

Bushfire

Services

Bushfire Protection Assessment

Proposed Subdivision
Lot 682 DP 568678, Lot 705 DP 613881
and Lot 810 DP 247285
Manyana Drive, Manyana

Shoalhaven City Council

June 2008

Our Reference: B1060581

BUSHFIRE PROTECTION ASSESSMENT

Our Reference: B1060581

Proposed Subdivision

Lot 682 DP 568678, Lot 705 DP 613881 and Lot 810 DP 247285

Manyana Drive, Manyana

Shoalhaven City Council

Prepared June 2008


for

Vacenta Pty Limited

PROJECT TEAM:

Rod Rose
Steve Edwards

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PART A The property and type of development

Name:	JWA Enterprises Pty Limited c/- Watkinson Apperley Pty Limited		
Postal address:	PO Box 495 Nowra NSW 2541		
Street or property Name:	Manyana Drive		
Suburb, town or locality:	Manyana	Postcode:	2539
Lot/DP no:	Lot 682 DP 568678, Lot 705 DP 613881 and Lot 810 DP 247285		
Local Government Area:	Shoalhaven City Council		
Type of area:	Urban <input checked="" type="checkbox"/> Rural Residential <input type="checkbox"/>		
Type of development:	Subdivision <input checked="" type="checkbox"/> no. of proposed lots 57 no. of existing lots 3		
	Boundary adjustment <input type="checkbox"/>	Lease which is subdivision <input type="checkbox"/>	
	Community title <input type="checkbox"/>	Strata subdivision <input type="checkbox"/>	

Figure 1 is an aerial photograph of the site.

Figure 2 shows the layout of the proposed subdivision.

The subject land was inspected on 18 December 2007.

Site photographs are provided on page 18.

Figure 1: Aerial photograph



KEY

- DENOTES ASSET PROTECTION ZONE AS DETERMINED BY BUSHFIRE ASSESSMENT
- CREEK
- PADMOUNT
- END OF EXISTING ROADS

THE BARBICAN

THE BARBETTE

THE PALISADE

THE BOUNTY

MANYANA DRIVE

SUNSET DRIVE

THE BULWARK

AUSTIN STREET

PROPOSED WETLANDS

DEFERRED FROM AMENDMENT No. 62 GAZETTED 5/2/99

158
3.97 ha
(3.07 ha Deferred Lot 2(e) Village)
(0.90 ha 2(a) Residential)

LOT 682 DP 568678, LOT 705 DP 613881 AND LOT 810 DP 247285

MANYANA DRIVE, MANYANA

FOR JWA ENTERPRISES PTY LIMITED

REDUCTION RATIO
1:1000 A1
1:2000 A3

DATUM
AHD

SURVEY
DESIGN TW
DRAWN BP
CHECKED TW
APPROVED

AMENDMENTS
0. ORIGINAL PLAN
1. AMEND LOT BOUNDARIES & ADD SCC SEWER PUMPING STATION
2. AMEND LOT BOUNDARIES 725-730, PATHWAY & SCC SEWER PUMPING STATION
3. AMEND LOT BOUNDARIES, ADD SEWER PUMPING STATION & PERIMETER FIRE TRAIL
4. REMOVE 14 LOTS, AMEND LOT BOUNDARIES, REDUCE ROAD WIDTH & CHANGING APZs
5. AMEND LOT BOUNDARIES

BY DATE
BP 22/8/03
TW/VI 16/12/03
TW/VI 18/2/04
TW/VI 31/3/05
DCA 20/12/07
DMC 24/04/08

NOTE: DIMENSIONS AND AREAS ARE SUBJECT TO FINAL SURVEY

WATKINSON APPERLEY PTY LIMITED
SURVEYORS & ENGINEERS
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DATE: 26 MARCH 2008

PROPOSED SUBDIVISION LAYOUT
LOT 682 DP 568678, LOT 705 DP 613881
AND LOT 810 DP 247285
MANYANA DRIVE, MANYANA
FOR JWA ENTERPRISES PTY LIMITED

SHEET 1 OF 1 SHEETS
REF. No. 101662
PLAN No. 03/141

PART B Bush fire threat assessment

The subject land is identified as bushfire prone land by Shoalhaven City Council. The following assessment is prepared in accordance with Section 100B of the *Rural Fires Act 1997*, Clause 46 of the *Rural Fires Regulation 2002*, and the *Planning for Bushfire Protection* guidelines (RFS 2006) herein referred to as the *PBP guidelines*.

