratings apply to an area, the higher BAL rating shall apply.
- The contours shall consider the future state of the site (i.e. after any planned land clears have occurred). These shall be adequately identified on the map.
- The inputs used to determine the BAL contours (i.e. vegetation lot number, vegetation classification, effective slope, actual separation distance, BAL rating).
- The map shall be revised throughout the design, construction, and handover of the site to indicate the location of the structures throughout the site.
- Colours for the BAL Contour Map is provided below:

| BAL | Colour | Colour Patch |
|----------|------------|---------------------------------------------------------------------------------------|
| BAL-FZ | Red |  |
| BAL-40 | Orange |  |
| BAL-29 | Yellow |  |
| BAL-19 | Blue |  |
| BAL-12.5 | Light Blue |  |
| BAL-LOW | Beige |  |

NOTE – The BAL Contour Map colours shall be displayed at a transparency level of 25% - 35%. This provides a clearer distinction between the BAL contours and to make the vegetation of the underlying aerial image visible.

3.3 Competency of Bushfire Expertise

Where a specialised bushfire expertise is to be engaged to conduct a BAL assessment and assist with the design of new assets and assessment and retrofitting of existing assets in Bushfire-Prone Areas, as set-out within this Technical Standard, relevant documentation and justification shall be submitted to the SA Water Representative for review and acceptance, in order to demonstrate the personnel suitability relevant to the size and complexity of the works.

The main objectives of engaging such expertise can be summarised as follows:

- Compliance with this Technical Standard.
- Providing effective, professional and consistent technical directions during the various stages of project development.
- Improving bushfire risk management measures being applied to land and assets.
- Strengthen SA Water assets' resilience to bushfire events to ensure continuance of services supply that meet SA Water obligations in regard to Level of Services, as mandated by Legislation, Standards and Australian Codes of Practice.

3.3.1 Qualifications of Personnel – BAL Assessor

The BAL assessment officer is responsible for conducting desktop and onsite assessment of the BALs taking into consideration the various factors influencing the assessment (refer Section 0), including but not limited to:

- Determining the appropriate BAL using Method 1 (simplified method of Section 3.2.2) and AS 3959.
- Providing general advice on the design and construction requirements in compliance with this Technical Standard and industry best practices.

While there is no requirement for bushfire accreditation to conduct a BAL assessment in South Australia, the assessment shall be conducted by an experienced contractor (minimum 5 years' experience) competent individual who has undertaken specific training in BAL assessments (such as Bushfire Attack Level Short Courses provided by FPA Australia).

3.3.2 Qualifications of Personnel – Fire Engineer

The Fire Engineer is responsible for ensuring that the design and construction work is completed in accordance with this Technical Standard and the development of design solutions that meet its requirements, including but not limited to:

- Undertaking bushfire hazard level assessments according to this Technical Standard.
- Developing BAL Contour Maps (Method 2 of Section 3.2.3).
- Application of bushfire protection hierarchy (Section 6) to develop acceptable solutions for planning designs according to this Technical Standard and industry best practices.
- Development of Bushfire Management Plans according to this Technical Standard (section 11).
- Provision of technical directions for planning and design purposes throughout the various stages of a project development.
- All the activities described for the BAL Assessor.

Where required, the Fire Engineer may propose alternative design solutions that achieve the main objectives of this standard (refer Section 2.1); such alternatives shall require a Technical Dispensation as per Section 2.2.1.

The Fire Engineer shall be a engineer with at least 5 years' experience and shall hold one of the following certifications:

- Chartered or registered on a training scheme to become a Chartered Engineer; or
- Graduate Certificate or Diploma in Building Fire Safety or Equivalent; or
- FPA Bushfire Attack Level Short Course operating by FPA Australia.

4 Bushfire Mechanisms and Climate (Informative)

4.1 Introduction

This section of the Technical Standard provides further information about bushfires. The information has been developed from the following sources:

| Document Name | Author | Revision / Date |
|---------------------------------------------------------|-------------------------------------------------|-----------------|
| 2009 Victorian Bushfire Royal Commission – Final Report | Bernard Teague Ronald McLeod Susan Pascoe | 2010 |
| Bushfire Research | Fire and Rescue New South Wales | 2021 |
| State of the Climate 2020 | Bureau of Meteorology | 2020 |

4.2 Mechanisms of Asset Damage During a Bushfire

4.2.1 Ember Attack

Ember attack can occur before, during and after a fire front has passed and is more intense in hot, dry, and windy conditions. It persists for the longest time and affects areas that are not reached by the main fire front. Recent studies indicate ember attack as being the highest cause for loss of buildings, with some houses destroyed at 700 metres from continuous vegetation in the 2003 Canberra bushfires and in Kinglake during the 2009 fires. Embers can ignite a building via entering through a small gap in the building structure.

4.2.2 Radiant heat

Radiant heat is projected from the fire front or from combustible elements on or near a building. Such heat can cause structural failure (melting or cracking), heat a building component to the point that gases ignite (either from embers or spontaneously) or dry the surface of the material, increasing its flammability.

4.2.3 Flame contact

Flame contact occurs across shorter distances than ember attack and radiant heat and can come from the fire front or other sources. Risk of direct flame contact is influenced by the siting of the building and the amount of fine fuels close to the building or heavier fuel sources such as fences and decks close by. The combustibility of external building elements is crucial to a building's vulnerability to ignition from direct flame contact.

4.2.4 Factors which Affect Bushfire Behaviour

Bushfire behaviour is determined by three factors as described below:

Fuel

Although fuel may be present in large quantities it is the condition of the fuel that, to a large extent, determines its flammability. The factors affecting the flammability of fuel are:

- size
- quantity (tonnes per hectare)
- type
- arrangement
- fuel moisture content (Percentage Oven-Dried Weight).

Weather

It is the difficulty in predicting fire behaviour that greatly increases the inherent dangers of bushfire fighting. The effects of weather can cause a bushfire to be unpredictable. It has the ability to cause a fire to increase in intensity and rate of spread, change in direction and fiercely erupt.

Fire behaviour can be altered by the effects of:

- wind
- temperature
- relative humidity
- atmospheric stability
- frontal movement
- effects of drought.

Topography

Topography can have a great impact on a bushfire's behaviour. During fires at Jindabyne and adjacent areas it was common knowledge to local residents that the surrounding mountain range had the potential to change a Westerly wind at the Southern tip of the ranges to a South/Westerly and further Northward along the Eastern side of the range to a South/Easterly to Easterly wind. Such is the affect of the mountain range. It requires a great deal of experience and local knowledge to be able to interpret the effects of such winds so as to accurately determine a fire's movements. A fire's progress will be affected to a large extent by the lay of the land. Slope will cause a fire to slow if it is burning downhill or accelerate if it is moving uphill.

The extent of the fire's progress, apart from the fuel load and weather conditions, will be determined by the angle of the slope. For each 10 degrees of uphill slope the fire will double in rate of spread. For each additional 10 degrees of slope, the rate of spread will double again. Similarly, for downhill slopes, for every 10 degrees of negative slope the rate of spread will halve, an additional 10 degrees again halving the fire's effects.

4.2.5 Climate Change

Australia's climate has warmed on average by 1.44 ± 0.24 °C since national records began in 1910, leading to an increase in the frequency of extreme heat events.

Fire weather is largely monitored in Australia using the FDI. This indicates the fire danger on a given day based on observations of temperature, rainfall, humidity and wind speed. The frequency of the most dangerous 10 per cent of fire weather days has increased significantly in recent decades across many regions of Australia, especially in the south and east. These increases are particularly evident during spring and summer and are associated with an earlier start to the southern fire weather season. Climate change is contributing to these changes in fire weather including by affecting temperature, relative humidity and associated changes to the fuel moisture content. Considerable year-to-year variability in fire weather also occurs. La Niña years, for example 2010–11 and 1999–2000, are associated with wet and cool climate anomalies and a lower number of days with high FDI values.

Dry lightning that occurs without significant rainfall is the primary source of natural ignition for bushfires. Understanding changes to bushfire ignition in Australia is a current area of active research, including the frequency of dry lightning. There is a significant trend in some regions of southern Australia towards more days with weather conditions conducive to extreme bushfires that can generate thunderstorms within their smoke plumes. These fire-generated thunderstorms can lead to extremely dangerous fire conditions, as observed during the 2019–20 summer, and for the Canberra (2003) and Victorian Black Saturday (2009) fires. In some cases, the lightning strikes produced from the smoke plumes generate new fires.

Climate change influences long-term trends in some of the key risk factors for bushfires in Australia. While the influence of climate change on long-term trends is clear, the attribution of a single fire event to climate change is difficult and is the subject of current research.

Climate change affects the dryness and amount of fuel, through changes in rainfall and air temperature and atmospheric moisture content that exacerbate landscape drying. Furthermore, increased CO₂ can also alter the rate and amount of plant growth, which may also affect the fuel load. Increased frequency and intensity of extreme heat as a result of climate change can also worsen extreme fire weather risk.

5 Risk Rating

5.1 Introduction

The risk rating process determines the extent of the bushfire mitigation strategies to be implemented based on the consequence and likelihood of a bushfire. This assessment is based on the National Emergency Risk Assessment Guidelines (NERAG) (2020).

NERAG is a document that has been prepared by the Australian Institute for Disaster Resilience and provides a nationally consistent approach to the risk assessment consistent with AS/NZS ISO 31000 (2018) "Risk Management – principles and guidelines".

There are numerous risk categories detailed within the NERAG. However, it has been adjusted to reflect the functions of SA Water assets and its impact on customers, level of services.

