C MULLER CONSULTING PTY LTD
Fire and Environmental Planning

Report on a

Bush Fire Threat Analysis

for Western Australia

February 2008

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Report on a Bush Fire Threat Analysis for Western Australia

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Preface

This report has been produced to meet the requirements of RFT 1005/04 to.

- Develop a 'Bush Fire Threat Analysis' (BFTA) model that will provide a standard approach for all bush fire management in WA for application to all natural lands in the state. The BFTA will be developed in line with AS/NZS 4360 principles.

- Develop a BFTA Spatial Decision Support System and its associated databases (spatial and a spatial).

- Develop the Spatial Decision Support System within an agreed ESRI GIS and mapping software platform (eg. ArcGIS).

The report outlines the development, assumptions, and limitations of the models and tools developed to implement the bush Fire Threat Analysis in ArcGIS and Microsoft Access, which accompany this report. Please note that the models require the ArGIS Spatial Analyst extension.

EXECUTIVE SUMMARY

Bush Fire Threat Analysis (BFTA) is an assessment of the comparative risk of damage resulting from bushfires throughout Western Australia. It is a strategic risk analysis and does not purport to be a real time fire simulation model.

In accord with the principles of Australian Standard AS/NZS 4360 (1999), risk is defined in terms of the likelihood of occurrence of an event (in this case a bushfire affecting a value), and the subsequent consequences should the event occur.

A combination of quantitative and qualitative approaches to risk assessment has been used in developing the BFTA model, making best use of available data, and supplementing this with expert opinion. Whilst not fully quantitative, the BFTA provides a framework for consistent and repeatable assessment of risk, and a basis for comparing risk in disparate areas. As requested by the Steering Committee, the analysis has been developed for the 95 percentile weather conditions.

The **Likelihood** of a damaging fire is dependant on:

- The chance of a fire starting (successful ignition).
- The size and intensity of any resulting fire, which in turn is a product of
    - fire behaviour should there be successful ignition.
    - The success of any suppression response.

  The likely size of a fire can be estimated by the number of units that can arrive in a given time multiplied by an estimated fireline production per unit, versus the potential ROS, where the ROS is within the suppression limits. However, this approach requires:

    - location and type of resource (including private resources);
    - estimate of fireline production capacity.

  A simplified alternative approach is to classify the study area into access classes to provide a measure of relative suppression difficulty/time. As detailed information on all suppression resources was not (and generally will not be) readily available in digital format, this approach has been used in the current models developed for the BFTA.

Consequence arising from a bush fire is measured in terms of the damage or loss incurred. This can include both direct (assets/values destroyed) and indirect (eg major downstream impacts resulting from infrastructure being destroyed).

A series of models have been developed utilising Microsoft Access databases and ESRI ArcGIS to determine the likelihood and consequence at each point in the landscape. The contributing factors are classified according to potential severity into one of five likelihood or six consequence classes.

Bush Fire Threat

The Risk or Bush Fire Threat is determined using the following risk assessment matrix.

Consequence Class	6: Catastrophic	5: Major	4: Serious	3: Moderate	2: Minor	1: Low
Likelihood Class						
5 Almost Certain	11	10	9	8	7	6
4 Likely	10	9	8	7	6	5
3 Possible	9	8	7	6	5	4
2 Unlikely	8	7	6	5	4	3
1 Rare	7	6	5	4	3	2

Risk Class (Threat)	
1 Low Risk	
2 Moderate Risk	
3 Significant Risk	
4 High Risk	
5 Very High Risk	

The ArcGIS model presented performs a spatial determination of the Bush Fire Threat in by summing the likelihood and consequence classes, and reclassifying the result as per the matrix.

Likelihood Classes

This is a weighted combination of the Ignition Risk, Suppression Response, and Fire Behaviour layers. Each of the layers is separately calculated and classified into five classes and then combined in the Bush Fire Threat Model. Ignition Risk and Suppression Response are given equal weighting, and the Fire Behaviour is weighted by a factor of two. Although the risk of ignition may be low in some areas, there is always a residual risk. Fire behaviour directly affects the size of the fire and difficulty of control and is the most important of the risk factors in determining the likelihood of damage.

Ignition Risk

The Ignition Risk model in the BFTA Toolbox calculates the average density of ignitions from fire report and hot spot data, and combining this with assumed risks related to infrastructure.

Fire history records are incomplete, and even the best data set (for forest areas) suffers from a lack of quality control.

The Hotspot data represents many hotspots that may be part of the same fire. These individual spots are first converted to likely individual fires based on date and proximity, and the centroid of these fires used in the density function. It is recognised that only fires that burn overnight will appear in this data set, but these will include the larger fires that are most likely to impact on values.

A brief examination was made into the possibility of using lightning data from remote sensing to identify areas prone to lightning caused fires. Whilst initial results showed some promise, there was insufficient data to draw conclusions, and additional work is suggested.

Ignition risk is classified as follows:

		Density for equivalent years of records			
		10yrs	**CALM**	**FESA**	**HS**
Likelihood Class			**19yrs**	**8yrs**	**7yrs**
5 Almost Certain	One fire/sq km in 10 years	1	1.9	0.8	0.7
4 Likely	One fire in 20 years	0.5	0.95	0.4	0.35
3 Possible	One in 50	0.2	0.38	0.16	0.14
2 Unlikely	One in 100	0.1	0.19	0.08	0.07
1 Rare	< 1 in 100	<0.1	<0.19	<0.08	<0.07

Likelihood Class	**Road Class**	**Road Raster Code**	**Powerlines Class**
5 Almost Certain			
4 Likely	Principal Rd Secondary Rd	3 4	High voltage carrier
3 Possible	Minor Rd Track	2 1	Low Voltage Distribution
2 Unlikely			HV Transmission 33-36kV
1 Rare			HV Transmission 66-220kV

Suppression Response

The Suppression Response model calculates the travel time through each cell according to road class, vegetation type, slope, and barriers such as reservoirs, lakes, and cliffs. Response times are then calculated using a least cost distance on a cell by cell basis from the centres where suppression resources are located.

A database has been prepared containing the estimated travel time in each vegetation (NVIS_2) class. Roads, slopes and barriers are also classified.

A model in the toolset facilitates preparing an input layer identifying the location of fire suppression resources from multiple agencies. This layer extends beyond the study area boundary to allow for resources outside but close to the study area that are likely to respond.

It is recognised that many fires, particularly those started by equipment, may be suppressed by the equipment on site and not the equipment from agencies. This is balanced by the fact that such fires will not appear on the Hotspot database, are often not reported, and will not be included in the ignition risk determination.

Suppression response times are grouped as follows:

Class 1:	Within 15 minutes
Class 2:	15-30min
Class 3	30-60min
Class 4	1-2 hr
Class 5	>2hr

Fire Behaviour Classes

Fire behaviour is calculated for the 95 percentile weather conditions. The weather conditions (rainfall, temperature, relative humidity, wind speed and long term drying) are integrated into a single index.

Surface moisture content for forest fuels is calculated from AWS data. It is not corrected by "actual" values following rain, and will over predict SMC for a period following rain.

Currently the drought factor assigned to each station is that from the nearest of four stations for which data was supplied. This is a major source of error, further compounded by the reduction in the number of records available for calculation to the overlap in the two data sets. The need for a script in Access to calculate drought factor from the AWS data for each station is identified.

A database of grass curing values from data supplied by DLI has been developed. The methods used are outlined, to assist in this being updated in future years.

As different fuels dry at different rates, the same weather conditions will result in different fire behaviour in different fuels. For each weather station, a maximum rate of spread index (ROSI) is calculated for each fuel type, ranked, and the 95 percentile value determined. Simple kriging is then used to interpolate between weather stations to provide a 95 percentile ROSI layer for "standard" conditions for

Pasture/Crop/Natural Grasses	(Rn)
Grazed/cut pasture	(Rcu)
Eaten out pasture	(Re)
Natural Grass under woodland with 2:1 wind ratio applied	(Rn2)
Mallee Heath	(Rmh)
Shrubland	(Rsh)
Hummock Grasslands (Spinifex)	(HG_Wind2m)
Northern Jarrah 6:1 wind ratio	(ROSInj6)
Northern Jarrah 5:1 wind ratio	(FDInj)
Northern Jarrah 4:1 wind ratio	(ROSInj4)
Northern Jarrah 3:1 wind ratio	(ROSInj3)
Northern Jarrah 2:1 wind ratio	(ROSInj2)

Karri 4 / 5	(FDIk)
Karri 3 / 6	(ROSIk36)
Karri 1./ 2	(ROSIk12)
Southern Jarrah	(ROSIsj)
Woodlands	(McAFDI)

The 95 percentile ROSI is then corrected for fuel factors and slope to calculate the predicted rate of spread and fireline intensity.

The following have been developed to support these calculations:

- Slope Model

- Fire scars geodatabase attributed with fuel age, and a script for future attribution for fire scars based on the DLI fire scar attribute information.

- Fuel classification database with the appropriate fire spread model and fuel calculation model identified for each vegetation association occurring in the study areas. (Note this database will need to be updated for other study areas if they include other vegetation associations not already classified).

The Fire Behaviour model identifies the fire model to be applied, and the fuel model to calculate the fuel parameters, according to the vegetation association. Cover density is required to calculate fuel quantity, identify the model to be applied according to wind ratio, and for the Spinifex fire spread model. The model uses a cover density layer. For two study areas, cover density from remote sensing (supplied by Graeme Behn, DEC) has been used. This is not currently universally available. It is recommended this work be validated and extended. Where this is not available, a cover density layer needs to be created by manually assigning density classes based on vegetation and fuel age.

Rate of spread and fireline intensity are calculated for each cell, and the results classified as below.

HEADFIRE BEHAVIOUR CLASSES
5 Indirect attack likely to fail
Intensity > 4000 kW/m and/or ROS > 800 m/hr in forest/woodland
Intensity > 8000 kW/m and/or ROS. 2000 m/hr in shrubland ROS > 10000 m/hr in grassland
4 Direct attack not possible/unlikely to succeed.
Intensity > 2000 kW/m and/or ROS > 400 m/hr in forest/woodland
Intensity > 2000* kW/m and/or ROS > 1000 m/hr in shrubland
Intensity > 5000 kW/m and/or ROS > 6500 m/hr in grassland
3 Direct machine and tanker attack possible
Intensity < 2000 kW/m and/or ROS < 400 m/hr in forest/woodland
Intensity < 2000* kW/m and/or ROS < 1000 m/hr in shrubland
Intensity < 5000 kW/m and/or ROS < 6500 m/hr in grassland
2 Hand tool attack possible
Intensity < 800 kW/m and/or ROS < 140 m/hr) in forest/woodland and shrubland
Intensity < 800 kW/m and/or ROS < 300 m/hr in grassland
1 Readily suppressed.
Intensity < 800 kW/m and/or ROS < 60 m/hr in all fuels

Consequence Classes (

Identified values are classified according to the consequence if damaged/destroyed by fire. With the exception of Aboriginal heritage values (that are already buffered in the database), a 500m buffer is applied to the values. This is both so they are visible when mapped, and because it is considered that under 95 percentile weather conditions any fire within 500m poses a threat to the value.

Where values/influence buffer zones overlap, only the highest value is shown, and used in the subsequent threat assessment.

The amount of information that can be extracted from existing WALIS and DEC databases is limited. Additional collection of data using local information is essential to improve the accuracy of analyses.

Additional data sources should also be pursued. The Valuer General's Office has information that would permit more accurate classification, but the costs of accessing this are currently prohibitive. Many large companies have databases that would help identify values, particularly in the mining regions. Approaches should be made to incorporate much of this data in the WALIS system.

The BFTA toolbox includes models to extract data from existing data sets and prepare these for input into the Values model, which creates the buffers and assigns the values to the appropriate consequence class.

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
6 CATASTROPHIC	**SPECIES EXTINCTION**	**ONE OR MORE FATALITIES**	**DAMAGE > $10,000,000**	**ONE OR MORE FATALITIES** **PERMANENT TOTAL INCAPACITY** **EXTENSIVE DAMAGE > $10,000,000**
	Only known occurrence of fire vulnerable threatened species or ecological community. Fire likely to result in extinction.	Areas with high risk of fatalities in event of bushfire.		Settlements, rural residential and special rural subdivisions with native vegetation, poor access, no reticulated water. Does NOT include larger urban areas with maintained gardens, ovals and structures for refuge and therefore a low risk to life.
		Camping areas with high fire season populations, restricted egress, no refuge area. (eg Murray Valley). Does NOT include areas where adequate refuge exists (eg beachside such as Hamelin Bay) or rapid escape/evacuation possible.		Hospitals and schools in bush settings
		High visitation recreation sites with dead end access and no refuge.		Public buildings in bush area used daily, access for suppression and evacuation poor.

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
5 MAJOR	**LOCAL EXTINCTION. MAJOR REDUCTIONS IN TOTAL POPULATIONS OF VULNERABLE SPECIES OR COMMUNITIES**	**PERMANENT DISABILITY / SERIOUS INJURY.**	**EXTENSIVE DAMAGE $5 - $10 MILLION**	**PERMANENT DISABILITY / SERIOUS INJURY. EXTENSIVE DAMAGE $5 - $10 MILLION**
	Priority 1 species or ecological communities. Risk of local extinction if burnt.	Major recreation/tourist areas) with good access, but sheer numbers pose a risk to life in event of fire. (eg Tree Top Walk, Boranup and Gloucester National Parks)		Vulnerable essential utilities (regional power, water, gas supply)
	Only known occurrence of fire vulnerable priority 2 species.	Popular long distance walk tracks & mountain bike trails		Rural/residential and special rural subdivisions, poor access, reticulated, regular fuel modification.
	Severely under-represented fire seral stages of communities with vulnerable species.			Public buildings with daily use access good, or weekly use access for suppression and evacuation poor.
	Severely under-represented structural types.			Built up areas
	Declared flora: IUCN critical			Fire vulnerable railway infrastructure with potential long term disruption (eg wooden bridges).

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
	Critically Endangered fauna			Remote communities/settlements with no fire services, significant infrastructure values.
4 SERIOUS	**LOCAL EXTEINCTIONS OF POORLY KNOWN SPECIES** **MAJOR REDUCTION IN LOCAL EXTENT OF VULNERABLE SPECIES OR COMMUNITIES**	**PERMANENT LOSS OF REGISTERED HERITAGE VALUES** **DAMAGE $100,000 TO $1,000,000**	**DAMAGE $1,000,000 TO $5,000,000**	**DAMAGE $1,000,000 TO $5,000,000** **PERSONAL INJURY (LTA)**
	Fire vulnerable* endangered, vulnerable and priority 2 species or ecological communities.	Fire vulnerable registered heritage sites	Pine plantations >100ha 8-20 yrs old.	Rural residential subdivisions, multiple access routes, reticulated, fuel modification..
	P1 species not known to be fire sensitive	Fire vulnerable registered Aboriginal sites	Consolidated Karri regrowth >1000ha, 5-30 yrs old	Public buildings, monthly use access good
	Long established (>15yrs) research/ monitoring plots and scientific reference areas to be kept fire free.	Major infrastructure		Public utilities, pumping stations, etc
	Area significant to the maintenance of overall structural diversity, species richness	Infrastructure posing significant environmental threat (eg bulk chemical storage).		High voltage distribution carriers
	Under-represented structural types eg old growth forest			
	Threatened species habitats			

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
	Declared flora: IUCN endangered			
	P1 flora			
	Threatened Ecological Communities			
	Endangered fauna			
	Threatened Fauna P1 & P2			
3 MODERATE	**LOSS OF PRIORITY SPECIES** **LOSS OF HABITAT/SPECIES DIVERSITY**	**DAMAGE $100,000 TO $1,000,000**	**DAMAGE $1,00,000 TO $1,000,000** **LONG LIVED CROPS** **HIGH VALUE ANNUAL CROPS**	**DAMAGE $100,000 TO $1,000,000**
	IUCN vulnerable and P2 flora not known to be fire sensitive	Harnessed catchments with erosion susceptible soils	Small (<100ha) pine and eucalypt plantations	Communications repeaters, masts and towers
	Declared endangered flora: IUCN critical & P2	Short term research/monitoring plots to be kept fire free	Other plantation areas (including oil mallee) not included elsewhere.	Scattered houses/buildings
	Vulnerable fauna		Orchards, vineyards, olive groves	Fire vulnerable railway infrastructure, short term impact
	Populations of known fire vulnerable priority 3 species and ecological communities		Consolidated Karri regrowth <50 years old	Transmission lines, steel towers (serious damage unlikely, but short term interruption to supply possible)
	Areas of regionally significant species richness, structural diversity		Consolidated Jarrah regrowth 5-20 yo.	
	Regionally under-represented seral stages or structural type		Intensive animal production	
			High value annual crops	

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
2 MINOR	**LOSS OF LOCALLY SIGNIFICANT SPECIES OR ECOLOGICAL COMMUNITIES**	**$10,000 TO $100,000**	**$10,000 TO $100,000**	**$10,000 TO $100,000**
	Locally significant species, communities	Recreation infrastructure	Developed farmland/pasture	Low voltage distribution carriers
	Priority 3 species: fire sensitivity unknown		Apiary sites	
	Priority 4 & 5 (conservation dependant) species or communities			
1 INSIGNFICANT	**<**	**< $10,000**	**< $10,000**	**< $10,000**
	Other native vegetation	Minor infrastructure	Other values not listed	

Summary of Recommendations

The report contains a number of recommendations regarding future data management. These are summarised below.

Ignition Risk Modelling

Recommendation: Further investigations be undertaken to determine if lightning data from remote sensing can be used to identify areas prone to lightning caused fires.

Recommendation: Improved quality control be implemented by both FESA and DEC for fire recording. For BFTA purposes the minimum information that should be recorded is the date, an accurate locational reference, and cause.

Fire Behaviour Modelling

Recommendation: The weather database be updated at least every two years and the 95 percentile weather (ROSI) layers recalculated.

Recommendation: The BoM algorithm for calculating Drought Factor be coded in VBA and used to calculate the DF for each station.

Recommendation: Curing data be saved and archived with weather data to maximise the number of valid records available to calculate percentile conditions.

Recommendation: The attribute table for the fire scars produced by DEC include a year-month date field in the same format as the DLI NOAA / MODIS fire scar data so the data sets can be more readily integrated, and the more accurate scars used where available.

Recommendation: The development of vegetation cover density algorithms (including field validation) be expanded to enable reliable cover maps to be produced for all areas of the State.

Values Identification for Consequence Modelling

Recommendation: Procedures be established for annual update of industry infrastructure (including camps and other areas at risk) in to the WALIS database.

Recommendation: To enable improved identification of potential consequences, FESA seek the inclusion of the VGO property type identification as a field in the SCDB.

INTRODUCTION

Bush Fire Threat Analysis (BFTA) is an assessment of the comparative risk of damage resulting from bushfires throughout Western Australia. It is a strategic risk analysis and does not purport to be a real time fire simulation model.

The brief called for the BFTA to be developed in accord with the principles of Australian Standard AS/NZS 4360 (1999). Risk is defined in terms of the likelihood of occurrence of an event (in this case a bushfire affecting a value), and the subsequent consequences should the event occur.

Likelihood of a damaging fire is dependant on:

- The probability of a fire starting (successful ignition and spread).
- The fire behaviour should there be successful ignition. The headfire rates of spread and fireline intensity directly influence the likelihood and extent of damage, and the difficulty of suppression.
- Response time for adequate resources to suppress a fire or protect assets. Response time has a direct impact on both the likelihood of successful initial attack, and the degree to which assets can be protected. Even fires that have the potential to develop fireline intensity where control is not possible can be successfully suppressed early in the initiating phase of a fire. The longer the time taken to control a fire, the larger the fire, the more assets/values are involved, and the greater the potential for damage.

Consequence arising from a bush fire is measured in terms of the damage or loss incurred. This can include both direct (assets/values destroyed) and indirect (eg major downstream impacts resulting from infrastructure being destroyed).

Australian Standard AS/NZS 4360 (1999) outlines both a quantitative and qualitative approach to risk assessment. Whilst a quantitative approach is desirable, this is not possible where there is insufficient data for statistical analysis of the risk factors. For the BFTA a combination of quantitative and qualitative approach has been used, making best use of available data, and supplementing this with expert opinion. Whilst not fully quantitative, the BFTA provides a framework for consistent and repeatable assessment of risk, and a basis for comparing risk in disparate areas.

General note re models

The models developed to implement the BFTA within ArcGIS and outlined in this report involve considerable geoprocessing, and are consequently relatively slow. Significant increase in performance efficiency can be expected if the algorithms outlined in the model are included in a Python or VB script, or implemented external to ArcGIS. This would also simplify implementing a selection of variable cell size depending on detail required, which would also markedly reduce processing time, albeit at the expense of loss of detail. This was not pursued in this development as programming time was not made available by DEC, as originally proposed in the contract.

Whilst the initial development commenced with the data stored in a geodatabase, the models were amended to access shape files for two reasons:

- The data supplied by DEC and DLI was in shapefiles.

- To maintain compatibility with different versions of ArcGIS. Geodatabases created in Arc 9.2 cannot be accessed by earlier versions. Shapefiles are universal to different versions of ArcGIS.

The coordinate system for the models is set to GDA 1994 MGA Zone 50. The models will run successfully even if the study area is outside zone 50, but will not match any data projected in the correct zone for the study area.

The models variously reference data in the BFTA_Data folder and sub-folders, and output to folders in the BFTAWorkspace folder. For the models to execute successfully, the BFTA_Data folder and its contents and the structure of the BFTAWorkspace and subfolders should be copied to the root directory of the host drive. All the models have been set to use relative pathnames, so should run on any drive with the above directories (folders).

The models are located in BFTA_Data\Toolboxes\BFTA Models.tbx

Summary of Data Sources

As identified elsewhere, there are deficiencies in the data available. Data was provided by the organisations / agencies as below.

Bureau of Meteorology (BoM)

Automatic Weather Station data

Conservation and Land Management / Department of Environment and Conservation (CALM/DEC)

The GIS corporate data supplied by Land Information Branch is the main source of data referred to by the models. This data is stored on an external hard drive (designated V drive, consistent with CALM practice at the time).

Graeme Behn supplied interim cover density data from remote sensing for the Mundaring and Pilbara areas.

Dr Li Shu provided fire scar data from Landsat interpretation for the Pilbara.

Fire records were supplied by Fire Management Services.

Interim (partially completed) RATIS database of recreation sites / infrastructure.

Department of Agriculture and Food (DAFWA)

Land use data (LandUsebyShire_llgda.shp)

Department of Land Information (DLI)

Fire scar data (NOAA / MODIS).

Hot Spot data

Lightning records

Curing data.

Fire and Emergency Services Authority (FESA)

Fire records

Resource locations

Rio Tinto

Pilbara infrastructure

BUSH FIRE THREAT

Threat is analysed on a cell by cell basis, using the Spatial Analyst extension of ArcGIS. A standard 100m * 100m cell has been chosen for the analysis. This results in long processing time for large study areas. Consideration was given to a variable cell size related to the size of the study area, but this results in unacceptable levels of error for many of the calculations that derive the likelihood, particularly slope and travel time. As the purpose of the BFTA is strategic analysis rather than real time fire spread modelling, it is considered the longer processing times are acceptable.

Although processing is based on a 100m * 100m raster, it must be recognised that the accuracy of any results is also dependant both on the accuracy and the resolution of the input data. Some data sets are quite coarse: for example the Aboriginal Heritage Sites data has large buffers, and where fuel age has been derived from NOAA fire scar data the spatial resolution of the fire behaviour map will be limited to the NOAA resolution (10km).

The following matrix is used to assign the risk or Bush Fire Threat to each cell in the analysis

Consequence Class	6: Catastrophic	5: Major	4: Serious	3: Moderate	2: Minor	1: Low
Likelihood Class						
5 Almost Certain	11	10	9	8	7	6
4 Likely	10	9	8	7	6	5
3 Possible	9	8	7	6	5	4
2 Unlikely	8	7	6	5	4	3
1 Rare	7	6	5	4	3	2

Risk Class (Threat)

1 Low Risk

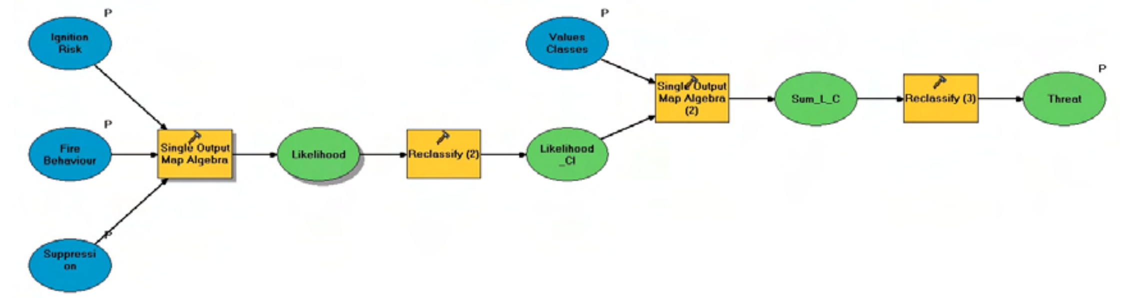
2 Moderate Risk

3 Significant Risk

4 High Risk

5 Very High Risk

The threat/risk is calculated in the model Bush Fire Threat by summing the likelihood and consequence classes, and reclassifying as per the matrix. The model also first calculates the Likelihood classes, as outlined below.



Bush Fire Threat Model

LIKELIHOOD OF FIRE DAMAGING A VALUE

The likelihood of a fire causing damage is a combination of the likelihood of a fire starting (ignition risk), and the size and intensity of any resultant fire, which in turn is a product of the fire behaviour and the suppression response.

The likely size of a fire can be estimated by the number of units that can arrive in a given time multiplied by an estimated fireline production per unit, versus the potential ROS, where the ROS is within the suppression limits. However, this approach requires:

- location and type of resource (including private resources);
- estimate of fireline production capacity.

A simplified alternative approach is to classify the study area into access classes to provide a measure of relative suppression difficulty/time. As detailed information on all suppression resources was not (and generally will not be) readily available in digital format, this approach has been used in the current models.

In modelling likelihood in the BFTA the three factors are:

- Ignition Risk: the likelihood that a fire will occur at any point in the landscape.
- Suppression Response: how quickly ground forces can reach a fire if it occurs. Any bush fire is likely to be able to be readily suppressed irrespective of the weather conditions if units can reach the fire within 15 minutes. The longer it takes resources to reach a fire, the longer it will take to achieve control, the larger the fire, and the greater the risk that values will be affected.

  The response time for ground forces only is considered. Fire bombers can reduce spread until ground forces arrive, but ground forces are still required. Fire bombing is most effective under mild conditions, and becomes increasingly ineffective as conditions become more severe. Under the 95 percentile conditions aerial attack may assist in protection of individual assets, but is less likely to have a significant effect on overall fire spread.

- Fire behaviour: Fireline intensity determines how readily a fire is controlled (or indeed if it can be) and the severity of damage. Rate of spread determines how quickly the fire "grows". The higher the ROS, the more quickly will the fire expand both in area and perimeter. The greater the perimeter, the longer it will take to control the fire, and again the greater the area and risk of damage.

Each of the above factors is separately modelled, and classified into 5 risk classes. These layers are then weighted and combined to provide an estimate of the likelihood of a damaging fire. Ignition Risk and Suppression Response are given equal weighting, and the Fire Behaviour is weighted by a factor of two. Fire behaviour is weighted because, although the risk of ignition may be low in some areas, there is always a residual risk. The size of the fire, and whether it can be controlled, is thus the most important of the risk factors in determining the likelihood of damage.

The combined weighting of the risk factors determining the likelihood is included in the Bush Fire Threat model previously illustrated. The individual models are described in more details in the following sections.

Ignition Risk

Model Overview

The BFTA Ignition Risk model makes best use of the limited existing data, supplemented by expert opinion. The likelihood of a fire occurring is estimated by:

- calculating the average density of ignitions from FESA and CALM/DEC fire reports.

  Fire records provide information on past fires, but they are not necessarily accurate predictors for the future. Changes in land use, management practices, education and enforcement, and demographic changes can all influence the risk of ignition. Where records provide information on causes, this can be used to predict future ignitions related to activities.

  Unfortunately, reasonably good fire records exist only for the SW forest areas, and even here a lack of quality control is evident, with the location of many fires being incorrectly recorded as occurring in the ocean.

- using an algorithm to reduce multiple fire hot spots from remote sensing to likely individual fires, and then calculating the density of fire occurrence based on these likely ignitions.

- assigning assumed risks related to predicted activity.

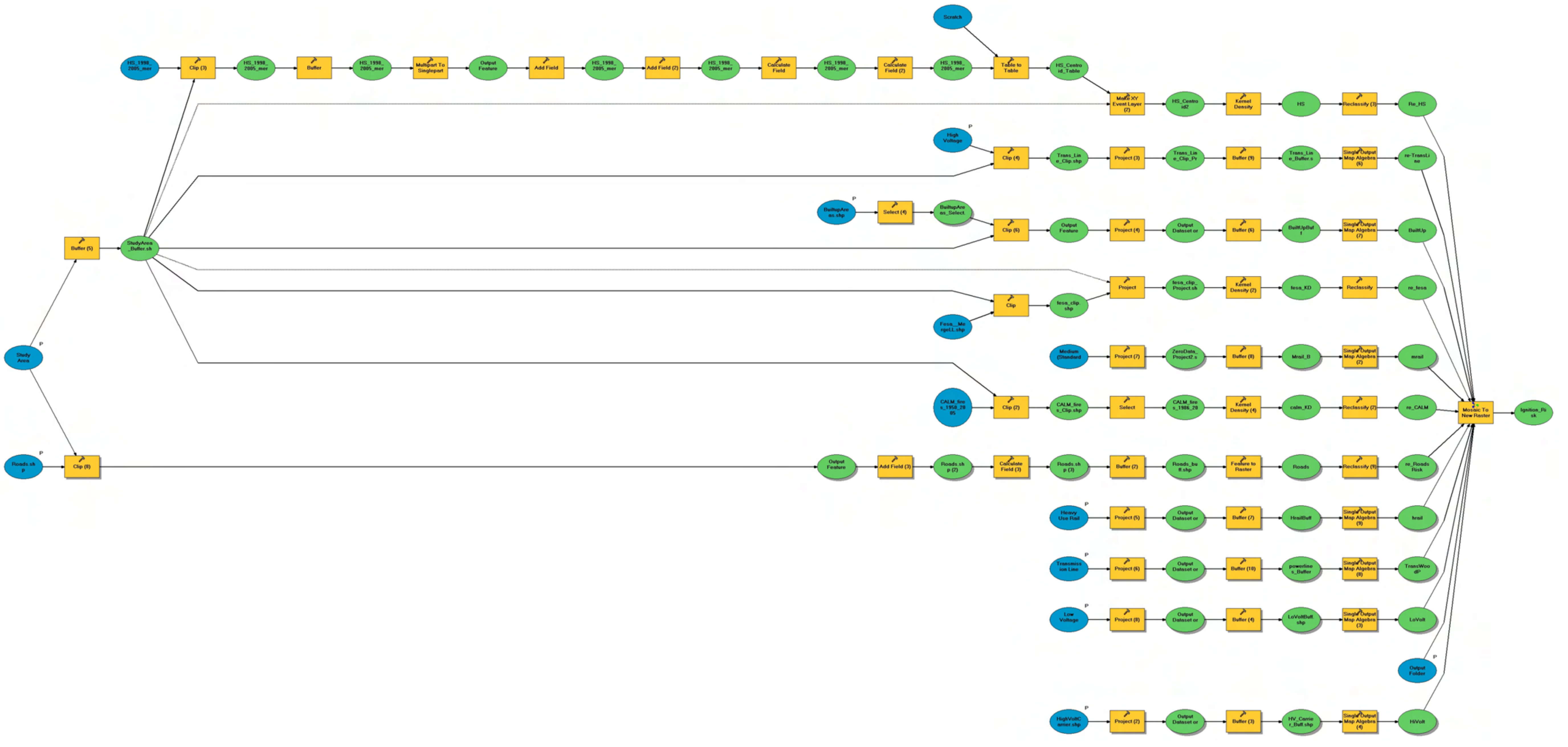
Kernel density is used estimate likelihood of ignition based on fire records and hotspots. The search radius for the density function is different for the three data sets to account of the different precision of the recording of the locations. The low precision of the FESA records in particular, results in a much generalised output. Improved future recording would improve the result.

With the exception of the FESA and CALM/DEC fire records and the Hot Spot records, all inputs to the Ignition Risk model have been set as parameters to facilitate use of the model with different data sources. The fire and hotspot records are not set as parameters because the calculation of the density data is based on the period of records. If these databases are changed, the density classification portions of the model for these data must also be changed.

Although the output is masked to the study area boundary, the extent of the data considered in determining risk extends 1 km beyond the boundaries of the study area. Thus ignition sources close to the boundary are included in the density calculations, and any "influence zones" from activities centred outside (but close to) the boundary will contribute to the overall risk.

A separate raster layer is created for each data source. These layers are mosaicked to a new raster on the maximum value of the overlapping rasters. Only the highest associated risk at any point is shown in the Ignition Risk layer.

Important note: Input values may extend beyond the study area, but each of the parameters <u>MUST</u> have a valid input within the extent of the study area, as the model will abort if there is an empty feature class. It is recommended the inputs be first displayed in ArcMap to confirm the presence of data within the study area. If there is no data for any parameter, the *\BFTA_Data\ZeroData.shp* file should be assigned. This provides a value of zero for anywhere in WA, and thus provides a valid number that will avoid the model aborting, but will not affect the result of the raster mosaic.



Ignition Risk Model

Lightning

Lightning is recognised as an important source of ignition, and is the major cause of fires in natural areas remote from access and infrastructure. Some success has been achieved in Canada and USA with predicting the likelihood of fires as a result of lightning, using ground based stations that record strikes and distinguish positive and negative charges. However, in WA there are insufficient ground stations to provide useful lightning strike data which would enable these methods to be used to identify potential “lightning belts”

The only lightning data available across WA is from satellite remote sensing. This data records all strikes, both air to ground and cloud to cloud. Preliminary investigations were undertaken into the feasibility of using such data to predict areas where lightning caused fires were more likely by testing the following hypothesis:

> “Areas with a higher average total density of lightning strikes will also have a higher density of ground strikes resulting in fires”.

For a ground strike to result in a fire requires a receptive fuel bed. The investigation aimed to look into spatial relationships between lightning density (total), fuel age, and recorded fires. Initial investigations were in remote areas. In the absence of reliable fire records, hotspot data was used to identify fires. It was recognised that this would only indicate fires that burnt into the night, but in remote areas with no suppression, it is only such fires that are of potential concern in any case.

Unfortunately the overlap between the lightning data, hotspot data and fire scar data was only one year. Whilst the initial results were encouraging, there was an insufficient period of records to provide conclusive results.

Recommendation: Further investigations be undertaken to determine if lightning data from remote sensing can be used to identify areas prone to lightning caused fires.

Fire and Hotspot Records

The kernel density for the respective data set has been calculated and the results reclassified into 5 classes based on the density as per the following table:

		Density for equivalent years of records			
		10yrs	**CALM**	**FESA**	**HS**
Likelihood Class			**19yrs**	**8yrs**	**7yrs**
5 Almost Certain	One fire/sq km in 10 years	1	1.9	0.8	0.7
4 Likely	One fire in 20 years	0.5	0.95	0.4	0.35
3 Possible	One in 50	0.2	0.38	0.16	0.14
2 Unlikely	One in 100	0.1	0.19	0.08	0.07
1 Rare	< 1 in 100	<0.1	<0.19	<0.08	<0.07

FESA Fire Records

The period for which records were available was 1998-2006 (8 years).

Separate shape files for each GDA zone were initially created from the Excel file provided. This highlighted the spatial inaccuracy of the data. In general, the data has been recorded only to the nearest grid square, with data being clustered in lines approximately 40km apart. Additionally, a significant number have been recorded in the incorrect zone. There is no information regarding probable cause.

Because of the spatial inaccuracy of the data, a 50km search radius has been used when calculating the kernel density giving a much generalised result.

CALM Fire Records

Although records are available from 1950, only records for the period 1986-2005 (19 years) have been used to minimise the skewing of the data due to changes in land use. Clearing burns were common prior to this and contributed to wildfires. In more recent years there has also been a reduction in the amount of stubble burning.

There have been some changes in the manner fire information has been recorded. The records from the different data sets have been merged, retaining only cause and date fields which were common to all records. Although the CALM records are detailed, it is evident there has been little/no quality control on data input, with numerous locations being in the ocean, particularly for 2002. Only valid records within the study area boundaries are considered.

Kernel density is calculated with a 5km search radius.

Recommendation: Improved quality control be implemented by both FESA and DEC for fire recording. For BFTA purposes the minimum information that should be recorded is the date, an accurate locational reference, and cause.

Hotspot Records

Daily hotspot data covering a period of seven years was provided by the WA Department of land Information (DLI) . The data is currently archived in a separate folder for each day, with the same filename for each day's records. These need to be amalgamated to enable analysis. For this analysis the data was compiled in a geodatabase, with all records for a year being in one feature class.

The hotspots present in any one day's data represent many hotspots that may be part of the same fire. In the model, these individual spots are first converted to likely individual fires based on date and proximity, and the centroid of these fires used in the density function. All hotpots occurring on the same date where a 5km overlapped were considered to be a single fire, represented by a point at the centroid. Kernel density is then calculated using a 10km search radius. Clearly the centroid is unlikely to be the point of ignition, but will be an adequate approximation consistent with the accuracy of the remote sensing data.

It is recognised that only fires that burn overnight will appear in this data set, but these will include the larger fires that are most likely to impact on values.

Assigned Risks

Roads, Rail & Powerlines

Infrastructure has been broadly classified according to the level of use/activity and associated potential for accidental or deliberate fire. The infrastructure has been classified, and a 500m buffer applied. This arbitrary distance has been applied both so it is visible in a mp display, and because it is reasonable to expect any point within 500m to be affected by any fire started under the 95 percentile.

Road classification is a text field, and converting to raster assigns numerical values according to alphabetical order. If all classes are not present in a particular area, it will result in a different classification value for the same road class in different study areas. To overcome this, a new numeric field is added and consistent class codes assigned as follows:

```
Dim mCode As Integer
Dim mClass As String
Dim mFeature As String
mClass = [Class]
mFeature = [Feat_Desc]
If mClass = "Principal Road" Then
mCode = 1
Else
  If mClass = "Secondary Road" Then
    mCode = 2
  Else
    If mClass = "Minor Road" Then
       mCode = 3
     Else
       If mClass = "Track" Then
          mCode = 4
       Else
          mCode = 5
       End If
     End If
  End If
 End If
```

Likelihood Class	Road Class	Road Class Code	Rail	Powerlines Class
5 Almost Certain				
4 Likely	Principal Rd Secondary Rd	1 2	Heavy use/high mtce. (eg Pilbara)	High voltage carrier 33KV transmission on wooden poles
3 Possible	Minor Rd Track Walking Track	3 4 5	Moderate/light traffic	Low Voltage Distribution
2 Unlikely				
1 Rare				Transmission lines, steel towers

Other

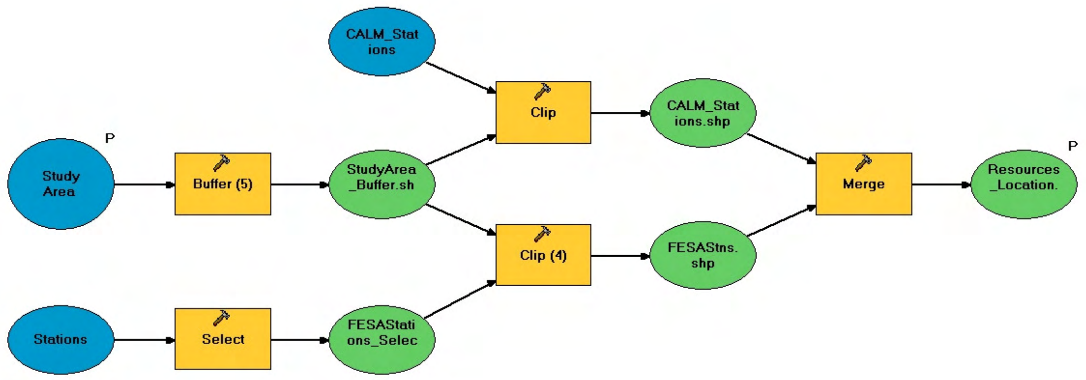
Built up areas have been assigned "likely" classification (4).

Camping areas may also pose an increased level of risk, although camp fires are prohibited in most areas. In the absence of data on camp sites, these have not currently been classified.

Suppression Response

Suppression response is calculated by preparing a travel time layer wherein the time taken to traverse each cell is identified. The response time from any nominated location to each cell in the map is then determined by applying a least cost analysis.

Creation of the layer to identify the points from which the response times are to be calculated has not been included within the Suppression Response model, but is a separate model to facilitate editing the layer to add additional locations for resources at other than DEC or FESA stations. This layer must be created before the Suppression Response model is run.



Fire Suppression Resource Locations Model

To create the travel time layer, each cell is assigned a value as per the classification below. To ensure integer values (required for the least cost analysis) for the slowest class the value assigned is not the time taken to traverse the cell, but the time (in minutes) it would take to travel 10km within that class. The final least cost values are subsequently adjusted for "real time" when reclassified into travel time classes as follows:

Class 1:	Within 15 minutes	150000
Class 2:	15-30min	300000
Class 3	30-60min	600000
Class 4	1-2 hr	1200000
Class 5	>2hr	> 120000

The table below shows the values assigned based on vegetation and road classes. This includes both vehicle and walking, so the shortest travel time to any location will include a combination of both. This can be modified if required. At consultation meetings with groups at Hyden, Merredin and Northam during the preparation of the BFTA for the Avon Catchment it was stated that any fire suppression would be vehicle based, and if vehicles could not access a site, there would be no initial attack at that point. It was requested the travel time map be modified accordingly. This is readily done by assigning a high value to all areas where the rate of travel is less than 4 kph.

The travel times in non-cleared areas is based on the broad vegetation types described in the NVIS2 field of the pre-European vegetation files.

	Raster Code	Travel Speed (kph)	Time to travel 10 km (10,000m) (minutes)
Roads		**TT_kph**	**TT_10k_mins**
Class 1 Principal	1	100	6
Class2 Secondary	2	75	8
Class 3 Minor	3	60	10
Class 4 Track	4	30	20
Walk tracks	5	4	150
Open Off Road (Grass)	55	20	30
Vegetation Classes			
NVIS_LV2	**Code**	**TT_kph**	**TT_10k_mins**
-9999	1	5	120
Chenopod shrubland	2	8	75
Closed forest	3	2	300
Closed mallee shrubland	4	3	200
Closed sedgeland	5	5	120
Closed shrubland	6	3	200
Fernland	7	10	60
Forbland	8	15	40
Heath	9	5	120
Hummock grassland	10	12	50
Isolated chenopod shrubs	11	20	30
Isolated clumps of shrubs	12	15	40
Isolated clumps of trees	13	15	40
Isolated samphire shrubs	14	20	30
Isolated shrubs	15	20	30
Isolated trees	16	20	30
Mallee shrubland	17	10	60
Open chenopod shrubland	18	15	40
Open forbland	19	20	30
Open forest	20	3	200
Open heath	21	8	75
Open hummock grassland	22	15	40
Open mallee shrubland	23	12	50
Open samphire shrubland	24	15	40
Open shrubland	25	15	40
Open tussock grassland	26	20	30
Open woodland	27	5	120
Open-mallee shrubland	28	5	120

Open-shrubland	29	5	120
Samphire shrubland	30	6	100
Shrubland	32	2	300
Sparse chenopod shrubland	33	10	60
Sparse forbland	34	20	30
Sparse heath	35	20	30
Sparse hummock grassland	36	15	40
Sparse mallee shrubland	37	15	40
Sparse open woodland	38	15	40
Sparse samphire shrubland	39	20	30
Sparse shrubland	40	15	40
Sparse tussock grassland	41	20	30
Tussock grassland	42	15	40
Woodland	43	3	200

The effect of slope is classified as follows:

Slope degrees	1 in X	Slope %	TT_kph	TT_10k_mins	
0-5			20	30	
5-10	11.4	8.75	10	60	
10-15	5.7	17.63	5	120	Limit for off road tanker
15-20	3.7	26.79	2	300	
20-25	2.7	36.4	1.5	400	
25-30	2.1	46.63	0.5	1200	
30-35	1.7	57.74	0.5	1200	
35-40	1.4	70.02	0.5	1200	
40-45	1.2	83.91	0.25	2400	
45-50	1	100	0.25	2400	
50-60	0.8	119.18	0.1	2400	
60-65	0.7	142.81	0.1	6000	
65-90	0.6	173.21	0.001	600000	Cliff. Limit of effective travel

Features in the *Waterbodies.shp* file are classified according to whether they aid or impede travel as below. The classification primarily relates to the effect on vehicles. If the area beyond a water feature is trafficable, the least time would involve further vehicle travel beyond the water feature, so allowance needs to be made for time taken by a vehicle. It may, for example, be much quicker to cross a watercourse on foot, but it would be unrealistic to apply this time in combination with further vehicle times. Because of the slower times related to travel on foot, and the short distances involved in crossing water bodies, the longer times will not significantly affect total foot travel times.

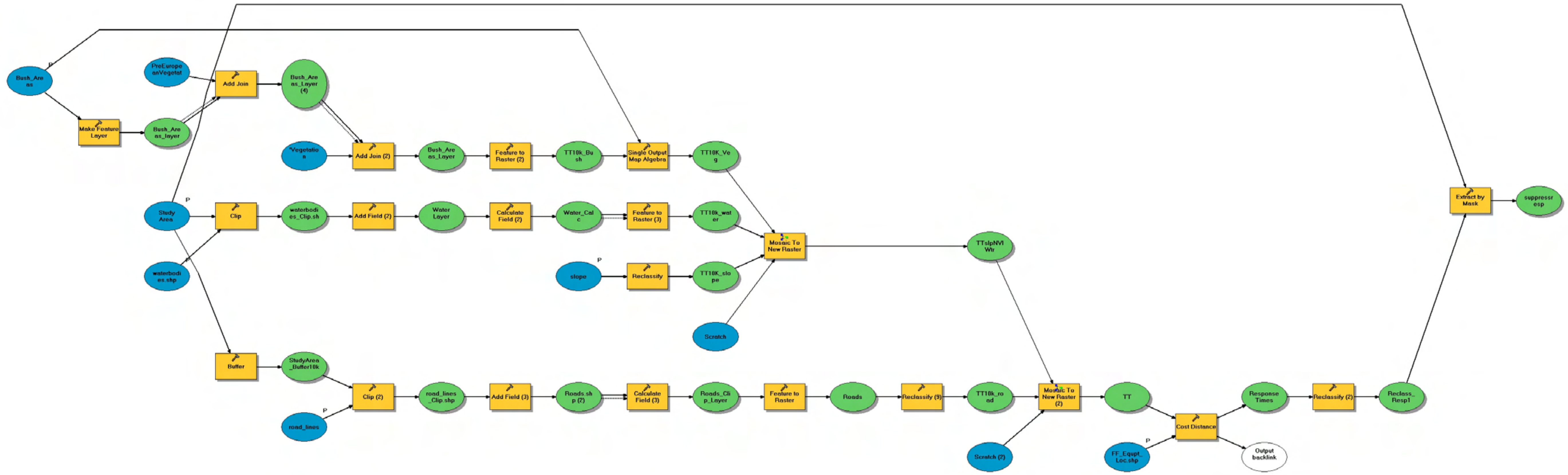
Feature Description	Travel Speed (kph)	Travel Time for 10km (minutes) Value Assigned to raster cell	Comment
Canal Reservoir Salt Evaporator Settling Pond Perennial Lake Marine Swamp	Barriers	600000	
Mangrove Flat	0.5 kph	1200	Difficult walking
Saline Coastal Flat	2 kph	300	Walking pace to check if trafficable to vehicles
Subject to inundation	0.5 kph	1200	Dependant on location. Includes tidal areas. A conservative approach taken
Swamp	0.1 kph	6000	Virtual barrier
Lake (non-perennial)	3 kph	200	Higher speed if solid and trafficable by vehicles, but slow speed assigned to allow for checking.
Watercourse	0.5 kph	1200	Time taken to find crossing. A delay, but not a barrier.

The Slope, Water bodies (barriers) and Vegetation Travel Time rasters are first mosaicked using the maximum value, to ensure the limiting factor is used in subsequent analysis. This raster is then mosaicked with the Roads travel time raster on minimum values: roads are constructed to bridge barriers. A least cost analysis is then undertaken on the resultant raster to determine the least time for forces to reach each location in the study area.

The travel time classes are stored in \BFTA_DATA\Reclassify Tables\TT_Classification.xls.

Prior to running the Suppression Classes model, a Slope layer and a Bush Areas layer must be created. A model for Slope is included with the Fire behaviour module. The Bush Areas layer is created by clipping the Vegetation to the Vegetation mask in the SW. In the non-agricultural regions the vegetation map can generally be used.

Both the Slope and Bush Areas layers are also required for the Fire Behaviour model.



Suppression Response Model

Fire Behaviour

Overview

The model calculates the potential ROS and fireline intensity under 95 percentile conditions at each point according to the fuels present. Note this assumes a "worst case" scenario with the slope and wind direction being coincident. The calculations do not model the growth of fires, or indicate potential perimeter, but only indicate the difficulty of control of a fire that has reached its pseudo-steady state at that point.

The 95 percentile conditions are calculated for the Restricted Burning Period for the area in which the weather station is located. The model may be modified to consider a lesser period (such as the period prior to crop harvest) where analysis is required for values potentially threatened that are present only for a shorter time.

The 95 percentile conditions cannot be determined by considering the weather parameters individually. "Fire weather" is the combined effects of rainfall (both long term and short term effects), temperature, relative humidity and wind. A Fire Danger Index (FDI) combines these weather variables into a single index, but strictly speaking only applies to the particular fuel type for which the index has been developed. The effect of daily conditions varies between fuel types, primarily due to differences in fuel moisture responses and the effect of wind in different structural types, and a single index cannot be used to calculate the fire spread in a range of fuels. A separate index is calculated for each fuel type to summarise the "fire weather". The "standard" ROS for each fuel class represented by this index is multiplied by correction factors for slope and fuel characteristics (quantity and/or height and cover density) to calculate rate of spread and fireline intensity.

For each fuel class, an hourly rate of spread index (ROSI) is calculated for each automatic weather station (AWS), the daily maxima determined and ranked, and the 95 percentile daily maximum ROSI identified. These values are specific to the location of each station. Kriging is used to interpolate between the stations.

Interpolated ROSI values are calculated using the following models:

Pasture/Crop/Natural Grasses	(Rn)
Grazed/cut pasture	(Rcu)
Eaten out pasture	(Re)
Natural Grass under woodland with 2:1 wind ratio applied	(Rn2)
Mallee Heath	(Rmh)
Shrubland	(Rsh)
Hummock Grasslands (Spinifex)	(HG_Wind2m)
Northern Jarrah 6:1 wind ratio	(ROSInj6)
Northern Jarrah 5:1 wind ratio	(FDInj)
Northern Jarrah 4:1 wind ratio	(ROSInj4)
Northern Jarrah 3:1 wind ratio	(ROSInj3)
Northern Jarrah 2:1 wind ratio	(ROSInj2)
Karri 4 / 5	(FDIk)

Karri 3 / 6	(ROSIk36)
Karri 1./ 2	(ROSIk12)
Southern Jarrah	(ROSIsj)
Woodlands	(McAFDI)

The predicted actual rate of spread and fireline intensity are calculated by multiplying the relevant ROSI values by correction factors for slope and fuel parameters (fuel load, fuel height, cover density) appropriate to the vegetation type and location.

Note that the effect of wind ratio on ROS is not constant, but is highly dependant on the wind speed, and to a lesser extent the SMC. It is therefore not possible to apply a simple correction factor to the FDI (standard ROS) to account for the differences in canopy density, and hence separate models are used for different wind ratios under canopies.

Fire Behaviour Model Inputs

Weather Data

The *FireBehaviour* model requires 95 percentile ROSI layers for fire weather inputs. Creation of these layers is a three stage process:

- Compile a database of available AWS data, and use this data to calculate the SMC% for forest fuels.
- Calculate the 95 percentile conditions for each fire spread model for each station using the above data.
- Interpolate the results in ArcGIS to create the map layers.

The MS Access database *Met_SMC_Data.mdb* contains the meteorological data and the calculated forest fuel moisture data used in calculating the percentile fire weather conditions in the *PercentileCondit.mdb* database. Both databases must be located in the folder C:\BFTA_Data\Weather to maintain the links between the databases. If located in another folder, the links will need to be re-established.

The *Met_SMC_Data.mdb* and *PercentileCondit.mdb* databases have been separated to:

- Facilitate use of the MC% calculations independent of the percentile conditions calculations
- Reduce potential confusion by separating the SQL queries used for moisture content calculation from those used in the percentile calculations.
- Reduce the risk of the database limits of Microsoft Access being exceeded as more years of AWS data are added.

The AWS data covers the period nominally from 1994 to 2004, however many AWS stations were established much later, or do not have valid records. In some cases only 1 year of data is available. Whilst all available data has been used, the result will be compromised by a lack of records. The database should be regularly updated by appending the new records to increase the size of the data set and to keep it current, and the fire behaviour re-calculated.

Recommendation: The weather database be updated at least every two years and the 95 percentile weather (ROSI) layers recalculated.

Due to the enormous distance between the locations of some AWS, any subsequent interpolation will have a very high standard error. If additional AWS data is available from other sources to "fill the gaps" this should be used, notwithstanding the stations are not BoM stations.

Weather Data and Fuel Moisture - the Met_SMC_Data.mdb database

Description

The *Met_SMC_Data.mdb*. contains the following:

Tables:

- Individual tables for each weather station with hourly automatic weather station (AWS) data
- The table StnDetails that contains the details for each Meteorological Station for which there are AWS tables.
- Tables that contain the SMC and PMC data calculated by the scripts in the modules section
- A link to a table (StnList) that contains a list of the stations for which SMC calculations are to be carried out in a batch process. This can be replaced with a link to any valid list of tables.

Modules

The scripts SMC_PMC_Batch and SMC_PMC_Calc_Single_Stn calculate the daily minimum surface (SMC) and profile moisture (PMC) contents for forest types from met. data using the equations in Beck (1995).

SMC_PMC_Calc_Single_Stn prompts for a station name as an input. SMC_PMC_Batch calculates the MC% for all stations with valid data in a list of table names.

SQL Queries

The queries relate to the steps required to calculate the moisture contents. It is essential that these queries are not altered or deleted or the scripts will not run.

Macros

The macro ImportBoM_1hr was used to ensure records imported from Bureau of Meteorology AWS data supplied as text files were imported in a consistent format for subsequent analysis, and that only valid records were imported.

Importing Weather Data

Automatic weather station (AWS) one-hourly data from the Bureau of Meteorology (BoM) has been imported into the database *Met_SMC_Data.mdb*. Only data relevant to fire weather was imported. The macro *ImportBoM_1hr* with the import specification "1Hr BoM Import Specification" was used to import only valid data in a consistent format. For each station, the format of the data imported is:

Field	Data Type	Description
Stn_No	Long Integer	Station identifier (B0M station number).
Yr	Integer	Year
Month	Integer	Moth
Day	Integer	Day
Hr	Integer	Hour
Min	Integer	Minute
Ppn_10	Double	Rainfall in past 10 minutes
Ppn_0900	Double	Cumulative rainfall since o900hrs
Temp	Double	Temperature (Celsius)
Dew_pt	Double	Dew Point (Celsius)
RH	Integer	Relative humidity %
Wnd_Spd	Integer	Wind speed (km/hr)
Wnd_Dir	Integer	Wind direction (degrees)
Wnd_Gust	Integer	Maximum wind gust in preceding 10 minutes (km/hr)

Data was also imported from CALM and EPA AWS, but subsequently discarded as the data did not include rainfall, which is essential to calculate fire weather.

The table *Stn Details* imported from the BoM data contains the geographical location of the stations, and is pivotal in providing the link in the relational database. All tables must be linked to this table by the field Stn_No.

