

# VISUAL DISAMENITY IN THE QUEENSLAND WET TROPICS: ESTIMATING THE ECONOMIC IMPACTS OF OVERHEAD TRANSMISSION LINES

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This paper examines procedures and findings in estimation of the 'visual disamenity cost' associated with installation of high-voltage overhead power lines in the Wet Tropics of Queensland<sup>1</sup>. The study was performed within a short timeframe and small budget, hence the need to design a relatively simple and cost-effective approach, yet one which would yield acceptable information on environmental values. An extensive literature review and advice from a number of resource economists indicated that there was little information from previous studies to support benefit transfer methodology. It was found possible to estimate disamenity costs to ecotourism operation (using a simplified travel cost approach), agricultural operations (based on compensation payments) and residential property values (through a simplified hedonic price approach). A planned contingent valuation of the intrusive effect of the transmission lines through rainforest areas did not proceed, due at least in part to the political sensitivity of this issue.

## 1. INTRODUCTION

The siting of new infrastructure which is intrusive upon the landscape – buildings, highways, powerlines and cableways – is often controversial within the local community. This can be a particularly sensitive issue in areas of high natural attractiveness where tourism is an important industry, as is the case in Far North Queensland.

A proposal was developed in the early 1990s to augment the electricity supply to Cairns and northern districts. This proposal included installing a new 275 kV double circuit line between Chalumbin and Worree on the south of Cairns, to augment an existing 132 kV line. A single corridor was proposed to accommodate both the new line and a renewal of an existing 132 kV line.

<sup>1</sup> This report arises out of a consultancy carried out through UniQuest at The University of Queensland for the Queensland Electricity Transmission Corporation (QETC). Reform in the Queensland Electricity Industry has led to a number of new agencies since this research was conducted in 1995 (at which time political sensitivity precluded publication). The views expressed here are those of the author, and do not necessarily reflect those of any agency in the Queensland electricity supply industry.

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Two siting options were under consideration. An aboveground line (AG) recommended by the Queensland Electricity Transmission Corporation (QETC) would follow an existing 132 kV line through a cleared rainforest corridor, then require a new corridor across the World Heritage Area. The line would next pass through cane-growing land, then between the suburb of White Rock and Trinity Inlet. The alternative (UG) would be a more direct line, with a shorter new rainforest section, avoiding cane land and the Trinity Inlet, and travelling underground for 3.5 km before running along the Bruce Highway into Worree.

Difficult issues arose about the siting of the aboveground power line because influential people in politics, the hospitality industry (highly important for the Cairns economy), land developers, and school parent and citizen associations. A concern for the QETC was that much of the opposition to the power line was expressed in socio-economic terms, yet their cost estimates were only in financial terms (the underground line option would be much more expensive). Extensive and protracted public consultation had been undertaken, in an effort to arrive at a route acceptable to the local community. Within this process, the QETC decided to augment its information base with an environmental economic valuation concerning the visual impact of the new line. It was felt that some information on the environmental cost of high-voltage power lines, in terms of landscape impact and other values – say in terms of dollars disamenity cost per pylon – would be useful information for planning and community consultation purposes.

Against this background, a small consultancy (reported by Harrison *et al.* 1995) was undertaken to estimate the various 'environmental' costs associated with the transmission line siting options. The task set for the economists was to carry out an 'environmental economic valuation', to estimate the 'visual disamenity cost' of high-voltage overhead power lines. A brief research proposal was developed, in consultation with the QETC engineer. A time period of six weeks and budget of approximately \$5,000 was agreed for Phase 1 of the project (relating to Trinity Inlet recreation, cane-farming and residential areas), with a tentative Phase 2 to investigate costs in relation to lines placed through rainforest areas.

This case study illustrates the multiple issues and multiple stakeholder groups which can be involved with what appears to be a relatively simple infrastructure project predominately in a rainforest and agricultural area. It also illustrates the difficulty of assembling information on environmental values within a short timeframe and small budget. Within these limitations, a methodology had to be devised which was relatively simple and inexpensive, yet yielded information which would be accepted as sufficiently reliable.