This process is to be conducted during the project feasibility and siting process to inform the minimum performance of the bushfire protection systems and is to be incorporated into the Bushfire Management Plan.

5.2 Bushfire Likelihood

The bushfire likelihood is to be assessed against historical fire data to determine the frequency of bushfires within the vicinity of the existing or proposed SAW Asset.

The process for determining the Bushfire likelihood is detailed as follows:

- Open <http://spatialwebapps.environment.sa.gov.au/firemaps/?viewer=firemaps> -> Select the "Layers" Tab -> Select "Map 3: Fire History"-> Turn off "Bush Fires – Last 10 Years" and "Prescribed Burns" -> Turn On "Fire Frequency (assumes one fire per year)" Layer.
- Determine if the existing, or proposed asset has previously been impacted by a bushfire by selecting the appropriate layer above the asset. If there is no layer above the asset then 0 bushfires have previously impacted the asset.
- Identify the likelihood on the Bushfire Likelihood Table 3 below:

| Quantity of Historical Bushfires | 0 | 1 | 2+ |
|----------------------------------|----------|--------|----------------|
| Resultant Likelihood | Possible | Likely | Almost Certain |

Table 3 – Bushfire Likelihood

5.3 Asset Criticality

The Asset Criticality Rating shall be defined based on assessment of bushfire consequences related to infrastructure, economy, services and social environmental well-being and public health as listed in Table 4.

On large sites which contain multiple different types of assets, each of the assets should be assessed separately. This will allow administrative, or storage building to be treated as a lower risk asset.

The Consequence Level shall be determined by the project team and incorporated into the sites Bushfire Management Plan during the preliminary design phases. The team should allocate a score for each of the consequence categories and select the highest resultant risk.

| Criticality Rating | Consequence Level | Infrastructure | Economic | Services | Social Environmental Well-being and Public Health |
|--------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Catastrophic | Long term failure of significant infrastructure (repairs will take longer than 6 months) and service delivery affecting all parts of the community, ongoing external support at large scale required. | <p>Failure of a significant community or industry as a direct result of the asset failure.</p> <p>SA Water's asset destruction.</p> <p>\$20M restoration and/or replacement costs.</p> <p>Functional requirement specification and project management essential to options exploration with rehabilitation and development.</p> <p>Project management practices, planning, tendering and appointment of specialised contractors.</p> <p>= >6 months downtime before total restoration commences.</p> | <p>No bypass available.</p> <p>Lengthy delays and only partial recovery within 48 hours.</p> <p>Complete restoration to resume normal operations >5 days.</p> <p>Reduced operating capacity to 25% of peak demand.</p> <p>Site specific contingency plan and emergency response plans activated.</p> <p>Consequences adversely impact on all operational aspects.</p> <p>Substantial loss of production with some loss of service.</p> | <p>Widespread Social, Environmental and public Health impacts.</p> <p>Widespread severe impairment or loss of ecosystem functions across species and landscape.</p> <p>Irrecoverable environmental damage.</p> <p>Widespread loss of objects of cultural significance.</p> <p>Community unable to support itself.</p> <p>Impacts beyond emotional and psychological capacity.</p> <p>Single large and multiple small communities affected, >15,000 customers.</p> |
| 4 | Major | Mid to long term failure of infrastructure (repairs will take longer than 6 months) and service delivery affecting large parts of the community, initial external support required. | <p>Significant structural adjustment required by the community to respond and recover.</p> <p>>\$5M and <\$20M rehabilitation and/or replacement costs.</p> <p>Functional requirement specification and project management essential to options exploration with rehabilitation or redevelopment.</p> <p>Project management practices, planning, tendering and appointment of specialised contractors.</p> <p>=>6 months downtime before total restoration commences.</p> | <p>No bypass available.</p> <p>Delays involved and only partial recovery within 24 hours.</p> <p>Complete restoration to resume normal operation within 5 days.</p> <p>Reduced operating capacity to 25% of peak demand.</p> <p>Site specific contingency plan activated.</p> <p>Consequences adversely impact on efficiency and effectiveness of operations.</p> <p>Considerable loss of production and minor loss of service impacting.</p> | <p>Localised Social, Environmental and Public Health impacts.</p> <p>Severe impairment or loss of ecosystem functions affecting many species or landscape, Progressive environmental damage.</p> <p>Significant loss or damage to objects of cultural significance.</p> <p>Reduced quality of life within the community.</p> <p>Impacts beyond emotional and psychological capacity.</p> <p>Single medium and multiple small size communities affected, >10,000 to 15,000 customers.</p> |

| Criticality Rating | Consequence Level | Infrastructure | Economic | Services | Social Environmental Well-being and Public Health |
|--------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Moderate | Mid-term failure of (significant) infrastructure (repairs may be undertaken in 3 to 6 months) and service delivery affecting some parts of the community, widespread inconveniences. | Community is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions directly attributable to the event. >\$1M and <\$5M rehabilitation and/or replacement costs. Functional requirement specification and project management essential to options exploration with rehabilitation or redevelopment. Project management practices, planning, tendering and appointment of specialised contractors. 3 to 6 months downtime before total restoration commences. | Restricted bypass available from the time of detection and full recovery within 24 hours. Complete restoration to resume normal operations within 48 hours. Reduced operating capacity to 25% of peak demand. Site specific contingency plan implemented. Consequences likely to impact on the effectiveness and efficiency of operations. Considerable loss of production and effect on services. | Localised Social, Environmental and Public Health impacts. Isolated but significant cases of impairment or loss of ecosystem functions. Intensive efforts for recovery required. Permeant damage to objects of cultural significance. Ongoing reduced services within the community. Impacts beyond emotional and psychological capacity. Single small to medium size community affected, >1,000 to 10,000 customers |
| 2 | Minor | Isolated cases of short to mid-term failure of infrastructure (repairs may be undertaken up to 3 month) and localised inconvenience | Industry or business sector is impacted by the emergency event, resulting in short-term (i.e., less than one year) profit reductions attributable to the event. >\$100K and <\$1M rehabilitation and/or replacement costs. Functional requirement specification and project management essential to options exploration with rehabilitation or redevelopment. Project management practices, planning, tendering/quotation and appointment of | Full bypass available from the time of detection and full recovery within 24 hours. Complete restoration to resume normal operations within 48 hours. Reduced operating capacity to 50% of peak demand. Incident response plan activated. Consequences could threaten the efficiency or effectiveness of some aspects of operations. Minor loss of production and effect on services. | Localised Social, Environmental and Public Health impacts. Isolated cases of environmental damage. One-off recovery efforts required. Repairable damage to objects of cultural significance. Isolated and temporary cases of reduced services within the community. Impacts within emotional and psychological capacity. Single small size community affected, <1,000 customers. |

| Criticality Rating | Consequence Level | Infrastructure | Economic | Services | Social Environmental Well-being and Public Health |
|--------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | | | specialised contractors. Up to 3 months downtime before total restoration commences. | | |
| 1 | Very Minor | Isolated cases of short to mid-term failure of infrastructure (repairs may be undertaken in 1 week to 1 month) and localised inconvenience | < \$100K Operational expenses or minor capital expenses to rehabilitate. Functional requirement specification and project management essential to options exploration with rehabilitation or redevelopment. Project management practices, planning, tendering/quotation and appointment of contractors. Up to 1 month downtime before total restoration is achieved. | Full bypass immediately available from time of detection and full recovery in 48 hours. Complete restoration to resume normal operation within 24 hours. No reduction in operating capacity. Corrective action by routine operations. Minor consequences affecting operations. No loss of production or effect on service. | No Social, Environmental or Public Health impacts affecting communities. Near misses or incidents without environmental damage. No recovery efforts required. No damage to objects of culture significance. Inconsequential short-term reduction of services No adverse emotional and psychological impacts. Very minimal impacts on customers. |

Table 4 – Bushfire Consequences and Asset Criticality Ratings.

5.4 Risk Matrix

Based on the determined likelihood of a bushfire occurring and consequence determined, the resultant risk is to be determined as shown on the following risk matrix Table 5.

| Likelihood | Asset Criticality/Consequence | | | | |
|----------------|-------------------------------|--------|----------|---------|--------------|
| | Very Minor | Minor | Moderate | Major | Catastrophic |
| Almost Certain | Medium | Medium | High | Extreme | Extreme |
| Likely | Low | Medium | High | Extreme | Extreme |
| Possible | Low | Low | Medium | High | Extreme |

Table 5 – Risk Matrix

6 Hierarchy of Protection

6.1 Introduction

Due to the varied function, location and operations of the SA Water sites it is not possible to implement a typical bushfire protection solution. Furthermore, the ability to retrospectively improve the facility to withstand a bushfire is limited.

To provide options to the design team a "Hierarchy of Protection" has been developed. This enables designers to choose the most appropriate solution for the site in consultation with key SAW stakeholders for optimised infrastructure lifecycle management. The solutions include both Passive Protection and Active Protection described as follows:

- Active Bushfire Protection - Equipment which is activated in the event of a bushfire to protect the asset. Examples include bushfire sprinkler systems.
- Passive Bushfire Protection - Refers to the provision of passive systems which reduce the risk of bushfire on the asset. Examples include the use of non-flammable construction materials.

The Hierarchy of Protection is separated into the following protection strategies:

- Site Protection: Asset protection Zones, Vegetation Clearance and Establishing of Fire Barriers.
- Building Protection: Building Fabric Performance (High and Low) and establishment of Vegetation exclusion zones.
- System Protection: Bushfire Sprinkler System.

