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**Estimation of the influence of view components on high-rise apartment pricing
using a public survey and GIS modeling**

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Abstract

A growing trend towards high-density urban living increases the significance of natural features within the urban fabric. In high-rise living the view is one means of continuing contact with the environment. Using visualizations, public survey techniques and a geographic information system (GIS), we estimate the effect of parks, water, industry and high-rise buildings on willingness-to-pay for views from high level apartments. With the GIS we determine what will be visible within the view and the proportion of different land uses or structures that make up the view. In order to link the analytical variables to the view values a set of base images is systematically altered in terms of the proportion of water, parks, buildings and industry present in the scenes. Surveys are conducted to determine the willingness of people to pay for preferred views. The results from a regression analysis show that water and green space have positive coefficients and buildings and industry both have negative coefficients. Particular attention is paid to the influence of distance on the view proportions. Our calculations are compared with empirical results from other studies.

Keywords: GIS, visualization, view components, willingness-to-pay, housing prices

1. Introduction

In cities all around the globe attractive natural areas can be found. Urban parks, urban woodlands, river corridors, lakes and ocean shores make a major contribution to the quality of life of people living in an urban environment. The social and ecological significance of green space has been recognized for many years (Sitte, 1922). The role of natural features in third dimension of sustainability, the economic

aspect, has long been acknowledged by the real-estate business and is now increasingly perceived by the general public and decision-makers.

A number of studies have shown that the economic value of a property depends significantly on its relative proximity to green space, water and open space (e.g. Conner et al., 1973; Luther & Gruehn, 2002; Tyrvaenen, 1997). However proximity and access are just one of the contributing land cover factors in housing valuation. The view is also of importance (Benson et al., 1998; Oh, 2002). With many cities showing a trend towards high rise urban living the view assumes extra importance as the continuing link between place of residence and environment.

The potential benefits of views are very substantial. Lange and Schaeffer (2001), for example, showed that the significance of a view to hotel profits and real estate value could be estimated from differentials in room charges and occupancy rates. For a single property they estimated that the effect of the view on property value was USD 16 million or more.

Consequently if a new apartment or hotel building is being considered, how important is the difference in view that may be available in different locations? How can the building be designed or oriented to maximize view value. For an existing hotel, what are the possible consequences of a new adjacent building which partially blocks the valued view? The same questions can be applied to new or existing apartment buildings where the view can strongly influence lease or purchase prices.

Using a geographic information system (GIS) we can determine for any particular location what will be visible within the view, we can also determine the proportion of different land uses or structures that make up the view. Can we link these analytical variables to view values? That is the key question being addressed by this paper.

Thus, in this study we attempt to

- (a) estimate the effect of different view characteristics on the willingness-to-pay for high-rise apartments, and
- (b) Show how this knowledge can be used with GIS based analysis to predict the view value of different locations or orientations of high-rise apartments.

A similar analysis could also be applied to hotel rooms.

A number of earlier studies have used GIS to identify elements of the view in housing price studies. In our opinion, these studies have had limited success because the emphasis has been on spatial mapping rather than what the analysis can say about the view itself. For example, in Paterson and Boyle (2002), although they used visibility analysis

- (a) there was no allowance for the effect of distance,
- (b) no height values were allocated to buildings or forest and so the visibility estimates are suspect (acknowledged by the authors), and

(c) the vertical elements themselves (building and trees) were not analyzed for their contribution to the view – only their spatial extent within the 'visible' area.

Lake et al. (2000) were more complete in their analysis. They included a distance effect, which was assumed to be linear, but again the vertical elements were only seen as obstructers of the view not as a contributing part.

Images of landscape are not normally treated as two dimensional entities. For example, Kaplan & Kaplan (1979) argued that we interpret the view as a combination of 2D (coherence and complexity) and 3D (legibility and mystery) factors. Bishop et al. (2000) suggested that depth was more important than content in determining visual preference in some landscapes. Many authors have distinguished between the impact of foreground, middleground and background as view components (Ott, 1993; Shafer and Brush, 1977; USDA Forest Service, 1974). In this study our images are all based on views from high-rise accommodation. This means they have little foreground and consequently legibility and mystery as normally construed will not be major factors in preference evaluation. We therefore argue here that the images may be analyzed purely in terms of their 2D components, and their relative proportions, without consideration of depth factors. Note however, that the distance to objects in the view remains extremely important because of the rapidly diminishing effect of distance on their visual magnitude (Iverson, 1985). The effect of distance as assessed using our methods is compared with results from hedonic pricing studies (especially Benson et al., 1998) in the discussion section below.

