The method developed in Dr Lothian’s PhD thesis to measure and map landscape quality has been applied to regions of South Australia and England, as well as in the assessment of visual impacts. The following figure illustrates the method.

Methodology for measuring and mapping landscape quality

The following 15 projects have been completed:

1. Landscape Quality Assessment of South Australia (PhD)
2. Visual Impact of Wind Farms in South Australia
3. Amenity Value of Scattered and Isolated trees
4. Coastal Viewscapes Project
5. Coastal Development Survey
6. Barossa and Region Landscape Assessment Study
7. Victor Harbor Landscape Amenity Project
8. River Murray Landscape Assessment Project
9. River Murray Development Project
10. Flinders Ranges Landscape Quality Assessment
11. Generic landscapes survey
12. Lake District National Park Landscape Quality Assessment
13. Mount Lofty Ranges Landscape Quality Assessment
14. World’s Best Landscapes Project

These are summarised below.

1. **LANDSCAPE QUALITY ASSESSMENT OF SOUTH AUSTRALIA**

The study was undertaken as part of Andrew Lothian’s PhD and involved the development of a methodology for measuring and mapping landscape quality at a regional scale. It was completed in 2000.

The study involved taking 1750 photographs throughout South Australia covering 19,000 km. The landscape character of South Australia was mapped and based on this, representative photographs selected. A set of 160 were chosen and shown to over 300 participants who rated them on a 1 (low) to 10 (high) scale.

The overall mean was 5.88 and the means for scenes ranged from 2.67 to 8.50. The scenes were comprehensively analysed in the following categories:

- land form
- land cover
- land use
- presence of water
- diversity
- naturalness
- colour

Comparison of the various influences on preferences found, in descending order of importance: diversity, naturalness, density of vegetation, extent and steepness of rock faces in mountain scenes, the influence of the serene/arousing psychological scale in coastal scenes, and the length of the land/water edge in coastal scenes.
Based on the findings, the landscape quality of South Australia was mapped. The Figure and Table illustrate the results.

![Map of South Australian Landscape Quality](image)

**Map of South Australian Landscape Quality**

<table>
<thead>
<tr>
<th>Proportion of Landscape Quality Ratings (%)</th>
<th>South Australia (excluding coast)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ratings</strong></td>
<td><strong>Southern Agricultural Province</strong></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>4</td>
<td>83.1</td>
</tr>
<tr>
<td>5</td>
<td>12.0</td>
</tr>
<tr>
<td>6</td>
<td>2.2</td>
</tr>
<tr>
<td>7</td>
<td>0.3</td>
</tr>
<tr>
<td>8</td>
<td>0.04</td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
</tr>
</tbody>
</table>

Over 300 participants were shown each scene in random order, once with and once without a wind farm. The perceived scenic quality of each scene was rated on a 1 (low) to 10 (high) scale.

Wind farms had a negative effect in all coastal locations where scenic quality is high. In the inland locations, the wind farms had a negative effect in landscapes of high quality but for low quality landscapes the wind farm actually enhanced landscape quality.

Distance to the wind farm did not appreciably reduce their visual effect. Varying the number of turbines indicated no clear trend. The colour of turbines slightly affected perceived scenic quality.

Wind farms should avoid areas of high perceived scenic quality, particularly on the coast and be located in areas of low to moderate scenic quality. Planning for wind farms require knowledge of perceived scenic quality, of wind resources, and an understanding of the community’s evaluation of the visual effect of wind farms. Based on this knowledge, governments can plan the siting of wind farms and provide greater certainty for the wind energy industry.
The study’s results were presented at the following international conferences:

- New Zealand Association for Impact Assessment, Dunedin, NZ, 30 Nov – 1 Dec 2006.

3. AMENITY VALUE OF SCATTERED AND ISOLATED TREES

The project was commissioned by the South Australian Native Vegetation Council which has responsibility to consider amenity aspects in its decisions on applications to clear trees. Such applications are common for vineyard development and pivot irrigation. It was undertaken during 2004.

The project involved photographing scattered and isolated trees in various regions, classifying the trees, selecting 112 photographs for the survey and preparing an Internet-based survey. The survey was conducted in April and May 2004 and 440 completed surveys were obtained.

The trees were classified by nine tree characteristics (e.g. height, canopy form, species) and two context (terrain, land use) which were used to quantify the contribution of each to the ratings of scenes. It found that preferences increased markedly with the greater number and density of trees, healthier trees, and the height of trees.

For the other characteristics however ratings did not change appreciably across them. There was some supporting evidence for a relationship between ecological health and landscape quality but it was not definitive.

Multiple regression analysis compared the ratings and the tree characteristics to derive a predictive model of scenic amenity of scattered and isolated trees. This could be used to determine the scenic quality provided by these trees in the field. The model was:

\[
Y = 2.98 + 0.24 \text{height} + 0.30 \text{verticality} - 0.17 \text{canopy density} + 0.40 \text{health} - 0.21 \text{species} + 0.35 \text{number} \quad (R^2 = 0.50)
\]

The model was tested against the 112 scenes and found to be accurate to an average of within 1%. Based on this, a workbook was developed to calculate the scenic rating in the field. The project achieved its aim of developing a model for assessment of scenic amenity of scattered and isolated trees.
4. COASTAL VIEWSCAPES OF SOUTH AUSTRALIA

In 2006, Dr Lothian won the Planning Institute of Australia National Award for Planning Excellence in the category of Environmental Planning or Conservation for his report: Coastal Viewscapes of South Australia. Previously he had won the PIA South Australian Division’s award in 2005 for this project.

The Coastal Viewscapes project to measure and map the scenic quality of the South Australian coastline was commissioned by the Coastal Protection Branch of the Department for Environment and Heritage.

