

VEGETATION AND BUSHFIRES

PART II — A SYSTEM FOR THE ASSESSMENT OF THE BEHAVIOUR OF VEGETATION AS APPLIED TO THE LANDSCAPING AROUND BUILDINGS IN BUSHFIRE AREAS

BY LISLE RUDOLPH

Introduction

THE PREVIOUS ISSUE of *Landscape Australia* contained a paper entitled 'The Behaviour of Vegetation as Applied to the Landscaping Around Buildings in Bushfire Areas — A Review and Evaluation'. That paper reviewed developments in this field in Australia up to the present time. It also listed all of the attributes of plants which are relevant to their fire behaviour. Those attributes, fourteen in number, were considered for their effect on bushfire attack, through each of the four possible modes of attack — embers, radiation, flame and wind. The complexity of the information resulting from this attempt to be comprehensive led to the need for a simplified, yet still comprehensive, assessment of the fire behaviour of plant species. The development of a system to achieve that is the subject of this paper.

Proposed System

Performance Characteristics of Plant Species

The effects of the fourteen attributes of plant species can be described in terms of a performance-based approach which describes how a plant performs in either promoting bushfire attack or retarding it. Three broad **performance characteristics** can be identified. These are:

1. flammability,
2. provision of ground fuel, and
3. barrier-forming ability.

Descriptions of Performance Characteristics

Flammability

Flammability is a composite term, the parameters of it being ease of ignition, rate of burning, and total heat output. The more flammable a plant is, the more likely it is to promote bushfire attack. Flammability of a plant will not be taken here to include the effects of ground fuel, which is considered separately.

Provision of ground fuel

The greater the quantity of fuel provided on the ground in a fire season, or persisting into a fire season, and the more flammable that fuel is, the more likely a plant is to promote bushfire attack. Ground fuel has no effect on wind.

Barrier-forming ability

The better the barrier-forming ability of a plant, the better it is able to filter out wind-blown embers, to reduce wind forces, or deflect wind or hot air up and over an object.

Effect of Attributes on Performance Characteristics

In Table 1, the letters I (increase) and D (decrease) have been assigned to show the effect of each attribute on each of the three performance characteristics. Table 1 is again general, in that it refers to any plant rather than to a particular species.

For example, a high moisture content in the leaves will decrease (D) the flammability, whereas a low moisture content will increase (I) flammability.

Application of proposed System

Application and Uses

Some attributes are more important than others, but with present knowledge no relative weightings can be applied to

Table 1.
Effect of attributes of plants on their performance characteristics

Attribute of Plant Species	Degree of attribute	Effect of attribute on performance characteristic		
		Flammability	Provision of ground fuel	Barrier-forming ability
1. moisture content of leaves	high/low	D/I	—	NE
2. volatile oil content of leaves	high/low	I/D	—	NE
3. mineral content of leaves	high/low	D/I	—	NE
4. leaf fineness	broad/narrow	D/I	—	I/D
5. density of foliage	closely spaced/sparse	I/D	—	I/D
6. continuity of plant form	connected/broken	I/D	—	I/D
7. height of lowest foliage	high/low	D/I	—	D/I
8. size of plant — volume	large/small	I/D	—	—
— spread	wide/narrow	—	—	I/D
9. dead material on plant	heavy/light	I/D	—	NE
10. bark texture	loose/tight	I/D	—	NE
11. quantity of ground fuel	heavy/light	I/D	I/D	NE
12. particle size of ground fuel	fine/coarse	I/D	I/D	NE
13. compactability of ground fuel	packs closely/loosely	D/I	D/I	NE
14. mineral content of ground fuel	high/low	D/I	D/I	NE

them. Similarly there is no gradation available for the extent to which individual species possess these attributes. With existing information only an 'increase/decrease/unknown' system of assessment is possible.

With increasing knowledge it will be possible to give weightings to the relative importance of the various degrees of attributes, and also to assign gradations to the effect they have on bushfire performance better than the simplified 'increase, decrease, or unknown' given here. These will be in either quantified or qualified terms, depending on the attribute.