B.1. Vegetation types and slope

The vegetation and slope has been assessed in four directions for each proposed allotments. In accord with the PBP guidelines the predominant vegetation class has been calculated for a distance of at least 140 m out from each building envelope and where appropriate out from the boundary of the subject land and/or the slope class “most significantly affecting fire behaviour having regard for vegetation found [on it]” for a distance of at least 100 m. The predominant vegetation and effective slope assessments are shown in Table 1 (p. 6).

PART C Asset protection zones (APZ)

The PBP guidelines have been used to determine the width of Asset Protection Zones (APZ) for each proposed allotment using the vegetation and slope data identified in Table 1 (p.6). The proposed APZ are also shown in Table 1 (p. 6). Part L provides RFS APZ calculator reports based upon the slope and vegetation types in Table 1.

Table 1: Threat assessment, APZ and category of bushfire attack

Direction from envelope	Slope ¹	Vegetation ²	PBP required APZ ³	Proposed APZ	AS3959 Construction Standard ⁵	Comment
Southern lots adjacent to The Bounty (Lots 140-148, 153 and 157)						
north, east and west	n/a	proposed and/or existing development	n/a	n/a	Level 1	
south	3° upslope	Forest	17m	25m	Level 2	About 20m of APZ is accommodated in The Bounty and the remainder in the building line setback from the road.

Direction from envelope	Slope ¹	Vegetation ²	PBP required APZ ³	Proposed APZ	AS3959 Construction Standard ⁵	Comment
Southern lots east of Austin Street (Lots 132-134)						
north, east and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
south	3° upslope	Forest	17m	17m	Level 3	
SE lot (Lot 131)						
north and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
east	1° upslope	Forest	19m	19m	Level 3	Slope rises to higher areas on dunes
south	3° upslope	Forest	17m	17m	Level 3	
Eastern lot, southern end (lots 130)						
north, east and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
east	1° upslope	Forest	19m	19m	Level 3	About 12m of APZ is accommodated in perimeter road and the remainder on lot
Eastern lot (lot 126)						
north, south and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
east	Level	Forest	20m	20m	Level 3	About 12m of APZ is accommodated in perimeter road and the remainder on lot
Eastern lot (lot 120)						
north, south and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	

Direction from envelope	Slope ¹	Vegetation ²	PBP required APZ ³	Proposed APZ	AS3959 Construction Standard ⁵	Comment
east	1° downslope	Forested wetlands	16m	16m	Level 3	About 12m of APZ is accommodated in perimeter road and the remainder on lot, Forest (to south) transitions to Forested Wetland (to north) near this allotment
Eastern lot (Lot 119)						
north	1° downslope	Forested wetlands	16m	16m	Level 3	About 12m of APZ is accommodated in perimeter road and the remainder on lot
east	1° downslope	Forested wetlands	16m	16m	Level 3	About 12m of APZ is accommodated in perimeter road and the remainder on lot
south and west	n/a	The proposed and/or existing development	n/a	n/a	Level 2	
Eastern lot (Lot 118)						
north, east south and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
NE	1° downslope	Forested wetlands	16m	16m	Level 3 (eastern and northern elevations)	About 12m of APZ is accommodated in perimeter road and the remainder on NE corner of lot Freshwater wetland occurs immediately to the north
Eastern lot (Lot 116)						
north, south and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
east	1° downslope	Freshwater wetlands (created by development)	9m	6m	Level 3	Wetlands access track provides 6 m APZ. A 1.8 m high colourbond fence provides a radiant heat barrier and security from wetland. An alternate solution is proposed to justify this approach (see text following this table).

Direction from envelope	Slope ¹	Vegetation ²	PBP required APZ ³	Proposed APZ	AS3959 Construction Standard ⁵	Comment
Eastern lot (Lot 115)						
north, south and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
east	1° downslope	Forested wetlands	16m	16m	Level 3	Entire APZ is accommodated on lot. A radiant heat barrier (1.8 m high colourbond fence) on southern boundary is recommended and may justify a lower construction standard at 79BA stage.
Eastern lots (Lots 108-114)						
north, east, and west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
south	1° downslope	Forested wetlands	16m	16m	Level 3	About 12m of APZ is in perimeter road and the remainder on lots
Eastern lot (Lot 107)						
north, east, west, south	n/a	proposed and/or existing development	n/a	n/a	Level 2	
SW	1° downslope	Forested wetlands	16m	16m	Level 3	About 12m of APZ is in perimeter road and the remainder on lot. Forested wetland shown in photos in Part K.
Eastern lot (Lot 103)						
north and east	n/a	proposed and/or existing development	n/a	n/a	Level 2	
south and west	1° downslope	Forested wetlands	16m	16m	Level 3	Entire APZ is on lot. Forested wetland shown in photos in Part K.
Eastern lot (Lot 102)						
north, east, west	n/a	proposed and/or existing development	n/a	n/a	Level 2	
south	1° downslope	Forested wetlands	16m	16m	Level 3	Part of APZ is accommodated in sewer pump station and remainder on lots

