Bushfire Assessment

In relation to

Sumatran Tiger Adventure Project

Taronga Zoo

Prepared for:

Taronga Conservation Society Australia

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1. Introduction

ABAC Australian Bushfire Assessment Consultants have been commissioned by Taronga Conservation Society Australia (TCSA) to carry out a bushfire assessment in relation to the proposed Sumatran Tiger Adventure project at Taronga Zoo.

Secretary's Environmental Assessment Requirements (SEARs) were issued for the project (Application Number SSD 6864) on 23 January 2015.

Item 7 of the Key Issues listed in the SEARs is entitled "Bushfire", with the requirement listed as:

> *Demonstrate compliance with the relevant provisions of Planning for Bushfire Protection (PBP) 2006 and detail any bushfire management and/or mitigation measures.*

The scope of this assessment is limited to the consideration of the proposed Sumatran Tiger Adventure project.

The following matters, inter alia, are outside the scope of this assessment:

- maintenance of vegetation on the site;
- emergency evacuation procedures;
- compliance or otherwise of the works with the relevant provisions of the Building Code of Australia (BCA).

A site inspection was carried out on 2 February 2015.

According to Mosman Council's bushfire prone land maps, the Taronga Zoo site is mapped as bushfire prone land.

2. The Proposal

The Sumatran Tiger Adventure project is shown on plans prepared by *lahznimmo architects* (Project: 14/07, 20.01.15) entitled *Taronga Zoo – Sumatran Tiger* as follows:

Drawing	Title	Revision	Date
A-SD-1100	Location Plan	B	07/01/15
A-SD-1200	Existing Site Plan	C	20/01/15
A-SD-1400	Proposed Site Plan	D	20/01/15
A-SD-1401	Proposed Roof Plan	C	20/01/15
A-SD-3000	Site Sections	C	20/01/15

The Sumatran Tiger Adventure project is not development for a special fire protection purpose as defined under the provisions of Section 100B of the *Rural Fires Act 1997* or as listed under Clause 46 of the *Rural Fires Regulation 2013*.

The Site Plan (Drawing A-0003) is reproduced in Figure 2.1 on the following page.

The intent for the Sumatran Tiger Adventure project and environs is to create a very moist environment akin to the rainforest habitat of the animals which will occupy the display. Planting of the area with predominantly rainforest species is proposed to create this environment.

The types of building materials proposed for use will be variable. The proposed tiger den area (denoted by "24" in Figure 2.1) will be constructed of core filled blockwork. Staff office areas ("22" in Figure 2.1), supermarket ("15") and interpretive display buildings ("03", and "11") are proposed for construction using lightweight materials. While the buildings will be newly constructed, the aesthetic that the TCSA is seeking to achieve is a character that one might expect to see of buildings in the deep jungle.

NOTES:

1. EXISTING TREES PROPOSED TO BE RETAINED SHOWN ONLY

KEY

00	TO TARONGA FOOD MARKET
01	EXISTING SUN BEAR EXHBIT
02	ENTRY TO PROPOSED EXHIBITS
03	INTERPRETIVE DISPLAY - INTRODUCTION
04	INTERPRETIVE DISPLAY - 'VILLAGE'
05	EXHIBIT TRAIL - INBOUND PATH
06	EXHIBIT VIEWING AREA
07	EXISTING SANDSTONE ROCK LEDGE
08	WATER COURSE - MAN-MADE
09	MAINTENANCE ACCESS
10	WEST RAMP CONNECTOR - RE-DIVERTED
11	INTERPRETIVE DISPLAY - EXHIBIT VIEWING AREA
12	TAHR MOUNTAIN EXHIBIT
13	TIGER NIGHT DENS
14	EXHIBIT TRAIL - OUTBOUND PATH
15	INTERPRETIVE DISPLAY - EXIT
16	EXIT TO PROPOSED EXHIBITS
17	BIRD SHOW ROAD
18	EXISTING RETAINING WALL
19	EXISTING FOOD AND BEVERAGE STAND
20	EXISTING BIRD SHOW SEATING
21	LOADING / GARBAGE AREA
22	STAFF OFFICE AREA
23	KEEPER ACCESSWAY
24	TIGER DENS
25	SUNBEAR ACCESS
26	ANIMAL FOOD PREPERATION AREA
27	RECONFIGURED ACCESS
28	EXISTING STORE AND COLDROOM

Figure 2.1 Site Plan (Source: lahznimmo architects)

The roofing proposed for the interpretive display buildings is corrugated iron roof sheeting. The TCSA is also seeking to have thatch type roofing, for example over the shopfronts to the southern elevation of the building containing staff offices to enhance the desired aesthetic. Thatch type roofing is also proposed for the roof of the open structures to be constructed to the exhibit viewing areas (denoted by “06” in Figure 2.1). The precise material to be selected for the thatch type roofing was not known at the time of assessment, although the client representative indicated that it was likely that a synthetic product would be utilised for this purpose, possibly some kind of recycled plastic product manufactured to look like thatch roofing.