Each of these protection strategies reduces the likelihood of asset damage due to a bushfire. This is summarised further below:

| Design Solutions | Mechanisms of Asset Damage | | |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------|
| | Ember Attack | Radiant Heat | Flame Contact |
| Site Protection – Asset Protection Zones | Reduced localised vegetation which could result in close range ember attack. Long range ember attack is still possible. | BAL reduced to BAL-12.5. | Vegetation exclusion zone in 5 m perimeter around the asset. |
| Site Protection – Vegetation Clearance | Reduced localised vegetation which could result in reduced close range ember attack. Long range ember attack is still possible. | Radiant heat is reduced, however, not to the acceptable BAL-12.5. | Vegetation exclusion zone in 5 m perimeter around the asset. |
| Site Protection – Establishment of Fire Barriers | Does not reduce the likelihood of ember attack. | Radiant heat is significantly reduced. | Flames unable to contact asset through fire wall. |
| Building Protection – Performance (High) | Designed to withstand ember attack. | Designed to withstand up to 40 kW/m ² | Not designed to withstand direct flame contact. |
| Building Protection – Performance (Low) | Designed to withstand ember attack. | Designed to withstand up to 12.5 kW/m ² | Not designed to withstand direct flame contact. |
| Building Protection – Vegetation | Reduces the sources flammable vegetation in immediate proximity | Does not reduce the likelihood of radiant | Vegetation exclusion zone in 5 m perimeter |

| Design Solutions | Mechanisms of Asset Damage | | |
|-----------------------------------------------|--------------------------------------------|-----------------------------------------|-------------------------------------------------------|
| | Ember Attack | Radiant Heat | Flame Contact |
| Exclusion Zone | of the asset. | heat. | around the asset. |
| System Protection – Bushfire Sprinkler System | Extinguishes and removes localised embers. | Limited ability to reduce radiant heat. | Not capable of mitigating the risks of flame contact. |

Table 6 – Design Solutions Based on the Mechanisms of Asset Damage.

A wholistic bushfire mitigation solution shall be devised which could include one or a combination of the solutions listed above in Table 6. This generally considers a combination of Site Protection and Building Protection solutions as both are passive solutions. System protection design solutions are also provided; however, they are not preferred as they may require ongoing maintenance and have increased rate of failure.

The Hierarchy of Performance is sorted in order of overall performance in the event of a bushfire. As such some of the lowest solutions are not considered to be suitable to protect assets.

The Design Requirements detail the available bushfire mitigation strategies to be implemented by the designers. These strategies reduce the likelihood or impact of a bushfire in the event of a bushfire occurring in the vicinity of the site.

The design requirements are separated into the following categories aligning with the Hierarchy of Protection (refer above):

- Site Protection (Section 8)
- Building Protection (Section 9)
- System Protection (Section 10)

Additionally, there is also a General Requirements (Section 7) which shall be considered for all sites and SA Water assets where applicable.

6.2 Risk Based Bushfire Design Options

Based on the risk assessment undertaken in accordance with Section 5, reference shall be made to Table 7 for the various design options available.

For existing sites, it is acknowledged that site constraints and operation criticalities including the environmental and heritage value of the site, may restrict the implementation of one or more of these options.

| Option | Site Protection | Building Protection | Site Protection |
|------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Suitable For All Risk Ratings | | | |
| Option A | Establish an Asset Protection Zone (refer Section 8.1) | Building Fabric Performance Low (refer Section 9.2) | - |
| Option B | Vegetation Clearance (refer Section 8.2) | Crushed rock, gravel or pavement to be established around asset perimeter (refer Section 9.1) Building Fabric High (refer Section 9.3) | - |
| Option C | Vegetation Clearance (refer Section 8.2) | Crushed rock, gravel or pavement to be established around asset perimeter (refer Section 9.1) | Bushfire Sprinkler System (Refer Section 10) |
| Option D | Radiant Heat Barrier (refer Section 8.3) | Building Fabric High (refer Section 9.3) | - |
| Option E | Radiant Heat Barrier (refer Section 8.3) | Building Fabric Performance Low (refer Section 9.2) | Bushfire Sprinkler System (Refer Section 10) |
| Suitable For Medium and Low Risk Rating | | | |
| Option F | - | Building Fabric Low (refer Section 9.2) | Bushfire Sprinkler System (Refer Section 10) |
| Suitable For Low Risk Rating | | | |
| Option G | - | - | Bushfire Sprinkler System (Refer Section 10) |

Table 7 – Risk Based Bushfire Design Options

7 General Requirements

7.1 Introduction

The General Requirements summarise general items on-site and shall apply to all existing and new sites.

7.2 Shielding from Exposure

Where an elevation of an asset is not exposed to the source of bushfire attack, then the construction requirements for that elevation can reduce to the next lower BAL. However, it shall not reduce to below BAL-12.5.

An elevation is deemed to be not exposed to the source of bushfire attack if all of the straight lines between that elevation and source of bushfire attack are obstructed by another part of the same building. However, it shall not reduce to below BAL-12.5. Refer AS 3959 Section 3.5 for further information.

The shielding of an elevation shall apply to all the elements of the wall, including openings, but shall not apply to subfloors or roofs.

7.3 Water Supply for Bushfire Firefighting Purposes

An on-site dedicated water supply must be provided with a storage capacity as detailed in South Australian Ministerial Building Standard MBS 008, Designated bushfire prone areas - additional requirements, for bushfire firefighting purposes.

Approval of the proposed Firefighting infrastructure on-site shall be reviewed and approved by the CFS during the Detailed Design Phase.

| Total Land Area | Minimum Water Supply |
|----------------------|----------------------|
| < 500 m ² | 10,000 L |
| ≥ 500 m ² | 22,000 L |

Table 8 – Firefighting Water Supply based on S.A. MBS 008 (July 2020).

The water storage required for bushfire purposes and fire protection systems (as required by the National Construction Code) can be combined where required.

On-site water storage tanks can also be used for this purpose provided its volume is adjusted to suit and complying fittings are installed.

The dedicated fire water storage can either be a tank or suitable open water source, however, the fittings need to comply with the following:

- a. Via a fire service adaptor fitted in the wall of the water storage facility near the bottom of the water storage facility, with a minimum outlet of 50 mm terminating in a 65 mm Storz outlet with a gate or ball valve for use by the relevant fire brigade; or
- b. Through an open water supply (such as an excavated tank) provided a hardened ground surface to fire appliance access is available within 3 m of the water supply.

The water storage system shall incorporate a volume control device such as an automatic float valve to ensure that the tank remains at the minimum water level.

Tanks are to be located not less than 10 m away from any high voltage electrical distribution equipment such as transformers, distribution boards or flammable stores. They shall also be located so that they are not obstructed or obscured by obstacles and are protected from any possible mechanical damage by vehicles.

7.3.1 Tank Materials

Where tanks are used for firefighting storage, they are to be constructed from non-combustible materials such as mild steel with minimum joints and sealant (welded tanks are preferred).

Final tank materials are to be confirmed by a qualified materials engineer.

The tank is to be provided with a level indicators and compatible connections for brigade take offs in accordance with Section 7.3.

Tank stands (where required) are to be constructed from non-combustible materials.

7.3.2 Pump

A dedicated on-site pump is not required for CFS bushfire protection purposes as they will utilise the pumps integrated into their trucks. Backflow prevention is required where appropriate to avoid stagnant water within the fire system from contaminating potable water supplies.

7.4 Water Storage Tanks

Suitability of various materials for use as water storage tanks need to be assessed on a case-by-case basis. The assessment needs to consider the following:

- Impact on the structural integrity of the tank (incl. stored water volume) based on the exposure of high temperatures as calculated in Appendix A.
- The assessment of the structural integrity is based on an approaching fire front and then succeeding front as it passes the tank. As such it needs to consider increasing exposure accordingly based on the information within Appendix A.
- The tank shall be assessed as a system including shell material, external protective coatings, internal liner, joint sealants and jointing technique (bolting and welding), and roof structure including slope.
- Tank materials are to be non-combustible in accordance with AS 1530.1.

This is to be assessed by a suitably qualified material and structural engineers based on materials data provided by contractors or similar.

Water storage tanks shall be provided with a 5 m exclusion zone as per Table 1 of SA Water "Bushfire Prevention Standard" and building protection requirements within Section 9.

7.5 Floating Storage Covers

Floating covers (such as Earth Bank Storage and or Floating Tank Roofs) are susceptible to damage from ember attack. The covers shall be provided with a system capable of extinguishing embers shortly after they land on the cover before significant damage can occur. Available options include:

- Provision irrigation sprinkler system which provides coverage across the entire floating cover. The irrigation system can utilise water pumped from within the Earth Bank/tank Storage.
- Provision of a deluge system which builds up a thin layer of water over the floating covers. The system can use pumped water from within the Earth Bank/tank Storage.
- Combination of the above options.

The maintenance and remote activation requirements are detailed within Section 10.1. Maintenance requirement would also be required to be included within the SA Water PM system.

7.6 Storage of Flammable Materials

Where flammable materials are present on-site, they shall be installed within a dedicated structure located a minimum of 10 m from all other structures on-site, site boundaries and any key accessways for the site.

The structure is to be constructed in accordance with the "Building Performance – Construction (High)" as per Section 9.3, which provides the greatest protection from ember attack.

7.7 Chemical Storage Tanks/Units and Pipework

7.7.1 Existing Sites

If the chemical storage tanks, units and pipework are critical to the operation of the site of a BAL 12.5 or greater they need to be provided with a radiant heat barrier in accordance with Section 8.3 or within a fire rated structure detailed in Section 9. The radiant heat barrier is to be provided between significant vegetation and the chemical units.