The Branch recognised that increasing developmental pressures on the coast threatened the very qualities that the community value. Development pressures included housing and land division, marinas, aquaculture, wind farms and access roads and trails.

The outcomes of the project were intended to assist in the development of planning policy and the assessment of development applications. The project was undertaken during 2004 - 5.

In essence the approach involved classifying the coast into units of similar characteristics, sampling these by the use of photographs, selecting photographs for an Internet-based survey, arranging for the scenic quality of these scenes to be rated by participants, analysing and modelling the results, and using the results as the basis for mapping the scenic quality of the South Australian coastline. The entire accessible coast was travelled, covering over 10,000 km during which nearly 1700 photographs were taken.

The South Australian coast was classified into five main landscape units: high cliffs, low cliffs & beaches, headlands & bays, beaches & dunes, and the samphire-mangrove formation. Each was described and its length measured. The proportion of each landscape unit per region provided the basis for the selection of photographs.

The Internet-based survey instrument used 138 coastal scenes plus 28 scenes from wider South Australia to ensure the rating of the coastal scenes reflected a State-wide perspective. The scenes were shown in random order which was changed for each participant. Ratings were on a 1 – 10 scale (low-high). The ratings of over 2200 participants provided the basis for analysis.

The scenic quality of scenes varied reflecting the presence or absence of certain features. The presence of the following factors were scored on a 1 – 5 scale: indentation of the coast, area of water, awe/ tranquillity scale, diversity, naturalness, quality of beach, and height of land forms. Each was scored by small groups of participants.

South East coast showing area with sea view (toning) and area without sea view (without toning)

At Dr Lothian’s request, DEH Environment Information prepared maps showing the land that can be seen from the sea. This viewshed comprised land with a sea view which was likely to come under greater development pressure than land without this view.

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Average ratings of scenes ranged from a low of 3.38 to a high of 8.65. The highest rating region was Kangaroo Island (7.15) while the lowest were the northern parts of the two Gulfs, St Vincent (4.64) and upper Spencer Gulf (4.57). The ratings by landscape unit were: high cliffs 7.84, low cliffs 6.32, headlands & bays 7.02, dunes & beaches 6.30, samphires & mangroves 4.75.

**Eyre Peninsula coast Rating 7.65**

Analysis of the ratings combined with the scores for the factors identified (e.g. naturalness, height) found that the strongest influences were diversity, tranquillity-awe, and naturalness. The presence of seaweed had a negative influence on ratings.

Multiple regression analysis was used to develop predictive models for the scenes. Its purpose was to identify the influence of the various factors that had been scored on the scenic quality rating that had been obtained by the survey. Models were derived for all the scenes, and then for each of the landscape units. The results of each model were tested against the survey ratings to assess their accuracy.

The project required scenic quality to be mapped a 1:50,000, a scale sufficient for planning and policy development. The following three zones were defined for mapping:

- **Zone 1**: The water/land interface and land immediately facing the sea.
- **Zone 2**: The land inland from Zone 1 from which the sea was visible.
- **Zone 3**: Land where the sea was not visible and comprised agricultural land, parks and other uses.

The Zone 1 ratings of the coast are shown in the map and summarised below.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Length km</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>na</td>
<td>38.8</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>31.4</td>
<td>0.7</td>
</tr>
<tr>
<td>4</td>
<td>402.8</td>
<td>8.4</td>
</tr>
<tr>
<td>5</td>
<td>813.5</td>
<td>17.0</td>
</tr>
<tr>
<td>6</td>
<td>1410.1</td>
<td>29.4</td>
</tr>
<tr>
<td>7</td>
<td>1987.9</td>
<td>41.5</td>
</tr>
<tr>
<td>8</td>
<td>107.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td>4792.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The highest rated areas were, in order, Whalers Way – Shoal Point and Cape Catastrophe - Cape Tournefort areas south of Port Lincoln, Cape du
Couedic - Kirkpatrick Point area on Kangaroo Island, and Cape Spencer at the toe of Yorke Peninsula.

Whalers Way, Eyre Peninsula Rating 8.16

Admiralty Arch, Kangaroo Island Rating 8.66

The project required recommendations for the incorporation of the results in the planning policy and development assessment processes. This was based on the findings of the Coastal Viewscapes project and the Coastal Development project (see project 5).

An extensive review was provided of coastal scenic area planning policies from South Australia, other states and overseas together with a synthesis.

Development options for high quality coasts were reviewed and the issue of a veto over development for high quality areas discussed. Options were presented ranging from complete exclusion to providing a high level of access. This is a policy issue which would require broad community input for its resolution.

The approach proposed to guide planning policy and development assessments classified coastal areas by their relationship to the sea (i.e. Zones 1, 2 or 3) and by the scenic quality rating – also in three zones, proposed as: SQ 1 rating more than 7.25, SQ 2 more than 5.0 and less than 7.25 and SQ 3 more than 3.0 and less than 5.0.

A matrix comprising SQ1, 2 and 3 across and Zones 1, 2, and 3 down was constructed.

Policy Framework

The strategic approach involved high levels of protection for Zone 1/SQ1 and lesser levels of protection for SQ2 and SQ3 and for Zones 2 and 3, allowing progressively greater levels of access, structures and developments consistent with maintaining the scenic values as well as other environmental values (e.g. wetlands in SQ3).

The matrix was then applied to access, visitor facilities, structures & infrastructure, commercial developments, tourist developments and housing developments. Mining and extractive industries, wind farms, aquaculture, marinas and marine infrastructure were also covered.

5. COASTAL DEVELOPMENT SURVEY

This survey was conducted as an adjunct to the Coastal Viewscapes of South Australia study.