Forest Fuel Moisture Calculation

Surface moisture content (SMC) and profile moisture content (PMC) have been calculated from the AWS data using the equations (Beck, 1995) for the Forest Fire Behaviour Tables for WA (FFBT, also known as the "Red Book").

The results of these calculations will differ slightly from manual calculations. The FFBT tables are known to under-predict drying following rain, and it is normal practice to take field samples to correct for this and re-initiate the calculations. This is not possible when calculating from AWS data, and there may be a significant over-prediction of moisture content for several days immediately following rain.

Two VBA modules have been written to calculate moisture content for either a single station *(SMC_PMC_Calc_Single_Stn)*, or for a list of stations in a batch process *(SMC_PMC_Batch)*.These utilise a series of SQL queries. The VBA scripts and SQL modules are detailed in the section "Fire Behaviour Scripts" in Volume 2 (BFTA Scripts) of this report. These provide details of the equations and processes used. The modules will facilitate future updates, however the following must be noted:

1. The scripts require the AWS data to be located in the same database as the modules and queries.

2. AWS tables MUST include the numeric fields:

   "Stn_No", "Yr", "Month", "Day", "Hr", "Min", "Ppn_0900", "Temp", "RH", "Wnd_Spd"

3. The tables must only contain valid data

   The program will only work with valid records. It filters out records with invalid/null values. As rainfall is an essential input, the program will not run with AWS data from DEC stations that do not record rainfall.

4. The table "Station_Details" lists details of AWS stations. There must be a link between all tables and this table, based on the field Stn_No.

5. Running either of the modules *SMC_PMC_Calc_Single_Stn* or *SMC_PMC_Batch* will call the linked queries as required.

6. SMC and PMC are output as a table with the name "XXXXX_SMC" where XXXXX is the station table name.

7. The scripts create temporary fields and index in the original station tables, which are deleted following MC calculation. If the program is interrupted during execution these changes will not be deleted, and an error message will appear next time the script is run. If this occurs, the fields and index will need to be removed manually from the table in "Design View"

Forest Fuel Moisture Content Equations

The following equations reproduced from Beck (1995) were used to calculate the daily forest fuel moisture contents.

Night Wetting Correction

NWCs(wet) = A / (1 + B * RAIN * X)

where

A = 121.42 - 94.27 / (1 + 107.55 exp(-0.037 YSMCa(NJ)))

B = 101.71 / (1 + 17.13 exp(-0.017 YSMCa(NJ)))

X = -0.84 - 0.62 / (1 + 1087.88 exp(-0.053 YSMCa(NJ)))

YSMCa(NJ) = yesterday's minimum surface moisture content for a given fuel type, in this case is northern jarrah (NJ)
RAIN = amount of rain (mm), recorded at 0800 hours, for the past 24 hour period

Application Bounds

5.	<	YSMCa(NJ)	<	200
0.1	<	RAIN	<	65.50.
5.	<	NWCs(wet)	<	100.

NWCs(dry) = Y ORHC + Z [2]

where

Y = 0.29 / (1 + 1.34 exp(-0.019 YSMCa(NJ)))

Z = 51.61 - 367.12(0.29/(1 + 1.34 exp(-0.019 YSMCa(NJ))))

ORHC = the overnight relative humidity count. The ORHC is the area enclosed by the overnight thermo hygrograph trace, between 2000 hrs and 0800 hrs that exceeds the 70 percent relative humidity level. The squares below the trace line are counted and one unit is equivalent to 2 percent relative humidity over a two hour duration.. The ORHC was calculated from the hourly weather data by calculating the amount above 70% RH for each time interval between 2000 hrs and 0800 hrs, and summing (time in hours) * (% >70) / 4. Full details and explanatory notes for the calculation are in Volume 2 BFTA Scripts.

Application Bounds

0.	<	YSMCa(NJ)	<	160.
0.	<	ORHC	<	101

Today's Maximum SMC

SMCz(NJ) = YSMCa(NJ) + NWCs(wet/dry)

Where

SMCz(NJ) = today's maximum (0800 hrs) SMC.

Basic Drying Unit

BDU = C / (1 + D exp (E (100 - RHa)))

where

C = 57.29 / (1 + 1.93 exp (-0.042 Tz))

D = 42.77 / (Tz - 5.80)

E = -0.016 Tz / (Tz - 5.27)

Application Bounds Data1

8.	<	Tz	<	48.
0.	<	RHa	<	90..

Day Drying Correction

DDCs(NJ) = F BDU + G + 10

where

F = (SMCz(NJ) - 103.79)/((SMCz(NJ) - 103.79)2 - 12643.93) 12.81 - 0.65

G = (SMCz(NJ) - 99.70) /((SMCz(NJ) - 99.70)2 - 25199.32) 3570.12 - 23.26

Application Bounds

6.	<	BDU	<	35..
6.	<	SMCz(NJ)	<	200

Today's Minimum SMC

SMCa(NJ) = SMCz(NJ) + DDCs(NJ)

	Application Bounds				
SMCa/z(SJ) = 1.12 SMCa/z(NJ)	5.	<	SMC(SJ)	<	56.
SMCa/z(K36) =1.20 SMCa/z(NJ) + 0.90	6.	<	SMC(K36)	<	60
SMCa/z(K45) =1.53 SMCa/z(NJ) - 0.10	7.	<	SMC(K45)	<	74.

SMCa/z(K12) =1.61 SMCa/z(NJ) + 1.70 9. < SMC(K12) < 80

SMCa/z(PP) = 0.74 SMCa/z(NJ) + 1.51 5. < SMC(PP) < 63

SMCa/z(PR) = 0.86 SMCa/z(NJ) + 1.02 5. < SMC(PR) < 70

Profile Moisture Content

For rainless nights, the maximum PMC for Karri 4/5 is taken to be the previous day's minimum PMC.

In the event of rain, the maximum PMC is calculated by substituting the PMC values for SMC in the NWC and Maximum SMC equations.

The following are applied to calculate today's minimum PMC.

DDCp(K45) = H BDU + I

where

H = (PMCz(K45) - 112.15) / ((PMCz(K45) - 112.15)2 - 21835.42) 40.96 - 0.46

I = (PMCz(K45) - 140.78) / ((PMCz(K45) - 140.78)2 - 24819.47) 298.78

Application Bounds

11.	<	PMCz(K45)	<	200.
1.	<	BDU <	35.	8.
-21.	<	DDCp(K45)	<	4

PMCa(K45) = PMCz(K45) + DDCp(K45)

Application Bounds

PMCa/z(SJ) = 0.75 PMCa/z(K45) + 2.19 10. < PMC(SJ) < 80.

PMCa/z(K36) = 0.81 PMCa/z(K45) + 2.98 11. < PMC(K36) < 85

PMCa/z(K12) = 1.26 PMCa/z(K45) + 2.28 16. < PMC(K12) < 125.

PMCa/z(PP) = 1.29 PMCa/z(K45) - 1.87 13. < PMC(PP) < 125.

PMCa/z(PR) = 1.26 PMCa/z(K45) + 2.95 16. < PMC(PR) < 125.

95 Percentile Conditions – the PercentileCondit.mdb database

Description

Calculation of the 95 percentile conditions is carried out in the database *PercentileCondit.mdb*. This database contains:

Tables

The moisture content and AWS data tables are accessed via links to the *Met_Smc_Data.mdb* database. The table names are of the form XXXX and XXXX_SMC for met data and MC% respectively, where XXXX is the met station number.

The table *BatchWeatherPercentileOutput* stores the results of the 95 percentile calculations when the SQL query *ROS_95percentileRP* or *ROS_95percentile_NW i*s run or called from a script. When the weather database is updated, the data in this table must be deleted prior to performing 95 percentile updates to avoid duplicate station records.

The links *SDI_Esperance, SDI_Fitzroy, SDI_Kalgoorlie, SDI_Karratha* and *SDI_Mundaring* link to the SDI and drought factor data for these stations provided by BoM via FESA. These tables must be updated whenever the met data is updated, or preferably replaced by direct calculation of the drought factor (See Drought Factor) below.

The linked table *Stn Details* provides the latitude and longitude for each station.

Stn_LGA_RPeriod lists the local government authority and relevant start and end date for the restricted period for each met station location.

SW_Curing contains curing data related to met stations in the SW Land Division. (See "Curing" below).

Valid_Stns is a link to a list of tables in the *Met_Smc_Data.mdb* that currently contain sufficient valid data. This can be used as an input list for batch calculation of the 95 percentile for all stations. (See modules, below).

Queries

The 95 percentile conditions are calculated by a series of linked SQL queries. Not all the SQL queries apply to each calculation. For ease of reference, these have been placed into groups.

The queries *ROS_95Percentile_NW, ROS_95_NW_WR, ROS_95percentileRP*, and *ROS_95percentile_Harvest* call the other queries required.

Note that to run any of the queries outside the modules it is necessary to manually change the table in *SOURCETABLE* and, for the SW queries also in *SMC_SourceTable,* to the station for which calculations are required.

The SQL queries are detailed in Volume 2 BFTA Scripts.

Groups

NW:
The queries that apply only to areas outside the SW Land Division. The major differences are the inclusion of hummock grasslands, and the assumption of 100% curing for grasslands in the absence of curing data.

NW_Wind_Ratio
This allows calculation for a single station with manual input for a wind ratio for all grassland models instead of only the 2:1 ratio for natural grass that is included in the NW and SW models. This allows for an estimate for areas with less grass under a denser woodland canopy if desired. Note that the reduced wind will only apply to the grassland models.

SW
The SQL queries that apply only in the SW land Division, where curing records are available.

Common to All
These SQL queries are utilised by the queries in the other groups.

Select Harvest Period
The SQL query *ROS_95Percentile_Harvest* will use the start of the restricted burning period for the station as the start date for records, but prompts for the input of an end month (Harvest Month). This enables the risk to be assessed for the weather conditions only when the crop is present.

Modules

BatchWeatherPercentileRP calculates the 95 percentile conditions for the Restricted Burning Period (the "fire season") for each station in a selected list of stations. It uses either the SW or NW set of SQL queries, depending on the location of the station. The result of the calculation for each station is appended to *BatchWeatherPercentileOutput.* The script for this module is in Vol. 2 BFTA Scripts.

Fire Spread Equations for ROSI Calculation

The following equations have been used to calculate the rate of spread index (i.e. ROS for "standard" fuel conditions and no slope) for each of the fuel types.

Grasslands (Rn, Rcu, Re, Rn2)

(Cheney et al 1998)

øM = exp (-0.108 * Mf) if Mf < 12%
øM = 0.684 - 0.0342 * Mf if Mf > 12%, U_{10} < 10kph
øM = 0.547 – 0.0228 *Mf if Mf > 12%. U_{10} > 10kph

where
Mf = dead fuel moisture content (%): application bounds 2 - 24%.

øC = 1.120 / (1 + 59.2 * exp (-0.124 (C-50)))

where
C is the degree of grass curing (%): application bounds 50 - 100%.

Rn = (0.054 + 0.269* U_{10}) * øM * øC if U_{10} < 5kph
Rcu = (0.054 + 0.209 * U_{10}) * øM * øC if U_{10} < 5kph

Rn = (1.4 + 0.838 $(U_{10}- 5)^{0.844}$.) * øM * øC if U_{10} > 5kph
Rcu = (1.1 + 0.715 * $(U_{10}-5)^{0.844}$) * øM * øC if U_{10} > 5kph

where:
Rn = quasi-steady rate of spread in undisturbed natural pastures (km/h).
Rcu = quasi-steady rate of spread in cut, grazed, or partially trampled pastures (km/h)
U_{10} = 10 m wind speed in the open (km/h) : application bounds (0-80 km/h).
øM = moisture coefficient
øC = curing coefficient

Re = (0.55 + 0.357 * $(U_{10} – 5)^{0.844}$) * øM * øC
 = 0.5 * Rcu

where
Re is quasi-steady rate of spread in eaten out pasture conditions (km/h).

Cheney et al's equations for natural pasture have been modified for woodland areas by substituting a reduced wind speed as follows:

Rn2 = (0.054 + 0.269* U_{10}/2) * øM * øC if U_{10} < 5kph

$Rn2 = (1.4 + 0.838\ (U_{10}/2 - 5)^{0.844}.) * øM * øC$ if $U_{10} > 5kph$

Where
Rn2 = quasi-steady rate of spread in undisturbed natural pastures (km/h).under a woodland canopy with a 2:1 wind ratio applied.

Mallee Heath Shrubland (Rmh)

(McCaw 1997)

Threshold for fire spread 8% or lower

$R = aU_2^b \exp(cMld)$ (m/sec)

where
the constants a, b and c have values of 0.292, 1.05, and -0.11 respectively.

U_2 = wind m/sec at 2m **in the open (**not under canopy). = $0.71U_{10}$
Mld = MC% deep litter
U_{10} = Wind m/sec at 10m in the open

MC% has been modelled using the equations developed by Viney (1991) based on the models of McArthur (1962*) viz:*

Desorption conditions (0600-1200 or for 2 days after 12.5mm or more rain)

$M = 0.113\ RH - 0.218\ T + 12.5$

Adsorption conditions (1200 on)

$M = 0.132\ RH - 0.168\ T + 6.8$

where
M is the per cent moisture content of the fuel and RH and T are relative humidity and air temperature respectively.

Shrubland / Mixed Heathland (Rsh)

(Catchpole et al 1999)

$R_{pred} = a\ U_2^b\ H^c$,

Where:
R_{pred} is the predicted spread rate (m/min)
U_2 is the wind speed measured at 2 m (km/hr)

H is the vegetation height (m).
a = 0.801 (standard error 0.221)
b = 1.10 (s.e. 0.10)
c = 0.49 (s.e. 0.08).

Hummock Grassland (Spinifex)

(Burrows et al 1999)

Spinifex is a special case. The ROS equations for Spinifex fuels require wind at 2m and profile moisture content as the "weather related" variables.

ROSFQ = 154.9(W) + 140.6(FQ) – 228.0(PMC) + 1581

Where:

W = average wind speed (km h-1) over a 5 minute period at 2 m above ground.
FQ = fuel quantity (Spinifex and other fine ground cover) (oven dry weight in t ha-1).
PMC = the profile moisture content of the Spinifex hummock (% oven dry weight).

There are currently no established relationships to calculate an estimate for profile moisture content from weather parameters. An assigned value is used for PMC%. This leaves wind as the only weather variable. Although relationships to calculate PMC% have not been established, it is known that this is influenced by rainfall, temperature and RH%. It is therefore not valid to determine the 95 percentile wind conditions in isolation of these factors. To make some allowance for the effects of weather variables on the profile moisture content, the calculation of the 95 percentile wind speed is related to grassland conditions. The 95 percentile Grassland ROS is calculated for the period of available valid records. This may result from a number of combinations of temperature, RH and wind. The mean wind from all records within 10% of the 95 percentile GROS is used.

For input into the Spinifex spread model, the wind at 2m is determined from the mean wind at 10m for the 95 percentile based on the following relationship:

$U_2 = 0.8329 + 0.57055U_{10}$ where U = wind speed in m/sec
(As per Cheney et al 1987 as quoted in Durre and Beer, 1989)

or

$U_2 = 0.8329 * 3.6 + 0.57055U_{10}$ where U = wind in km/hr
$= 2.99844 + 0.57055U_{10}$

SW Forests (FDInj, ROSInj6, ROSInj5, ROSInj4, ROSInj3, ROSInj2, FDIk, ROSIk36, ROSIk12, ROSIsj)

(Beck 1995)

FDI(NJs) = $Yj + Aj \exp(\text{WINDfg} \quad Nj)$

where

$Yj = 21.37 - 3.42\ SMC + 0.085\ SMC^2$

$Aj = 48.09\ SMC \exp(-0.60\ SMC) + 11.90$

$Nj = -0.0096\ SMC^{1.05} + 0.44$

WINDfg is the wind speed (kph) at a height of 1-2m above the ground in the forest.

Application Bounds

3.	<	SMC	<	27.
0.	<	WINDfg	<	11.2

FDI(Ks) = $Yk + Ak \exp(\text{WINDfg}\ Nk)$

where

$Yk = 4.88 - 263.78\ SMC\text{-}1.80$

$Ak = 163.40\ SMC\text{-}1.18$

$Nk = -0.0059\ SMC + 0.54$

Application Bounds

3.	<	SMC	<	25.
0.	<	WINDfg	<	7.2

ROSIk36)
ROSIk12) use the FDI(Ks) equations with the relevant SMC substituted
ROSIsj)

Woodland / Forest outside SW (McAFDI)

(Noble et al. 1980)

$$FDI = 2.0 * \exp(-0.450 + 0.987 * \ln(D) - 0.0345 * RH + 0.338 * T + 0.0234 * V)$$

Where

D = Drought Factor (supplied by BoM: see Drought Factor below)
T= Temperature (Celsius)
RH = Relative humidity %
V = 10m wind speed (km/hr)

Drought Factor

Drought factor (DF) is a required input for the forest fire calculations using the equations for the McArthur Forest Fire Danger Meter.

Preferably the DF would be calculated for each station from the AWS data. This provides improved accuracy when interpolating fire weather conditions between stations by ensuring:

- The maximum number of available points are used for interpolation
- The maximum number of valid data records for each station is used. Where the DF from another station is used, only those records where the dates are common to both can be used. This can lead to a substantial reduction in the available data.

The BoM provided DF/KBDI/SDI calculated records for five locations (Fitzroy Crossing, Karratha, Kalgoorlie, Esperance, and Mundaring) via FESA. They also provided the algorithm to DEC for translation into VBA for implementation in the Microsoft Access database environment for the BFTA, but DEC advised they did not have the resources to translate the C^{++} code into VBA for implementation in this project. Use of this algorithm with the AWS data:

- eliminates the need for manual assignment of appropriate values to individual stations each time the data is updated, and permits automation of the process
- Increases reliability of results, as the drought factor is calculated for each station
- Increases the reliability of results by making maximum use of all available AWS data as there will automatically be a matching record for each corresponding day of valid AWS data. If DF data from another station is used only those days where records are available for both stations are available for calculation.

Recommendation: The BoM algorithm for calculating Drought Factor be coded in VBA and used to calculate the DF for each station.

Despite the inherent inaccuracies, in order to permit calculations in the absence of the VBA code, the DF value from the nearest of the five locations has been assigned to each station. These values are accessed by links to the file *C:\BFTA_Data\Weather Data\KBDI\kbdi_ralph_mkII.xls*.

It is strongly recommended the VBA script be written and these values be replaced with the value calculated for each station from the AWS data.

Weather Districts

The table *Weather_Districts* identifies the fire weather district for each station, and whether the stations are within the SW Land Division. This table is used to assign the daily curing values used in the grassland calculations according to the weather district in which the station is located. The "Division" field is used in the VBA module to identify whether the queries relevant to the SW Land Division (i.e. where curing data is available) are applied, or if the NW queries apply.

Grassland Curing Indices

Preparation Of Curing Table

Curing data for each fire weather forecast sub-district was obtained from DLI as text files, from 1997-2005. The period covered by these files varies, depending on the rate of curing: recording stops when the grasses approach fully cured. In some cases there are multiple values for the same period over the same District as different images were used to derive the curing index value (eg when partial cloud cover). The period for which curing data is available does not necessarily correspond with the period for which weather data is available. The curing values themselves are the results of remote sensing and have not been verified. At best they are a broad guide to the curing in an area. Because of the imprecise and limited data, a table (SW_Curing) has been created to allow curing to be assigned as per the logic of the SQL statement below.

IIF ([SourceTable].yr=[SW_Curing].Year AND [SourceTable].month = [SW_Curing].Month AND [SourceTable].Day <=15, [SW_Curing].Index_A, IIF ([SourceTable].yr=[SW_Curing].Year AND [SourceTable].month= [SW_Curing].Month AND [SourceTable].Day >15, [SW_Curing].Index_B,	Index value if record exists for the period in SW_Curing_Values
IIF ([SourceTable].month = [SW_Curing_Monthly_Av].Month AND [SourceTable].Day <=15, [SW_Curing_Monthly_Av].AvgMonth_A, IIF ([SourceTable].month = [SW_Curing_Monthly_Av].Month AND [SourceTable].Day >15, [SW_Curing_Monthly_Av].AvgMonth_B,	Assign average bi-monthly value where no actual record for that period.
IIF ([SourceTable].Month <6, 100, 0)))) AS Curing	Assign 100 for remainder of restricted period, and 0 prior to restricted period.

FROM SourceTable, SW_Curing_Monthly_Av, SW_Curing;

Whilst the above SQL statements outlines the logic, problems were encountered with the relationships required to run it as a query, and the SW_Curing table was instead prepared using Excel and Access as follows:

- Run macros in Curing.xls to import text files and append to worksheets. Note the format changes in 1999, so slightly different macros are required. (See Vol 2 BFTA Scripts)

- Copy to combine all records in a single worksheet (Curing Combined).

- Classify records into "half monthly" categories: Index_A (those scenes that were prior to 15^{th} of the month) or Index_B (latter part of the month).

- Import Curing Combined into Access. Delete "no data" invalid records.

- Use a Select query (SW_Curing_Recorded) to create single bi-monthly curing values for first (Index_A) and second (Index_B) half of each year and "half-month" for which there are records by averaging values where there are multiple records for the same District for that period. Export to Excel (worksheet SW_Curing_Recorded).

- Create an ID field by combining the District, Yr, and Month fields in the SW_Curing_Recorded worksheet.

- Use a Select query (SW_Curing_Monthly_Av) to create a table with the long term (i.e. all available years) "half-monthly" average value for each District. Export to Excel.

- Create an ID field by combining District and Month in the SW_Curing_Monthly_Av worksheet.

- Create a date list for each district covering the period of the earliest met or curing record (August 1994) to the last (31 Jan 2006). (Note: because of size limits, this needs to be over 2 worksheets: District_Dates_1 and District_Dates_2).

- Use the following formula (field IndexA-B Formula) to look up the value for each day and each District in the recorded values table (SW_Curing_Recorded).

  =OFFSET(SW_Curing_Recorded!$A$1,MATCH(District_Dates_1!F58490,SW_Curing_Recorded!$D$2:$D$626,0),IF(District_Dates_1!E58490<16,4,5))

  Note, this attempts to match each day in the District_Dates record set with a corresponding date in the curing records. If it finds the date, it returns the value in the offset (i.e. Index_A or Index_B) depending on day in the month. It returns #N/A where there are no corresponding dates, and 0 if there is a date, but a blank record.

- Copy and "Paste Special" values only. Filter and delete 0 and #N/A. (Ensure you start at the first record).

- Use the following to add monthly average values where there are no actual values.

  =IF(District_Dates_1!I2="",OFFSET(SW_Curing_Monthly_Av!$A$1,MATCH(Dis trict_Dates_1!G2,SW_Curing_Monthly_Av!$C$2:$C$626,0),IF(District_Dates_1!E2 <16,3,4)),I2)

- Copy and "Paste Special" values only. Filter and delete 0 and #N/A.
- Assign values to periods outside when the curing was recorded. As follows:

  =IF(K2="",IF(D2<6,100,5),K2)

  This assigns 100 to the balance of the autumn to cover the rest of the restricted period, and a nominal 5% prior to the period. Note that this will also result in 100 beyond the RP in some cases, but this is not a problem if only records within the RP are selected.
- Import District_Dates_1 and District_Dates_2 into Access as SW_Curing table. Delete redundant fields in Design View.

Relationship between curing and weather tables

The curing and individual weather station tables are linked by the station number and date. Only records where there is valid data in both tables being available for calculation, resulting in a reduction in the number of records on which to base the percentile weather calculations where the curing data and AWS data do not overlap. To avoid this issue in the future, all the curing data provided by DLI to FESA should be archived with the weather data, so a complete record of curing to match AWS data is available.

Recommendation: Curing data be saved and archived with weather data to maximise the number of valid records available to calculate percentile conditions.

Restricted Period

The 95 percentile conditions are calculated for the "fire season", which has been taken to be the Restricted Burning Period. The dates used for the commencement and end of the restricted period are those gazetted as the "standard" dates current as at 19 April 2006. The start and end dates may be varied up to two weeks for any particular area according to seasonal conditions. Any such variations have not been included when filtering the data to be processed. Any differences in the 95 percentile values are unlikely to be significant.

The table *Stn_LGA_RPeriod* identifies the location of each weather station by the area in which it is located and by the applicable restricted burning periods.

Percentile Weather Data Map Layers

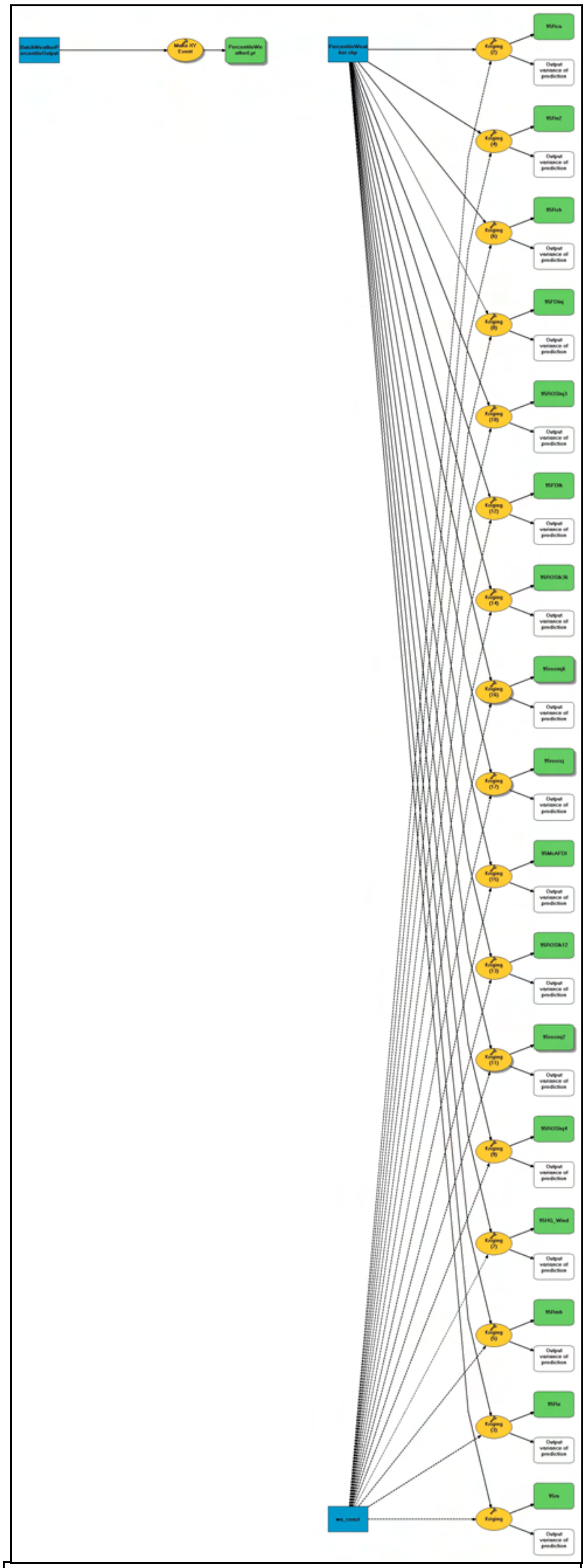


Figure 1 PercentileLayers Model

A map layer is created for each FDI/ROSI by interpolating between the locations for the weather stations the values derived from the AWS data for those locations..

The following methods for interpolation were compared:

With Spatial Analyst

- IDW
- Kriging
- Spline
- With Geostatistical Analyst
- Normal Kriging Prediction
- Normal Kriging with trend removal
- Thin plate spline

Normal kriging with global trend removal and no anisotropy correction provided the lowest RMS error of the methods compared, but this was not universal and varied with the data set / fuel type. Errors were high, and the reduction in RMS error with / without anisotropy correction and trend removal was not sufficient to warrant separate individual analysis for each case. For simplicity, normal kriging within Spatial Analyst, using the standard defaults for lag size and number has been applied.

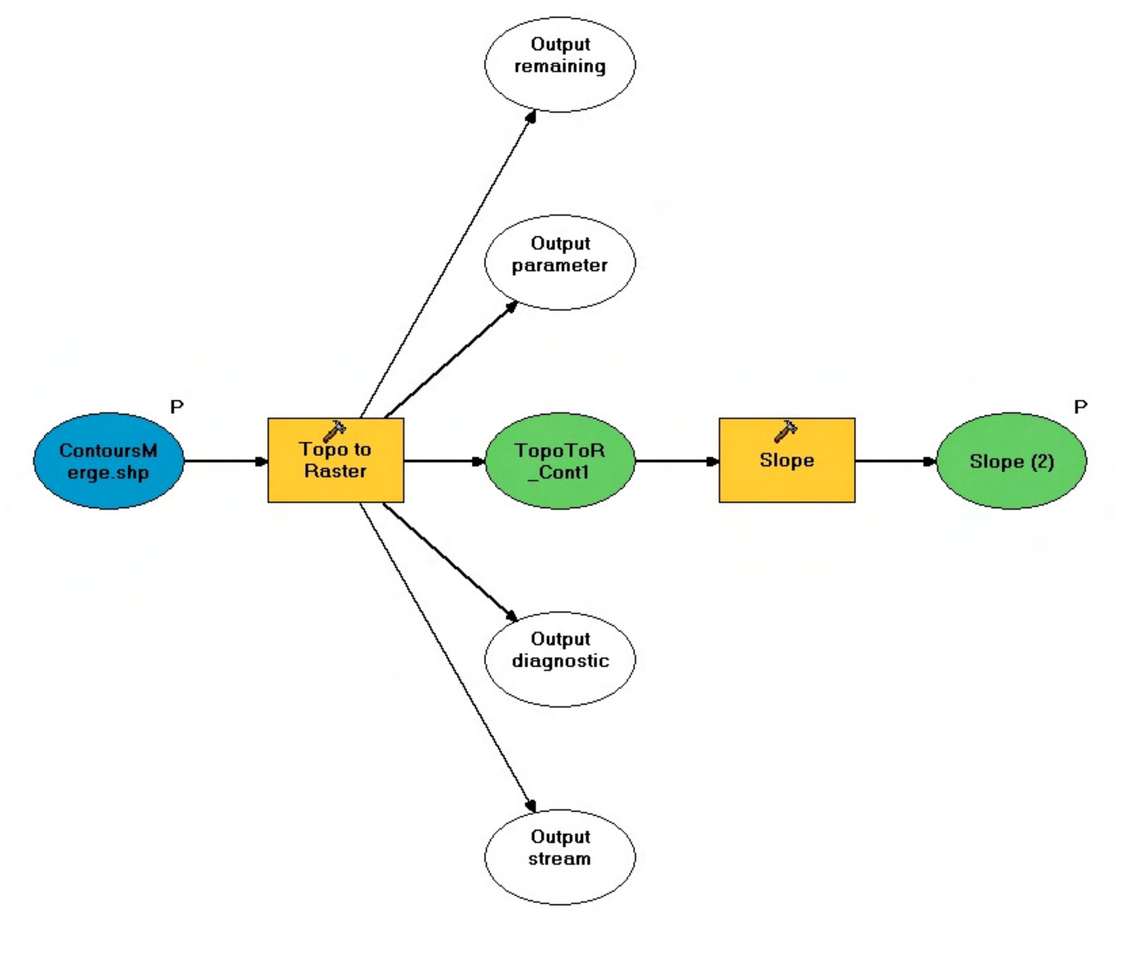
The model *PercentileLayers* creates all the layers from the table *BatchWeatherPercentileOutput* in the *PercentileCondit.mdb* database.

In this instance the event layer *PercentileWeatherLyr* is converted to a shapefile *PercentileWeather.shp* to facilitate populating the *McAFDI95* field by selecting stations in ArcMap according to location, and using the field calculator to assign the most appropriate of the McAFDIxxxxDF values calculated for each station with the five Drought Factor values that were provided.

If/when the VBA script to calculate the Drought Factor for each station is incorporated, this step will not be necessary, and the model can be modified to use the temporary event layer file for the input layer for kriging.

Slope

The *Slope* model calculates the slope in degrees from a contour layer for the area.



Slope Model

The model has only the output cell size set at 100m. No other environment variables are set. The extent and raster analysis mask should be set to the study area under consideration This can be set globally, rather than in the model.

The input is a parameter, a shapefile of contour data. If the extent is greater than a single map sheet coverage of the contour data, the individual map sheets must first be merged to create a single contour layer covering the full extent of the study area.

The output is also a parameter, permitting the destination to be readily set.

Fuel Parameters

Fuel Age

For DEC lands in the SW a shapefile is available showing fuel age, however for most areas, fuel age can only be determined from fire scars identified by remote sensing. Fuel age is not time since YLB, as the summer "fire season" extends over two years. To determine the fuel age, the season last burnt must be identified. For simplicity, in the following process this has been identified by the year the season ends. i.e. 1995/96 season is identified as season ending (Seas_End) 96

The fuel age is the difference between the current season and season last burnt.

Fuel age is derived from the Department of Land Information NOAA/MODIS fire scar data as follows:

- Merge all available years' fire scar data, ***with years in sequential order (earliest at top of list)***. This results in the latest polygon being on top (and this polygon value used when converted to a raster).
- Add YR, MONTH,SEAS_END, and FUEL_AGE fields.
- Calculate fields as follows
    - [YR] = Left([YR_MTH],4)
    - [MONTH] = Right([YR_MTH],2)
    - [SEAS_END] = 'Season' with the following pre-processing in the "Advanced" section using Calculate Field in table view in ArcMap.

```
Dim Season As Integer
Dim mMonth As Integer
Dim mYr As Integer
mMonth = [Month]
mYr = [YR]
If mMonth < 7 then
Season = mYr
Else
Season = (mYr + 1)
End If
```

- [FUEL_AGE] = *2008* – [SEAS_END]
  (Note, the fuel age is only current in the year it is run, it needs to be recalculated each year in relation to the current year. In the above case the fuel age will be age to the 2007/2008 fire season***).***

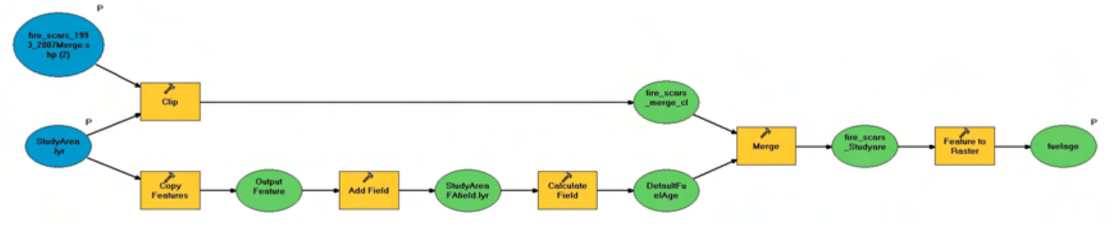
The NOAA/MODIS data has limited accuracy. DEC have more accurate fire scar mapping from Landsat interpretation, and where available this should be used in preference. Before this data can be used, SEAS_END and FUEL_AGE fields must be calculated. Before the above procedure can be applied, the attribute tables in the DEC data must be modified to provide a single field for year and month. To facilitate integrating the more accurate data where available, it is strongly recommended that in future all fire scars be identified by year and month, either in a single YR_MTH field as with the DLI data (which would allow identical procedures to be applied without additional procedures), or with individual fields for year and month.

Recommendation: The attribute table for the fire scars produced by DEC include a year-month date field in the same format as the DLI NOAA / MODIS fire scar data so the data sets can be more readily integrated, and the more accurate scars used where available.

Determination of fuel age from fire scars is best carried out to the full extent of the available data. The selected study area is then clipped. The fire scars provide fuel age only for the fire scar area, not for the areas for which there is no fire scar record. To determine fuel quantities, a fuel age is required for all areas. A default value of 25 years is assigned to areas where there is no fire record. This value has been chosen as in most cases fuel accumulation beyond 25 years is very slow, leading to only small underestimates of fuel quantity in longer unburnt areas. It will result in an overestimate of fuel quantity in areas where there are more recent but unrecorded fires.

The default is applied by creating a FUEL_AGE value of 25 for the whole study area, and merging this layer with the fire scar data (ensuring the 25 year layer is the "bottom" layer). The resultant layer is converted to a raster on FUEL_AGE values as in the Fuel_Age model. Only the value of the uppermost of the merged layers is converted to raster, hence the importance of the hierarchy of layers during the merge process to ensure the top layer is the most recent burnt.

Where data from different sources (DLI fire scars, DEC Landsat scars, DEC shapefile for SW) is available, preference should be given to the data with the highest resolution.



Fuel_Age Model

Fuel Classification - the FuelClassification.mdb database

Vegetation maps are used to identify the fire models and fuel accumulation models to be applied. In the examples illustrated, the *Pre-European* vegetation layer has been used as this is the only classification available State wide, but other more detailed vegetation maps can be used where available to assign fuel types and fire models.

A *Bush_Areas* layer is created for the study area. In the SW, the *Pre_European* layer is clipped to *VegMask* to retain only those areas with remnant native vegetation. This is joined with the *PreEuropeanVegetation_Attribute.dbf* table on the *Veg_Assoc* fields. The attribute table from the resultant *Bush_Areas* layer is exported, duplicate records removed (based on *veg_assoc*), and a fire model and fuel type assigned.

The *FuelClassification.mdb* database contains a table *FuelClasses* with the classifications carried out to date. **This is not a complete classification and must be updated by appending classifications for new vegetation associations that may be present in subsequent study areas.**

The following fields relate to fuel quantity and fire spread models:

- *FireModel:* This identifies which fire of the 95Percentile layers will be used for that vegetation type when calculating the potential fire behaviour.
- *FM_Code:* The code assigned for raster calculations
- *Fuel_Type:* The fuel type to which the vegetation association has been assigned for calculation of fuel quantity.
- *FT_Code:* The code assigned to fuel type for raster calculation.

The codes relating to each fire model and fuel type are listed in the following tables

Fire Model Descriptors and Codes

FM_Model	***FM_Code***	***Application notes***
Rn	1	Pasture/Crop/Natural Grasses
Rcu	2	Grazed/cut pasture
Re	3	Eaten out pasture
Rn2	4	Natural Grass under woodland with 2:1 wind ratio applied
Rmh	5	Mallee Heath)

Rsh	6	Other Shrubland
HG	7	Hummock Grasslands (both hard and soft Spinifex)
NJ	8	Northern Jarrah (wind ratio is assigned according to densityj)
K45	12	Karri 4 / 5
K36	13	Karri 3 / 6
K12	14	Karri 1./ 2
SJ	15	Southern Jarrah
McA	16	Woodlands
LowSpread	17	Samphire, chenopds
NoSpread	18	Bare areas, water
Plntn	19	Plantations (FDInj is currently applied with "standard" fuels assumed)

Note: Codes 9-11 are not used. These were initially assigned to different wind ratio models for NJ. These are now assigned according to density in the fire behaviour calculations.

Fuel Type Descriptors and Codes

Fuel_Type	***FT_Code***	***General description of applicable types***
Banksia	1	Banksia woodlands
Bare	2	Clay pans, rocky areas, bare
Mallee Heath	3	Various mallee heat types
NJ	4	Northern jarrah, wandoo
Rn	5	Natural grasslands
Samph	6	Samphire and open chenopod

Wandoo	7	Wandoo woodlands and forest associations
Karri	8	All southern forest types
SoftSpinifex	9	Hummock grasslands containing predominantly "Soft" Spinifex species
HardSpinifex	10	Hummock grasslands containing predominantly "Hard" Spinifex species
Rcu	11	Cut, grazed pasture

Other Parameters

Density

Canopy cover is required to allocate the appropriate fire spread models to forest types.

Spinifex cover density is a required input for the hummock grassland fire spread model.

Both can be derived from remote sensing. The density layers used for the Pilbara and Mundaring study areas were provided by Graeme Behn from DEC's land Information Branch. The densities have not been thoroughly verified by field studies, but the classifications used appear reasonable. Further work is warranted to develop and test the density algorithm for different areas, as this provides the only practicable way to obtain canopy and/or ground cover.

If a cover density layer is not available, one must be created by assigning densities on the basis of vegetation maps, fuel age, and, for forests, cutting history. This is both time consuming and inaccurate.

Recommendation: The development of vegetation cover density algorithms (including field validation) be expanded to enable reliable cover maps to be produced for all areas of the State.

Vegetation Layers

The vegetation layers are used to identify the fuel accumulation and fire spread models to be applied at any point in the landscape.

In the current model the *Bush_Areas* layer is derived from the pre-European vegetation data (clipped to remnant vegetation in the SW). It does not take into account changes other than land clearing, and includes some areas that are no longer natural vegetation. The *Plantations* and *Water* layers identify such changes within the bush areas as well as in the cleared land.

Important note: to avoid errors all parameters to the model must have a valid data layer. The model identifies *C:\BFTA_DATA\Veg_Fuel Classification\NoPlantation.shp* as the default. This layer covers all WA, and has a null value. For areas where there are plantations, this is replaced with the appropriate plantation file.

Areas that are not natural vegetation, water, or plantation are assigned to grassland. Crops and pastures are not currently separately identified, and all pasture/crop has been assigned to the Rcu (Cut or grazed pasture) model.

Early investigations into the feasibility of using remote sensing to distinguish areas of crop from areas of pasture (Appendix 1) demonstrated the feasibility of doing so. The areas under crop vary annually, so this would require an annual update, which may not be warranted for broad scale strategic threat analysis. In areas subject to cropping, it would be more appropriate to use the Re (eaten out) model if the 95 percentile conditions are used, as these invariably occur after harvest time.

The *Water* layer identifies water bodies such as lakes and reservoirs and assigns a zero rate of spread to them. If there is no data available for any study area, the *NoPlantation.shp* should be assigned to provide null values.

Study_Area Layer

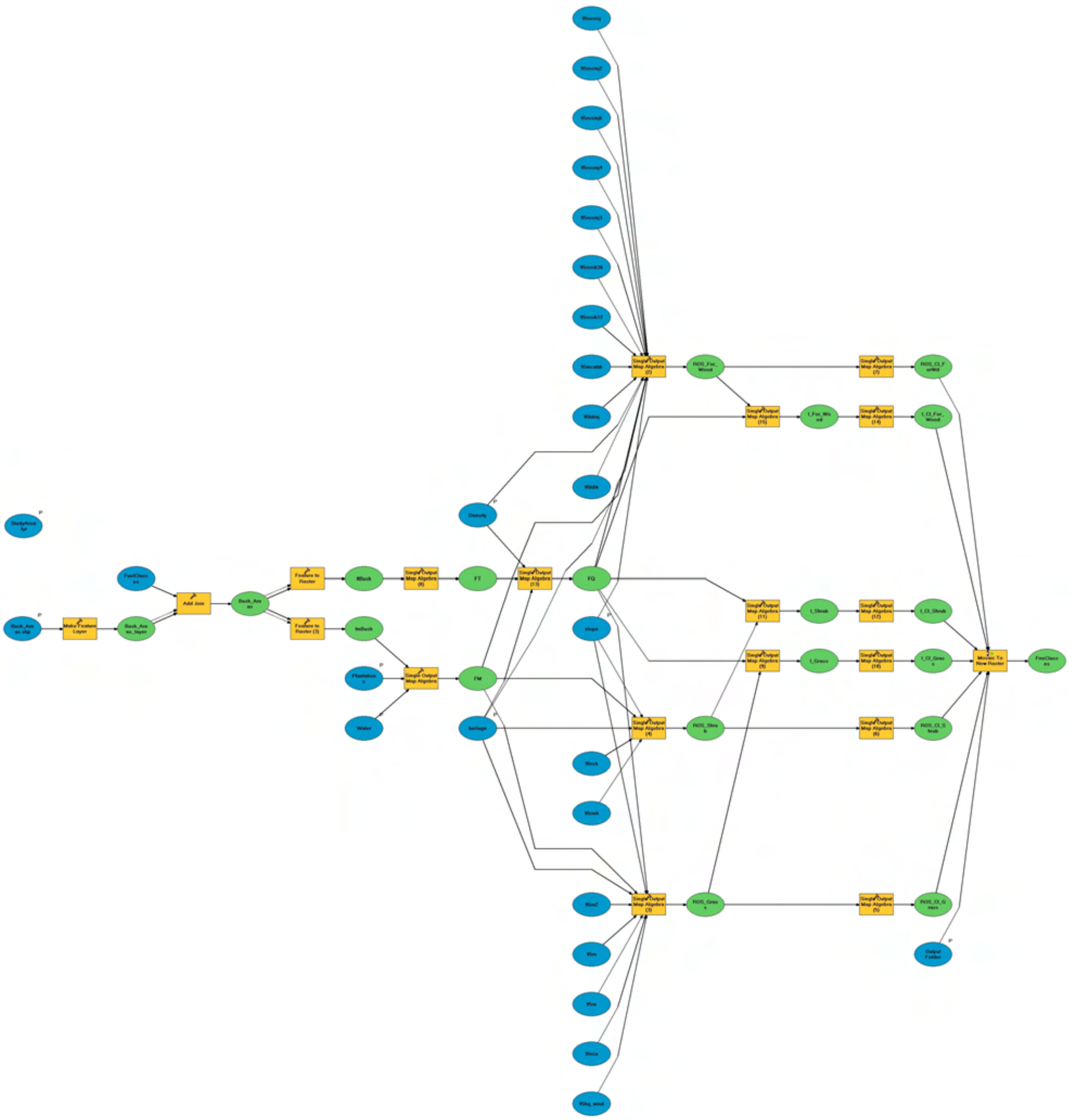
A Study Area layer must be created to define the area under consideration. This layer is used to define the extent and raster mask.

Output Location

The default location is \Workspace\BFTA_Themes, but any folder (directory) can be assigned. All the themes (Fire Behaviour, Suppression Response, Ignition Risk and Values,) must be located in the same directory.

Fire Behaviour Model

The overall fire model for fire behaviour is illustrated below. This is examined in more detail in the sections which follow.

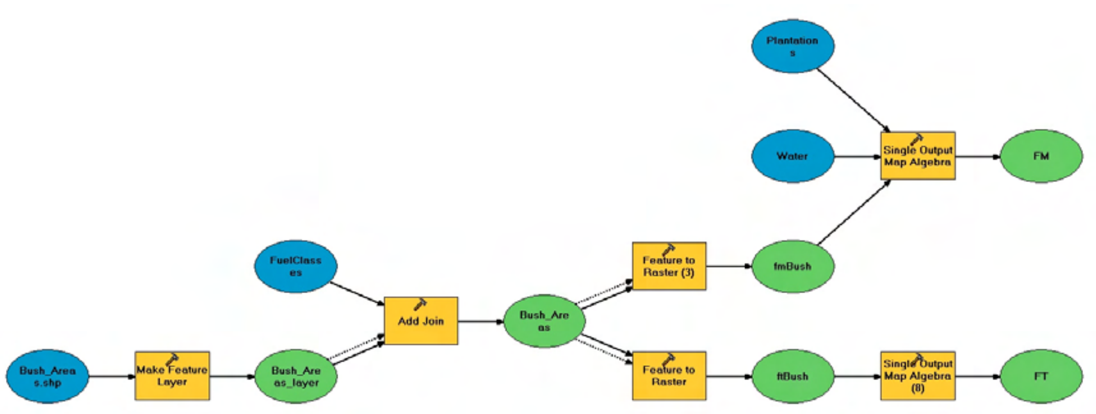


The fire behaviour model calculates the headfire ROS and fireline intensity, and produces a map layer for fire behaviour classified according to suppression difficulty.

If ROS or Intensity maps are required, the model can be partially run from the edit mode to produce these maps.

The processes and assumptions in the model are outlined below.

Creating FT and FM layers



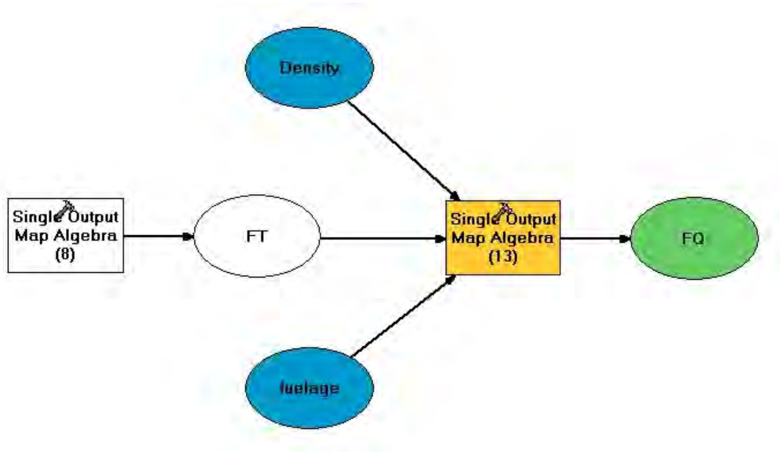
Bush_Areas is joined to the table *FuelClasses* (located in C:\BFTA_Data\Veg_Fuel Classification\FuelClassification.mdb) on the field *VEG_ASSOC*. This table contains the fields *FT_Co*de and *FM_Code*. A raster is created for each of these. This raster covers only the bush areas.

Conditional statements are used to create the FM and FT raster layers with values assigned to all areas, including null (non-bush) areas. For the FM calculation, the codes for "Plantation" and "No Spread" (for water areas) are assigned if these are present. The code for grasslands (Rn) is assigned to null areas.

"Water" and "Plantations" are parameters, but can be left set to any valid file (not necessarily covering the study area) if there are no water bodies or plantations in the study area, and the null value for those parameters will be automatically assigned.

Fuel Quantity Calculation

The fire spread relationships for forests developed by McArthur and those from the Forest Fire Behaviour Tables for WA require fuel quantity as an input. Fuel quantity is also required to calculate fireline intensity. Fuel accumulation relationships have been established for some (but not all) forest, eucalypt woodlands and shrubland. Many of these have been developed in higher rainfall types (eg Sydney sandstone heathland, eastern States open forest) and result in much higher fuel loadings than reported in WA. . Further work is required in many fuel types in WA, particularly in more arid woodlands and shrublands.



FT identifies the fuel accumulation expression to be used to calculate the fuel quantity value to be applied to a cell. Density is the vegetation cover (crown canopy or percentage of ground covered, dependant on vegetation type).

The following equations have been used to model fuel accumulation for the respective fuel types.

Wandoo

$Wt=(3.931 + 0.017 * CC^{1.475}) * (1-e^{(-0.105*FuelAge)})$

Where Wt = Fuel Weight (tonnes/ha)

CC = canopy cover (%)

Jarrah

$Wt=(8.896 + 0.566*CC^{0.766}) * (1-e^{(-0.087*FuelAge)})$

Karri/Southern Jarrah

$Wt=(27.044 + 0.159*CC^{1.198}) * (1-e^{(-0.0835*FuelAge)})$

The above equations were developed by non-linear regression of the respective accumulation tables in the Forest Fire Behaviour Tables for WA. (Appendix 2) These were used in preference to the equations developed by Peet (1971) as they provided a better fit to the data in the tables. The equations follow a "standard" fuel accumulation form, and are an alternative to the equations developed by Beck (1991). The results from these equations and those developed by beck are similar.

Mallee Heath (McCaw 1997, Plucinski 2003)

$Wt = (1 - e^{(-0.252 * FuelAge)}) * 13.31)$

Banksia: (Burrows et al 1989)

$Wt\ (total) = 7.36 * (1 - e^{(-0.345 * FuelAge)})$

For **Grass/Natural pasture (Rn)** a value of 4.5 tonne/ha is assigned, based on figures quoted in Luke and McArthur (1978).

For **Cut/Grazed grass (Rcu)** a value of 1.5 tonnes/ha is assigned

For **Eaten out pasture (Re)** a value of 0.5 tonnes/ha is assigned.

Spinifex (Hummock Grassland fuels) (Burrows et al 1999)

FF = 0.25 * [Cover] + 0.04 * Ht – 3.2

FQ = 0.98 * FF -0.08

Where FF is fuel factor

FQ is fuel weight tonnes/ha

There are no published relationships to model Spinifex height. Rate of growth is highly dependant of seasonal conditions following fires, and any estimate will have a high standard error. It is clear, however, that height does vary with fuel age, and it is not appropriate to assign an "average" value irrespective of age. The relationships developed by Conroy (see Plucinski 2003) for wet heath and dry heath appear to provide reasonable "average" values for soft Spinifex and hard Spinifex respectively, and have been used to provide a broad estimate of Spinifex fuel loading.

Soft Spinifex Ht = 0.634*(1-EXP(-0.794*[FuelAge])) (Conroy, Wet Heath)

Hard Spinifex Ht = 0.36*(1-EXP(-0.15*[FuelAge])) (Conroy, Dry heath)

The consolidated equations used are therefore:

Soft Spinifex

FQ_SoftSp = 0.98 * (0.25 * [Density_Clipped.ers] + 0.04 * 0.634*(1-EXP(-0.794*[FuelAge])) – 3.2) -0.08

Hard Spinifex

FQ_HardSp = 0.98 * (0.25 * [Density_Clipped.ers] + 0.04 * 0.36*(1-EXP(-0.15*[FuelAge])) – 3.2) -0.08

For fuel class **Samphire** a value of 0.2 tonnes/ha has been arbitrarily assigned.

For **Bare** areas a dummy value of 0.1 is assigned to avoid 0 in subsequent calculations

In the model, the fuel accumulation equations have been used in conjunction with a CON (IF) statement to provide a nominal (0.2 tonnes/ha) minimum value for areas less than 1 yo. This avoids null values that can result in errors in subsequent calculations using this as an input layer.

Cover density derived by Graeme Behn (DEC) from Landsat remote sensing data has been used for cover density. This has not been extensively field tested, but is the best currently available data. Remote sensing is the only practicable way of obtaining canopy cover over extensive areas. Where such data is not available, a value can be assigned according to vegetation association, but this will not take into account other changes such as reduction in canopy due to logging operations.

Headfire ROS and Fireline Intensity Calculation

Rate of Spread is calculated by correcting the 95 percentile ROSI for each fire model by correction factors for fuel parameters (fuel quantity, shrub height) and slope. The Single Output Map Algebra (SOMA) expressions for calculating ROS for each group are reproduced below with brief explanatory notes, where:

ROS = headfire rate of spread

ROSI = Rate of spread index ((5 percentile layer)

FQCF = Fuel Quantity Correction Factor. For the forest models, these are the equations developed by beck (1991) for the FFBT. For the McArthur model used for woodland fuels, the FQCF is that from Noble et al (1980).

SLCF = Slope Correction Factor. For all models except shrubland (Rsh), this is the relationship developed by McArthur, viz

SLCF = EXP (0.069 * [Slope])

For shrubland,

SLCF = EXP (0.035 * [Slope]) as per Catchpole et al (1999)

Intensity is calculated by the expression:

I = Hwr (Byram 1959)

Where I = fireline intensity

W = fuel weight

H = heat of combustion

R = rate of spread.