3. The Site

The Sumatran Tiger Adventure is to be located within the Taronga Zoo site, within the south-western part of the overall Zoo site. The area proposed for the location of the Sumatran Tiger Adventure project site is presently occupied by displays housing Lions, Tigers, Snow Leopards, Meerkats, Malaysian Tapir, and Fennec Fox. The existing Himilayan Tahr exhibit and large heritage listed man-made mountain structure to that exhibit in the north-western part of the project site will be retained as will the existing Sun Bear exhibit to the eastern end of the project site.

The bird show seating area and associated facilities is located to the south-west of the project site, as the area occupied by the existing Roar ‘n’ Snore overnight accommodation facility. These areas are located downslope from the project site and any vegetation likely to pose any bushfire hazard to the Sumatran Tiger Adventure project site is located further downslope and to the south-west of these adjacent facilities (closer to the sewage treatment plant for the Zoo) and the foreshore to Little Sirius Cove and Whiting Beach.

The following photographs show the area on and around the proposed Sumatran Tiger Adventure site.

Photo 3.1 **View of the western part of the existing areas within the Sumatran Tiger Adventure project site (part of the “mountain” to the Himilayan Tahr exhibit is shown at left)**

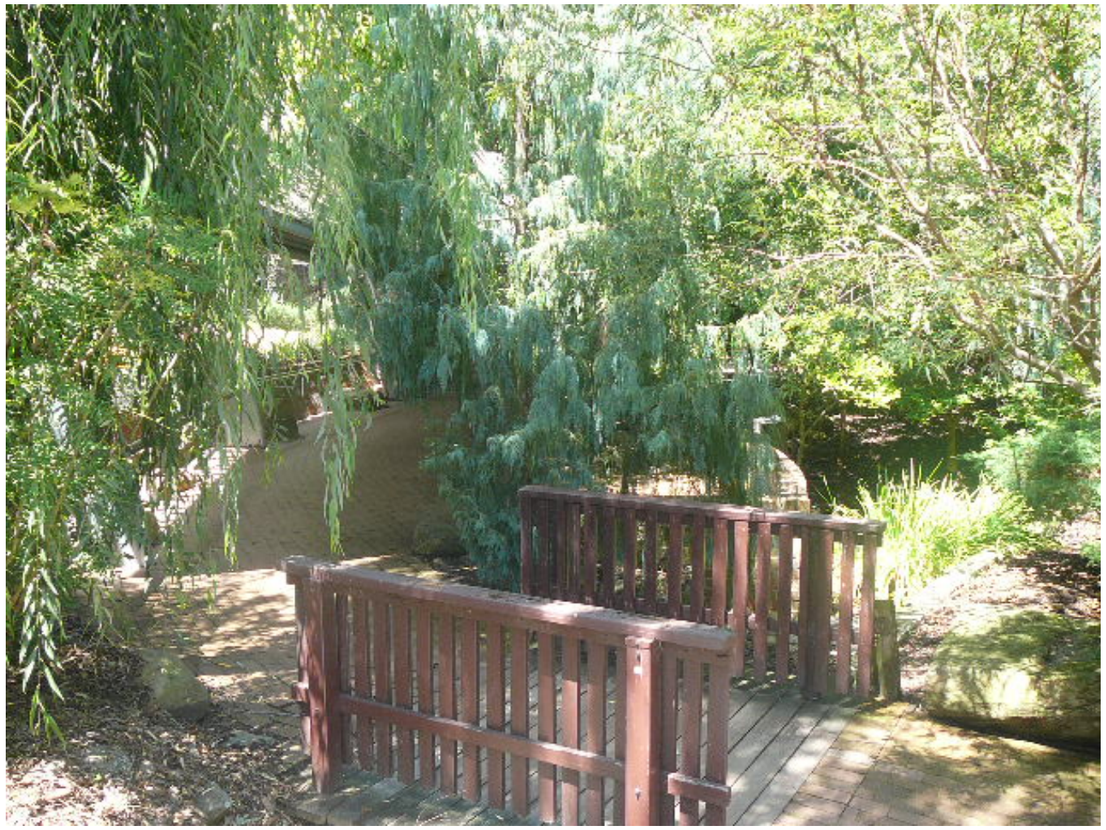

Photo 3.2 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.3 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.4 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.5 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.6 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.7 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.8 View of existing areas within the Sumatran Tiger Adventure project site

