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**SITING WASTE DISPOSAL FACILITIES IN NEW ZEALAND
COPING WITH COMMUNITY CONCERNS
OR
ARE THERE ANY SKELETONS IN THE CUPBOARD?**

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ABSTRACT

This publicly-funded research project asks two central questions. Firstly, is there, from a social perspective, a systematic pattern to landfill siting in New Zealand? Secondly, if so, how would this pattern be characterised from the perspective of the host communities involved? Patterns and trends were assessed in terms of separation distances from dwellings and from urban boundaries, site visibility and the type of land uses existing in the neighbourhood of the site. Statistical comparisons between waste source communities and facilities' host communities were possible in 30 cases. While comparison of host and source communities yields no indications of systematic bias against socio-economically disadvantaged communities, a comparison of the selected host communities with the alternative candidate host communities (i.e. alternative sites) indicates clearly that during the process of site selection, more powerful candidate communities have been consistently more effective in avoiding final selection. The implications of these findings for the planning and decision-making process are discussed. On-going research is outlined.

Keywords: solid waste, landfill siting, social justice, host community, planning, effects

1 INTRODUCTION

1.1 Theme

The principal theme of the research reported in this paper is social and environmental equity in facility siting decisions. Do social considerations influence landfill siting? How do landfill operations impact on their host communities? Of particular interest is the relationship between source communities and host communities. Does the siting of these facilities reflect relative social, economic or political disadvantage between communities? For example, referring specifically to hazardous waste sites in the US, Bullard (1994) reported that a national study of uncontrolled hazardous waste sites and commercial hazardous waste landfills "concluded that race was the single most important variable associated with the location of these sites." In New Zealand, there are no separate hazardous waste facilities. Many materials that would be classified

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as hazardous (e.g. asbestos, bio-medical wastes) are managed by the practice of 'co-disposal' in general dumps or landfills.

Many years ago, past practices such as the location of dump sites in river margins or in open shingle pits began to raise concerns about threats to freshwater resources in communities around the country. The traditional urban response of turning to the rural margins for a disposal site has caused friction amongst different groups within the wider community. It is apparent that many of the concerns focus around a core issue of social equity - why should one section of the community accept the risks associated with disposal of the whole community's refuse? It raises questions about what constitutes socially unacceptable impacts in practice, and whether initial community concerns are borne out in actual experience.

1.2 Context and objectives

The research reported in this paper forms the first part of a three-year programme that aims to assist the process of urban and rural planning in New Zealand. When completed, it will have assembled a body of knowledge on key social factors that are relevant to decisions on the siting and operation of solid waste facilities in this country.

The first part of the research programme is intended to answer two central questions:

1. Is there a systematic pattern of landfill siting in New Zealand?
2. If so, how would this historical pattern be characterised from the social perspective of the host communities involved?

The second part of the research (being carried out at present) is intended to ask two further questions:

3. What have been the day-to-day effects and the longer-term effects on host communities of landfill and transfer station operations?
4. How do actual effects compare with effects that were projected at the time of siting?

1.3 Institutional setting

The Resource Management Act (1991) put the focus of land-use planning in New Zealand onto an effects-oriented basis. In other words, instead of using a land zoning approach, activities such as solid waste dumping can in future be located anywhere so long as their off-site effects can be kept within acceptable limits. The implications of this for refuse disposal practices have become increasingly apparent in recent years. The need to renew consents for the on-going use of existing "dumps" has highlighted the unsustainable outcomes of past practices and past trends.

2 RESEARCH METHODS

2.1 Sample selection

The sample of facilities (27 landfills, with demographic data for 22; and 8 transfer stations, with demographic data for all 8) was drawn from a national data base of waste management facilities. Selection criteria involved consideration of :

- (i) a range of siting dates (i.e. both older and newer sites), with specific attention to spanning the transition in planning legislation from the Town & Country Planning Act (1977) to the Resource Management Act (1991).
- (ii) a range of sizes (i.e. facilities serving metropolitan areas, medium-sized cities and towns, and smaller rural centres). Communities with usually-resident populations of fewer than 4000 were excluded from the sample.
- (iii) landfills with and without public access, and with varying design standards (i.e. with and without impermeable liners, etc.).
- (iv) facilities which have been sited in totally rural settings and those within city and town boundaries,
- (v) cases where the choice included continued use of an existing facility/site and those where only new sites were considered. In fact, preference was given to new sites.
- (vi) practical considerations such as regional clusters of sites, to minimise field travel time.