For natural fuels, where fuel weight is in tonnes/ha and rate of spread expressed in m/hr, this simplifies to

I = 0.47 * ROS * Fuel Wt

Forests and Woodlands

Expression	Comment
CON ([FM] == 8,	NJ fire model.
CON ([Density] < 5, [95ROSInj2] * (CON ([FQ] < 8.0 , 1.02 / (1 + 7266.33 * EXP(- 1.36 * [FQ])) + 0.1 , (6.03 + 5.81 * [FQ]) / 53.44)) * EXP (0.069 * [Slope]),	The 95 percentile ROSI layer is dependant on wind ratio, assigned as follows:.
CON ([Density] < 10,	Density < 5 use 2:1 Wind Ratio
[95ROSInj3] * (CON ([FQ] < 8.0 , 1.02 / (1 + 7266.33 * EXP(- 1.36 * [FQ])) + 0.1 , (6.03 + 5.81 * [FQ]) / 53.44)) * EXP (0.069 * [Slope]),	Density 5-10 use 3:1 wind ratio 10-20 use 4:1 20-30 use 5:1 >30 use 6:1
CON ([Density] < 20,	
[95ROSInj4] * (CON ([FQ] < 8.0 , 1.02 / (1 + 7266.33 * EXP(- 1.36 * [FQ])) + 0.1 , (6.03 + 5.81 * [FQ]) / 53.44)) * EXP (0.069 * [Slope]),	ROS = ROSI * FQCF * SLCF FQCF: only equations for SMC< 9 (Beck 1991) are programmed (for 95 percentile conditions). One of two FQCF is applicable, dependant on fuel quantity.
CON ([Density] < 30,	
[95FDInj] * (CON ([FQ] < 8.0 , 1.02 / (1 + 7266.33 * EXP(- 1.36 * [FQ])) + 0.1 , (6.03 + 5.81 * [FQ]) / 53.44)) * EXP (0.069 * [Slope]),	
[95ROSInj6] * (CON ([FQ] < 8.0 , 1.02 / (1 + 7266.33 * EXP(- 1.36 * [FQ])) + 0.1 , (6.03 + 5.81 * [FQ]) / 53.44)) * EXP (0.069 * [Slope]))))),	
CON ([FM] == 12,	K45
(CON ([FQ] < 17.0 , 0.95 / (1 + 957.74 * EXP(- 0.52 * [FQ])) + 0.16 , (5.08 +6.26 * [FQ]) / 111.5)) * [95FDIk] * EXP (0.069 * [Slope]),	ROS = (95FDIk) * FQCF * SLCF
CON ([FM] == 13,	K36
(CON ([FQ] < 17.0 , 0.95 / (1 + 957.74 * EXP(- 0.52 * [FQ])) + 0.16 , (5.08 +6.26 * [FQ]) / 111.5)) * [95ROSIk36] * EXP (0.069 * [Slope]),	ROS = (95K36) * FQCF * SLCF

CON ([FM] == 14,	K12
(CON ([FQ] < 17.0 , 0.95 / (1 + 957.74 * EXP(- 0.52 * [FQ])) + 0.16 , (5.08 +6.26 * [FQ]) / 111.5)) * [95ROSIk12] * EXP (0.069 * [Slope]),	ROS = (95K12) * FQCF * SLCF
CON ([FM] == 15,	SJ
(CON ([FQ] < 17.0 , 0.95 / (1 + 957.74 * EXP(- 0.52 * [FQ])) + 0.16 , (5.08 +6.26 * [FQ]) / 111.5)) * [95ROSIsj] * EXP (0.069 * [Slope]),	ROS = (95SJ) * FQCF * SLCF
CON ([FM] == 16,	McA
[95McAFDI] * 0.0012 * [FQ] * EXP (0.069 * [Slope]),	ROS = (95McA) * FQCF * SLCF
CON ([FM] == 19, [95FDInj] * EXP (0.069 * [Slope])	Due to lack of information, a standard 8 tonnes/ha is applied to pine, and the FQ layer is not used..
)))))))	

If more detailed data becomes available for plantations, the model could be modified using Beck's (9991) equations.

The study area did not include southern forest types, nor was a cover density layer available for this area. Further investigation is required, and it likely that the allocation to fire model can be done on the basis of density, as for northern jarrah. Alternatively, forest type maps may be used to allocate models. This data was not made available at the time of model development.

Grasslands

Expression	**Comment**
CON ([FM] == 1, [95Rn] * EXP (0.069 * [Slope]),	Slope corrected Pasture/Crop/Natural grass ROS. ROS = ROSI * FQCF There is no FQCF for grass
CON ([FM] == 2, [95Rcu] * EXP (0.069 * [Slope]),	Slope corrected cut/grazed pasture ROS
CON ([FM] == 3, [95Re] * EXP (0.069 * [Slope]),	Slope corrected eaten out pasture ROS
CON ([FM] == 4, [95Rn2] * EXP (0.069 * [Slope]),	Slope corrected ROS for grass under woodland with 2:1 wind ratio.

CON ([FM] == 7, (154.9 * [95HG_Wind] + 140.6 * [FQ] - 229.1 * 12) * EXP (0.069 * [Slope])	Spinifex fuels. The ROS equation is the same for both hard and soft Spinifex , (Burrows et al, 1999) but the rates of spread are differentiated by the fuel accumulation expressions. No attempt has been made to model PMC. A 12% profile moisture content has been assumed.
)))))	

Shrublands

Expression	Comment
CON ([FM] == 5,	Mallee Heath.
CON ([FuelAge] <3, 1, [95Rmh] * EXP (0.069 * [Slope])),	Negligible spread if burnt in last two years. (McCaw, pers comm.).
CON ([FM] == 6,	Shrublands
[95Rsh] * EXP (0.035 * [Slope]) * (POW((CON ([FuelAge] < 3, 1, (1 - EXP(- 0.323 * [FuelAge])) * 0.925)), 0.49)),	Note different slope function (0.035 cf 0.069) for shrub as per Catchpole et al. ROS = Rsh * SLCF * Shrub Ht CF. ShrubHt CF = H^c / H^c for 95Rsh As Shrub Ht was taken as 1 in calculating 95Rsh, ShrubHt CF = H^c can just apply the H^c direct ie $H^{0.49.}$ Height = (1 - $e^{(-0.323 * [Shrub\_Age])}$) * 0.925) (Plucinski 2003) See note on shrub height below. A value of 1 is assigned for fuel age 2 or less.
CON ([FM] == 17,	LowSpread
0.1 * 95Rsh] * EXP (0.035 * [Slope]) * (POW((CON ([FuelAge] < 3, 1, (1 - EXP(- 0.323 * [FuelAge])) * 0.925)), 0.49)),	10% of shrub spread assumed. Most low spread areas are scattered low shrubland.

CON ([FM] == 18, No Spread

0

))))

ROS and Intensity Classification

The ROS and Intensity for each fire model are separately classified, and then combine into a single map layer. The classification is as per the table below:

HEADFIRE BEHAVIOUR CLASSES
1 Readily suppressed. Intensity < 800 kW/m and/or ROS < 60 m/hr in all fuels
2 Hand tool attack possible Intensity < 800 kW/m and/or ROS < 140 m/hr) in forest/woodland and shrubland Intensity < 800 kW/m and/or ROS < 300 m/hr in grassland
3 Direct machine and tanker attack possible Intensity < 2000 kW/m and/or ROS < 400 m/hr in forest/woodland Intensity < 2000* kW/m and/or ROS < 1000 m/hr in shrubland Intensity < 5000 kW/m and/or ROS < 6500 m/hr in grassland
4 Direct attack not possible/unlikely to succeed. Intensity > 2000 kW/m and/or ROS > 400 m/hr in forest/woodland Intensity > 2000* kW/m and/or ROS > 1000 m/hr in shrubland Intensity > 5000 kW/m and/or ROS > 6500 m/hr in grassland
5 Indirect attack likely to fail Intensity > 4000 kW/m and/or ROS > 800 m/hr in forest/woodland Intensity > 8000 kW/m and/or ROS. 2000 m/hr in shrubland ROS > 10000 m/hr in grassland

CONSEQUENCES

Values Classification

Values vulnerable to damage by bush fires include both market and non-market values. Traditionally these have been difficult to compare, and none of the many methods applied to assign commercial values to non-market benefits have met with universal success. For the BFTA, no attempt has been made to assign market prices to non-market values (although such amounts may be broadly inferred). Instead, values are assigned to one of six broad categories based on the likely consequences if damaged/destroyed by fire, using the table below as a guide.

The values present can vary greatly according to location. As new values are identified and decisions made re appropriate classification, this table should be expanded to incorporate those values and provide guidance for future consistent classification.

This current table is based on the classification previously developed for fire threat analysis on DEC managed lands (Muller 1993, 2001). The table includes feedback from participants at workshops held at Northam, Merredin and Hyden during the preparation of the Avon BFTA. Unfortunately there was a very poor response to those workshops and whilst there was general agreement to the classification little additional information was obtained, despite the table being circulated to participants for their further consideration and discussion with others.

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
6 CATASTROPHIC	**SPECIES EXTINCTION**	**ONE OR MORE FATALITIES**	**DAMAGE > $10,000,000**	**ONE OR MORE FATALITIES** **PERMANENT TOTAL INCAPACITY** **EXTENSIVE DAMAGE > $10,000,000**
	Only known occurrence of fire vulnerable threatened species or ecological community. Fire likely to result in extinction.	Areas with high risk of fatalities in event of bushfire.		Settlements, rural residential and special rural subdivisions with native vegetation, poor access, no reticulated water. Does NOT include larger urban areas with maintained gardens, ovals and structures for refuge and therefore a low risk to life.
		Camping areas with high fire season populations, restricted egress, no refuge area. (eg Murray Valley). Does NOT include areas where adequate refuge exists (eg beachside such as Hamelin Bay) or rapid escape/evacuation possible.		Hospitals and schools in bush settings
		High visitation recreation sites with dead end access and no refuge.		Public buildings in bush area used daily, access for suppression and evacuation poor.

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
5 MAJOR	**LOCAL EXTINCTION.** **MAJOR REDUCTIONS IN TOTAL POPULATIONS OF VULNERABLE SPECIES OR COMMUNITIES**	**PERMANENT DISABILITY / SERIOUS INJURY.**	**EXTENSIVE DAMAGE $5 - $10 MILLION**	**PERMANENT DISABILITY / SERIOUS INJURY.** **EXTENSIVE DAMAGE $5 - $10 MILLION**
	Priority 1 species or ecological communities. Risk of local extinction if burnt.	Major recreation/tourist areas) with good access, but sheer numbers pose a risk to life in event of fire. (eg Tree Top Walk, Boranup and Gloucester National Parks)		Vulnerable essential utilities (regional power, water, gas supply)
	Only known occurrence of fire vulnerable priority 2 species.	Popular long distance walk tracks & mountain bike trails		Rural/residential and special rural subdivisions, poor access, reticulated, regular fuel modification.
	Severely under-represented fire seral stages of communities with vulnerable species.			Public buildings with daily use access good, or weekly use access for suppression and evacuation poor.
	Severely under-represented structural types.			Built up areas
	Declared flora: IUCN critical			Fire vulnerable railway infrastructure with potential long term disruption (eg wooden bridges).

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
	Critically Endangered fauna			Remote communities/settlements with no fire services, significant infrastructure values.
4 SERIOUS	**LOCAL EXTEINCTIONS OF POORLY KNOWN SPECIES** **MAJOR REDUCTION IN LOCAL EXTENT OF VULNERABLE SPECIES OR COMMUNITIES**	**PERMANENT LOSS OF REGISTERED HERITAGE VALUES** **DAMAGE $100,000 TO $1,000,000**	**DAMAGE $1,000,000 TO $5,000,000**	**DAMAGE $1,000,000 TO $5,000,000** **PERSONAL INJURY (LTA)**
	Fire vulnerable endangered, vulnerable and priority 2 species or ecological communities.	Fire vulnerable registered heritage sites	Pine plantations >100ha 8-20 yrs old.	Rural residential subdivisions, multiple access, reticulated, fuel modification..
	P1 species not known to be fire sensitive	Fire vulnerable registered Aboriginal sites	Consolidated Karri regrowth >1000ha, 5-30 yrs old	Public buildings, monthly use access good
	Long established (>15yrs) research/ monitoring plots and scientific reference areas to be kept fire free.	Major infrastructure		Public utilities, pumping stations, etc
	Area significant to the maintenance of overall structural diversity, species richness	Infrastructure posing significant environmental threat (eg bulk chemical storage).		High voltage distribution carriers
	Under-represented structural types eg old growth forest			
	Threatened species habitats			

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
	Declared flora: IUCN endangered			
	P1 flora			
	Threatened Ecological Communities			
	Endangered fauna			
	Threatened Fauna P1 & P2			
3 MODERATE	**LOSS OF PRIORITY SPECIES** **LOSS OF HABITAT/SPECIES DIVERSITY**	**DAMAGE $100,000 TO $1,000,000**	**DAMAGE $1,00,000 TO $1,000,000** **LONG LIVED CROPS** **HIGH VALUE ANNUAL CROPS**	**DAMAGE $100,000 TO $1,000,000**
	IUCN vulnerable and P2 flora not known to be fire sensitive	Harnessed catchments with erosion susceptible soils	Small (<100ha) pine and eucalypt plantations	Communications repeaters, masts and towers
	Declared endangered flora: IUCN critical & P2	Short term research/monitoring plots to be kept fire free	Other plantation areas (including oil mallee) not included elsewhere.	Scattered houses/buildings
	Vulnerable fauna		Orchards, vineyards, olive groves	Fire vulnerable railway infrastructure, short term impact
	Populations of known fire vulnerable priority 3 species and ecological communities		Consolidated Karri regrowth <50 years old	Transmission lines, steel towers (serious damage unlikely, but short term interruption to supply possible)
	Areas of regionally significant species richness, structural diversity		Consolidated Jarrah regrowth 5-20 yo.	
	Regionally under-represented seral stages or structural type		Intensive animal production	
			High value annual crops	

GUIDE TO CLASSIFYING VALUES FOR BUSH FIRE THREAT ANALYSIS based on likely consequences if burnt				
CONSEQUENCE	**BIODIVERSITY CONSERVATION**	**RECREATION/LANDSCAPE/ENVIRONMENT**	**PRIMARY PRODUCTION**	**COMMUNITY PROTECTION**
2 MINOR	**LOSS OF LOCALLY SIGNIFICANT SPECIES OR ECOLOGICAL COMMUNITIES**	**$10,000 TO $100,000**	**$10,000 TO $100,000**	**$10,000 TO $100,000**
	Locally significant species, communities	Recreation infrastructure	Developed farmland/pasture	Low voltage distribution carriers
	Priority 3 species: fire sensitivity unknown		Apiary sites	
	Priority 4 & 5 (conservation dependant) species or communities			
1 INSIGNFICANT	**<**	**< $10,000**	**< $10,000**	**< $10,000**
	Other native vegetation	Minor infrastructure	Other values not listed	

Data Sources

The WALIS/CALM/DEC databases contain only limited data that can be extracted to identify values and assign them to classes based on likely consequence. Much of the data that does exist is out of date, inaccurate, and has insufficient attribute data to permit accurate classification. Whilst best use has been made of existing data in the models that follow, local knowledge is required to collate additional relevant information for any study area for which a BFTA is undertaken.

A summary of data sources used and investigated follows. Details of the selection and consequence class assigned are discussed in the description of the models.

CALM/DEC Corporate Data (including WALIS Data)

Apiary Sites:
V:\GIS1-Corporate\Data\CALM_Operations\apiary_sites.shp

Aboriginal Sites:
V:\GIS1-Corporate\Data\Sensitive_Sites\aboriginal_sites.shp

Built-up Areas:
V:\GIS1-Corporate\Data\Geodata\Infrastructure*DECRegion*\builtup_areas.shp

Buildings:
V:\GIS1-Corporate\Data\Geodata\Infrastructure*DECRegion*\buildings.shp
This database was noted to be out of date and highly inaccurate, at least for the Pilbara where the author has personal knowledge. Many buildings shown on the database no longer exist (including whole communities such as Shay Gap) and others (including known Aboriginal communities) are missing. Only "operational" buildings are selected, however, unlike the VGO database (see below), the WALIS information does not distinguish between building types. All buildings are classified as "isolated buildings" as the default classification. The building database is also used in conjunction with the cadastre (SCDB) and Vegetation Mask to identify bush subdivisions, which have a higher classification. The highest classification is the value applied when the rasters are mosaicked.

Bush Areas:
V:\GIS1-Corporate\Data\Vegetation\Remnant*DEC_Region*\vegmask.shp
Used in the identification of bush subdivisions.

Heritage Sites:
V:\GIS1-Corporate\Data\Sensitive_Sites\heritage_commission_sites.shp

Masts and Towers:
V:\GIS1-Corporate\Data\Geodata\Infrastructure*DECRegion*\utility_points.shp

Endangered Flora:
V:\GIS1-Corporate\Data\Flora\State\DEFL.shp

Threatened Ecological Communities

Threatened Fauna
V:\GIS1-Corporate\Data\Fauna\state\threatened_fauna.shp

Low Voltage Carrier:
V:\GIS1-Corporate\Data\
Man_Made_Structures\Western_Power\Dist_low_voltage_carrier_line.shp

High Voltage Carrier:
V:\GIS1-Corporate\
Data\Man_Made_Structures\Western_Power\Dist_High_Voltage_Carrier_line.shp

Transmission Lines:
V:\GIS1-Corporate\Data\Geodata\Infrastructure*DECRegion*\power_lines, V:\GIS1-Corporate\Data\Man_Made_Structures\Western_Power\Trans_line_overhead_only_line.shp

Communications Repeaters:
V:\GIS1-Corporate\
Data\Man_Made_Structures\Communications\CALM\communications_repeater_stnions.shp

Recreation Sites:
There is no recreation data in the corporate GIS data supplied. An interim copy of the RATIS database was used, plus some data from the Pilbara. The RATIS database is incomplete and has not been quality checked. There is no information on camping grounds or other recreation sites not on CALM/DEC lands. This is a serious omission for the BFTA, as some popular bush camping sites on private land could be at risk.

Plantations:
V:\GIS1-Corporate\Data\Plantation\State\plantation_annual_report.shp

Railway Points:
V:\GIS1-Corporate\Data\Geodata\Infrastructure*DECRegion*\railway_points.shp.
Whilst bridges and other points are identified, there is no information on materials that would allow an assessment of fire vulnerability to be made. Except for the first study area (Avon) no points were identified, as it is assumed that infrastructure would be steel and unaffected by bush fires.

State Cadastral Database:
V:\GIS1-Corporate\Data\Tenure\scdb*DEC_Region*\scdb.shp
This is used to identify land parcels for the Bush Subdivisions layer.

DAFWA Data

The file LandUseByShire_llgda.shp was provided by the Department of Agriculture and Food (DAFWA). This was used to identify cropping areas, intensive animal production, horticulture and non-FPC (Forests Products Commission) plantations.

Industry Sources

Particularly outside the SW Land Division, many of the major assets at risk are owned by large companies, particularly resource companies. During the recent boom, many new mining areas and associated infrastructure (including accommodation areas) have been developed. Some of these “at risk” areas such as exploration and construction camps, albeit they may be substantial, can have only a relatively short life but during this period may be at risk from natural events (as demonstrated by the deaths at the FMG rail construction camp in 2007).

Because of the rapid changes taking place, only the companies themselves are likely to have current digital data. For the Pilbara study area, some data was obtained from Rio Tinto (see *\Pilbara\Values\Rio Tinto)* through personal contact, although other information requested was not received. To prepare and maintain current any BFTA needs accurate and up-to-date information. It is recommended that FESA liaise with DOIR regarding annual updates for the WALIS database.

Recommendation: Procedures be established for annual update of industry infrastructure (including camps and other areas at risk) in to the WALIS database.

VGO Valuations.

Discussions were held with the Office of the Valuer general regarding the potential for use of data maintained by them for the values classification for the BFTA.

The VGO advises the only raw data from their comprehensive database they can release is recent sales data. They would be bale to provide a broad estimate of insurance replacement cost for properties, but the cost of this would be $6.77 per estimate. As there are 21,320 active land parcel IDs, including around 17,000 houses, in the Mundaring study area alone, the cost of this would be prohibitive, particularly if the BFTA is to be periodically updated.

The VGO database does include a field identifying property type, as follows:

AGED UNITS	COLLEGE	FACTORY UNITS
AMBULANCE DEPOT	COMMUNITY CENTRE	FARM
ART GALLERY	CONCRETE BATCH	FARM - RESIDENCE
BAKERY	CONVENT	farming land
BANK	COTTAGE	FASTFOOD OUTLET
BUSHLAND	DAM	FIRE STATION
BUSINESS - RESIDENCE	DAYCARE CENTRE	FLAT
CAR PARK	DENTAL SURGERY	FLATS
CAR YARD	DEPOT	FUNCTION CENTRE
CARAVAN PARK	DISUSED BUILDING	GARAGE
CATCHMENT	DRAIN	GOLF COURSE
CENTRE	DRAIN RESERVE	GROUP HOUSE
CHURCH	DUPLEX	GROUP HOUSES
CHURCH - MANSE	DUPLEX UNIT	HALL
CIVIC CENTRE	EXCHANGE	HARDWARE
CLINIC	FACTORY	HEALTH CLINIC
CLUB	FACTORY - RESIDENCE	HOSPITAL
COLD STORE	FACTORY UNIT	HOSTEL

HOTEL
HOUSE
HOUSE - BUSINESS
HOUSE - COTTAGE
HOUSE - FARM
HOUSE - FLAT
HOUSE - GALLERY
HOUSE - GRANNYFLAT
HOUSE - LAND
HOUSE - MARKET GARDEN
HOUSE - NURSERY
HOUSE - ORCHARD
HOUSE - SHED
HOUSE - STABLE
HOUSE - VINEYARD
HOUSE - WORKSHOP
HOUSE & STUDIO
HOUSES
KENNELS - RESIDENCE
KINDERGARTEN
LIBRARY
LIQUOR STORE
MANSE
MARKET GARDEN - RESIDENCE
MEDICAL SUITES
MILL
MOTEL
NURSERY
NURSERY - RESIDENCE
NURSING HOME
OFF/RES BLDG
OFFICE
OFFICE - FACTORY
OFFICE - STORE
OFFICE - WAREHOUSE
OFFICE - WORKS
OFFICE - WORKSHOP
OFFICES
ORCHARD
ORCHARD - RESIDENCE
P.A.W.
PAD MOUNT SITE
PAD MOUNT TRANSFORMER
PADDOCK
PADDOCKS
PARK
PHYSIO
PIPE LINE
POST OFFICE
POULTRY FARM
PRIMARY - PRE PRIMARY
PRIMARY SCHOOL
PSYCH HOSTEL
PUBLIC HALL
PUBLIC RECREATION
PUMP STATION
QUARRY
QUARTERS
REGIONAL PARK
RESERVE
RESERVOIR
RESORT - COMPLEX
RESTAURANT
RETAIL STORE
RETIREMENT VILLAGE
ROAD RESERVE
ROADHOUSE - RESTAURANT
ROADHOUSE - TAVERN
SALE YARD
SCHOOL
SCHOOL - CHURCH
SERVICE STATION
SERVICE STATION - RESIDENCE
SERVICE STATION - SHOP
SEWERAGE INFRASTRUCTURE
SEWERAGE WORKS
SHED
SHED - LAND
SHOP
SHOP - RESIDENCE
SHOP - STORE
SHOP - WAREHOUSE
SHOPPING CENTRE
SHOPS
SHOWROOM - FACTORY
SHOWROOM - WAREHOUSE
SHOWROOM - WORKSHOP
SPORTS PAVILION
SQUASH COURTS
STABLES
STABLES - RESIDENCE
STORAGE TANK
STORE
STOREROOM
STUDIO
SUB STATION
SUPERMARKET
SUPERSEDED CHURCH HALL
SURGERY
SURGERY - RESIDENCE
TAB AGENCY
TAVERN
TENNIS CLUB
THEATRE
TOILETS
TRANSFORMER
TRANSPORTABLE HOME
TRIPLEX
TV TRANS
VACANT LAND
VET - RESIDENCE
VET HOSPITAL
VET SURGERY
VILLA HOUSE
VILLA HOUSES
WAREHOUSE
WAREHOUSE - RESIDENCE
WATER SUPPLY
WATER TANK
WATER TOWER
WILDLIFE PARK
WINERY
WORKSHOP
WORKSHOP - RESIDENCE
YARD

If the State Cadastral Database (SCDB) available through WALIS included this field with the land parcels, it would permit improved classification into the broad value classes used in the BFTA. Whilst identification of property type would not appear sensitive information, the VGO advise that even this is considered "protected" and cannot be released (without Ministerial approval).

Recommendation: To enable improved identification of potential consequences, FESA seek the inclusion of the VGO property type identification as a field in the SCDB.

Models

There is considerable variation in the values present, the data available, and data sources, for different parts of the State. Whilst a model has been developed that will allow for many variations through the user interface, modifications will be required as improved data sets become available.

The Values model has been split into several models because:

- The separate models facilitate incorporating data from different sources and different formats. Data can be pre-processed to make it compatible with the Values model.

- There is a bug in the ArcGIS 9.2 software that prevents a model running in some circumstances (ESRI Nimbus Id: NIM006497). This bug affects the processing to identify and classify values. By splitting the models the bug has been isolated to data preparation models that only need to be run once for the State whenever the data is updated. These models can be run in the Edit mode with manual intervention (as outlined in the model). The Values model is then not affected. (This bug will be fixed in 9.3).

The Data Prep Toolset

The models in the Data Prep Toolset must be run before any of the other models in the Values toolset. Due to the bug in 9.32, these models must be run in the edit mode. They will fail to execute the merge function, but running the model again from that point whilst still in the edit mode will complete the process. These models select multiple classes from a single attribute table, and assign the results to the relevant value class.

Agricultural and Horticultural Values

The model *Create Agricultural and Horticultural Valuesclasses file (State)* selects from the DAFWA land use database the following areas, and assigns them to value classes.

Land Use	Value Class
cropping areas	2
intensive animal production	3
improved pasture	2
horticultural areas	3

Pastoral/unimproved grazing has not been selected as the value class for this is the same as the default value applied where no higher value has been identified.

As noted in the Fire Behaviour model, more precise information on crops could be obtained through remote sensing (See Appendix 1).

Create Agricultural and Horticultural Valuesclasses file (State)

Plantations

The *Create Plantation Values file (State)* model accesses the FPC annual report database, and the DAFWA LandUseByShire database to select and assign values as follows:

Selection	Value Class
DAFWA "SLU_DESC" = 'Plantation forestry'	3
FPC Pines > 8yo >100ha	4
FPC other plantations	3

As the DAFWA attribute table does not provide details on species or age of plantations, all DAFWA plantations have been assigned to "other plantations" values group.

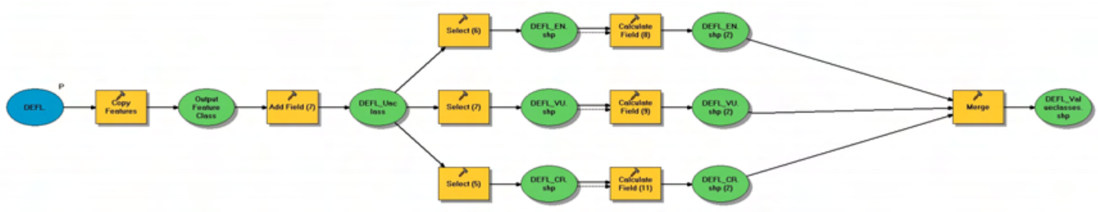
Create Plantation Values file (State) model

Declared Flora Values

The classification of values as per the guidelines requires some knowledge of fire response/vulnerability for accurate classification. DEC was unable/unwilling to provide any information regarding the vulnerability of the flora indicated as being present at the sites identified in their "public' database. The custodian was also not prepared to provide further information such as species present which may have enabled an improved classification without charging for the information (albeit it is for DEC's benefit) and confirmation of the requirement from Fire Management Services. The request was passed on to Fire Management Services, but no data was provided.

In the absence of further information, declared flora has been assigned to classes as follows:

Selection	Value Class
"IUCN_Rank" = 'EN' or "CONSVCODE" = '1'	4
"IUCN_Rank" = 'VU' or "CONSVCODE" >= '2'	3
"IUCN_Rank" = 'CR'	5

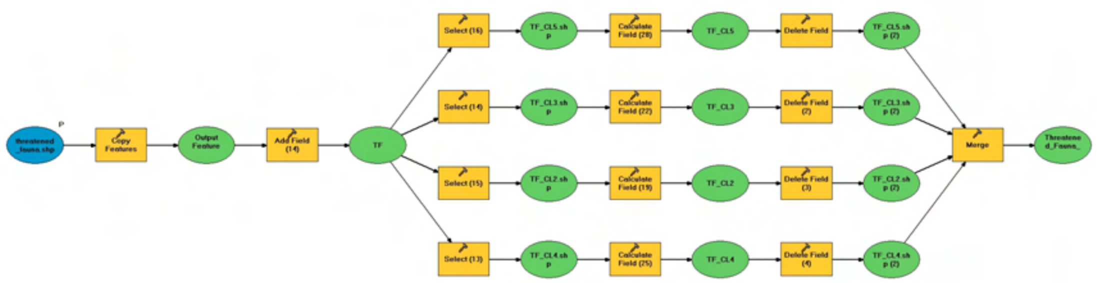


Create DEFL Classes File (State) model

Threatened Fauna

The *Create Threatened Fauna valueclasses file (State)* model selects and assigns values as follows:

Selection	Value Class
"IUCN" = 'Critically Endangered'	5
"IUCN" = 'Endangered' OR "WA_LIST" = 'Priority One: Taxa with few, poorly known populations on threatened lands' OR "WA_LIST" ='Priority Two: Taxa with few, poorly known populations on conservation lands'	4
"IUCN" = 'Vulnerable'	3
"WA_LIST" = 'Priority Three: Taxa with several, poorly known populations, some on conservation lands' OR "WA_LIST" = 'Priority Four: Taxa in need of monitoring' OR "WA_LIST" = 'Priority Five: Taxa in need of monitoring (conservation dependent)'	2



Create Threatened Fauna valueclasses file (State) model

Prepare Inputs Model

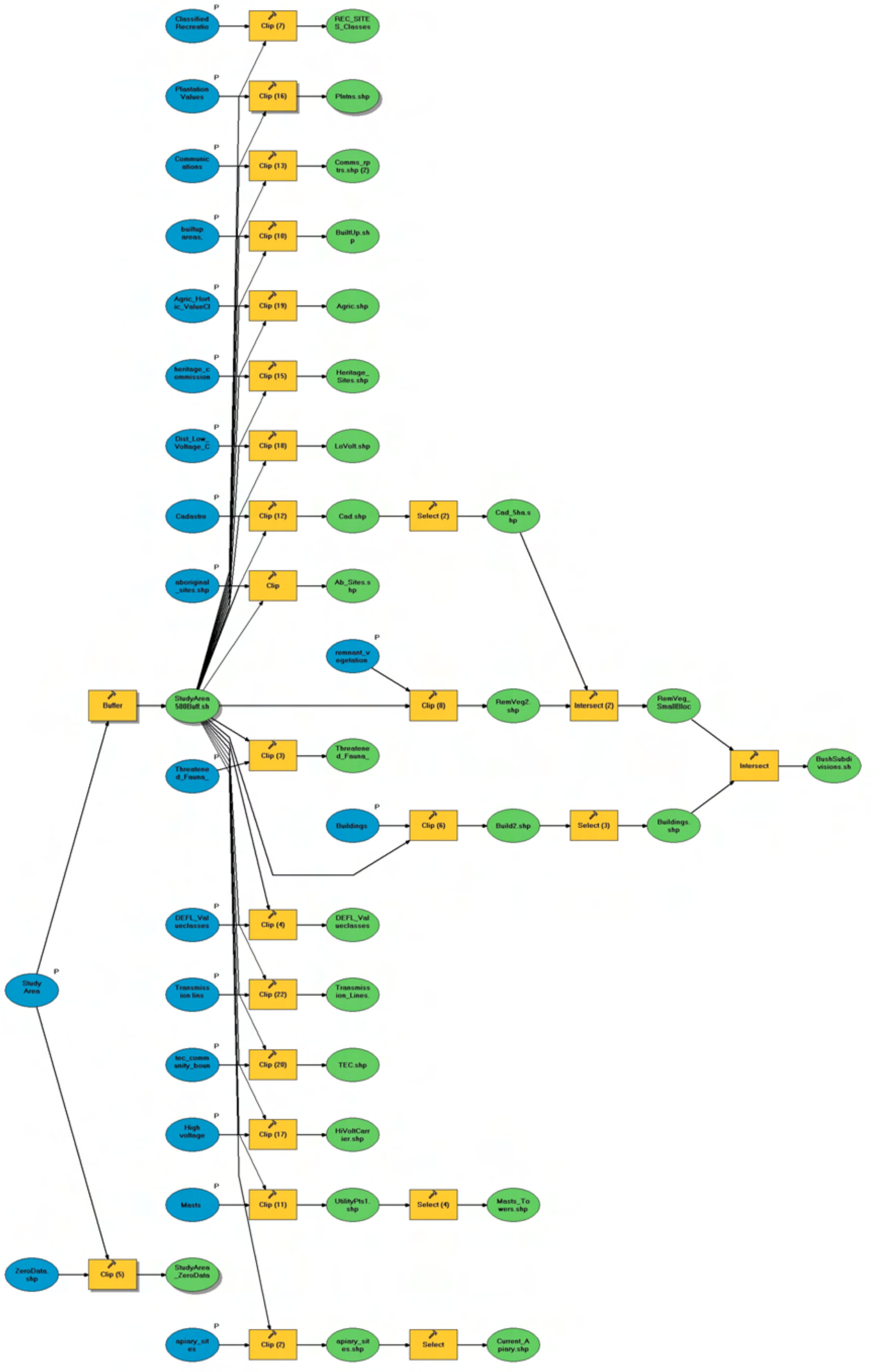
The *Prepare inputs for Values Model* model:

- Clips the inputs from the relevant files to the study area analysis extent (1km larger than the study area boundary).
- Selects the current apiary sites to create a relevant input
- Prepares the Masts and Towers input by selecting these from the Utility_Points file.
- Prepares the Bush Subdivision layer by identifying all bush blocks less than 5 ha that have a building on them.
- Creates the StudyArea_ZeroData.shp file to substitute for any inputs where there is no current data. Note that this file is clipped to the study area boundary, not the

larger analysis extent boundary. This is because when substituted for other files a buffer is created, and this buffer must be within the analysis extent for the model to execute. If the StudyArea_ZeroData is clipped to the extent boundary, the subsequent buffer would lie outside the extent.

This model provides the framework for inputs that ensure the Values model will run, and simplifies identification of inputs where there is no current data. Whilst the default data sources are the DEC Corporate Data, any data sources can be used, and data from different sources can be first be merged to create any of the inputs.

The multiple outputs from this model (one for each value) are saved to disk (*BFTAWorkspace\Values)*, so they can be readily loaded into ArcMap. Note that these files will be overwritten next time the model is run, so if it is wished to retain them they should be transferred to another folder.



Model: Prepare inputs for Values Model

Values Model

The *Values* model uses as inputs the outputs from the *Prepare Inputs for Values Model* model. It creates the Values raster as follows:

- For the following inputs, checks for the presence of the Value_Class field(which would be present if the StudyArea_ZeroData file is the input). If not present, it adds the field and assigns the appropriate value as indicated in parentheses

  - Current Apiary Sites (2)
  - Heritage Sites (4)
  - Communications Repeaters (3)
  - High Voltage Carrier (4)
  - Lo Voltage Carrier (2)
  - Transmission Lines (3)
  - Masts and Towers (3)
  - Buildings (3)
  - Bush Subdivisions (5)
  - Threatened Ecological Communities (4)
  - Aboriginal Sites (4)
  - Built up areas/Settlements (5)

  (Declared flora, threatened fauna, agricultural/horticultural, plantations and recreation sites are assigned to value (consequence) classes in the preparatory models outlined above.)

- With the exception of Aboriginal sites (which are already buffered in the database), creates a 500m buffer around all values based on the values assigned. This buffer is applied both so they are visible when mapped, and because it is considered that under 95 percentile weather conditions any fire within 500m poses a threat to the value.

- Mosaics to a new raster. Where buffered value zones overlap, the highest value is assigned.

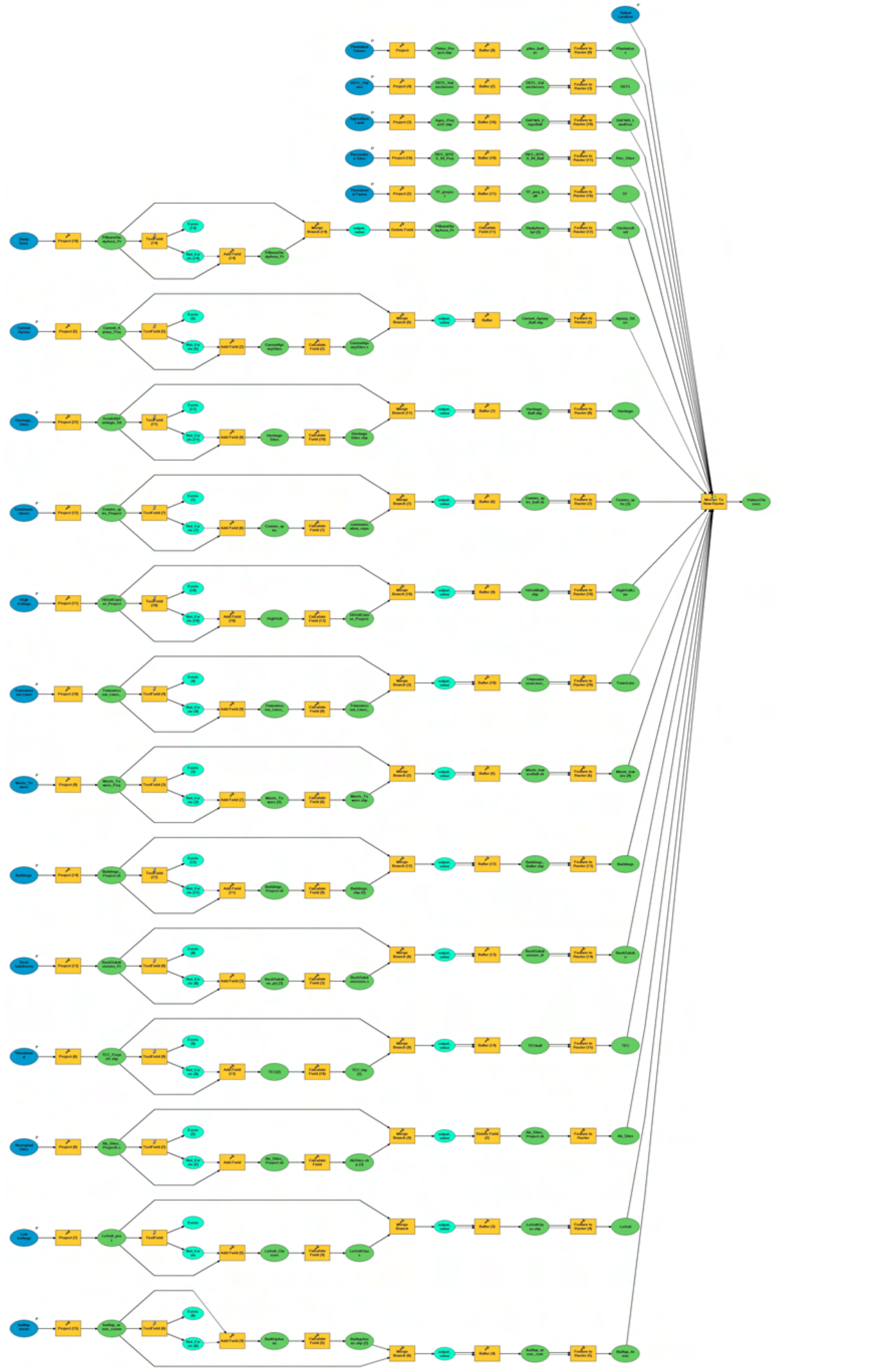
No class 6 values have been identified in the model. It is likely such values exist in the Mundaring study area, however the current databases do not permit these to be identified. If an estimate of property values (or even identification of property type, to which a value could be broadly assigned by class type) was available from the VGO, category 6 values could be identified by creating a "$ value density layer" (similar to the fire records density layers) intersected with bush areas.

Note: It is essential that all input files contain data within the study area analysis extent, or the mosaic to raster will fail to execute. Where a parameter has no valid data, the *StudyArea_ZeroData.shp* file should be substituted.

The *Values* model is best run from within ArcMap. The default location for input data in the model is the current map document. If the contents of the *BFTAWorkspace\Values* folder are displayed in ArcMap after the *Prepare inputs for Values Model* model is executed, empty data sets can be readily identified, and removed from the view. The missing data that requires the StudyArea_ZeroData file to be substituted in the *Values* model will then be readily apparent when this model is run from the Toolbox.

For the inputs outlined in dot point 1 above, the model will accept source files other than those resulting from the *Prepare inputs for Values Model* model, however such files **MUST** contain valid data within the study area analysis extent. To reduce the risk of no data present, it is strongly recommended that all inputs are first clipped to this analysis extent (as occurs in the *Prepare inputs for Values Model* model) and the attribute table checked for valid data.

The resultant Values raster file provides the Consequence input for the Bush Fire Threat model.



Values Model

REFERENCES

Beck J.A., 1995: *Equations for the Forest Fire Behaviour Tables for Western Australia.* CALMScience Vol 1 No 3 Pp 325-345

Burrows, N D and McCaw W L 1989 *Fuel Characteristics and Bushfire Control in Banksia Low Woodlands in Western Australia* Jouirnal of Environmental management Vol 31 No 3 pp 229-236

Burrows, N., Ward, B. and Robinson, A. 1999. *A guide to predicting fire behaviour and to patch burning in hummock grasslands: version 2.* Department of Conservation and Land Management, Western Australia.

Catchpole, W.R., Bradstock, R.A., Choate, J., Fogarty, L.G., Gellie, N., McCarthy, G.J., McCaw, W.L., Marsden-Smedley, J.B. and Pearce, G. (1999) *Cooperative development of predictive equations for fire behaviour in heathlands and shrublands.* In 'Proceedings of the Australian Bushfire Conference.'Albury, July, 1999.

Cheney NP, Gould JS, Catchpole WR 1998: *Prediction of Fire Spread in Grasslands.* Int J of Wildland Fire 8(1): 1-13

Durre A M and Beer T 1989: *Wind Information Prediction Study: Annaburoo Meteorological Data Analysis.* CSIRO Division of Atmospheric Research Technical Paper 17.

Luke R H and McArthur A G (1978): *Bushfires in Australia.* AGPS. ISBN 0 642 02341 7

McArthur, A.G. (1962) *Control burning in eucalypt forests.* Commonwealth of Australia Forest and Timber Bureau Leaflet, 80.

McCaw W L 1997 *Predicting fire spread in Western Australian Mallee- heath shrubland.* PhD Thesis. School of Mathematics and Statistics, University College, UNSW.

Muller C, 1993: *Wildfire Threat Analysis Manual for lands managed by the Department Of Conservation and Land Managemeno* Unpublished report, CALM WA

Muller C, 2001:*A review of fire operations in forest regions managed by the Department of Conservtion and Land Management. Conservation and Land management*

Noble J R, Bary G A V & Gill A M 1980 *McArthur's fire danger meters expressed as equations.* Aust, Journal of Ecology 5 Pp 202-203

Peet G B 1971 *Litter Accumulation in Jarrah and Karri Forests* Australian Forestry

Plucinski M P 2003 *The Investigation of Factors Governing Ignition and Development of Fires in Heathland Vegetation* PhD Thesis School of Mathematics and Statistics, UNSW, ADFA

Sneeuwjagt, R.J. and Peet, G.B. (1985*) Forest Fire Behaviour Tables for Western Australia.* (3rd Ed.)Department of Conservation and Land Management, Perth.

Viney, N. R and T. J. Hatton. 1989. *Assessment of existing fine fuel moisture models applied to Eucalyptus litter*. Australian Forestry 52: 82-93.

Viney, N. R. 1991. *A review of fine fuel moisture modelling*. International Journal of Wildland Fire 1: 215-234.

Viney, N. R. 1992. *Modelling fine fuel moisture content*. Unpublished Doctoral Thesis, Department of Mathematics, University College, University of New South Wales. 137 pages.

APPENDICES

Appendix 1:
Remote Sensing for grassland fuel classification for Bush Fire Threat Analysis in SW Western Australia.

C Muller
June 2006

The fuels in farmland vary considerably both spatially and temporally. A major influence is the annual cropping. Immediately prior to harvest, both the fuel levels and the standing crop value are at their highest. Crops are rotated, and the same paddocks are not necessarily under crop in successive years.

The annual variation is important for localised fire threat analysis. It may not be significant for an assessment on a broad regional and long term scale, where it may be satisfactory to assume the proportion of the area under crop remains relatively constant (albeit the paddocks under crop may change) but even in this case some knowledge of the areas under crop is required in order to determine the crop/pasture ratio.

There is potential for differentiating between major grassland fuels using satellite remote sensing. The following investigation was carried out using a portion of the Mallee_Wimmera IBRA sub-region as a study area. As the data was historical data, it was not possible to ground truth the results.

An examination of the 2005 "summer" Landsat composite showed potential to discriminate between crop, cut or grazed pasture, heavily eaten out pasture, and bare areas. (Pic 1).

To reduce the range and improve the ability to discriminate between pasture classes, the Landsat image was masked to exclude the majority of perennial vegetation using the Remnant Vegetation data from Agriculture WA. The resultant image (Pic 2) was classified without calibration within ArcGIS(Pic 3). This illustrates the potential for fuel type mapping for crop/pasture, but cannot be applied across larger areas of the mosaic without further calibration as the variation across the composite scene was greater than the difference between fuel classes. (Pics 4a & b).

The scenes comprising the summer 2005 mosaic ranged from November 2004 to the first week in February 2005, and were all close to the period of harvest. The dates for the scenes in the summer 2006 mosaic range from late January to early May, well after harvest period, and the ability to discriminate fuel types is reduced. (The 2006 image also has considerable cloud and other glitches).

Whilst the summer image can potentially provide a posteriora fuel classification if the dates of the scenes are suitable, it does not provide information on the forthcoming fire season. If information is desired on the spatial variability of potential fire behaviour in any forthcoming fire season, a predictive model of annual fuel distribution is required to enable an annual update.

DLI have been undertaking research into predicting crop areas for CBH using a MODIS time series. Whilst the resolution of this data is far coarser, it does provide predictive information valuable for fuel mapping.

The current product discriminates between crop and pasture only. (Pic 5), with all perennial vegetation, bare and salt affected areas, non arable land and no-data areas masked out. Whilst it is obviously not possible to distinguish eaten out areas in advance, some improvement in fuel classification is possible by masking out the “bush” areas as above. (Pic 6). If all bare and long term salt affected areas were identified separately from no-data areas it would greatly improve the value of this data for fuel classification.

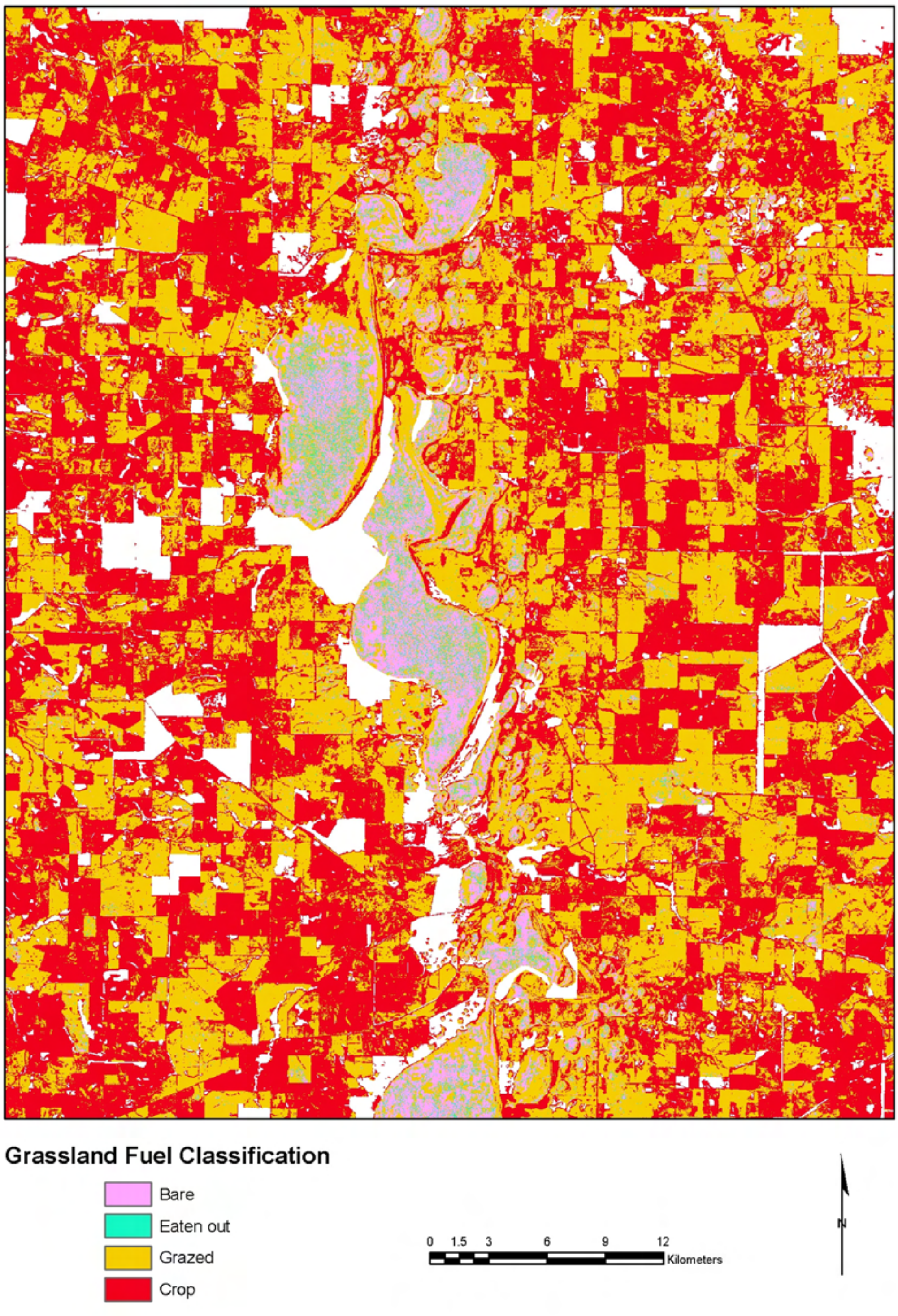
Clearly more detailed boundaries are possible from the higher resolution Landsat data than from data derived from MODIS alone. This is illustrated by comparing the summer 2005 data at 25m resolution (Pic 3) with the same data reclassified at 250m resolution (Pic 7). This is not significant at a regional level, but is significant if the ability to zoom to more localised analysis is desired.

Recommendation:

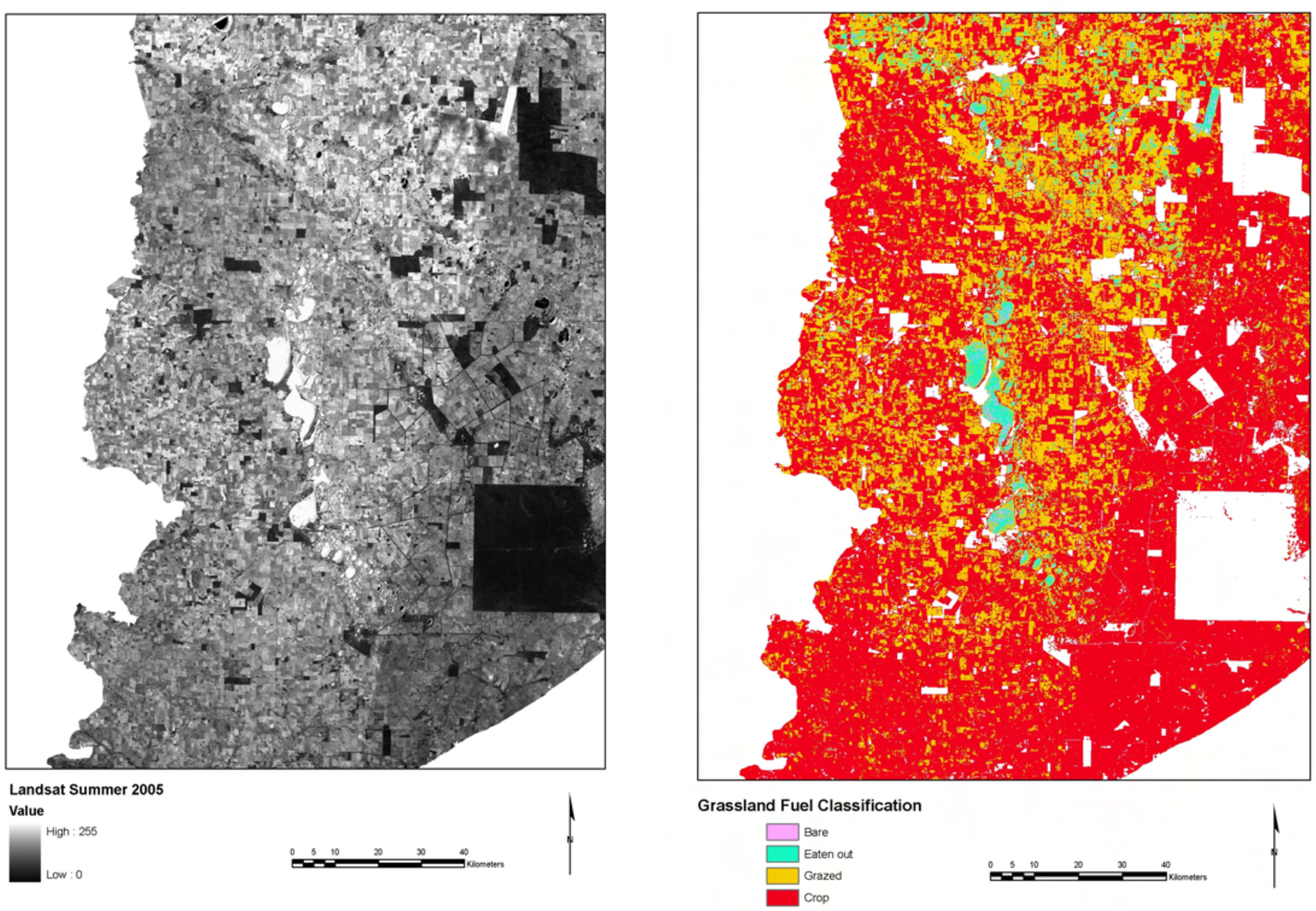
- Bare areas, salt affected areas, and water bodies be separately identified to no-data areas so such low fuel areas can be classified as a “low fuel” or “no fuel” classes.
- The possibilities for more detailed mapping using Landsat or MODIS/Landsat combination be investigated.

Pic 1: Portion of Landsat mosaic.

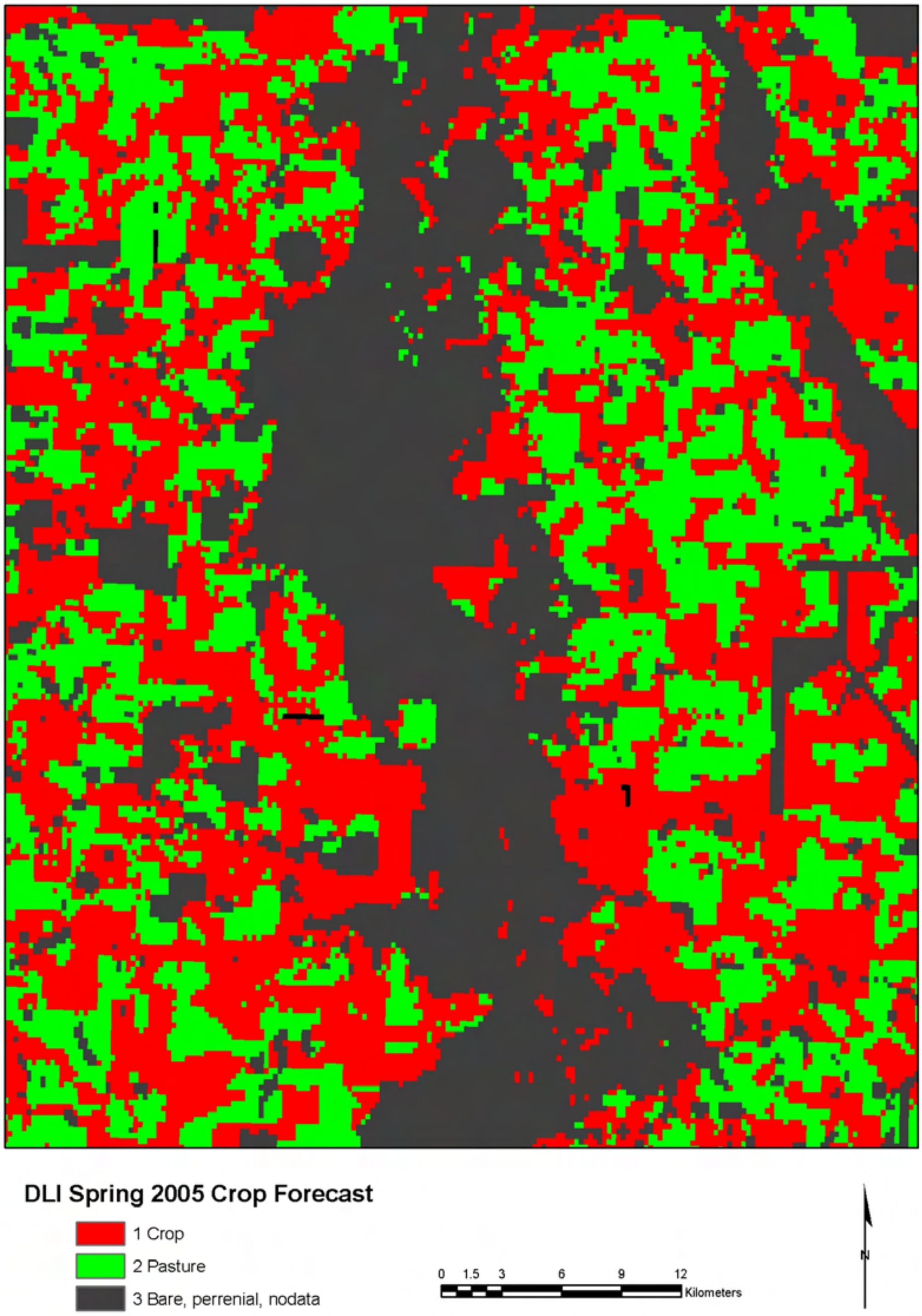
Pic 2: “Bush” masked out using AgWA Remnant Vegetation theme.