This paper first outlines issues in the estimation of visual disamenity costs, and then reviews previous studies on this topic. Brief details of the valuation methods and some of the results are then presented, followed by comments on the overall evaluation process.

## 2. VISUAL AMENITY AND DISAMENITY AS ECONOMIC CONCEPTS

Economists have long recognised that attractive views – such as landscape views by day and city lights by night – have a value. Properties with views attract price

premiums. It is axiomatic that unattractive views reduce values below that of properties which are otherwise similar, as do intrusive structures on the landscape. If an attractive outlook has an amenity value in the eyes of the beholder, then a reduction in the quality of views imposes a disamenity cost. 'Visual disamenity' may be looked upon as a particular type of environmental good (or rather 'bad'), or as a particular form of pollution. In particular, it could be considered as a form of air pollution, c.f. noise, smog and dust pollution. Court cases involving compensation or injunctions against visual disamenity are a reflection of the economic cost of this form of pollution.

Many public sector projects have an impact on landscape values. Such impacts were for a long time regarded as an unmeasurable *externalities* or spillover effects of development by economists. About 20 years ago, Price in his book on *Landscape Economics*, wrote:

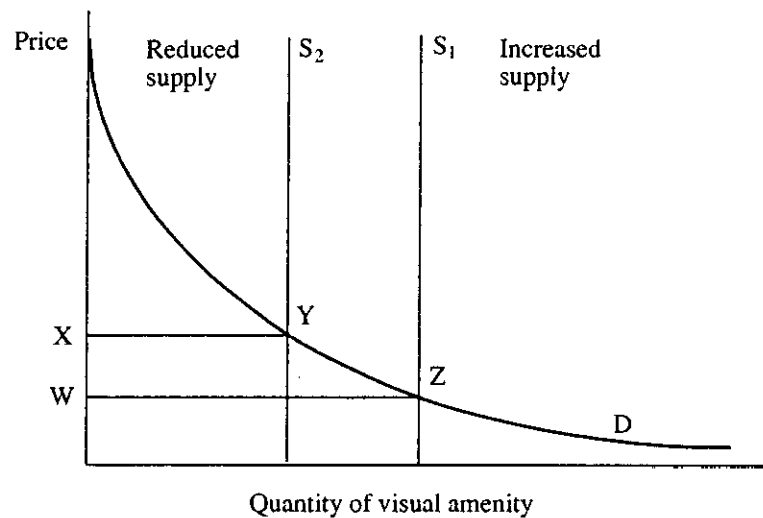
Economists are generally expected to leave beauty alone. In this nasty, commercialised world, it is argued, some things should be sacred. 'How', asks the rhetorical question, 'can you put a value on a sunset, the song of the skylark, or the sight of magnificent mountains?' Hence the first hurdle in developing the study of landscape economics is a prevalent aversion to the idea that landscape is a subject fit for economic inquiry (Price, 1978, p. 1).

Since Price's pioneering studies, community attitudes to protection of landscape amenity have firmed. This is a topic where environmental and social issues are difficult to separate. Public objections to landscape changes are raised on environmental grounds, but impacts are imposed on both quality of life and property values.

Undesired visual features on the landscape are usually observed by and affect a number of people. These people would be prepared to pay various amounts to have less visual disamenity. In economic terms, there are a number of consumers whose collective willingness-to-pay constitutes a demand curve for preserving the quality of visual resources or landscape. In this context, consumer demand is expressed in relation to the level of visual *amenity* and not *disamenity*.

Demand at any time for various quantities of visual amenity would vary between people, according to their preferences or tastes and ability to pay. In Figure 1, the curve labelled D depicts the short-run community or 'market' demand for visual amenity. This would apply for a fixed set of consumers, e.g. the residents of a particular suburb. The horizontal axis represents the quantity of visual amenity, associated with the quality of the views from residential properties. At any point in time, a fixed supply  $S_1$  of visual amenity exists. Installation of visually intrusive new infrastructure would reduce this to  $S_2$ . Collectively, the community would be prepared to pay a large amount to avoid this loss in visual amenity, represented by the change in *economic surplus* WXYZ in Figure 1. This reduction in the consumer surplus is a measure of the social cost of visual disamenity which economists seek to measure. Notably, a loss in producer surplus could also arise, e.g. firms supplying tourism services may lose trade and hence income.