An Internet-based survey was conducted to ascertain the impact of development on scenic quality. The survey covered housing-type developments of various forms and scales, plus marinas and aquaculture. Scenes were prepared digitally with development included and the same scene without the development. The survey comprised 82 scenes.

The survey was held during May, 2005 and attracted 2413 participants. Of these, 1659 (69%) completed all scenes and provided the basis for analysis.

The scenes without development averaged 7.09 and with development 5.00, a significant difference of over two units.

Interestingly, analysis showed that the impact was independent of the particular level of scenic quality and was uniform across the range of scenic quality (see Figure). The decrease in...
scenic value attributable to development was around two units regardless of whether the scenic quality was eight or six.

Coastal scene without development Rating 8.0

Coastal scene with development Rating 4.7

Coastal Development Survey Results

Other findings from the analysis of the results were:

- The largest impact was from housing and marina development while aquaculture appeared to have a lesser impact
- The impact was similar whether the development was on headlands or dunes
- While the impact of development was lower for distant scenes, it was similar in the near and middle distance
- The impacts were similar for shack development and high rise development and both were greater than for housing development
- Interestingly the impact was greater for less familiar scenes than for scenes of high familiarity.

6. BAROSSA AND LIGHT REGION LANDSCAPE ASSESSMENT STUDY

The project was commissioned by the Barossa and Light Councils and Planning SA. Its purpose was to “assess the scenic quality of the Barossa Valley Region rural landscapes outside of townships”. It required a “publicly defendable and repeatable valuation of the scenic quality of the landscapes and landmarks of the area, giving a value to every landscape unit.” The outcomes of the project were intended to contribute to the setting of “clear strategic directions for the use of land within the Barossa and Light region.” It was undertaken during 2005.

Chateau Tanunda Rating 5.60

Over 1700 photographs were taken of the region during April and May, 2005. Fourteen landscape units were defined by reference to their land form, land cover, land use, water and any other significant features. In addition, photographs were selected to represent various key features such as cultural aspects, wineries, farm structures, trees along roads and streams, and industry.

The survey comprised 120 Barossa scenes plus a further 30 scenes from elsewhere in South Australia to ensure that the ratings reflected a State-wide perspective.

Landscape factors which might assist in understanding why certain landscapes are preferred were identified: the significance in the landscape of trees, vines, water and buildings & structures, the nature of the terrain, the naturalness of the landscape, and the visibility of the Barossa Ranges.

An Internet-based survey was used in June 2005 yielding over 1200 participants.
Barossa Ranges Rating 5.69

The overall mean of the ratings was 5.30 and the majority of ratings of individual scenes were in the 4.5 – 6.5 range.

Of the landscape factors examined, the influence of naturalness, trees and terrain were strongest and water and the visibility of the Barossa Ranges were lower. The presence of vines and buildings & structures actually had a negative influence on ratings. However churches and ruins attracted higher ratings than farm sheds and winery buildings.

The scores for naturalness and trees factors both correlated highly with the scenic quality ratings. Naturalness also correlated closely with terrain, trees and the visibility of the Barossa Ranges.

Predictive models using multiple regression analysis were derived for all 120 scenes and some of the landscape units.

Near Angaston Rating 5.02

The model for the entire region used all seven factors, had a correlation coefficient ($R^2$) of 0.54, and was statistically significant. The model was as follows:

$$ Y = 2.795 + 0.430 \text{ Natural} + 0.265 \text{ Water} + 0.259 \text{ Trees} + 0.172 \text{ Vines} + 0.106 \text{ Terrain} + 0.076 \text{ Barossa Ranges} - 0.013 \text{ Building} $$

Models were also derived for the several landscape units.

Mapping the region’s scenic rating was based on the landscape unit ratings, equivalent scenes from other landscape units, special analyses of sets of scenes (e.g. scenes with vines), and the predictive models.

Barossa Region Landscape Quality

Overall the northern and western areas were low rating, 5 – 5.25, while the eastern area (Collingrove - Eden Valley) was higher 5.50 –5.75. The core viticulture areas had generally moderate ratings, 5.50. The higher rated Barossa Ranges overlooked the area with most of the Ranges rating 5.50 to 6.50.

In addition to the landscape unit ratings, scenic quality ratings were derived covering particular landscape features within landscape units which were not represented adequately by the scenes in each unit.

Recommendations were made relating to the planning, development and management of the Barossa Study Region’s scenic quality.
7. VICTOR HARBOR LANDSCAPE AMENITY PROJECT

The project was commissioned by the City of Victor Harbor as part of its strategic planning process. The tasks were to describe the landscape characteristics and assess scenic quality for the region and make recommendations covering landscape amenity for strategic planning. It was undertaken during 2005 – 6.

The project defined landscape units on the basis of land forms, vegetation, the presence of a sea view, and land use.

Scenic quality ratings were derived from previous studies of similar landscapes. Ratings ranged from 4 to 7 on a 1 (low) to 10 (high) scale of landscape quality.

A total of 34 recommendations were made covering planning and development policies and environmental policies.

8. RIVER MURRAY LANDSCAPE ASSESSMENT PROJECT

The project was commissioned by the Department of Water, Land and Biodiversity Conservation and the South Australian Murray Darling Basin Natural Resources Management Board. It was undertaken during 2006 - 7.

The objective was to undertake a valuation of landscape value associated with the River Murray Floodplain Protection Area in South Australia established under the River Murray Act 2003. The region covered the River Murray, Lakes and the Coorong.

The outcomes were intended to contribute to the development of policies, in particular a Landscape & Amenity Policy, to assist in achieving the Objects and Objectives for a Healthy River Murray as contained in the Act.