There are various methods for arriving at an overall assessment. The simple addition of the scores of all attributes, unweighted or weighted, is known as a linear combination method. With the present state of knowledge, and in the absence of weightings, the overall assessment of the performance characteristics for any particular species of plant is the simple addition of the scores for all attributes, as if each were of equal importance (Tables 2, 3, 4 and 5). While the result is therefore statistically distorted, the system can be operated immediately.

It is also possible to indicate for certain species some of the attributes that are already known to be critical for one or more of the performance characteristics. These attributes and characteristics can be red-flagged to draw attention to them for immediate use. This process may assist in the development of weightings in the long term.

Another way of making an overall assessment is to use a 'rules-of-combination' method. In this method, rules would be worked out for certain attributes and combinations of

attributes. The rules would state levels at which their performance characteristics become critical, and would be expressed in terms of verbal logic rather than in numbers and arithmetic. As a hypothetical example, a rule might state that, say, if any three of five particular attributes are present in any one plant to certain critical degrees, then the plant is automatically assessed overall as 'very high' for that performance characteristic. A possible rule-of-combination might be based on the division of attributes into two groups — the chemical and the architectural attributes.

The process of red-flagging referred to above is an informal variation of the rules-of-combination method. Further information on the method may be found in Hopkins (1977).

One table for every species represents a large amount of research work, but the system provides a framework for this. The information produced would be on two levels. The first level is the complete analysis, carried out and used mostly by researchers. The second level is the summary or final overall assessment of the three performance characteristics. Landscape designers would make an initial choice of species by using the summary, and make a further check of the fourteen attributes if necessary.

In choosing plants for landscaping, a balance should be achieved between all characteristics, including bushfire performance and other characteristics such as growth rate, drought tolerance and aesthetic qualities. These could be combined in computer-based expert systems in the future, but with present data and information this is not possible.

Test Case 5 — Application to individual plant species

Tables 2, 3, 4 and 5 show the system applied to particular plant species using information currently available, partly from Simpfordorfer (1989). For the purposes of the present exercise, simple addition has been used to arrive at an overall assessment.

Table 2
Effect of attributes of a species on its performance characteristics

Name of species (botanical): *Leptospermum laevigatum*
(Common name): Coastal tea-tree

Attribute of Plant Species	Degree of attribute	Effect of attribute on performance characteristic		
		I = increase, D = decrease	NE = negligible or no effect	? = unknown, — = effect considered elsewhere in table
		Flammability	Provision of ground fuel	Barrier-forming ability
1. moisture content of leaves	low	I	—	NE
2. volatile oil content of leaves	high	I	—	NE
3. mineral content of leaves	?	?	—	NE
4. leaf fineness	narrow	I	—	D
5. density of foliage	closely spaced	I	—	I
6. continuity of plant form	connected	I	—	I
7. height of lowest foliage	low	I	—	I
8. size of plant - volume	small	D	—	—
- spread	wide	—	—	I
9. dead material on plant	heavy	I	—	NE
10. bark texture	loose	I	—	NE
11. quantity of ground fuel	heavy	I	I	NE
12. particle size of ground fuel	fine	I	I	NE
13. compactability of ground fuel	packs loosely	I	I	NE
14. mineral content of ground fuel	?	?	?	NE
Overall assessment (Summary)		11-I I-D	3-I	4-I I-D

Comments:

The high flammability of this common tree is emphasised by the 11-I, I-D result in the table. However, the tree is also shown to have reasonable barrier-forming ability.

The combination of these two characteristics suggests that these trees could be used in landscaping around buildings provided their flammability is countered. This might be done by locating trees correctly in relation to the building, by pruning of lower branches and dead material, and by regular clearing of ground fuel.