**FIGURE 1**  
**MARKET DEMAND CURVE FOR 'CONSUMPTION' OF VISUAL AMENITY**



### 3. VISUAL IMPACT ASSESSMENT OF OVERHEAD TRANSMISSION LINES

A methodology is relatively well established for estimating the visual impact, in a physical sense, of high-voltage overhead transmission lines. This sometimes forms part of an environmental impact statement (EIS), e.g. see Mitchell McCotter and Associates (1993) and Pacific Power (1994) for Australian examples. The visual impact of transmission towers will depend on viewer location and activity. Obviously, the closer to the tower a viewer is, the greater the impact which could be expected. The literature suggests that most of the visual impact is typically confined to within one kilometre of a transmission line, with high visual impact usually found only in disjoint sections within 0.5 km of the line. Viewers in moving vehicles (e.g. highway traffic) are less likely to be concerned than stationary viewers, e.g. those on sports fields or recreation areas near a line.

A number of factors concerning tower design and location which affect their visual impact (and hence visual disamenity cost) have been identified. These include tower height; tower location (whether there is 'skylining', proximity to houses); colour (shiny new, natural ageing, painted camouflage colours); tower construction (slimline towers, steel or concrete columns); and extent of screening by vegetation.

A concept related to visual amenity is the a 'visual space index', which has been devised to assist in planning to see objects such as wildlife in reserves, or to avoid

seeing objects such as other campers or walkers in parks (Rasmussen, 1993).

A problem with both of these concepts is that no attempt is made to place a cost on the adverse visual impacts, and hence it is not possible to compare options such as alternative transmission corridors on a social cost basis.

#### 4. REVIEW OF ESTIMATION OF VISUAL DISAMENITY COSTS

Some landmark studies have been undertaken of the value of views or 'visibility' – of desirable landscape features and wildlife – and by implication of the cost of factors which reduce this visibility. Randall *et al.* (1974) conducted an early study of placing values on aesthetic environmental improvements. In a seminal research project, Brookshire and others in the USA estimated the community valuation of preserving 'air visibility' or views (e.g. Rowe *et al.*, 1980; Schulze and Brookshire, 1983). They obtained a total preservation value of \$4.43 per person per month for views of the Grand Canyon, compared with a user bid of \$0.07, the difference being attributed to high existence value. It is to be noted that what was being valued was the visibility, not the canyon itself.

When it comes to placing values on unattractive views, finding relevant studies for benefit transfer becomes more difficult. Unattractive views might be expected to have an environmental cost, relative to some concept of a normal or pre-existing vista. Randall *et al.* (1974) applied the contingent valuation technique to estimate community willingness-to-pay (WTP) for abatement of aesthetic environmental damage from air pollution, strip mining and transmission lines. The mean willingness to pay, in 2001 Australian dollars, was about \$400 to \$700 per household per year, depending on the level of improvement. The greatest improvement scenario included no emissions, transmission lines underground and strip-mined land reclaimed. Contributions from the three individual components were not differentiated.

Brookshire *et al.* (1976) also using contingent valuation estimated the community WTP for reduced aesthetic damages from a proposed power station near Colorado River in the Glen Canyon National Recreation Area. The two aesthetic damages were 230 m tall smoke stacks and smoke plumes. The estimates obtained were considerably lower than those from the Randall *et al.* (1974) study, at about \$13 to \$20 per household per year, in current Australian dollars. The willingness-to-pay estimates were higher for recreationalists than residents, though the authors considered that the value for residents may have been underestimated due to use of an inappropriate payment vehicle (entrance fees).

Thayer (1981) applied contingent valuation to estimate WTP to prevent geothermal development in the Jemez Mountains, Santa Fe National Park, USA. Part of the concern was visual impacts of drilling, pipelines, transmission lines and electricity generation facilities. There was also concern over removal of vegetative cover, emissions and noise levels. The mean WTP was approximately \$20 per person per visit, in current Australian dollars. Other studies identified in this general area include those on air quality (Scott and Company, 1980, various studies by Lohman reported by Mitchell and Carson, 1989; Randall *et al.*, 1985), and being able to view wildlife (e.g. Clayton and Mendelsohn, 1993).