River Murray scene Rating 6.40

The project involved two surveys of community preferences, the first survey of scenic quality and the second survey of developments along the River Murray.

Over 6000 photographs were taken covering all parts of the region, including nearly 3800 from land and 2500 from the water.

The region into landscape units of similar physical characteristics was described, drawing on a range of previous classifications.

An Internet survey comprising 150 scenes (including 30 South Australian scenes) was used
to assess scenic quality. It ran for a month and over 2100 participated. Landscape factors were scored by small groups of participants.

Following deletion of incomplete surveys and those suspected of strategic bias, the data set comprised 1673 surveys. This provided an excellent confidence interval of 2.4. Participant characteristics were analysed and their comments on the region compiled.

The overall mean of the region’s scenes was 6.03 and mean ratings ranged from 3.2 to 8.4. Most scenes rated five (23%), six (33%) and seven (22%).

The data set comprised the ratings of the 120 scenes and the scores derived covered a range of landscape factors. Scenes were analysed in respect of landscape features, regions and qualities.

Key features and qualities which enhanced landscape quality were found to be the presence of water, high dense red gums, and high sheer cliffs. River reflections, evening sunlight on cliffs and wildlife added to the ratings.

Lakes Alexandrina and Albert rated fairly low but the Coorong rated higher, influenced by its tranquillity and naturalness. The average ratings of the River Murray (6.2) and Coorong (6.0) were similar and higher than the Lakes (5.4).

Models were developed for the entire region and for the River Murray, Lakes and Coorong separately. High correlation coefficients were obtained for most models (60 – 85%). The models were found to closely approximate the ratings. The model for the River Murray is shown below.
River Murray Model
\[ Y = 1.811 + 0.469 \text{ cliffs} + 0.463 \text{ diversity} + 0.303 \text{ tree health} + 0.263 \text{ natural} + 0.255 \text{ water} + 0.166 \text{ trees} - 0.436 \text{ tranquility} \]

Diversity and cliffs were key factors in the River Murray scenes. Naturalness was important in the Lakes and Coorong scenes.

Based on the results, scenic quality was mapped for the region. Excluding the ‘5’ rating which lay mainly outside the River valley, the table summarises the ratings.

### River Murray scenic quality ratings

<table>
<thead>
<tr>
<th>Rating</th>
<th>Sq km</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>382.13</td>
<td>31.1</td>
</tr>
<tr>
<td>4</td>
<td>155.20</td>
<td>12.6</td>
</tr>
<tr>
<td>6</td>
<td>669.00</td>
<td>54.5</td>
</tr>
<tr>
<td>7</td>
<td>21.45</td>
<td>1.7</td>
</tr>
<tr>
<td>Total area</td>
<td>1227.76</td>
<td>100.0</td>
</tr>
</tbody>
</table>

9. **RIVER MURRAY DEVELOPMENT SURVEY**

The survey was conducted as an adjunct to the River Murray scenic quality survey. The survey comprised 80 scenes and covered houseboats (14 scenes), housing location, form and surrounds (44), waterfront treatments (17), caravan and recreation parks (10), and pumps (4).

A 1 – 9 grade bipolar (dislike – like) scale was used and participants asked to rate, in the context of the surroundings, whether they liked or disliked the visual appearance of the development shown in the scene.

The survey was placed on the Internet for a month over November – December 2006. A total of 1427 participated and after removing those that completed less than 20% and checking for strategic bias, 1259 surveys remained. This provided an excellent confidence interval of 2.76.

The participant characteristics were analysed. The areas most familiar to participants were those closest the Adelaide, the exception being Lakes Alexandrina and Albert.

The most popular activities in the region were houseboating, fishing and skiing/boating and many participated in a range of activities.

Over 300 participants offered comments about development on the River, and there were also over 1500 comments on individual scenes used in the survey. There were twice as many negative comments on individual developments as there were positive comments. The number of negative comments corresponded with the low rating of the scene.

The median of the 1 – 9 scale is 5 which represented a neutral view.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disliked</td>
<td>Neutral</td>
<td>Liked</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Houses on the floodplain rated the highest followed by those above the floodplain with cliff top houses being the least preferred.

Housing that was set back from the water was preferred over housing along the waterfront or dense housing. Surprisingly, canal developments rated among the lowest due possibly due to their lack of integration with the existing environment.

Houses surrounded by native trees were preferred over exotic trees or barren surrounds.

Houses on floodplain Rating 3.62

The highest rated waterfront scenes were those with a natural bank. Sand beaches and jetties were not particularly liked while the presence of retaining walls and wharves were disliked and eroded riverbanks disliked even more. People preferred the waterfront to be left in a natural condition, jetties were tolerated but retaining walls and wharves less so.

Informal camping area Rating 7.29
Both formal and informal areas for caravans and recreation appealed, particularly the informal areas.

People regarded a few houseboats moored along the river bank positively but this turned negative with more houseboats – around seven appeared to be the threshold.

Houseboats moored along bank Rating 4.72

Marinas were regarded somewhat negatively, possibly because they involved greater change to the River than mooring along the bank.

Permanently occupied houseboats with their urban like fences, gardens, lawns were perceived as inappropriate in the River setting and quite disliked.

Pumps were seen as essential form of infrastructure but their visual impact was regarded as quite severe.

Pump infrastructure Rating 2.81

The strength of the opinions given on some of the individual scenes was striking – participants felt strongly about what they regarded as desecration of the riverine environment.

Resulting from the scenic survey and the development survey, 48 recommendations were presented covering the management of scenic resources and the management of development.

Scenic quality would be protected through protection of its scenic resources including water, trees and cliffs. The provision of environmental flows for the floodplain was considered critical.