Table 3
Effect of attributes of a species on its performance characteristics

Name of species (botanical): *Melaleuca armillaris*
(Common name): Giant honey-myrtle

Attribute of Plant Species	Degree of attribute	Effect of attribute on performance characteristic		
		I = increase, D = decrease	NE = negligible or no effect	? = unknown, — = effect considered elsewhere in table
		Flammability	Provision of ground fuel	Barrier-forming ability
1. moisture content of leaves	low	I	—	NE
2. volatile oil content of leaves	heavy	I	—	NE
3. mineral content of leaves	?	?	—	NE
4. leaf fineness	narrow	I	—	D
5. density of foliage	closely spaced	I	—	I
6. continuity of plant form	connected	I	—	I
7. height of lowest foliage	low	I	—	I
8. size of plant - volume	small	D	—	—
- spread	narrow	—	—	D
9. dead material on plant	heavy	I	—	NE
10. bark texture	loose	I	—	NE
11. quantity of ground fuel	light	D	D	NE
12. particle size of ground fuel	fine	I	I	NE
13. compactability of ground fuel	packs closely	D	D	NE
14. mineral content of ground fuel	?	?	?	NE
Overall assessment (Summary)		9-I 3-D	1-I 2-D	3-I 2-D

Comments:

Simple addition indicates that flammability is high. In addition, the large amount of fine dead twigs and branchlets inside the canopy could be red-flagged. The other two performance characteristics, ground fuel and barrier, are not pronounced either way.

Table 4
Effect of attributes of a species on its performance characteristics

Name of species (botanical): *Eucalyptus globulus*
(Common name): Southern blue gum

Attribute of Plant Species	Degree of attribute	Effect of attribute on performance characteristic		
		I = increase, D = decrease	NE = negligible or no effect	? = unknown, — = effect considered elsewhere in table
		Flammability	Provision of ground fuel	Barrier-forming ability
1. moisture content of leaves	low	I	—	NE

2. volatile oil content of leaves	high	I	—	NE
3. mineral content of leaves	low	I	—	NE
4. leaf fineness	broad	D	—	I
5. density of foliage	closely spaced	I	—	I
6. continuity of plant form	broken	D	—	D
7. height of lowest foliage	high	D	—	D
8. size of plant - volume	large	I	—	—
- spread	wide	—	—	I
9. dead material on plant	heavy	I	—	NE
10. bark texture	loose	I	—	NE
11. quantity of ground fuel	heavy	I	I	NE
12. particle size of ground fuel	course	D	D	NE
13. compactability of ground fuel	packs loosely	I	I	NE
14. mineral content of ground fuel	?	?	?	NE
Overall assessment (Summary)		9-I 4-D	2-I 1-D	3-I 2-D

Comments:

In addition to the high score of favouring increased flammability (9I-4D), the large amount of dead material on the tree, particularly the long ribbony bark, and the very loose bark texture could probably both be red-flagged for their effect on increasing flammability. For the provision of ground fuel a score of 2I-1D is not as pronounced as one might expect for this tree, but there are only four attributes affecting the characteristic, and one of these is a question mark.

Table 5
Effect of attributes of a species on its performance characteristics

Name of species (botanical): *Quercus robur*
(Common name): English oak

Attribute of Plant Species	Degree of attribute	Effect of attribute on performance characteristic		
		Flammability	Provision of ground fuel	Barrier-forming ability
I = increase, D = decrease NE = negligible or no effect ? = unknown, — = effect considered elsewhere in table				
1. moisture content of leaves	high	D	—	NE
2. volatile oil content of leaves	low	D	—	NE
3. mineral content of leaves	?	?	—	NE
4. leaf fineness	broad	D	—	I
5. density of foliage	closely spaced	I	—	I
6. continuity of plant form	connected	I	—	I
7. height of lowest foliage	low	I	—	I
8. size of plant - volume	large	I	—	—
- spread	wide	—	—	I
9. dead material on plant	light	D	—	NE
10. bark texture	tight	D	—	NE
11. quantity of ground fuel	light	D	D	NE
12. particle size of ground fuel	coarse	D	D	NE
13. compactability of ground fuel	packs tightly	D	D	NE
14. mineral content of ground fuel	?	?	?	NE
Overall assessment (Summary)		4-I 8-D	0-I 3-D	5-I 0-D

Comments:

Although this is a deciduous tree, the table shows its ability to provide ground fuel for a bushfire attack tends towards decreasing rather than increasing. This is because its ground fuel almost disappears by the fire season following autumn leaf fall. By definition from the description of attributes, ground fuel refers only to that which is available in the fire season.