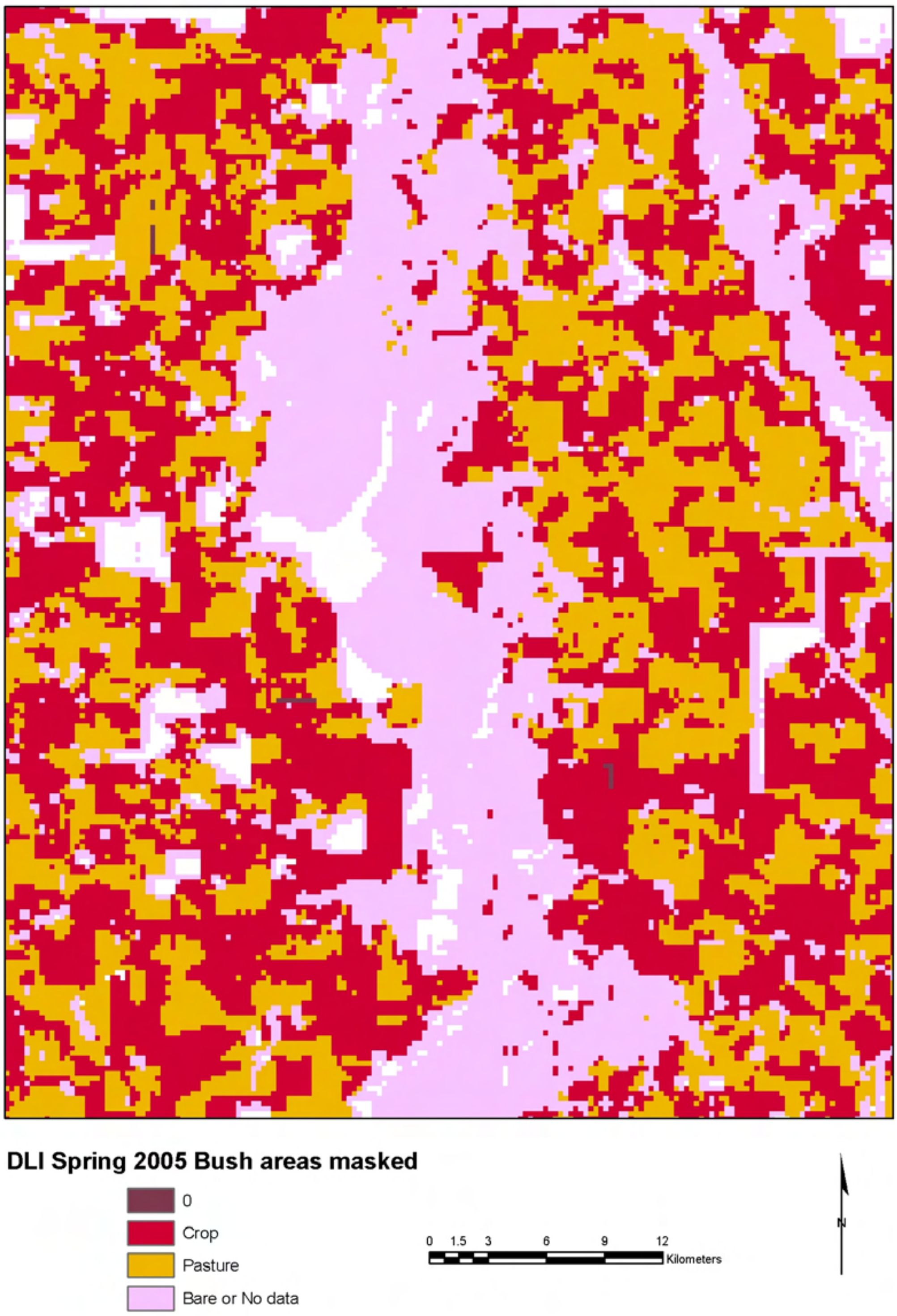
Pic 3: Fuel classification from single Landsat (summer 2005) image



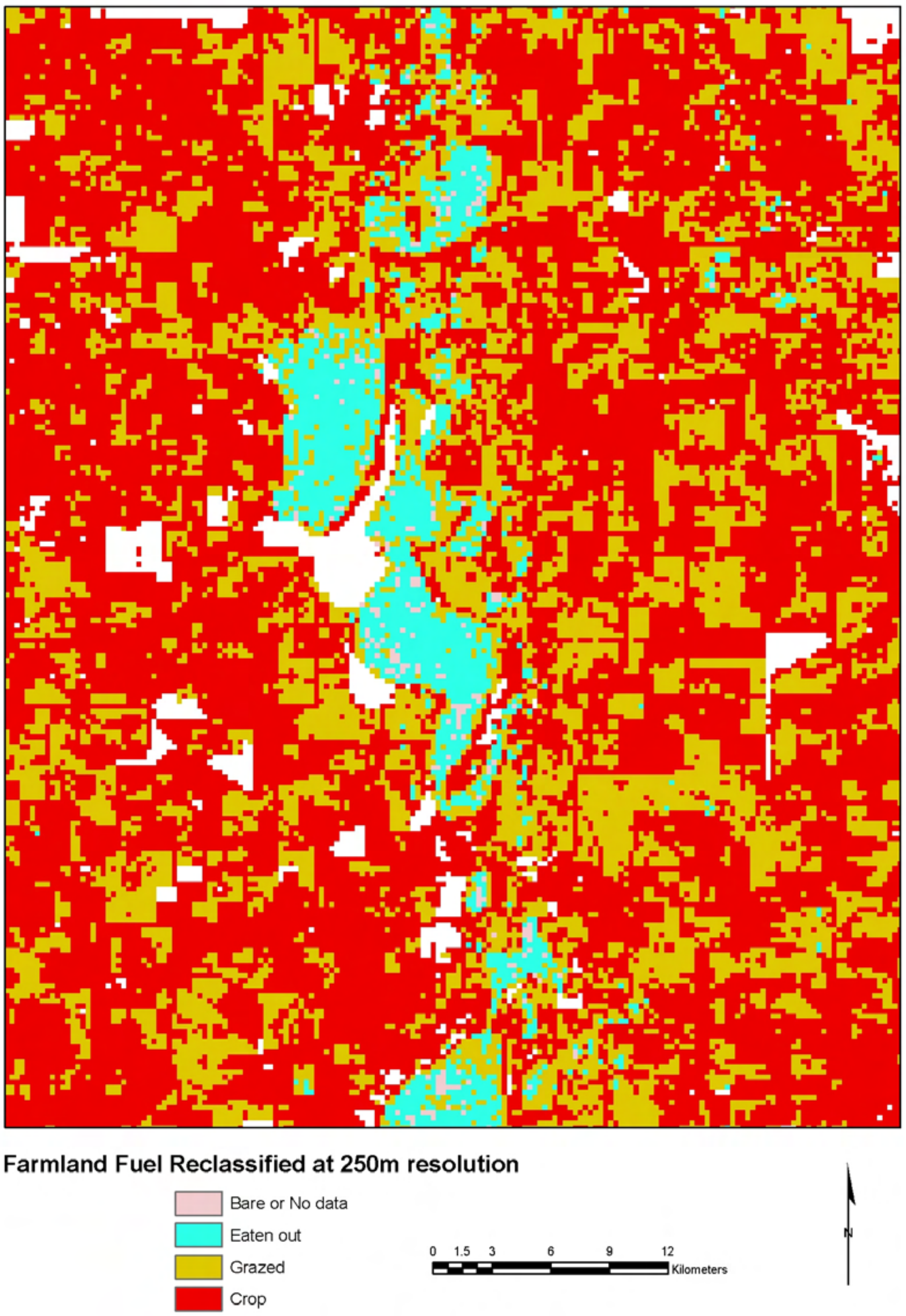
Pic 4: Variation across the mosaic is greater than variation between fuel classes, restricting fuel classification to localised areas without further calibration.



Pic 5: Note, this image is for the 2005/6 season and therefore the areas of crop do not coincide with the Summer 2005 Landsat image (which corresponds to the 2004/05 season).


DLI Spring 2005 Bush areas masked
0
Crop
Pasture
Bare or No data
0 1.5 3 6 9 12
Kilometers
N

Pic 6:



Pic 7: Data derived from classification of Landsat mosaic at 25m reclassified at a 250m resolution.

Appendix 2:
Fuel Accumulation Regressions

Wandoo Fuel Quantity

Wandoo
Wt=(3.931 + 0.017*CC^1.475) * (1-EXP(-0.105*FuelAge))

```
1: //"Wandoo Fuel Quantity"//
2: VARIABLE FuelAge, Wt, CC;
3: Parameter a,b,c,d;
4: FUNCTION Wt=(a  + b*CC^c)  *  (1-EXP(-d*FuelAge)) ;
5: PLOT;
6: DATA ;
```

Beginning computation...
Stopped due to: Relative function convergence.

---- Final Results ----

NLREG version 6.3
Copyright (c) 1992-2005 Phillip H. Sherrod.

Number of observations = 50
Maximum allowed number of iterations = 500
Convergence tolerance factor = 1.000000E-010
Stopped due to: Relative function convergence.
Number of iterations performed = 27
Final sum of squared deviations = 8.4079247E+000
Final sum of deviations = 3.4451875E+000
Standard error of estimate = 0.427529
Average deviation = 0.329597
Maximum deviation for any observation = 0.988706
Proportion of variance explained (R^2) = 0.9835 (98.35%)
Adjusted coefficient of multiple determination (Ra^2) = 0.9824 (98.24%)
Durbin-Watson test for autocorrelation = 0.446
This Durbin-Watson value indicates autocorrelation or inappropriate function.
Analysis completed 18-Dec-2007 16:30. Runtime = 0.02 seconds.

---- Descriptive Statistics for Variables ----

Variable	Minimum value	Maximum value	Mean value	Standard dev.
FuelAge	1	30	10.66	8.587152
Wt	1	14.4	5.464	3.222292
CC	20	80	50	22.22336

---- Calculated Parameter Values ----

Parameter	Initial guess	Final estimate	Standard error	t	Prob(t)
a	1	3.93049858	0.4958517	7.93	0.00001
b	1	0.0170755021	0.01194133	1.43	0.15949
c	1	1.47533633	0.1524871	9.68	0.00001
d	1	0.104567589	0.004902013	21.33	0.00001

---- Analysis of Variance ----

Source	DF	Sum of Squares	Mean Square	F value	Prob(F)
Regression	3	500.3673	166.7891	912.51	0.00001
Error	46	8.407925	0.182781		
Total	49	508.7752			

Jarrah Fuel Quantity

Jarrah
Wt=(8.896 + 0.566*CC^0.766) * (1-EXP(-0.087*FuelAge))

```
   1: //"Jarrah Fuel Quantity"//
   2: VARIABLE FuelAge, Wt, CC;
   3: Parameter a,b,c,d;
   4: FUNCTION Wt=(a  + b*CC^c)  *  (1-EXP(-d*FuelAge)) ;
   5: PLOT;
   6: DATA ;
```

Beginning computation...
Stopped due to: Relative function convergence.

---- Final Results ----

NLREG version 6.3
Copyright (c) 1992-2005 Phillip H. Sherrod.

Number of observations = 50
Maximum allowed number of iterations = 500
Convergence tolerance factor = 1.000000E-010
Stopped due to: Relative function convergence.
Number of iterations performed = 9
Final sum of squared deviations = 2.3234171E+001
Final sum of deviations = 3.7947137E+000
Standard error of estimate = 0.710697
Average deviation = 0.573152
Maximum deviation for any observation = 1.92852
Proportion of variance explained (R^2) = 0.9822 (98.22%)
Adjusted coefficient of multiple determination (Ra^2) = 0.9811 (98.11%)
Durbin-Watson test for autocorrelation = 0.530
This Durbin-Watson value indicates autocorrelation or inappropriate function.
Analysis completed 18-Dec-2007 16:54. Runtime = 0.02 seconds.

---- Descriptive Statistics for Variables ----

Variable	Minimum value	Maximum value	Mean value	Standard dev.
FuelAge	1	25	10.02	7.155674
Wt	1	20.2	10.218	5.166402

CC	20	80	50	20.20305

---- Calculated Parameter Values ----

Parameter	Initial guess	Final estimate	Standard error	t	Prob(t)
a	1	8.89625284	2.975061	2.99	0.00447
b	1	0.565668084	0.6550503	0.86	0.39232
c	1	0.766201768	0.2278261	3.36	0.00156
d	1	0.0871969054	0.004686122	18.61	0.00001

---- Analysis of Variance ----

Source	DF	Sum of Squares	Mean Square	F value	Prob(F)
Regression	3	1284.66	428.2199	847.81	0.00001
Error	46	23.23417	0.5050907		
Total	49	1307.894			

Karri Fuel Quantity

Wt=(27.044 + 0.159*CC^1.198) * (1-EXP(-0.0835*FuelAge))

```
   1: //"Karri Fuel Quantity"//
   2: VARIABLE FuelAge, Wt, CC;
   3: Parameter a,b,c,d;
   4: FUNCTION Wt=(a  + b*CC^c)  *  (1-EXP(-d*FuelAge)) ;
   5: PLOT;
   6: DATA ;
```

Beginning computation...
Stopped due to: Relative function convergence.

---- Final Results ----

NLREG version 6.3

Number of observations = 50
Maximum allowed number of iterations = 500
Convergence tolerance factor = 1.000000E-010
Stopped due to: Relative function convergence.
Number of iterations performed = 39
Final sum of squared deviations = 1.9953406E+002
Final sum of deviations = 2.4308111E+001
Standard error of estimate = 2.08271
Average deviation = 1.46792
Maximum deviation for any observation = 7.1536
Proportion of variance explained (R^2) = 0.9774 (97.74%)
Adjusted coefficient of multiple determination (Ra^2) = 0.9760 (97.60%)
Durbin-Watson test for autocorrelation = 0.543
This Durbin-Watson value indicates autocorrelation or inappropriate function.
Analysis completed 19-Dec-2007 08:13. Runtime = 0.02 seconds.

---- Descriptive Statistics for Variables ----

Variable	Minimum value	Maximum value	Mean value	Standard dev.
FuelAge	1	25	9.44	7.65629
Wt	4	58	23.406	13.43347
CC	30	100	60.6	23.15961

---- Calculated Parameter Values ----

Parameter	Initial guess	Final estimate	Standard error	t	Prob(t)
a	1	27.0441788	5.468687	4.95	0.00001
b	1	0.159425775	0.2439387	0.65	0.51666
c	1	1.19789765	0.3068936	3.90	0.00031
d	1	0.0835454442	0.00504307	16.57	0.00001

---- Analysis of Variance ----

Source	DF	Sum of Squares	Mean Square	F value	Prob(F)
Regression	3	8642.914	2880.971	664.17	0.00001
Error	46	199.5341	4.337697		
Total	49	8842.448			

Appendix 3:
Scripts

Bush Fire Threat Model

```
' ----------------------------------------------------------------------
--------
' Threat.vbs
' Created on: Sun Feb 10 2008 11:44:49 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: Threat <Ignition_Risk> <Fire_Behaviour>
<Suppression_Response> <Values_Classes> <Threat>
' Description:
' Classifies threat according to the risk assessment matrix.
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "spatial"

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial
Analyst Tools.tbx"

' Set the Geoprocessing environment...
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.outputCoordinateSystem = ""
gp.extent = "MAXOF"
gp.cellSize = "100"
gp.mask = "C:\MUNDARING\BFTA Themes\firebehaviour"
gp.workspace = "C:\BFTAWorkspace"

' Script arguments...
Ignition_Risk = wscript.arguments.item(0)
if Ignition_Risk = "#" then
 Ignition_Risk = "C:\MUNDARING\BFTA Themes\ignition_risk" ' provide a
default value if unspecified
end if

Fire_Behaviour = wscript.arguments.item(1)
if Fire_Behaviour = "#" then
 Fire_Behaviour = "C:\MUNDARING\BFTA Themes\firebehaviour" ' provide
a default value if unspecified
end if

Suppression_Response = wscript.arguments.item(2)
if Suppression_Response = "#" then
```

```
 Suppression_Response = "C:\MUNDARING\BFTA Themes\suppressresp" '
provide a default value if unspecified
end if

Values_Classes = wscript.arguments.item(3)
if Values_Classes = "#" then
 Values_Classes = "C:\MUNDARING\BFTA Themes\valuesclasses" ' provide
a default value if unspecified
end if

Threat = wscript.arguments.item(4)
if Threat = "#" then
 Threat = "C:\BFTAWorkspace\BFTA_Themes\Threat" ' provide a default
value if unspecified
end if

' Local variables...
Likelihood = "C:\BFTAWorkspace\Scratch\Likelihood"
Likelihood_Cl = "C:\BFTAWorkspace\Scratch\Likelihood_Cl"
Sum_L_C = "C:\BFTAWorkspace\Scratch\sum_l_c"

' Process: Single Output Map Algebra...
gp.SingleOutputMapAlgebra_sa " [Suppression Response]  + ([Fire
Behaviour]  *  2 )  +  [Ignition Risk]", Likelihood,
"'C:\MUNDARING\BFTA Themes\suppressresp';'C:\MUNDARING\BFTA
Themes\firebehaviour';'C:\MUNDARING\BFTA Themes\ignition_risk'"

' Process: Reclassify (2)...
gp.Reclassify_sa Likelihood, "VALUE", "3 6.4000000000000004
1;6.4000000000000004 9.8000000000000007 2;9.8000000000000007
13.200000000000001 3;13.200000000000001 16.600000000000001
4;16.600000000000001 20 5;NODATA 1", Likelihood_Cl, "DATA"

' Process: Single Output Map Algebra (2)...
gp.SingleOutputMapAlgebra_sa "[Likelihood_Cl]  + [Values Classes]",
Sum_L_C, "C:\BFTAWorkspace\Scratch\Likelihood_Cl;'C:\MUNDARING\BFTA
Themes\valuesclasses'"

' Process: Reclassify (3)...
gp.Reclassify_sa Sum_L_C, "VALUE", "2 1;3 1;4 2;5 2;6 3;7 4;8 4;9
5;10 5;11 5", Threat, "DATA"
```

Ignition Risk Model

```
' ---------------------------------------------------------------------
--------
' IgnitionRisk.vbs
' Created on: Sun Feb 10 2008 11:45:39 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: IgnitionRisk <Low_Voltage_Carrier> <BuiltupAreas_shp>
<HighVoltCarrier_shp> <Roads_shp> <Output_Folder>
<Transmission_Line_Wooden_Poles> <Heavy_Use_Rail__eg_iron_ore_>
<Study_Area> <High_Voltage_Transmission_Lines>
' Description:
' IMPORTANT NOTE: All inputs must have values within the Stuy Area
extent. If any input does not exist in a particular area, use the
```

```
C:\BFTA_Data\ZeroData.shp file. This will result in a (valid) zero
value for that parameter, and will prevent the program crashing as it
will if it encounters empty data sets. Note that Hotspot and fire
record data are not shown as parameters: these values are not
optional.
' -------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "spatial"

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial
Analyst Tools.tbx"
gp.AddToolbox "C:/Program
Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Set the Geoprocessing environment...
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.extent = "C:\BFTAWorkspace\Scratch\StudyArea_Buffer.shp"
gp.cellSize = "100"
gp.mask = "MDG_StudyArea"
gp.workspace = "C:\BFTAWorkspace"

' Script arguments...
Low_Voltage_Carrier = wscript.arguments.item(0)
if Low_Voltage_Carrier = "#" then
 Low_Voltage_Carrier = "C:\MUNDARING\Values\LowVoltCarrier.shp" '
provide a default value if unspecified
end if

BuiltupAreas_shp = wscript.arguments.item(1)
if BuiltupAreas_shp = "#" then
 BuiltupAreas_shp = "C:\MUNDARING\Values\BuiltupAreas.shp" ' provide
a default value if unspecified
end if

HighVoltCarrier_shp = wscript.arguments.item(2)
if HighVoltCarrier_shp = "#" then
 HighVoltCarrier_shp = "C:\MUNDARING\Values\HighVoltCarrier.shp" '
provide a default value if unspecified
end if


Roads_shp = wscript.arguments.item(3)
if Roads_shp = "#" then
 Roads_shp = "C:\MUNDARING\BaseData\Roads.shp" ' provide a default
value if unspecified
end if

Output_Folder = wscript.arguments.item(4)
if Output_Folder = "#" then
```

```
 Output_Folder = "C:\BFTAWorkspace\BFTA_Themes" ' provide a default
value if unspecified
end if

Transmission_Line_Wooden_Poles = wscript.arguments.item(5)
if Transmission_Line_Wooden_Poles = "#" then
 Transmission_Line_Wooden_Poles = "C:\BFTA_DATA\ZeroData.shp" '
provide a default value if unspecified
end if

Heavy_Use_Rail__eg_iron_ore_ = wscript.arguments.item(6)
if Heavy_Use_Rail__eg_iron_ore_ = "#" then
 Heavy_Use_Rail__eg_iron_ore_ = "C:\BFTA_DATA\ZeroData.shp" ' provide
a default value if unspecified
end if

Study_Area = wscript.arguments.item(7)
if Study_Area = "#" then
 Study_Area = "MDG_StudyArea" ' provide a default value if
unspecified
end if

High_Voltage_Transmission_Lines = wscript.arguments.item(8)
if High_Voltage_Transmission_Lines = "#" then
 High_Voltage_Transmission_Lines =
"C:\MUNDARING\Values\TransmissionLines.shp" ' provide a default value
if unspecified
end if

' Local variables...
fesa_clip_shp = "C:\BFTAWorkspace\Scratch\fesa_clip.shp"
CALM_fires_Clip_shp = "C:\BFTAWorkspace\Scratch\CALM_fires_Clip.shp"
HS_1998_2005_merge_Clip_shp =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip.shp"
CALM_fires_1950_2005 = "C:\BFTA_DATA\Fire Records\Fire
Records.mdb\CALM_fires_1950_2005"
calm_KD = "C:\BFTAWorkspace\Scratch\calm_kd"
re_CALM = "C:\BFTAWorkspace\Scratch\re_calm"
re_fesa = "C:\BFTAWorkspace\Scratch\re_fesa"
HS_1998_2005_merge = "C:\BFTA_DATA\Fire
Records\Hotspots.mdb\HS_1998_2005_merge"
HS_1998_2005_merge_Clip_Buff_shp =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff.shp"
HS_1998_2005_merge_Clip_Buff_shp__5_ =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp"
HS_1998_2005_merge_Clip_Buff_shp__6_ =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp"
HS_1998_2005_merge_Clip_Buff_shp__2_ =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp"
HS_1998_2005_merge_Clip_Buff_shp__4_ =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp"
HS_Centroid2 = "HS_Centroid2"
Output_Feature_Class =
"C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp"
LoVoltBuff_shp = "C:\BFTAWorkspace\Scratch\LoVoltBuff.shp"
BuiltUpBuff = "C:\BFTAWorkspace\Scratch\BuiltUpBuff.shp"
Ignition_Risk = "C:\BFTAWorkspace\BFTA_Themes\Ignition_Risk"
Roads_buff_shp = "C:\BFTAWorkspace\Scratch\Roads_buff.shp"

Roads = "C:\BFTAWorkspace\Scratch\roads"
```

```
re_RoadsRisk = "C:\BFTAWorkspace\Scratch\re_roadsrisk"
HV_Carrier_Buff_shp = "C:\BFTAWorkspace\Scratch\HV_Carrier_buff.shp"
fesa_KD = "C:\BFTAWorkspace\Scratch\fesa_kd"
HS = "C:\BFTAWorkspace\Scratch\hs"
HS_Centroid_Table = "C:\BFTAWorkspace\Scratch\HS_Centroid_Table"
Roads_shp__2_ = "C:\BFTAWorkspace\Scratch\Roads_Clip1.shp"
Roads_shp__3_ = "C:\BFTAWorkspace\Scratch\Roads_Clip1.shp"
Fesa__MergeLL_shp = "C:\BFTA_DATA\Fire Records\Fesa__MergeLL.shp"
Scratch = "C:\BFTAWorkspace\Scratch"
Output_Feature_Class__7_ = "C:\BFTAWorkspace\Scratch\Roads_Clip1.shp"
Mrail_B = "C:\BFTAWorkspace\Scratch\Mrail_B.shp"
CALM_fires_1986_2005_shp =
"C:\BFTAWorkspace\Scratch\CALM_fires_1986_2005.shp"
LoVolt = "C:\BFTAWorkspace\Scratch\lovolt"
mrail = "C:\BFTAWorkspace\Scratch\mrail"
HiVolt = "C:\BFTAWorkspace\Scratch\hivolt"
BuiltupAreas_Select_shp =
"C:\BFTAWorkspace\Scratch\BuiltupAreas_Select.shp"
BuiltUp = "C:\BFTAWorkspace\Scratch\builtup"
powerlines_Buffer =
"C:\BFTAWorkspace\Scratch\ZeroData_Project2_Buffer.shp"
TransWoodP = "C:\BFTAWorkspace\Scratch\TransWoodP"
hrail = "C:\BFTAWorkspace\Scratch\hrail"
HrailBuff = "C:\BFTAWorkspace\Scratch\HrailBuff.shp"
re-TransLine = "C:\BFTAWorkspace\Scratch\re-TransLine"
StudyArea_Buffer_shp =
"C:\BFTAWorkspace\Scratch\StudyArea_Buffer.shp"
Re_HS = "C:\BFTAWorkspace\Scratch\re_hs"
Output_Feature_Class__4_ =
"C:\BFTAWorkspace\Scratch\BuiltupAreas_Select_Clip.shp"
fesa_clip_Project_shp =
"C:\BFTAWorkspace\Scratch\fesa_clip_Project2.shp"
Trans_Line_Clip_shp = "C:\BFTAWorkspace\Scratch\Trans_Line_Clip.shp"
Trans_Line_Buffer_shp =
"C:\BFTAWorkspace\Scratch\Trans_Line_Buffer.shp"
Output_Dataset_or_Feature_Class__2_ =
"C:\BFTAWorkspace\Scratch\HighVoltCarrier_Project2.shp"
Trans_Line_Clip_Project_shp =
"C:\BFTAWorkspace\Scratch\Trans_Line_Clip_Project1.shp"
Output_Dataset_or_Feature_Class__3_ =
"C:\BFTAWorkspace\Scratch\BuiltupAreas_Select_Clip_Pro1.shp"
Output_Dataset_or_Feature_Class__4_ =
"C:\BFTAWorkspace\Scratch\ZeroData_Project2.shp"
Output_Dataset_or_Feature_Class__6_ =
"C:\BFTAWorkspace\Scratch\ZeroData_Project2.shp"
ZeroData_Project2_shp =
"C:\BFTAWorkspace\Scratch\ZeroData_Project3.shp"
Output_Dataset_or_Feature_Class__5_ =
"C:\BFTAWorkspace\Scratch\LowVoltCarrier_Project2.shp"
Medium__Standard_Govt__Rail = "C:\BFTA_DATA\ZeroData.shp"

' Process: Buffer (5)...
gp.Buffer_analysis Study_Area, StudyArea_Buffer_shp, "1 Kilometers",
"FULL", "ROUND", "LIST", "FID"

' Process: Clip (2)...
gp.Clip_analysis CALM_fires_1950_2005, StudyArea_Buffer_shp,
CALM_fires_Clip_shp, ""

' Process: Select...
```

```
gp.Select_analysis CALM_fires_Clip_shp, CALM_fires_1986_2005_shp,
"""D_DATE"" > date '1986-04-01'"

' Process: Kernel Density (4)...
gp.KernelDensity_sa CALM_fires_1986_2005_shp, "NONE", calm_KD, "100",
"5000", "SQUARE_KILOMETERS"

' Process: Reclassify (2)...
gp.Reclassify_sa calm_KD, "Value", "0 0.19 1;0.19 0.38 2;0.38
0.94999999999999996 3;0.94999999999999996 1.8999999999999999
4;1.8999999999999999 100 5", re_CALM, "DATA"

' Process: Clip (8)...
gp.Clip_analysis Roads_shp, Study_Area, Output_Feature_Class__7_, ""

' Process: Add Field (3)...
gp.AddField_management Output_Feature_Class__7_, "Class_Code",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (3)...
gp.CalculateField_management Roads_shp__2_, "Class_Code", "mCode",
"VB", "Dim mCode As Integer\nDim mClass As String\nDim mFeature As
String\nmClass = [Class]\nmFeature = [Feat_Desc]\n\nIf mClass =
""Principal Road"" Then\nmCode = 1\nElse\n    If mClass = ""Secondary
Road"" Then\n        mCode = 2\n    Else\n       If mClass = ""Minor
Road"" Then\n             mCode = 3\n        Else\n            If
mClass = ""Track"" Then\n                 mCode = 4\n
Else\n               mCode = 5\n            End If\n        End If\n
End If\n   End If\n"

' Process: Buffer (2)...
gp.Buffer_analysis Roads_shp__3_, Roads_buff_shp, "500 Meters",
"FULL", "ROUND", "LIST", "Class_Code"

' Process: Feature to Raster...
gp.FeatureToRaster_conversion Roads_buff_shp, "Class_Code", Roads,
"100"

' Process: Reclassify (9)...
gp.Reclassify_sa Roads, "VALUE", "1 4;2 4;3 3;4 3;5 3", re_RoadsRisk,
"DATA"

' Process: Clip...
gp.Clip_analysis Fesa__MergeLL_shp, StudyArea_Buffer_shp,
fesa_clip_shp, ""

' Process: Project...
gp.Project_management fesa_clip_shp, fesa_clip_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"GEOGCS['GCS_GDA_1994',DATUM['D_GDA_1994',SPHEROID['GRS_1980',6378137
.0,298.257222101]],PRIMEM['Greenwich',0.0],UNIT['Degree',0.0174532925
199433]]"

' Process: Kernel Density (2)...
```

```
gp.KernelDensity_sa fesa_clip_Project_shp, "NONE", fesa_KD, "100",
"50000", "SQUARE_KILOMETERS"

' Process: Reclassify...
gp.Reclassify_sa fesa_KD, "Value", "0 0.080000000000000002
1;0.080000000000000002 0.16 2;0.16 0.40000000000000002
3;0.40000000000000002 0.80000000000000004 4;0.80000000000000004 100
5", re_fesa, "DATA"

' Process: Clip (3)...
gp.Clip_analysis HS_1998_2005_merge, StudyArea_Buffer_shp,
HS_1998_2005_merge_Clip_shp, ""

' Process: Buffer...
gp.Buffer_analysis HS_1998_2005_merge_Clip_shp,
HS_1998_2005_merge_Clip_Buff_shp, "5000 Meters", "FULL", "ROUND",
"LIST", "StrikeDate"

' Process: Multipart To Singlepart...
gp.MultipartToSinglepart_management HS_1998_2005_merge_Clip_Buff_shp,
Output_Feature_Class

' Process: Add Field...
gp.AddField_management Output_Feature_Class, "Easting", "DOUBLE", "",
"", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Add Field (2)...
gp.AddField_management HS_1998_2005_merge_Clip_Buff_shp__6_,
"Northing", "DOUBLE", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED",
""

' Process: Calculate Field...
gp.CalculateField_management HS_1998_2005_merge_Clip_Buff_shp__2_,
"Easting", "dblX", "VB", "Dim dblX As Double\nDim pArea As IArea\nSet
pArea = [Shape]\ndblX = pArea.Centroid.X\n"

' Process: Calculate Field (2)...
gp.CalculateField_management HS_1998_2005_merge_Clip_Buff_shp__5_,
"Northing", "dblY", "VB", "Dim dblY As Double\nDim pArea As
IArea\nSet pArea = [Shape]\ndblY = pArea.Centroid.Y\n"

' Process: Table to Table...
gp.TableToTable_conversion HS_1998_2005_merge_Clip_Buff_shp__4_,
Scratch, "HS_Centroid_Table", "", "StrikeDate StrikeDate true true
false 15 Text 0 0
,First,#,C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp,S
trikeDate,-1,-1;BUFF_DIST BUFF_DIST true true false 0 Double 0 0
,First,#,C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp,B
UFF_DIST,-1,-1;Easting Easting true false false -1 Double -1 -2
,First,#,C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp,E
asting,-1,-1;Northing Northing true false false -1 Double -1 -2
,First,#,C:\BFTAWorkspace\Scratch\HS_1998_2005_merge_Clip_Buff4.shp,N
orthing,-1,-1", ""

' Process: Make XY Event Layer (2)...
gp.MakeXYEventLayer_management HS_Centroid_Table, "Easting",
"Northing", HS_Centroid2,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
```

```
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]];-
5120900 1900 450445547.391054;#;#;0.001;#;#;IsHighPrecision"

' Process: Kernel Density...
gp.KernelDensity_sa HS_Centroid2, "NONE", HS, "100", "10000",
"SQUARE_KILOMETERS"

' Process: Reclassify (3)...
gp.Reclassify_sa HS, "Value", "0 0.070000000000000007
1;0.070000000000000007 0.14000000000000001 2;0.14000000000000001
0.34999999999999998 3;0.34999999999999998 0.69999999999999996
4;0.69999999999999996 100 5", Re_HS, "DATA"

' Process: Clip (4)...
gp.Clip_analysis High_Voltage_Transmission_Lines,
StudyArea_Buffer_shp, Trans_Line_Clip_shp, ""

' Process: Project (3)...
gp.Project_management Trans_Line_Clip_shp,
Trans_Line_Clip_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (9)...
gp.Buffer_analysis Trans_Line_Clip_Project_shp,
Trans_Line_Buffer_shp, "500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (6)...
gp.SingleOutputMapAlgebra_sa "CON ([Trans_Line_Buffer.shp] == 0, 0,
1)
", re-TransLine, "C:\BFTAWorkspace\Scratch\Trans_Line_Buffer.shp"

' Process: Project (7)...
gp.Project_management Medium__Standard_Govt__Rail,
ZeroData_Project2_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"GEOGCS['GCS_GDA_1994',DATUM['D_GDA_1994',SPHEROID['GRS_1980',6378137
.0,298.257222101]],PRIMEM['Greenwich',0.0],UNIT['Degree',0.0174532925
199433]]"

' Process: Buffer (8)...
```

```
gp.Buffer_analysis ZeroData_Project2_shp, Mrail_B, "500 Meters",
"FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (2)...
gp.SingleOutputMapAlgebra_sa "CON ([Mrail_B] == 0, 0, 3)", mrail,
"C:\BFTAWorkspace\Scratch\Mrail_B.shp"

' Process: Project (5)...
gp.Project_management Heavy_Use_Rail__eg_iron_ore_,
Output_Dataset_or_Feature_Class__4_,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (7)...
gp.Buffer_analysis Output_Dataset_or_Feature_Class__4_, HrailBuff,
"500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (9)...
gp.SingleOutputMapAlgebra_sa "CON ([HrailBuff] == 0, 0, 4])", hrail,
"C:\BFTAWorkspace\Scratch\HrailBuff.shp"

' Process: Project (6)...
gp.Project_management Transmission_Line_Wooden_Poles,
Output_Dataset_or_Feature_Class__6_,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (10)...
gp.Buffer_analysis Output_Dataset_or_Feature_Class__6_,
powerlines_Buffer, "500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (8)...
gp.SingleOutputMapAlgebra_sa "CON ([Powerlines_Buffer] == 0, 0, 4)",
TransWoodP, "C:\BFTAWorkspace\Scratch\ZeroData_Project2_Buffer.shp"

' Process: Project (2)...
gp.Project_management HighVoltCarrier_shp,
Output_Dataset_or_Feature_Class__2_,
```

```
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (3)...
gp.Buffer_analysis Output_Dataset_or_Feature_Class__2_,
HV_Carrier_Buff_shp, "500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (4)...
gp.SingleOutputMapAlgebra_sa "CON ([HV_Carrier_Buff.shp] == 0, 0, 4)
", HiVolt, "C:\BFTAWorkspace\Scratch\HV_Carrier_buff.shp"

' Process: Project (8)...
gp.Project_management Low_Voltage_Carrier,
Output_Dataset_or_Feature_Class__5_,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (4)...
gp.Buffer_analysis Output_Dataset_or_Feature_Class__5_,
LoVoltBuff_shp, "500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (3)...
gp.SingleOutputMapAlgebra_sa "CON ( [LoVoltBuff.shp] == 0, 0, 3)",
LoVolt, "C:\BFTAWorkspace\Scratch\LoVoltBuff.shp"

' Process: Select (4)...
gp.Select_analysis BuiltupAreas_shp, BuiltupAreas_Select_shp,
"""FEAT_DESC"" = 'Built-up Area'"

' Process: Clip (6)...
gp.Clip_analysis BuiltupAreas_Select_shp, StudyArea_Buffer_shp,
Output_Feature_Class__4_, ""

' Process: Project (4)...
gp.Project_management Output_Feature_Class__4_,
Output_Dataset_or_Feature_Class__3_,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
```

```
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (6)...
gp.Buffer_analysis Output_Dataset_or_Feature_Class__3_, BuiltUpBuff,
"500 Meters", "FULL", "ROUND", "NONE", ""

' Process: Single Output Map Algebra (7)...
gp.SingleOutputMapAlgebra_sa "CON ( [BuiltUpBuff] == 0, 0, 4) ",
BuiltUp, "C:\BFTAWorkspace\Scratch\BuiltUpBuff.shp"

' Process: Mosaic To New Raster...
tempEnvironment0 = gp.cellSize
gp.cellSize = "100"
gp.MosaicToNewRaster_management
"C:\BFTAWorkspace\Scratch\re_calm;C:\BFTAWorkspace\Scratch\re_roadsri
sk;C:\BFTAWorkspace\Scratch\re_fesa;C:\BFTAWorkspace\Scratch\re_hs;C:
\BFTAWorkspace\Scratch\re-
TransLine;C:\BFTAWorkspace\Scratch\mrail;C:\BFTAWorkspace\Scratch\hra
il;C:\BFTAWorkspace\Scratch\TransWoodP;C:\BFTAWorkspace\Scratch\hivol
t;C:\BFTAWorkspace\Scratch\lovolt;C:\BFTAWorkspace\Scratch\builtup",
Output_Folder, "Ignition_Risk",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"8_BIT_UNSIGNED", "100", "1", "MAXIMUM", "MATCH"
gp.cellSize = tempEnvironment0
```

Suppression Response Model

```
' ---------------------------------------------------------------------
--------
' SuppressionResponse.vbs
' Created on: Wed Jan 30 2008 10:31:15 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: SuppressionResponse <Study_Area_> <road_lines> <Bush_Areas>
<slope> <waterbodies_shp> <FF_Equpt_Loc_shp>
' Description:
' Calculates shortest ground based travel times for suppression
forces to reach any point from nominated locations.

Note the output will be stored as
C;\BFTA_Workspace\BFTA_Themes|SuppressResp
```

```
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "spatial"


' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial
Analyst Tools.tbx"
gp.AddToolbox "C:/Program
Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Set the Geoprocessing environment...
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.outputCoordinateSystem =
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"
gp.extent = "C:\BFTAWorkspace\Scratch\StudyArea_Buffer10k.shp"
gp.cellSize = "100"
gp.mask = "C:\BFTAWorkspace\Scratch\StudyArea_Buffer10k.shp"
gp.workspace = "C:\BFTAWorkspace"

' Script arguments...
Study_Area_ = wscript.arguments.item(0)
if Study_Area_ = "#" then
 Study_Area_ = "C:\PILBARA\PilbaraStudyArea.lyr" ' provide a default
value if unspecified
end if


road_lines = wscript.arguments.item(1)
if road_lines = "#" then
 road_lines = "C:\PILBARA\BaseData\road_lines.shp" ' provide a
default value if unspecified
end if

Bush_Areas = wscript.arguments.item(2)
if Bush_Areas = "#" then
 Bush_Areas = "C:\PILBARA\Vegetation\Bush_Areas.shp" ' provide a
default value if unspecified
end if

slope = wscript.arguments.item(3)
if slope = "#" then
 slope = "C:\PILBARA\Slope\slope" ' provide a default value if
unspecified
end if
```

```
waterbodies_shp = wscript.arguments.item(4)
if waterbodies_shp = "#" then
 waterbodies_shp = "C:\PILBARA\BaseData\waterbodies.shp" ' provide a
default value if unspecified
end if

FF_Equpt_Loc_shp = wscript.arguments.item(5)
if FF_Equpt_Loc_shp = "#" then
 FF_Equpt_Loc_shp = "C:\PILBARA\BaseData\FF_Equpt_Loc.shp" ' provide
a default value if unspecified
end if

' Local variables...
Roads = "C:\BFTAWorkspace\Scratch\roads"
TT10k_road = "C:\BFTAWorkspace\Scratch\TT10k_road"
Roads_shp__2_ = "C:\BFTAWorkspace\Scratch\road_lines_Clip.shp"
Roads_Clip_Layer = "C:\BFTAWorkspace\Scratch\road_lines_Clip.shp"
Bush_Areas_layer = "Bush_Areas_Layer"
TT10k_Bush = "C:\BFTAWorkspace\Scratch\TT10k_Bush"
TT10K_slope = "C:\BFTAWorkspace\Scratch\TT10K_slope"
TT10k_water = "C:\BFTAWorkspace\Scratch\TT10k_water"
waterbodies_Clip_shp =
"C:\BFTAWorkspace\Scratch\waterbodies_Clip.shp"
road_lines_Clip_shp = "C:\BFTAWorkspace\Scratch\road_lines_Clip.shp"
TTslpNVIWtr = "C:\BFTAWorkspace\Scratch\TTslpNVIWtr"
Scratch = "C:\BFTAWorkspace\Scratch"

TT = "C:\BFTAWorkspace\Scratch\tt"
Scratch__2_ = "C:\BFTAWorkspace\Scratch"
Bush_Areas_Layer__2_ = "Bush_Areas_Layer"
v_Vegetation_Classes____2_ = "C:\BFTA_DATA\Reclassify
Tables\TT_Classification.xls\'Vegetation Classes$'"
Bush_Areas_Layer__4_ = "Bush_Areas_Layer"
PreEuropeanVegetation_attributes_dbf = "C:\BFTA_DATA\Veg_Fuel
Classification\PreEuropeanVegetation_attributes.dbf"
TT10K_Veg = "C:\BFTAWorkspace\Scratch\TT10K_Veg"
Water_Calc = "C:\BFTAWorkspace\Scratch\waterbodies_Clip.shp"
Water_Layer_Field = "C:\BFTAWorkspace\Scratch\waterbodies_Clip.shp"
ResponseTimes = "C:\BFTAWorkspace\Scratch\ResponseTimes"
Output_backlink_raster = ""
StudyArea_Buffer10k_shp =
"C:\BFTAWorkspace\Scratch\StudyArea_Buffer10k.shp"
Reclass_Resp1 = "C:\BFTAWorkspace\Scratch\Reclass_Resp1"
suppressresp = "C:\BFTAWorkspace\BFTA_Themes\suppressresp"

' Process: Buffer...
gp.Buffer_analysis Study_Area_, StudyArea_Buffer10k_shp, "10
Kilometers", "FULL", "ROUND", "LIST", "FID"

' Process: Clip (2)...
gp.Clip_analysis road_lines, StudyArea_Buffer10k_shp,
road_lines_Clip_shp, ""

' Process: Add Field (3)...
gp.AddField_management road_lines_Clip_shp, "Class_Code", "SHORT",
"", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (3)...
gp.CalculateField_management Roads_shp__2_, "Class_Code", "mCode",
"VB", "Dim mCode As Integer\nDim mClass As String\nDim mFeature As
```

```
String\nmClass = [Class]\nmFeature = [Feat_Desc]\n\nIf mClass =
""Principal Road"" Then\nmCode = 1\nElse\n    If mClass = ""Secondary
Road"" Then\n        mCode = 2\n    Else\n       If mClass = ""Minor
Road"" Then\n            mCode = 3\n        Else\n            If
mClass = ""Track"" Then\n                 mCode = 4\n
Else\n               mCode = 5\n            End If\n        End If\n
End If\n   End If\n"

' Process: Feature to Raster...
gp.FeatureToRaster_conversion Roads_Clip_Layer, "Class_Code", Roads,
"100"

' Process: Reclassify (9)...
gp.Reclassify_sa Roads, "VALUE", "1 6;2 8;3 10;4 20;5 150",
TT10k_road, "DATA"

' Process: Reclassify...
gp.Reclassify_sa slope, "Value", "0 5 30;5 10 60;10 15 120;15 20
300;25 40 1200;40 60 2400;60 65 6000;65 90 600000", TT10K_slope,
"DATA"

' Process: Make Feature Layer...
gp.MakeFeatureLayer_management Bush_Areas, Bush_Areas_layer, "", "",
"ID_LUT ID_LUT VISIBLE;SYSTEM SYSTEM VISIBLE;VEG_ASSOC VEG_ASSOC
VISIBLE;SYS_ASSOC SYS_ASSOC VISIBLE;VSA_CODE VSA_CODE
VISIBLE;MAPUNIT_ID MAPUNIT_ID VISIBLE"

' Process: Add Join...
gp.AddJoin_management Bush_Areas_layer, "VEG_ASSOC",
PreEuropeanVegetation_attributes_dbf, "VEG_ASSOC", "KEEP_ALL"

' Process: Add Join (2)...
gp.AddJoin_management Bush_Areas_Layer__4_,
"PreEuropeanVegetation_attributes.NVIS_LV2",
v_Vegetation_Classes____2_, "NVIS_LV2", "KEEP_ALL"

' Process: Feature to Raster (2)...
gp.FeatureToRaster_conversion Bush_Areas_Layer__2_, "'Vegetation
Classes$'.TT_10k_mins", TT10k_Bush, "100"

' Process: Single Output Map Algebra...
gp.SingleOutputMapAlgebra_sa "Con (isnull([Bush_Areas]), 30,
[TT10K_Bush])", TT10K_Veg,
"C:\PILBARA\Vegetation\Bush_Areas.shp;C:\BFTAWorkspace\Scratch\TT10k_
Bush"

' Process: Clip...
gp.Clip_analysis waterbodies_shp, Study_Area_, waterbodies_Clip_shp,
""

' Process: Add Field (2)...
gp.AddField_management waterbodies_Clip_shp, "TT10K", "LONG", "", "",
"", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (2)...
gp.CalculateField_management Water_Layer_Field, "TT10k", "mTT", "VB",
"Dim mTT As Long\nDim mFeat_Desc As String\nDim mPerennial As
String\nmFeat_Desc = [FEAT_DESC]\n\nIf mFeat_Desc = ""Canal""
Then\nmTT = 600000\n        Else\n            If mFeat_Desc =
""Mangrove Flat"" Then\n                 mTT = 1200\n
```

```
Else\n              If mFeat_Desc = ""Saline Coastal Flat"" Then\n
mTT = 300\n            Else\n              If mFeat_Desc =
""Reservoir"" Then\n                  mTT = 600000\n
Else\n                If mFeat_Desc = ""Salt Evaporator"" Then\n
mTT = 600000\n               Else\n                    If
mFeat_Desc = ""Settling Pond"" Then\n                    mTT =
600000\n                Else\n                      If
mFeat_Desc = ""Subject to inundation"" Then\n
mTT = 2400\nElse\n                      If mFeat_Desc = ""Swamp""
Then\n                        mTT = 6000\n
Else\n    If mFeat_Desc = ""Lake"" Then\n        If mPerennial =
""Perennial"" Then\n            mTT = 600000\n       Else\n
mTT = 200\n      End If\n    Else\n                             If
mFeat_Desc = ""Marine Swamp"" Then\n
mTT = 600000\n                      Else\n           If mFeat_Desc
= ""Watercourse"" Then\n                 mTT = 1200\n
Else\nEnd If\nEnd If\nEnd If\nEnd If\nEnd If\nEnd If\nEnd If\nEnd
If\nEnd If\nEnd If\nEnd If\n"

' Process: Feature to Raster (3)...
gp.FeatureToRaster_conversion Water_Calc, "TT10K", TT10k_water, "100"

' Process: Mosaic To New Raster...
gp.MosaicToNewRaster_management
"C:\BFTAWorkspace\Scratch\TT10K_slope;C:\BFTAWorkspace\Scratch\TT10K_
Veg;C:\BFTAWorkspace\Scratch\TT10k_water", Scratch, "TTslpNVIWtr",
"", "32_BIT_FLOAT", "100", "1", "MAXIMUM", "FIRST"

' Process: Mosaic To New Raster (2)...
gp.MosaicToNewRaster_management
"C:\BFTAWorkspace\Scratch\TT10k_road;C:\BFTAWorkspace\Scratch\TTslpNV
IWtr", Scratch__2_, "TT", "", "32_BIT_FLOAT", "100", "1", "MINIMUM",
"FIRST"

' Process: Cost Distance...
gp.CostDistance_sa FF_Equpt_Loc_shp, TT, ResponseTimes, "",
Output_backlink_raster

' Process: Reclassify (2)...
gp.Reclassify_sa ResponseTimes, "Value", "0 150000
1;150000.00000999999 300000 2;300000.00001000002 600000
3;600000.00000999996 1200000 4;1200000 1e+020 5", Reclass_Resp1,
"DATA"

' Process: Extract by Mask...
gp.ExtractByMask_sa Reclass_Resp1, Study_Area_, suppressresp
```

Fire Behaviour Calculations

Met_SMC_Data.mdb DATABASE

VBA Modules

The two scripts below are similar: one prompts for entry of a single station for calculation and the other calculates the MC% for multiple stations from a list in a batch process. Both modules use the same linked SQL queries.