There has been limited research on the relationship between property values and distance from artificial landscape objects. Smith and Desvousges (1986) investigated demand for distance from disposal sites. An interesting study by Thibodeau (1990) examined the relationship between a high-rise office building and nearby house values. Values were found to increase with distance from the high-rise, for distances of up to 1 km, due to visual intrusion and traffic congestion. For greater distances, property values decreased with distance suggesting householders may be willing to pay to live close to work, or land prices may be bid up in anticipation of future development.

Price (1993) considered decisions about routing electricity transmission lines on the island of Skye, a protected wilderness area in Scotland. The choice of route was between Glen Shiel (affecting many tourists) and Kinloch Hourn (a more remote area through which line construction was more costly). Price was concerned with the reduction in willingness to pay to view a landscape arising from intrusion of pylons into the scene, or intrinsic value of preserving the landscape from pylons. He argued that 'the impact of pylons varies, not only with their design, but also according to other features in the analysis: land form, composition, land use, vegetation type, other artefacts, and even transitory factors like weather' (Price, 1976, p. 830). He opted for a subjective valuation approach, but taking into account a number of relevant factors, stating that the researcher should 'go beyond the simple hypothesis that the presence of pylons reduces visits, or that the existence of other artefacts reduces their impact' (p. 831). He divided the routes up into sections, and applied the following cost function:

$$\text{degradation cost} = \text{mean degradation \%} \times \text{exposure hours} \times \text{mean hourly rate}$$

where mean degradation is a weighted average of quality of views by percentage degradation, and exposure hours are:

$$\text{exposure hours} = \text{visibility \%} \times \text{vehicle numbers} \times \text{vehicle occupancy} \times \text{visit duration}$$

Price estimated the 'annual aesthetic degradation' cost for the Glen Shiel option, adjusted to 2001 Australian currency, of about \$17,000 per kilometre, assuming 3,750 visits per day. A much smaller figure was obtained for Kinloch Hourn, due to the low visitor numbers.

No Australian studies in which visual disamenity costs have been quantified were identified. Research in the Daintree area in North Queensland suggests that supply of grid-based electricity will impose private economic costs associated with lifestyle changes (Wilson, 1994; Carroll and Donohue; 1994), though these costs are attributed to an increasingly urbanised environment, rather than to overhead transmission lines in particular. It has been argued that underground power though highly expensive would be the most appropriate means of reticulation in the Daintree, due to the sensitivity of the environment, although no cost estimates have been made (Bannock Humphreys, 1994).

The literature search revealed the difficulty of locating studies of close relevance to a specific non-market valuation problem. Approaches to interstate and overseas electricity authorities proved fruitless, although there was research on visibility distances for power lines. Since this study was undertaken, more research on visual disamenity costs has come to light. In particular, Garrod and Willis (1998) applied contingent ranking to estimate the loss of amenity value from the placement of pipelines and cables along canals in the United Kingdom.

##### 5. RESEARCH METHOD AND VALUE ESTIMATES

Installation of a high-voltage transmission line into Cairns from the south would have a number of direct community benefits in terms of future reliability of power supplies to industry and households. Given the high rate of population growth, these benefits may be very large, such that the installation is an essential infrastructure development. For the analysis, it was assumed that the power benefits would be unaffected by the choice of supply alternative (all aboveground AG or part underground UG). Both could pose outage risks due to line disruption; the AG alternative would be more prone to cyclone damage, while repairs could take longer for the UG option, particularly if overseas technicians had to be called in. The analysis allowed for variations in capital costs and in environmental costs.