Measures to protect the area from adverse development impacts covered housing, the waterfront, houseboats, caravan and recreation parks, infrastructure, and the dairy flats.

10. FLINDERS RANGES LANDSCAPE ASSESSMENT

The project was initiated by the Department for Environment and Heritage. Its purpose was to measure and map the scenic quality of the Flinders Ranges, comprising arid mountainous ranges north of Hawker. It was carried out in late 2008.

The project report traced the history of human appreciation of mountainous landscapes, highlighting the significant changes in attitude which occurred in the 17th century when the prevailing view of mountains as wastelands haunted by devils gave way to feelings of awe and eventually to an appreciation of their outstanding scenic qualities.

Based on an evolutionary perspective, landscape theory contends that humans prefer landscapes which are survival enhancing. However there are obvious difficulties in applying this to arid mountainous landscapes. An interesting aspect of this study therefore was to examine the results in the light of theory.

St Marys Peak, Wilpena Pound Rating 7.55

The perception of the Flinders Ranges landscape was examined through the eyes of the indigenous Adnyamathanha people and those of early explorers and colonists and of artists such as Hans Heysen.

Over recent decades, considerable attention has been given to the assessment, management and
The collection of data on which the scenic quality survey was based is described. The Flinders Ranges landscapes are described and classified. The chapter describes the photography of the Flinders Ranges, the criteria for the selection and choice of photographs. The design of the Internet survey and its implementation on the Internet are described. Finally, the identification and scoring of landscape factors is described.

Over 1500 photographs were taken and supplemented by slides from private collections. A set of 127 scenes were selected plus 20 South Australian benchmark scenes. The Internet survey ran for 27 days in November – December. On its completion, 3549 people had participated and of these, 2452 who had completed 110 or more scenes were selected. Following removal of 30 for strategic bias, the data set comprised 2422. This provided a confidence interval of 1.99 which is excellent. Landscape factors were scored by small groups of participants.

The highest rated area was Wilpena Pound followed by the Heysen and Elder Ranges, all in the 7 - 7.2 range. The Mt Painter area together with the Gammon Ranges and Freeling Heights were in the 5.8 – 6.3 range. The central ranges around Mt Hack were near 6. The flatter areas north-west of the ranges were lower at 4.4.

The spectacular and terrain landscape factors were highly correlated as were vegetation and aridity, and terrain and rockfaces. Spectacular, diversity and terrain factors correlated strongest with the landscape ratings.

A model with eight factors explained 85% of the variance in landscape ratings but a simpler model with only the spectacular factor explained 78%.

Generic ratings were derived for each area in the Flinders Ranges and mapped.

The Generic Landscape Survey, carried out as private research in late 2012, examined whether generic landscapes approach might provide an alternative to measuring and mapping landscape quality, and also seek to put landscape quality assessment on a more scientific footing. Scenes were digitally altered using Photoshop so as to provide scenes with and without hills, trees and water. The ratings provided an indication of the influence of each component to landscape quality.

The survey focused on scenes from the agricultural regions of South Australia, particularly the Mid North, with the addition of some scenes from the Mt Lofty Ranges to provide a greater range of ratings. A selection of 130 scenes was made covering plains and flat slopes with various land uses and land cover, hills with and without trees, backing hills and ranges to plains, and scenes with water. Fifteen benchmark scenes of South Australia were included making a total of 145 scenes.
The on-line survey instrument, Survey Monkey, was employed. A total of 204 people participated, 155 of which had completed 140 or more scenes. The confidence interval for 204 participants was 6.86.

The mean ratings of groups of scenes on flat or gently sloping land were: bare 2.03, samphires 3.94, crops and pastures 3.32, scattered trees 5.71, dense trees 6.86. Straw coloured crops and pastures rated 3.05 and green coloured rated 3.70. In contrast, in scenes with scattered trees, straw coloured ground rated 5.80 while green coloured rated 5.36. Dense trees rated 6.86 overall, comprising mallee 6.28, sclerophyll woodland 6.67, and sclerophyll forest 7.51.

The presence of water bodies increased ratings by an average of 0.44 or 8.4%, slightly more on plains than in hills. Little water was needed to increase ratings; for every 10% water area increased ratings by 1.3.

Overall a useful survey in which new approaches and technologies were used which proved to have considerable potential for future surveys.

### 12. Lake District National Park Landscape Quality Assessment

During 2013, a major project was commenced and completed of measuring and mapping the landscape quality of the Lake District National Park in England. The Lake District, probably the UK’s foremost National Park which attracts over 15 million visitors annually, is of outstanding beauty. It has long been the subject of artists, photographers, poets such as Wordsworth and writers such as John Ruskin, Beatrix Potter and Arthur Ransome. The project was undertaken pro bono with the cooperation of the Lake District National Park Authority.

Where the forest or woodland had open ground it rated 6.54 while closed ground rated 7.51. Scenes of vines with backing ranges rated 4.37 and without the ranges 3.36. Scenes of hills rated a mean of 5.15: low 4.44, medium 4.54, and high 6.07. Scattered or dense trees on the hills increased these ratings. In low and medium hills, scattered trees increased ratings by 47% while dense trees in high hills increased ratings by 18%.

The presence of background hills raised ratings by an average of 0.95 or 28.5%. Distance, elevation, and angle of view to the backing hills had negligible effect on the ratings. The boost to ratings from background hills and ranges, a common South Australian landscape, was a significant finding from the survey.

The project commenced with three week-long photographic trips through the area in March (winter snow), June (spring flowers) and July (summer). An internet survey was then compiled and invitations to participate were emailed to over 1500 addresses in the UK.