The most important constraint was the availability of demographic statistics which were obtained for 1981 onwards, from the 5-yearly censuses. Another constraint, was the loss of institutional memory in some Territorial Local Authorities (TLA) where several cycles of re-organisation and loss of personnel meant that no-one remains in the present organisation who remembers the planning processes for site selection. In some cases, the documentary records do not exist either.

2.2 Site visits and interviews

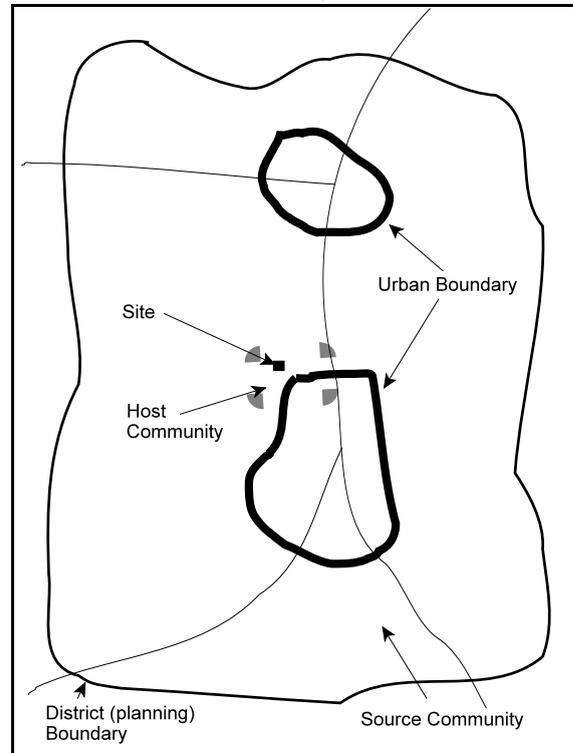
Information was gathered from a range of sources. Some background information was sourced from the 1995 Landfill Census database, commissioned by the Ministry for the Environment, prior to visiting the facility operators. These site visits involved a structured interview (covering facility planning and decision making, and the operator's knowledge of the historical setting for the site), and inspection of the site itself and its neighbouring area aimed at specifying the boundaries of the host community. The structured interview material was compiled into a database for systematic analysis.

2.3 Specifying 'host communities' and 'source communities'

The research employs the concepts of '*source community*' and '*host community*'. The term '*source community*' implies the entire population resident in the geographic area covered by the TLA which has responsibility for deciding the location of the solid waste facility. The '*source*

community' incorporates all those who generate solid waste which requires either handling in a transfer station and/or disposal at a landfill (see Figure 1). The term 'host community' is used to refer to the community resident in the geographic area most clearly associated with a particular solid waste facility. It is not limited to those residents who may experience direct physical effects from the operation of such a facility (such as the effects of noise, litter, or odour). It extends to include members of a coherent community - perceived in a social sense - that already existed at the time the facility siting decision was taken, and which will continue to develop in ways that may or may not be affected by the presence of the solid waste facility in its locality. In a sense, all distinct local communities within a 'source community' are potential 'host communities' at the time a site selection process is initiated.

Figure 1: Relating the concepts of 'host community' and 'source community'



2.4 Demographic analysis

Based on the fieldwork, the research team met to finalise the host community specifications so that the corresponding statistical areas could be mapped in relation to census boundaries.

In looking for appropriate social indicators, attention was focussed on socio-economic variables that could be considered to correlate with 'less powerful' groups in the community - 'power' as in the ability to understand, take part in, or in any way influence the kind of decisions which lead to the siting of solid waste facilities, which are usually subject to adverse expectations. The seven variables selected were:

- Educational qualifications % of population (15years+) with NO tertiary qualification
- Ethnicity % of total population that is NON European
- Occupational status % of population (15years+) who are NOT legislators, administrators, professionals, technicians
- Employment status % of the population (15years+) who are NOT employed
- Life stage % of households with at least one child under 5 years old
- Tenure % of private dwellings NOT owned by the occupant
- Income median household income

Host communities were compared with source communities by examining the ratio between 'observed' and 'expected' values for each demographic variable and for each site. The comparison was subject to two levels of testing.

Firstly, each individual comparison - host community with source community for each demographic indicator - was subject to a significance test based on the chi-square measure, where

each value is compared to the chi-square distribution with one degree of freedom. In other words, if the host community in one locality is different from its source community, in terms of having say a higher proportion of non-professional workers or a higher proportion of people not owning the dwelling they live in, then how strong is the evidence for the difference? This analysis focuses on each individual locality and siting decision.