Although four attributes favour increased flammability, they are outweighed by eight which favour decreased flammability.

Further Research

The proposed system as exemplified in Table 1 could be applied and tested for some of the common species in the shorter term, to expand knowledge, and to test its effectiveness in practice.

Summary and Conclusions

Early research into the performance of buildings in bushfires shows an awareness of the significance of the landscape around buildings. With recent increases in knowledge about ignition of buildings in bushfires and their protection, a need has emerged for a better understanding of the role of vegetation in these processes.

Most of the recent publications available to users contain information about the fire behaviour of plants in general terms, but they do not apply this to individual species. One publication in particular (Simpfendorfer, 1989) does list attributes for a large number of species, but not all of the attributes that affect fire behaviour are included.

In the foregoing paper in *Landscape Australia* 1/93, a method was devised to include all of the attributes of plants which are relevant to their fire behaviour. These attributes have been considered for their effect on bushfire attack, through each of the four possible modes of attack — embers, radiation, flame and wind. The complexity of the information resulting from this attempt to be comprehensive has led to the adoption in this paper of a simplified, performance-based description of the fire behaviour of plants. The performance characteristics adopted, namely flammability, the provision of ground fuel, and barrier-forming ability, provide a feasible and comprehensive system for assessing the fire behaviour of vegetation as applied to landscaping around buildings on bushfire areas in Australia.

Acknowledgments

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BOOK REVIEWS

Title: An Introduction to Building Contracts

Author: Don McLagan

Publisher: The Law Book Company Limited

Price: \$36.00

A good knowledge of contract administration is vital to ensuring that the landscape project conceived by the designer on the drawing board is successfully implemented on the ground. A landscape architect who fails to perform in contract administration can do inestimable damage to the reputation of the profession and to landscape architecture as a whole. The recent publishing of this book should thus be a matter of interest to the landscape profession.

In this book, Don McLagan, an architect by profession, sets out to describe in a simple, clear and concise manner the basic principles of building contracts and their administration. Despite the inclusion of the word 'building' in the title, the book can be easily understood by landscape architects and it is just as applicable to the landscape industry. His style of presentation reflects his many years of teaching and practice in this area. Most chapters conclude with a set of 'exercises' to test how well the reader has comprehended the material presented. It is up to date, in that it reflects the increasing complexities over recent years of the process of building and its administration.

The book is divided into three sections. Part I seeks to provide an understanding of contracts as they apply to building, and the conditions of contract. The author deals with the subject throughout the book in the context of four different general conditions of contract, namely the National Public Works Conference (NPWC Ed3), Joint Conditions of Contract (JCC A&B), Australian Standards Association (AS 2124), and Royal Australian Institute of Architects (SBW 1). In one chapter the roles and responsibilities of Principal, Contractor, Superintendent, Consultant, and Clerk of Works are clearly defined.

Part II builds on this theme and concentrates on the manner in which the contract is administered. Each chapter is devoted to a discussion of a particular aspect of administration such as 'The Site of Works', 'Certificates and Payments' and 'Contract Time', the relevant clauses in all four general conditions of contract heading the chapter. This facilitates easy reference at a later time if and when a particular problem arises.

Part III deals with the operational aspects of contracting, touching on legal issues and the important process of dispute settlement. The first chapter in this section is devoted to a substantial discussion on the all important subject of 'Communications'. Other chapters of interest cover 'Arbitration', 'Professional Indemnity Insurance' and 'The Expert Witness'.