¹ Slope most significantly influencing the fire behaviour of the site having regard to vegetation found. Slope classes are according to PBP guidelines.

² Predominant vegetation is identified, according to PBP guidelines and “Where a mix of vegetation types exist the type providing the greater hazard is said to be predominate”.

³ Assessment according to PBP guidelines and RFS APZ Calculator (see Part L)

⁴ Assessment according to PBP guidelines

⁵ Building construction standard required under Australian Standard AS3959

Part C (cont.)

Alternate Solution APZ for Lot 116

Lot 116 adjoins a proposed freshwater wetland (See Figure 2). The freshwater wetland landscaping is described in Part D. The RFS APZ calculator predicts a 9 m wide APZ for the 1⁰ downslopes found on site. However wide areas of open water will occur in the man made freshwater wetland (see Part D) and the fire threat from the residual hazard to Lot 116 which is located to the west of the wetland will be minimal.

A 6 m wide access track will separate the wetland from Lot 116 and will be used by Council for access for wetland maintenance purposes. This track plus a 1.8 m high steel fence will eliminate the potential radiant heat and flame contact potential for a future dwelling on Lot 116 and the Level 3 building construction standard will provide best practice protection against burning debris attack. As there is no potential for crown fire from a westerly spreading fire out of the freshwater wetland into the fringe vegetation and the 6 m wide APZ provided by the access track, the 1.8 m high radiant heat barrier will be very effective.

Leonard *et al* (2006) of the CSIRO tested among other things the performance of 1.8 m high colourbond steel fencing as a radiant heat barrier and concluded the following:

- (p. 61) “... it maintained structural integrity as a heat barrier under all experimental exposure conditions, and it did not spread flame laterally or contribute to the fire intensity during exposure. The fencing reduced radiation levels within the fencing boundary to below 5 kW/m² immediately behind the fencing system during all radiation exposures, and reduced the radiant heat exposure on a structure 9 m from the fencing by at least a factor of two.”

The CSIRO tests included “a flame front of 10 megawatts/metre (MW/m) fire line intensity (flame heights typically 5 m)” (p. 25). As the fire hazard to the east of Lot 116 has a freshwater wetland vegetation structure a crown fire is not possible within the wetland; this wetland extends about 50 m to the east of Lot 116.

In the absence of a crown fire the proposed 1.8 m high radiant heat barrier, colourbond fence, will perform in a manner similar to that tested by the CSIRO (Leonard *et al*, 2006). This performance will remove the proposed buildings beyond the point where a 29kW/m² radiant heat flux will occur and application of the Leonard *et al* 2006 research suggests the colourbond fence will reduce the radiant heat flux levels by a factor of at least two, and probably higher. The radiant heat flux at about 6 m is therefore predicted to be less than 20 kW/m² and well less than 29kW/m² threshold.

PART D Asset protection zone maintenance plan

Fuel management within the APZ is to be as follows:

- No tree or tree canopy is to occur within 2 m of the dwelling roofline;
- The presence of a few shrubs or trees in the APZ is acceptable provided that they:
 - are well spread out and do not form a continuous canopy;
 - are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and
 - are located far enough away from the building so that they will not ignite the building by direct flame contact or radiant heat emission.
- Any landscaping or plantings should preferably be local endemic mesic species or other low flammability species;
- A minimal ground fuel is to be maintained to include less than 4 tonnes per hectare of fine fuel (*fine fuel* means ANY dead or living vegetation of <6 mm in diameter e.g. twigs less than a pencil in thickness. 4 t/ha is equivalent to a 1 cm thick layer of leaf litter);
- Any structures storing combustible materials such as firewood (e.g. sheds) must be sealed to prevent entry of burning debris;

Freshwater wetland landscaping

The wetland planting strategy will be based on the wetland design depths/zones to meet stormwater quality objectives. The vegetation will incorporate appropriate plant species that suit the depth range of the wetland zones and have the structural characteristics to perform particular treatment processes (e.g. well distributed flows, enhance sedimentation, maximise surface area for the adhesion of particles and provide a substratum for algal epiphytes and biofilms). The macrophyte zone typically comprises four marsh zones (defined by water depth) and an open water zone. The four marsh zones are ephemeral marsh, shallow marsh, marsh and deep marsh as depicted in Figure below. The relative proportion of each marsh zone will be dependent on the specific pollutant(s) being targeted by the wetland.