Photo 3.9 View of the existing seating to the bird show area (downslope and to the south-west of the Sumatran Tiger Adventure project site). Any potential bushfire hazard vegetation is to the downslope and to the south-west of the area shown

4. Planning for Bush Fire Protection

In NSW, *Planning for Bush Fire Protection 2006* applies to all development on bushfire prone land. All development on bush fire prone land must satisfy the aim and objectives of *Planning for Bush Fire Protection 2006*.

The aim of *Planning for Bush Fire Protection* is:

> *to use the NSW development assessment system to provide for the protection of human life (including firefighters) and to minimise impacts on property from the threat of bush fire, while having due regard to development potential, on-site amenity and protection of the environment.*

The objectives of *Planning for Bush Fire Protection* are to:

i. afford occupants of any building adequate protection from exposure to a bush fire;
ii. provide for a defendable space to be located around buildings;
iii. provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
iv. ensure that safe operational access and egress for emergency service personnel and residents is available;
v. provide for ongoing management and maintenance of bush fire protection
vi. measures, including fuel loads in the asset protection zone (APZ); and
vii. ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bush fire fighting).

The controls outlined in *Planning for Bush Fire Protection* are based upon six (6) key Bush Fire Protection Measures (BPMs):

a) The provision of clear separation of buildings and bush fire hazards, in the form of fuel-reduced APZ (and their subsets, inner and outer protection areas and defendable space);
b) Construction standards and design;
c) Appropriate access standards for residents, fire fighters, emergency service workers and those involved in evacuation;
d) Adequate water supply and pressure;
e) Emergency management arrangements for fire protection and/or evacuation; and
f) Suitable landscaping, to limit fire spreading to a building.

Planning for Bush Fire Protection applies specific controls to development for residential development/subdivision and other development that is defined as development for a "special fire protection purpose" (SFPP) under the provisions of Section 100B of the Rural Fires Act 1997 (NSW) and Clause 46 of the Rural Fires Regulation 2013.

The Sumatran Tiger Adventure project is not development for a special fire protection purpose as defined under the provisions of Section 100B of the *Rural Fires Act 1997* or as listed under Clause 46 of the *Rural Fires Regulation 2013* and there are no specific controls applicable for the purposes of *Planning for Bush Fire Protection*.

The aim and objectives of *Planning for Bush Fire Protection* apply to the proposed Sumatran Tiger Adventure project.

Planning for Bush Fire Protection 2006 (and AS3959-2009) is adopted by reference for the purposes of Volume 1 of the Building Code of Australia 2014 (BCA 2014). NSW G5.2 (Protection) of Volume 1 of BCA 2014 applies to Class 2, 3 and 4 buildings or a Class 9 building that is development for a SFPP in a bushfire prone area. NSW Clause G5.2(a) provides that these buildings must comply with AS3959-2009 except for Section 9 Construction for Bushfire Attack Level FZ (BAL-FZ).

The BCA consultant has advised the client that the Interpretive Buildings (hangar/supermarket/mid-point) within the Sumatran Tiger Adventure project will be Class 9b for the purposes of the Building Code of Australia (BCA). While the Sumatran Tiger Adventure project is not development for a SFPP, general compliance with AS3959-2009 will be recommended for the hangar and supermarket buildings. The mid-point building will not be recommended for compliance with AS3959 as the design of this building is required to incorporate lightweight materials to achieve the aesthetic as discussed in Section 2.

5. AS3959-2009 Construction of Buildings in Bushfire-prone areas

The objective of AS3959-2009 (Construction of Buildings in Bushfire Prone Areas) is to prescribe particular construction requirements/details for buildings to reduce the risk of ignition from a bushfire while the fire front passes.