Over 500 participated in the survey, the results of which were analysed and the landscape quality mapped. Seven separate surveys of components considered to contribute to landscape quality were also prepared and scored by a small number of selected respondents.
Ratings of Lake District landscapes

<table>
<thead>
<tr>
<th>Landscape</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountains</td>
<td>7.05</td>
</tr>
<tr>
<td>Valleys with lakes</td>
<td>7.02</td>
</tr>
<tr>
<td>Rockfaces</td>
<td>6.81</td>
</tr>
<tr>
<td>Roads</td>
<td>6.85</td>
</tr>
<tr>
<td>Streams</td>
<td>6.47</td>
</tr>
<tr>
<td>Valleys without lakes</td>
<td>6.27</td>
</tr>
<tr>
<td>High fells</td>
<td>5.87</td>
</tr>
<tr>
<td>Low fells</td>
<td>5.66</td>
</tr>
<tr>
<td>Coast</td>
<td>5.56</td>
</tr>
<tr>
<td>Dense trees</td>
<td>5.24</td>
</tr>
<tr>
<td>Pines</td>
<td>4.39</td>
</tr>
</tbody>
</table>

Langdale Valley Rating 7.99

Scene without powerlines Rating 4.71

Scene with powerlines Rating 2.91

Nine comparisons were conducted of scenes with and without certain features. The following table summarises the comparison scenes.

Ratings of comparison scenes – Lake District

<table>
<thead>
<tr>
<th>Comparison</th>
<th>With</th>
<th>Without</th>
<th>Diff</th>
<th>% diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>6.28</td>
<td>5.63</td>
<td>0.64</td>
<td>10.25</td>
</tr>
<tr>
<td>People</td>
<td>6.92</td>
<td>7.33</td>
<td>-0.41</td>
<td>-5.92</td>
</tr>
<tr>
<td>Powerlines</td>
<td>3.27</td>
<td>4.75</td>
<td>-1.47</td>
<td>-45</td>
</tr>
<tr>
<td>Roads</td>
<td>6.19</td>
<td>6.07</td>
<td>0.12</td>
<td>1.94</td>
</tr>
<tr>
<td>Stone walls</td>
<td>5.41</td>
<td>5.22</td>
<td>0.19</td>
<td>3.51</td>
</tr>
<tr>
<td>Seasonal</td>
<td>7.50</td>
<td>7.31</td>
<td>0.19</td>
<td>2.53</td>
</tr>
<tr>
<td>Sheep</td>
<td>5.34</td>
<td>4.83</td>
<td>0.51</td>
<td>9.55</td>
</tr>
<tr>
<td>Trees</td>
<td>5.94</td>
<td>6.11</td>
<td>-0.16</td>
<td>2.84</td>
</tr>
<tr>
<td>Water</td>
<td>7.11</td>
<td>6.41</td>
<td>0.70</td>
<td>9.85</td>
</tr>
</tbody>
</table>

13. Mount Lofty Ranges Landscape Quality Assessment

The Mount Lofty Ranges Landscape Quality Assessment project was carried out during 2015 to measure and map the scenic quality of the region in South Australia. The area is 4,700 sq. km. The project was carried out pro bono to assist the bid for World Heritage listing of the region.

The project commenced with 7,000 photos taken of the region. An additional 6,000
photos had been taken previously. For the first time, this survey used spliced photos, two images spliced together to provide a wider angle of view which aids immersion of the viewer in the landscape. A total of 150 images were selected to cover land forms, land cover, land uses, presence of water, seasonal colour, fire damaged landscapes and landscape units, and included images used in the author’s PhD Thesis, the previous Barossa study plus benchmark scenes of South Australia. Of the 150 images, 119 were spliced and the remaining 31 were single photos.

In addition to the main survey instrument, six surveys covered the components: land form, land cover, naturalness, visual diversity, colour and water. The surveys used the Survey Monkey on-line survey facility.

To gain participation in the landscape survey, invitations were emailed to approximately 1700 addresses, located from Internet searches of outdoor, sports, social and interest clubs, councils, service and environmental groups, and newspapers throughout Adelaide and the Ranges. The survey was conducted in July and yielded 519 useable responses, a confidence interval of 0.043. Scoring of the six component surveys was also undertaken.

In scenes with open grazing or cropping land, the winter green pastures and crops are 0.8 higher than the summer brown. This particularly affects those parts of the Ranges with scattered trees over pastures and the eastern cropping areas. In many areas this is the difference between a 5 and a 6 rating. Interestingly however, vines and orchards which also change colour with the seasons retain the same rating throughout the year.

### Influence of seasonal colour on ratings

<table>
<thead>
<tr>
<th>Component</th>
<th>Winter Rating</th>
<th>Summer Rating</th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>Green</td>
<td>Brown or yellow</td>
<td>-0.42</td>
<td>-7.07%</td>
</tr>
<tr>
<td>Vines</td>
<td>6.46</td>
<td>5.68</td>
<td>0.78</td>
<td>12.07%</td>
</tr>
</tbody>
</table>

In mapping, the winter ratings were adopted, e.g. 6 instead of 5 for much of the scattered trees area.

The study analysed each of these features and components in detail. Using multiple regression, models were derived for the landscape quality. The best model was that which used all six components and achieved a correlation coefficient (R2) of 0.90:

\[
Y = -0.63 + 0.55 \text{ naturalness} + 0.54 \text{ diversity} + 0.37 \text{ land cover} + 0.28 \text{ land form} + 0.28 \text{ colour} + 0.14 \text{ water}
\]

A model with only two components achieved an R2 of 0.81:

\[
Y = 1.075 + 0.66 \text{ naturalness} + 1.03 \text{ diversity}
\]
In mapping the landscape quality, certain principles were followed: The resultant ratings and map of landscape quality for the Mt Lofty Ranges are shown below.