7.7.2 New Sites

Chemical storage tanks, units and pipework critical to the operation of the site are to be located within a suitably fire rated structure according with Section 9 or with a radiant heat barrier in accordance with Section 8.3.

7.8 Safe Access for Fire Fighting Vehicles

7.8.1 Access to Asset Protection Zones (APZ)

Access to the APZ by firefighting vehicles is to be by all-weather roadway with the following performance:

- Capable of supporting firefighting vehicles with a gross vehicle mass of 21 tonnes; and
- Providing a vehicle clearance area of not less than 4 m in width and 4 m in height.

7.8.2 Fire Access Track

- Establish and maintain tracks in accordance with the site-specific Bushfire Management Plan.
- Where a Bushfire Management Plan does not exist use Table 1 within the Bushfire Prevention Standard as a guideline (extracted in Table 9 herein).
- Wherever possible, tracks used for fire access should be established on cleared land to minimise damage to native and other vegetation.
- Where practicable, a track used for fire access should be incorporated within a firebreak.
- Tracks used for fire access should complement existing or planned tracks outlined in the relevant BMAP or Cooperative Plan.
- It is recommended to slash tracks comprising of annual exotic grasses in early September and then again in late November, depending on the season, to encourage the regeneration of native grasses.
- Where slashing is not appropriate grade or doze access tracks as required.
- Use the following classification standards when establishing or maintaining tracks used for fire access (For further information on the establishment and maintenance of fire access tracks refer to [Firebreaks and Access Tracks, Guidelines for State Government Agencies, Government Agencies Fire Management Working Group](#)).

7.8.2.1 Service Track

- Does not necessarily meet any of the standards listed below.
- May only be used during emergency operations with absolute caution.
- While marked on maps, a service track may only be used in the event of a fire under suitable fire behaviour or weather conditions and with the benefit of local knowledge.

7.8.2.2 Minor Fire Tracks

- May be used by all fire appliances.
- The track shall be maintained to a width between 4 and 5 metres.
- Sufficiently clear of vegetation (both sides and overhead) to allow ready and safe access.
- Single lane access is permitted on through roads.

7.8.2.3 Standard Fire Tracks

- May be used by all fire appliances.
- The track shall be maintained to a width between 4 and 5 metres.
- Sufficiently clear of vegetation (both sides and overhead) to allow ready and safe access.
- Shall be constructed with passing bays permitting two-way access.
- Passing bays shall have a minimum length of 17 metres, a minimum width of 6 metres and a maximum width in native vegetation of 8 metres.
- Maximum intervals between opportunities to pass should be 400 metres.

7.8.2.4 Major Fire Tracks

- May be used by all fire appliances.
- Will be maintained to a minimum width of 7 metres.
- Sufficiently clear of vegetation (both sides and overhead) to allow ready and safe two-way access along the full length of the track.

7.9 Protection of Engineering Services

The engineering services are often critical to the ongoing operation of SAW sites. These include the following:

- Above ground pipework (excluding pipework made with concrete)
- Electrical
- Heating, Ventilation and Air Conditioning
- Pressure Vessels

These systems shall be designed and installed as part of greenfield, or brownfield works in accordance with the relevant standards and guidelines.

The following section provides additional guidance to improve the likelihood continuous operation during a bushfire.

7.9.1 Above Ground Pipework

This section refers to pipework within SA Water sites that is either combustible or will limit the operation of the site if damaged from a bushfire (such as plastics but excludes external coatings).

Pipe work greater than 300 mm (such as transmission pipework) or service connections within the general network does not need to be protected as per the below.

7.9.1.1 Existing Sites

Where it is not feasible to replace the existing pipework, consideration shall be given to establishing radiant heat barriers between the pipework and the nearby vegetation. This will reduce the heat experienced by the pipework to ensure that it continues to operate. The radiant heat barrier shall be provided in accordance with Section 8.3.

Underground pits which have a grate lid accumulate vegetation at the bottom of the pit which could be ignited during an ember attack. Where appropriate pits shall be provided with an ember proof mesh (corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size) or an enclosed lid. Where installation of an ember proof mesh is not appropriate due for safety or operational purposes the pit shall be routinely cleared as part of preventative maintenance activities. These works are to be included within the BMP.

7.9.1.2 New Sites

Water and wastewater pipework shall be reticulated below ground to avoid the impact of radiant heat or flame contact. The steel pipework shall extend a minimum 400 mm within the building or 100 mm below the ground.

Where the pipework cannot be reticulated below ground or protected from radiant heat via fire rated structures, the pipework shall be constructed with a non-combustible material (mild steel, ductile iron, stainless steel, copper) with a minimum wall thickness in accordance with the relevant standards/regulations or 0.9 mm (whichever is greater).

Where pipework is installed within an underground pit without a completely enclosed lid there is a risk of an ember attack sparking a secondary fire at the base of the pit where vegetation can build up. The pit shall be provided with an ember proof mesh (corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size) or an enclosed lid. Where installation of an ember proof mesh is not appropriate due for safety or operational purposes the pit shall be routinely cleared as part of preventative maintenance activities. These works are to be included within the BMP.

7.9.2 Electrical Infrastructure

7.9.2.1 Existing Sites

Electrical Infrastructure critical to the operation of the site is to be protected by a Bushfire Sprinkler System installed in accordance with AS 5414 (2012) and Section 10.1 of this standard or located within a shelter complying with Section 9.

Electrical conduits are to be painted with Temprotex ignition barrier coatings or approved alternatives where exposure to radiant heat can occur.

7.9.2.2 New Sites

Where possible, electrical switchboards to be installed within an appropriately fire rated structure in accordance with all Australian Standards and regulations.

External standby generators and/or transformers provided are to be located so that the maximum BAL is BAL-12.5 or provided with a bushfire sprinkler system. Achievement of the BAL-12.5 requirement can be achieved via shielding in accordance with AS 3959.

Air intakes and exhausts on containerised generators are to be provided with an ember proof mesh (corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size). Designers to consider the impact of reduced openable area on system performance.

Where on-site generators are not provided, Main Switchboards should be provided with the ability to connect a temporary generator of sufficient size to power the minimum load to operate the critical plant in the event the failure of utility infrastructure after a bushfire.

External cabling and conduits reticulated horizontally on cable trays is to be provided with a capping to prevent embers settling on top of cabling. Electrical conduits are to be painted with Temprotex ignition barrier coatings or approved alternatives where exposure to radiant heat can occur.

Cabling reticulated vertically is to be protected by a Colourbond flashing and are to be painted with Temprotex ignition barrier coatings or approved alternatives where exposure to radiant heat can occur.

7.9.3 Heating Ventilation and Air Conditioning Systems

Evaporative type air conditioning systems are not to be installed on any sites.

Refer to the TS0245 Design Requirements for Ventilation and Cooling Systems for further information about preferred systems.

Outside air inlets and exhaust points (including rotary ventilators) are to be screened with an ember proof mesh (corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size). Consideration shall be provided to the additional static pressure loss from the screening. The screen is to be installed externally.

7.9.4 Pressure Vessels

Pressure vessels likely to be exposed to radiant heat during a bushfire are to be provided with pressure relief valves in accordance with the requirements of AS 1210.

7.10 Vegetation Management

Vegetation management is to be conducted in accordance with SA Waters Environmental and Biodiversity objectives as detailed within the following SA Water Standards:

- Bushfire Prevention Standard (SAWS-LM-0003).
- Native Vegetation Standard Operating Procedure (SAWD-EMS-0017).

7.11 Stakeholder Engagement

As part of the design development, the project team shall engage with the following internal and external stakeholders.

- SA Water Environmental Team – Approval for vegetation modifications (clearances, removal of trees etc.) and establishment of Asset Protection Zones.
- SA Water Engineering and Infrastructure Planning & Strategy Teams – At key design milestones for endorsement of the proposed Bushfire Solutions.
- CFS – Need to be engaged during the Detailed Design phase by the Designer/Constructor to seek approval for any on-site firefighting systems. Further engagement may be required during commissioning.

8 Site Protection

8.1 Asset Protection Zones (APZ)

An Asset Protection Zone is an actively managed fuel reduction area that surrounds, or is adjacent to, assets for the purpose of minimising risks to the asset. An APZ reduces the intense radiant heat, prevent flame contact, and reduce short distance ember attack from the immediate environment.

APZs can also be used as a defensible space by the CFS to protect the critical asset in the event of a bushfire.

This area shall be adequately identified on site plans throughout design and construction. These shall also be detailed on site plans handed over after construction as part of the Bushfire Management Plan.

The requirements for vegetation clearance for APZs shall align with the SA State Bushfire Coordination Committee's: '*Fire Management Zone Standard and Guidance for Use*'. This differs from the existing Bushfire Prevention Standard. Therefore, all proposed APZs need to be reviewed and approved by the SA Water Environmental team.

The design development of APZ should be conducted with assistance of a Landscape Designer.

8.1.1 Asset Protection Zone Width

The width of the APZ shall be based on reducing the experienced BAL to BAL-12.5 (based on the methodology detailed in Section 3.2).

Identification of appropriate Asset Protection Zone (APZ) should be considered during the Concept Design Phase. This process shall also consider SA Waters Environmental and Heritage team and biodiversity objectives as detailed in Section 7.10.

8.1.2 APZ Vegetation Performance Requirements

The APZ shall be maintained to keep surface and shrub level fine fuels at Moderate or lower (as an average across the zone) as defined in the Department for Environment and Water's: '*Overall Fuel Hazard Guide for South Australia*'. This process also needs to consider SA Waters environmental and biodiversity objectives as detailed in Section 7.10.