2. Method

2.1 Creation of simulated views

A set of potential base images was taken from multi-storied buildings in the Central Business District (CBD) of Melbourne, Australia. They were chosen because public access is available. These buildings (hotels, housing apartments and commercial buildings) were representative of many buildings in the city area. Locations on different floors and views facing in different direction were used as available.

The images:

- o were taken using a standard digital camera in landscape format with a resolution of 1600x1200.
- o included aspects of all the major city land uses – residential areas, green areas (mostly parkland), water bodies (mainly the sea but also the Yarra river), industrial and commercial areas (including other high rise buildings).
- o were taken on a normal sunny day while there was uniform lighting. The choice of season has very limited influence on Melbourne views because of the high proportion of evergreen trees and absence of snow.

- o involved no attempt to keep the area of sky uniform but since the area is generally flat the variation in the sky area of the images was low (as seen below the analysis is based entirely on the non-sky area)

Figure 1. Some of the original and altered images used in the survey.

Among the many photographs taken, three were selected to be the base images from which test images were developed: one contained an area of sea and a lake (Figure 1(e)), one contained a large area of park as well as numerous office buildings (Figure 1(a)), the third included a similar mix of parkland and public buildings but was taken at a lower level (Figure 1(c)). Because of the flatness of the terrain and the spread of

suburbs in the distance in all directions we felt that almost any images would form suitable starting points. Adobe Photoshop Elements was used to bring image fragments from the other original photographs (giving introduced objects a similar perspective) and these were positioned at roughly appropriate scales within the base images (Figure 1). The image alteration process sought first to create realistic changes with three levels of increase of each of the changing land covers. There was no prior determination of the proportion of each land cover to be used.

When the images were completed, an outlining and pixel counting process was used to determine the proportion of the non-sky pixels that represented water, green space, high-rise building, industry and the undifferentiated suburbs.

2.2 Willingness to pay assessment

In order to determine the willingness of people to pay for preferred views, a survey was conducted. The survey had two parts:

- o the original base images were compared with each of the three levels of increase in the four key land uses in a web based survey
- o the base images were compared with each other in a subsequent survey using prints.

We had a choice in setting-up the survey whether to portray the images as views from hotel rooms or from a flat / apartment. We chose the later because of our predominantly student survey group and their probable greater familiarity with apartment living. An analogous procedure would be used for hotel rooms.

In the first part the base images were distributed randomly on the left or the right, with one of the comparison images next to it on the other side. The pairs were then ordered as to whether they were testing Green Space, Water, High Rise Buildings or Industry respectively with the level of amendment distributed as in Table 1.

Table 1. The sequence of the 12 pairs of comparative images used in the first part of the survey.

Pair #	Left Image	Right Image	Pair #	Left Image	Right Image
1	Medium Green	Base Green	7	High Buildings	Base Buildings
2	Low Water	Base Water	8	Base Industry	Medium Industry
3	Base Buildings	Low Buildings	9	Low Green	Base Green
4	High Industry	Base Industry	10	Medium Water	Base Water
5	Base Green	High Green	11	Base Buildings	Medium Buildings
6	Base Water	High Water	12	Low Industry	Base Industry

People undertaking the survey were provided with the following instructions:

Suppose you have a number of choices to rent a room / apartment / flat in the CBD. The only difference between apartments is the view from the window. The images below are the possible views from the living area of the apartment. Consider each pair of images independently in turn. For each pair

- a) decide which you prefer - the right or the left image
- b) indicate, for the preferred image, how much extra per week you would be willing to pay for this view

If you have no preference, or are unwilling to pay any extra for the preferred view then do not click any of the buttons for that pair of images.

The available sums to choose were between \$10 and \$30 in increments of \$5. At time of writing, one Australian dollar is about 65 US cents. A one-bedroom high rise apartment in Melbourne costs from around \$200 per week upwards. The top of our scale was therefore an increment of up to 15% on starting rental. Similar figures might apply on a daily basis in a hotel specific survey.