### Summary of landscape quality ratings

<table>
<thead>
<tr>
<th>Rating</th>
<th>Square km</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3.14</td>
<td>0.30</td>
</tr>
<tr>
<td>4</td>
<td>181</td>
<td>3.82</td>
</tr>
<tr>
<td>5</td>
<td>1070</td>
<td>22.60</td>
</tr>
<tr>
<td>6</td>
<td>3315</td>
<td>70.03</td>
</tr>
<tr>
<td>7</td>
<td>152</td>
<td>3.21</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>0.04</td>
</tr>
<tr>
<td>Total</td>
<td>4734</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The next highest rating, 7, applied to the Hills Face Zone overlooking Adelaide, the steep land near the Kangaroo Creek Reservoir, the Deep Creek – Blowhole Creek – Talisker area, and parts of the Fleurieu coast.

The dominant rating throughout the Ranges is 6, reflecting the prevalence of undulating land with either scattered trees or tracts of trees. The 6 rating also applied to roadside trees, exotic trees, hills faces including the Barossa Ranges and the Willunga Scarp, the Inman and Hindmarsh Valleys, areas of dense vegetation, and to the seven reservoirs in the Ranges. Tree-lined creeks in the eastern ranges rate 6.

The 5 rating applied to the many vineyards including the McLaren Vale and those scattered throughout the Ranges. It also applied to flat land with trees and to undulating but barren land. The undulating but bare cropping land south of Truro rated 5. Market gardens and orchards rated 5. The eastern ranges are rated 5. The Hills Faces south of Gawler and also overlooking Morphett Vale both rate 5.

The 4 rating applied to the many vineyards including the Mt Crawford, Kuitpo and Inman Valley areas. Flat bare areas used for cropping rate 4.

The 3 rating applied to quarries, including those in the Hills Face Zone, sand workings and mines.

Detailed analysis of the map by councils was undertaken. The Adelaide Hills Council has the most extensive areas of high quality landscapes (6 – 8), followed by Yankalilla and Mitcham Councils.
Overall the map brings out some important points:

- The rating 6 dominates the Ranges and is bound in the east by the bare hills and escarpment of rating 5 and in the west by the hills face at Gawler, Adelaide, Morphett Vale and Willunga, rating 5 – 7.

- Landscape quality also varies over time with changes in land use. The establishment of pine forests decades ago transformed 5 and 6 rating landscapes to 4 rating. The current spread of tree plantations will have a similar effect as they also rate 4.

- Vines are becoming the new land use across the Ranges. Pockets of vines exist from south of Yankalilla north through to the Eden Valley and across much of the central Ranges. In many areas they are transforming the landscapes of scattered trees on grazing land to monocultures of vines stretching across the undulating hills but with all remnant trees removed. Thus more vines means less trees. Vineyards do not generally tolerate trees in their midst. And it is the trees that enhance landscape quality, not vines (see Barossa survey).

- While the seasonal colour of vines in autumn might be thought to enhance the landscape, this study showed that the ratings of autumnal colour were lower than their summer green. Also, the ratings of vines in green leaf were lower than that of green pastures. Thus the argument that the spread of vines across the Ranges will enhance landscape quality is not supported by this survey.

In order to position the Ranges better in terms of World Heritage nomination, a Ranges-wide Landscape Protection Zone was proposed that would be adopted by all Councils and included in their Development Plans. This would include strengthened Objectives and Principles of Development Control as well as provisions relating to their application by Councils. Townships would be excluded from the Zone.

Proposals to improve the landscape management of the Ranges were presented covering: nomination under Criterion 7 of World Heritage Convention, Ranges-wide Landscape Protection Zone, protection of hills faces in the Inman and Hindmarsh Valleys and other localities, regeneration of scattered trees and protection of trees in vineyard development, use of mixed species in tree plantations, protection of roadside trees, encouragement to land holders to beautify their dams, provision of viewing areas along roads, designation of Scenic Routes along major roads, removal of eyesores, provision of lookouts over reservoirs which have significant landscape value, and cessation of softwood plantations in the Ranges.

14. WORLD’S BEST LANDSCAPES PROJECT

Having measured and mapped landscapes in South Australia and the Lake District in England, all of which averaged in the range 5 to 7, the question arose, what rating do the World’s best landscapes achieve? What are the characteristics of such landscapes? Where are such landscapes located? The project was carried in early 2016.

The list of what may be the World’s best landscapes was prepared based on the World Heritage list which includes landscapes that meet Criterion 7 of landscape aesthetics. Also two dozen lists of the World’s Wonders were reviewed and from these plus the World Heritage list, a set of 45 locations were selected. Based on strict criteria, three photographs for each site were chosen, mainly from the Internet. The survey comprised 143 scenes. An Internet survey was launched and 128 useable responses were obtained in 16 days.

The top rating of an individual scene was 8.55 and for a group of three scenes was 7.93. The top rated scene was of the Plitvice Lakes in Croatia, a relatively small set of waterfalls. The lower than expected ratings – there were no 9’s – may be due to respondents saving
their 9’s and 10 ratings because they did not know what was ahead in the rest of the survey. The scenes were largely unfamiliar which may also contribute to the lower ratings.

The presence of water was found to have a significant influence on ratings, increasing ratings by 5%. Of the top 20 scenes, 17 included water.

Many of the scenes contained cliffs and high mountains, and scenes of mountains viewed across lakes or the sea. The following figure compares the ratings of these. It also shows the ratings of mountains which are conical in shape, including volcanoes, and also those which are a high narrow tower.