An extensive review of literature was undertaken, and contact was made with a number of resource economists in a search for information about past studies on 'environmental disamenity costs'.<sup>2</sup> Site visits were undertaken, and discussions held with officers of the local electricity industry and in tourism and real-estate agencies. Data were obtained on property sales in the suburb of White Rock, where high-voltage transmission lines ran close to housing. The main environmental impacts of the Chalumbin to Woree line were identified as:

- (a) loss in tourism value of Trinity Inlet from visual impact of the line, in terms of both producer (tourist operator) and consumer (domestic visitor) surplus.
- (b) loss of residential property values from visual disamenity and concern over electromagnetic fields and their possible health effects.
- (c) loss in rural property values from reduced productive value and subdivision potential for option AG.
- (d) loss in amenity value of Wet Tropics for residents and visitors to Cairns and the hinterland.
- (e) loss in development value of real estate due to visual impact along the northward-running section of option AG.

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<sup>2</sup> The advice of Jeff Bennett, Richard Carson, Nick Hanley, Michael Lockwood, Colin Price, Murray McGregor, Anton Meister, Mark Morrison, Alan Randall, Dale Squires and Ken Willis at the time of this study is gratefully acknowledged. Assistance from Ron Stillman and Tom Mandeville in carrying out aspects of this study is much appreciated.

### 5.1 Cost to Trinity Inlet ecotourism operations

Trinity Inlet and the surrounding wetlands are recognised as an area of high ecological value, and as such have been accorded protected status under the Trinity Inlet Management Programme (TIMP)<sup>3</sup>. While TIMP does not allow for any major works within the Wetland Protection Management Area, it recognises that there may be circumstances in which public works are can be allowed, provided the proponent demonstrate that: (1) a clear community need exists; (2) no reasonable alternatives are available; (3) the proposal is compatible with the overriding principles of management for Trinity Inlet; and (4) there is evidence of broadly-based community support (Trinity Inlet Management Plan Steering Committee, 1992, p. 116). The transmission line (option AG) would pass over the Wetland Protection Management Area, with tower footings within this area. Visual impact guidelines for the Trinity Inlet reported both positive and negative landscape features. It was observed that some 'necessary but unattractive services of urban development are noted between the urban fringes of Cairns and Woree and the mangrove wetlands ... The proposed QEC powerlines are a current pressure that will require specific attention during the preparation of the design guidelines' (TIMP, c1994, p. 124).

The waterways of Trinity Inlet are an important recreation resource. Two cruise craft provided 'harbour and everglades cruises', with a number of smaller charter and private boats using the inlet. Recreation cruises are linked with visits to the Edward River Crocodile Farm (a Pormpuraaw aboriginal community enterprise). Economic values arise with regard to producer surplus from commercial operations providing recreation on the inlet and consumer surplus from visitors taking part in recreation activities. The presence of transmission towers and wires fringing and in some cases traversing the wetlands would impose costs on tourism operations. The question arose as to the extent that visitors to Trinity Inlet would be aware of (and affected by) the presence of transmission lines – and hence suffer reduced recreation benefits – and the extent to which people who would otherwise take first or repeat trips would choose not to do so. Changes in visitation would depend on the visual impact of the transmission lines from the waterways, and the perception of potential cruise customers resulting from their knowledge that the power lines are in place. A three-dimensional visualisation of the Trinity Inlet area had been developed, which allowed transmission towers to be superimposed on the mangrove forest, so as to examine their visibility from the waterways. It was observed that mangroves reach a height of 25 to 30 m. The transmission towers would in most cases be more than one kilometre from the viewing points. The recreation visitor attention would be for the most part on the immediate visual features (wetland vegetation, bird life, crocodiles sunning), but also with more distant views of the mountain ranges and peaks such as Walsh's Pyramid.

<sup>3</sup> The signatories to this management plan are the state and local government and the Cairns Port Authority. A number of management areas are recognized, including the waterways and mangrove-melaleuca wetlands which are designated as Wetland Protection, and the entire catchment (designated as Catchment Protection).



The two cruise boats were licensed to carry a total of 136 passengers, with high utilisation rate in the winter tourist season in particular. Other recreation craft operating in Trinity Inlet are smaller, with a single deck, and unlikely to be affected by pylon views. The fare per adult person for harbour and everglades cruises ranged from \$16 to \$22, varying between the two operators and with time of day (more for cruises in which lunch is provided rather than afternoon tea).