PART E Construction Standards

The level of bushfire attack and required building construction standard (under Australian Standard AS 3959 (2000)) for each allotment is shown in Table 1, p.7.

PART F Water supply

The subject land is serviced by reticulated water. The furthest point of any building from a hydrant is not greater than 70 m.

PART G Gas and electricity supplies

In accordance with *PBP 2006*, electricity should be underground wherever practicable. Where overhead electrical transmission lines are installed;

- lines are to be installed with short pole spacing, unless crossing gullies, and
- no part of a tree should be closer to a powerline than the distance set out in Appendix 4 of *PBP 2006* (Appendix 2).

Any gas services are to be installed and maintained in accordance with AS 1596. The relief valves of any gas cylinder located near the dwelling will be directed away from buildings and away from combustible materials.

PART H Property access roads and public road system capacity

H.1. Capacity of public roads

In the event of a bush fire emergency the public road servicing the subject land has the capacity to handle the increased volume of traffic associated with the subdivision.

H.2. Access and egress

The access and egress system and design standard is shown in Figure 2. Details of the design standards proposed for the access are shown in Table 2, Table 3 and Table 4.

Table 2: Compliance with Acceptable Solutions for public roads

PBP (p. 21) – Acceptable Solution	Compliance	Comment
• public roads are two-wheel drive, all weather roads.	Yes	
• urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 4.1 – Road widths for Category 1 Tanker (medium Rigid Vehicle).	Yes	
• the perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas.	Yes	See Section H3 re fire trails
• traffic management devices are constructed to facilitate access by emergency services vehicles.	Yes	None proposed
• public roads have a cross fall not exceeding 3 degrees.	Yes	
• all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the	Yes	

PBP (p. 21) – Acceptable Solution	Compliance	Comment
hazard.		
• curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress.	Yes	
• the minimum distance between inner and outer curves is six metres.	Yes	
• maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient.	Yes	
• there is a minimum vertical clearance to a height of four metres above the road at all times.	Yes	
• the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicate load rating.	Yes	
• public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression.	Yes	
• public roads between 6.5 metres and 8 metres wide are No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression.	Yes	
• public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.	Yes	
• one way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.	Yes	
• parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays.	Yes	
• public roads directly interfacing the bush fire hazard vegetation provide roll top kerbing to the hazard side of the road.	Yes	

Table 3: Compliance with Acceptable Solutions for property access roads

PBP (p. 23) – Acceptable Solution	Compliance
Note: No specific access requirements apply in a urban area where a 70 metres unobstructed path can be demonstrated between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles (i.e. a hydrant or water supply).	Yes

Table 4: Compliance with Acceptable Solutions for fire trails

PBP (p. 25) – Acceptable Solution	Compliance
• a minimum carriageway width of four metres with an additional one metre wide strip on each side of the trail (clear of bushes and long grass) is provided.	Yes
• the trail is a maximum grade of 15 degrees if sealed and not more than 10 degrees if unsealed.	Yes
• a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches is provided.	Yes
• the crossfall of the trail is not more than 10 degrees.	Yes
<p>• the trail has the capacity for passing by: - reversing bays using the access to properties to reverse fire tankers, which are six metres wide and eight metres deep to any gates, with an inner minimum turning radius of six metres and outer minimum radius of 12 metres; and/or - a passing bay every 200 metres, 20 metres long by three metres wide, making a minimum trafficable width of seven metres at the passing bay.</p> <p><i>Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m) and extend for no more than 30m and where obstruction cannot be reasonably avoided or removed.</i></p>	Yes
• the fire trail is accessible to firefighters and maintained in a serviceable condition by the owner of the land.	Yes
• appropriate drainage and erosion controls are provided.	Yes
• the fire trail system is connected to the property access road and/or to the through road system at frequent intervals of 200 metres or less.	Yes
• fire trails do not traverse a wetlands or other land potentially subject to periodic inundation (other than a flood or storm surge).	Yes