In the first part of the survey, thirty-one valid responses were received mainly from graduate students at the University of Melbourne. They were recruited by circulating an e-mail to graduate students in the Department of Geomatics giving the URL of the survey and asking for their participation. All results were collected in a few days. The students are a group with limited disposable income and we are unable therefore to regard the results as coming from a representative sample of the population. Nevertheless, the relative valuation of the different views is likely to provide a good indication of the potential of the approach. The importance of the survey was to provide data which could be used in the GIS analysis to establish the appropriate mechanism for differentiating view values on the basis on land use or land cover distribution. Basic demographic data was collected at the start of the survey but was not used in the analysis.

In the second part of the survey, the three base images were compared (the same base having been used for the building and park series of simulations). The same process was used as above except that hard copy images were shown. This component of the survey should ideally have been combined with the first part. The omission arose because in the early stage of the experiment the concept was simply to determine the extent to which increases in a particular land cover would influence view values. It became apparent during the analysis that a multivariate approach was both possible and desirable. Just eight people completed the second stage of the survey. However, the high level of consistency in outcome (see below) was reassuring. While a larger and more representative response group would be essential to a definitive study of view values, we consider this result sufficiently indicative to proceed with development of the GIS based analysis.

2.3 Mapping values using GIS

The images used in this study, as is the case generally of views from high rise buildings, have no foreground and the variation in depth from view to view is low. In generally flat terrain depth differences from view to view are minimal (unless another high rise building blocks the view). As argued in the introduction, it was appropriate to consider the view as essentially a two dimensional picture and to analyse that picture for its content: i.e. the proportion of the view-image occupied

by the different land cover types. In a GIS land cover mapping may be based on grid cells or polygons. The analysis process which we developed is based on grid cell mapping but it would be possible to develop similar algorithms for polygon mapping (or they could be converted to grid cells). The proportion of the view contributed by each grid cell in the landscape depends on whether the cell is characterized by a 'flat' land use (e.g. water, snow, pasture – the visible material lies on the terrain) or by standing objects (e.g. forest, buildings)

For 'flat' land uses the visual magnitude of a visible cell depends on a number of factors. These are:

- whether or not the cell is visible (based on terrain elevations amended by land cover type – see below)
- the distance of the cell from the observer
- the cell size
- the height of the observer relative to the cell.
- the slope and aspect of the cell (this has minimal effect in the flat landscape of central Melbourne and is ignored)

If VH is the elevation of the observer and CH the elevation of the cell, CW the cell dimension, and D the distance between the observer and the cell, then the visual magnitude (VM) (see also Iverson, 1985) of the cell is:

$$VM = H/(H^2+D^2)^{1/2} * CW^2/D^2 \quad (1)$$

where $H = (VH-CH)$ and the first term accounts for the effect of observer height on the apparent size of a horizontal cell, while the second term is essentially the distance effect where the visual magnitude declines as $1/D^2$. This gives a measure of visual magnitude in square radians, to convert this to square degrees multiply by $(180^2/\pi^2)$. This gives a more intuitive unit than square radians since the size of a fingernail at arms length is very roughly 1 square degree.

Note also that as D increases the term $H/(H^2+D^2)^{1/2}$ can be approximated by H/D . Thus, with the unit correction applied the equation becomes:

$$VM = 3.28 * 10^3 * H * CW^2 / D^3 \quad (2)$$

where H, CW and D need to be in the same units

For 'standing' land uses (assuming only the front face of the cell is visible) the visual magnitude depends on

- whether the cell is visible (based on terrain elevations amended by land cover type – see below)
- the distance of the cell from the observer
- the cell size
- the height of the standing objects

Using the same symbols as above but with OH as the height of the standing objects, visual magnitude may be calculated as:

$$VM = CW * OH / D^2 \quad (3)$$

With conversion to square minutes this becomes:

$$VM = 3.28 * 10^3 * CW * OH / D^2 \quad (4)$$

On this basis, neglecting the influence of height variation and the effect of slope and aspect, a processing algorithm has the following steps.

A. Preliminary steps for whole of study area:

- 1) separate the land cover into separate 0/1 maps
- 2) create a terrain model where the height is the terrain height (DTM) plus the standing height for each land use

B. Then for every point for which a view assessment is required:

- 3) define the point (within a loop if doing a regional assessment)
- 4) create a distance map from this point – this provides the value of D at each point
- 5) apply the relevant function to each of the separated land cover maps (Step 1) using H, CW, OH and D to generate a potential score for each cell
- 6) create a visibility map (0/1) for the point in question on the basis of the land cover amended DTM (step 2)
- 7) multiply the potential score map for each land use (Step 5) by the visibility map (Step 6)
- 8) add the scores for each visible cell for each land use (this was done by exporting the attribute table then using spreadsheet software)

This will give the contribution of each land cover to the view and a percentage of non-sky cells within the view can then easily be computed for each land cover.