This can be achieved using the following recommendations:

- a. Vegetation clearance can be undertaken within the APZ including surface fuel and near surface and elevated fuel shall be removed (i.e. leaf litter, shrubs, high grasses). Small/juvenile trees should also be removed. A regularly slashed/low grass area or rubbled/gravelled area is an ideal scenario in this context. These sites would still require at least annual maintenance.
- b. Larger/established native trees, priority shall be given to removing limbs that overhang the asset and/or have the potential to directly impact on the asset. If, based on the advice on an arborist, such trimming would compromise the tree, the tree should be removed.
- c. Larger/established native trees that fall within the 10 m buffer that do not overhang or directly impact the asset should be left in-situ where practical. The lower limbs of these trees (3-5 m) should still be trimmed to provide vertical fire break.
- d. Established exotic weedy trees including olives, pines etc within the 10 m buffer should be removed.
- e. Manage understory plants so that the leaf area of the vegetation is not vertically or horizontally continuous. 'Clumping' of shrubs is more desirable than evenly connected coverage. Separate shrubs and trees to minimise vertical fuel 'ladders'.
- f. Fences within or around the APZ are to be constructed from non-combustible materials.

- g. Dead shrubs/understory plants shall be removed.
- h. Grasses within the APZ should be reduced to a maximum height of 50 mm.
- i. Prior to any clearance, consideration must be given to potential visual amenity/buffer and/or community value of the vegetation. In cases where new vegetation works are planned around assets that abut private dwellings or may potentially be valued by the community, SA Water's Community Stakeholder Engagement team shall be notified.

8.1.3 CFS Firefighting Requirements

APZs can also be used as a defensible space by the CFS to protect the assets during a bushfire. For the CFS to utilise the space there need access to firefighting water and safe access for firefighting vehicles.

The firefighting requirements are to be coordinated and approved by appropriate CFS representatives.

8.2 Vegetation Clearance

Subject to approval of SA Water Environmental Team, and where it is not possible to achieve the minimum width of the APZ to reduce the BAL to BAL 12.5, vegetation shall be cleared as significantly as possible to reduce the radiant heat experienced by the asset. These works are to align with the SA Water Bushfire Prevention Standard.

This process shall also consider SA Waters environmental and biodiversity objectives as detailed in Section 7.10.

Requirements for vegetation clearance shall align with the requirements in Section 8.1.2.

8.3 Radiant Heat Barrier

Where it is not possible to establish an APZ or clear the vegetation, a Radiant Heat barrier can be provided to enable protection from radiant heat and flame contact. This can be used as a boundary fence.

The fire barrier shall comply with the following performance requirements.

- a. Fire Barrier to be established between the asset to be protected and vegetation. Ideally closest to the asset.
- b. 1.0 metre gap between barrier and the asset to be accessible for maintenance and inspection purposes. The ground within the gap is to be sealed to minimise the potential growth of weeds and other vegetation.
- c. The Fire Resistance Level of the fire barrier to be a minimum of -/60/60.
- d. The wall needs to extend a minimum 0.25 m past the edges of the asset depending on the direction of the bushfire attack. E.g. the width of the wall needs to extend 0.25 m past each side of the asset.

9 Building Protection

9.1 Perimeter Protection

To reduce the likelihood of flame contact on the asset establish a perimeter vegetation exclusion zone around the asset. This will also protect the asset from localised flare ups due to ember attack and allows access for ongoing maintenance works.

The performance requirements of the exclusion zone are to align with the SA Water Bushfire Prevention Standard. Typical examples are provided in Table 9

| Asset Type | Recommended Exclusion Zone Including Conditions |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Above Ground Pipelines | <p>¹Clearance of groundcovers and/or shrubs directly under pipeline and up to 4 m each side of edge of pipeline. Where feasible groundcovers should be retained.</p> <p>²Mature trees to be retained within envelope unless directly impacting the infrastructure or impeding access that prevents operation/repairs.</p> |
| Below Ground Pipelines | <p>¹Up to 8 m total clearance width (inclusive of access tracks where parallel to pipeline).</p> <p>²Mature trees* to be retained within envelope unless directly impacting the infrastructure or impeding access that prevents operation/repairs.</p> |
| Ancillary infrastructure within SA Water Property/Facilities including: meters, fireplugs, inducts/educts, switchboards, SCADA units (poles towers), valves, PRVs, CP test points, TR units | <p>¹Up to 2 m radially around infrastructure plus area to access/park (up to 2 additional meters on single access side/point).</p> |
| Tanks | <p>¹Up to 5 m around tank Overhanging limbs can be removed.</p> <p>²Whole trees removed only where absolutely necessary.</p> |
| Bores | <p>¹Up to 2 m radially around infrastructure plus area to access/park (up to 2 additional meters on single access side/point)</p> |
| Operational areas within SA Water operational facilities (e.g. treatment plants etc) to control regrowth necessary to protect, maintain or operate existing infrastructure | <p>³To the extent it can be demonstrated the area was cleared for construction and where vegetation has regrown.</p> <p>⁴Previous cleared areas to be supported by archival photos etc.</p> |
| Constructed drains/ spillways/ channels | <p>¹Within the channel and up to 3 m to enable access on one side</p> |
| Reservoir/ weir structures/ dams/ lagoons/ culverts /Earth Bank Storage | <p>¹On dam wall / face or banks of lagoons and up to 5 m adjacent structure; and/or To extent it can be demonstrated the area was cleared for construction and where vegetation has regrown (note this is limited to area required to maintain structural integrity). Includes removing native vegetation regrowth to remove built-up sediment</p> |
| Buildings (Depots/offices, Workshops, Sheds, Pump Stations, Treatment plant buildings) | <p>¹Vegetation within 10 m of building. All limbs which overhang the building shall be removed. River Murray Floodplain Area: Clearance restricted to ¹pruning of tree limbs only (not ²whole trees)</p> |

| | |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vehicle access / track (existing) (4 wheels) | 1&5 To width of existing access track and not more than 5 m |
| Walking access | 1 To establish or maintain walking track up to 0.5 m in width – only for operational purposes. |
| Fences (existing) | <p>1&5Clearance should be limited to the extent required to obtain access to maintain fence.</p> <p>1&5Where fence located on a property boundary clearance up to 5 m each side is permitted (10 m total)</p> <p>1&5Fences within a single property (internal fences) clearance up to 5 m in total is permitted.</p> |

Table 9 – Exclusion Zone Around Structures.

Notes:

1. No approval required where clearance within specified envelope for groundcovers/shrubs
2. Removal of mature trees to be approved by SA Water's Manager Environment, Land and Heritage
3. No approval required where in accordance with defined "operational areas" in Land Management Plans
4. Where clearance is limited to vegetation that has regrown the preceding 5 years. Where area has not been cleared for >5 years to be assessed by Environment Officer and approved by Manager Environment, Land and Heritage
5. Clearance in road or rail reserves must be done in accordance with an approved Roadside Vegetation Management Plan or the NVC Guidelines for Management of Roadside Vegetation.

9.2 Building Protection Performance (Low)

The following Architectural and Structural Details are based on the BAL-12.5 requirements within AS 3959 (2018). This provides protection from ember attack and radiant heat up to and including 12.5 kW/m².

9.2.1 Sub-Floor

9.2.1.1 Existing Structures

If the existing building is constructed on top of a concrete slab, no improvement is required.

If the existing building is elevated, the subfloor shall be enclosed with one of the following systems:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
 - Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in situ wall of concrete or aerated concrete.
 - Earth wall including mud brick.

Or
- b. A mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion resistant steel, bronze or aluminium

Or
- c. A combination of the above.

9.2.1.2 New Structures

Where possible buildings are to be built on top of concrete slabs and elevated construction on platforms is to be avoided.

Where this is not possible the subfloor shall be enclosed with one of the following systems:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
 - Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in sit wall of concrete or aerated concrete.

Or

- b. A system conforming with AS 1530.8.2 when tested from the outside

Or

- c. A system with FRL of 30/30/30 or -/30/30 when tested from the outside

Or

- d. A combination of the above.

9.2.2 Walls

9.2.2.1 Existing Structures

Walls to be upgraded to align with the 'New Structure' requirements detailed below.

9.2.2.2 New Structures

General

The exposed components of external walls shall be as follows:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
 - Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in sit wall of concrete or aerated concrete.
 - Earth wall including mud brick.

Or

- b. A system conforming with AS 1530.8.1 when tested from the outside

Or

- c. A system with FRL of 30/30/30 or -/30/30 when tested from the outside

Or

- d. A combination of the above.

Joints

All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed to prevent ember egress.

Vents and weepholes

Vents and weepholes in external walls shall be screened with a mesh made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size.

9.2.3 Windows and Sidelights

9.2.3.1 Existing and New Structures

Windows and sidelights shall be completely protected by either of the two following systems:

- a. A bushfire shutter that conforms with the following:
 - Protect the entire window assembly including framing, glazing, sash and sill;
 - Be fixed to the building and be non removeable.
 - Be capable of being closed manually from either inside or outside or motorised shutter systems (if they are not reliant on mains power to close).
 - Be constructed of a non-combustible material.
 - When in the closed position, have no gap greater than 2 mm between the shutter and the wall, frame, or sill.
- b. Protected by a screen conforming with the following:
 - Screens fitted to window openings shall have a maximum aperture of 2 mm and shall be tight fitting to the frame.
 - Made of corrosion-resistant steel, bronze or aluminium.
 - The frame supporting the mesh shall be made from metal.
 - Screen assemblies shall be attached using metal fixings

9.2.4 Doors (Side-Hung)

9.2.4.1 Existing and New Structures

Side hung doors panels shall conform with the following:

- a. Door panel materials shall be:
 - Non-Combustible or
 - Solid timber having a minimum thickness of 35 mm for the first 400 mm above the threshold and protected on the outside by a metal-framed screen door with a mesh or perforated sheet made with a mesh made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size.
- b. The door frame material shall be metal.
- c. Weather strips draught excluders and draught seals shall be installed.
- d. Doors shall be tight fitting to the door frame or abutting door (if applicable).