The annual net social benefits of cruise operations comprise both producer (cruise operator) and consumer (recreation visitor) surpluses. In the absence of supply and demand functions for cruises, a more subjective approach was required. A spreadsheet (Table 1) was developed as a transparent method to indicate assumptions and estimate economic surplus foregone. The producer surplus is estimated as the average rate of profit of cruise operators after all costs (including imputed interest on capital invested and allowance for operator's labour). The consumer 'profit' or surplus represents the mean willingness-to-pay of visitors, over and above actual expenditure. Following Price (1993), this has been estimated at 50% of actual expenditure.<sup>4</sup> No allowance has been made for travel costs, on the grounds that Trinity Inlet cruises tend to be an incidental recreation activity rather than major reason for visiting Cairns. Estimation of consumer surplus is limited to tourists of Australian origin. On the basis of discussions with staff of the Far North Queensland Promotion Bureau and TIMP Steering Committee, the share of domestic visitors has been estimated at 50% of total cruise customers. Any reduction in these cruises would also have some impact on number of visitors to the Edward River Crocodile Farm, because many boat passengers choose the combined package. The crocodile farm also has road access, and is located further to the east in Trinity Inlet, hence being less likely to be affected by visual impacts of transmission lines. A fall in visitation rate of 10% due to the transmission line under option AG is assumed. A real discount rate of 8% was adopted. An increase of visitation rate of 12% per year was assumed, based on the annual rate of increase in motel room-nights in Cairns, as reported by W.S. Cummings Economic Research Services (1994, p. 16). A cumulative loss over 20 years of \$2.7m was estimated.<sup>5</sup>

## 5.2 Cost to sugarcane farmers

Concern arose over the impact that that the transmission line would have on values of farming land. This was the subject of a submission to the Minister for Minerals and Energy commissioned by the Edmonton Power Opposition Group (EPOG). Their argument was that large-scale residential development would be needed

<sup>4</sup> As pointed out by a reviewer, this is a rather arbitrary approach. Further, the estimate is probably highly conservative, c.f. Driml (this volume) estimated the mean consumer surplus for visits to the Wet Tropics World Heritage Area at \$49 per day. Notably in comparison, Trinity Inlet cruises are of relatively short duration (about three hours) and a relatively narrow species variety is observable (mangrove vegetation, some birds and occasionally crocodiles).

<sup>5</sup> Some sensitivity analysis was performed, e.g. reducing the discount rate to 5% would increase the estimated economic loss to \$3.8M.

**TABLE 1**  
**SPREADSHEET FOR DERIVING LOSS IN RELATION TO**  
**TRINITY INLET BOAT CRUISES**

Item	Amount
Current cruise boat capacity (persons)	136
Cruise boat utilization (%)	75
Average number of passengers per day (persons)	102
Average fare per passenger (\$/trip)	18
Number of cruises per boat per year	700
Annual number of passengers	71400
Total revenue from cruise operations (\$1000)	1285.2
Producer surplus (%)	30
Producer surplus (\$1000)	385.6
Proportion of passengers of domestic origin (%)	50
Consumer surplus (% of fare)	50
Consumer surplus (\$1000)	321.3
Total annual cruise economic surplus (\$1000)	706.9
Edward River Crocodile Farm economic surplus (\$1000)	300
Total annual economic surplus (\$1000)	1006.9
Annual loss in economic surplus from installation (%)	10
Annual loss in economic surplus (\$1000)	100.7
Annual rate of growth in visitor numbers (%)	12%
Real discount rate (%)	8%
Cumulative economic loss (present value, \$M)	2.7

south of the area designated as residential under the (then) Mulgrave Shire Development Control Plan (DCP), with substantial appreciation in land values. However, compensation would be paid to farmers based on productive value of land only (with allowance for dislocation to the farm business). The EPOG argument raised issues of future land zoning, and conflict between land uses for farming and residential purposes. There are strong economic arguments for preserving high quality agricultural land, both for its future productive use and for the viability of rural infrastructure such as sugar mills.