3. Results

3.1 Raw Survey results

Firstly, a distribution analysis was run on the raw results to determine whether the range of available values was appropriate, how it was used, and what differences in response patterns were provoked by the different land use changes. Figure 2 shows the distribution of willingness to pay (disregarding whether preference was left or right). It appears that in each case – except perhaps water – there was no need for the scale to offer sums above \$30. From these charts it appears also that a more complete picture would have emerged if the \$5 option had also been included – especially in the buildings case. When a question was left unanswered we treated this as a case of no preference (i.e. unwillingness to pay extra for either view). The shape of the charts suggests that this treatment was reasonable.

People were generally prepared to allocate more funds in the water case, i.e. opinions were stronger. There was, by contrast, much more indecision about preference in the case of the increasing appearance of highrise buildings. In 28% of cases no preference was indicated. The somewhat bimodal structure of the industry result is difficult to interpret.

The next step was to code each response as a number, based on the indicated willingness to pay, with negative value if the left image was preferred and positive value if the right was preferred. These values were averaged for each image pair (N=31). This gave a measure of the relative value of one image relative to the base image in that set (see the first column of numbers in Table 2). Thus each base image has a value of zero and the altered images are above or below that depending on whether they were preferred or not. The most preferred image – relative to its base – was the highly altered water scene with an average willingness to pay of \$12.00.

The comparison between the base images followed a similar approach (second column of numbers in Table 2) but here there was the possibility to check for consistency of result since each base was compared with each other base. From the averages, the water base was preferred over the park and buildings base by \$4.40, the industry base was preferred over the water base by \$5.00 and with great consistency from the raters the industry base attracted \$9.40 additional willingness to pay over the park and buildings base (which image was then treated as the base \$0.00 case).

By combining the within image group ratings with the between image group ratings we arrived at overall willingness to pay for all scenes relative to the park/buildings base (third column of numbers in Table 2). Now the most highly valued scene (+\$16.40) was that with maximum water content and the least valued (-\$6.55) was that with maximum highrise buildings. This outcome is in accord with existing literature on landscape preference. The trends are not always as expected – eg. ‘low parks’ scores better than ‘medium parks’ while ‘medium industry’ fares worse than ‘high industry’. These may be the result of idiosyncrasies of the individual simulations or simply statistical variation following from a relatively small sample size. On the other hand they may be real comments on diversity, complexity and contrast in views. Further studies would be needed to resolve such questions.

Figure 2. The absolute money allocations for the four landuse change series added over the three comparisons for each land use (N=31x3=91).

3.2 Regression analysis of willingness to pay

The final values of willingness to pay for each view were taken as the dependent variable and the proportions of the images occupied by each land cover type (see Table 2) were used as the independent variables in a linear regression.

Table 2. Willingness to pay evaluations and image content analysis

IMAGE	Willingness to Pay (\$\$)			Percentage of images occupied by each land cover				
	Within group images	Between group images	Overall	Highrise buildings	Parks / green space	Industry	Water	Other (suburbs)
Base image for water	0	4.4	4.4	8	60	0	0	32
Low added water	9	4.4	13.4	8	54	0	6	32
Medium added water	10.83	4.4	15.23	8	53	0	12	27
High added water	12.00	4.4	16.40	8	52	0	17	23
Base image for parks	0	0	0	25	25	0	1	49
Low added parks	6.33	0	6.33	25	42	0	0	33
Medium added parks	3.17	0	3.17	25	54	0	0	21
High added parks	6.67	0	6.67	25	66	0	0	9

Base image for major buildings	0	0	0	25	25	0	1	49
Low added buildings	-3.97	0	-3.97	38	12	0	1	49
Medium added buildings	-5.69	0	-5.69	42	8	0	1	49
High added buildings	-6.55	0	-6.55	45	6	0	1	48
Base image for industry	0	9.4	9.4	9	14	0	7	70
Low added industry	-9.67	9.4	-0.27	9	10	17	7	57
Medium added industry	-15.17	9.4	-5.77	0	9	33	7	51
High added industry	-13.67	9.4	-4.27	0	2	41	7	50

Note: base images for assessment of parks and major buildings were the same. These were given the zero value in the comparison of the price estimates of the base images

The regression result is shown in Table 3. The adjusted R^2 was 0.902 suggesting 90% of the variation in willingness to pay could be explained through a linear equation using four of the image content variables. The variable omitted as insignificant in the analysis was the area of other / suburban land use. However as the five variables added to 100 for each image the omission of one was inevitable. The adjusted R^2 was surprisingly high given the rather speculative nature of the simulations and survey. We were also pleased to see that the size and sign of the coefficients also made sense. Water and green space had positive coefficients – with water higher – and buildings and industry both had negative coefficients with industry more negative. All four factors were significant ($p < 0.05$). This fit of the regression model provided a good base from which to explore the potential of GIS analysis.