9.2.5 Doors (Vehicle Access)

9.2.5.1 Existing and New Structures

The following applies to vehicle access doors for buildings (i.e., does not apply to access gates around the perimeter of the site):

- a. Vehicle access doors are to be constructed from non-combustible materials.

- b. All vehicle access doors shall be protected with suitable weather strips, draught excluders, draught seals, or brushes. Door assemblies shall be fitted with guide tracks.
- c. Weather strips, draught excluders, draught seals, or brushes to protect edge gaps or thresholds shall be manufactured from materials not having a flammability index not exceeding 5.
- d. Doors can include ventilation slots but need to be protected with a metal mesh with maximum aperture of 2 mm.

9.2.6 Roofs (including penetrations, eaves, fascia's and gables and gutters and downpipes)

9.2.6.1 Existing Structures

Where replacing the roof eaves, fascia, and gables to improve the bushfire preparedness is not a feasible solution, consideration shall be given to installation of System Protections as per Section 10.

9.2.6.2 New Structures

General

The following applies to all types of roofs:

- a. Roof tiles, roof sheets and roof covering accessories shall be non-combustible.
- b. The roof/wall and roof/roof junction shall be sealed either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.
- c. Roof ventilation openings, such as gable and roof vents, shall be fitted with ember guards made of corrosion resistant steel, bronze or aluminium with a maximum 2 mm aperture size.

Tiled Roofs

Tiled roofs shall be fully sarked. The sarking shall achieve the following:

- a. Be located on top of the roof framing, except that the roof battens may be fixed above the sarking;
- b. Cover the entire roof including ridges and hips; and
- c. Extend into the gutters and valleys.

Sheet Roofs

Sheet roofs shall:

- a. Be fully sarked in accordance with the following:
 - Be located on top of the roof framing, except that the roof battens may be fixed above the sarking;
 - Cover the entire roof including ridges and hips; and
 - Extend into the gutters and valleys.
- b. Have any gaps sealed at the fascia or wall line hips and ridges by:
 - A mesh or perforated sheet made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size; or
 - Mineral wool; or

- Other non-combustible materials; or
- A combination of items of the above.

Roof Penetrations

The following applies to roof penetrations:

- Roof penetrations, including roof ventilators, aerials and vent pipes need to be sealed with a non-combustible material.
- Pipes or conduits that penetrate the roof covering shall be non-combustible.

Eaves lining, fascias and gables

The following applies eaves linings, fascias and gables:

- Gables are to align with the requirements for walls.
- Eaves penetrations shall align with the requirements for roof penetrations.
- Eaves ventilation opening shall be fitted with ember guards in maximum aperture of 2 mm and shall be made of corrosion resistant steel, bronze or aluminium.

Gutters and downpipes

- If installed, gutter and valley leaf guards shall be non-combustible.
- Gutters and downpipes shall be non-combustible.
- Box gutters shall be non-combustible and flashed at the junction with the roof with non-combustible material.

9.3 Building Protection Performance (High)

Building Fabric Performance is integral to the resistance of both radiant heat and ember attack.

The following Architectural and Structural Details are based on the BAL-40 requirements within AS 3959 (2018).

9.3.1 Sub-Floor

9.3.1.1 Existing Structures

If the existing building is constructed on top of a concrete slab, no improvement is required.

If the existing building is elevated, the subfloor shall be enclosed with one of the following systems:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
 - Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in sit wall of concrete or aerated concrete.
 - Earth wall including mud brick.

Or

- b. A system conforming with AS 1530.8.2 when tested from the outside

Or

- c. A system with FRL of 30/30/30 or -/30/30 when tested from the outside

Or

- d. A combination of the above.

9.3.1.2 New Structures

Where possible buildings are to be built on top of concrete slabs and elevated construction on platforms is to be avoided.

Where this is not possible, the subfloor shall be enclosed with one of the following systems:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
- Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in sit wall of concrete or aerated concrete.

Or

- b. A system conforming with AS 1530.8.2 when tested from the outside

Or

- c. A system with FRL of 30/30/30 or -/30/30 when tested from the outside

Or

- d. A combination of the above.

9.3.2 Walls

9.3.2.1 Existing Structures

Walls to be upgraded to align with requirements detailed in the “New Structure”.

9.3.2.2 New Structures

General

The exposed components of external walls shall be as follows:

- a. Non-combustible material including the following, provided the minimum thickness is 90 mm:
- Full masonry or masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone.
 - Precast or in sit wall of concrete or aerated concrete.
 - Earth wall including mud brick.

Or

- b. A system conforming with AS 1530.8.1 when tested from the outside

Or

- c. A system with FRL of 30/30/30 or -/30/30 when tested from the outside

Or

- d. A combination of the above.

Joints

All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed.

Vents and Weepholes

Vents and weepholes in external walls shall be screened with a mesh made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size.

9.3.3 External Glazed Elements

9.3.3.1 Existing and New Structures

Skylights and windows are to be avoided where possible in the building design.

Where external light is required for compliance with the National Construction Code, the system shall conform with the following:

- a. Skylights shall conform with the following:
 - To be constructed with Grade A laminated safety glass complying with AS 1288.
 - To have a minimum pitch of 18 degrees to the horizontal.
- b. Windows shall conform with the following:
 - Frame material: All window frames, and joinery to be constructed with fire resistant materials.
 - Hardware: Externally fitted hardware that supports the sash in its functions of opening and closing shall be metal.
 - Glazing: To be constructed with toughed glass with minimum thickness of 6 mm.
 - Alternatively, be completely protected by a bushfire shutter that conforms with Section 9.2.3.1.
- c. Where used, seals and weather strips to stiles, head and sills or thresholds shall be manufactured from materials having a flammability index not exceeding 5, or from silicone.

9.3.4 Doors (Side-Hung)

9.3.4.1 Existing and New Structures

Side hung doors panels shall conform with the following:

- a. Door panel materials shall be:
 - Non-Combustible; or
 - Solid timber having a minimum thickness of 35 mm for the first 400 mm above the threshold and protected on the outside by a metal-framed screen door with a mesh or perforated sheet made with a mesh made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size.
- b. The door frame material shall be metal.
- c. Where doors incorporate glazing, the glazing shall be toughened glass a minimum of 6 mm in thickness.
- d. Weather strips draught excluders and draught seals shall be installed.
- e. Doors shall be tight fitting to the door frame or abutting door (if applicable).

9.3.5 Doors (Sliding Doors)

9.3.5.1 Existing and New Structures

The following applies to sliding doors for buildings:

- a. The material for door frames shall be made from metal.
- b. Externally fitted hardware that supports the panel in its functions of open and closing shall be metal. Trims (or other components) may use materials other than metal.
- c. Where doors incorporate glazing, the glazing shall be toughened glass a minimum of 6 mm in thickness.
- d. Seals to stiles, head and sills or thresholds shall be manufactured from materials with a flammability index not exceeding 5.

9.3.6 Doors (Vehicle Access)

9.3.6.1 Existing and New Structures

The following applies to vehicle access doors for buildings (i.e. does not apply to access gates around the perimeter of the site):

- a. Vehicle access doors are to be constructed from non-combustible materials.
- b. All vehicle access doors shall be protected with suitable weather strips, draught excluders, draught seals, or brushes. Door assemblies shall be fitted with guide tracks.
- c. Weather strips, draught excluders, draught seals, or brushes to protect edge gaps or thresholds shall be manufactured from materials not having a flammability index not exceeding 5.
- d. Doors shall not include ventilation slots.

9.3.7 Roofs (including penetrations, eaves, fascia's and gables and gutters and downpipes)

9.3.7.1 Existing Structures

Where replacing the roof eaves, fascia, and gables to improve the bushfire preparedness is not a feasible solution, consideration shall be given to installation of System Protections as per Section 10.

9.3.7.2 New Structures

General

The following applies to all types of roofs:

- a. Roof tiles, roof sheets and roof covering accessories shall be non-combustible.
- b. The roof/wall and roof/roof junction shall be sealed either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.
- c. Roof ventilation openings, such as gable and roof vents, shall be fitted with ember guards made of corrosion resistant steel or bronze with a maximum 2 mm aperture size.

Tiled Roofs

Tiled roofs shall be fully sarked. The sarking shall achieve the following:

- a. Be located on top of the roof framing, except that the roof battens may be fixed above the sarking;
- b. Cover the entire roof including ridges and hips; and
- c. Extend into the gutters and valleys.

Sheet Roofs

Sheet roofs shall:

- a. Be fully sarked in accordance with the following:
 - Be located on top of the roof framing, except that the roof battens may be fixed above the sarking;
 - Cover the entire roof including ridges and hips; and
 - Extend into the gutters and valleys.
- b. Have any gaps sealed at the fascia or wall line hips and ridges by:
 - A mesh or perforated sheet made of corrosion resistant steel, bronze, or aluminium with a maximum 2 mm aperture size; or
 - Mineral wool; or
 - Other non-combustible materials; or
 - A combination of items of the above.