By and large the author has dealt adequately with each area covered, although at times a more substantial coverage would have helped. For example in the chapter on 'The Tender Process' a more comprehensive coverage of the evaluation of tenders would have been useful.

An Introduction to Building Contracts appears to be directed principally at undergraduate students in the design and building professions who are studying professional practice in their final or near final year. It would also be an extremely useful reference for graduates in their first 8 to 10 years of practice, including those preparing for examinations required for entrance into corporate membership of professional bodies. The book also has potential for more experienced landscape architects who are honest enough to

admit that they need to brush up on their contract knowledge from time to time.

The book is fairly priced at \$36. The publisher, The Law Book Company, has offices in Sydney, Melbourne, Brisbane, and Perth. Their 'free call' number outside the Sydney metropolitan area is 008 252314. Some University bookshops are also known to stock it.

Reviewed by:

John Gray

Visiting Lecturer in Landscape Architecture,
Faculty of Environmental Design,
University of Canberra.

Title: Designs on the Landscape

Author: Roy Preece

Publisher: Belhaven Press, London

It is interesting to consider when a group, a community, even society as a whole, is ready to hear an idea. I doubt if Belhaven Press would have been eager to publish *Designs on the Landscape* in the mid 1980s, when the Docklands development was gearing up in Britain and Thatcher's Enterprise Culture was getting under way. Now, in 1993, we have Common Ground blossoming as a conservation movement aimed at holding local distinctiveness in Britain, the AILA has just held a conference called Common Ground - the community landscape, and contemporary philosophers are writing about the importance of localism, the community and the many ways we can now interpret what were previously considered to be single-dimensional certainties.

It is in this intellectual climate that Preece has written *Designs on the Landscape*; a book purporting to be about landscape as scenery, but in fact being about a great deal more, including issues about local distinctiveness and community values. The book is dense and somewhat confusing in its message, which probably says more about the way intellectual thought is moving away from certainties to uncertainties than it says about the somewhat rambling writing style.

Preece states that he has written a text whose central concern is the visual aspect of landscape. He seeks to cover the issues of landscape as scenery in a multifarious way, which is quite different to previous scenic landscape evaluation texts where the values of objectivity and measurable scenic landscape assessment have been the main focus.

Instead, Preece maintains that scenery and landscape are strongly emotive and hence elicit subjective responses and it is this very subjectivity which is denied credibility in our rational world. To address this problem, he sets out to give 'scenery' a rational framework for discussion, which includes an analysis of both subjectivity and objectivity, in the hope that in any assessment of landscape values 'scenery' can stand beside 'ecology' and 'wildlife' and more recently 'heritage'. He points out that all these aspects of landscape are intimately related and each is a valid way of representing an understanding of landscape. In order to develop his argument Preece has divided the book into three sections. The first section looks at fundamental aesthetic and historical principles of landscape design, from which guidelines can be drawn for contemporary design. In this section Preece has continued the tradition of British books on landscape design. One is aware of such preceding authors as Sylvia Crowe,

Continued page 167 ►

Brenda Colvin, Nan Fairbrother, the Jellicoes and Jay Appleton, in his message and his writing style.

Preece espouses a contemporary British landscape design philosophy which is clearly derived from its 18th century precedents. There is an unquestioning belief in informality, organic designs and a return to naturalistic plantings. It is interesting to contrast this approach with contemporary writings about landscape design in the USA, such as the works of Henry Arnold and Anne Whiston Spirn as well as the writings in American landscape design journals; all of which seem quite comfortable with the idea of formality in the landscape.

The middle section of the book covers important issues related to the management of scenic landscapes; the most interesting chapter deals with the British landscape 'viruses' which are bringing about visual change. Although Preece makes no reference to the Common Ground movement in Britain or to the current philosophical writings on localism, this chapter brings out the central issue all landscape planners now have to confront; namely the erosive impact on landscape character caused by the proliferation of small scale design changes brought about by standardised designs and design detailing as well as the clichés of new 'traditional' landscape materials. The loss of local distinctiveness in landscapes is having a marked effect on visual character.