Table 3 The coefficients of the linear regression of willingness to pay against the image variables. The adjusted R^2 was 0.902 ($p < .01$).

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	2.997	3.552		.844	.417
High rise buildings	-.228	.086	-.433	-2.670	.022
Green space	.120	.043	.358	2.823	.017
Industry	-.348	.088	-.591	-3.934	.002
Water	.611	.168	.403	3.638	.004

Dependent Variable: Willingness-to-pay

3.3 Development of a GIS based prediction tool

The algorithm described in Section 2.3 was used to generate estimates of view statistics for another coastal city in Victoria, Australia. This section is intended to illustrate the processing required to implement the statistical model through a GIS.

It is not an attempt to validate the model in another context. Such a validation would require a further round of image taking and public assessment.

Figure 3 shows the data set used for this illustration. The land uses are a mix similar to before but it was assumed that from the view points chosen there were no other highrise buildings visible. The 'standing' structures were therefore industry and forest ('green'), while the 'flat' landcovers were agriculture (which was also treated as 'green') and water.

Figure 3. ArcView analysis of visibility with 90 degree field-of-view in direction V1 from the view point labeled S2. The analysis covers the range 500 m to 20 km. Most of the view is over water. Other lands uses are also shown.

Two viewpoints (S1 and S2) were chosen. S1 has views that include industry, with the sea beyond, low rise suburbs, agricultural land and inland water bodies. When looking to the NNE (S1-V1) the industry and water dominate, when looking to the SE (S1-V2) the agriculture and inland water are visible across the suburbs. S2 was placed close to the shore. A view direction ENE was chosen to maximize the water view (S2-V1). In each case the field of view was set as 90 degrees, the height of the viewer as 100 m and the distance range of the land viewed 500 m to 20 km. We also included a variant of S1-V1 in which the height of industry was changed from 50m to 5m (S1-V1B).

Table 4 shows the percentage of the view occupied by each land use. This is then multiplied by the coefficients from Table 3 to give the contribution to relative value

of each visible land cover type. The contributions of each land cover are added to give the relative value of the view. Note that this value is relative to the base value established by the view in Figure 1(a). These are definitely not absolute values of the view. However they do suggest, on the basis of this survey and analysis, that view S2V1 over the water is worth around \$38 more per week in apartment rental than view S1V1 which has substantial industrial foreground.

In order to test the effect of distance from a key visual element (e.g. water) using our approach, the Site 2 viewpoint (beside the sea) was moved back inland by 3.2 km (about 2 miles). The move inland has reduced the willingness to pay (see view S3V1) by around \$31.00 per week. At the inland location this is lower than our base view (Figure 1a) but still higher than some of the industrial views in the survey. However at this distance all premium from the sea view seems to have disappeared. Indeed the water view component of the inland site willingness to pay is only \$1.00.

Table 4. Some trials of the GIS analysis algorithm. It was assumed that existing urban areas were essentially low rise. The weights are taken from the regression analysis (Table 3).

	Percentage of non-sky view					Weight	Relative Value (\$)				
	S1V1	S1V2	S1V1b	S2V1	S3V1		S1V1	S1V2	S1V1b	S2V1	S3V1
Green (flat)	0.35	2.01	0.17	12.79	0.13	0.120	0.042	0.241	0.021	1.535	0.015
Green (standing)	1.40	34.45	0.64	1.06	1.57	0.120	0.168	4.134	0.077	0.127	0.189
Other (suburban)	44.34	63.28	82.38	0.90	65.24	0	0	0	0	0	0
Industry	51.82	0.04	9.97	33.94	31.41	-0.348	-18.035	-0.015	-3.468	-11.812	-10.931
Water	2.08	0.22	6.84	51.30	1.64	0.611	1.271	0.134	4.178	31.345	1.003
Total	100	100	100	100	100		-16.55	4.49	0.81	21.20	-9.72
S1V1	view to NNE										
S1V2	view to SE										
S1V1b	view to NNE but with height of industrial cells reduced from 50 to 5 m										
S2V1	view to the ENE from coastal vantage point										
S3V1	view as for S2V1 but 3.2 km (2 mi) back from coast and looking in the same direction										

4. Discussion

The major uncertainty in pursuing an analysis of this kind is the effect of distance. Is it appropriate to assume that the perceived importance of a view element drops at the same rate as its geometric importance?