Single Station Calculation: SMC_PMC_Calc_Single_Station

```
Attribute VB_Name = "SMC_Pmc_Calc_Single_Stn"
Option Compare Database

Option Explicit

Global NWC As Double
Global NWCP As Double


Sub SMC()

'This calculates SMC and PMC for SW forest types using Beck's
equations for the FFBT for a single met station
'The input table must contain hourly AWS data and be in the format of
the tables in this database.
'Chris Muller, April 2007
'Revised October 2007

Dim dbsRdBk As DAO.Database
    Dim rstStnList As DAO.Recordset
    Dim rstDailyData As DAO.Recordset
    Dim Field As DAO.Field
    Dim SMCmin As Double
    Dim SMCmax As Double
    Dim PMCmin As Double
    Dim PMCmax As Double
    Dim YminSMC As Double
    Dim YmaxSMC As Double
    Dim YminPMC As Double
    Dim YmaxPMC As Double
    Dim rMaxTemp As Double
    Dim rMinRH As Double
    Dim rRain As Double
    Dim rORHC As Double
    Dim InputTableName As String
    Dim OutputTableName As String
    Dim QueryName As String
    Dim Stn As String

    Dim Response As String
    Dim rstNewTable As DAO.Recordset


    Dim fBDU As Double
    Dim RDate1 As Date
    Dim RDate2 As Date
    Dim Date_Diff As Integer
```

```
    Dim mSMCsj As Double
    Dim mSMCk36 As Double
    Dim mSMCk45 As Double
    Dim mSMCk12 As Double

    Dim mSMCpp As Double
    Dim mSMCpr As Double
    Dim mPMCsj As Double
    Dim mPMCk36 As Double
    Dim mPMCk45 As Double
    Dim mPMCk12 As Double

    Set dbsRdBk = Application.CurrentDb

    InputTableName = InputBox("Enter name of AWS data table") 'Enter
AWS Station table name

    If InputTableName = "" Then 'ie if the cancel option is chosen
        Exit Sub
    End If

    MakeChangesToTable (InputTableName) 'Adds required autonumber
field and index

    If QueryExists("SOURCETABLE") = True Then
       DoCmd.DeleteObject acQuery, "SOURCETABLE"
    End If

    Set_Source (InputTableName)

    Set rstDailyData = dbsRdBk.OpenRecordset("DailyData")

    Stn = rstDailyData.Fields("Stn_No")
    OutputTableName = Stn & "_SMC"

    If (TableExists(OutputTableName) = True) Then
        Response = MsgBox("The file " & OutputTableName & " already
exists. Continuing will overwrite this file. Do you want to
continue?", vbYesNo)
        If Response = vbNo Then
            Exit Sub
        Else
            DoCmd.DeleteObject acTable, OutputTableName
        End If
    End If


    CreateSMCTable OutputTableName
    Set rstNewTable = getTable(OutputTableName)


    rstDailyData.MoveFirst
    'ensures the initial FindNext in the loop finds the first day
rain >10

    Do While Not rstDailyData.EOF

        rstDailyData.FindNext ("ppn_0900 > 10")
```

```
        ' finds first rainday, and if more than 5 days records
missing, reinitiates at next rainfall event

        If rstDailyData.NoMatch Then
            Exit Do
        End If
        ' if no rain days before end of file to intiate or reinitiate

        RDate1 = rstDailyData.Fields("Date") 'date of rain day
        rstDailyData.MoveNext
        RDate2 = rstDailyData.Fields("Date") ' date of first record
to be calculated

        SMCmin = 60   'initialise value for first record
        YminSMC = 60  'initialise for use in next days calculation
        PMCmin = 100   'initialise value for first record
        YminPMC = 100  'initialise for use in next days calculation

        Date_Diff = RDate2 - RDate1 'Initial date difference required
to ensure next record within 5 days when enter loop

        Do While Date_Diff < 6
        'Uses last known YminSMC if gap is not more than 5 days.
        'Exits loop and requires reinitialisation after rain if >
5days


            Do While Date_Diff = 0
                rstDailyData.MoveNext
                RDate2 = rstDailyData.Fields("Date") 'read new record
date
                Date_Diff = RDate2 - RDate1
                'ie skip records: only one record per day to be
calculated
            Loop

            If Date_Diff > 5 Then 'This traps the situation where the
first valid record is > 5 days after the rain day.
                Exit Do
            End If

            rORHC = rstDailyData.Fields("ORHC")
            rRain = rstDailyData.Fields("ppn_0900")
            rMaxTemp = rstDailyData.Fields("MaxTemp")
            rMinRH = rstDailyData.Fields("MinRH")


            If (rRain > 0) Then
                Call NWCWet(rRain, SMCmin)
                Call NWCWetP(rRain, PMCmin)
            Else
                Call NWCDry(YminSMC, rORHC)
                 NWCP = 0            'PMC remains unchanged on
rainless nights
            End If

            SMCmax = YminSMC + NWC
            PMCmax = YminPMC + NWCP

            fBDU = BDU(rMaxTemp, rMinRH)
```

```
            SMCmin = SMCmax + DDC(fBDU, SMCmax)
            PMCmin = PMCmax + DDCP(fBDU, PMCmax)

            mSMCsj = 1.12 * SMCmin
            mSMCk36 = 1.2 * SMCmin + 0.9
            mSMCk45 = 1.53 * SMCmin - 0.1
            mSMCk12 = 1.61 * SMCmin + 1.7
            mSMCpp = 0.74 * SMCmin + 1.51
            mSMCpr = 0.86 * SMCmin + 1.02

            mPMCsj = 0.75 * PMCmin + 2.19
            mPMCk36 = 0.81 * PMCmin + 2.98
            mPMCk45 = PMCmin
            mPMCk12 = 1.26 * PMCmin + 2.28

            rstNewTable.AddNew
            rstNewTable.Fields("Date_") = RDate2
            rstNewTable.Fields("SMCsj") = mSMCsj
            rstNewTable.Fields("SMCk36") = mSMCk36
            rstNewTable.Fields("SMCk45") = mSMCk45
            rstNewTable.Fields("SMCk12") = mSMCk12
            rstNewTable.Fields("SMCpp") = mSMCpp
            rstNewTable.Fields("SMCpr") = mSMCpr
            rstNewTable.Fields("SMCnj") = SMCmin
            rstNewTable.Fields("SMCnj") = SMCmin
            rstNewTable.Fields("PMCsj") = mPMCsj
            rstNewTable.Fields("PMCk36") = mPMCk36
            rstNewTable.Fields("PMCk45") = mPMCk45
            rstNewTable.Fields("PMCk12") = mPMCk12

            rstNewTable.Update  'Write SMC value to the table for
that date.

            YminSMC = SMCmin   'Retains SMC value for next days
calculation
            YminPMC = PMCmin

            RDate1 = rstDailyData.Fields("Date")  'Resets Date1 value
for next iteration

            rstDailyData.MoveNext

            If rstDailyData.EOF Then
                Exit Do
            End If


            RDate2 = rstDailyData.Fields("Date") 'read record date
            Date_Diff = RDate2 - RDate1

        Loop
    Loop
    rstDailyData.Close
    Set rstDailyData = Nothing
    RemoveChangesToTable (InputTableName)

    dbsRdBk.Close
    Set dbsRdBk = Nothing
```

```
End Sub

Sub NWCWet(Rain As Double, YSMCa As Double)

Dim A As Double
Dim B As Double
Dim X As Double

If (YSMCa >= 200) Then
YSMCa = 200
End If
'Equation application bound

    A = 121.42 - 94.27 / (1 + 107.55 * Exp(-0.037 * YSMCa))
    B = 101.71 / (1 + 17.13 * Exp(-0.017 * YSMCa))
    X = -0.84 - 0.62 / (1 + 1087.88 * Exp(-0.053 * YSMCa))

    If (Rain > 65) Then
        Rain = 65
'equation application bound

    End If

    NWC = A / (1 + B * Exp(Log(Rain) * X))

End Sub



Sub NWCDry(YSMCa As Double, ORHC As Double)

Dim Y As Double
Dim Z As Double

If (YSMCa >= 160) Then
YSMCa = 160
End If
'application bound

If (ORHC > 100) Then
ORHC = 100
End If
'ORHC application bound

Y = 0.29 / (1 + 1.34 * Exp(-0.019 * YSMCa))
Z = 51.61 - 367.12 * (0.29 / (1 + 1.34 * Exp(-0.019 * YSMCa)))

NWC = Y * ORHC + Z

End Sub



Function BDU(MaxTemp As Double, MinRH As Double)


    Dim C As Double
    Dim D As Double
```

```
    Dim E As Double


    If (MaxTemp > 48) Then
       MaxTemp = 48
    Else
        If (MaxTemp < 8) Then
            MaxTemp = 8
        End If
    ' application bounds

    End If

    If (MinRH > 90) Then
        MinRH = 90
    End If

    C = 57.29 / (1 + 1.93 * Exp(-0.042 * MaxTemp))
    D = 42.77 / (MaxTemp - 5.8)
    E = -0.016 * MaxTemp / (MaxTemp - 5.27)

    BDU = C / (1 + D * Exp(E * (100 - MinRH)))

End Function


Function DDC(fBDU As Double, SMCz As Double)

Dim F As Double
Dim G As Double


    If (fBDU < 6) Then
        fBDU = 6
    End If

    If (fBDU > 35) Then
        fBDU = 35
    End If

    If (SMCz < 6) Then
        SMCz = 6
    End If

    If (SMCz > 200) Then
        SMCz = 200
    End If
'application bounds

    F = (SMCz - 103.79) / ((SMCz - 103.79) ^ 2 - 12643.93) * 12.81 -
0.65
    G = (SMCz - 99.7) / ((SMCz - 99.7) ^ 2 - 25199.32) * 3570.12 -
23.26

    DDC = F * fBDU + G + 10

End Function


Sub CreateSMCTable(TableName As String)
```

```
    Dim SQL As String

    SQL = "CREATE TABLE " & TableName & "(Stn_No Integer, Date_ Date,
SMCnj Double,SMCsj Double, SMCk36 Double, SMCK45 Double, SMCk12
Double, SMCpp Double, SMCpr Double, PMCsj Double, PMCk36 Double,
PMCK45 Double, PMCk12 Double);"

    Call CurrentDb.Execute(SQL)

End Sub


Function getTable(TableName As String) As DAO.Recordset
    Dim pDatabase As DAO.Database
    Dim pRecordSet As DAO.Recordset

    Set pDatabase = Application.CurrentDb
    Set pRecordSet = pDatabase.OpenRecordset(TableName)

    Set getTable = pRecordSet

End Function

Function TableExists(ByVal TableName As String) As Boolean

    On Error GoTo Except
    TableExists = True
    Call DoCmd.SelectObject(acTable, TableName, True)
    Exit Function

Except:
    TableExists = False
    Err.Clear

End Function

Function QueryExists(ByVal QueryName As String) As Boolean



    On Error GoTo Except
    QueryExists = True
    Call DoCmd.SelectObject(acQuery, QueryName, True)
    Exit Function

Except:
    QueryExists = False
    Err.Clear

End Function

Sub Set_Source(TableName As String)

    Dim SQL As String
    Dim qSource As QueryDef
    Dim dbsRdBk As Database

    Set dbsRdBk = Application.CurrentDb
```

```
    SQL = "SELECT DateValue([Day] & '/ ' & [Month] & '/' & [Yr]) AS
[Date], [" & TableName & "].* FROM " & TableName & ";"

    Set qSource = dbsRdBk.CreateQueryDef("SOURCETABLE", SQL)

End Sub

Sub MakeChangesToTable(TableName As String)

    Dim SQL As String
    SQL = "ALTER TABLE " & TableName & " ADD COLUMN ID_Time1
Autoincrement, CONSTRAINT PKey PRIMARY KEY (Yr,Month,Day,Hr,Min));"
    Call CurrentDb.Execute(SQL)

End Sub

Sub RemoveChangesToTable(TableName As String)

    CurrentDb.Close
    Dim SQL As String
    SQL = "ALTER TABLE " & TableName & " DROP COLUMN ID_Time1,
CONSTRAINT PKey);"
    Call CurrentDb.Execute(SQL)

End Sub

Sub NWCWetP(Rain As Double, YPMCa As Double)

Dim A As Double
Dim B As Double
Dim X As Double


If (YPMCa >= 200) Then
YPMCa = 200
End If
'Equation application bound

    A = 121.42 - 94.27 / (1 + 107.55 * Exp(-0.037 * YPMCa))
    B = 101.71 / (1 + 17.13 * Exp(-0.017 * YPMCa))
    X = -0.84 - 0.62 / (1 + 1087.88 * Exp(-0.053 * YPMCa))

    If (Rain > 65) Then
        Rain = 65
'equation application bound

    End If

    NWCP = A / (1 + B * Exp(Log(Rain) * X))

End Sub
Function DDCP(fBDU As Double, PMCz As Double)

Dim H As Double
Dim I As Double


    If (fBDU < 1) Then
        fBDU = 1
    End If
```

```
    If (fBDU > 35) Then
        fBDU = 35
    End If

    If (PMCz < 11) Then
        PMCz = 11
    End If

    If (PMCz > 200) Then
        PMCz = 200
    End If
'application bounds

    H = (PMCz - 112.15) / ((PMCz - 112.15) ^ 2 - 21835.42) * 40.96 -
0.46
    I = (PMCz - 140.78) / ((PMCz - 140.78) ^ 2 - 24819.47) * 298.78

    DDCP = H * fBDU + I

End Function
```

Calculation for a List of Stations: SMC_PMC_Batch

```
Attribute VB_Name = "SMC_PMC_Batch"
Option Compare Database

Option Explicit

Global NWC As Double
Global NWCP As Double




Sub SMC()

'This calculates SMC and PMC values for SW forest types for a list of
weather stations using Beck's equations for the FFBT.
'WARNING: It will overwrite any tables of the same name as the output
table XXXX_SMC, where XXX is the station number.
'All data tables must contain hourly AWS data and be in the format of
the tables in this database.
'If the program is interrupted before completion, it will display an
error message 'Field ID_Time1 already exists'. This occurs
'because the programme was stopped before the temporary changes made
to the table were deleted. The field and the primary key
'must be deleted manually from the table in design view.
'Chris Muller, October 2007

    Dim dbsRdBk As DAO.Database
    Dim rstStnList As DAO.Recordset
    Dim rstDailyData As DAO.Recordset
    Dim Field As DAO.Field
    Dim SMCmin As Double
    Dim SMCmax As Double
    Dim PMCmin As Double
    Dim PMCmax As Double
    Dim YminSMC As Double
    Dim YmaxSMC As Double
    Dim YminPMC As Double
    Dim YmaxPMC As Double
    Dim rMaxTemp As Double
    Dim rMinRH As Double
    Dim rRain As Double
    Dim rORHC As Double
    Dim InputTableName As String
    Dim InputList As String
    Dim OutputTableName As String
    Dim QueryName As String
    Dim Stn As String

    Dim Response As String
    Dim rstNewTable As DAO.Recordset


    Dim fBDU As Double
```

```
    Dim RDate1 As Date
    Dim RDate2 As Date
    Dim Date_Diff As Integer

    Dim mSMCsj As Double
    Dim mSMCk36 As Double
    Dim mSMCk45 As Double
    Dim mSMCk12 As Double
    Dim mSMCpp As Double
    Dim mSMCpr As Double
    Dim mPMCsj As Double
    Dim mPMCk36 As Double
    Dim mPMCk45 As Double
    Dim mPMCk12 As Double

'MAIN

Set dbsRdBk = Application.CurrentDb

   InputList = InputBox("Enter name of data table containing the list
of stations") 'Enter StnList table name

    If InputList = "" Then 'ie if the cancel option is chosen
        Exit Sub
    End If


    Response = MsgBox("WARNING: this program creates a file of the
form 'StnNo_SMC' where 'StnNo' is the station number in the input
list of stations. This will overwrite any exisiting tables of the
same name without further warning. Do you want to continue?",
vbYesNo)
    If Response = vbNo Then
        Exit Sub
    End If


Set rstStnList = dbsRdBk.OpenRecordset(InputList)

rstStnList.MoveFirst

Do While Not rstStnList.EOF 'Initiates looping through all
calculations for each Met Station with valid records

    InputTableName = rstStnList.Fields("Stn_No")

    MakeChangesToTable (InputTableName) 'Adds required autonumber
field and index

    If QueryExists("SOURCETABLE") = True Then
       DoCmd.DeleteObject acQuery, "SOURCETABLE"
    End If

    Set_Source (InputTableName)

    Set rstDailyData = dbsRdBk.OpenRecordset("DailyData")

    If Not rstDailyData.EOF Then  'Checks first that there are valid
records in the file
        Stn = rstDailyData.Fields("Stn_No")
```

```
        OutputTableName = InputTableName & "_SMC"

         If (TableExists(OutputTableName) = True) Then
            DoCmd.DeleteObject acTable, OutputTableName
        End If

        CreateSMCTable OutputTableName
        Set rstNewTable = getTable(OutputTableName)



        rstDailyData.MoveFirst

        'ensures the initial FindNext in the loop finds the first day
rain >10

        Do While Not rstDailyData.EOF 'Loop calculates daily MC%
            rstDailyData.FindNext ("ppn_0900 > 10")
            'finds starting record, and if more than 5 days records
missing, reinitiates at next rainfall event

            If rstDailyData.NoMatch Then
                Exit Do
            End If
            ' if no rain days before end of file to intiate or
reinitiate

            RDate1 = rstDailyData.Fields("Date") 'date of rain day
            rstDailyData.MoveNext
            RDate2 = rstDailyData.Fields("Date") ' date of first
record to be calculate

            SMCmin = 60   'initialise value for first record
            YminSMC = 60  'initialise for use in next days
calculation
            PMCmin = 100   'initialise value for first record
            YminPMC = 100  'initialise for use in next days
calculation

            Date_Diff = RDate2 - RDate1 'Initial date difference
required to ensure next record within 5 days when enter loop

                Do While Date_Diff < 6 And Not rstDailyData.EOF
                    'Uses last known YminSMC if gap is not more than
5 days.
                    'Exits loop and requires reinitialisation after
rain if > 5days

                    Do While Date_Diff = 0 And Not rstDailyData.EOF
                        rstDailyData.MoveNext
                        RDate2 = rstDailyData.Fields("Date") 'read
new record date
                        Date_Diff = RDate2 - RDate1
                        'ie skip records: only one record per day to
be calculated
                    Loop

                    rORHC = rstDailyData.Fields("ORHC")
                    rRain = rstDailyData.Fields("ppn_0900")
                    rMaxTemp = rstDailyData.Fields("MaxTemp")
```

```
                    rMinRH = rstDailyData.Fields("MinRH")

                    If (rRain > 0) Then
                        Call NWCWet(rRain, SMCmin)
                        Call NWCWetP(rRain, PMCmin)
                    Else:
                        Call NWCDry(YminSMC, rORHC)
                        NWCP = 0            'PMC remains unchanged on
rainless nights
                    End If

                    SMCmax = YminSMC + NWC
                    PMCmax = YminPMC + NWCP

                    fBDU = BDU(rMaxTemp, rMinRH)

                    SMCmin = SMCmax + DDC(fBDU, SMCmax)
                    PMCmin = PMCmax + DDCP(fBDU, PMCmax)

                    mSMCsj = 1.12 * SMCmin
                    mSMCk36 = 1.2 * SMCmin + 0.9
                    mSMCk45 = 1.53 * SMCmin - 0.1
                    mSMCk12 = 1.61 * SMCmin + 1.7
                    mSMCpp = 0.74 * SMCmin + 1.51
                    mSMCpr = 0.86 * SMCmin + 1.02

                    mPMCsj = 0.75 * PMCmin + 2.19
                    mPMCk36 = 0.81 * PMCmin + 2.98
                    mPMCk45 = PMCmin
                    mPMCk12 = 1.26 * PMCmin + 2.28

                    rstNewTable.AddNew
                    rstNewTable.Fields("Stn_No") = Stn
                    rstNewTable.Fields("Date_") = RDate2
                    rstNewTable.Fields("SMCsj") = mSMCsj
                    rstNewTable.Fields("SMCk36") = mSMCk36
                    rstNewTable.Fields("SMCk45") = mSMCk45
                    rstNewTable.Fields("SMCk12") = mSMCk12
                    rstNewTable.Fields("SMCpp") = mSMCpp
                    rstNewTable.Fields("SMCpr") = mSMCpr
                    rstNewTable.Fields("SMCnj") = SMCmin
                    rstNewTable.Fields("PMCsj") = mPMCsj
                    rstNewTable.Fields("PMCk36") = mPMCk36
                    rstNewTable.Fields("PMCk45") = mPMCk45
                    rstNewTable.Fields("PMCk12") = mPMCk12

                    rstNewTable.Update  'Write SMC and PMC values to
the table for that date.

                    YminSMC = SMCmin   'Retains SMC value for next
days calculation
                    YminPMC = PMCmin

                    RDate1 = rstDailyData.Fields("Date")  'Resets
Date1 value for next iteration

                    rstDailyData.MoveNext

                    If rstDailyData.EOF Then
                        Exit Do
```

```
                    End If

                    RDate2 = rstDailyData.Fields("Date") 'read record
date
                    Date_Diff = RDate2 - RDate1

                Loop  'Loop through daily calculation while any gap
in records is <6 days

            Loop 'Loops to find next rainfall initiation event if not
EOF

            rstNewTable.Close

        Else: MsgBox (InputTableName & " does not contain all the
records necessary to calculate MC%. No Table " & InputTableName &
"_SMC will be created")

        End If

        rstDailyData.Close
        Set rstDailyData = Nothing
        RemoveChangesToTable (InputTableName)

        Set rstNewTable = Nothing
        rstStnList.MoveNext



Loop ' to next station

dbsRdBk.Close
Set dbsRdBk = Nothing

End Sub


Sub NWCWet(Rain As Double, YSMCa As Double)

Dim A As Double
Dim B As Double
Dim X As Double


If (YSMCa >= 200) Then
YSMCa = 200
End If
'Equation application bound

    A = 121.42 - 94.27 / (1 + 107.55 * Exp(-0.037 * YSMCa))
    B = 101.71 / (1 + 17.13 * Exp(-0.017 * YSMCa))
    X = -0.84 - 0.62 / (1 + 1087.88 * Exp(-0.053 * YSMCa))

    If (Rain > 65) Then
        Rain = 65
'equation application bound

    End If

    NWC = A / (1 + B * Exp(Log(Rain) * X))
```

```
End Sub



Sub NWCDry(YSMCa As Double, ORHC As Double)

Dim Y As Double
Dim Z As Double

If (YSMCa >= 160) Then
YSMCa = 160
End If
'application bound

If (ORHC > 100) Then
ORHC = 100
End If
'ORHC application bound

Y = 0.29 / (1 + 1.34 * Exp(-0.019 * YSMCa))
Z = 51.61 - 367.12 * (0.29 / (1 + 1.34 * Exp(-0.019 * YSMCa)))

NWC = Y * ORHC + Z

End Sub



Function BDU(MaxTemp As Double, MinRH As Double)


    Dim C As Double
    Dim D As Double
    Dim E As Double


    If (MaxTemp > 48) Then
       MaxTemp = 48
    Else
        If (MaxTemp < 8) Then
            MaxTemp = 8
        End If
    ' application bounds

    End If

    If (MinRH > 90) Then
        MinRH = 90
    End If

    C = 57.29 / (1 + 1.93 * Exp(-0.042 * MaxTemp))
    D = 42.77 / (MaxTemp - 5.8)
    E = -0.016 * MaxTemp / (MaxTemp - 5.27)

    BDU = C / (1 + D * Exp(E * (100 - MinRH)))

End Function
```

```
Function DDC(fBDU As Double, SMCz As Double)

Dim F As Double
Dim G As Double


    If (fBDU < 6) Then
        fBDU = 6

    End If

    If (fBDU > 35) Then
        fBDU = 35
    End If

    If (SMCz < 6) Then
        SMCz = 6
    End If

    If (SMCz > 200) Then
        SMCz = 200
    End If
'application bounds

    F = (SMCz - 103.79) / ((SMCz - 103.79) ^ 2 - 12643.93) * 12.81 -
0.65
    G = (SMCz - 99.7) / ((SMCz - 99.7) ^ 2 - 25199.32) * 3570.12 -
23.26

    DDC = F * fBDU + G + 10

End Function


Sub CreateSMCTable(TableName As String)
    Dim SQL As String

    SQL = "CREATE TABLE " & TableName & "(Stn_No Integer, Date_ Date,
SMCnj Double,SMCsj Double, SMCk36 Double, SMCK45 Double, SMCk12
Double, SMCpp Double, SMCpr Double, PMCsj Double, PMCk36 Double,
PMCK45 Double, PMCk12 Double);"

    Call CurrentDb.Execute(SQL)

End Sub



Function getTable(TableName As String) As DAO.Recordset
    Dim pDatabase As DAO.Database
    Dim pRecordSet As DAO.Recordset

    Set pDatabase = Application.CurrentDb
    Set pRecordSet = pDatabase.OpenRecordset(TableName)

    Set getTable = pRecordSet

End Function
```

```
Function TableExists(ByVal TableName As String) As Boolean

    On Error GoTo Except
    TableExists = True
    Call DoCmd.SelectObject(acTable, TableName, True)
    Exit Function

Except:
    TableExists = False
    Err.Clear

End Function

Function QueryExists(ByVal QueryName As String) As Boolean



    On Error GoTo Except
    QueryExists = True
    Call DoCmd.SelectObject(acQuery, QueryName, True)
    Exit Function

Except:
    QueryExists = False
    Err.Clear

End Function

Sub Set_Source(TableName As String)

    Dim SQL As String
    Dim qSource As QueryDef
    Dim dbsRdBk As Database

    Set dbsRdBk = Application.CurrentDb

    SQL = "SELECT DateValue([Day] & '/ ' & [Month] & '/' & [Yr]) AS
[Date], [" & TableName & "].* FROM " & TableName & ";"

    Set qSource = dbsRdBk.CreateQueryDef("SOURCETABLE", SQL)

End Sub

Sub MakeChangesToTable(TableName As String)

    Dim SQL As String
    SQL = "ALTER TABLE " & TableName & " ADD COLUMN ID_Time1
Autoincrement, CONSTRAINT PKey PRIMARY KEY (Yr,Month,Day,Hr,Min));"
    Call CurrentDb.Execute(SQL)

End Sub

Sub RemoveChangesToTable(TableName As String)

    CurrentDb.Close
    Dim SQL As String
    SQL = "ALTER TABLE " & TableName & " DROP COLUMN ID_Time1,
CONSTRAINT PKey);"
    Call CurrentDb.Execute(SQL)
```

```
End Sub

Sub NWCWetP(Rain As Double, YPMCa As Double)

Dim A As Double
Dim B As Double
Dim X As Double

If (YPMCa >= 200) Then
YPMCa = 200
End If
'Equation application bound

    A = 121.42 - 94.27 / (1 + 107.55 * Exp(-0.037 * YPMCa))
    B = 101.71 / (1 + 17.13 * Exp(-0.017 * YPMCa))
    X = -0.84 - 0.62 / (1 + 1087.88 * Exp(-0.053 * YPMCa))

    If (Rain > 65) Then
        Rain = 65
'equation application bound

    End If

    NWCP = A / (1 + B * Exp(Log(Rain) * X))

End Sub
Function DDCP(fBDU As Double, PMCz As Double)

Dim H As Double
Dim I As Double


    If (fBDU < 1) Then
        fBDU = 1
    End If

    If (fBDU > 35) Then
        fBDU = 35
    End If

    If (PMCz < 11) Then
        PMCz = 11
    End If

    If (PMCz > 200) Then
        PMCz = 200
    End If
'application bounds

    H = (PMCz - 112.15) / ((PMCz - 112.15) ^ 2 - 21835.42) * 40.96 -
0.46
    I = (PMCz - 140.78) / ((PMCz - 140.78) ^ 2 - 24819.47) * 298.78

    DDCP = H * fBDU + I

End Function
```

SQL Queries

Note on ORHC calculation

The overnight RH count is the count of the area above 70% RH on a thermo hydrograph trace, in units 2 % * 2 hrs.

The following scripts are linked, and run in the sequence shown.

A preliminary requirement to running the queries is to create an autonumber field ID_Time1 in the source table (ie the actual table, not the SourceTable query). This is automatically done in the VBA Scripts, which creates the autonumber field and then deletes it when the SMC table has been created. However, if you wish to run ORHC query outside of the script, the auto-number field must be manually created in design view.

Sourcetable Query

Creates date and provides a simple way of using subsequent queries and scripts without multiple filename replacements by using the same SOURCETABLE name in those queries and instead replacing the station table (in the case show, [9538]) in this query

```
SELECT

 DateValue([Day] & "/ " & [Month] & "/" & [Yr]) AS [Date],

[9538].*

FROM 9538;
```

Data_Time2 Query

Creates a duplicate table with the records offset by 1

```
SELECT

SOURCETABLE.*,

[ID_Time1]-1 AS ID_Time2,

FROM SOURCETABLE;
```

This sets the values for ID-Time2 equivalent to ID_Time1 one record ahead.

ORHC_Hourly Query

Calculates the average ORH units for each hour.

SELECT
Data_Time2.Date,

Round(([SourceTable.Hr]+(SourceTable.Min/60)),2) AS DecHrTime1,	Convert hours and minutes to decimal hours
Round(([Data_Time2].[Hr]+([Data_Time2].[Min]/60)),2) AS DecHrTime2,	
IIf([DecHrTime1]<9, [DecHrTime1]+24, [DecHrTime1]) AS Time1,	Creates sequential times after midnight till 0800 to permit ready calculation of time interval. Time1 is the time at the commencement of the recording interval. Note only records between 2000 and 0800 have been selected.
IIf([DecHrTime2]<9, [DecHrTime2]+24, [DecHrTime2]) AS Time2,	Time at the end of the recoding interval
SOURCETABLE.RH AS RH1,	RH1 is the RH at the beginning of the interval
Data_Time2.RH AS RH2,	RH2 is Rh at end of interval
Round(([Time2]-[Time1]),2) AS Time_Diff,	Time interval
IIf([Time2]<=24,[Date]+1,[Date]) AS ORHC_Date,	Identifies all the ORH data from 2000hrs previous evening to 0800hrs by the same (morning) date so the period can be grouped.
IIf([Time_Diff]<5, ([RH1]+[RH2])/2, 50/12*[Time_Diff]) AS AvPeriodRH,	This identifies missing data, assigns the equivalent of 50 ORH count to missing data (see Red Book), and calculates the average RH for the time period for valid data.
IIf([AvPeriodRH]>70, ([AvPeriodRH]-70)*[Time_Diff]/4, 0) AS PeriodRHCount	One ORHC unit is 2hr by 2% above 70% RH

FROM SOURCETABLE INNER JOIN Data_Time2 ON
SOURCETABLE.ID_Time1 = Data_Time2.ID_Time2

WHERE
(((SOURCETABLE.RH) Is Not Null)
AND
((Data_Time2.RH) Is Not Null)
AND
((SOURCETABLE.Hr)>=20 Or (Data_Time2.Hr)<=8));

Only selects valid RH records

Time filter is based on Time1 for beginning of period, and time2 for end

ORHC Query

Sums the hourly ORH units.

SELECT

ORHC_Hourly.Date AS [Date],

Round(Sum(ORHC_Hourly.PeriodRHCount),1) AS ORHC

FROM ORHC_Hourly

GROUP BY ORHC_Hourly.Date;

MaxMin Query

Determines the daily maximum temperature and minimium RH

SELECT
ORHC_Hourly.ORHC_Date AS [Date],

Round(Sum(ORHC_Hourly.PeriodRHCount),1) AS ORHC

FROM ORHC_Hourly

GROUP BY ORHC_Hourly.ORHC_Date;

0800Rain

Selects o800 rainfall records. As AWS readings are not always on the hour, a range is used to select records. This may result in multiple records that need to be subsequently filtered out when calculating the SMC.

```
SELECT

SOURCETABLE.Stn_No

SOURCETABLE.Date,

SOURCETABLE.Hr,

SOURCETABLE.Min,

SOURCETABLE.Ppn_0900

FROM SOURCETABLE

WHERE
(((((SOURCETABLE.Hr)=8) AND
((SOURCETABLE.Min)<5))
OR
(((SOURCETABLE.Hr)=7) AND
((SOURCETABLE.Min)>55))) AND
```

Note: As the AWS records are not always precisely on the hour a small range has been allowed. This may result in more than one record for each day> This needs to be filtered in subsequent calculations.

```
 ((SOURCETABLE.Ppn_0900) Is Not Null));
```

Only use valid records

DailyData

Combines the data required for calculation of SMC in one location to facilitate programming. Note there may be duplicate daily records that will need to be filtered (see notes under 0800_Rain).

```
 SELECT

[0800Rain].Stn_No

[0800Rain].Date

[0800Rain].Ppn_0900,

ORHC.ORHC,

MaxMin.MaxTemp,

MaxMin.MinRH

FROM
```

See note in 0800 rain re multiple daily records.

```
(0800Rain INNER JOIN MaxMin ON
[0800Rain].Date = MaxMin.Date)

INNER JOIN ORHC ON MaxMin.Date = ORHC.Date

WHERE
((([0800Rain].Ppn_0900) Is Not Null)
AND
((ORHC.ORHC) Is Not Null)
AND
```

Ensures valid data for SMC calculation

```
((MaxMin.MaxTemp) Is Not Null)
 AND
((MaxMin.MinRH) Is Not Null));
```

PercentileCondit.mdb DATABASE

VBA Module

Calculate percentiles for a list of stations: BatchWeatherPercentileRP

This script calls SQL queries outlined in the following sections.

```
Attribute VB_Name = "BatchWeatherPercentileRP"
Option Compare Database


Sub RunList()


' This calculates the 95percentile values for a list of weather
stations using the queries in a batch process.
' The stations in the SW land Division will have forest values
calculated, and use the curing table for grassland calculations.
' For met stations in the rest of the State grassland calculations
assume fully cured.
' Reuslts are appended to the table BatchWeatherPercentileOutput.
This table must be present
' WARNING: the append query calculates the McArthur FDI for each
station for all the locations for which DF/SDI has been
' provided. These do not all apply to that location. It is necessary
to manually transfer the appropriate values for the
' station to the 95MCAFDI field. This can readily be done by
selecting stations by location after import into ArcMap and
' calculating the field on selected stations.



Dim dbsThisDB As DAO.Database
Dim rstStnList As DAO.RecordSet
Dim InputList As String
Dim MetTableName As String
Dim Test As String
Dim rstSMCSource As DAO.RecordSet
Dim rstSourceTable As DAO.RecordSet

'MAIN

Set dbsThisDB = Application.CurrentDb

InputList = InputBox("Enter name of data table containing the list of
stations") 'Enter StnList table name

If InputList = "" Then 'ie if the cancel option is chosen
    Exit Sub
End If

Set rstStnList = dbsThisDB.OpenRecordset(InputList)
```

```
rstStnList.MoveFirst

Do While Not rstStnList.EOF
    If QueryExists("SOURCETABLE") = True Then
       DoCmd.DeleteObject acQuery, "SOURCETABLE"
    End If

    If QueryExists("SMC_SOURCETABLE") = True Then
       DoCmd.DeleteObject acQuery, "SMC_SOURCETABLE"
    End If

    MetTableName = rstStnList.Fields("Stn_No")

    If TableExists(MetTableName) Then ' Note both Met Data and SMC
data table must be present

       If TableExists(MetTableName & "_SMC") Then 'Checks SMC data
table present
            Set_Source (MetTableName)
            Set_SMCSource (MetTableName)

            Set rstSMCSource =
dbsThisDB.OpenRecordset("SMC_SourceTable")
            Set rstSourceTable =
dbsThisDB.OpenRecordset("SourceTable")

            If rstSMCSource.EOF Then
                MsgBox ("No records in SMC table. Check if there was
a day with 10mm rain to intiate SMC calculations. Clik OK to skip
this station and continue.")
                rstSMCSource.Close
                GoTo NoSMCRecord
            End If

            Test = rstSourceTable.Fields("Division")

            If Test = "SW" Then
                dbsThisDB.Execute ("ROS_95percentileRP")
            Else
                dbsThisDB.Execute ("ROS_95percentile_NW")
            End If
            rstSMCSource.Close
            rstSourceTable.Close

        Else
            MsgBox ("Table " & MetTableName & "_SMC not found. Click
OK to skip this Station and continue")
        End If

    Else
        MsgBox ("Table " & MetTableName & " not found. Click OK to
skip this Station and continue")
    End If

NoSMCRecord:


   rstStnList.MoveNext

Loop
```

```
rstStnList.Close
Set rstStnList = Nothing
Set rstSMCSource = Nothing
Set rstSourceTable = Nothing


dbsThisDB.Close
Set dbsThisDB = Nothing

End Sub


Sub Set_Source(TableName As String)

    Dim SQL As String
    Dim qSource As QueryDef
    Dim dbsThisDB As Database

    Set dbsThisDB = Application.CurrentDb

    SQL = "SELECT DateValue([Day] & '/ ' & [Month] & '/' & [Yr]) AS
[Date], [" & TableName & "].*, Weather_Districts.Division FROM " &
TableName & " INNER JOIN Weather_Districts ON [" & TableName &
"].Stn_No = Weather_Districts.STN_NO;"

    Set qSource = dbsThisDB.CreateQueryDef("SOURCETABLE", SQL)

End Sub
Sub Set_SMCSource(TableName As String)

    Dim SQL As String
    Dim qSmcSource As QueryDef
    Dim dbsThisDB As Database

    Set dbsThisDB = Application.CurrentDb

    SQL = "SELECT  [" & TableName & "_SMC].* FROM " & TableName &
"_SMC;"

    Set qSmcSource = dbsThisDB.CreateQueryDef("SMC_SourceTable", SQL)

End Sub

Function QueryExists(ByVal QueryName As String) As Boolean



    On Error GoTo Except
    QueryExists = True
    Call DoCmd.SelectObject(acQuery, QueryName, True)
    Exit Function

Except:
    QueryExists = False
    Err.Clear

End Function
```

```
Function TableExists(ByVal TableName As String) As Boolean

    On Error GoTo Except

    TableExists = True
    Call DoCmd.SelectObject(acTable, TableName, True)
    Exit Function

Except:
    TableExists = False
    Err.Clear

End Function
```

SQL Queries

The following queries are listed in the order in which they execute. Where there is more than one form of the query depending on location (ie SW Land Division or elsewhere) or selected period, they have been grouped together, notwithstanding that only one of these will be required for a particular subsequent query.

Identifying the source data

To avoid having to change the table name in numerous scripts/queries, a single table *SourceTable* is used that is common to all scripts. A second table *SMC_SourceTable* is used for the FDI queries that require SMC. All queries can be run for any table by altering the table in *SourceTable* and *SMC_SourceTable.* These changes are made automatically when called from the module *BatchWeatherPercentileRP.*

SourceTable Query

Replace XXXX with the name of the table to be used in the calculations.

SELECT
DateValue([Day] & '/ ' & [Month] & '/' & [Yr]) AS [Date],
[XXXX].*,
Weather_Districts.Division
FROM XXXX INNER JOIN Weather_Districts ON [XXXX].Stn_No =
Weather_Districts.STN_NO;

SMC_SourceTable Query

Replace XXXX with the name of the table to be used in the calculations.

SELECT [XXXX_SMC].*
FROM XXXX_SMC;

Grasslands and Shrublands: GROS Scripts

Calculates hourly ROS for:

- natural pasture and crop (Rn),
- cut/grazed pasture (Rcu),
- heavily grazed (Re) pasture.
- Natural pasture under woodland with 2:1 wind ratio (Rn2)
- Mallee heath (Rmh)
- Shrubland heath (Rsh)

If calculations exceed application bounds, they are assigned default values that results in 0 for ROS if at the "wet" end of the scale, and the upper application bound value at the higher ROS end of the spectrum. All records where the cumulative (0900) rain exceeds 2mm (ie effective rainfall)are assigned 0 for Grassland ROS.

For the *GROS* and *GROS_Harvest* queries, curing has been assigned in the SW_Curing table as follows:

- for periods where there are curing records for weather districts, the recorded values are assigned on a "half monthly" basis. i.e. for each District the mean of any records that fall in the first 15 days of the month in that year are assigned to each of the 15 days, and those in the second half of the month to the balance of the days in that month.
- For years where there are no record, the mean half monthly value for all years is assigned.
- For periods after records in any year until and including May, 100% curing is assumed. Note, this may result in an overestimate of ROS if the period for calculation is extended beyond the RP, and a check would be required. For the Restricted period, it assumes that once fully cured, this will remain the case for the balance of the period. This may also result in an overestimate if there is rainfall resulting in growth prior to the end of the RP.
- A nominal 5% is assigned to values prior to records. This is not significant, as the application bounds for the grasslands ROS equations is 50%. ROS 0 is assigned below this.

The **GROS_NW** script is identical, except a value of 100 is assigned for curing.

Prior to running these queries, open the query SourceTable in design view, replace the current table with the station table desired, and use * to select all fields. Note the Query SourceTable calculates the date from the Day, Month and Year fields.

GROS Query

This query returns all records for the restricted period for the selected station.

SELECT	
[SourceTable].Stn_No,	
[Stn Details].[Stn Name],	
SourceTable.Date,	
[SourceTable].Yr,	
[SourceTable].Month,	
[SourceTable].Day,	
[SourceTable].Hr,	

[SourceTable].Ppn_0900,	
[SourceTable].Temp,	
[SourceTable].RH,	
[SourceTable].Wnd_Spd,	
[SourceTable].Wnd_Dir,	
	GRASSLAND (Noble et al)
SW_Curing.Curing,	See assumptions in curing table
9.58 - 0.205*[Temp] +0.138*[RH] AS Mf,	McArthur Mk IV Cheney et al 1989 No range trapping as done in tM
IIf([Mf]<2, Exp(-0.108*2), IIf([Mf]>=2 And [Mf]<=12, Exp(-0.108*[Mf]), IIf([Mf]>12 And [Mf]<24 And [Wnd_Spd]<10, 0.684-0.0342*[Mf], IIf([Mf]>12 And [Mf]<24 And [Wnd_Spd]>10, 0.547-0.0228*[Mf], 0)))) AS tM,	Assigns limit value if MC <2, 0 if MC >24 (Application bounds) and appropriate equation between.
IIf(Curing<50, 0, 1.120 / (1 + 59.2 * exp (-0.124 * ([Curing]-50)))) AS tC,	Application bound for Curing
Round(IIf([Ppn_0900]>2, 0,	i.e. if “effective rain” (>2mm), assign 0 to ROS, else
IIf([Wnd_Spd]<=5, (0.054+0.269*[Wnd_Spd])*[tM]*[tC]*1000,	ROS m/hr natural/crop Wind<5
(1.4+0.838*Exp(Log([Wnd_Spd]-5)*0.844))* [tM]* [tC]*1000)) ,0) AS Rn,	ROS m/hr natural pasture/crop Wind >5
Round(IIf([Ppn_0900]>2, 0,	i.e. if “effective rain“ (>2mm), assign 0 to

	ROS, else
IIf([Wnd_Spd]<=5, (0.054+0.209*[Wnd_Spd])*[tM]*[tC]*1000,	ROS m/hr cut/grazed, Wind <5
(1.1+0.715*Exp(Log([Wnd_Spd]-5)*0.844)) *[tM]* [tC]*1000)) ,0) AS Rcu,	ROS m/hr cut/grazed Wind > 5
Round(0.5 * Rcu,0) AS Re,	ROS eaten out.
Round(IIf([Ppn_0900]>2, 0, IIf([Wnd_Spd]/2<=5, (0.054+0.269*[Wnd_Spd]/2)*[tM]*[tC]*1000, (1.4+0.838*Exp(Log([Wnd_Spd]/2-5)*0.844))*[tM]*[tC]*1000)) ,0) AS Rn2,	ROS natural pasture under woodland canopy with 2:1 wind ratio
	MALLEE HEATH (McCaw)
Round(IIf([Hr]<12 Or [Ppn_0900]>12.5, 0.113*[RH]-0.218*[Temp]+12.5, 0.132*[RH]-0.168*[Temp]+6.8) ,0) AS Mv,	MC% in pm (CBEF model, Viney 1991) or after rain. (Note, for simplicity, desorption equation applied for only 1 day after rain, not two)
Round(IIF ([Wnd_Spd]=0, 0, IIf([Mv]>8, 0, 3600*(0.292*Exp(Log([Wnd_Spd]/3.6*0.71)*1.05))*Exp(-0.11*[Mv]))) ,0) AS Rmh,	3600 to bring m/sec to m/hr Wind ratio of 0.71 (Equn C1 from thesis) used. 3.6 factor to convert U10 km/hr to U2 m/sec ROS m/sec. Threshold MC 8%
	"Standard" SHRUBLAND HEATH (Catchpole et al)

1.2 AS SH_Ht,	Assume shrub ht 1.2m as “standard”
Round(IIF ([Wnd_spd]=0, 0, (0.801*Exp((Log([Wnd_Spd]*0.71))*1.1)*Exp(Log([SH_Ht])*0.49))*60) ,0) AS Rsh	Use Wind Ratio (0.71) from McCaw for 10m to to 2m *60 to convert ROS m/min to m/hr
FROM (Weather_Districts INNER JOIN (([Stn Details] INNER JOIN SourceTable ON [Stn Details].Stn_No = SourceTable.Stn_No) INNER JOIN Stn_LGA_RPeriod ON SourceTable.Stn_No = Stn_LGA_RPeriod.STN_NO) ON Weather_Districts.Stn_No = [Stn Details].Stn_No) INNER JOIN SW_Curing ON (SourceTable.Date = SW_Curing.Date) AND (Weather_Districts.District = SW_Curing.District)	
WHERE	
((([SourceTable].Temp) Is Not Null)	
AND	
((SourceTable.RH) Is Not Null)	
AND	
((SourceTable.Wnd_Spd) Is Not Null)	
AND	
((([SourceTable].month>[Stn_LGA_Rperiod].RP_StartMonth) OR (([SourceTable].month=[Stn_LGA_Rperiod].RP_StartMonth) AND ([SourceTable].day >=[Stn_LGA_Rperiod].RP_StartDay))	Start Restricted Period
OR	
(([SourceTable].month)< [Stn_LGA_Rperiod].RP_EndMonth) OR (([SourceTable].month)= [Stn_LGA_Rperiod].RP_EndMonth) AND ([SourceTable].day)<=[Stn_LGA_Rperiod].RP_EndDay)<>False));	End Restricted Period and filter for valid records.

GROS_Harvest Query

The script below uses the restricted period starting date, but requires entry of an end month (the Harvest Month). Only records between the beginning of the restricted burning period and end of harvest month will be included.

SELECT	
[SourceTable].Stn_No,	
[Stn Details].[Stn Name],	
SourceTable.Date,	

[SourceTable].Yr,	
[SourceTable].Month,	
[SourceTable].Day,	
[SourceTable].Hr,	
[SourceTable].Ppn_0900,	
[SourceTable].Temp,	
[SourceTable].RH,	
[SourceTable].Wnd_Spd,	
[SourceTable].Wnd_Dir,	
	GRASSLAND (Noble et al)
SW_Curing.Curing,	See assumptions in curing table
9.58 - 0.205*[Temp] +0.138*[RH] AS Mf,	McArthur Mk IV Cheney et al 1989 No range trapping as done in tM
IIf([Mf]<2, Exp(-0.108*2), IIf([Mf]>=2 And [Mf]<=12, Exp(-0.108*[Mf]), IIf([Mf]>12 And [Mf]<24 And [Wnd_Spd]<10, 0.684-0.0342*[Mf], IIf([Mf]>12 And [Mf]<24 And [Wnd_Spd]>10, 0.547-0.0228*[Mf], 0)))) AS tM,	Assigns limit value if MC <2, 0 if MC >24 (Application bounds) and appropriate equation between.
IIf(Curing<50, 0, 1.120 / (1 + 59.2 * exp (-0.124 * ([Curing]-50)))) AS tC,	Application bound for Curing
Round(IIf([Ppn_0900]>2, 0,	i.e. if "effective rain" (>2mm), assign 0 to ROS, else
IIf([Wnd_Spd]<=5, (0.054+0.269*[Wnd_Spd])*[tM]*[tC]*1000,	ROS m/hr natural/crop Wind<5
(1.4+0.838*Exp(Log([Wnd_Spd]-5)*0.844))* [tM]* [tC]*1000)) ,0) AS Rn,	ROS m/hr natural pasture/crop Wind >5

Round(IIf([Ppn_0900]>2, 0,	i.e. if "effective rain" (>2mm), assign 0 to ROS, else
IIf([Wnd_Spd]<=5, (0.054+0.209*[Wnd_Spd])*[tM]*[tC]*1000,	ROS m/hr cut/grazed, Wind <5
(1.1+0.715*Exp(Log([Wnd_Spd]-5)*0.844)) *[tM]* [tC]*1000)) ,0) AS Rcu,	ROS m/hr cut/grazed Wind > 5
Round(0.5 * Rcu,0) AS Re,	ROS eaten out.
Round(IIf([Ppn_0900]>2, 0, IIf([Wnd_Spd]/2<=5, (0.054+0.269*[Wnd_Spd]/2)*[tM]*[tC]*1000, (1.4+0.838*Exp(Log([Wnd_Spd]/2-5)*0.844))*[tM]*[tC]*1000)) ,0) AS Rn2,	ROS natural pasture under woodland canopy with 2:1 wind ratio
	MALLEE HEATH (McCaw)
Round(IIf([Hr]<12 Or [Ppn_0900]>12.5, 0.113*[RH]-0.218*[Temp]+12.5, 0.132*[RH]-0.168*[Temp]+6.8) ,0) AS Mv,	MC% in pm (CBEF model, Viney 1991) or after rain. (Note, for simplicity, desorption equation applied for only 1 day after rain, not two)
Round(IIF ([Wnd_Spd]=0, 0, IIf([Mv]>8, 0, 3600*(0.292*Exp(Log([Wnd_Spd]/3.6*0.71)*1.05))*Exp(-0.11*[Mv]))) ,0) AS Rmh,	3600 to bring m/sec to m/hr Wind ratio of 0.71 (Equn C1 from thesis) used. 3.6 factor to convert U10 km/hr to U2 m/sec ROS m/sec. Threshold MC 8%

	"Standard" SHRUBLAND HEATH (Catchpole et al)
1.2 AS SH_Ht,	Assume shrub ht 1.2m as "standard"
Round(IIF ([Wnd_spd]=0, 0, (0.801*Exp((Log([Wnd_Spd]*0.71))*1.1)*Exp(Log([SH_Ht])*0.49))*60) ,0) AS Rsh	Use Wind Ratio (0.71) from McCaw for 10m to to 2m *60 to convert ROS m/min to m/hr
FROM (Weather_Districts INNER JOIN (([Stn Details] INNER JOIN SourceTable ON [Stn Details].Stn_No = SourceTable.Stn_No) INNER JOIN Stn_LGA_RPeriod ON SourceTable.Stn_No = Stn_LGA_RPeriod.STN_NO) ON Weather_Districts.Stn_No = [Stn Details].Stn_No) INNER JOIN SW_Curing ON (SourceTable.Date = SW_Curing.Date) AND (Weather_Districts.District = SW_Curing.District)	
WHERE	
(SourceTable.Temp Is Not Null	
AND	
SourceTable.RH Is Not Null	
AND	
SourceTable.Wnd_Spd Is Not Null	
AND	
[SourceTable].month>[Stn_LGA_Rperiod].RP_StartMonth OR ([SourceTable].month=[Stn_LGA_Rperiod].RP_StartMonth AND [SourceTable].day >=[Stn_LGA_Rperiod].RP_StartDay)	Start Restricted Period
OR	
(SourceTable.month <= [Harvest_Month] and SourceTable.month > Stn_LGA_Rperiod.RP_StartMonth)	Between start RP and harvest where harvest month before end of year
OR	
(SourceTable.month <= [Harvest_Month] and [Harvest_Month] < Stn_LGA_Rperiod.RP_StartMonth) <>False);	Between start RP and harvest where harvest month in new year.

GROS_NW Query

The **GROS_NW** script is identical to GROS, except a value of 100 is assigned for curing.

Forests and Woodlands: FFBT and McArthur Meter FDIs

FDI Query

Calculates FFDI (ROS standard conditions and fuels) for the restricted period using Beck's equations for the FFB Tables.

This requires use of the SMC_SourceTable query to link the SMC table with the SourceTable.
Important note:.Make sure the SourceTable query contains the *Stn_No* table corresponding to the SMC_*Stn_No* table.

SELECT	
Stn_LGA_RPeriod.STN_NO, SOURCETABLE.Date, SOURCETABLE.Hr, SOURCETABLE.Wnd_Spd, SMC_SourceTable.SMCnj, SMC_SourceTable.SMCsj, SMC_SourceTable.SMCk45, SMC_SourceTable.SMCk36, SMC_SourceTable.SMCk12,	
	NORTHERN JARRAH (Beck)
Iif([SMCnj] > 26, -9999, Iif([SMCnj]<3, 3, [SMCnj])) AS [SMCaNJ],	Application bounds for SMC. Use the new SMCa field in further calcs.
(21.37 - 3.42 * [SMCaNJ] + 0.085 * [SMCaNJ] *[SMCaNJ]) AS [Yj], (48.09 * [SMCaNJ] * exp(-0.60 * [SMCaNJ]) + 11.90) AS [Aj], (-0.0096 * exp(log([SMCNJ])* 1.05) + 0.44) AS [Nj],	
Iif([Wnd_Spd]>56, 11.2, [Wnd_Spd]/5) AS [WINDfg],	5:1 "standard" wind ratio for ROSI. Applic bound 11.2.
Iif ([SMCaNJ]=-9999, 0, ([Yj] + [Aj] * exp([WINDfg] * [Nj]))) AS FDINJ,	NJ FDI, Wind Ratio 5:1
IIf([Wnd_Spd]/4>11.2, 11.2, [Wnd_Spd]/4) AS WINDfg4, IIf([SMCaNJ]=-9999,	NJ ROSI Wind Ratio 4:1

0, ([Yj]+[Aj]*Exp([WINDfg4]*[Nj]))) AS ROSInj4,	
IIf([Wnd_Spd]/3>11.2, 11.2, [Wnd_Spd]/3) AS WINDfg3, IIf([SMCaNJ]=-9999, 0, ([Yj]+[Aj]*Exp([WINDfg3]*[Nj]))) AS ROSInj3,	NJ ROSI Wind Ratio 3:1
IIf([Wnd_Spd]/2>11.2, 11.2, [Wnd_Spd]/2) AS WINDfg2, IIf([SMCaNJ]=-9999, 0, ([Yj]+[Aj]*Exp([WINDfg2]*[Nj]))) AS ROSInj2,	NJ ROSI Wind Ratio 2:1
	KARRI FDI (Beck)
Iif([SMCk45] >= 25, -9999, Iif([SMCk45]<3, 3, [SMCk45])) AS [SMCks],	Karri 45 SMC applic bounds for FDI equn.
(4.88 - 263.78 * exp(log([SMCks])*-1.80)) AS [Yk], (163.4 * exp(log([SMCks]) * -1.18)) AS [Ak], (-0.0059 * [SMCks] + 0.54) AS [Nk],	
Iif([Wnd_Spd]>50.4, 7.2, [Wnd_Spd]/7) AS [WINDfgk],	7:1 “standard” wind ratio for ROSI. Applic bound 7.2.
Iif([SMCks]=-9999, 0, ([Yk] + [Ak] * exp([WINDfgk] * [Nk]))) AS FDIK,	
	KARRI 3/6 ROSI(Beck)
Iif([SMCk36] >= 25, -9999, Iif([SMCk36]<3, 3, [SMCk36])) AS [SMCk36a],	Karri SMC applic bounds
(4.88 - 263.78 * exp(log([SMCk36a])*-1.80)) AS [Yk3], (163.4 * exp(log([SMCk36a]) * -1.18)) AS [Ak3], (-0.0059 * [SMCk36a] + 0.54) AS [Nk3],	
Iif([Wnd_Spd]/6 > 7.2, 7.2, [Wnd_Spd]/6) AS [WINDfgk36],	6:1 “standard” wind ratio for ROSI.K36 Applic bound 7.2.

Iif([SMCk36a]=-9999, 0, ([Yk3] + [Ak3] * exp([WINDfgk] * [Nk3]))) AS ROSIK36,	
	KARRI 1/2 ROSI(Beck)
Iif([SMCk12] >= 25, -9999, Iif([SMCk12]<3, 3, [SMCk12])) AS [SMCk12a],	Karri SMC applic bounds
(4.88 - 263.78 * exp(log([SMCk12a])*-1.80)) AS [Yk1], (163.4 * exp(log([SMCk12a]) * -1.18)) AS [Ak1], (-0.0059 * [SMCk12a] + 0.54) AS [Nk1],	
Iif([Wnd_Spd]/9 > 7.2, 7.2, [Wnd_Spd]/9) AS [WINDfgk12],	9:1 “standard” wind ratio for ROSI.K12 Applic bound 7.2.
Iif([SMCk12a]=-9999, 0, ([Yk1] + [Ak1] * exp([WINDfgk] * [Nk1]))) AS ROSIk12,	
	SOUTHERN JARRAH ROSI (Beck)
Iif([SMCsj] >= 25, -9999, Iif([SMCsj]<3, 3, [SMCsj])) AS [SMCsja],	Karri/SJ SMC applic bounds
(4.88 - 263.78 * exp(log([SMCsja])*-1.80)) AS [Ysj], (163.4 * exp(log([SMCsja]) * -1.18)) AS [Asj], (-0.0059 * [SMCsja] + 0.54) AS [Nsj],	
Iif([Wnd_Spd]/5.5 > 7.2, 7.2, [Wnd_Spd]/5.5) AS [WINDfgsj],	5.5:1 “standard” wind ratio for ROSI.SJ Applic bound 7.2.
Iif([SMCsja]=-9999, 0, ([Ysj] + [Asj] * exp([WINDfgsj] * [Nsj]))) AS ROSIsj	
FROM SMC_SourceTable INNER JOIN (SOURCETABLE INNER JOIN Stn_LGA_RPeriod ON SOURCETABLE.Stn_No = Stn_LGA_RPeriod.STN_NO) ON SMC_SourceTable.Date_ =	

SOURCETABLE.Date	
WHERE	
((([SourceTable].Hr)>13) AND (([SourceTable].Hr)<18)	Cannot use 1500 values as in some cases there may be multiple records between 1500 and 1600. Instead look for peak afternoon FDI assuming little change in SMC between 1400 and 1700.
AND	
((SMC_SourceTable.SMCnj) Is Not Null)	If SMCnj is not null there will be a valid value in all SMCs
AND	
(([SourceTable].RH) Is Not Null)	RH valid record
AND	
(([SourceTable].Wnd_Spd) Is Not Null)	Wind speed valid record
AND	
((([SourceTable].month>[Stn_LGA_Rperiod].RP_StartMonth) OR (([SourceTable].month=[Stn_LGA_Rperiod].RP_StartMonth) AND ([SourceTable].day >=[Stn_LGA_Rperiod].RP_StartDay))	Start Restricted Period
OR	Note: as these are not dates, OR is used to return records lower than the end period and greater than the start period.
(([SourceTable].month)< [Stn_LGA_Rperiod].RP_EndMonth) OR (([SourceTable].month)= [Stn_LGA_Rperiod].RP_EndMonth) AND ([SourceTable].day)<=[Stn_LGA_Rperiod].RP_EndDay)<>False));	End Restricted Period and filter for valid records.

```
SELECT
Stn_LGA_RPeriod.STN_NO,
SOURCETABLE.Date,
SOURCETABLE.Hr,
SOURCETABLE.Wnd_Spd,
SMC_SourceTable.SMCnj,
SMC_SourceTable.SMCsj,
SMC_SourceTable.SMCk45,
SMC_SourceTable.SMCk36,
SMC_SourceTable.SMCsj,
```

NORTHERN JARRAH (Beck)

Application bounds for SMC. Use the new SMC2 field in further calcs.

```
Iif([SMCnj] > 26,
   -9999,
   Iif([SMCnj]<3,
      3,
      [SMCnj])) AS [SMCaNJ],
```

```
(21.37 - 3.42 * [SMCaNJ] + 0.085 * [SMCaNJ] *[SMCaNJ]) AS
[Yj],

(48.09 * [SMCaNJ] * exp(-0.60 * [SMCaNJ]) + 11.90) AS [Aj],

(-0.0096 * exp(log([SMCNJ])* 1.05) + 0.44) AS [Nj],

Iif([Wnd_Spd]>56,                               5:1 “standard” wind ratio
   11.2,                                        for ROSI.
   [Wnd_Spd]/5) AS [WINDfg],                    Applic bound 11.2.

Iif ([SMCaNJ]=-9999,                            NJ FDI, Wind Ratio 5:1
   0,
   ([Yj] + [Aj] * exp([WINDfg] * [Nj])))
AS FDINJ,
IIf([Wnd_Spd]/4>11.2,                           NJ ROSI Wind Ratio  4:1
    11.2,
    [Wnd_Spd]/4) AS WINDfg4,
IIf([SMCaNJ]=-9999,
   0,
   ([Yj]+[Aj]*Exp([WINDfg4]*[Nj])))
AS ROSInj4,
IIf([Wnd_Spd]/3>11.2,                           NJ ROSI Wind Ratio  3:1
    11.2,
    [Wnd_Spd]/3) AS WINDfg3,
IIf([SMCaNJ]=-9999,
   0,
   ([Yj]+[Aj]*Exp([WINDfg3]*[Nj])))
AS ROSInj3,
IIf([Wnd_Spd]/2>11.2,                           NJ ROSI Wind Ratio  2:1
    11.2,
    [Wnd_Spd]/2) AS WINDfg2,
IIf([SMCaNJ]=-9999,
   0,
   ([Yj]+[Aj]*Exp([WINDfg2]*[Nj])))
AS ROSInj2,
```

KARRI FDI (Beck)

```
Iif([SMCk45] >= 25,                             Karri SMC applic bounds
   -9999,
   Iif([SMCk45]<3,
      3,
      [SMCk45])) AS [SMCks],

(4.88 - 263.78 * exp(log([SMCks])*-1.80)) AS [Yk],

(163.4 * exp(log([SMCks]) * -1.18)) AS [Ak],

(-0.0059 * [SMCks] + 0.54) AS [Nk],

Iif([Wnd_Spd]>50.4,                             7:1 “standard” wind ratio
   7.2,                                         for ROSI.
   [Wnd_Spd]/7) AS [WINDfgk],                   Applic bound 7.2.

Iif([SMCks]=-9999,
   0,
   ([Yk] + [Ak] * exp([WINDfgk] * [Nk])))
AS FDIK,
```

KARRI 3/6 ROSI(Beck)

```
Iif([SMCk36] >= 25,
   -9999,
   Iif([SMCk36]<3,
      3,
      [SMCk36])) AS [SMCk36a],

(4.88 - 263.78 * exp(log([SMCk36a])*-1.80)) AS [Yk3],

(163.4 * exp(log([SMCk36a]) * -1.18)) AS [Ak3],

(-0.0059 * [SMCk36a] + 0.54) AS [Nk3],
```

Karri SMC applic bounds

```
Iif([Wnd_Spd]/6 > 7.2,
   7.2,
   [Wnd_Spd]/6) AS [WINDfgk36],
```

6:1 “standard” wind ratio for ROSI.K36 Applic bound 7.2.

```
Iif([SMCk36]=-9999,
   0,
   ([Yk3] + [Ak3] * exp([WINDfgk] * [Nk3])))
AS ROSIK36,
```

KARRI 1/2 ROSI(Beck)

```
Iif([SMCk12] >= 25,
   -9999,
   Iif([SMCk12]<3,
      3,
      [SMCk12])) AS [SMCk12a],

(4.88 - 263.78 * exp(log([SMCk12a])*-1.80)) AS [Yk1],

(163.4 * exp(log([SMCk12a]) * -1.18)) AS [Ak1],

(-0.0059 * [SMCk12a] + 0.54) AS [Nk1],
```

Karri SMC applic bounds

```
Iif([Wnd_Spd]/9 > 7.2,
   7.2,
   [Wnd_Spd]/9) AS [WINDfgk12],
```

9:1 “standard” wind ratio for ROSI.K12 Applic bound 7.2.

```
Iif([SMCk12]=-9999,
   0,
   ([Yk1] + [Ak1] * exp([WINDfgk] * [Nk1])))
AS ROSIk12,
```

SOUTHERN JARRAH ROSI (Beck)

```
Iif([SMCsj] >= 25,
   -9999,
   Iif([SMCsj]<3,
      3,
      [SMCsj])) AS [SMCsja],
```

Karri/SJ SMC applic bounds

(4.88 - 263.78 * exp(log([SMCsja])*-1.80)) AS [Ysj],	
(163.4 * exp(log([SMCsja]) * -1.18)) AS [Asj],	
(-0.0059 * [SMCsja] + 0.54) AS [Nsj],	
Iif([Wnd_Spd]/5.5 > 7.2, 7.2, [Wnd_Spd]/5.5) AS [WINDfgsj],	5.5:1 “standard” wind ratio for ROSI.SJ Applic bound 7.2.
Iif([SMCsj]=-9999, 0, ([Ysj] + [Asj] * exp([WINDfgsj] * [Nsj]))) AS ROSIsj	
FROM SMC_SourceTable INNER JOIN (SOURCETABLE INNER JOIN Stn_LGA_RPeriod ON SOURCETABLE.Stn_No = Stn_LGA_RPeriod.STN_NO) ON SMC_SourceTable.Date_ = SOURCETABLE.Date	
WHERE	
((([SourceTable].Hr)>13) AND (([SourceTable].Hr)<18)	Cannot use 1500 values as in some cases there may be multiple records between 1500 and 1600. Instead look for peak afternoon FDI assuming little change in SMC between 1400 and 1700.
AND	
((SMC_SourceTable.SMCnj) Is Not Null)	If SMCnj is not null there will be a valid value in all SMCs
AND	
(([SourceTable].RH) Is Not Null)	RH valid record
AND	
(([SourceTable].Wnd_Spd) Is Not Null)	Wind speed valid record
AND	
((([SourceTable].month>[Stn_LGA_Rperiod].RP_StartMonth) OR (([SourceTable].month=[Stn_LGA_Rperiod].RP_StartMonth) AND ([SourceTable].day >=[Stn_LGA_Rperiod].RP_StartDay))	Start Restricted Period
OR	Note: as these are not dates, OR is used to return records lower than the end period and greater than the start period.
(([SourceTable].month)< [Stn_LGA_Rperiod].RP_EndMonth) OR (([SourceTable].month)= [Stn_LGA_Rperiod].RP_EndMonth) AND ([SourceTable].day)<=[Stn_LGA_Rperiod].RP_EndDay)<>False));	End Restricted Period and filter for valid records.