The Standard notes that it is first necessary to determine the Bushfire Attack Level (BAL) – by an assessment of the site and classified vegetation impacting on the site – before construction requirements can be determined.

AS3959-2009 uses six (6) BALs, each of which are based on heat flux exposure standards. Table 3.1 of AS3959-2009 provides a description of the characteristics of each BAL used in the Standard. In summary, these are:

- BAL – LOW: there is insufficient risk to warrant specific construction requirements;
- BAL – 12.5 (heat flux exposure ≤12.5kW/m^2): ember attack;
- BAL – 19 (heat flux exposure >12.5kW/m^2 and ≤19kW/m^2): increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux;
- BAL – 29 (heat flux exposure >19kW/m^2 and ≤29kW/m^2): increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux;
- BAL – 40 (heat flux exposure >29kW/m^2 and ≤40kW/m^2): increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames; and
- BAL – FZ (heat flux exposure >40kW/m^2): direct exposure to flames from fire front in addition to heat flux and ember attack.

Section 2 of AS3959-2009 provides the basis for the determination of bushfire attack level (BAL) for a site (or building). The BAL is influenced by:

- the type of and extent of potential bushfire hazard vegetation (classified vegetation);
- the distance of a site (or building) from classified vegetation; and
- the slope of the land under the classified vegetation.

Where buildings are located within 100 metres of classified vegetation, the construction of those buildings is required to comply with the construction requirements applicable for the identified BAL.

As noted in the previous section, the BCA applies the construction requirements as per AS3959-2009 to a Class 9 building that is development for a SFPP. The Interpretive Buildings (hangar/supermarket/mid-point) within the Sumatran Tiger Adventure project will be Class 9b for the purposes of the Building Code of Australia (BCA).

It has been identified that the Sumatran Tiger Adventure project is not development for a SFPP. Nevertheless, the application of elements of the construction requirements as per AS3959-2009 to the hangar and supermarket buildings will provide for more resilient construction.

6. Assessment of vegetation

The Taronga Zoo site contains a considerable amount of vegetation mainly comprising landscaping and retained vegetation within the larger Zoo complex. Overall, this vegetation comprises maintained vegetation, managed as part of the operational procedures of the Zoo. The vegetation comprises some larger and smaller areas of remnant vegetation, fragmented by the constructed pathways, retaining structures, enclosures/displays and other structures and infrastructure associated with the Zoo and located within the site.

The Sumatran Tiger Adventure project will involve the construction of a number of new buildings throughout the area of interest, including a number of detached low-scale buildings in order to achieve the aesthetic desired by TCSA for the project area.

As mentioned previously, the project site will also be subject to significant planting of the area with predominantly rainforest species to recreate the jungle/rainforest environment characteristic of the habitat of the Sumatran Tiger.

Buildings within the project area will be generally concentrated towards the eastern end of the project site, with plantings concentrated within the areas proposed as Tiger Exhibits 01, 02 and 03 (in the central and western parts of the project site.

The largest area of vegetation within the Zoo site in relation to the area proposed for the Sumatran Tiger Adventure project is located to the west/south-west of the project site.

As noted in Section 3 of this assessment, this vegetation is located to the south-west of and downslope from the bird show seating area and the area occupied by the existing Roar ‘n’ Snore overnight accommodation facility.

These areas are located downslope from the project site and these areas provide a significant effective separation distance between the project site and any potential bushfire hazard vegetation.

This vegetation is located within the lower elevations of the Zoo site, nearer the sewage treatment plant for the Zoo. There is also vegetation located outside the Zoo site to the west and south-west, around the foreshore to Little Sirius Cove and Whiting Beach. This vegetation, together with other isolated remnant vegetation within the Zoo site, may have some impact on the Sumatran Tiger Adventure project in terms of a potential for ember generation.

The vegetation within the Zoo site, for a distance of 140 metres from the location of the Sumatran Tiger Adventure project, has been considered as remnant vegetation given the characteristics of the vegetation as identified above and, therefore, a low hazard for the purposes of A2.3 of *Planning for Bush Fire Protection 2006*.

As such, building construction standards for this area of vegetation can be considered as the same as for rainforests. The vegetation formation converted to the AUSLIG (1990) vegetation classification utilised for AS3959-2009 is *rainforest*.

7. Assessment of slope

The land within the Zoo site is steeply sloping in parts.

This slope is variable and has been both modified and influenced by the natural and man-made features within the site.