From a social cost-benefit perspective, future windfall gains would represent *transfer payments* between one sector of the economy (landholders or land developers) and another (purchasers of housing and commercial land), and not a net gain to society. It would be appropriate to make an allowance from a social viewpoint if loss of the option of developing this land led to development of less suitable land (e.g. greater development cost, greater cost of providing services, greater travel cost for commuters). No allowance has been made for this possibility in the present study. The estimated compensation cost which would be paid for easements through farm land along the corridor (\$0.9 million) is taken as reasonable estimates of social cost.

### 5.3 Impact on residential property values

High-voltage transmission lines can have a major impact on the values of residential properties along and close to the corridor. Property values can be depressed from the time of public awareness of the planned corridor, and further affected at and after the construction stage. The fall in property values represents a once-only cost to society. The impact on property values could be expected to vary with distance to the transmission lines, tower height and visibility of the lines, and contemporary views on health risks associated with electric and magnetic fields (EMF). Once people become accustomed to the presence of high-voltage power lines, part of the depression in property prices can disappear. The QTEC has adopted the policy of 'prudent avoidance' (Gibbs, 1991) in respect to electromagnetic fields by locating the line corridor as far as practical from existing dwellings, ensuring a corridor width of 100m, and arranging circuitry to minimise the electromagnetic field.

There is considerable visual evidence in Cairns suburbs of residential properties located close to high-voltage transmission lines, including very high value properties in the range foothills. A number of local real-estate agents were asked: (i) 'By how much would the value of two properties differ if they were identical except that one was close to power lines and the other was not?'; (ii) 'For what distance from a transmission line would the effect on property values be felt?'; and (iii) 'How would the effect vary with value of properties?'. Three types of response were obtained: there would be no effect on property values; there must be some effect on property values, but it is not possible to quantify this effect; and property values would be reduced by of the order of 10%, whether the transmission line is on the property boundary or 100 m away, regardless of the overall property value. It was pointed out by one agent that the number of buyers for any property close to lines is reduced, and reduced buyer competition results in lower prices.

The suburb of White Rock is particularly close to the corridor which was proposed. Records of property sales in this suburb over the period 1992 to 1994 obtained from the Valuer Generals Department were examined. Details of the preferred corridor were made public about October 1993. Allowing three months for this to be reflected in property sales, data for 1994 was taken to reflect experience after the announcement. Properties were divided into three groups, viz. (a) those built along an existing 132 kV line (with transmission towers along the footpath within metres of houses), (b) those which would possibly be affected by the proposed line, and (c) unaffected properties. Mean prices for properties along the existing line (group a) were about \$15,000 lower than for unaffected properties (group c), although house quality appeared similar. Mean property prices on the western fringe of White Rock (group b) were approximately \$12,600 lower than houses in unaffected streets (group c) for the two years 1992 and 1993, but in 1994, this margin widened by \$5,600.

Option AG specified that the transmission line within the residential area be removed, to be replaced by a twin-line corridor established on the fringe of the wetlands (across parkland and not less than 100m from housing). If it is accepted that electric and magnetic fields have no effect at distances of 100m, then the impact

of the new line would be mainly one of visual impact rather than anxiety over health. While the towers would be taller, the greater distance and presence of some trees in the parkland would reduce their visual impact. For the purposes of this analysis, a price depression of \$10,000 has been adopted for properties affected by new transmission lines, and a price increase of \$15,000 has been adopted for properties on streets for which existing lines would be removed. Aerial photographs were used to determine the number of properties which would gain or lose under Option AG. Streets were chosen for which a substantial proportion of houses would have direct views of the new line. An allowance, equivalent to the number of houses which could be placed over the same distance, was made for school playgrounds. The totals are indicated in Table 2.

**TABLE 2**  
**AGGREGATE IMPACT ON WHITE ROCK PROPERTY VALUES**

Property class	Number of properties	Unit cost or benefit (\$1000)	Aggregate cost or benefit (\$1000)
New properties to be affected	100	10	1000
Existing properties for which effect removed	110	15	1650
Net social gain (\$1000)			650

This analysis indicates a net social gain of \$650,000. It is recognised that some people's properties will be devaluated, while others will appreciate. The figure derived can be regarded as an estimate of the present value of benefits to householders from line relocation (including addition of a second line). The above calculations make no allowance of transactions costs or other disutility associated with reluctant relocation. Omission of these costs seems justified in that property sales data do not indicate any increase in numbers of movers in 1994. Under Option UG, the aboveground section of the new 275 kV line could impose adverse visual impacts on a small number of properties, and a cost of \$240,000 was estimated for these.