FDI_McA_xxxxDF

The following script is the same for all the McArthur FDI stations, where XXXX is replaced with the name of the location for which drought factors have been provided, viz:

- Esperance
- Fitzroy
- Kalgoorlie
- Karratha
- Mundaring

The scripts in the database are titled:

- FDI_McA_EspDF
- FDI_McA_FitzDF
- FDI_McA_KalDF
- FDI_McA_KtaDF
- FDI_McA_MdgDF

SELECT	
SOURCETABLE.Stn_No, SOURCETABLE.Date, SOURCETABLE.Temp AS T, SOURCETABLE.RH, SDI_XXXX.DF_FOREST AS D, SOURCETABLE.Wnd_Spd AS V,	
Round(2*Exp(-0.45+0.987*Log([D])-0.0345*[RH]+0.0338*[T]+0.0234*[V]) ,0) AS FDI	McArthur FDI: this is not ROS
FROM (SOURCETABLE INNER JOIN SDI_XXXX ON SOURCETABLE.Date = SDI_XXXX.LSD) INNER JOIN Stn_LGA_RPeriod ON SOURCETABLE.Stn_No = Stn_LGA_RPeriod.STN_NO	
WHERE	
(((SOURCETABLE.RH) Is Not Null)	Valid RH record
AND	
((SDI_XXXX.DF_FOREST) >0)	Valid Drought Factor record
AND	
((SOURCETABLE.Wnd_Spd) Is Not Null)	Wind speed valid record
AND	
((([SourceTable].month>[Stn_LGA_Rperiod].RP_StartMonth) OR (([SourceTable].month=[Stn_LGA_Rperiod].RP_StartMonth) AND ([SourceTable].day >=[Stn_LGA_Rperiod].RP_StartDay))	Start Restricted Period
OR	Note: as these are not dates, OR is used to return records lower than the end period and greater than the start period.

(([SourceTable].month)< [Stn_LGA_Rperiod].RP_EndMonth) OR (([SourceTable].month)= [Stn_LGA_Rperiod].RP_EndMonth) AND ([SourceTable].day)<=[Stn_LGA_Rperiod].RP_EndDay)<>False));	End Restricted Period and filter for valid records.

Daily Maxima for FDI/ROSI - DailyMax Queries

GROSDailyMax

```
SELECT
GROS.Stn_No,
GROS.Date,
Max(GROS.Rn) AS MaxOfRn,
Max(GROS.Rcu) AS MaxOfRcu,
Max(GROS.Re) AS MaxOfRe,
Max(GROS.Rn2) AS MaxOfRn2,
Max(GROS.Rmh) AS MaxOfRmh,
Max(GROS.Rsh) AS MaxOfRsh
FROM GROS
GROUP BY GROS.Stn_No, GROS.Date;
```

GROSDailyMax_Harvest

```
SELECT
GROS_Harvest.Stn_No,
GROS_Harvest.Date,
Max(GROS_Harvest.Rn) AS MaxOfRn,
Max(GROS_Harvest.Rcu) AS MaxOfRcu,
Max(GROS_Harvest.Re) AS MaxOfRe,
Max(GROS_Harvest.Rmh) AS MaxOfRmh,
Max(GROS_Harvest.Rsh) AS MaxOfRsh
FROM GROS_Harvest
GROUP BY GROS_Harvest.Stn_No, GROS_Harvest.Date;
```

NWGROSDailyMax

```
SELECT
NWGROS.Stn_No,
NWGROS.Date,
Max(NWGROS.Rn) AS MaxOfRn,
Max(NWGROS.Rcu) AS MaxOfRcu,
Max(NWGROS.Re) AS MaxOfRe,
Max(NWGROS.Rn2) AS MaxOfRn2,
Max(NWGROS.Rmh) AS MaxOfRmh,
Max(NWGROS.Rsh) AS MaxOfRsh
FROM NWGROS
GROUP BY NWGROS.Stn_No, NWGROS.Date;
```

NWGROS_WRDailyMax

```
SELECT
NWGROS_WR.Stn_No,
NWGROS_WR.Date,
Max(NWGROS_WR.Rn) AS MaxOfRn,
Max(NWGROS_WR.Rcu) AS MaxOfRcu,
Max(NWGROS_WR.Re) AS MaxOfRe,
Max(NWGROS_WR.Rmh) AS MaxOfRmh,
Max(NWGROS_WR.Rsh) AS MaxOfRsh
FROM NWGROS_WR
GROUP BY NWGROS_WR.Stn_No, NWGROS_WR.Date;
```

FDIDailyMax

```
SELECT
FDI.STN_NO,
FDI.Date,
Max(Round([FDINJ],0)) AS MaxofFDINJ,
Max(Round([ROSInj4],0)) AS MaxofROSInj4,
Max(Round([ROSInj3],0)) AS MaxofROSInj3,
Max(Round([ROSInj2],0)) AS MaxofROSInj2,
Max(Round([FDIk],0)) AS MaxofFDIk,
Max(Round([ROSIk36],0)) AS MaxofROSIk36,
Max(Round([ROSIk12],0)) AS MaxofROSIk12,
Max(Round([ROSIsj],0)) AS MaxofROSIsj
FROM FDI
GROUP BY FDI.STN_NO, FDI.Date;
```

FDI_McA_EspDF_DailyMax

```
SELECT
FDI_McA_EspDF.Stn_No,
FDI_McA_EspDF.Date,
Max(FDI_McA_EspDF.FDI) AS MaxofFDI_McA_Esp
FROM FDI_McA_EspDF
GROUP BY FDI_McA_EspDF.Stn_No, FDI_McA_EspDF.Date;
```

FDI_McA_FitzDF_DailyMax

```
SELECT
FDI_McA_FitzDF.Stn_No,
FDI_McA_FitzDF.Date,
Max(FDI_McA_FitzDF.FDI) AS MaxofFDI_McA_Fitz
FROM FDI_McA_FitzDF
GROUP BY FDI_McA_FitzDF.Stn_No, FDI_McA_FitzDF.Date;
```

FDI_McA_KalDF_DailyMax

```
SELECT
FDI_McA_KalDF.Stn_No,
FDI_McA_KalDF.Date,
Max(FDI_McA_KalDF.FDI) AS MaxofFDI_McA_Kal
FROM FDI_McA_KalDF
GROUP BY FDI_McA_KalDF.Stn_No, FDI_McA_KalDF.Date;
```

FDI_McA_KtaDF_DailyMax

```
SELECT
FDI_McA_KtaDF.Stn_No,
FDI_McA_KtaDF.Date,
Max(FDI_McA_KtaDF.FDI) AS MaxofFDI_McA_Kta
FROM FDI_McA_KtaDF
GROUP BY FDI_McA_KtaDF.Stn_No, FDI_McA_KtaDF.Date;
```

FDI_McA_MdgDF_DailyMax

```
SELECT
FDI_McA_MdgDF.Stn_No,
FDI_McA_MdgDF.Date,
Max(FDI_McA_MdgDF.FDI) AS MaxofFDI_McA_Mdg
FROM FDI_McA_MdgDF
GROUP BY FDI_McA_MdgDF.Stn_No, FDI_McA_MdgDF.Date;
```

Determining the 95 Percentile Value

The query that ranks and selects the 95 percentile value for each fuel type FDI/ROSI is in an identical format that below, where *ZZZZ* is the ROSI identifier, and *XXXX* is the DailyMax query in which the appropriate maximum value for that fuel class is calculated.

A ROSI is not calculated for Spinifex (Hummock Grassland). For Spinifex the average wind speed at 2m for all grassland ROS values within 10% of the 95 percentile grassland ROS is determined by the queries *NW_95_Wind* and *NW_HG_95*. This wind at 2m is an input into the Spinifex fire behaviour calculations.

```
SELECT Last([MaxofZZZZ]) AS 95Rmh
FROM (SELECT TOP 5 PERCENT
MaxofZZZZ
FROM XXXXDailyMax
ORDER BY [MaxofZZZZ] DESC);
```

Ranks values, selects top 5% and retrieves last value on this list as the 95 percentile value.

For GROSDailyMax

Rcu_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRcu]) AS 95Rcu
FROM (SELECT TOP 5 PERCENT MaxofRcu, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRcu] DESC);
```

Re_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRe]) AS 95Re
FROM (SELECT TOP 5 PERCENT MaxofRe, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRe] DESC);
```

Rn_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRn]) AS 95Rn
FROM (SELECT TOP 5 PERCENT MaxofRn, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRn] DESC);
```

Rn2_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRn2]) AS 95Rn2
FROM (SELECT TOP 5 PERCENT MaxofRn2, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRn2] DESC);
```

Rmh_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRmh]) AS 95Rmh
FROM (SELECT TOP 5 PERCENT MaxofRmh, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRmh] DESC);
```

Rsh_95

```
SELECT Last (Stn_No) AS Station_No, Last([MaxofRsh]) AS 95Rsh
FROM (SELECT TOP 5 PERCENT MaxofRsh, Stn_No
FROM GROSDailyMax
ORDER BY [MaxofRsh] DESC);
```

For FDI_McA_DailyMax

FDI_McA_Esp_95

```
SELECT
Last(Stn_No) AS Station_No,
Last([MaxofFDI_McA_Esp]) AS 95McA_Esp
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofFDI_McA_Esp
```

FROM FDI_McA_EspDF_DailyMax
ORDER BY [MaxofFDI_McA_Esp] DESC);

FDI_McA_Fitz_95

SELECT
Last(Stn_No) AS Station_No,
Last([MaxofFDI_McA_Fitz]) AS 95McA_Fitz
FROM (SELECT TOP 5 PERCENT Stn_No, MaxofFDI_McA_Fitz
FROM FDI_McA_FitzDF_DailyMax
ORDER BY [MaxofFDI_McA_Fitz] DESC);

FDI_McA_Kal_95

SELECT
Last(Stn_No) AS Station_No,
Last([MaxofFDI_McA_Kal]) AS 95McA_Kal
FROM (SELECT TOP 5 PERCENT Stn_No, MaxofFDI_McA_Kal
FROM FDI_McA_KalDF_DailyMax
ORDER BY [MaxofFDI_McA_Kal] DESC);

FDI_McA_Kta_95

SELECT
Last(Stn_No) AS Station_No,
Last([MaxofFDI_McA_Kta]) AS 95McA_Kta
FROM (SELECT TOP 5 PERCENT Stn_No, MaxofFDI_McA_Kta
FROM FDI_McA_KtaDF_DailyMax
ORDER BY [MaxofFDI_McA_Kta] DESC);

FDI_McA_Mdg_95

SELECT
Last(Stn_No) AS Station_No,
Last([MaxofFDI_McA_Mdg]) AS 95McA_Mdg
FROM (SELECT TOP 5 PERCENT Stn_No, MaxofFDI_McA_Mdg
FROM FDI_McA_MdgDF_DailyMax
ORDER BY [MaxofFDI_McA_Mdg] DESC);

For FDI_DaliyMax

FDInj_95

SELECT
Last(Stn_No) AS Station_No,
Last (MaxofFDINJ) AS 95FDInj
FROM (SELECT TOP 5 PERCENT Stn_No, MaxofFDInj
FROM FDIDailyMax
ORDER BY [MaxofFDInj] DESC);

ROSInj4_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSINJ4) AS 95ROSInj4
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSInj4
FROM FDIDailyMax
ORDER BY [MaxofROSInj4] DESC);
```

ROSInj3_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSINJ3) AS 95ROSInj3
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSInj3
FROM FDIDailyMax
ORDER BY [MaxofROSInj3] DESC);
```

ROSInj2_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSINJ2) AS 95ROSInj2
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSInj2
FROM FDIDailyMax
ORDER BY [MaxofROSInj2] DESC);
```

FDIk_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofFDIK) AS 95FDIk
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofFDIk
FROM FDIDailyMax
ORDER BY [MaxofFDIk] DESC);
```

ROSIk12_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSIK12) AS 95ROSIk12
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSIk12
FROM FDIDailyMax
ORDER BY [MaxofROSIk12] DESC);
```

ROSIk36_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSIK36) AS 95ROSIk36
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSIk36
FROM FDIDailyMax
ORDER BY [MaxofROSIk36] DESC);
```

ROSIsj_95

```
SELECT
Last(Stn_No) AS Station_No,
Last (MaxofROSISJ) AS 95ROSIsj
FROM (SELECT TOP 5 PERCENT Stn_No,  MaxofROSIsj
FROM FDIDailyMax
ORDER BY [MaxofROSIsj] DESC);
```

For Hummock Grasslands

NW_95Wind

```
SELECT
NWGROS.Stn_No,
NWGROS.[Stn Name],
NWGROS.Date,
NWGROS.Ppn_0900,
NWGROS.Temp,
NWGROS.RH,
NWGROS.Wnd_Spd,
NW_Rn_95.[95Rn],
NWGROS.Rn

FROM NW_Rn_95 INNER JOIN NWGROS ON
NW_Rn_95.Station_No = NWGROS.Stn_No
WHERE
(((NWGROS.Rn)>=(0.9*[95Rn]) And                    +/- 10% of the 95 percentile
(NWGROS.Rn)<=(1.1*[95Rn])));                        value
```

NW_HG_95

```
SELECT
NW_95Wind.Stn_No,
NW_95Wind.[Stn Name],

Avg(NW_95Wind.Wnd_Spd) AS AvgOfWnd_Spd,               Average wind speed for 95
                                                      percentile conditions
Round((2.99844+0.57055*[AvgOfWnd_Spd]),2) AS Wind2m   Converts 10m wind to wind
                                                      at 2m
FROM NW_95Wind
GROUP BY NW_95Wind.Stn_No,
NW_95Wind.[Stn Name];
```

95 Percentile Summary Queries

The and *ROS_95percentileRP* and *ROS_95percentileRP_NW* queries both append to the same table, but differ in the queries called appropriate to the station locations. Both these queries are called by the VBA module *BatchWeatherPercentileRP*.

The *ROS_95percentile_Harvest* and *ROS_95percentile_NW_WR* queries are select queries only, intended to investigate particular aspects for individual areas, and are not included in the batch process.

ROS_95percentileRP: Append Query

```
INSERT INTO BatchWeatherPercentileOutput
( Station_No,
[Stn Name],
Lat,
[Long],
95Rn,
95Rcu,
95Re,
95Rn2,
95Rmh,
95Rsh,
95FDINJ,
95ROSInj4,
95ROSInj3,
95ROSInj2,
95FDIK,
95ROSIk12,
95ROSIk36,
95ROSIsj,
95McA_Esp,
95McA_Fitz,
95McA_Kal,
95McA_Kta,
95McA_Mdg )

SELECT
Rn_95.Station_No,
[Stn Details].[Stn Name],
[Stn Details].Lat,
[Stn Details].Long,
Rn_95.[95Rn],
Rcu_95.[95Rcu],
Re_95.[95Re],
Rn2_95.[95Rn2],
Rmh_95.[95Rmh],
Rsh_95.[95Rsh],
FDInj_95.[95FDINJ],
ROSInj4_95.[95ROSInj4],
ROSInj3_95.[95ROSInj3],
ROSInj2_95.[95ROSInj2],
FDIk_95.[95FDIK],
ROSIk12_95.[ROSIk12],
ROSIk36_95.[ROSIk36],
ROSIsj_95.[ROSIsj],
FDI_McA_Esp_95.[95McA_Esp],
FDI_McA_Fitz_95.[95McA_Fitz],
FDI_McA_Kal_95.[95McA_Kal],
FDI_McA_Kta_95.[95McA_Kta],
FDI_McA_Mdg_95.[95McA_Mdg]
```

FROM FDI_McA_Fitz_95 INNER JOIN (FDI_McA_Kta_95 INNER JOIN ((ROSInj3_95 INNER JOIN (ROSInj2_95 INNER JOIN (((FDI_McA_Kal_95 INNER JOIN (FDI_McA_Mdg_95 INNER JOIN ((((((([Stn Details] INNER JOIN Rn_95 ON [Stn Details].Stn_No = Rn_95.Station_No) INNER JOIN Re_95 ON Rn_95.Station_No = Re_95.Station_No) INNER JOIN Rcu_95 ON Re_95.Station_No = Rcu_95.Station_No) INNER JOIN Rmh_95 ON Rcu_95.Station_No = Rmh_95.Station_No) INNER JOIN Rsh_95 ON Rmh_95.Station_No = Rsh_95.Station_No) INNER JOIN FDIk_95 ON Rsh_95.Station_No = FDIk_95.Station_No) INNER JOIN FDInj_95 ON FDIk_95.Station_No = FDInj_95.Station_No) ON FDI_McA_Mdg_95.Station_No = Rn_95.Station_No) ON FDI_McA_Kal_95.Station_No = Rsh_95.Station_No) INNER JOIN FDI_McA_Esp_95 ON FDI_McA_Mdg_95.Station_No = FDI_McA_Esp_95.Station_No) INNER JOIN ROSInj4_95 ON FDI_McA_Esp_95.Station_No = ROSInj4_95.Station_No) ON ROSInj2_95.Station_No = FDI_McA_Kal_95.Station_No) ON ROSInj3_95.Station_No = ROSInj2_95.Station_No) INNER JOIN Rn2_95 ON ROSInj4_95.Station_No = Rn2_95.Station_No) ON FDI_McA_Kta_95.Station_No = FDI_McA_Kal_95.Station_No) ON FDI_McA_Fitz_95.Station_No = FDI_McA_Kta_95.Station_No;	All tables joined on Stn_Name

ROS_95percentile_NW: Append Query

INSERT INTO BatchWeatherPercentileOutput (Station_No, [Stn Name], Lat, [Long], 95Rn, 95Rcu, 95Re, 95Rn2, 95Rmh, 95Rsh, 95HG_Wind, 95FDI_McA_Mdg, 95FDI_McA_Kal, 95FDI_McA_Esp, 95FDI_McA_Kta, 95FDI_McA_Fitz) SELECT NW_Rcu_95.Station_No, [Stn Details].[Stn Name], [Stn Details].Lat, [Stn Details].Long, NW_Rn_95.[95Rn], NW_Rcu_95.[95Rcu], NW_Re_95.[95Re], NW_Rn2_95.[95Rn2], NW_Rmh95.[95Rmh], NW_Rsh_95.[95Rsh], NW_HG_95.Wind2m AS 95HG_wind, FDI_McA_Mdg_95.[95FDI_McA_Mdg], FDI_McA_Kal_95.[95FDI_McA_Kal], FDI_McA_Esp_95.[95FDI_McA_Esp], FDI_McA_Kta_95.[95FDI_McA_Kta], FDI_McA_Fitz_95.[95FDI_McA_Fitz]	
FROM ((((((((((([Stn Details] INNER JOIN NW_HG_95 ON [Stn Details].Stn_No = NW_HG_95.Stn_No) INNER JOIN NW_Rcu_95 ON NW_HG_95.Stn_No = NW_Rcu_95.Station_No) INNER JOIN NW_Re_95 ON NW_Rcu_95.Station_No = NW_Re_95.Station_No) INNER JOIN NW_Rmh95 ON NW_Re_95.Station_No = NW_Rmh95.Station_No) INNER JOIN NW_Rn_95 ON NW_Rmh95.Station_No = NW_Rn_95.Station_No) INNER JOIN NW_Rsh_95 ON NW_Rn_95.Station_No = NW_Rsh_95.Station_No) INNER JOIN NW_Rn2_95 ON NW_Rsh_95.Station_No = NW_Rn2_95.Station_No) INNER JOIN FDI_McA_Fitz_95 ON [Stn Details].Stn_No = FDI_McA_Fitz_95.Station_No) INNER JOIN FDI_McA_Kal_95 ON FDI_McA_Fitz_95.Station_No = FDI_McA_Kal_95.Station_No) INNER JOIN FDI_McA_Kta_95 ON	All tables joined on Stn_Name

FDI_McA_Kal_95.Station_No = FDI_McA_Kta_95.Station_No) INNER JOIN FDI_McA_Mdg_95 ON FDI_McA_Kta_95.Station_No = FDI_McA_Mdg_95.Station_No) INNER JOIN FDI_McA_Esp_95 ON NW_Rn2_95.Station_No = FDI_McA_Esp_95.Station_No;

ROS_95percentile_Harvest

SELECT [Stn Details].Stn_No, [Stn Details].[Stn Name], [Stn Details].Lat, [Stn Details].Long, [HarvestMonth] AS [Harvest Month], Rn_95_Harvest.[95Rn], Rcu_95_Harvest.[95Rcu], Re_95_Harvest.[95Re]

FROM (([Stn Details] INNER JOIN Rn_95_Harvest ON [Stn Details].Stn_No = Rn_95_Harvest.Station_No) INNER JOIN Rcu_95_Harvest ON Rn_95_Harvest.Station_No = Rcu_95_Harvest.Station_No) INNER JOIN Re_95_Harvest ON Rcu_95_Harvest.Station_No = Re_95_Harvest.Station_No;

Note: Summarises 95 percentile conditions from start restricted period to end of the input harvest month only.
All tables joined on Stn_Name

ROS_95percentile_NW_WR

SELECT
[Stn Details].[Stn Name],
[Stn Details].Lat,
[Stn Details].Long,
NW_WR_Rn_95.[95Rn],
NW_WR_Rcu_95.[95Rcu],
NW_WR_Re_95.[95Re],
NW_WR_Rmh_95.[95Rmh],
NW_WR_Rsh_95.[95Rsh]
FROM
(((([Stn Details] INNER JOIN NW_WR_Rcu_95 ON [Stn Details].Stn_No = NW_WR_Rcu_95.Station_No) INNER JOIN NW_WR_Re_95 ON NW_WR_Rcu_95.Station_No = NW_WR_Re_95.Station_No) INNER JOIN NW_WR_Rmh_95 ON NW_WR_Re_95.Station_No = NW_WR_Rmh_95.Station_No) INNER JOIN NW_WR_Rn_95 ON NW_WR_Rmh_95.Station_No = NW_WR_Rn_95.Station_No) INNER JOIN NW_WR_Rsh_95 ON NW_WR_Rn_95.Station_No = NW_WR_Rsh_95.Station_No;

Note: Wind ratio only applies to grassland fuels.(See queries called).

All tables joined on Stn_Name

Preparing Curing Table

Macro to import pre 99 curing data

```
Attribute VB_Name = "Module3"
 Sub Pre99()
Attribute Pre99.VB_Description = "Macro recorded 10/06/2006 by Chris"
```

```
Attribute Pre99.VB_ProcData.VB_Invoke_Func = " \n14"
'
' Pre_99
' Imports Curing data from the file structure to end of 1998
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_pre99.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D3").Select
    Selection.Copy
    ActiveWindow.Zoom = 70

Range("E10,E12,E14,E16,E18,E20,E22,E24,E26,E28,E30,E32,E34,E36,E38,E4
0,E42,E44,E46" _
        ).Select
    Range("E46").Activate
    ActiveSheet.Paste
    Range("A10:E46").Select
    Range("E46").Activate
```

```
    Selection.Copy
    Sheets("Pre_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub

 Sub Post_99()
'
' Post_99
' Imports Curing data from the file structure from 1999 on
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_99on.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
```

```
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D2").Select
    Selection.Copy
    ActiveWindow.Zoom = 70

Range("E9,E11,E13,E15,E17,E19,E21,E23,E25,E27,E29,E31,E33,E35,E37,E39
,E41,E43,E45" _
        ).Select
    Range("E45").Activate
    ActiveSheet.Paste
    Range("A9:E45").Select
    Range("E45").Activate
    Selection.Copy
    Sheets("Post_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub
```

```
Attribute VB_Name = "Module3"
 Sub Pre99()
Attribute Pre99.VB_Description = "Macro recorded 10/06/2006 by Chris"
Attribute Pre99.VB_ProcData.VB_Invoke_Func = " \n14"
'
' Pre_99
' Imports Curing data from the file structure to end of 1998
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_pre99.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D3").Select
    Selection.Copy
    ActiveWindow.Zoom = 70

Range("E10,E12,E14,E16,E18,E20,E22,E24,E26,E28,E30,E32,E34,E36,E38,E4
0,E42,E44,E46" _
        ).Select
    Range("E46").Activate
```

```
    ActiveSheet.Paste
    Range("A10:E46").Select
    Range("E46").Activate
    Selection.Copy
    Sheets("Pre_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub

 Sub Post_99()
'
' Post_99
' Imports Curing data from the file structure from 1999 on
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_99on.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
```

```
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D2").Select
    Selection.Copy
    ActiveWindow.Zoom = 70

Range("E9,E11,E13,E15,E17,E19,E21,E23,E25,E27,E29,E31,E33,E35,E37,E39
,E41,E43,E45" _
        ).Select
    Range("E45").Activate
    ActiveSheet.Paste
    Range("A9:E45").Select
    Range("E45").Activate
    Selection.Copy
    Sheets("Post_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub
```

Macro to import post 99 curing data

```
Attribute VB_Name = "Module3"
 Sub Pre99()
Attribute Pre99.VB_Description = "Macro recorded 10/06/2006 by Chris"
Attribute Pre99.VB_ProcData.VB_Invoke_Func = " \n14"
'
' Pre_99
' Imports Curing data from the file structure to end of 1998
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_pre99.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D3").Select
    Selection.Copy
    ActiveWindow.Zoom = 70
```

```
Range("E10,E12,E14,E16,E18,E20,E22,E24,E26,E28,E30,E32,E34,E36,E38,E4
0,E42,E44,E46" _
        ).Select
    Range("E46").Activate
    ActiveSheet.Paste
    Range("A10:E46").Select
    Range("E46").Activate
    Selection.Copy
    Sheets("Pre_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub

 Sub Post_99()
'
' Post_99
' Imports Curing data from the file structure from 1999 on
' Chris Muller 12 June 06
'
Dim FileDate, Filename, FileLoc As String
Dim CellIncr, FileNo As Integer
Open "C:\Documents and Settings\Chris\My
Documents\Weather\Curing\FileList_99on.txt" For Input As #1
CellIncr = 3
FileNo = 1
Do While Not EOF(1)

Input #1, Filename

FileLoc = "TEXT;D:\" & Filename
'
    Cells.Select
    Selection.ClearContents
    Range("A1").Select
    With ActiveSheet.QueryTables.Add(Connection:=FileLoc, _
        Destination:=Range("A1"))
        .Name = Filename
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlInsertDeleteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = 850
        .TextFileStartRow = 1
```

```
        .TextFileParseType = xlFixedWidth
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = True
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = False
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 2, 4)
        .TextFileFixedColumnWidths = Array(25, 12, 12)
        .TextFileTrailingMinusNumbers = True
        .Refresh BackgroundQuery:=False
    End With
    Range("D2").Select
    Selection.Copy
    ActiveWindow.Zoom = 70

Range("E9,E11,E13,E15,E17,E19,E21,E23,E25,E27,E29,E31,E33,E35,E37,E39
,E41,E43,E45" _
        ).Select
    Range("E45").Activate
    ActiveSheet.Paste
    Range("A9:E45").Select
    Range("E45").Activate
    Selection.Copy
    Sheets("Post_99").Select
    Range("A" & CellIncr).Select

    Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,
SkipBlanks _
        :=False, Transpose:=False

    CellIncr = CellIncr + 48
    FileNo = FileNo + 1
    Sheets("Work_Sheet").Select
    Range("A1").Select
Loop
End Sub
```

SW_Curing _Recorded query

SELECT

[Curing Combined].District,

[Curing Combined].Year,

[Curing Combined].Month,

Avg([Curing Combined].Index_A) AS IndexA,

Avg([Curing Combined].Index_B) AS IndexB

FROM [Curing Combined]

GROUP BY [Curing Combined].District, [Curing Combined].Year, [Curing Combined].Month;

SW_Curing_Monthly_Av query

```
SELECT
SW_Curing_Recorded.District,
SW_Curing_Recorded.Month,
Avg(SW_Curing_Recorded.IndexA) AS Av_Index_A,
Avg(SW_Curing_Recorded.IndexB) AS Av_Index_B
FROM SW_Curing_Recorded
GROUP BY SW_Curing_Recorded.District, SW_Curing_Recorded.Month;
```

PercentileLayers Model Script

```
' ----------------------------------------------------------------------
--------
' PercentileLayers.vbs
' Created on: Tue Jan 15 2008 05:12:17 AM
'   (generated by ArcGIS/ModelBuilder)
' Description:
' Creates 95 percentile layer for all fuel types using normal kriging
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "spatial"

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial
Analyst Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"


' Local variables...
v95rn = "C:\BFTA_DATA\Weather Data\95percentile\95rn"
Output_variance_of_prediction_raster = ""
wa_coast = "wa_coast"
PercentileWeather_shp = "C:\BFTA_DATA\Weather
Data\PercentileWeather.shp"
v95Rcu = "C:\BFTA_DATA\Weather Data\95percentile\95rcu"
Output_variance_of_prediction_raster__2_ = ""
v95Re = "C:\BFTA_DATA\Weather Data\95percentile\95re"
Output_variance_of_prediction_raster__3_ = ""
v95Rn2 = "C:\BFTA_DATA\Weather Data\95percentile\95rn2"
Output_variance_of_prediction_raster__4_ = ""
v95Rmh = "C:\BFTA_DATA\Weather Data\95percentile\95rmh"
Output_variance_of_prediction_raster__5_ = ""
v95Rsh = "C:\BFTA_DATA\Weather Data\95percentile\95rsh"
Output_variance_of_prediction_raster__6_ = ""
v95HG_Wind = "C:\BFTA_DATA\Weather Data\95percentile\95HG_Wind"
Output_variance_of_prediction_raster__7_ = ""
v95FDInj = "C:\BFTA_DATA\Weather Data\95percentile\95fdinj"
Output_variance_of_prediction_raster__8_ = ""
v95ROSInj4 = "C:\BFTA_DATA\Weather Data\95percentile\95ROSInj4"
Output_variance_of_prediction_raster__9_ = ""
v95ROSInj3 = "C:\BFTA_DATA\Weather Data\95percentile\95ROSInj3"
Output_variance_of_prediction_raster__10_ = ""
v95rosinj2 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj2"
Output_variance_of_prediction_raster__11_ = ""
v95FDIk = "C:\BFTA_DATA\Weather Data\95percentile\95fdik"
Output_variance_of_prediction_raster__12_ = ""
v95ROSIk12 = "C:\BFTA_DATA\Weather Data\95percentile\95ROSIk12"
Output_variance_of_prediction_raster__13_ = ""
v95ROSIk36 = "C:\BFTA_DATA\Weather Data\95percentile\95ROSIk36"
Output_variance_of_prediction_raster__14_ = ""
```

```
v95McAFDI = "C:\BFTA_DATA\Weather Data\95percentile\95mcafdi"
Output_variance_of_prediction_raster__15_ = ""
PercentileWeatherLyr = "PercentileWeatherLyr"
BatchWeatherPercentileOutput = "C:\BFTA_DATA\Weather
Data\PercentileCondit.mdb\BatchWeatherPercentileOutput"
v95rosinj6 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj6"
Output_variance_of_prediction_raster__16_ = ""
v95rosisj = "C:\BFTA_DATA\Weather Data\95percentile\95rosisj"
Output_variance_of_prediction_raster__17_ = ""

' Process: Kriging...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Rn", v95rn, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster

gp.extent = tempEnvironment0

' Process: Kriging (2)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Rcu", v95Rcu, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__2_
gp.extent = tempEnvironment0

' Process: Kriging (3)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Re", v95Re, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__3_

gp.extent = tempEnvironment0

' Process: Kriging (4)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Rn2", v95Rn2, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__4_
gp.extent = tempEnvironment0

' Process: Kriging (5)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Rmh", v95Rmh, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__5_
gp.extent = tempEnvironment0

' Process: Kriging (6)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95Rsh", v95Rsh, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__6_
gp.extent = tempEnvironment0
```

```
' Process: Kriging (7)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95HG_Wind", v95HG_Wind,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__7_
gp.extent = tempEnvironment0

' Process: Kriging (8)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95FDINJ", v95FDInj, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__8_
gp.extent = tempEnvironment0

' Process: Kriging (9)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSInj4", v95ROSInj4,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__9_
gp.extent = tempEnvironment0

' Process: Kriging (10)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSInj3", v95ROSInj3,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__10_
gp.extent = tempEnvironment0

' Process: Kriging (11)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSInj2", v95rosinj2,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__11_
gp.extent = tempEnvironment0

' Process: Kriging (12)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95FDIK", v95FDIk, "Spherical
0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__12_
gp.extent = tempEnvironment0

' Process: Kriging (13)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSIk12", v95ROSIk12,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__13_
gp.extent = tempEnvironment0

' Process: Kriging (14)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
```

```
gp.Kriging_sa PercentileWeather_shp, "95ROSIk36", v95ROSIk36,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__14_
gp.extent = tempEnvironment0

' Process: Kriging (15)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95McAFDI", v95McAFDI,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__15_
gp.extent = tempEnvironment0

' Process: Make XY Event Layer...
gp.MakeXYEventLayer_management BatchWeatherPercentileOutput, "long",
"lat", PercentileWeatherLyr, ""

' Process: Kriging (16)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSInj6", v95rosinj6,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__16_
gp.extent = tempEnvironment0

' Process: Kriging (17)...
tempEnvironment0 = gp.extent
gp.extent = "wa_coast"
gp.Kriging_sa PercentileWeather_shp, "95ROSIsj", v95rosisj,
"Spherical 0.061208", "0.06432", "VARIABLE 12",
Output_variance_of_prediction_raster__17_
gp.extent = tempEnvironment0
```

Slope Model Script

```
' ----------------------------------------------------------------------
--------
' Slope.vbs
' Created on: Tue Jan 01 2008 04:04:06 PM
'   (generated by ArcGIS/ModelBuilder)
' Usage: Slope <ContoursMerge_shp> <Slope__3_>
' Description:
' Calculates slope (degrees) from merged contour data .
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "3D"

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/3D
Analyst Tools.tbx"

' Script arguments...
ContoursMerge_shp = wscript.arguments.item(0)
if ContoursMerge_shp = "#" then
 ContoursMerge_shp = "C:\BFTA_Output\Slope\ContoursMerge.shp" '
provide a default value if unspecified
end if

Slope__3_ = wscript.arguments.item(1)
if Slope__3_ = "#" then
 Slope__3_ = "C:\BFTA_Output\Slope\Slope" ' provide a default value
if unspecified

end if

' Local variables...
TopoToR_Cont1 = "C:\BFTA_Output\Slope\TopoToR_Cont1"
Output_stream_polyline_features = ""
Output_remaining_sink_point_features = ""
Output_diagnostic_file = ""
Output_parameter_file = ""

' Process: Topo to Raster...

gp.TopoToRaster_3d "C:\BFTA_Output\Slope\ContoursMerge.shp HEIGHT
Contour", TopoToR_Cont1, "100", "405033.939811827 6293170.62636005
546838.044076314 6514983.35392506", "20", "", "", "ENFORCE",
"CONTOUR", "40", "", "1", "0", "", "",
Output_stream_polyline_features,
Output_remaining_sink_point_features, Output_diagnostic_file,
Output_parameter_file

' Process: Slope...
gp.Slope_3d TopoToR_Cont1, Slope__3_, "DEGREE", "1"
```

Fuel_Age Model Script

```
' ----------------------------------------------------------------------
--------
' Fuel_Age.vbs
' Created on: Sun Feb 10 2008 11:25:12 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: Fuel_Age <StudyArea_lyr> <fire_scars_1993_2007Merge_shp__2_>
<fuelage>
' Description:
' Prepares fuel age raster for defined area from a databse table of
fire scar ages. Assigns default age of 25 where no fire scars have
been recorded.


' ----------------------------------------------------------------------
--------



' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.AddToolbox "C:/Program
Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Script arguments...
StudyArea_lyr = wscript.arguments.item(0)
if StudyArea_lyr = "#" then
 StudyArea_lyr = "C:\PILBARA\PilbaraStudyArea.lyr" ' provide a
default value if unspecified
end if

fire_scars_1993_2007Merge_shp__2_ = wscript.arguments.item(1)
if fire_scars_1993_2007Merge_shp__2_ = "#" then
 fire_scars_1993_2007Merge_shp__2_ =
"C:\BFTA_DATA\FireScarData\NOAA_MODIS\fire_scars_1993_2007Merge.shp"
' provide a default value if unspecified
end if

fuelage = wscript.arguments.item(2)
if fuelage = "#" then
 fuelage = "C:\PILBARA\Vegetation\fuelage" ' provide a default value
if unspecified
end if

' Local variables...
fire_scars_merge_clip_shp =
"C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp"
StudyAreaFAfield_lyr = "C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp"
DefaultFuelAge = "C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp"
```

```
fire_scars_Studyarea_merge_shp =
"C:\BFTAWorkspace\Scratch\fire_scars_Studyarea_merge.shp"
Output_Feature_Class = "C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp"
Exists = "true"
Not_Exists = "false"
output_value = "C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp"

' Process: Copy Features...
gp.CopyFeatures_management StudyArea_lyr, Output_Feature_Class, "",
"0", "0", "0"

' Process: TestField...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField Output_Feature_Class, "Fuel_Age"

' Process: Add Field...
gp.AddField_management Output_Feature_Class, "Fuel_Age", "LONG", "",
"", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Merge Branch...
gp.MergeBranch_management
"C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp;C:\PILBARA\PilbaraStudy
Area_CopyFeature1.shp"

' Process: Calculate Field...
gp.CalculateField_management output_value, "Fuel_Age", "25", "VB", ""

' Process: Clip...
gp.Clip_analysis fire_scars_1993_2007Merge_shp__2_, StudyArea_lyr,
fire_scars_merge_clip_shp, ""

' Process: Merge...
gp.Merge_management
"C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp;C:\BFTAWorkspace\Scratc
h\fire_scars_merge_clip.shp", fire_scars_Studyarea_merge_shp,
"Fuel_Age Fuel_Age true false false 9 Long 0 9
,First,#,C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp,Fuel_Age,
-1,-1,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,Fuel_Age,-1,-
1;YR_MTH YR_MTH true false false 8 Long 0 8
,First,#,C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp,YR_MTH,-
1,-1;YR YR true false false 4 Short 0 4
,First,#,C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp,YR,-1,-
1;Month Month true false false 4 Short 0 4
,First,#,C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp,Month,-
1,-1;Seas_End Seas_End true false false 9 Long 0 9
,First,#,C:\BFTAWorkspace\Scratch\fire_scars_merge_clip.shp,Seas_End,
-1,-1;OBJECTID OBJECTID true false false 9 Long 0 9
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,OBJECTID,-1,-
1;SUB_NAME SUB_NAME true false false 80 Text 0 0
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,SUB_NAME,-1,-
1;SUB_CODE SUB_CODE true false false 6 Text 0 0
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,SUB_CODE,-1,-
1;SUB_NO SUB_NO true false false 9 Long 0 9
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,SUB_NO,-1,-
1;REG_NAME REG_NAME true false false 30 Text 0 0
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,REG_NAME,-1,-
1;REG_CODE REG_CODE true false false 4 Text 0 0
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,REG_CODE,-1,-
1;REG_NO REG_NO true false false 9 Long 0 9
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,REG_NO,-1,-
```

```
1;STATE STATE true false false 4 Text 0 0
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,STATE,-1,-
1;SHAPE_LENG SHAPE_LENG true false false 19 Double 11 18
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,SHAPE_LENG,-1,-
1;SHAPE_AREA SHAPE_AREA true false false 19 Double 11 18
,First,#,C:\PILBARA\PilbaraStudyArea_CopyFeature1.shp,SHAPE_AREA,-1,-
1"

' Process: Feature to Raster...
gp.FeatureToRaster_conversion fire_scars_Studyarea_merge_shp,
"Fuel_Age", fuelage, "100"
```

FireBehaviour Model Script

```
' ----------------------------------------------------------------------------
' FireBehaviour.vbs
' Created on: Thu Jan 17 2008 04:19:16 PM
'   (generated by ArcGIS/ModelBuilder)
' Usage: FireBehaviour <Density> <Bush_Areas_shp> <Water>
<Plantations> <slope> <fuelage> <StudyArea_lyr> <Output_Folder>
' Description:
' Calculates the fuel quantity based on fuel age and type, and for
shrublands the shrub height.
The results are output to BFTA\Workspace\Fuels for input into the
fire spread models.
' ----------------------------------------------------------------------------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Check out any necessary licenses
gp.CheckOutExtension "spatial"

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial
Analyst Tools.tbx"
gp.AddToolbox "C:/Program
Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"

' Set the Geoprocessing environment...
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.outputCoordinateSystem = ""
gp.extent = "C:\MUNDARING\MDG_StudyArea.lyr"
gp.cellSize = "100"
gp.mask = "C:\MUNDARING\MDG_StudyArea.lyr"
gp.workspace = "C:\BFTAWorkspace"

' Script arguments...
Density = wscript.arguments.item(0)
if Density = "#" then
 Density = "C:\MUNDARING\Vegetation\Density_clipped.ers" ' provide a
default value if unspecified
end if

Bush_Areas_shp = wscript.arguments.item(1)
if Bush_Areas_shp = "#" then
 Bush_Areas_shp = "C:\MUNDARING\Vegetation\Bush_Areas.shp" ' provide
a default value if unspecified
end if

Water = wscript.arguments.item(2)
if Water = "#" then
 Water = "C:\MUNDARING\BaseData\WaterBodies.shp" ' provide a default
value if unspecified
end if
```

```
Plantations = wscript.arguments.item(3)
if Plantations = "#" then
 Plantations = "C:\MUNDARING\Values\DAFW_plntn.shp" ' provide a
default value if unspecified
end if

slope = wscript.arguments.item(4)
if slope = "#" then
 slope = "C:\MUNDARING\Slope\slope" ' provide a default value if
unspecified
end if

fuelage = wscript.arguments.item(5)
if fuelage = "#" then
 fuelage = "C:\MUNDARING\Fuels\fuelage" ' provide a default value if
unspecified
end if

StudyArea_lyr = wscript.arguments.item(6)
if StudyArea_lyr = "#" then
 StudyArea_lyr = "C:\MUNDARING\MDG_StudyArea.lyr" ' provide a default
value if unspecified
end if

Output_Folder = wscript.arguments.item(7)
if Output_Folder = "#" then
 Output_Folder = "C:\BFTAWorkspace\BFTA_Themes" ' provide a default
value if unspecified
end if

' Local variables...
Bush_Areas = "Bush_Areas_Layer"
FuelClasses = "C:\BFTA_DATA\Veg_Fuel
Classification\FuelClassification.mdb\FuelClasses"
ftBush = "C:\BFTAWorkspace\Scratch\ftbush"
FQ = "C:\BFTAWorkspace\Scratch\fq"
fmBush = "C:\BFTAWorkspace\Scratch\fmbush"
ROS_For_Wood = "C:\BFTAWorkspace\Scratch\ROS_For_Wood"
v95fdik = "C:\BFTA_DATA\Weather Data\95percentile\95fdik"
v95fdinj = "C:\BFTA_DATA\Weather Data\95percentile\95fdinj"
v95hg_wind = "C:\BFTA_DATA\Weather Data\95percentile\95hg_wind"
v95mcafdi = "C:\BFTA_DATA\Weather Data\95percentile\95mcafdi"
v95rcu = "C:\BFTA_DATA\Weather Data\95percentile\95rcu"
v95re = "C:\BFTA_DATA\Weather Data\95percentile\95re"
v95rmh = "C:\BFTA_DATA\Weather Data\95percentile\95rmh"
v95rn = "C:\BFTA_DATA\Weather Data\95percentile\95rn"
v95rn2 = "C:\BFTA_DATA\Weather Data\95percentile\95rn2"
v95rosik12 = "C:\BFTA_DATA\Weather Data\95percentile\95rosik12"
v95rosik36 = "C:\BFTA_DATA\Weather Data\95percentile\95rosik36"
v95rosinj3 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj3"
v95rosinj4 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj4"
v95rsh = "C:\BFTA_DATA\Weather Data\95percentile\95rsh"
v95rosinj6 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj6"
v95rosinj2 = "C:\BFTA_DATA\Weather Data\95percentile\95rosinj2"
v95rosisj = "C:\BFTA_DATA\Weather Data\95percentile\95rosisj"
ROS_Grass = "C:\BFTAWorkspace\Scratch\ROS_Grass"
ROS_Shrub = "C:\BFTAWorkspace\Scratch\ROS_Shrub"
FM = "C:\BFTAWorkspace\Scratch\fm"
Bush_Areas_layer = "Bush_Areas_Layer"
ROS_Cl_Grass = "C:\BFTAWorkspace\Scratch\ros_cl_grass"
```

```
ROS_Cl_Shrub = "C:\BFTAWorkspace\Scratch\ROS_Cl_Shrub"
ROS_Cl_ForWd = "C:\BFTAWorkspace\Scratch\ros_cl_forwd"
FT = "C:\BFTAWorkspace\Scratch\ft"
I_Grass = "C:\BFTAWorkspace\Scratch\i_grass"
I_Cl_Grass = "C:\BFTAWorkspace\Scratch\i_cl_grass"
I_Shrub = "C:\BFTAWorkspace\Scratch\i_shrub"
I_Cl_Shrub = "C:\BFTAWorkspace\Scratch\i_cl_shrub"
I_Cl_For_Wood = "C:\BFTAWorkspace\Scratch\i_cl_for_wood"
I_For_Wood = "C:\BFTAWorkspace\Scratch\I_For_Wood"
FireClasses = "C:\BFTAWorkspace\BFTA_Themes\FireClasses"

' Process: Make Feature Layer...
gp.MakeFeatureLayer_management Bush_Areas_shp, Bush_Areas_layer, "",
"", "ID_LUT ID_LUT VISIBLE;SYSTEM SYSTEM VISIBLE;VEG_ASSOC VEG_ASSOC
VISIBLE;SYS_ASSOC SYS_ASSOC VISIBLE;VSA_CODE VSA_CODE
VISIBLE;MAPUNIT_ID MAPUNIT_ID VISIBLE"

' Process: Add Join...
gp.AddJoin_management Bush_Areas_layer, "VEG_ASSOC", FuelClasses,
"VEG_ASSOC", "KEEP_ALL"

' Process: Feature to Raster...
gp.FeatureToRaster_conversion Bush_Areas, "FuelClasses.FT_Code",
ftBush, "100"

' Process: Single Output Map Algebra (8)...
gp.SingleOutputMapAlgebra_sa "CON ( isnull ([FTBush]), 11, [FTBush])
", FT, "C:\BFTAWorkspace\Scratch\ftbush"

' Process: Single Output Map Algebra (13)...
gp.SingleOutputMapAlgebra_sa "CON ( [FT] == 1,  CON ( [FuelAge] <1,
0.2, (1 - EXP( -0.345 * [FuelAge]) ) * 7.36),
CON ( [FT] == 2, 0.1,
CON ( [FT] == 3,  CON ( [FuelAge] < 1,  0.2,  (1 - EXP( -0.252 *
[FuelAge]) ) * 13.31),
CON ( [FT] == 4,  CON ( [FuelAge] < 1 , 0.2, (8.896 + 0.566 *
POW([Density], 0.766) ) * (1 - EXP(-0.087 * [FuelAge]))),
CON ( [FT] == 5 , 4.5,
CON ( [FT] == 6 , 0.2,
CON ( [FT] == 7,  CON ( [FuelAge] < 1 , 0.2, (3.931 + 0.017 *
POW([Density], 1.475) ) * (1 - EXP(-0.105 * [FuelAge]))),
CON ( [FT] == 8,  CON ( [FuelAge]  < 1 , 0.2, (27.044 + 0.159 *
POW([Density], 1.198) ) * (1 - EXP(-0.0835 * [FuelAge]))),
CON ( [FT] == 9 ,  CON ( [FuelAge] < 1,  0.1, (0.25 * [Density] +
0.04 * 0.634*(1-EXP(-0.794*[FuelAge]))  - 3.2) * 0.98 -0.08),
CON ( [FT] == 10,  CON ( [FuelAge] < 1,  0.1, (0.25 * [Density] +
0.04 * 0.36*(1-EXP(-0.15*[FuelAge])) - 3.2) * 0.98 -0.08),
CON ( [FT] == 11, 1.5,
CON ( [FT] == 12, 0.5
0))))))))))))
", FQ,
"C:\MUNDARING\Fuels\fuelage;C:\MUNDARING\Vegetation\Density_clipped.e
rs;C:\BFTAWorkspace\Scratch\ft"

' Process: Feature to Raster (3)...
gp.FeatureToRaster_conversion Bush_Areas, "FuelClasses.FM_Code",
fmBush, "100"

' Process: Single Output Map Algebra...
gp.SingleOutputMapAlgebra_sa "CON ( isnull ([Water]),
```

```
CON ( isnull ([Plantations]),
CON (isnull([fmBush]), 2, [fmBush]),
19),
0)", FM,
"C:\BFTAWorkspace\Scratch\fmbush;C:\MUNDARING\BaseData\WaterBodies.sh
p;'C:\BFTA_DATA\Veg_Fuel Classification\NoPlantation.shp'"

' Process: Single Output Map Algebra (3)...
gp.SingleOutputMapAlgebra_sa "
CON ( [FM] == 1, [95Rn] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 2, [95Rcu] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 3, [95Re] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 4, [95Rn2] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 7, (154.9 * [95HG_Wind] + 140.6 * [FQ] - 229.1 * 12) *
EXP ( 0.069 * [Slope] ) )))))


", ROS_Grass, "C:\MUNDARING\Slope\slope;'C:\BFTA_DATA\Weather
Data\95percentile\95rcu';'C:\BFTA_DATA\Weather
Data\95percentile\95re';'C:\BFTA_DATA\Weather
Data\95percentile\95rn';'C:\BFTA_DATA\Weather
Data\95percentile\95hg_wind';'C:\BFTA_DATA\Weather
Data\95percentile\95rn2';C:\MUNDARING\Fuels\fuelage;C:\BFTAWorkspace\
Scratch\fq;C:\BFTAWorkspace\Scratch\fm"

' Process: Single Output Map Algebra (5)...
gp.SingleOutputMapAlgebra_sa "CON ([ROS_GRASS] < 60 , 1,
CON (([ROS_GRASS]  >= 60 AND [ROS_GRASS] < 300), 2 ,
CON (([ROS_GRASS]  >= 300 AND [ROS_GRASS] < 6500), 3 ,
CON (([ROS_GRASS]  >= 6500 AND [ROS_GRASS] < 10000), 4 ,
CON ([ROS_GRASS] > 10000, 5 )))))

", ROS_Cl_Grass, "C:\BFTAWorkspace\Scratch\ROS_Grass"

' Process: Single Output Map Algebra (9)...
gp.SingleOutputMapAlgebra_sa "[ROS_Grass] * [FQ] * 0.47", I_Grass,
"C:\BFTAWorkspace\Scratch\ROS_Grass;C:\BFTAWorkspace\Scratch\fq"

' Process: Single Output Map Algebra (10)...
gp.SingleOutputMapAlgebra_sa "CON ([I_Grass] < 800 , 1,
CON (([I_GRASS]  >= 800 AND [I_GRASS] < 5000), 3 ,
CON (([I_GRASS]  >= 5000 AND [I_GRASS] < 8000), 4 ,
CON ([I_GRASS] > 8000, 5 ))))
", I_Cl_Grass, "C:\BFTAWorkspace\Scratch\i_grass"