Roof Penetrations

The following applies to roof penetrations:

- Roof penetrations, including roof ventilators, aerials and vent pipes shall be sealed with a non-combustible material.
- Pipes or conduits that penetrate the roof covering shall be non-combustible.

Eaves lining, fascias and gables

The following applies eaves linings, fascias and gables:

- Gables are to align with the requirements for walls.
- Fascias and bargeboard shall comply with AS 1530.8.1.
- Eaves linings shall be fibre cement sheet with a minimum 6 mm in thickness.
- Eaves penetrations shall align with the requirements for roof penetrations.
- Joints in eaves linings, fascia and gables may be sealed with plastic joining strips or timber storm moulds.

Gutters and Downpipes

Gutters and downpipes should be avoided where possible.

- If installed, gutter and valley leaf guards shall be non-combustible.
- Gutters and downpipes shall be non-combustible.
- Box gutters shall be non-combustible and flashed at the junction with the roof with non-combustible materials.

10 System Protection

10.1 Bushfire Water Spray System

A bushfire water spray system provides some protection against ember attack and low levels of radiant heat flux. As such this system needs to be combined with other systems to provide a high level of protection on-site.

The bushfire water spray system shall be designed and installed in accordance with AS 5414 (2012).

10.1.1 System Design

Bushfire water spray systems shall be arranged to discharge water over all points of vulnerability and possible ember ingress. This includes windows, eaves, engineering services and doors and the entire floating cover of combustible materials over tanks and earth bank storages.

The design and layout of the spray nozzles is to align with the details provided in AS 5414 (2012) Section 2.

10.1.2 System Activation

Three forms of activation systems are proposed:

- **Local Activation:** enables users at sites which are generally manned to activate the water spray system prior to leaving the site. This enables pre-wetting of the surfaces prior to the arrival of the bushfire. System is to operate until the water storage is empty.
- **Remote Activation:** enables pre-exposure wetting to reduce the likelihood of damage prior to the arrival of the fire front, however, this relies on operational communication networks which can be damaged during a bushfire. This is proposed for use on-sites which are not typically manned. System is to operate until the water storage is empty.
- **Automatic Activation:** automatic activation is to be achieved using linear heat detector cable installed externally around the perimeter of the asset. This will enable automatic activation of the water spray system when high temperatures are detected at the asset. Opportunity for pre-wetting is not possible. System is to operate until the water storage is empty.

10.1.3 Water Supplies

Water supplies are to be calculated based on the rates detailed within AS 5414 (2012), however, the duration is to be a minimum of 120 minutes. This is based on the following:

- 45 minute – pre-exposure wetting
- 30 minute – exposure wetting
- 45 minute – post-exposure wetting

The dedicated fire water storage can either be a tank or suitable open water source. If a tank is to be utilised it is to be constructed from non-combustible materials e.g. mild steel with minimum joints and sealant. Final tank materials are to be confirmed by qualified materials engineer. Refer Section 7.3 for further information.

The tank is to be provided with a level indicators and compatible connections for brigade take offs in accordance with Section 7.3.

The tank is to be connected to a mains water supply via a float valve to ensure that the system is always full.

10.1.4 Pump sets

The pump set shall be chosen to meet the expected system demand. It shall be driven by an internal combustion engine with a trickle-charged starting battery and a fuel tank capacity of not less than 3 hours. It shall be located that is accessible at the time of operation and is unlikely to be subjected to physical damaged or be affected by weather. It shall be protected against bushfire exposure for not less than 3 hours.

The pump system shall have control arrangement to facilitate the activation systems within Section 10.1.2.

The pump set shall incorporate the following:

- Lockable (normally open) suction valve.
- Pump (diesel is preferred, however, electrical can be provided if a backup generator is provided on the site).
- Pump suction inline strainer.
- Inline pressure gauge on the discharge side of the pump.
- Lockable (normally open) discharge valve.

10.1.5 Commissioning

The installer shall perform the following commissioning tests:

- Check water tank is full.
- Check function of tank water level indicator.
- Check float valve operation.
- Check fuel tank is full.
- Flush all pipework (prior to installing the spray nozzles).
- Fit pressure gauge to piping pressure gauge connection and run full scale discharge test. Ensure that the pressure gauge reading is not less than 160 kPa.
- Ensure correct functioning of components critical to the correct operation of the water spray system.
- Ensure correct operation of local, remote, and automatic activation of system.
- Ensure all signage is in place and appropriate.

10.1.6 Maintenance

Maintenance is to be conducted in accordance with AS 5414 (2012) Appendix C. Appendix C includes planned maintenance of components and functional testing of the systems.

Maintenance to be incorporated to the sites planned maintenance program.

11 Bushfire Management Plan (BMP)

11.1 Definition

A Bushfire Management Plan (BMP) is a living document that sets out short, medium and long-term bushfire risk management measures for the life of the asset.

It shall include consideration to the requirements of this Technical Standard and industry best practices.

11.2 Purpose

A Bushfire Management Plan is required to accompany existing and new SA Water assets developed in a bushfire prone area.

A BMP includes the bushfire assessment, identification of the bushfire hazard issues arising from the relevant assessment and a clear demonstration that compliance with the bushfire protection measures contained within this Technical Standard, is or can be achieved.

A Bushfire Management Plan would apply broad consideration of the bushfire protection measures such as selecting a site with a BAL 12.5 or less, siting the asset away from extreme risk areas.

At the Concept and Detailed Design Stages, the Bushfire Management Plan would need to include more specific consideration to ensure Hazard Separation Zones and Asset and Building Protection Zones can be established with information detailed successively at each stage.

11.3 Preparing The BMP

It is strongly recommended BMPs are prepared by a qualified Bushfire Practitioner at the level appropriate to the information required (refer Section 3.3).

The BMP should be prepared as early as possible in the project development process and progressively refined or reviewed as the level of detail increases.

The preparation of the BMP should be incorporated in the Safety in Design process for the project.

11.4 Bushfire Management Plan Topics

The BMP shall include the following, but not limited to:

- **Project Details:** A brief description of the project including criticality rating.
- **Environmental Considerations:** The BMP shall identify whether onsite clearing or modification of native vegetation will be required; and whether areas are proposed to be revegetated as part of the proposed project.

The BMP shall provide evidence, from relevant authorities, that the vegetation clearing and/or modification can be achieved. If evidence is unavailable, it may be satisfactory to identify the need to seek these approvals at a subsequent stage of the project development and to acknowledge that if approval is not forthcoming there may be a need to revise the BMP.

- **Bushfire Assessment Results:** undertaken in accordance with the relevant methodology contained within this Technical Standard
- **Document Liaison with Internal and External Stakeholders:** As per Section 7.11
- **Identification of Bushfire Hazard Issues:** Identify any bushfire hazard issues identified through examination of the environmental considerations and the bushfire risk assessment. This may include access constraints both within and outside of the site, the location of

significant and remaining bushfire hazards (e.g., regional reserves, National Parks, etc.) and other relevant bushfire hazards. This will assist in the understanding of whether the proposed project is likely to be able to comply with the bushfire protection requirements.

- **Assessment Against the Bushfire Protection Hierarchy:** To demonstrate compliance by either addressing the relevant acceptable solutions; or where these acceptable solutions cannot be fully met, performance-based solutions can be developed to achieve the objectives of this Technical Standard as set out in Section 2.

Acceptable solutions shall be provided within a table and not duplicated in the body of the BMP.

- **Final Site Plans Detailing:**

- Asset Protection Zones.
- Water Storage for CFS or Bushfire Water Spray System.
- Flammable and Hazardous Materials on-site.
- Radiant Heat Barriers
- Location of pumps for Bushfire Water Spray Systems.

- **Responsibilities for Implementation and Management of the Bushfire Measures:** To set out in a table and list separately the responsibilities for the initial implementation and ongoing maintenance of the required bushfire risk mitigation measures.

- **Details of Maintenance Activities:** Such as ongoing vegetation clearing and testing/maintenance of Bushfire Water Spray System in accordance with AS 5414 (2012). These are to be incorporated into SA Water maintenance management software.

11.5 Submission of the Bushfire Management Plan

For each stage of the project development phases, a draft site-specific Bushfire Management Plan shall be submitted for SA Water review and acceptance.

The site-specific BMP shall be progressively refined or reviewed as the level of detail increases.

It should be continually updated as part of modifications to the site (e.g., construction of new assets).

A final Bushfire Management Plan shall be delivered as part of the completion of the project and handover.