PBP (p. 25) – Acceptable Solution	Compliance
• gates for fire trails are provided and locked with a key/lock system authorized by the local RFS.	Yes
• fire trail design does not adversely impact on natural hydrological flows.	Yes
• fire trail design acts as an effective barrier to the spread of weeds and nutrients.	Yes
• fire trail construction does not expose acid-sulphate soils.	Yes

H.3. Alternate solution to perimeter road on Lots 102, 103, 115, 131 – 134 and 116

Figure 2 shows that a perimeter road is not provided for the above mentioned lots. It is the author's expert judgment that as Lots 102, 103, 115 and 116 adjoin an Endangered Ecological Community and the bushfire risk is relatively low in this remnant vegetation adjoining the Manyana beach an adequate performance outcome consistent with that in PBP 2006 is available for firefighters operating from the existing or proposed road network (see Figure 2).

In the case of Lot 115 fire fighters can operate off Sunset Strip and run hoses through the APZ to the southern boundary of the lot, a distance of 30 m. If a fire trail was provided in this location it is extremely unlikely to be used, however due to the location of the proposed wetland and the EEC such a trail is not feasible.

In the case of Lot 116 an 6 m wide maintenance access track is provided and provides adequate firefighter access over the 50 m length of Lot 116 with fire appliances remaining on the public road.

In the case of Lot 103 and 102, fire fighters may operate from the roadway at the sewerage pumping station (below lot 101 and 102) or off Sunset Strip down the western side of Lot 103. The total distance of hose lay required would not be 45 m on the western side of Lot 103 and about 40 m on the southern side of Lots 103 and 102. These small distances do not warrant a fire trail and fires can be well managed from the road system through the APZ of Lots 103 and 102.

Lots 131 – 134 are 38 m to 42 m in depth and a bushfire tanker can be positioned on either Manyana Drive (adjoining the southern boundary of Lot 134) or the north-eastern corner of Lot 131 such that the furthest part of any building is less than 70 m from these positions. A fire hydrant can be placed in these positions if required. As there are only four lots in this portion of the subdivision and fire tanker access is available to 50% of the perimeter of Lots 131 – 134 it is considered unnecessary to have a perimeter trail.

PART I Assessment of environmental issues

Kevin Mills and associates have prepared a flora and fauna assessment for the development, and BES has prepared a separate orchid survey. The impacts of the proposed bushfire protection measures are considered in these reports. The Department of Planning is the determining authority for this development and they will assess any potential environmental and heritage issues associated with the bushfire protection measures.

PART J Summary of protection provisions and conformity with PBP

Table 3 summarises the bushfire protection proposed and its conformity with the PBP guidelines.

Table 3: Assessment of conformity with PBP guidelines

Bushfire protection provision	Proposal	Conformity with PBP guidelines
Asset Protection Zones	Table 1 (p.6) identifies the size of proposed APZs. A minor alternate solution based upon expert judgement is provided for the Lot 116 APZ.	Complies with PBP performance criteria.
Construction Standards	Construction standard under AS 3959 provided in Table 1 (p.7). Radiant heat barrier used adjoining Lot 116	Complies with PBP performance criteria.
Access	See Part H (p.15). No perimeter road is provided for some situations.	Complies with PBP performance criteria.
Water supply	Reticulated water is provided, see p.14.	Complies with PBP

J.1. Conclusion

In the author's professional opinion the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed development, a standard that is consistent with the *Planning for Bushfire Protection* guidelines (RFS 2006) and appropriate for the issues of a *Bushfire Safety Authority*.



Rod Rose
Managing Director

References

- NSW Rural Fire Service (RFS). 2006. *Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*. Australian Government Publishing Service, Canberra.
- NSW Rural Fire Service (RFS). 2004. *Building in Bush Fire Prone Areas: Guidelines for Subdivision Applications*. Australian Government Publishing Service, Canberra.
- Standards Australia 2000, *Construction of buildings in bushfire-prone areas, AS 3959*, Second edition 1999 and Amendment 1, 2000, Standards Australia International Ltd, Sydney

PART K Photographs

Photo 1: Tall Heath currently south of Lots 131 & 134 – it has been assumed this may revert to forest



Photo 2: Tall Heath currently south of Lots 131 & 134 – it has been assumed this may revert to forest