' Process: Single Output Map Algebra (4)...
gp.SingleOutputMapAlgebra_sa "CON ( [FM] == 5,  CON ([FuelAge] <3, 1,
[95Rmh] * EXP ( 0.069 * [Slope] )),
CON ( [FM] == 6,  [95Rsh] * EXP ( 0.035 * [Slope] ) * (POW((CON
([FuelAge] < 3, 1, (1 - EXP( -  0.323 * [FuelAge]) ) * 0.925 )),
0.49)),
CON ( [FM] == 17,  0.1 * 95Rsh] * EXP ( 0.035 * [Slope] ) * (POW((CON
([FuelAge] < 3,  1, (1 - EXP( -  0.323 * [FuelAge]) ) * 0.925 )),
0.49)),
CON ( [FM] == 18,  0
))))

", ROS_Shrub, "C:\MUNDARING\Slope\slope;'C:\BFTA_DATA\Weather
Data\95percentile\95rmh';'C:\BFTA_DATA\Weather
```

```
Data\95percentile\95rsh';C:\MUNDARING\Fuels\fuelage;C:\BFTAWorkspace\
Scratch\fm"

' Process: Single Output Map Algebra (6)...
gp.SingleOutputMapAlgebra_sa "CON ([ROS_SHRUB] < 60 , 1,
CON (([ROS_SHRUB]  >= 60 AND [ROS_SHRUB] < 140), 2 ,
CON (([ROS_SHRUB]  >= 140 AND [ROS_SHRUB] < 1000), 3 ,
CON (([ROS_SHRUB]  >= 1000 AND [ROS_SHRUB] < 2000), 4 ,
CON ([ROS_SHRUB] > 2000, 5 )))))

", ROS_Cl_Shrub, "C:\BFTAWorkspace\Scratch\ROS_Shrub"

' Process: Single Output Map Algebra (11)...
gp.SingleOutputMapAlgebra_sa "[ROS_Shrub] * [FQ] * 0.47", I_Shrub,
"C:\BFTAWorkspace\Scratch\ROS_Shrub;C:\BFTAWorkspace\Scratch\fq"

' Process: Single Output Map Algebra (12)...
gp.SingleOutputMapAlgebra_sa "CON ([I_Shrub] < 800 , 1,
CON (([I_SHRUB]  >= 800 AND [I_SHRUB] < 2000), 3 ,
CON (([I_SHRUB]  >= 2000 AND [I_SHRUB] < 8000), 4 ,
CON ([I_SHRUB] > 8000, 5 ))))


", I_Cl_Shrub, "C:\BFTAWorkspace\Scratch\i_shrub"

' Process: Single Output Map Algebra (2)...
gp.SingleOutputMapAlgebra_sa "CON ( [FM] == 8, CON ( [Density] < 5,
[95ROSInj2] * (CON ([FQ]  < 8.0 , 1.02 / ( 1 + 7266.33 * EXP( - 1.36
* [FQ] ) ) + 0.1 , ( 6.03 + 5.81 * [FQ] ) /  53.44 )) * EXP ( 0.069 *
[Slope] ), CON ( [Density] < 10,  [95ROSInj3] * (CON ([FQ]  < 8.0 ,
1.02 / ( 1 + 7266.33 * EXP( - 1.36 * [FQ] ) ) + 0.1 , ( 6.03 + 5.81 *
[FQ] ) /  53.44 )) * EXP ( 0.069 * [Slope] ),  CON ( [Density] < 20,
[95ROSInj4] * (CON ([FQ]  < 8.0 , 1.02 / ( 1 + 7266.33 * EXP( - 1.36
* [FQ] ) ) + 0.1 , ( 6.03 + 5.81 * [FQ] ) /  53.44 )) * EXP ( 0.069 *
[Slope] ),  CON ( [Density] < 30,  [95FDInj] * (CON ([FQ]  < 8.0 ,
1.02 / ( 1 + 7266.33 * EXP( - 1.36 * [FQ] ) ) + 0.1 , ( 6.03 + 5.81 *
[FQ] ) /  53.44 )) * EXP ( 0.069 * [Slope] ),  [95ROSInj6] * (CON
([FQ]  < 8.0 , 1.02 / ( 1 + 7266.33 * EXP( - 1.36 * [FQ] ) ) + 0.1 ,
( 6.03 + 5.81 * [FQ] ) /  53.44 )) * EXP ( 0.069 * [Slope] ) )))),

CON ( [FM] == 12, (CON ([FQ]  < 17.0 , 0.95 / ( 1 + 957.74 * EXP( -
0.52 * [FQ] ) ) + 0.16 , ( 5.08 +6.26 * [FQ] ) / 111.5 )) * [95FDIk]
* EXP ( 0.069 * [Slope] ),
CON ( [FM] == 13, (CON ([FQ]  < 17.0 , 0.95 / ( 1 + 957.74 * EXP( -
0.52 * [FQ] ) ) + 0.16 , ( 5.08 +6.26 * [FQ] ) / 111.5 )) *
[95ROSIk36] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 14, (CON ([FQ]  < 17.0 , 0.95 / ( 1 + 957.74 * EXP( -
0.52 * [FQ] ) ) + 0.16 , ( 5.08 +6.26 * [FQ] ) / 111.5 )) *
[95ROSIk12] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 15, (CON ([FQ]  < 17.0 , 0.95 / ( 1 + 957.74 * EXP( -
0.52 * [FQ] ) ) + 0.16 , ( 5.08 +6.26 * [FQ] ) / 111.5 )) *
[95ROSIsj] * EXP ( 0.069 * [Slope] ),
CON ( [FM] == 16, [95McAFDI] * 0.0012 * [FQ] * EXP ( 0.069 *
[Slope]),
CON ( [FM] == 19, [95FDInj]  * EXP ( 0.069 * [Slope])
)))))))
", ROS_For_Wood, "C:\MUNDARING\Slope\slope;'C:\BFTA_DATA\Weather
Data\95percentile\95fdik';'C:\BFTA_DATA\Weather
Data\95percentile\95fdinj';'C:\BFTA_DATA\Weather
Data\95percentile\95mcafdi';'C:\BFTA_DATA\Weather
```

```
Data\95percentile\95rosik12';'C:\BFTA_DATA\Weather
Data\95percentile\95rosik36';'C:\BFTA_DATA\Weather
Data\95percentile\95rosinj3';'C:\BFTA_DATA\Weather
Data\95percentile\95rosinj4';C:\MUNDARING\Fuels\fuelage;C:\BFTAWorksp
ace\Scratch\fq;C:\MUNDARING\Vegetation\Density_clipped.ers;'C:\BFTA_D
ATA\Weather Data\95percentile\95rosinj6';'C:\BFTA_DATA\Weather
Data\95percentile\95rosinj2';'C:\BFTA_DATA\Weather
Data\95percentile\95rosisj';C:\BFTAWorkspace\Scratch\fm"

' Process: Single Output Map Algebra (7)...
gp.SingleOutputMapAlgebra_sa "CON ([ROS_FOR_WOOD] < 60 , 1,
CON (([ROS_FOR_WOOD]  >= 60 AND [ROS_FOR_WOOD] < 140), 2 ,
CON (([ROS_FOR_WOOD]  >= 140 AND [ROS_FOR_WOOD] < 400), 3 ,
CON (([ROS_FOR_WOOD]  >= 400 AND [ROS_FOR_WOOD] < 800), 4 ,
CON ([ROS_FOR_WOOD] > 800, 5 )))))
", ROS_Cl_ForWd, "C:\BFTAWorkspace\Scratch\ROS_For_Wood"

' Process: Single Output Map Algebra (15)...
gp.SingleOutputMapAlgebra_sa "[ROS_For_Wood] * [FQ] * 0.47",
I_For_Wood,
"C:\BFTAWorkspace\Scratch\ROS_For_Wood;C:\BFTAWorkspace\Scratch\fq"

' Process: Single Output Map Algebra (14)...
gp.SingleOutputMapAlgebra_sa "CON ([I_For_Wood] < 800 , 1,
CON (([I_FOR_WOOD]  >= 800 AND [I_FOR_WOOD] < 2000), 3 ,
CON (([I_FOR_WOOD]  >= 2000 AND [I_FOR_WOOD] < 4000), 4 ,
CON ([I_FOR_WOOD] > 4000, 5 ))))

", I_Cl_For_Wood, "C:\BFTAWorkspace\Scratch\I_For_Wood"

' Process: Mosaic To New Raster...
gp.MosaicToNewRaster_management
"C:\BFTAWorkspace\Scratch\ros_cl_grass;C:\BFTAWorkspace\Scratch\i_cl_
grass;C:\BFTAWorkspace\Scratch\ROS_Cl_Shrub;C:\BFTAWorkspace\Scratch\
i_cl_shrub;C:\BFTAWorkspace\Scratch\ros_cl_forwd;C:\BFTAWorkspace\Scr
atch\i_cl_for_wood", Output_Folder, "FireClasses", "",
"8_BIT_UNSIGNED", "", "1", "MAXIMUM", "FIRST"
```

Consequence (Values) Scripts

Create Agricultural and Horticultural valuesclasses file (State) Model

```
' ---------------------------------------------------------------------------
' CreateAgricClasses.vbs
' Created on: Sun Feb 10 2008 11:32:48 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: CreateAgricClasses <LandUseByShire_llgda_shp>
' Description:
' THIS MODEL MUST BE RUN IN EDIT MODE. The model will fail to execute
the Merge tool. When this happens, right click on Merge, and click
"Run" to complete the processing. There is a bug in the ESRI ArcGIS
9.2 software (Nimbus Id: NIM006497) that  will be fixed in 9.3.
**********************************************

This model uses the DAFW land use file to classify agricultural and
horticultural values. Output is stored as
C:\BFTA_DATA\ValuesData\Agric_Hortic_ValueClasses.shp. This model
only needs to be run once whenever the database is updated. The
output file is then available as an input into the Values model.
' ---------------------------------------------------------------------------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Script arguments...
LandUseByShire_llgda_shp = wscript.arguments.item(0)
if LandUseByShire_llgda_shp = "#" then
 LandUseByShire_llgda_shp =
"V:\GIS_Data_Other\DAFW\LandUseByShire_llgda.shp" ' provide a default
value if unspecified
end if

' Local variables...
DAFW_2_ = "V:\GIS_Data_Other\DAFW\LandUseByShire_llgda_CopyFea2.shp"
crops_shp__2_ = "C:\BFTAWorkspace\Scratch\Crops.shp"
Crops_shp = "C:\BFTAWorkspace\Scratch\Crops.shp"
Output_Feature_Class =
"V:\GIS_Data_Other\DAFW\LandUseByShire_llgda_CopyFea2.shp"
Horticulture_shp = "C:\BFTAWorkspace\Scratch\Horticulture.shp"
Intensive_Animal_shp =
"C:\BFTAWorkspace\Scratch\Intensive_Animal.shp"
Pasture_shp = "C:\BFTAWorkspace\Scratch\Pasture.shp"
Horticulture_shp__2_ = "C:\BFTAWorkspace\Scratch\Horticulture.shp"
Intensive_Animal_shp__2_ =
"C:\BFTAWorkspace\Scratch\Intensive_Animal.shp"
Pasture_shp__2_ = "C:\BFTAWorkspace\Scratch\Pasture.shp"
```

```
Agric_Hortic_ValueClasses_shp =
"C:\BFTA_DATA\ValuesData\Agric_Hortic_ValueClasses.shp"

' Process: Copy Features...
gp.CopyFeatures_management LandUseByShire_llgda_shp,
Output_Feature_Class, "", "0", "0", "0"

' Process: Add Field (9)...
gp.AddField_management Output_Feature_Class, "ValueClass", "SHORT",
"", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Select (17)...
gp.Select_analysis DAFW_2_, Crops_shp, """SLU_DESC"" = 'Cropping'"

' Process: Calculate Field (21)...
gp.CalculateField_management Crops_shp, "ValueClass", "2", "VB", ""

' Process: Select...
gp.Select_analysis DAFW_2_, Horticulture_shp, """SLU_DESC"" =
'Intensive horticulture'"

' Process: Calculate Field...
gp.CalculateField_management Horticulture_shp, "ValueClass", "3",
"VB", ""

' Process: Select (2)...
gp.Select_analysis DAFW_2_, Intensive_Animal_shp, """SLU_DESC"" =
'Intensive animal production'"

' Process: Calculate Field (2)...
gp.CalculateField_management Intensive_Animal_shp, "ValueClass", "3",
"VB", ""

' Process: Select (3)...
gp.Select_analysis DAFW_2_, Pasture_shp, """SLU_DESC"" = 'Grazing and
improved pastures'"

' Process: Calculate Field (3)...
gp.CalculateField_management Pasture_shp, "ValueClass", "2", "VB", ""

' Process: Merge...
gp.Merge_management
"C:\BFTAWorkspace\Scratch\Crops.shp;C:\BFTAWorkspace\Scratch\Horticul
ture.shp;C:\BFTAWorkspace\Scratch\Intensive_Animal.shp;C:\BFTAWorkspa
ce\Scratch\Pasture.shp", Agric_Hortic_ValueClasses_shp, "SLU_DESC
SLU_DESC true false false 254 Text 0 0
,First,#,C:\BFTAWorkspace\Scratch\Crops.shp,SLU_DESC,-1,-
1,C:\BFTAWorkspace\Scratch\Horticulture.shp,SLU_DESC,-1,-
1,C:\BFTAWorkspace\Scratch\Intensive_Animal.shp,SLU_DESC,-1,-
1,C:\BFTAWorkspace\Scratch\Pasture.shp,SLU_DESC,-1,-1;ValueClass
ValueClass true false false 4 Short 0 4
,First,#,C:\BFTAWorkspace\Scratch\Crops.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\Horticulture.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\Intensive_Animal.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\Pasture.shp,ValueClass,-1,-1"
```

Create DEFL Values Class File (State) Model

```
' ---------------------------------------------------------------------------
' CreateDEFLclasses.vbs
' Created on: Sun Feb 10 2008 11:33:57 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: CreateDEFLclasses <DEFL_>
' Description:
' THIS MODEL MUST BE RUN IN EDIT MODE. The model will fail to execute
the Merge tool. When this happens, right click on Merge, and click
"Run" to complete the processing. There is a bug in the ESRI ArcGIS
9.2 software (Nimbus Id: NIM006497) that  will be fixed in 9.3.
***********************************************
This model classifies declared flora. Output file is
C:\BFTAWorkspace\Values\DEFL_Classes.shp.  This only needs to be run
whenever the database is updated. The output file is then available
as an input into the Values model.
' ---------------------------------------------------------------------------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Script arguments...
DEFL_ = wscript.arguments.item(0)
if DEFL_ = "#" then
 DEFL_ = "V:\GIS1-Corporate\Data\Flora\State\DEFL.shp" ' provide a
default value if unspecified
end if

' Local variables...
DEFL_Unclass = "V:\GIS1-
Corporate\Data\Flora\State\DEFL_CopyFeatures1.shp"
DEFL_CR_shp = "C:\BFTAWorkspace\Scratch\DEFL_CR.shp"
DEFL_CR_shp__2_ = "C:\BFTAWorkspace\Scratch\DEFL_CR.shp"
DEFL_EN_shp = "C:\BFTAWorkspace\Scratch\DEFL_EN.shp"
DEFL_EN_shp__2_ = "C:\BFTAWorkspace\Scratch\DEFL_EN.shp"
DEFL_VU_shp = "C:\BFTAWorkspace\Scratch\DEFL_VU.shp"
DEFL_VU_shp__2_ = "C:\BFTAWorkspace\Scratch\DEFL_VU.shp"
DEFL_Valueclasses_shp =
"C:\BFTA_DATA\ValuesData\DEFL_Valueclasses.shp"
Output_Feature_Class = "V:\GIS1-
Corporate\Data\Flora\State\DEFL_CopyFeatures1.shp"

' Process: Copy Features...
gp.CopyFeatures_management DEFL_, Output_Feature_Class, "", "0", "0",
"0"

' Process: Add Field (7)...
```

```
gp.AddField_management Output_Feature_Class, "ValueClass", "SHORT",
"", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Select (6)...
gp.Select_analysis DEFL_Unclass, DEFL_EN_shp, """IUCN_Rank"" = 'EN'
or ""CONSVCODE"" = '1'"

' Process: Calculate Field (8)...
gp.CalculateField_management DEFL_EN_shp, "ValueClass", "4", "VB", ""

' Process: Select (7)...
gp.Select_analysis DEFL_Unclass, DEFL_VU_shp, " ""IUCN_Rank"" = 'VU'
or ""CONSVCODE"" >= '2'"

' Process: Calculate Field (9)...
gp.CalculateField_management DEFL_VU_shp, "ValueClass", "3", "VB", ""

' Process: Select (5)...
gp.Select_analysis DEFL_Unclass, DEFL_CR_shp, """IUCN_Rank"" = 'CR'"

' Process: Calculate Field (11)...
gp.CalculateField_management DEFL_CR_shp, "ValueClass", "5", "VB", ""

' Process: Merge...
gp.Merge_management
"C:\BFTAWorkspace\Scratch\DEFL_EN.shp;C:\BFTAWorkspace\Scratch\DEFL_V
U.shp;C:\BFTAWorkspace\Scratch\DEFL_CR.shp", DEFL_Valueclasses_shp,
"CONSVCODE CONSVCODE true false false 1 Text 0 0
,First,#,C:\BFTAWorkspace\Scratch\DEFL_EN.shp,CONSVCODE,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_VU.shp,CONSVCODE,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_CR.shp,CONSVCODE,-1,-1;IUCN_Rank
IUCN_Rank true false false 2 Text 0 0
,First,#,C:\BFTAWorkspace\Scratch\DEFL_EN.shp,IUCN_Rank,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_VU.shp,IUCN_Rank,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_CR.shp,IUCN_Rank,-1,-1;ValueClass
ValueClass true false false 4 Short 0 4
,First,#,C:\BFTAWorkspace\Scratch\DEFL_EN.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_VU.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\DEFL_CR.shp,ValueClass,-1,-1"
```

Create Plantations Values File (State) model

```
' ----------------------------------------------------------------------
--------
' CreatePltnsClasses.vbs
' Created on: Sun Feb 10 2008 11:34:47 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: CreatePltnsClasses <plantation_annual_report_shp>
<LandUseByShire_llgda_shp>
' Description:
' THIS MODEL MUST BE RUN IN EDIT MODE. The model will fail to execute
the Merge tool. When this happens, right click on Merge, and click
"Run" to complete the processing. There is a bug in the ESRI ArcGIS
9.2 software (Nimbus Id: NIM006497) that  will be fixed in 9.3.
***********************************************
This model uses the FPC plantation_annual_report.shp and the DAFWA
LandUSeByShire_ll.shp files to extract and classify plantations.
This only needs to be run whenever the database is updated. The
output file is then available as an input into the Values model.
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Set the Geoprocessing environment...
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.workspace = "C:\BFTAWorkspace"

' Script arguments...
plantation_annual_report_shp = wscript.arguments.item(0)
if plantation_annual_report_shp = "#" then
 plantation_annual_report_shp = "V:\GIS1-
Corporate\Data\Plantation\State\plantation_annual_report.shp" '
provide a default value if unspecified
end if

LandUseByShire_llgda_shp = wscript.arguments.item(1)
if LandUseByShire_llgda_shp = "#" then
 LandUseByShire_llgda_shp =
"V:\GIS_Data_Other\DAFW\LandUseByShire_llgda.shp" ' provide a default
value if unspecified
end if

' Local variables...
FPCother = "C:\MUNDARING\Scratch\Other_plntns.shp"
pine98_shp = "C:\BFTAWorkspace\Scratch\pine98.shp"
pinearea = "C:\BFTAWorkspace\Scratch\pinearea"
v98_Layer__2_ = "98_Layer"
v98_Layer = "98_Layer"
```

```
FPCplantations_Copy_shp =
"C:\BFTAWorkspace\Scratch\FPCplantations_Copy.shp"
Pines_older8_over100ha =
"C:\BFTAWorkspace\Scratch\Pines_older8_over100ha.shp"
Other_plntns_shp = "C:\MUNDARING\Scratch\Other_plntns.shp"
Pines_older8_over100ha_2_ =
"C:\BFTAWorkspace\Scratch\Pines_older8_over100ha.shp"
Other_plntns_shp__3_ = "C:\MUNDARING\Scratch\Other_plntns.shp"
Pines_older8_over100ha_shp =
"C:\BFTAWorkspace\Scratch\Pines_older8_over100ha.shp"
Other_plntns_shp__2_ = "C:\MUNDARING\Scratch\Other_plntns.shp"
Pines_older8_over100ha_shp__2_ =
"C:\BFTAWorkspace\Scratch\Pines_older8_over100ha.shp"
Plantations_ValueClasses_shp =
"C:\BFTA_DATA\ValuesData\Plantations_ValueClasses.shp"
DAFWA_Plntns_shp = "C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp"
DAFWA_Plntns_shp__2_ = "C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp"
DAFWA_Plntns_shp__3_ = "C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp"
DAFWA_Plntns_shp__4_ = "C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp"


' Process: Copy Features...
gp.CopyFeatures_management plantation_annual_report_shp,
FPCplantations_Copy_shp, "", "0", "0", "0"

' Process: Select (9)...
gp.Select_analysis FPCplantations_Copy_shp, FPCother, "NOT (""GENUS""
= 'Pinus' AND ""PYEAR"" <=  1998 )"

' Process: Add Field (3)...
gp.AddField_management FPCother, "ValueClass", "SHORT", "", "", "",
"", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (3)...
gp.CalculateField_management Other_plntns_shp, "ValueClass", "3",
"VB", ""

' Process: Delete Field...
gp.DeleteField_management Other_plntns_shp__3_,
"PTN_ID;SECTION;COMP;SUBCOMP;PYEAR;PGIS_AREA;ROTATION;GENUS;SPECIES;I
NFRA_SPEC;AR_CATEGOR"

' Process: Select (10)...
gp.Select_analysis FPCplantations_Copy_shp, pine98_shp, """GENUS"" =
'Pinus' AND ""PYEAR"" <= 1998"

' Process: Make Feature Layer...
gp.MakeFeatureLayer_management pine98_shp, v98_Layer, "", "", "PTN_ID
PTN_ID VISIBLE;SECTION SECTION_ VISIBLE;COMP COMP_ VISIBLE;SUBCOMP
SUBCOMP VISIBLE;PYEAR PYEAR VISIBLE;PGIS_AREA PGIS_AREA
VISIBLE;ROTATION ROTATION VISIBLE;GENUS GENUS VISIBLE;SPECIES SPECIES
VISIBLE;INFRA_SPEC INFRA_SPEC VISIBLE;AR_CATEGOR AR_CATEGOR VISIBLE"

' Process: Summary Statistics...
gp.Statistics_analysis pine98_shp, pinearea, "PGIS_AREA SUM",
"PTN_ID"

' Process: Add Join...
gp.AddJoin_management v98_Layer, "PTN_ID", pinearea, "PTN_ID",
"KEEP_ALL"
```

```
' Process: Select (8)...
gp.Select_analysis v98_Layer__2_, Pines_older8_over100ha_shp,
"""pinearea:SUM_PGIS_AREA""   >=1000000"

' Process: Add Field...
gp.AddField_management Pines_older8_over100ha_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field...
gp.CalculateField_management Pines_older8_over100ha, "ValueClass",
"4", "VB", ""

' Process: Delete Field (2)...
gp.DeleteField_management Pines_older8_over100ha_2_,
"pine98_PTN;pine98_SEC;pine98_COM;pine98_SUB;pine98_PYE;pine98_PGI;pi
ne98_ROT;pine98_GEN;pine98_SPE;pine98_INF;pine98_AR_;pinearea_R;pinea
rea_F;pinearea_P;pinearea_1;pinearea_S"

' Process: Select...
gp.Select_analysis LandUseByShire_llgda_shp, DAFWA_Plntns_shp,
"""SLU_DESC"" = 'Plantation forestry'"

' Process: Add Field (2)...
gp.AddField_management DAFWA_Plntns_shp, "ValueClass", "SHORT", "",
"", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (2)...
gp.CalculateField_management DAFWA_Plntns_shp__2_, "ValueClass", "3",
"VB", ""

' Process: Delete Field (3)...
gp.DeleteField_management DAFWA_Plntns_shp__3_,
"SHIRE_NAME;Area;PRIMARY_LU;PLU_DESC;SECONDARY_;SLU_DESC;TERTIARY_L;T
LU_DESC;ID3;TempField1"

' Process: Merge...
gp.Merge_management
"C:\MUNDARING\Scratch\Other_plntns.shp;C:\BFTAWorkspace\Scratch\Pines
_older8_over100ha.shp;C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp",
Plantations_ValueClasses_shp, "ValueClass ValueClass true false false
4 Short 0 4
,First,#,C:\BFTAWorkspace\Scratch\Pines_older8_over100ha.shp,ValueCla
ss,-1,-1,C:\MUNDARING\Scratch\Other_plntns.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\DAFWA_Plntns.shp,ValueClass,-1,-1"
```

Create Threatened Fauna valuesclass file (State) model

```
' ---------------------------------------------------------------------------
--------
' CreateTFclasses.vbs
' Created on: Sun Feb 10 2008 11:36:19 AM
'   (generated by ArcGIS/ModelBuilder)
' Usage: CreateTFclasses <threatened_fauna_shp>
' Description:
' THIS MODEL MUST BE RUN IN EDIT MODE. The model will fail to execute
the Merge tool. When this happens, right click on Merge, and click
"Run" to complete the processing. There is a bug in the ESRI ArcGIS
9.2 software (Nimbus Id: NIM006497) that  will be fixed in 9.3.
******************************************
*Classifies the entire TF file and stores the result as
C:\BFTA_DATA\ValuesData\Threatened_Fauna_ValueClasses.shp. This only
needs to be run whenever the database is updated. The output file is
then available as an input into the Values model.
' ---------------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Script arguments...
threatened_fauna_shp = wscript.arguments.item(0)
if threatened_fauna_shp = "#" then
 threatened_fauna_shp = "V:\GIS1-
Corporate\Data\Fauna\state\threatened_fauna.shp" ' provide a default
value if unspecified
end if

' Local variables...
TF = "V:\GIS1-
Corporate\Data\Fauna\state\threatened_fauna_CopyFeature6.shp"
TF_CL2 = "C:\BFTAWorkspace\Scratch\TF_CL2.shp"
TF_CL5_shp = "C:\BFTAWorkspace\Scratch\TF_CL5.shp"
TF_CL4_shp = "C:\BFTAWorkspace\Scratch\TF_CL4.shp"
TF_CL3_shp = "C:\BFTAWorkspace\Scratch\TF_CL3.shp"
TF_CL2_shp = "C:\BFTAWorkspace\Scratch\TF_CL2.shp"
TF_CL3 = "C:\BFTAWorkspace\Scratch\TF_CL3.shp"
TF_CL4 = "C:\BFTAWorkspace\Scratch\TF_CL4.shp"
TF_CL5 = "C:\BFTAWorkspace\Scratch\TF_CL5.shp"
TF_CL5_shp__2_ = "C:\BFTAWorkspace\Scratch\TF_CL5.shp"
TF_CL3_shp__2_ = "C:\BFTAWorkspace\Scratch\TF_CL3.shp"
TF_CL2_shp__2_ = "C:\BFTAWorkspace\Scratch\TF_CL2.shp"
TF_CL4_shp__2_ = "C:\BFTAWorkspace\Scratch\TF_CL4.shp"
Output_Feature_Class = "V:\GIS1-
Corporate\Data\Fauna\state\threatened_fauna_CopyFeature6.shp"
Threatened_Fauna_ValueClasses_shp =
"C:\BFTA_DATA\ValuesData\Threatened_Fauna_ValueClasses.shp"
```

```
' Process: Copy Features...
gp.CopyFeatures_management threatened_fauna_shp,
Output_Feature_Class, "", "0", "0", "0"

' Process: Add Field (14)...
gp.AddField_management Output_Feature_Class, "ValueClass", "SHORT",
"", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Select (15)...
gp.Select_analysis TF, TF_CL2_shp, """WA_LIST"" = 'Priority Three:
Taxa with several, poorly known populations, some on conservation
lands' OR ""WA_LIST"" = 'Priority Four: Taxa in need of monitoring'
OR ""WA_LIST"" = 'Priority Five: Taxa in need of monitoring
(conservation dependent)'"

' Process: Calculate Field (19)...
gp.CalculateField_management TF_CL2_shp, "ValueClass", "2", "VB", ""

' Process: Delete Field (3)...
gp.DeleteField_management TF_CL2,
"CLASSNAME;DATE_;DBNO;WA_LIST;IUCN;CERTAINTY;RESOLUTION;METHOD;LEGEND
"

' Process: Select (13)...
gp.Select_analysis TF, TF_CL4_shp, """IUCN"" = 'Endangered' OR
""WA_LIST"" = 'Priority One: Taxa with few, poorly known populations
on threatened lands' OR ""WA_LIST"" ='Priority Two: Taxa with few,
poorly known populations on conservation lands'"

' Process: Calculate Field (25)...
gp.CalculateField_management TF_CL4_shp, "ValueClass", "4", "VB", ""

' Process: Delete Field (4)...
gp.DeleteField_management TF_CL4,
"CLASSNAME;DATE_;DBNO;WA_LIST;IUCN;CERTAINTY;RESOLUTION;METHOD;LEGEND
"

' Process: Select (14)...
gp.Select_analysis TF, TF_CL3_shp, """IUCN"" = 'Vulnerable'"

' Process: Calculate Field (22)...
gp.CalculateField_management TF_CL3_shp, "ValueClass", "3", "VB", ""

' Process: Delete Field (2)...
gp.DeleteField_management TF_CL3,
"CLASSNAME;DATE_;DBNO;WA_LIST;IUCN;CERTAINTY;RESOLUTION;METHOD;LEGEND
"

' Process: Select (16)...
gp.Select_analysis TF, TF_CL5_shp, """IUCN"" = 'Critically
Endangered'"

' Process: Calculate Field (28)...
gp.CalculateField_management TF_CL5_shp, "ValueClass", "5", "VB", ""

' Process: Delete Field...
gp.DeleteField_management TF_CL5,
"CLASSNAME;DATE_;DBNO;WA_LIST;IUCN;CERTAINTY;RESOLUTION;METHOD;LEGEND
"
```

```
' Process: Merge...
gp.Merge_management
"C:\BFTAWorkspace\Scratch\TF_CL2.shp;C:\BFTAWorkspace\Scratch\TF_CL4.
shp;C:\BFTAWorkspace\Scratch\TF_CL3.shp;C:\BFTAWorkspace\Scratch\TF_C
L5.shp", Threatened_Fauna_ValueClasses_shp, "ValueClass ValueClass
true false false -1 Short -1 -2
,First,#,C:\BFTAWorkspace\Scratch\TF_CL2.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\TF_CL4.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\TF_CL3.shp,ValueClass,-1,-
1,C:\BFTAWorkspace\Scratch\TF_CL5.shp,ValueClass,-1,-1"
```

Prepare Inputs for Values Model model

```
' ----------------------------------------------------------------------
--------
' PrepareInputsforValues.vbs
' Created on: Fri Feb 22 2008 03:24:57 PM
'   (generated by ArcGIS/ModelBuilder)
' Usage: PrepareInputsforValues <Study_Area_Layer>
<Plantation_Values__Classified_> <Communications_repeaters>
<builtup_areas__settlements__communities_region_2>
<Agric_Hortic_ValueClasses> <heritage_commission_sites_shp>
<Dist_Low_Voltage_Carrier_line_shp> <aboriginal_sites_shp>
<Threatened_Fauna_ValueClasses_shp> <DEFL_Valueclasses_shp>
<Transmission_lins_steel_towers> <tec_community_boundaries_shp>
<High_voltage_cariier__wooden_poles> <Masts_> <apiary_sites>
<Cadastre_> <remnant_vegetation_> <Buildings_>
<Classified_Recreation_Sites>
' Description:
' Ensure the models in the Data Prep Toolset have been run prior to
this model being run. Prepares inputs for the Values model. Default
is to use the CALM/DEC Corporate GIS data.. Where the Study Area
includes more than one DEC Region, it may be necessary to first merge
some data sets. Clips to a buffer surrounding the Study Area so
values close to the boundary are considerd. Outputs all files to
BFTAWorkspace\Values.
' ----------------------------------------------------------------------
--------

' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Set the Geoprocessing environment...
gp.XYResolution = ""
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.MTolerance = ""
gp.randomGenerator = "0 ACM599"
gp.outputCoordinateSystem =
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"
gp.outputZFlag = "Same As Input"
gp.qualifiedFieldNames = "true"
gp.extent = "C:\BFTAWorkspace\Scratch\StudyArea500Buff.shp"
gp.XYTolerance = ""
gp.outputZValue = ""
gp.outputMFlag = "Same As Input"
gp.geographicTransformations = ""
gp.ZResolution = ""
gp.workspace = "C:\BFTAWorkspace"
gp.MResolution = ""
```

```
gp.ZTolerance = ""

' Script arguments...
Study_Area_Layer = wscript.arguments.item(0)
if Study_Area_Layer = "#" then
 Study_Area_Layer = "C:\PILBARA\PilbaraStudyArea.lyr" ' provide a
default value if unspecified
end if

Plantation_Values__Classified_ = wscript.arguments.item(1)
if Plantation_Values__Classified_ = "#" then
 Plantation_Values__Classified_ =
"C:\BFTA_DATA\ValuesData\Plantations_ValueClasses.shp" ' provide a
default value if unspecified
end if

Communications_repeaters = wscript.arguments.item(2)
if Communications_repeaters = "#" then
 Communications_repeaters = "V:\GIS1-
Corporate\Data\Man_Made_Structures\Communications\CALM\communication_
repeater_stations.shp" ' provide a default value if unspecified
end if

builtup_areas__settlements__communities_region_2 =
wscript.arguments.item(3)
if builtup_areas__settlements__communities_region_2 = "#" then
 builtup_areas__settlements__communities_region_2 = "V:\GIS1-
Corporate\Data\Geodata\Infrastructure\Pilbara\builtup_areas.shp" '
provide a default value if unspecified
end if

Agric_Hortic_ValueClasses = wscript.arguments.item(4)
if Agric_Hortic_ValueClasses = "#" then
 Agric_Hortic_ValueClasses =
"C:\BFTA_DATA\ValuesData\Agric_Hortic_ValueClasses.shp" ' provide a
default value if unspecified
end if

heritage_commission_sites_shp = wscript.arguments.item(5)
if heritage_commission_sites_shp = "#" then
 heritage_commission_sites_shp = "V:\GIS1-
Corporate\Data\Sensitive_Sites\heritage_commission_sites.shp" '
provide a default value if unspecified
end if

Dist_Low_Voltage_Carrier_line_shp = wscript.arguments.item(6)
if Dist_Low_Voltage_Carrier_line_shp = "#" then
 Dist_Low_Voltage_Carrier_line_shp = "V:\GIS1-
Corporate\Data\Man_Made_Structures\Western_Power\Dist_Low_Voltage_Car
rier_line.shp" ' provide a default value if unspecified
end if

aboriginal_sites_shp = wscript.arguments.item(7)
if aboriginal_sites_shp = "#" then
 aboriginal_sites_shp = "V:\GIS1-
Corporate\Data\Sensitive_Sites\aboriginal_sites.shp" ' provide a
default value if unspecified
end if

Threatened_Fauna_ValueClasses_shp = wscript.arguments.item(8)
```

```
if Threatened_Fauna_ValueClasses_shp = "#" then
 Threatened_Fauna_ValueClasses_shp =
"C:\BFTA_DATA\ValuesData\Threatened_Fauna_ValueClasses.shp" ' provide
a default value if unspecified
end if

DEFL_Valueclasses_shp = wscript.arguments.item(9)
if DEFL_Valueclasses_shp = "#" then
 DEFL_Valueclasses_shp =
"C:\BFTA_DATA\ValuesData\DEFL_Valueclasses.shp" ' provide a default
value if unspecified
end if

Transmission_lins_steel_towers = wscript.arguments.item(10)
if Transmission_lins_steel_towers = "#" then
 Transmission_lins_steel_towers = "V:\GIS1-
Corporate\Data\Man_Made_Structures\Western_Power\Trans_Lines_overhead
_only_line.shp" ' provide a default value if unspecified
end if

tec_community_boundaries_shp = wscript.arguments.item(11)
if tec_community_boundaries_shp = "#" then
 tec_community_boundaries_shp = "V:\GIS1-
Corporate\Data\Vegetation\Threatened_Ecological_Communities\tec_commu
nity_boundaries.shp" ' provide a default value if unspecified
end if

High_voltage_cariier__wooden_poles = wscript.arguments.item(12)
if High_voltage_cariier__wooden_poles = "#" then
 High_voltage_cariier__wooden_poles = "V:\GIS1-
Corporate\Data\Man_Made_Structures\Western_Power\Dist_High_Voltage_Ca
rrier_line.shp" ' provide a default value if unspecified
end if

Masts_ = wscript.arguments.item(13)
if Masts_ = "#" then
 Masts_ = "V:\GIS1-
Corporate\Data\Geodata\Infrastructure\Pilbara\utility_points.shp" '
provide a default value if unspecified
end if

apiary_sites = wscript.arguments.item(14)
if apiary_sites = "#" then
 apiary_sites = "V:\GIS1-
Corporate\Data\CALM_Operations\apiary_sites.shp" ' provide a default
value if unspecified
end if

Cadastre_ = wscript.arguments.item(15)
if Cadastre_ = "#" then
 Cadastre_ = "V:\GIS1-Corporate\Data\Tenure\scdb\PILBARA\scdb.shp" '
provide a default value if unspecified
end if

remnant_vegetation_ = wscript.arguments.item(16)
if remnant_vegetation_ = "#" then
 remnant_vegetation_ = "V:\GIS1-
Corporate\Data\Vegetation\Remnant\Wheatbelt\remnant_vegetation.shp" '
provide a default value if unspecified
end if
```

```
Buildings_ = wscript.arguments.item(17)
if Buildings_ = "#" then
 Buildings_ = "V:\GIS1-
Corporate\Data\Geodata\Infrastructure\Pilbara\buildings.shp" '
provide a default value if unspecified
end if

Classified_Recreation_Sites = wscript.arguments.item(18)
if Classified_Recreation_Sites = "#" then
 Classified_Recreation_Sites = "REC_SITES_94" ' provide a default
value if unspecified
end if

' Local variables...
apiary_sites_shp = "C:\BFTAWorkspace\Scratch\apiary_sites.shp"
Current_Apiary_shp = "C:\BFTAWorkspace\Values\Current_Apiary.shp"
UtilityPts1_shp = "C:\BFTAWorkspace\Scratch\UtilityPts1.shp"
Masts_Towers_shp = "C:\BFTAWorkspace\Values\Masts_Towers.shp"
StudyArea500Buff_shp =
"C:\BFTAWorkspace\Scratch\StudyArea500Buff.shp"
HiVoltCarrier_shp = "C:\BFTAWorkspace\Values\HiVoltCarrier.shp"
TEC_shp = "C:\BFTAWorkspace\Values\TEC.shp"
Transmission_Lines_shp =
"C:\BFTAWorkspace\Values\Transmission_Lines.shp"
Threatened_Fauna_ValueClass_shp =
"C:\BFTAWorkspace\Values\Threatened_Fauna_ValueClass.shp"
DEFL_Valueclasses_shp__2_ =
"C:\BFTAWorkspace\Values\DEFL_Valueclasses.shp"
Ab_Sites_shp = "C:\BFTAWorkspace\Values\Ab_Sites.shp"
LoVolt_shp = "C:\BFTAWorkspace\Values\LoVolt.shp"
Heritage_Sites_shp = "C:\BFTAWorkspace\Values\Heritage_Sites.shp"
Agric_shp = "C:\BFTAWorkspace\Values\Agric.shp"
BuiltUp_shp = "C:\BFTAWorkspace\Scratch\BuiltUp.shp"
Comms_rptrs_shp__2_ = "C:\BFTAWorkspace\Values\Comms_rptrs.shp"
Plntns_shp = "C:\BFTAWorkspace\Values\Plntns.shp"
Build2_shp = "C:\BFTAWorkspace\Scratch\Build2.shp"
Buildings_shp = "C:\BFTAWorkspace\Values\Buildings.shp"
RemVeg2_shp = "C:\BFTAWorkspace\Scratch\RemVeg2.shp"
Cad_shp = "C:\BFTAWorkspace\Scratch\Cad.shp"
BushSubdivisions_shp = "C:\BFTAWorkspace\Values\BushSubdivisions.shp"
Cad_5ha_shp = "C:\BFTAWorkspace\Scratch\Cad_5ha.shp"
RemVeg_SmallBlocks_shp =
"C:\BFTAWorkspace\Scratch\RemVeg_SmallBlocks.shp"
StudyArea_ZeroData_shp =
"C:\BFTAWorkspace\Values\StudyArea_ZeroData.shp"
ZeroData_shp = "C:\BFTA_DATA\ZeroData.shp"
REC_SITES_Classes_Clip_shp =
"C:\BFTAWorkspace\Scratch\REC_SITES_Classes_Clip.shp"

' Process: Buffer...
gp.Buffer_analysis Study_Area_Layer, StudyArea500Buff_shp, "500
Meters", "FULL", "ROUND", "NONE", ""

' Process: Clip (2)...
gp.Clip_analysis apiary_sites, StudyArea500Buff_shp,
apiary_sites_shp, ""

' Process: Select...
```

```
gp.Select_analysis apiary_sites_shp, Current_Apiary_shp, """STATUS""
= 'CURRENT'"

' Process: Clip (11)...
gp.Clip_analysis Masts_, StudyArea500Buff_shp, UtilityPts1_shp, ""

' Process: Select (4)...
gp.Select_analysis UtilityPts1_shp, Masts_Towers_shp, """DESCRIPTIO""
= 'mast' OR ""DESCRIPTIO"" = 'tower' OR ""DESCRIPTIO"" = 'fire tower'
"

' Process: Clip (17)...
gp.Clip_analysis High_voltage_cariier__wooden_poles,
StudyArea500Buff_shp, HiVoltCarrier_shp, ""


' Process: Clip (20)...
gp.Clip_analysis tec_community_boundaries_shp, StudyArea500Buff_shp,
TEC_shp, ""

' Process: Clip (22)...
gp.Clip_analysis Transmission_lins_steel_towers,
StudyArea500Buff_shp, Transmission_Lines_shp, ""

' Process: Clip (3)...
gp.Clip_analysis Threatened_Fauna_ValueClasses_shp,
StudyArea500Buff_shp, Threatened_Fauna_ValueClass_shp, ""

' Process: Clip (4)...
gp.Clip_analysis DEFL_Valueclasses_shp, StudyArea500Buff_shp,
DEFL_Valueclasses_shp__2_, ""

' Process: Clip...
gp.Clip_analysis aboriginal_sites_shp, StudyArea500Buff_shp,
Ab_Sites_shp, ""

' Process: Clip (18)...
gp.Clip_analysis Dist_Low_Voltage_Carrier_line_shp,
StudyArea500Buff_shp, LoVolt_shp, ""

' Process: Clip (15)...
gp.Clip_analysis heritage_commission_sites_shp, StudyArea500Buff_shp,
Heritage_Sites_shp, ""

' Process: Clip (19)...
gp.Clip_analysis Agric_Hortic_ValueClasses, StudyArea500Buff_shp,
Agric_shp, ""

' Process: Clip (10)...
gp.Clip_analysis builtup_areas__settlements__communities_region_2,
StudyArea500Buff_shp, BuiltUp_shp, ""

' Process: Clip (13)...
gp.Clip_analysis Communications_repeaters, StudyArea500Buff_shp,
Comms_rptrs_shp__2_, ""

' Process: Clip (16)...
gp.Clip_analysis Plantation_Values__Classified_,
StudyArea500Buff_shp, Plntns_shp, ""
```

```
' Process: Clip (12)...
gp.Clip_analysis Cadastre_, StudyArea500Buff_shp, Cad_shp, ""

' Process: Select (2)...
gp.Select_analysis Cad_shp, Cad_5ha_shp, """LEGAL_AREA"" < '50000'"

' Process: Clip (8)...
gp.Clip_analysis remnant_vegetation_, StudyArea500Buff_shp,
RemVeg2_shp, ""

' Process: Intersect (2)...
gp.Intersect_analysis "C:\BFTAWorkspace\Scratch\Cad_5ha.shp
#;C:\BFTAWorkspace\Scratch\RemVeg2.shp #", RemVeg_SmallBlocks_shp,
"ALL", "", "INPUT"

' Process: Clip (6)...
gp.Clip_analysis Buildings_, StudyArea500Buff_shp, Build2_shp, ""

' Process: Select (3)...
gp.Select_analysis Build2_shp, Buildings_shp, """BUILDING"" =
'Operational'"

' Process: Intersect...
gp.Intersect_analysis
"C:\BFTAWorkspace\Scratch\RemVeg_SmallBlocks.shp
#;C:\BFTAWorkspace\Values\Buildings.shp #", BushSubdivisions_shp,
"ALL", "", "INPUT"

' Process: Clip (5)...
gp.Clip_analysis ZeroData_shp, Study_Area_Layer,
StudyArea_ZeroData_shp, ""

' Process: Clip (7)...
gp.Clip_analysis Classified_Recreation_Sites, StudyArea500Buff_shp,
REC_SITES_Classes_Clip_shp, ""
```

TestField Script

Python Script

```
#****************************************************************
**
# Description:
# Tests if a field exists and outputs two booleans:
#   Exists - true if the field exists, false if it doesn't exist
#   Not_Exists - true if the field doesn't exist, false if it does
exist
#                (the logical NOT of the first output).
#
# Arguments:
#  0 - Table name
#  1 - Field name
#  2 - Exists (boolean - see above)
#  3 - Not_Exists (boolean - see above)
#
# Created by: ESRI
#****************************************************************
**

# Standard error handling - put everything in a try/except block
#
try:

    # Import system modules
    import sys, string, os, arcgisscripting

    # Create the Geoprocessor object
    gp = arcgisscripting.create()

    # Get input arguments - table name, field name
    #
    in_Table = gp.GetParameterAsText(0)
    in_Field = gp.GetParameterAsText(1)

    # First check that the table exists
    #
    if not gp.Exists(in_Table):
        raise Exception, "Input table does not exist"

    # Use the ListFields function to return a list of fields that
matches
    #  the name of in_Field. This is a wildcard match. Since in_Field
is an
    #  exact string (no wildcards like "*"), only one field should be
returned,
    #  exactly matching the input field name.
    #
    fields = gp.ListFields(in_Table, in_Field)

    # If ListFields returned anything, the Next operator will fetch
the
    #  field. We can use this as a Boolean condition.
    #
    field_found = fields.Next()
```

```
    # Branch depending on whether field found or not. Issue a
    #  message, and then set our two output variables accordingly
    #
    if field_found:
        gp.AddMessage("Field %s found in %s" % (in_Field, in_Table))
        gp.SetParameterAsText(2, "True")
        gp.SetParameterAsText(3, "False")
    else:
        gp.AddMessage("Field %s not found in %s" % (in_Field,
in_Table))
        gp.SetParameterAsText(2, "False")
        gp.SetParameterAsText(3, "True")


# Handle script errors
#
except Exception, errMsg:

    # If we have messages of severity error (2), we assume a GP tool
raised it,
    #  so we'll output that.  Otherwise, we assume we raised the
error and the
    #  information is in errMsg.
    #
    if gp.GetMessages(2):
        gp.AddError(GP.GetMessages(2))
    else:
        gp.AddError(str(errMsg))
```

Values Model

```
' ---------------------------------------------------------------------------
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' ValuesGeneric.vbs
' Created on: Fri Feb 22 2008 03:59:34 PM
'   (generated by ArcGIS/ModelBuilder)
' Usage: ValuesGeneric <builtup_areas_settlements_communities_>
<Threatened_Fauna_Values__Classified_> <Output_Location>
<Low_Voltage_Distribution_Lines>
<Recreation_Sites_Values__Classified_> <Aboriginal_Sites>
<Threatened_Ecological_Communities>
<Agricultural_and_Horticultural_Values__Classified_>
<DEFL_Values__Classified_> <Plantation_Values__Classified_>
<Bush_Subdivisions> <Buildings_> <Masts_Towers>
<Transmission_Lines_Steel_Towers>
<High_Voltage_Carrier__wooden_poles> <Communications_repeaters>
<Heritage_Sites> <Current_Apiary_Sites>
' Description:
' Values at risk classified into consequence classes. Before running
this model, ensure the models in the Data Preparation Toolset have
been run. ALL INPUTS MUST HAVE VALID DATA. If any parameter does not
apply to an area, substitute the StudyArea_ZeroData.shp file created
by the Data Prep model. It is recommended that all the layers from
running the Data Prep model (stored in in BFTAWorkspace\Values ) be
displayed in ArcMap and individually checked for presence of valid
data. If invalid files are removed from the display before this model
is opened, the missing data will be obvious. EMPTY THE
BFTAWorkspace\Values\Rasters BEFORE RUNNING THIS MODEL. The model
will not run if there are existing rasters of the same name in this
output location.
' ---------------------------------------------------------------------------
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' Create the Geoprocessor object
set gp = WScript.CreateObject("esriGeoprocessing.GPDispatch.1")

' Load required toolboxes...
gp.AddToolbox "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.AddToolbox "C:/Program
Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Data
Management Tools.tbx"
gp.AddToolbox "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.AddToolbox "C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis
Tools.tbx"

' Set the Geoprocessing environment...
gp.XYResolution = ""
gp.scratchWorkspace = "C:\BFTAWorkspace\Scratch"
gp.MTolerance = ""
gp.randomGenerator = "0 ACM599"
gp.outputCoordinateSystem = ""
gp.outputZFlag = "Same As Input"
gp.qualifiedFieldNames = "true"
gp.XYTolerance = ""
gp.cellSize = "100"
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gp.outputZValue = ""
gp.outputMFlag = "Same As Input"
gp.geographicTransformations = ""
gp.ZResolution = ""
gp.mask = "PilbaraStudyArea"
gp.workspace = ""
gp.MResolution = ""
gp.ZTolerance = ""

' Script arguments...
builtup_areas_settlements_communities_ = wscript.arguments.item(0)
if builtup_areas_settlements_communities_ = "#" then
 builtup_areas_settlements_communities_ = "builtup_areas_communities"
' provide a default value if unspecified
end if

Threatened_Fauna_Values__Classified_ = wscript.arguments.item(1)
if Threatened_Fauna_Values__Classified_ = "#" then
 Threatened_Fauna_Values__Classified_ = "Threatened_Fauna_ValueClass"
' provide a default value if unspecified
end if

Output_Location = wscript.arguments.item(2)
if Output_Location = "#" then
 Output_Location = "C:\BFTAWorkspace\BFTA_Themes" ' provide a default
value if unspecified
end if

Low_Voltage_Distribution_Lines = wscript.arguments.item(3)
if Low_Voltage_Distribution_Lines = "#" then
 Low_Voltage_Distribution_Lines = "LoVolt" ' provide a default value
if unspecified
end if

Recreation_Sites_Values__Classified_ = wscript.arguments.item(4)
if Recreation_Sites_Values__Classified_ = "#" then
 Recreation_Sites_Values__Classified_ = "REC_SITES_94" ' provide a
default value if unspecified
end if

Aboriginal_Sites = wscript.arguments.item(5)
if Aboriginal_Sites = "#" then
 Aboriginal_Sites = "Ab_Sites" ' provide a default value if
unspecified
end if

Threatened_Ecological_Communities = wscript.arguments.item(6)
if Threatened_Ecological_Communities = "#" then
 Threatened_Ecological_Communities = "TEC" ' provide a default value
if unspecified
end if

Agricultural_and_Horticultural_Values__Classified_ =
wscript.arguments.item(7)
if Agricultural_and_Horticultural_Values__Classified_ = "#" then
 Agricultural_and_Horticultural_Values__Classified_ = "Agric" '
provide a default value if unspecified
end if

DEFL_Values__Classified_ = wscript.arguments.item(8)
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if DEFL_Values__Classified_ = "#" then
 DEFL_Values__Classified_ = "DEFL_Valueclasses" ' provide a default
value if unspecified
end if

Plantation_Values__Classified_ = wscript.arguments.item(9)
if Plantation_Values__Classified_ = "#" then
 Plantation_Values__Classified_ = "Plntns" ' provide a default value
if unspecified
end if

Bush_Subdivisions = wscript.arguments.item(10)
if Bush_Subdivisions = "#" then
 Bush_Subdivisions = "BushSubdivisions" ' provide a default value if
unspecified
end if

Buildings_ = wscript.arguments.item(11)
if Buildings_ = "#" then
 Buildings_ = "Buildings" ' provide a default value if unspecified
end if

Masts_Towers = wscript.arguments.item(12)
if Masts_Towers = "#" then
 Masts_Towers = "Masts_Towers" ' provide a default value if
unspecified
end if

Transmission_Lines_Steel_Towers = wscript.arguments.item(13)
if Transmission_Lines_Steel_Towers = "#" then
 Transmission_Lines_Steel_Towers = "Transmission_Lines" ' provide a
default value if unspecified
end if

High_Voltage_Carrier__wooden_poles = wscript.arguments.item(14)
if High_Voltage_Carrier__wooden_poles = "#" then
 High_Voltage_Carrier__wooden_poles = "HiVoltCarrier" ' provide a
default value if unspecified
end if

Communications_repeaters = wscript.arguments.item(15)
if Communications_repeaters = "#" then
 Communications_repeaters = "Comms_rptrs" ' provide a default value
if unspecified
end if

Heritage_Sites = wscript.arguments.item(16)
if Heritage_Sites = "#" then
 Heritage_Sites = "Heritage_Sites" ' provide a default value if
unspecified
end if

Current_Apiary_Sites = wscript.arguments.item(17)
if Current_Apiary_Sites = "#" then
 Current_Apiary_Sites = "Current_Apiary" ' provide a default value if
unspecified
end if

' Local variables...
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Ab_Sites_Project_shp =
"C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp"
AbSites_shp__3_ = "C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp"
CurrentApiarySites =
"C:\BFTAWorkspace\Scratch\Current_Apiary_Project.shp"