#### 5.4 Visual disamenity cost with respect to the wet tropics rainforests

Stage 2 of the project was designed to derive an environmental cost from placing the transmission line through the Wet Tropics rainforests. The community disamenity value would be expected to be greatest for lines visible from the city of Cairns, where the rainforest backdrop contributes to attractiveness of the city for residents and visitors. Any damage to the protected rainforests would exacerbate the intrusiveness of the transmission lines. The construction options of a cleared strip, or very high pylons and cleared footings only, both imply large non-market costs, the former in loss of native vegetation and habitat and the latter in terms of skylining and visual intrusiveness of pylons. Computer visualisation was developed for this

scenario, as a powerful means of illustrating the impact of alternative line sitings on the rainforest vista. A contingent valuation study was designed to elicit community disamenity values on these visual impacts, but the decision was made to discontinue this research.

## 6. AGGREGATE VALUES AND THE SITING DECISION

Estimated capital costs differed greatly between the two options, mainly because of the difference in cost of overhead lines (about \$0.25 M/km) and underground cabling (\$4M/km). Table 3 summarises the major cost estimates from this study. Unless the environmental cost with respect to siting on lines through rainforest areas for the AG option exceeded that of the UG option by about \$16M, it would appear that the former alternative was preferable on economic grounds. The decision was subsequently made to implement the UG option, so as to minimize the visual disamenity cost and impact on land values. In a sense, this transfers part of the cost of the power line from the landholder to the electricity consumers. Since there is some levelling of power costs across the state, this cost is shared by a large number of small consumers.

TABLE 3  
CAPITAL AND ENVIRONMENTAL COST ESTIMATES OF THE  
TRANSMISSION LINE OPTIONS

Cost category	Option AG	Option UG
Capital outlay (\$M)	9.5	27.5
Trinity Inlet ecotourism cost (\$M)	2.7	Small
Reduction in residential property values (\$M)	(0.7)	0.2
Decline in rural property values (\$M)	0.9	Negligible
Total of estimated costs (\$M)	12.4	27.9

## 7. DISCUSSION

This study revealed that unattractive industrial installations can have a major visual disamenity cost, though placing a value on this cost to the various stakeholder groups is a difficult task. Often benefit transfer is the only workable approach, particularly when the time and budget for the valuation is small. However, at the time of the study, there was an almost complete absence of relevant studies from which to infer costs for the target site. Nowadays, more information is available, and existence of email discussion groups such as RESECON makes an international search for comparable studies much easier to conduct. Nevertheless, the number of similar studies would be small, such that applying benefit transfer methodology remains difficult.

The study also revealed the long and tortuous community consultation process with regard to construction of industrial installations, and the procedural complexity in arriving at a decision, including the role of vested interests and political intermediation. The estimates made by economists can play a role, but not

necessarily a major role, in this overall process.

The reason for not proceeding with the proposed Phase 2 of this study was presumably a judgment of the engineer that this would not be a worthwhile step. This decision is hardly surprising. In Australia, the major environmental disputes where environmental valuations have been undertaken – Gordon-below-Franklin hydroelectricity proposal, Coronation Hill mining proposal, and Fraser Island logging – have all resulted in a conservation decision. It may be that application of contingent valuation to a proposed development which has negative environmental impacts generates publicity which galvanises opposition to the development, and tests the nerve of decision-makers to proceed. A more cynical explanation would be that the decision-makers have come to recognize that their proposed development is unpopular electorally, and are looking for an 'out', which the report of an environmental inquiry will provide.

This study highlights the need to apply a methodology relevant to the environmental issues but practical in terms of the research resources available. Often, this will involve practical expedients rather than sophisticated frontier research techniques. The study also highlights the importance of further development of databases of environmental values, so that benefit transfer can be applied with greater confidence of the reliability of estimates.

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