There are few empirical studies. However, Benson et al. (1998) studied real-estate values at different distances from ocean views. Their results provide a point of comparison for not only the distance effect but also the absolute levels of value contribution.

Benson et al. (1998) identified an inverse relationship between ocean distance and hours price premium, but did not attempt to give any shape to that relationship. Figure 4 is a plot of their view value estimates. The relationships here are close to linear but this may be affected by the confounding factors. A 'full' ocean view at a distance of 3.2 km (2 miles) is likely to be achieved only from an elevated position. The intervening visible space may also contribute visual interest of its own. However Benson (pers comm.) feels that the ocean remains the dominant attraction and price modifier even at this distance.

Figure 4. A plot of the effect of distance on view values using the figures of Benson et al. (1998). The relationship appears to be close to linear although the decline is somewhat more rapid (for all view conditions) at small distances as in a $1/D$ relationship.

The calculations given in Section 2.3 suggest that water's share of the view diminishes as $1/D^3$. This is very much more rapid than Benson's finding. There are two element of geometry which potentially reduce the discrepancy however. Firstly, if the water element is very large (e.g. the ocean) then as a viewer moves further away a greater amount comes into the field of view (unlike the case in Figure 3 where the assumed field of view was already filled by the sea). Secondly, in order to maintain a view the height of the observer can be assumed to increase in most cases. This increases the factor H and hence the proportion of the view also. Figure 5 is a direct comparison of Benson's 'Full View' curve (in \$\$) with a rescaled image area calculation for a body of water stretching endlessly to right and left and view height increasing by 10m for each 100 m further away. Beyond 500-600 m the curves are very similar, it is the initial drop that is quite different.

There is again a reasonable explanation available. Once the water contribution gets to a certain size, increasing further may have little effect on the preference for and willing-ness to pay for the view. While we can rationalize many aspects of this analysis we still do not know sufficient about the relationship between physical measures of view components and perceptual measures. Both revisitation of the

several studies which considered views as combinations of fore-, middle- and back-ground (starting with Shafer and Brush, 1977) and further experiment and empirical work on this question seem warranted.

Figure 5. A comparison of the 'Full View' figures of Benson et al. (1998) with computed view extents. The computed figures are in thousands of pixels within trial rendered images. Their absolute values are therefore of no significance. It is only the shape of the curves which is being compared.

Benson et al. (1998) also found an increase in market price for a home with the 'highest-quality ocean views' of almost 60% compared to a comparable home without ocean views. Our regression equation suggests, with its water coefficient of 0.611, that if water occupies 60% of the view the increase in willingness to pay would be \$36.66 per week. On a \$200 per week apartment this is about 18%, significantly lower than the Benson figure. There are a large number of factors which could be making a difference here:

- our analysis and survey was based on a highrise apartment which may restrict the apparent significance of the water
- we limited our extra payment to \$30 per week which Figure 2 shows may have been unnecessarily restrictive
- purchase prices may include a speculative component which does not apply in the rental market
- our survey group were graduate students (comparatively low income)

So, whether our estimation of contributions to visual quality (and view values) should be simply based on visual magnitude or whether we need to emphasize the contribution of special features (regardless of their size) remains an open question.

5. Conclusion

The survey component of this research, and hence the GIS analysis, represent a very simple case. The ground surface is treated as flat, the number of land cover types is

quite restricted, the number of cases and respondents were lower than ideal. However the initial success of the regression process suggests that a GIS based approach to likely willingness-to-pay is viable given further calibration. The difficulty is that, as with general studies of visual quality, the calibration and analysis may have to be undertaken anew in any locality seeking to use this approach to maximize the benefits of development location and orientation. However, image processing and web-based survey techniques make the execution of such calibration studies much cheaper and less time consuming than even a few years ago. The size of the value differentials suggests that that up-front cost is small compared to the potential benefits for major projects.

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