The assessment of effective slope in terms of the relationship between the Sumatran Tiger Adventure project and any potential bushfire hazard vegetation, while an element to be considered in any bushfire assessment, is not considered critical in terms of the realistic bushfire hazard potential of vegetation within the Zoo site and the relationship or potential impact of same on the project site.

While the effective slope in relation to potential bushfire behaviour would be likely to be assessed as downslope – as areas of vegetation have been identified some distance to the south-west of the project site – the project site is located a sufficient distance from any large tracts of vegetation. Therefore, there is unlikely to be any situation arising where any buildings within the project site would be subject to any significant radiant heat impacts in the event of any unplanned fire occurring in vegetation on or around the site.

In recognition of the sloping nature of the site, however, the effective slope within 100 metres of the project site (that is, the slope of the land under vegetation most likely to influence bushfire behaviour in relation to the building, has been assessed as being >10-15° downslope.

The project site is well in excess of 50 metres from any unmanaged vegetation located to the south-west of the project site.

8. Bushfire Assessment

The Bushfire Assessment for the Sumatran Tiger Adventure project is a combination of quantitative and qualitative analysis.

8.1 Quantitative Analysis

The quantitative assessment for the project site has been based on any buildings being at least 50 -60 metres (and generally greater) from any potential bushfire hazard vegetation located to the south-west.

The relevant fire danger index (FDI) is 100 for the purposes of assessment under AS3959-2009.

The classification of vegetation and assessment of effective slope have been based on the following assumptions:

- Vegetation structure within 140 metres of the building is remnant vegetation;
- building construction standards for remnant vegetation can be considered as the same as for rainforests; and
- The effective slope of land under vegetation is >10-15° downslope.

The relevant parameters for the BAL assessment for the Sumatran Tiger Adventure project are shown in Table 8.1.

The simplified procedure (Method 1) as per Section 2.2 of AS3959 has been to determine the BAL for the project site. The simplified procedure applies where the effective slope under the classified vegetation is no more than 20° down slope. The site slope – that is, the slope of land between the building and any classified vegetation – is not relevant for the simplified procedure.

Table 8.1

Parameter	Value
Maximum slope under the vegetation to 100 metres from building	>10-15°
Fire Danger Index	100
Vegetation classification	Remnant/rainforest (see Section 6)
Distance of the building from classified vegetation	At least 50-60 metres (minimum)

Using Table 2.4.2 of AS3959, the assessed BAL for buildings within the Sumatran Tiger Adventure project site is BAL-12.5.

Noting the comments in Section 4, buildings within the Sumatran Tiger Adventure project site are technically not subject to the provisions of AS3959-2009 (Construction of Buildings in Bushfire-prone areas).

Given that the bushfire assessment has indicated that the project site is likely to be subject to some degree of ember protection in the event of a bushfire, however, the adoption of the construction requirements for BAL-12.5 is to be recommended.

8.2 Qualitative Analysis

The qualitative analysis has been carried out to supplement the quantitative analysis.

The qualitative analysis considers the aim and objectives of *Planning for Bush Fire Protection 200*6.

The aim of *Planning for Bush Fire Protection 2006* is:
to use the NSW development assessment system to provide for the protection of human life (including firefighters) and to minimise impacts on property from the threat of bush fire, while having due regard to development potential, on-site amenity and protection of the environment.

The objectives of *Planning for Bush Fire Protection 2006* are to:

i. *afford occupants of any building adequate protection from exposure to a bush fire;*
ii. *provide for a defendable space to be located around buildings;*
iii. *provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;*
iv. *ensure that safe operational access and egress for emergency service personnel and residents is available;*
v. *provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the asset protection zone (APZ); and*
vi. *ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bush fire fighting).*

In relation to the objectives of *Planning for Bush Fire Protection 2006,* the following points are relevant:

- The design and location of the Sumatran Tiger Adventure project is such that it may be subject to some degree of ember attack in the event of a bushfire occurring within vegetation on and around the site. The project site will be separated from any potential bushfire hazard vegetation and material ignition is unlikely as the distance between any buildings within the project site and any potential hazard will reduce the possibility for direct flame contact or significant radiant heat to impinge upon the building fabric. The hangar and supermarket buildings within the project site are proposed to be constructed to meet the requirements for construction for BAL-12.5 as per AS3959-2009 to mitigate any effects arising from potential ember attack.