Photo 3: Edge of Forested Wetland near Lot 119



Photo 4: Forested Wetland east of Lot 120



Photo 5: Forested Wetland east of Lot 115



PART L Asset protection zone modelling reports



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forests**

Effective Slope (degree): **3** (upslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **65** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **20**

Overall Fuel Load (t/ha): **25**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **6.22** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **17** (IPA=9m, OPA=8m)

Rate of Fire Spread (km/h): **1.95** (Noble et al., 1980)

Fire Intensity (kW/m): **25204**

Transmissivity: **0.851** (Fuss and Hammins, 2002)

Flame Length (m): **15.68** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **18/12/2007**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forests**

Effective Slope (degree): **1** (downslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **62** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **20**

Overall Fuel Load (t/ha): **25**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **8.33** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **21** (IPA=11m, OPA=10m)

Rate of Fire Spread (km/h): **2.57** (Noble et al., 1980)

Fire Intensity (kW/m): **33215**

Transmissivity: **0.841** (Fuss and Hammins, 2002)

Flame Length (m): **19.71** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **27/3/2008**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forests**

Effective Slope (degree): **1** (upslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **63** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **20**

Overall Fuel Load (t/ha): **25**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **7.49** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **19** (IPA=10m, OPA=9m)

Rate of Fire Spread (km/h): **2.24** (Noble et al., 1980)

Fire Intensity (kW/m): **28933**

Transmissivity: **0.846** (Fuss and Hammins, 2002)

Flame Length (m): **17.56** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **27/3/2008**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forested wetlands**

Effective Slope (degree): **1** (upslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **64** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **15**

Overall Fuel Load (t/ha): **20**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **5.73** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **15** (IPA=15m, OPA=0m)

Rate of Fire Spread (km/h): **1.68** (Noble et al., 1980)

Fire Intensity (kW/m): **17360**

Transmissivity: **0.857** (Fuss and Hammins, 2002)

Flame Length (m): **13.32** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **18/3/2008**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forested wetlands**

Effective Slope (degree): **0** (level)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **63** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **15**

Overall Fuel Load (t/ha): **20**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **6.28** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **16** (IPA=16m, OPA=0m)

Rate of Fire Spread (km/h): **1.8** (Noble et al., 1980)

Fire Intensity (kW/m): **18600**

Transmissivity: **0.855** (Fuss and Hammins, 2002)

Flame Length (m): **14.1** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **18/3/2008**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Forested wetlands**

Effective Slope (degree): **1** (downslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **63** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **15**

Overall Fuel Load (t/ha): **20**

Fire Danger Index: **100** (Fire Weather Area: Illawarra / Shoalhaven)

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **6.37** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **16** (IPA=16m, OPA=0m)

Rate of Fire Spread (km/h): **1.93** (Noble et al., 1980)

Fire Intensity (kW/m): **19929**

Transmissivity: **0.853** (Fuss and Hammins, 2002)

Flame Length (m): **14.94** (RFS PBP, 2001)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **18/12/2007**

Modelled By: **BES**



ASSET PROTECTION ZONE MODELLING REPORT

For Site Located At: **Manyana**

Created By: **RFS APZ Calculator**

1. User's Inputs

Development Purposes: **Residential Subdivision**

Local Government Area: **Shoalhaven**

In Alpine Areas: **No**

Vegetation: **Freshwater wetlands**

Effective Slope (degree): **1** (downslope)

2. Program's Settings

Flame Width (m) : **100**

Flame Angle (degree): **65** (determined by the built-in algorithm)

Flame Temperature (K) : **1090**

Flame Emissivity: **0.95**

Surface Available Fuel Load (t/ha): **15**

Overall Fuel Load (t/ha): **15**

Vegetation Height (m): **1.5**

Wind Speed (km/h): **45**

Relative Humidity (%): **25**

Ambient Temperature (K): **308**

Heat of Combustion (kJ/kg): **18600**

Elevation of Receiver (m): **3.46** (determined by the built-in algorithm)

3. Program Outputs

Asset Protection Zone (m): **9** (IPA=9m, OPA=0m)

Rate of Fire Spread (km/h): **3.07** (Catchpole et al., 1998)

Fire Intensity (kW/m): **23794**

Transmissivity: **0.874** (Fuss and Hammins, 2002)

Flame Length (m): **7.99** (Byram, 1959)

Expected Radiant Heat Exposure (kW/m²): **29**

Assessment Date: **4/3/2008**

Modelled By: **BES**