Quantifying the Visual Effects of Wind Farms;

A Theoretical Process in an Evolving Australian Visual Landscape.

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I like to refer to the roller coaster as a metaphor to the emotional and character defining experience during my candidature. There have been times of seldom boredom, loneliness and a lack of motivation. Conversely there have been moments of brightness when milestones are completed and certain theoretical topics mesh together cohesively. These periods of achievement, be they minor, helped to sustain motivation and drive needed to strive for the ultimate goal of producing this dissertation.

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ABSTRACT

Renewable energy production takes on many forms; wind farms and their turbines are but one. Turbines are a unique dynamic infrastructure within the landscape, which signifies a change in social attitude towards sustainable developments. The clarity and simplicity of the turbines' function (wind blows, blades turn, turbine spins and electrical power is generated) enforces the benign qualities that wind farms possess. However there are implications associated with the compatibility of turbines to landscape visual character and conservation.

The environmental impacts associated with wind turbines include noise, shadow flicker, bird strikes and electromagnetic interference with radio and television signals. However, research suggests the major issue facing planning and development approval is on a social level, with visual pollution being the dominant public criticism.

Wind farms must be located where consistent strong winds permeate to generate maximum efficiency. The efficiency of output is dependent on clear exposure to the prevailing wind, which normally implies ridgelines and escarpments which are both visually dominant topographical locations. The Australian Wind Energy Association (AUSWEA) has established guidelines confirming that smooth hilltops are the most preferred topography for airflow, free from obstructions. In contrast, locations with excessive turbulence will cause fatigue to the rotor blades, consequently shortening the life span of the turbine.

Hence the conspicuous siting of wind farms brings to the forefront a dilemma of conflicting values; safe and renewable energy development versus scenic preservation.

The aim of a visual assessment methodology is to gain validity, reliability, utility and sensitivity, and be quantifiable and justifiable in a court of law. The methodological model needs to ascertain an objective clarification of landscape values, which also reflects community preferences.

The current two models used to assess the visual impacts of wind farm developments are the subjective (Psychophysical Model) and the objective (Formal Aesthetic Model). These two models are similar in their intent of quantifying the quality of the landscape; however they differ in their theoretical methodologies and interpretations to landscape perception. The objective paradigm regards the visual quality to be

inherent in the physical landscape, whereas the subjective realm distinguishes the landscape to be interpreted as a product of the mind– in what Meinig termed, “in the eye of the beholder”.

The objective paradigm of visual assessment, (namely Expert, Professional, Formal Aesthetic or Visual Management System (VMS) models) is to consider the landscape to have aesthetic qualities, which are intrinsic. The fundamental approach to this model of thinking is that a professional consultant (Landscape Architect, Environmental Planner) who has been formally trained in landscape perception assesses in a detailed discussion the physical impacts with respect to the interrelationship of topography, vegetation, forms, lines and landscape patterning.

Visual envelopes, Global Positioning Systems (GPS), Geographic Information Systems (GIS), 3D simulations, mapping and photomontage are some of the tools and language used in this process. The positive aspects of this model are that it is useful in evaluating physical changes to the landscape and spatial configurations of landscape modification. The accumulated results of landscape classification can be cartographically mapped representing the visual effect. The foremost advantage of this model is the ease and minimal cost associated with its application. These attributes are all positives in delineating a legible and cohesive value for landscape impact.

The fundamental failure of the objectivist approach lies ironically in its intrinsic subjectivity, a sole practitioner interprets the landscape; hence there is a belief that the landscape possesses normative aesthetic values. Where the model gains in utility it is deficient in validity and sensitivity. The lack of sensitivity paradoxically lies in the limited classification categories of landscape quality. There is also some question as to whether landscape architects would agree with each other in their assessments. Furthermore it is contentious as to whether an association between these assessments and public preference can be established.

The subjective realm of assessment (Psychophysical model) is an objective evaluation of subjective public perceptions. It is commonly conducted in the form of a survey. The principle is to measure the impacts of scenic beauty for potential wind farm locations before development and visual representations of the completed project. It is a field of psychology developed by Gustav Fechner (1801-87) that deals with establishing quantitative relationships between physical features, environmental stimuli and human perception values. Relationships are determined through an empirical process providing statistical data, which represents the preferences of the community; consequently it is justifiable in a court of law.

To provide a framework for visual assessment which encompasses an analysis of people's perceptions of the landscape and a quantified evaluation of the landscape visual change, a new approach is required.

This thesis will seek to develop a framework which integrates both approaches into a new theoretical paradigm which evaluates the amenity of the landscape through the eyes of the beholder, but interprets the visual change as an inherent quality. Using two separate methodologies in a parallel process, the results can be spatially referenced in GIS, providing tools for illustrative cartographic analysis of visual impact.

PART ONE: AESTHETICS, PERCEPTION AND LANDSCAPE VISUAL ASSESSMENT

9 DISCUSSION & CONCLUSIONS

ABBREVIATIONS

AAPT: Average Annual Daily Traffic

ACNT: Australian Council of National Trust

AR: Augmented Reality

ASL: Above Sea Level

AUSWEA: Australian Wind Energy Association

BLM: Bureau of Land Management

CAD: Computer Aided Design

CASA: Civil Aviation Safety Authority

CAVE: CAVE Automatic Virtual Environment

DAC: Development Assessment Commission

DEM: Digital Elevation Model

DTM: Digital Terrain Model

EES: Environmental Effects Statement

EIA: Environmental Impact Assessment

EIS: Environmental Impact Statement

EPA: Environmental Protection Authority

FOV: Field of View

GIS: Geographic Information System

GPS: Geographic Positioning System

HVE: Horizontal Visual Effect

IPCC: Intergorvernmental Panel on Climate Change

LCJ: Law of Comparative Judgement

MRET: Mandatory Renewable Energy Targets

NIMBY: Not in My Back Yard

OLS: Optical Limitation Service

PER: Public Environment Report

PLV: Perceived Landscape Value

PVA: Percent of Visual Absorption

PVC: Percent of Visual Change

PVI: Percent of Visual Impact

PWEP: Portland Wind Energy Project

RECS: Renewable Energy Certificates

RPS: Renewable Portfolio Standard

RRRC: Recreational Resources Review Commission

SEA: Strategic Environmental Assessment

SBE: Scenic Beauty Estimation

SLR: Single Lens Reflex

SNH: Scottish Natural Heritage

VA: Visibility Analysis

VCAT: Victorian Civil and Administration Tribunal

VE: Visual Envelope

VEDF: Visual Effect of Development Form

VLCV: Visual Landscape Character Value

VMS: Visual Management System

VR: Virtual Reality

VRIA: Visual Resource Impact Assessment

VRML: Virtual Reality Modelling Language

ZTV: Zone of Theoretical Visibility

ZTVI: Zone of Theoretical Visual Influence

VVE: Vertical Visual Effect

WTG: Wind Turbine Generator

WWEA: World Wind Energy Association