High, narrow towers: Guilin Mountains, China 7.92

15. Community survey of the visual impact & acceptability of wind farms in Australia

Fifteen years after the author’s 2003 survey of wind farms, this was a follow-up survey with scenes of actual wind farms in NSW, Victoria and SA, together with some of the coastal scenes from the earlier survey. Respondents were asked to rate the scenic quality of the landscape with and without the wind farm and to also rate the acceptability of each wind farm in the landscape on a 5-point scale. The order of the scenes was randomised. The survey comprised 49 scenes with wind farms and 49 without, a total of 98 scenes. Over 800 turbines were shown in the images.

Invitations to participate in the survey were emailed to councils and councillors in NSW, Victoria and SA plus clubs and individuals throughout Australia. The survey ran for a month in March, 2018.

The data set comprised 779 participants from across Australia. While they were generally well educated, they included 40% who had only a certificate or diploma.

Participants from SA, Victoria, NSW and Queensland were the most familiar with wind farms although 12 participants claimed to have never seen one. Nine times as many said in principle they were in favour of wind farms as those who were against them. The largest number opposed to wind farms was from NSW and Qld. Those with less education opposed wind farms more than those with higher education. A higher proportion of females than males were opposed to wind farms.

The overall average for the scenes without the wind farms was 6.82 and the scenes with the
wind farms was 5.61, a reduction of 1.21 (1 low – 10 high scale).

**Attitude towards wind farms vs familiarity**

<table>
<thead>
<tr>
<th></th>
<th>Never seen one</th>
<th>Seen a few</th>
<th>Seen many</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Against</td>
<td>2</td>
<td>24</td>
<td>33</td>
<td>59</td>
<td>8</td>
</tr>
<tr>
<td>In favour</td>
<td>5</td>
<td>252</td>
<td>250</td>
<td>508</td>
<td>68</td>
</tr>
<tr>
<td>It depends</td>
<td>5</td>
<td>106</td>
<td>70</td>
<td>182</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>382</strong></td>
<td><strong>353</strong></td>
<td><strong>749</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>%</td>
<td>1.6</td>
<td>51</td>
<td>47.1</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

The surprising and unexpected finding was that by far the majority of participants found the wind farms acceptable in virtually all landscapes. Only one landscape was judged unacceptable.

**Pennington Bay, Kangaroo Island, South Australia. The sole scene which was judged unacceptable for wind farms.**

This was despite the participant's own ratings showing that scenes with wind farms rated lower than scenes without them. In other words, despite their acknowledgement that wind farms diminished scenic quality, they still found them acceptable.

Participants who were in favour of wind farms voted heavily for their acceptability in each of the scenes whereas the minority opposed to wind farms voted them unacceptable.

**Acceptability frequency of scenes**

<table>
<thead>
<tr>
<th>Acceptability</th>
<th>Participants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very acceptable</td>
<td>152</td>
<td>29</td>
</tr>
<tr>
<td>Acceptable</td>
<td>199</td>
<td>38</td>
</tr>
<tr>
<td>Neutral</td>
<td>59</td>
<td>11</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>63</td>
<td>12</td>
</tr>
<tr>
<td>Very unacceptable</td>
<td>52</td>
<td>10</td>
</tr>
</tbody>
</table>

The table shows that three times as many people rated the scenes as acceptable compared with those who rated them unacceptable.

This suggests that the community is far more tolerant of the visual impact of wind farms than previously believed. It might also indicate a substantial shift in opinion over the past decade as wind farms proliferated across Australia. Now that most of the community has seen wind farms, their former fears have been allayed and they are much more accepting of them. It might also suggest that the community regard clean energy as more important than scenic quality.

The report discusses the implications of the findings for the wind farm developers, the community, government, and the landscape.

**CONCLUSIONS**

The studies summarised here provide a glimpse into the measurement and mapping of scenic quality, a subjective quality which can be objectively assessed as demonstrated by these studies.

The studies show that although variation occurs among individuals regarding the scenic quality of a scene, the similarities are greater than the differences. There tends to be greatest agreement over the high quality scenes while a wider range of opinion is evident for less beautiful scenes – we can agree on what we like but less so on what we do not like.

The ratings used in the studies were surrogates or indicators of scenic quality: they do not comprise scenic quality. While people do not normally express their opinion about a scene in terms of a number, the rating scale forces the individual to compare the scene with a standard of beauty that is held in their mind.

The scale focuses only on the aesthetic value of a landscape, its visual quality, not on the range of historic, cultural, botanical or other values that might be present in a scene. However in viewing the scene, the viewer unconsciously brings these influences to bear on their appraisal.

Scenic quality is a community and environmental resource of considerable significance. A century ago for example it was estimated that Switzerland gained between US$10,000 – $40,000 per square mile from its scenery per year. Landscape sells; it adds to...
the well-being, not to say, the quality of life of people.

But landscape quality is also a resource under pressure. Sea-change development of the coast and the siting of wind farms in scenic areas are examples of significant pressures on landscape quality. By measuring and mapping landscape quality the community is better placed to decide the best location for developments, developments which will provide economic benefits while not ruining the visual qualities which also provide benefits.

The studies summarised here demonstrate that landscape quality can be measured and mapped, and the visual impact of developments can be assessed in an objective way.

It is hoped that the methodology employed and the insights gained of the underlying factors which generate scenic quality, will inform and educate planning, environmental and land management professionals and the community generally.

BOOK: THE SCIENCE OF SCENERY

In 2017, Dr Lothian published The Science of Scenery which brings together in the one publication all he has learnt over 25 years about landscape quality and its measurement and mapping. The book is available through Amazon.com as a print-on-demand publication.

PAPERS BY DR ANDREW LOTHIAN

Journals


Conference Papers


An Innovative Landscape Quality Assessment Methodology, NZPI & PIA Congress 5 April 2006.


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