Appendix A - Schedule of Hold/Witness Points

| Project Phase | Section | Type | Description |
|-----------------------|----------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition Phase | 3.1 | Hold | Determine if the site within a Bushfire Prone Area using SAPPA. |
| Concept Design Phase | 3.2.2 3.3 5 6 | Hold | <ul style="list-style-type: none"> Engaging a specialised bushfire expertise Bushfire Attack Level Assessment Identification of the Asset Criticality Identification of the proposed Site Protection, Building Protection and System Protection systems aligned with the Hierarchy of Protection. |
| Detailed Design Phase | 3.2.3 7 8 9 10 11 | Hold | <ul style="list-style-type: none"> Development of BAL Contour Map Updated layout of the site including location of the following items (as required): <ul style="list-style-type: none"> Asset Protection Zones. Water Storage for CFS or Bushfire Water Spray System. Flammable Materials Radiant Heat Barriers Location of pumps for Bushfire Water Spray Systems. Preliminary feedback from Country Fire Service representatives on the proposed site layout and firefighting capabilities. Develop site-specific bushfire management plan. |
| Construction Phase | 10.1.5 11 | Witness | <ul style="list-style-type: none"> Testing of the Bushfire Water Spray system (including the different activation strategies). Delivery of the Bushfire Management Plan to SA Water. Details of maintenance activities such as ongoing vegetation clearing and testing/maintenance of Bushfire Water Spray System in accordance with AS 5414 (2012). These are to be incorporated into SA Water maintenance management software. Details of liaison with Country Fire Service (where required). |

Appendix B - Prediction of Expected Surface Temperature Based on BAL

Introduction

Determination of the suitability of materials during a bushfire is generally conducted via physical testing in accordance with the following Australian Standards:

- AS 1530.8.1 – Methods for fire tests on building materials, components, and structures: Part 8.1 Tests on elements of construction for buildings exposed to simulated bushfire attack – Radiant heat and small flaming sources.
- AS 1530.8.2 – Methods for fire tests on building materials, components, and structures: Part 8.2: Tests on elements of construction for buildings exposed to simulated bushfire attack – Large flaming sources.

However, some of the critical assets operated by SA Water are not applicable to these standards. Therefore, the suitability to be installed within a Bushfire Prone Area may need to be assessed on a project-by-project basis.

As detailed in Section 4.2 there are numerous causes of damage during a bushfire, however, one of the most predictable is due to radiant heat. Radiant heat generated by the flames reduces the load bearing capacity of materials.

The following calculation identifies the surface temperature of various materials at different BALs.

Calculation

The surface temperature experienced in the event of a bushfire is calculated based on the Stefan Boltzmann Law.

$$E = \epsilon \cdot \sigma \cdot T^4$$

$$\text{Rearranged to } T = \sqrt[4]{\frac{E}{\epsilon \cdot \sigma}}$$

$$E = \text{Heat Flux or BAL } \left(\frac{W}{m^2}\right)$$

ϵ = Emissivity of the Material

σ = Stephan Boltzman Constant (5.67×10^{-8})

T = Temperature ($^{\circ}$ Kelvin)

The emissivity of the materials is from the SFPE Handbook of Fire Protection Engineering (2016), Table 4.2.

A Safety Factor of 1.25 has also been applied to the final temperatures.

Results

| Bushfire Attack Level | Surface Temperature of Material (°C) | | | | |
|-----------------------|-----------------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------------|
| | Rough Concrete ($\epsilon = 0.94$) | Brick ($\epsilon = 0.8$) | Plaster ($\epsilon = 0.48$) | Aluminium ($\epsilon = 0.22$) | Galvanised Iron ($\epsilon = 0.6$) |
| BAL-12.5 | 529 | 564 | 688 | 909 | 631 |
| BAL-19 | 625 | 664 | 801 | 1048 | 739 |
| BAL-29 | 733 | 776 | 929 | 1203 | 860 |
| BAL-40 | 823 | 870 | 1035 | 1331 | 960 |

Limitations

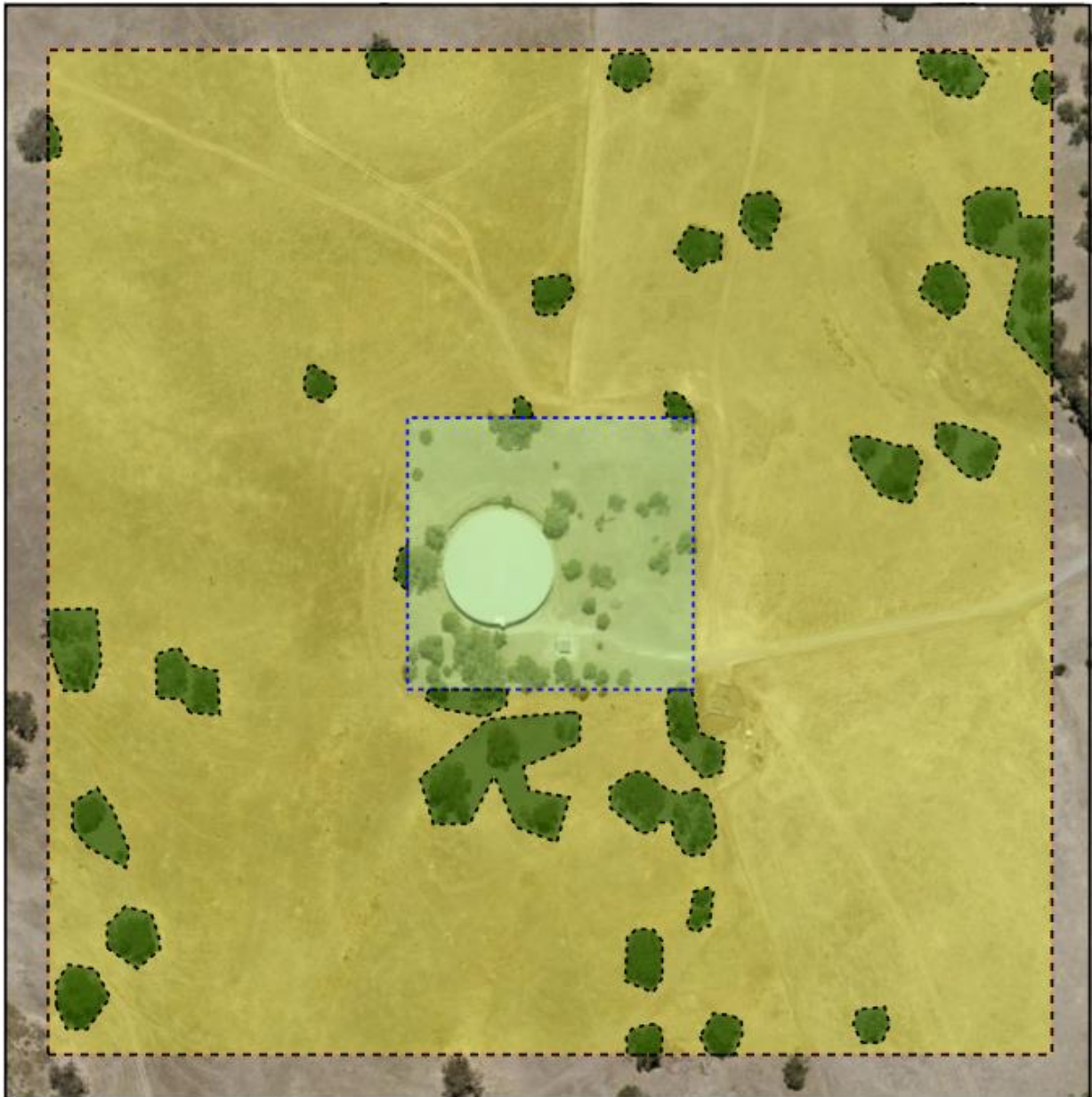
- This calculation identifies the expected surface temperature of the material but does not consider the thermal mass of the object. This will need to be considered when assessing the structural capacity.
- This considers only the peak of the radiation exposure, however, during a bushfire the radiation exposure would steadily increase as the bushfire moved closer to the site. It is proposed that the following is considered, noting that this is highly dependent on the winds during a bushfire.

| | Exposure Durations | | | |
|-----------------------------|----------------------------|--------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| | Maximum BAL of BAL-12.5 | Maximum BAL of BAL-19 | Maximum BAL of BAL-29 | Maximum BAL of BAL-40 |
| Bushfire on Approach | BAL-12.5 - 2 Minutes | BAL-12.5 – 2 Minutes BAL-19 – 2 Minutes | BAL-12.5 – 3 Minutes BAL-19 – 2 Minutes BAL-29 – 2 Minutes | BAL-12.5 – 3 Minutes BAL-19 – 2 Minutes BAL-29 – 2 Minutes BAL 40 – 2 Minutes |
| Bushfire has Passed | BAL 12.5 - 1 Minute | BAL 12.5 – 2 Minutes | BAL-19 – 1 Minute BAL-12.5 – 1 Minute | BAL-29 – 1 Minutes BAL-19 – 1 Minutes BAL-12.5 – 1 Minute |

- This assessment does not consider the impact of BAL-FZ (Flame Zone) on the asset.
- Other forms of heat transfer (such as convection) are likely to also occur during a bushfire, as such the measured temperature may also be greater than calculated.

Appendix C - BAL Contour Map Examples

Vegetation Classification Map



| | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Location details:</p> <p>Assessment date:</p> <p>Prepared by:</p> <p>Accreditation level:</p> <p>Accreditation number:</p> <p>Accreditation expiry date:</p> <p>Date aerial photo:</p> | <p>Vegetation Classification Map (BAL Contour Map)</p> | <p>Legend</p> <p>Assessment Area (150m from the external boundary of the subject site)</p> <p>Subject Land</p> <p>Vegetation Plot Boundary</p> <p>Vegetation Class</p> <p>B, Woodland</p> <p>G, Grasland</p> <p>Area to be modified to low threat state</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

BAL Contour Map



| | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Location details:</p> <p>Assessment date:</p> <p>Prepared by:</p> <p>Accreditation level:</p> <p>Accreditation number:</p> <p>Accreditation expiry date:</p> <p>Date aerial photo:</p> | <h2>BAL Contour Map</h2> | <p>Legend</p> <ul style="list-style-type: none"> BAL Contour Assessment Area (100m from the external boundary of the subject site) Subject Land Vegetation Plot Boundary <p>Indicative Bushfire Attack Level</p> <ul style="list-style-type: none"> BAL - 12.5 BAL - 19 BAL - 29 BAL - 40 BAL - FZ |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|