- The buildings within the project site will be constructed to meet all relevant requirements of the BCA as applicable to individual buildings within the project site including construction, fire detection and suppression measures. In the event of a bushfire, emergency procedures will apply to ensure the safety of any patrons present in the Sumatran Tiger Adventure exhibit, and patrons present within the overall Zoo site as a whole.
- The project site is located a sufficient distance from any large tracts of vegetation. This will ensure that significant defendable space is available within the project site and there is unlikely to be any situation arising where any buildings within the project site would be subject to any significant radiant heat impacts in the event of any unplanned fire occurring in vegetation on or around the Zoo site.
- Access will be available for the purposes of an emergency response in the event of a bushfire. The Zoo is subject to emergency management and response procedures and has its own fire fighting capability.
- The Zoo site is subject to detailed operational procedures and is stringently managed and monitored to ensure public safety and the safe and efficient operation of the Zoo. Aspects of this management include maintenance of the vegetation within the site, as well as the maintenance of buildings within the complex.

The proposal is consistent with the aim and objectives of *Planning for Bush Fire Protection 200*6.

9. Conclusion

It has been identified that the realistic bushfire attack potential for the Sumatran Tiger Adventure project site is relatively low. The main mode of bushfire attack that may potentially impact upon buildings within the project site has been identified as being ember attack in the event of an unplanned bushfire occurring in the vegetation on and around the site.

The Taronga Zoo site contains a considerable amount of vegetation, mainly comprising landscaping and retained vegetation within the larger Zoo complex. Overall, this vegetation comprises maintained vegetation, managed as part of the operational procedures of the Zoo. The vegetation comprises some larger and smaller areas of remnant vegetation, fragmented by the constructed pathways, retaining structures, enclosures/displays and other structures and infrastructure associated with the Zoo and located within the site.

The effect of the above is that the context and setting of the Zoo site is characterised by vegetation interspersed throughout the site. This vegetation establishes the character of the site and provides the backdrop for the displays and exhibits that comprise the Zoo.

In relation to the specific area proposed for the Sumatran Tiger Adventure project, the project site will also be subject to significant planting of the area with predominantly rainforest species to recreate the jungle/rainforest environment characteristic of the habitat of the Sumatran Tiger.

The Bushfire Assessment demonstrates, however, that the existence of vegetation throughout the Zoo site does not equate to a significant bushfire risk to the buildings and other infrastructure throughout the site.

The Zoo site is subject to detailed operational procedures and is stringently managed and monitored to ensure public safety and the safe and efficient operation of the Zoo. Aspects of this management include maintenance of the vegetation within the site, as well as the maintenance of buildings within the complex.

The potential for an unplanned fire to occur within the site, while unlikely, cannot be discounted entirely. Therefore, it is important that the potential for ember generation to impact on the Sumatran Tiger Adventure project site be recognised, and measures adopted to mitigate against these impacts.

10. Recommendations

The following recommendations are made in relation to bushfire protection measures for the Sumatran Tiger Adventure project at Taronga Zoo:

A The construction of the buildings proposed for the Sumatran Tiger Adventure project site is to comply with the construction requirements for BAL-12.5 as per *AS 3959-2009 Construction of buildings in bushfire-prone area*.

B The design of each building within the project site be assessed in relation to each element of the construction requirements relevant to A to ensure that the incorporation of requirements envisaged by the Standard are appropriate to the function and use of the building (as the Sumatran Tiger Adventure project is not development for a SFPP and compliance or otherwise with any aspects of AS3959 are optional to facilitate more resilient construction where appropriate). For example, it is not intended that Recommendation A would:

(i) preclude the use of roofing material having an appearance similar to thatch roofing on limited areas of roof to buildings within the project site. The use of thatch type roofing should, however, should be avoided on enclosed buildings

likely to be used for public assembly within the project site (the interpretive buildings, for example).

(ii) Require the screening of openings with metal mesh screens. The buildings are based on the flow of Zoo patrons through them and are required to be open in parts to facilitate viewing of the external environment around the buildings.

(iii) Apply to the mid-point building. The design of this building is required to incorporate lightweight materials to achieve the “jungle buildings” character desired by TSCA.

References

NSW Rural Fire Service (2006)
Planning for Bush Fire Protection.

AS 3959, “Construction of buildings in bushfire-prone areas” (incorporating Amendments Nos. 1, 2 and 3), Standards Australia, 2009.