The last section of the book explores practical applications of landscape design ideas related to surface materials, ground modelling, tree planting and tree preservation. This section seems strangely unconnected to the first two sections. The style and method of presentation are evocative of Tandy's *Urban Landscape Handbook*; in this case, however, Preece is dealing with soft landscape elements only.

Although he states that visual planning is the main concern of this book, Preece seems to have found it difficult to stay with visual planning and has attempted to cover a much wider subject, including a textbook approach to technical aspects of landscape design.

The book has been difficult to review. Despite a number of readings, it has been awkward to summarise. It is frequently confusing in its intent, because it covers too much in too much detail in some areas and there is not enough detail in other areas.

Nevertheless I will attempt a summary by stating that the first section is easy to read and quite conversational, drawing interesting analogies between contemporary designs and their historic precedents. Similarly the middle section is comprehensive and interesting. I particularly enjoyed the reference to the British landscape architect Michael Brown's comment on 'the rate race of the quantifiable' where things of importance have to give way to things of secondary value because they cannot be quantified! The third section, however, seems to be another book, and I found it hard to connect the level of detail given on technical aspects of landscape implementation with the central concern of visual quality.

In Preece's defence, he does say that certain values of society are expressed in the treatment of the landscape and that themes of symbolism, meaning and delight are used throughout the book as criteria on which practical decisions should be based.

Preece concludes *Designs on the Landscape* with a chapter on future landscapes. Here he explains that future landscape considerations should be less concerned about what landscapes could possibly look like in the future and more concerned with how we think about valued landscapes now, so that we can hold them in trust for future generations.

Preece states that in one sense this is a book for beginners in landscape design — students of landscape design, town planning, engineering, and natural scientists who end up in a landscape management role. In another sense, he feels it is intended for older beginners, such as local councillors whose decisions affect our scenery.

Whoever the reader may be, we have in *Designs on the Landscape* another voice to add to the growing clamour about the importance of the vernacular landscape and local distinctiveness.

Reviewed by:

Helen Armstrong
Senior Lecturer
School of Landscape Architecture
University of New South Wales

Title: Amenity Landscape Management; a resource handbook.

Author: Ralph Cobham (editor)

Publisher: E. & F.N. Spon: London

British publications such as Cliff Tandy's *Urban Landscape Handbook* and Brian Clouston's *Landscape Design with Plants* have tended to give a comprehensive overview of their subject, containing comprehensive texts, checklists, tables and categories. *Amenity Landscape Management* is another overview; similarly systematic and full of categories. Its relevance to landscape architects, however, may be somewhat limited.

The book concentrates on the cost-effectiveness of different aspects of landscape management of public open space and although some chapters are devoted to the management of water bodies, hard surfaces and structures, the main emphasis is on the management of plants — grasslands, woody plants, herbaceous planting and various specialist plantings.

Each of these aspects of plant management is considered, with a heavy emphasis on mechanical and chemical techniques. Each chapter consists of tables and checklists. There are no diagrams or details; instead this book appears to be aimed at park supervisors who are concerned about time management and budgets.

It is clear that the central concern of this book is the cost effectiveness of different management techniques. In an early chapter, the reader is introduced to SMVs — Standard Minute Values — the cost of management in terms of time. Sadly, we no longer talk of manhours (sic), we now speak of minute values. The space/time collapse has even affected the art of gardening.

The book is prefaced by an idealistic foreword by David Bellamy, where he talks about the importance of 'softer management which gives us green gain'. It is therefore strange to find this book emphasising chemical and mechanical control, measuring activities in seconds and generally avoiding alternative approaches to landscape management.

If one were looking for a checklist of soft landscape management considerations, this book is quite comprehensive. It also includes extensive bibliographies, which may lead to the details not evident in the book.

Reviewed by:

Helen Armstrong
Senior Lecturer
School of Landscape Architecture
University of New South Wales.