CurrentApiarySites_shp__2_ =
"C:\BFTAWorkspace\Scratch\Current_Apiary_Project.shp"
Current_Apiary_Buff_shp =
"C:\BFTAWorkspace\Scratch\Current_Apiary_Buff.shp"
Ab_Sites = "C:\BFTAWorkspace\Values\Rasters\ab_sites"
Apiary_Sites = "C:\BFTAWorkspace\Values\Rasters\Apiary_Sites"
BuiltUpAreas =
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr2.shp"
BuiltupAreas_shp__2_ =
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr2.shp"
Builtup_Areas = "C:\BFTAWorkspace\Values\Rasters\BuiltupAreas"
Masts_towersBuff_shp =
"C:\BFTAWorkspace\Scratch\Masts_towersBuff.shp"
Masts_towers__4_ = "C:\BFTAWorkspace\Values\Rasters\Masts_towers"
Comms_rptrs = "C:\BFTAWorkspace\Scratch\Comms_rptrs_Project1.shp"
communication_repeater_stati_shp__2_ =
"C:\BFTAWorkspace\Scratch\Comms_rptrs_Project1.shp"
Comms_rptrs_buff_shp =
"C:\BFTAWorkspace\Scratch\Comms_rptrs_buff.shp"
Comms_rptrs__3_ = "C:\BFTAWorkspace\Values\Rasters\Comms_rptrs"
Heritage_Sites_shp__2_ =
"C:\BFTAWorkspace\Scratch\Heritage_Sites_Project1.shp"
Heritage_Buff_shp = "C:\BFTAWorkspace\Scratch\Heritage_Buff.shp"
Heritage = "C:\BFTAWorkspace\Values\Rasters\heritage"
HighVolt = "C:\BFTAWorkspace\Scratch\HiVoltCarrier_Project1.shp"
HiVoltCarrier_Project_shp =
"C:\BFTAWorkspace\Scratch\HiVoltCarrier_Project1.shp"
HiVoltBuff_shp = "C:\BFTAWorkspace\Scratch\HiVoltBuff.shp"
HighVoltLine = "C:\BFTAWorkspace\Values\Rasters\hivolt"
pltns_buffer = "C:\BFTAWorkspace\Scratch\pltns_buffer.shp"
TEC_2_ = "C:\BFTAWorkspace\Scratch\TEC_Project.shp"
TEC_shp__2_ = "C:\BFTAWorkspace\Scratch\TEC_Project.shp"
TECbuff = "C:\BFTAWorkspace\Scratch\TEC_buff.shp"
TEC = "C:\BFTAWorkspace\Values\Rasters\tec"
ValuesClasses = "C:\BFTAWorkspace\BFTA_Themes\ValuesClasses"
DAFWA_CropsBuff = "C:\BFTAWorkspace\Scratch\DAFWA_cropsBuff.shp"
DAFWA_LandUse = "C:\BFTAWorkspace\Values\Rasters\DAFWA_LandUse"
TrtansmissionLines_Buff_shp =
"C:\BFTAWorkspace\Scratch\TrtansmissionLines_Buff.shp"
TransLine = "C:\BFTAWorkspace\Values\Rasters\TransLine"
Plntns_Project_shp = "C:\BFTAWorkspace\Scratch\Plntns_Project.shp"
Current_Apiary_Project_shp =
"C:\BFTAWorkspace\Scratch\Current_Apiary_Project.shp"
Agric_Project1_shp = "C:\BFTAWorkspace\Scratch\Agric_Project.shp"
TEC_Project1_shp = "C:\BFTAWorkspace\Scratch\TEC_Project.shp"
Ab_Sites_Project5_shp =
"C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp"
Transmission_Lines_Project2_shp =
"C:\BFTAWorkspace\Scratch\Transmission_Lines_Project1.shp"
HiVoltCarrier_Project4_shp =
"C:\BFTAWorkspace\Scratch\HiVoltCarrier_Project1.shp"
Comms_rptrs_Project4_shp =
"C:\BFTAWorkspace\Scratch\Comms_rptrs_Project1.shp"
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Scratch_Heritage_Sites_Project1_shp =
"C:\BFTAWorkspace\Scratch\Heritage_Sites_Project1.shp"
Plantations = "C:\BFTAWorkspace\Values\Rasters\Plantations"
Buildings_Buffer_shp =
"C:\BFTAWorkspace\Scratch\Buildings_Project1_Buffer.shp"
BushSubdivisions_Buffer_shp =
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project_Buf.shp"
Buildings = "C:\BFTAWorkspace\Values\Rasters\Buildings"
BushSubdiv = "C:\BFTAWorkspace\Values\Rasters\BushSubdiv"
DEFL_Valueclasses_Clip_Proje1_shp =
"C:\BFTAWorkspace\Scratch\DEFL_Valueclasses_Project_Bu.shp"
DEFL = "C:\BFTAWorkspace\Values\Rasters\defl"
LoVolt_proj = "C:\BFTAWorkspace\Scratch\LoVolt_Project1.shp"
LoVoltClass_shp = "C:\BFTAWorkspace\Scratch\LoVoltClass.shp"
LoVolt = "C:\BFTAWorkspace\Values\Rasters\LoVolt"
DEFL_Valueclasses_Project1_shp =
"C:\BFTAWorkspace\Scratch\DEFL_Valueclasses_Project.shp"
TF_proj_buff = "C:\BFTAWorkspace\Scratch\TF_proj_buff.shp"
TF_project =
"C:\BFTAWorkspace\Scratch\Threatened_Fauna_ValueClass_1.shp"
REC_SITES_94_Buffer_shp =
"C:\BFTAWorkspace\Scratch\REC_SITES_94_Project1_Buffer.shp"
Masts_Towers__2_ =
"C:\BFTAWorkspace\Scratch\Masts_Towers_Project1.shp"
Masts_Towers_shp__2_ =
"C:\BFTAWorkspace\Scratch\Masts_Towers_Project1.shp"
Masts_Towers_Project4_shp =
"C:\BFTAWorkspace\Scratch\Masts_Towers_Project1.shp"
Exists__3_ = "false"
Not_Exists__3_ = "true"
output_value__2_ =
"C:\BFTAWorkspace\Scratch\Masts_Towers_Project1.shp"
LoVolt_Classes = "C:\BFTAWorkspace\Scratch\LoVolt_Project1.shp"
LoVoltClass = "C:\BFTAWorkspace\Scratch\LoVolt_Project1.shp"
Exists = "true"
Not_Exists = "false"
output_value = "C:\BFTAWorkspace\Scratch\LoVolt_Project1.shp"
Transmission_Lines_Project_shp =
"C:\BFTAWorkspace\Scratch\Transmission_Lines_Project1.shp"
Transmission_Lines_Project1_shp =
"C:\BFTAWorkspace\Scratch\Transmission_Lines_Project1.shp"
Exists__4_ = "false"
Not_Exists__4_ = "true"
output_value__3_ =
"C:\BFTAWorkspace\Scratch\Transmission_Lines_Project1.shp"
Exists__2_ = "false"
Not_Exists__2_ = "true"
output_value__4_ = "C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp"
Exists__5_ = "true"
Not_Exists__5_ = "false"
output_value__5_ =
"C:\BFTAWorkspace\Scratch\Current_Apiary_Project.shp"
output_value__6_ =
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr2.shp"
Exists__6_ = "false"
Not_Exists__6_ = "true"
Exists__7_ = "false"
Not_Exists__7_ = "true"
output_value__7_ =
"C:\BFTAWorkspace\Scratch\Comms_rptrs_Project1.shp"
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BushSubdvivisions_shp__2_ =
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project.shp"
BushSubdive_prj__3_ =
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project.shp"
output_value__8_ =
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project.shp"
Exists__9_ = "true"
Not_Exists__9_ = "false"
output_value__9_ = "C:\BFTAWorkspace\Scratch\TEC_Project.shp"
output_value__10_ =
"C:\BFTAWorkspace\Scratch\HiVoltCarrier_Project1.shp"
Exists__10_ = "false"
Not_Exists__10_ = "true"
Exists__11_ = "false"
Not_Exists__11_ = "true"
output_value__11_ =
"C:\BFTAWorkspace\Scratch\Heritage_Sites_Project1.shp"
Buildings_shp__5_ = "C:\BFTAWorkspace\Scratch\Buildings_Project1.shp"
Exists__12_ = "false"
Not_Exists__12_ = "true"
output_value__12_ = "C:\BFTAWorkspace\Scratch\Buildings_Project1.shp"
Buildings_Project_shp =
"C:\BFTAWorkspace\Scratch\Buildings_Project1.shp"
Buildings_Project_shp__2_ =
"C:\BFTAWorkspace\Scratch\Buildings_Project1.shp"
BushSubdivisions_Project_shp =
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project.shp"
Exists__8_ = "true"
Not_Exists__8_ = "false"
builtup_areas_communities_Pr_shp =
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr2.shp"
builtup_areas_communities_Pr2_shp =
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr1.shp"
Rec_Sites = "C:\BFTAWorkspace\Values\Rasters\Rec_Sites"
REC_SITES_94_Project_shp =
"C:\BFTAWorkspace\Scratch\REC_SITES_94_Project1.shp"
StudyArea_lyr__3_ =
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp"
Unclassified = "C:\BFTAWorkspace\Values\Rasters\Unclassified"
Exists__14_ = "true"
Not_Exists__14_ = "false"
Study_Area_ = "PilbaraStudyArea"
output_value__14_ =
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp"
PilbaraStudyArea_Project1_shp =
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp"
PilbaraStudyArea_Project_shp__2_ =
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp"
PilbaraStudyArea_Project_shp =
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp"
Ab_Sites_Project_shp__2_ =
"C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp"
TF_ = "C:\BFTAWorkspace\Scratch\TF"

' Process: Project (8)...
gp.Project_management Aboriginal_Sites, Ab_Sites_Project5_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
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000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (2)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField Ab_Sites_Project5_shp, "ValueClass"

' Process: Add Field...
gp.AddField_management Ab_Sites_Project5_shp, "ValueClass", "SHORT",
"", "", "", "", "NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field...
gp.CalculateField_management Ab_Sites_Project_shp, "ValueClass", "4",
"VB", ""

' Process: Merge Branch (4)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Ab_Sites_Project1.shp;C:\BFTAWorkspace\Scra
tch\Ab_Sites_Project1.shp"

' Process: Delete Field (2)...
gp.DeleteField_management output_value__4_,
"SITE_ID;SITE_NO;SITE_NAME;STATUS;ACCESS_TYP;RELIABILIT;SITE_TYPE;LAS
T_UPDAT;RESTRICTIO"

' Process: Feature to Raster...
gp.FeatureToRaster_conversion Ab_Sites_Project_shp__2_, "ValueClass",
Ab_Sites, "100"

' Process: Project (5)...
gp.Project_management Current_Apiary_Sites,
Current_Apiary_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (5)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField Current_Apiary_Project_shp, "ValueClass"

' Process: Add Field (2)...
gp.AddField_management Current_Apiary_Project_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""
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```
' Process: Calculate Field (2)...
gp.CalculateField_management CurrentApiarySites, "ValueClass", "2",
"VB", ""

' Process: Merge Branch (5)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Current_Apiary_Project.shp;C:\BFTAWorkspace
\Scratch\Current_Apiary_Project.shp"

' Process: Buffer...
gp.Buffer_analysis output_value__5_, Current_Apiary_Buff_shp, "500
Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (2)...
gp.FeatureToRaster_conversion Current_Apiary_Buff_shp, "ValueClass",
Apiary_Sites, "100"

' Process: Project (15)...
gp.Project_management builtup_areas_settlements_communities_,
builtup_areas_communities_Pr_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (6)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField builtup_areas_communities_Pr_shp, "ValueClass"

' Process: Add Field (4)...
gp.AddField_management builtup_areas_communities_Pr_shp,
"ValueClass", "SHORT", "", "", "", "", "NON_NULLABLE",
"NON_REQUIRED", ""

' Process: Calculate Field (5)...
gp.CalculateField_management BuiltUpAreas, "ValueClass", "5", "VB",
""

' Process: Merge Branch (6)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\builtup_areas_communities_Pr2.shp;C:\BFTAWo
rkspace\Scratch\builtup_areas_communities_Pr2.shp"

' Process: Buffer (4)...
gp.Buffer_analysis output_value__6_,
builtup_areas_communities_Pr2_shp, "500 Meters", "FULL", "ROUND",
"LIST", "ValueClass"

' Process: Feature to Raster (5)...
```

```
gp.FeatureToRaster_conversion builtup_areas_communities_Pr2_shp,
"ValueClass", Builtup_Areas, "100"

' Process: Project (9)...
gp.Project_management Masts_Towers, Masts_Towers_Project4_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (3)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField Masts_Towers_Project4_shp, "ValueClass"

' Process: Add Field (7)...
gp.AddField_management Masts_Towers_Project4_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (6)...
gp.CalculateField_management Masts_Towers__2_, "ValueClass", "3",
"VB", ""

' Process: Merge Branch (2)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Masts_Towers_Project1.shp;C:\BFTAWorkspace\
Scratch\Masts_Towers_Project1.shp"

' Process: Buffer (5)...
gp.Buffer_analysis output_value__2_, Masts_towersBuff_shp, "500
Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (6)...
gp.FeatureToRaster_conversion Masts_towersBuff_shp, "ValueClass",
Masts_towers__4_, "100"

' Process: Project (12)...
gp.Project_management Communications_repeaters,
Comms_rptrs_Project4_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"
```

```
' Process: TestField (7)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField Comms_rptrs_Project4_shp, "ValueClass"

' Process: Add Field (6)...
gp.AddField_management Comms_rptrs_Project4_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (7)...
gp.CalculateField_management Comms_rptrs, "ValueClass", "3", "VB", ""

' Process: Merge Branch (7)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Comms_rptrs_Project1.shp;C:\BFTAWorkspace\S
cratch\Comms_rptrs_Project1.shp"

' Process: Buffer (6)...
gp.Buffer_analysis output_value__7_, Comms_rptrs_buff_shp, "500
Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (7)...
gp.FeatureToRaster_conversion Comms_rptrs_buff_shp, "ValueClass",
Comms_rptrs__3_, "100"

' Process: Project (22)...
gp.Project_management Heritage_Sites,
Scratch_Heritage_Sites_Project1_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (11)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField Scratch_Heritage_Sites_Project1_shp, "ValueClass"

' Process: Add Field (8)...
gp.AddField_management Scratch_Heritage_Sites_Project1_shp,
"ValueClass", "SHORT", "", "", "", "", "NON_NULLABLE",
"NON_REQUIRED", ""

' Process: Calculate Field (10)...
gp.CalculateField_management Heritage_Sites, "ValueClass", "4", "VB",
""

' Process: Merge Branch (11)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Heritage_Sites_Project1.shp;C:\BFTAWorkspac
e\Scratch\Heritage_Sites_Project1.shp"
```

```
' Process: Buffer (7)...
gp.Buffer_analysis output_value__11_, Heritage_Buff_shp, "500
Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (8)...
gp.FeatureToRaster_conversion Heritage_Buff_shp, "ValueClass",
Heritage, "100"

' Process: Project (11)...
gp.Project_management High_Voltage_Carrier__wooden_poles,
HiVoltCarrier_Project4_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (10)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField HiVoltCarrier_Project4_shp, "ValueClass"

' Process: Add Field (10)...
gp.AddField_management HiVoltCarrier_Project4_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (13)...
gp.CalculateField_management HighVolt, "ValueClass", "4", "VB", ""

' Process: Merge Branch (10)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\HiVoltCarrier_Project1.shp;C:\BFTAWorkspace
\Scratch\HiVoltCarrier_Project1.shp"

' Process: Buffer (9)...
gp.Buffer_analysis output_value__10_, HiVoltBuff_shp, "500 Meters",
"FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (10)...
gp.FeatureToRaster_conversion HiVoltBuff_shp, "ValueClass",
HighVoltLine, "100"

' Process: Project (6)...
gp.Project_management Threatened_Ecological_Communities,
TEC_Project1_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
```

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4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (9)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField TEC_Project1_shp, "ValueClass"

' Process: Add Field (13)...
gp.AddField_management TEC_Project1_shp, "ValueClass", "SHORT", "",
"", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (18)...
gp.CalculateField_management TEC_2_, "ValueClass", "4", "VB", ""

' Process: Merge Branch (9)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\TEC_Project.shp;C:\BFTAWorkspace\Scratch\TE
C_Project.shp"

' Process: Buffer (14)...
gp.Buffer_analysis output_value__9_, TECbuff, "500 Meters", "FULL",
"ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (15)...
gp.FeatureToRaster_conversion TECbuff, "ValueClass", TEC, "100"

' Process: Project (3)...
gp.Project_management
Agricultural_and_Horticultural_Values__Classified_,
Agric_Project1_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (16)...
gp.Buffer_analysis Agric_Project1_shp, DAFWA_CropsBuff, "500 Meters",
"FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (18)...
gp.FeatureToRaster_conversion DAFWA_CropsBuff, "ValueClass",
DAFWA_LandUse, "100"

' Process: Project (10)...
gp.Project_management Transmission_Lines_Steel_Towers,
Transmission_Lines_Project2_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
```

```
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (4)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField Transmission_Lines_Project2_shp, "ValueClass"

' Process: Add Field (9)...
gp.AddField_management Transmission_Lines_Project2_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (8)...
gp.CalculateField_management Transmission_Lines_Project_shp,
"ValueClass", "3", "VB", ""

' Process: Merge Branch (3)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Transmission_Lines_Project1.shp;C:\BFTAWork
space\Scratch\Transmission_Lines_Project1.shp"

' Process: Buffer (18)...
gp.Buffer_analysis output_value__3_, TrtansmissionLines_Buff_shp,
"500 Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (20)...
gp.FeatureToRaster_conversion TrtansmissionLines_Buff_shp,
"ValueClass", TransLine, "100"

' Process: Project (7)...
gp.Project_management Low_Voltage_Distribution_Lines, LoVolt_proj,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField LoVolt_proj, "ValueClass"

' Process: Add Field (5)...
gp.AddField_management LoVolt_proj, "ValueClass", "SHORT", "", "",
"", "", "NON_NULLABLE", "NON_REQUIRED", ""
```

```
' Process: Calculate Field (4)...
gp.CalculateField_management LoVolt_Classes, "ValueClass", "2", "VB",
""

' Process: Merge Branch...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\LoVolt_Project1.shp;C:\BFTAWorkspace\Scratc
h\LoVolt_Project1.shp"

' Process: Buffer (3)...
gp.Buffer_analysis output_value, LoVoltClass_shp, "500 Meters",
"FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (4)...
gp.FeatureToRaster_conversion LoVoltClass_shp, "ValueClass", LoVolt,
"100"

' Process: Project (4)...
gp.Project_management DEFL_Values__Classified_,
DEFL_Valueclasses_Project1_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (2)...
gp.Buffer_analysis DEFL_Valueclasses_Project1_shp,
DEFL_Valueclasses_Clip_Proje1_shp, "500 Meters", "FULL", "ROUND",
"LIST", "ValueClass"

' Process: Feature to Raster (3)...
gp.FeatureToRaster_conversion DEFL_Valueclasses_Clip_Proje1_shp,
"ValueClass", DEFL, "100"

' Process: Project (13)...
gp.Project_management Bush_Subdivisions,
BushSubdivisions_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"
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```
' Process: TestField (8)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField BushSubdivisions_Project_shp, "ValueClass"

' Process: Add Field (3)...
gp.AddField_management BushSubdivisions_Project_shp, "ValueClass",
"SHORT", "", "", "", "", "NON_NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (3)...
gp.CalculateField_management BushSubdive_prj__3_, "ValueClass", "5",
"VB", ""

' Process: Merge Branch (8)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\BushSubdivisions_Project.shp;C:\BFTAWorkspa
ce\Scratch\BushSubdivisions_Project.shp"

' Process: Buffer (13)...
gp.Buffer_analysis output_value__8_, BushSubdivisions_Buffer_shp,
"500 Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (14)...
gp.FeatureToRaster_conversion BushSubdivisions_Buffer_shp,
"ValueClass", BushSubdiv, "100"

' Process: Project (14)...
gp.Project_management Buildings_, Buildings_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (12)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Old.tbx"
gp.TestField Buildings_Project_shp, "ValueClass"

' Process: Add Field (11)...
gp.AddField_management Buildings_Project_shp, "ValueClass", "LONG",
"", "", "", "", "NULLABLE", "NON_REQUIRED", ""

' Process: Calculate Field (9)...
gp.CalculateField_management Buildings_Project_shp__2_, "ValueClass",
"3", "VB", ""

' Process: Merge Branch (12)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\Buildings_Project1.shp;C:\BFTAWorkspace\Scr
atch\Buildings_Project1.shp"

' Process: Buffer (12)...
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gp.Buffer_analysis output_value__12_, Buildings_Buffer_shp, "500
Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (13)...
gp.FeatureToRaster_conversion Buildings_Buffer_shp, "ValueClass",
Buildings, "100"

' Process: Project...
gp.Project_management Plantation_Values__Classified_,
Plntns_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (8)...
gp.Buffer_analysis Plntns_Project_shp, pltns_buffer, "500 Meters",
"FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (9)...
gp.FeatureToRaster_conversion pltns_buffer, "ValueClass",
Plantations, "100"

' Process: Project (16)...
gp.Project_management Recreation_Sites_Values__Classified_,
REC_SITES_94_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"GEOGCS['GCS_GDA_1994',DATUM['D_GDA_1994',SPHEROID['GRS_1980',6378137
.0,298.257222101]],PRIMEM['Greenwich',0.0],UNIT['Degree',0.0174532925
199433]]"

' Process: Buffer (10)...
gp.Buffer_analysis REC_SITES_94_Project_shp, REC_SITES_94_Buffer_shp,
"500 Meters", "FULL", "ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (11)...
gp.FeatureToRaster_conversion REC_SITES_94_Buffer_shp, "ValueClass",
Rec_Sites, "100"

' Process: Project (18)...
gp.Project_management Study_Area_, PilbaraStudyArea_Project_shp,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
```

```
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: TestField (14)...
gp.toolbox = "C:/BFTA_DATA/ToolBoxes/BFTA Models.tbx"
gp.TestField PilbaraStudyArea_Project_shp, "ValueClass"

' Process: Add Field (14)...
gp.AddField_management PilbaraStudyArea_Project_shp, "ValueClass",
"SHORT", "", "", "", "", "NULLABLE", "NON_REQUIRED", ""

' Process: Merge Branch (14)...
gp.MergeBranch_management
"C:\BFTAWorkspace\Scratch\PilbaraStudyArea_Project1.shp;C:\BFTAWorksp
ace\Scratch\PilbaraStudyArea_Project1.shp"

' Process: Delete Field...
gp.DeleteField_management output_value__14_,
"OBJECTID;SUB_NAME;SUB_CODE;SUB_NO;REG_NAME;REG_CODE;REG_NO;STATE;SHA
PE_LENG;SHAPE_AREA;Fuel_Age"


' Process: Calculate Field (11)...
gp.CalculateField_management PilbaraStudyArea_Project_shp__2_,
"ValueClass", "1", "VB", ""

' Process: Feature to Raster (12)...
gp.FeatureToRaster_conversion StudyArea_lyr__3_, "ValueClass",
Unclassified, "1280.11894"

' Process: Project (2)...
gp.Project_management Threatened_Fauna_Values__Classified_,
TF_project,
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]",
"",
"PROJCS['GDA_1994_MGA_Zone_50',GEOGCS['GCS_GDA_1994',DATUM['D_GDA_199
4',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0
.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Transverse_Mercato
r'],PARAMETER['False_Easting',500000.0],PARAMETER['False_Northing',10
000000.0],PARAMETER['Central_Meridian',117.0],PARAMETER['Scale_Factor
',0.9996],PARAMETER['Latitude_Of_Origin',0.0],UNIT['Meter',1.0]]"

' Process: Buffer (11)...
gp.Buffer_analysis TF_project, TF_proj_buff, "500 Meters", "FULL",
"ROUND", "LIST", "ValueClass"

' Process: Feature to Raster (16)...
gp.FeatureToRaster_conversion TF_proj_buff, "ValueClass", TF_, "100"
```

```
' Process: Mosaic To New Raster...
gp.MosaicToNewRaster_management
"C:\BFTAWorkspace\Values\Rasters\ab_sites;C:\BFTAWorkspace\Values\Ras
ters\Apiary_Sites;C:\BFTAWorkspace\Values\Rasters\BuiltupAreas;C:\BFT
AWorkspace\Values\Rasters\Masts_towers;C:\BFTAWorkspace\Values\Raster
s\Comms_rptrs;C:\BFTAWorkspace\Values\Rasters\heritage;C:\BFTAWorkspa
ce\Values\Rasters\hivolt;C:\BFTAWorkspace\Values\Rasters\tec;C:\BFTAW
orkspace\Values\Rasters\DAFWA_LandUse;C:\BFTAWorkspace\Values\Rasters
\TransLine;C:\BFTAWorkspace\Values\Rasters\LoVolt;C:\BFTAWorkspace\Va
lues\Rasters\defl;C:\BFTAWorkspace\Values\Rasters\BushSubdiv;C:\BFTAW
orkspace\Values\Rasters\Buildings;C:\BFTAWorkspace\Values\Rasters\Pla
ntations;C:\BFTAWorkspace\Values\Rasters\Rec_Sites;C:\BFTAWorkspace\V
alues\Rasters\Unclassified;C:\BFTAWorkspace\Scratch\TF",
Output_Location, "ValuesClasses", "", "8_BIT_UNSIGNED", "", "1",
"MAXIMUM", "FIRST"
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Appendix 4: Sample Maps

Disclaimer:

The attached maps demonstrate the applicability of the models to three study areas. The accuracy of the results is limited to the accuracy of the input data. The themes most affected are:

Likelihood:

Ignition Risk:

Lack of accurate fire record and lightning data as outlined in the report.

Fire Behaviour

- The vast distances between the limited weather stations, and the limited data available, results in high standard errors in the fire weather layers.

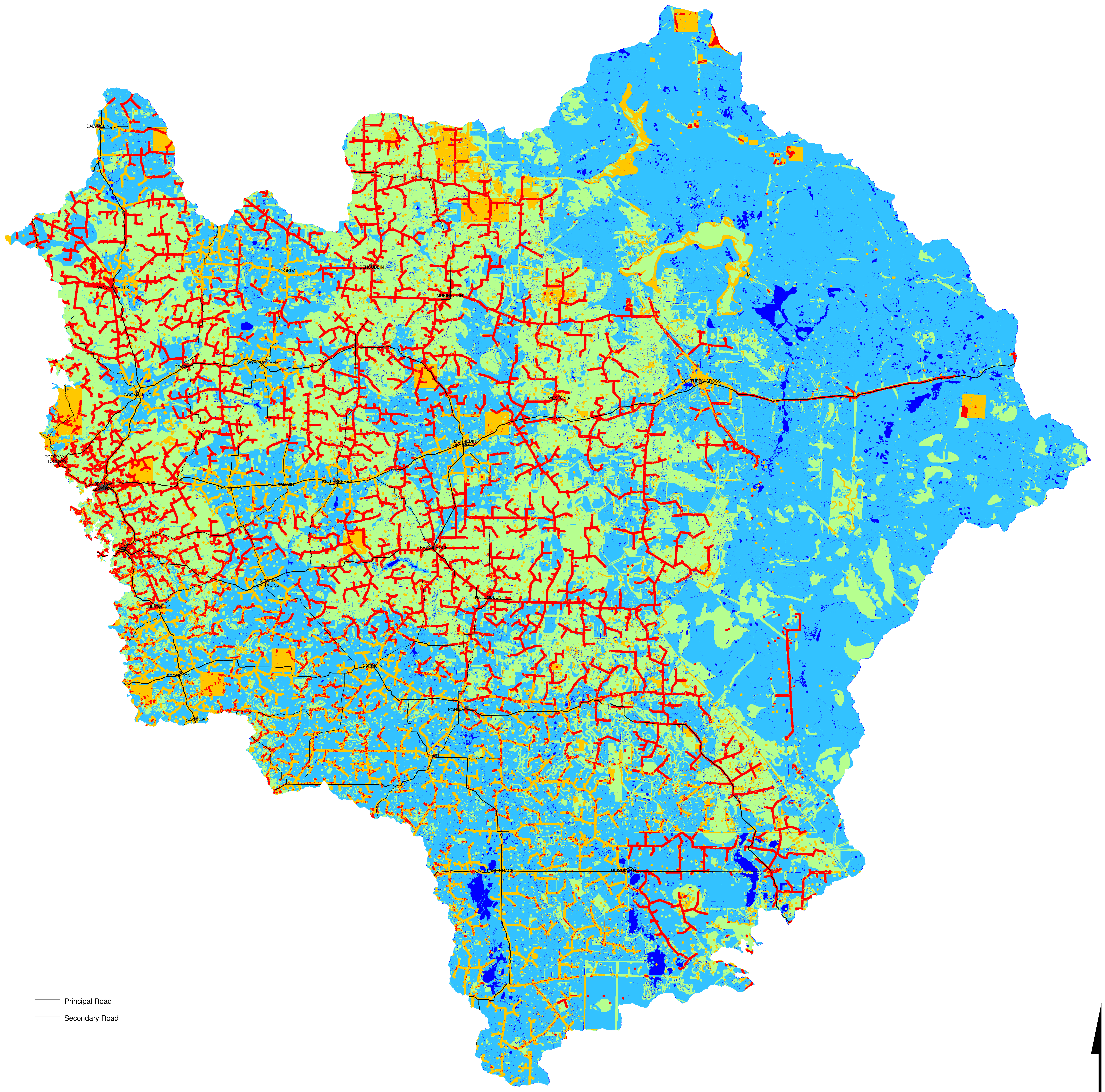
- Except for the Mundaring study area, fuel age has been taken from the DLI fire scar data. This has low resolution, and is inadequate for more detailed analysis in smaller areas. For the Mundaring study area, both the DEC and DLI data were used, with the fuel age derived from DLI fire scars being used for areas not covered by the DEC fuel age layer.

- The DEC fire scar data for the Pilbara was not used, as the attribute table was not in a suitable format to facilitate fuel age calculation.

Consequences:

The Values layer is grossly deficient, lacking local input. As outlined in the body of the report, data available from exisiting databases is inadequate.

Avon Study Area



Threat

Combined Likelihood and Consequence

- 1 Low Risk
- 2 Moderate Risk
- 3 Significant Risk
- 4 High Risk
- 5 Very High Risk

- Principal Road
- Secondary Road

Bushfire Threat Analysis - Avon Catchment

Bush Fire Threat

95 percentile weather conditions
Restricted Period

0 5 10 20 30 40 Kilometers

Projection: GDA 1994 MGA Zone 50

Prepared: August 2007
C Muller Consulting Pty Ltd *(cmconsult@gmail.com)*

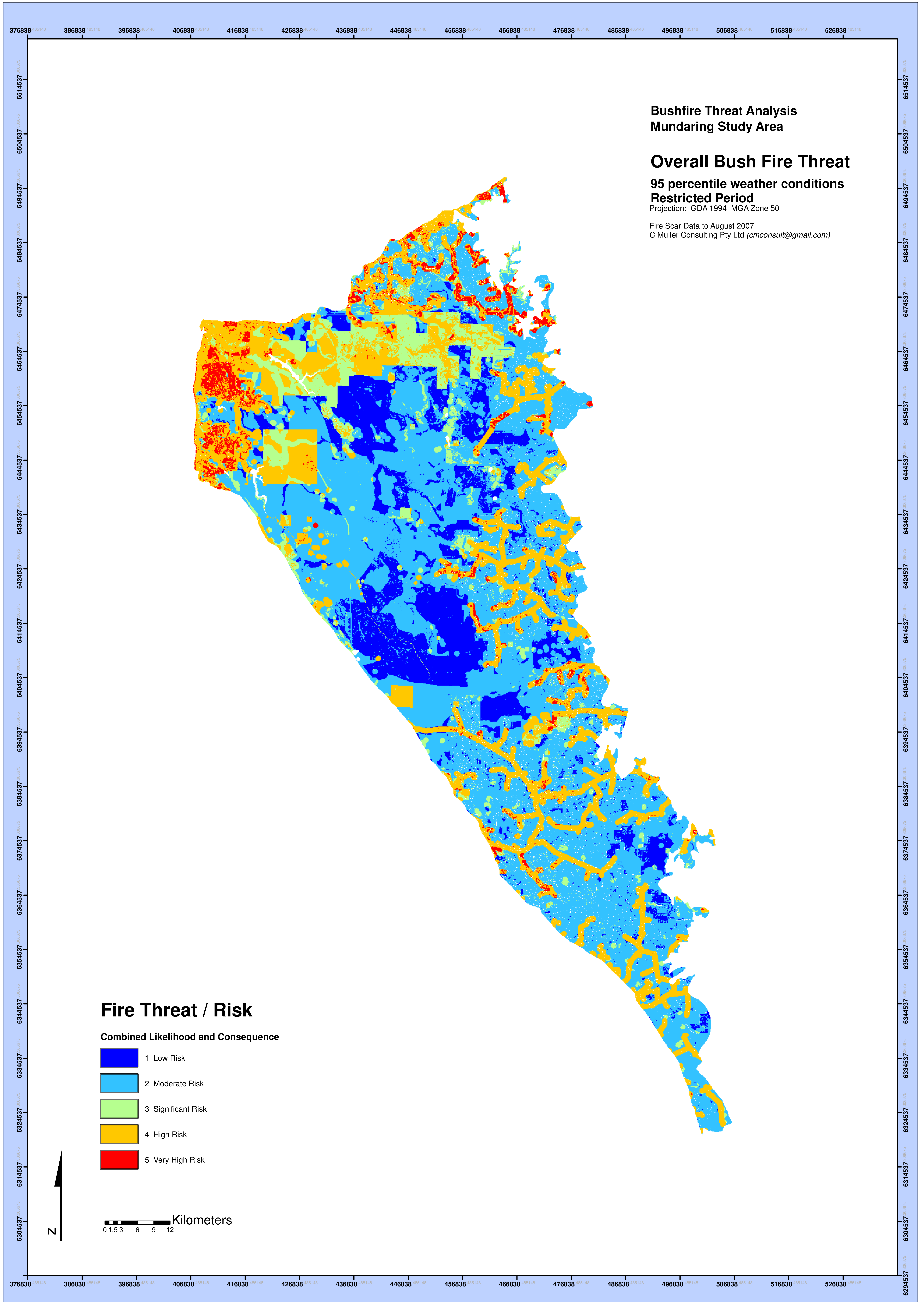

Ignition Risk
1 Rare (1:100+ yrs)
2 Unlikely (1:50-100 yrs)
3 Possible (1:20-50 yrs)
4 Likely (1:10-20 yrs)
5 Almost certain (1: <10yrs)
Roads
Principal Road
Secondary Road
Bushfire Threat Analysis - Avon Catchment
Ignition Risk
95 percentile weather conditions
Restricted Period
Kilometers
0 5 10 20 30 40
N
Projection: GDA 1994 MGA Zone 50
Prepared: August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

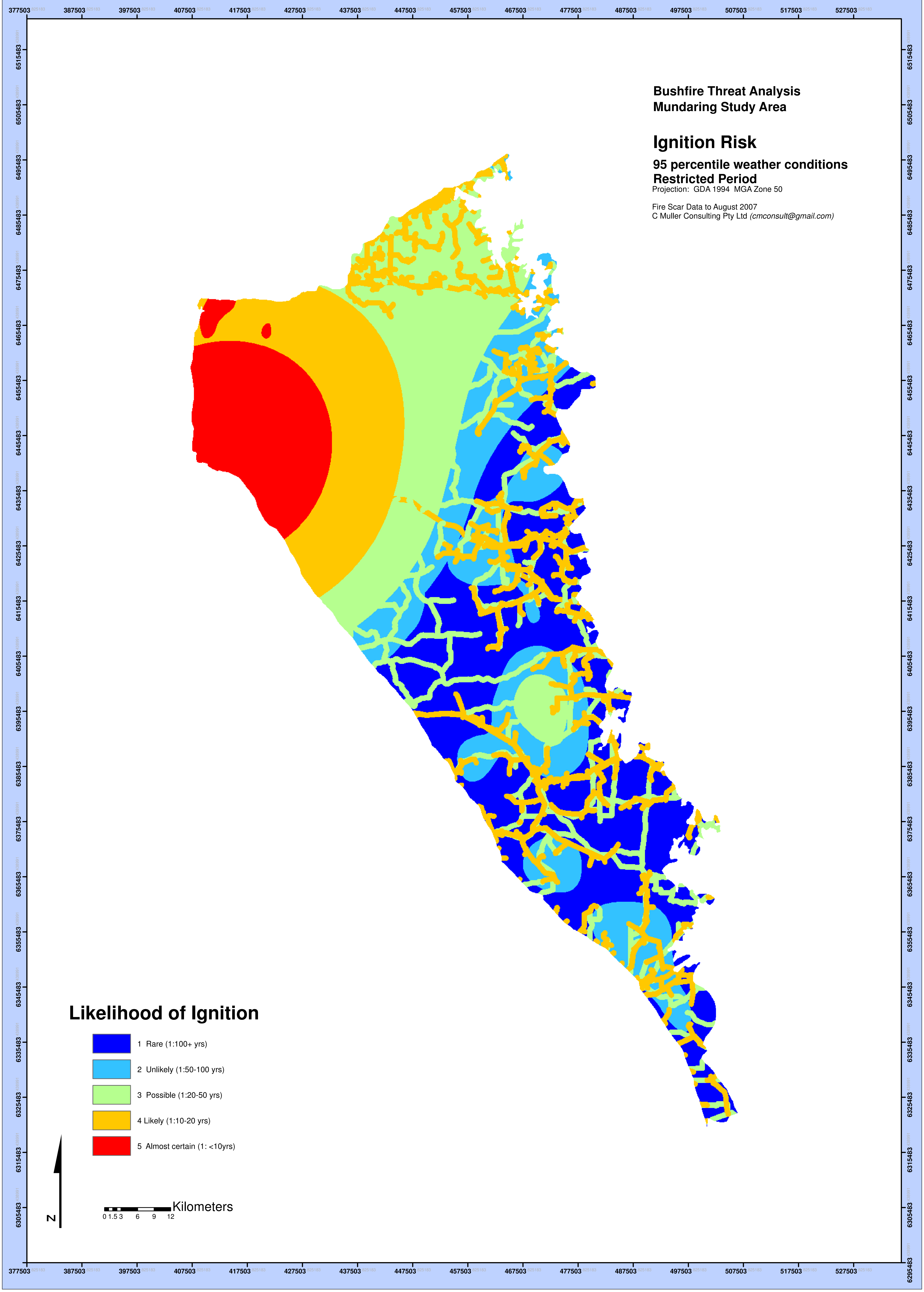
DALWALLINU
BENCUBBIN
MUKINBUDIN
DOWERIN
WESTONIA
TOODYAY
BRUCE ROCK
NAREMBEEN
KONDININ
Response Travel Times from Brigade Centres
Response_Classified
Response Times
Within 15 minutes
15 - 30 minutes
30 - 60 minutes
1 - 2 hrs
> 2 hrs
Principal Road
Secondary Road
N
Bushfire Threat Analysis - Avon Catchment
Suppression Response
95 percentile weather conditions
Restricted Period
0 5 10 20 30 40 Kilometers
Projection: GDA 1994 MGA Zone 50
Prepared: August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

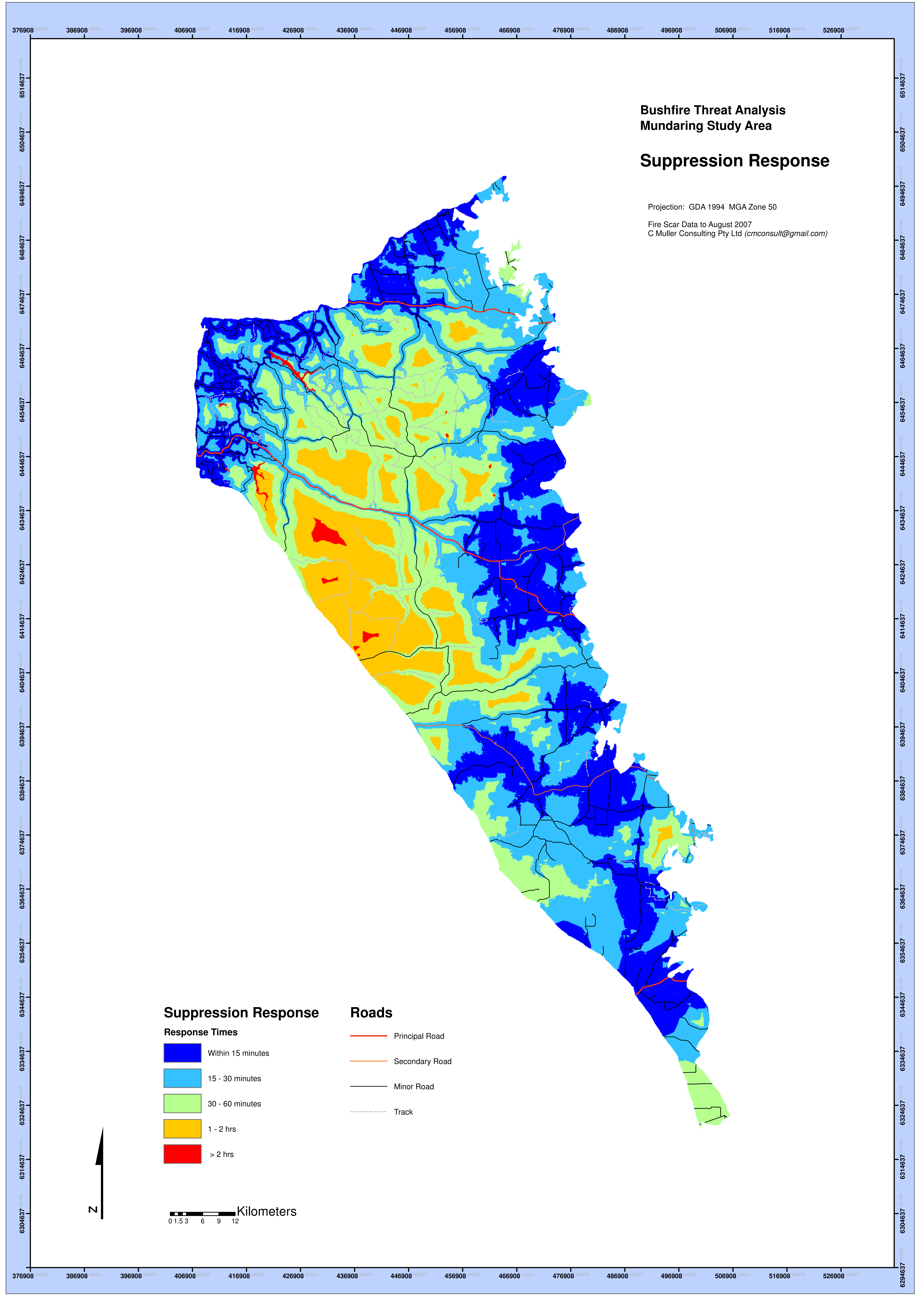
Fire Behaviour - Suppression Class
1 Readily suppressed.
2 Hand tool attack possible
3 Direct machine and tanker attack possible
4 Direct attack not possible/unlikely to succeed.
5 Indirect attack likely to fail
Principal Road
Secondary Road
DALWALLINU
KOORDA
BENCUBBIN
WONGAN HILLS
MUKINBUDIN
DOWERIN
WYALKATCHEM
GOOMALLING
SOUTHERN CROSS
WESTONIA
MERREDIN
TOODYAY
NORTHAM
CUNDERDIN
TAMMIN
KELLERBERRIN
BRUCE ROCK
YORK
QUAIRADING
NAREMBEEN
BEVERLEY
CORRIGIN
BROOKTON
PINGELLY
KULIN
NEWDEGATE
N
Bushfire Threat Analysis - Avon Catchment
Fire Behaviour
95 percentile weather conditions
Restricted Period
Kilometers
0 5 10 20 30 40
Projection: GDA 1994 MGA Zone 50
Prepared: August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

Consequence if fire occurs
1 Low
2 Minor
3 Moderate
4 Serious
5 Major
6 Catastrophic
Principal Road
Secondary Road
N
Bushfire Threat Analysis - Avon Catchment
Consequence Classes
95 percentile weather conditions
Restricted Period
0 5 10 20 30 40 Kilometers
Projection: GDA 1994 MGA Zone 50
Prepared: August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

Mundaring Study Area


Bushfire Threat Analysis
Mundaring Study Area
Overall Bush Fire Threat
95 percentile weather conditions
Restricted Period
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
Fire Threat / Risk
Combined Likelihood and Consequence
1 Low Risk
2 Moderate Risk
3 Significant Risk
4 High Risk
5 Very High Risk
N
0 1.5 3 6 9 12
Kilometers
376838 386838 396838 406838 416838 426838 436838 446838 456838 466838 476838 486838 496838 506838 516838 526838
6514537 6504537 6494537 6484537 6474537 6464537 6454537 6444537 6434537 6424537 6414537 6404537 6394537 6384537 6374537 6364537 6354537 6344537 6334537 6324537 6314537 6304537 6294537


Bushfire Threat Analysis
Mundaring Study Area
Ignition Risk
95 percentile weather conditions
Restricted Period
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
Likelihood of Ignition
1 Rare (1:100+ yrs)
2 Unlikely (1:50-100 yrs)
3 Possible (1:20-50 yrs)
4 Likely (1:10-20 yrs)
5 Almost certain (1: <10yrs)
N
0 1.5 3 6 9 12
Kilometers
377503 387503 397503 407503 417503 427503 437503 447503 457503 467503 477503 487503 497503 507503 517503 527503
6515483 6505483 6495483 6485483 6475483 6465483 6455483 6445483 6435483 6425483 6415483 6405483 6395483 6385483 6375483 6365483 6355483 6345483 6335483 6325483 6315483 6305483 6295483


Bushfire Threat Analysis
Mundaring Study Area
Suppression Response
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
Suppression Response
Response Times
Within 15 minutes
15 - 30 minutes
30 - 60 minutes
1 - 2 hrs
> 2 hrs
Roads
Principal Road
Secondary Road
Minor Road
Track
N
0 1.5 3 6 9 12
Kilometers
376908
386908
396908
406908
416908
426908
436908
446908
456908
466908
476908
486908
496908
506908
516908
526908
6514637
6504637
6494637
6484637
6474637
6464637
6454637
6444637
6434637
6424637
6414637
6404637
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6374637
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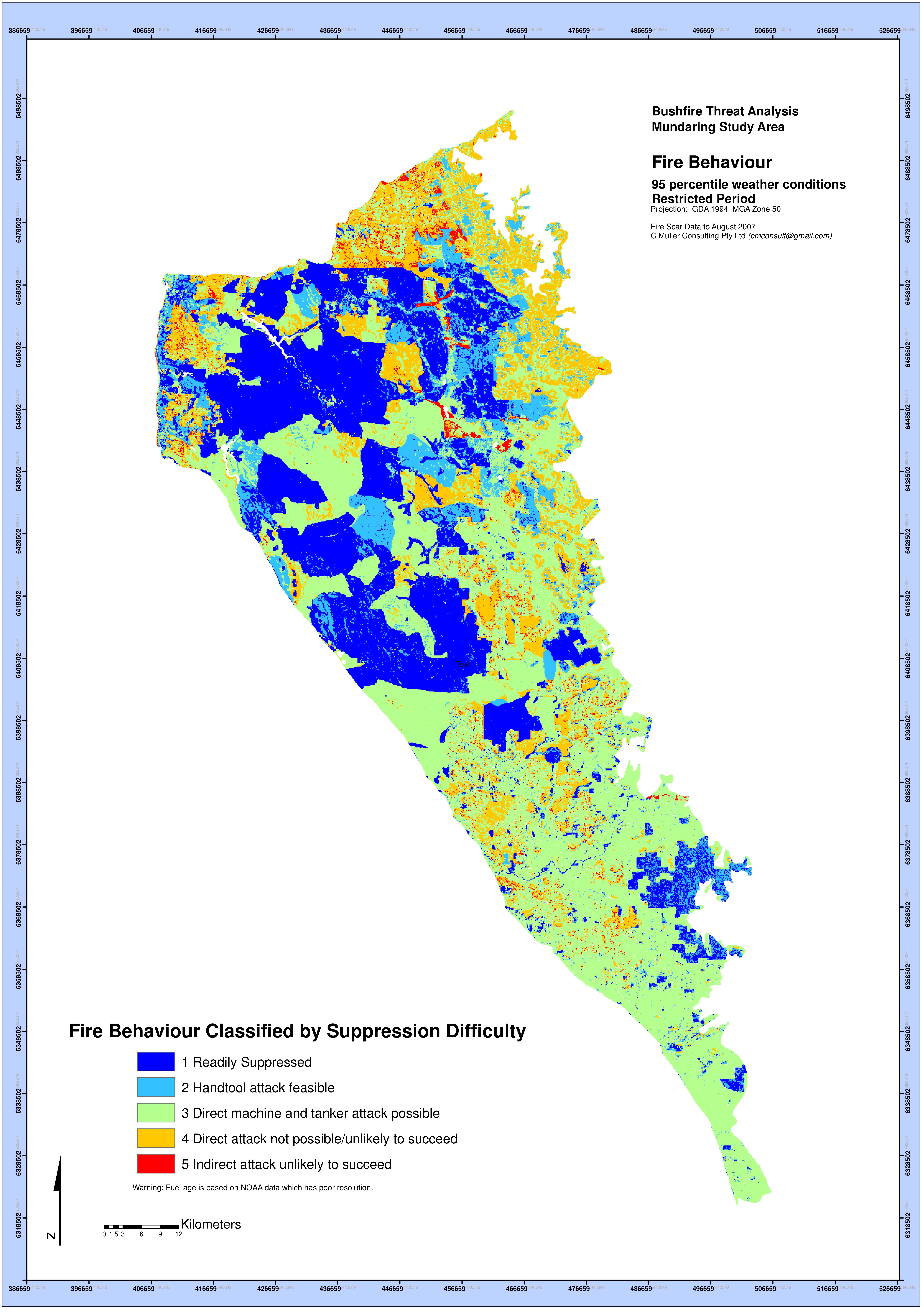
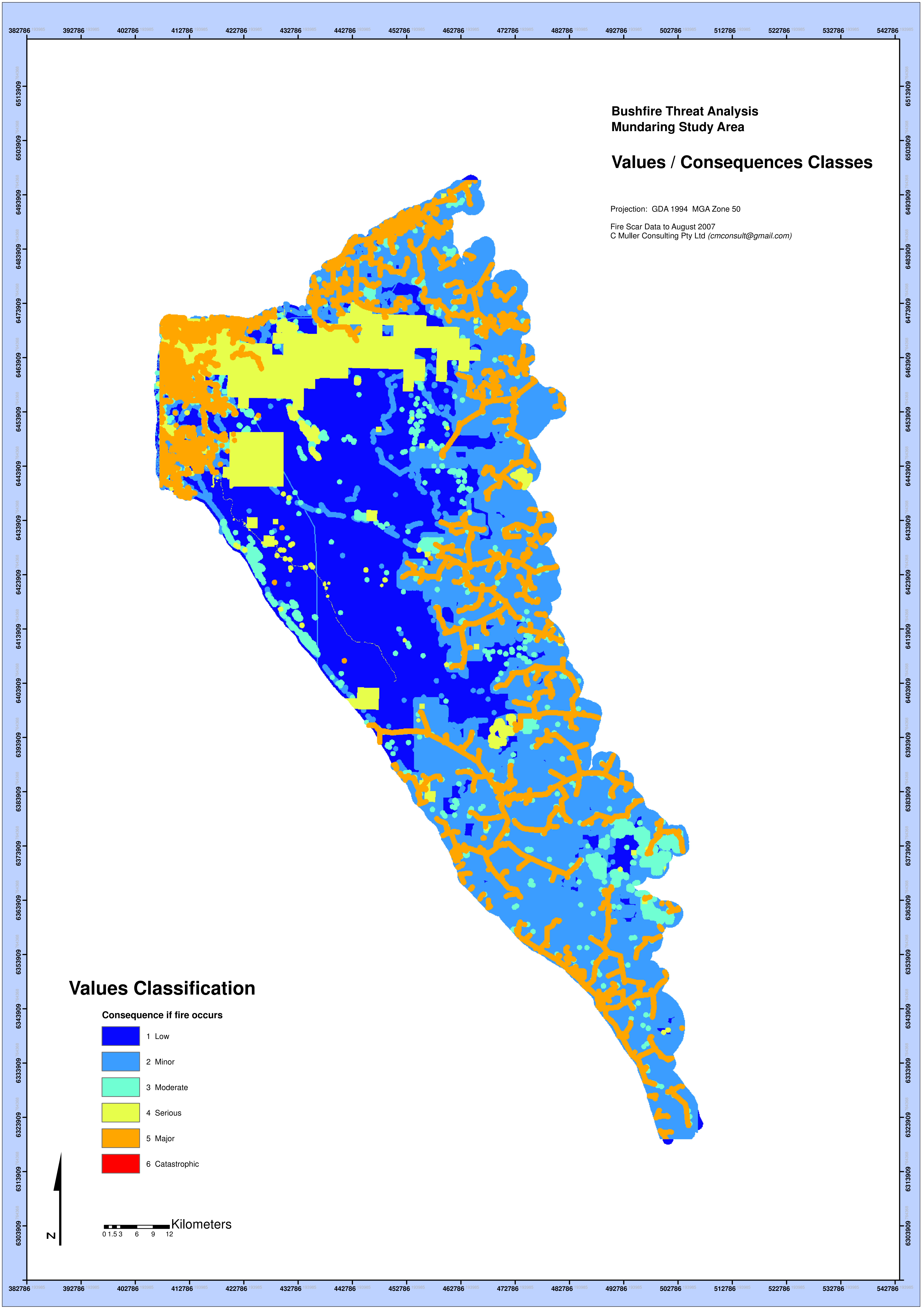
6344637
6334637
6324637
6314637
6304637
6294637


Bushfire Threat Analysis
Mundaring Study Area
Fire Behaviour
95 percentile weather conditions
Restricted Period
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
Fire Behaviour Classified by Suppression Difficulty
1 Readily Suppressed
2 Handtool attack feasible
3 Direct machine and tanker attack possible
4 Direct attack not possible/unlikely to succeed
5 Indirect attack unlikely to succeed
Warning: Fuel age is based on NOAA data which has poor resolution.
Text
N
0 1.5 3 6 9 12
Kilometers
386659
396659
406659
416659
426659
436659
446659
456659
466659
476659
486659
496659
506659
516659
526659
6498502
6488502
6478502
6468502
6458502
6448502
6438502
6428502
6418502
6408502
6398502
6388502
6378502
6368502
6358502
6348502
6338502
6328502
6318502


Bushfire Threat Analysis
Mundaring Study Area
Values / Consequences Classes
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
Values Classification
Consequence if fire occurs
1 Low
2 Minor
3 Moderate
4 Serious
5 Major
6 Catastrophic
N
0 1.5 3 6 9 12
Kilometers
382786
392786
402786
412786
422786
432786
442786
452786
462786
472786
482786
492786
502786
512786
522786
532786
542786
6513909
6503909
6493909
6483909
6473909
6463909
6453909
6443909
6433909
6423909
6413909
6403909
6393909
6383909
6373909
6363909
6353909
6343909
6333909
6323909
6313909
6303909

Pilbara Study Area


372097
472097
572097
672097
772097
872097
972097
7781542
7681542
7581542
7481542
Ignition Risk
threat
Combined Likelihood and Consequence
1 Low Risk
2 Moderate Risk
3 Significant Risk
4 High Risk
5 Very High Risk
N
Bushfire Threat Analysis
Pilbara Study Area
Overall Bush Fire Threat
95 percentile weather conditions
Restricted Period
Kilometers
0 4 8 16 24 32
Projection: GDA 1994 MGA Zone 50
Hotspot data 1998-2005. Fire records to 2005
C Muller Consulting Pty Ltd *(cmconsult@gmail.com)*

400000
500000
600000
700000
800000
900000
7800000
7700000
7600000
7500000
7400000
Ignition Risk
1 Rare (1:100+ yrs)
2 Unlikely (1:50-100 yrs)
3 Possible (1:20-50 yrs)
4 Likely (1:10-20 yrs)
5 Almost certain (1: <10yrs)
N
Bushfire Threat Analysis
Pilbara Study Area
Ignition Risk
95 percentile weather conditions
Restricted Period
Kilometers
0 5 10 20 30 40
Projection: GDA 1994 MGA Zone 50
Hotspot data 1998-2005. Fire records to 2005
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

400000
500000
600000
700000
800000
900000
7800000
7700000
7600000
7500000
7400000
Suppression Response
Response Times
Within 15 minutes
15 - 30 minutes
30 - 60 minutes
1 - 2 hrs
> 2 hrs
Road Lines 15k buff
CLASS
Minor Road
Principal Road
Secondary Road
Track
N
Bushfire Threat Analysis
Pilbara Study Area
Suppression Response
Ground based travel
Kilometers
0 4.5 9 18 27 36
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)


400000
500000
600000
700000
800000
900000
7800000
7700000
7600000
7500000
7400000
Fire Behaviour - Suppression Class
1 Readily Suppressed
2 Handtool attack feasible
3 Direct machine and tanker attack possible
4 Direct attack not possible/unlikely to succeed
5 Indirect attack unlikely to succeed
N
Bushfire Threat Analysis
Fire Behaviour
95 percentile weather conditions
Restricted Period
0 4.5 9 18 27 36 Kilometers
Projection: GDA 1994 MGA Zone 50
Fire Scar Data to August 2007
C Muller Consulting Pty Ltd (cmconsult@gmail.com)

Bushfire Threat Analysis
Pilbara Study Area
Values / Consequences
valuesclasses
Consequence if fire occurs
1 Low
2 Minor
3 Moderate
4 Serious
5 Major
6 Catastrophic
N
0 4.5 9 18 27 36 Kilometers
Projection: GDA 1994 MGA Zone 50
Hotspot data 1998-2005. Fire records to 2005
C Muller Consulting Pty Ltd (cmconsult@gmail.com)
372097
472097
572097
672097
772097
872097
972097
7781542
7681542
7581542
7481542
7381542