Secondly, the statistics were pooled for each variable over all sites to assess whether there is any indication of systematic bias in the demographic characteristics of selected sites. In other words, if the pooled statistics describing say the proportion of non-European residents or the proportion of unemployed residents for all the host communities appears different from the corresponding statistics for all source communities, then how strong is the statistical evidence for this difference?

The research focusses primarily on the second level of analysis to assess whether there is any evidence of systematic bias. However, the individual comparisons allow some analysis of trends over time. The host communities at selected sites were also compared with 'alternative host communities' - those which would have been host communities had alternative sites been selected from the short list in each case.

3 MAIN FINDINGS

3.1 Demographics

To interpret the results presented in the tables that follow, the reader should note: -

(a) that a ratio greater than Unity (>1) indicates 'relative disadvantage' between host and source communities (i.e. the host community has a greater proportion of 'less powerful' residents than the source community) and a ratio less than Unity (<1) indicates that the host community was not disadvantaged in this regard; and

(b) a Chi-square value greater than 3.84 is normally taken to indicate a statistically significant result. However, given that we are dealing with census data, large Chi-square values are to be expected and the Chi-square values reported here should be interpreted as relative measures of strength of evidence, rather than strict indicators of "significance".

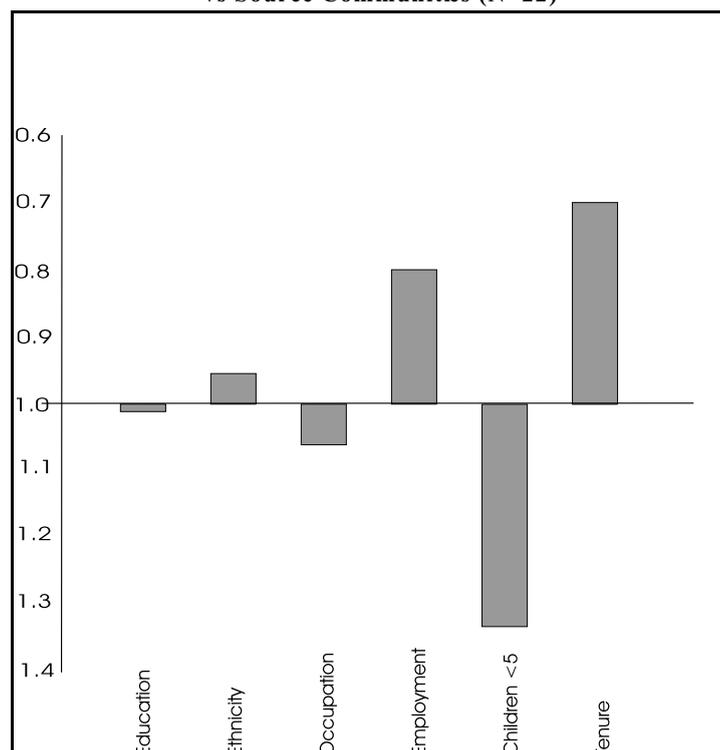
Comparing selected 'host communities' with source communities (N=22):

The pooled results over all 22 landfill sites reveal that host communities are typically different from source communities when analysed for indicators of 'power to influence decisions'. However, there is no consistent bias towards relative disadvantage in host communities, as shown in Table 1 and Figure 2. Three indicators suggest relative disadvantage (lack of education, non-professional occupations, dependents in the household) while three suggest relative advantage (high proportions of pakeha residents, high proportions in active employment, high proportion of property ownership). This grouping of demographic features is characteristic of rural populations, and is therefore consistent with the fact that landfill sites are most often located in peri-urban or rural areas.

Table 1: Pooled results for landfill sites (N=22)

| | Education | Ethnicity | Occupation | Employment | Children | Tenure |
|-------------------------------|-----------|-----------|------------|------------|----------|--------|
| Pooled Ratio values | 1.02 | 0.96 | 1.06 | 0.91 | 1.33 | 0.84 |
| Host-source relativity | disadv. | adv. | disadv. | adv. | disadv. | adv. |
| Chi-square | 19.19 | 9.17 | 204.54 | 10.67 | 241.30 | 105.48 |

Figure 2: Pooled Ratios (R-Values) - Host Communities vs Source Communities (N=22)



The differences between host and source community (as shown by the Pooled Ratio values) are typically not large, with the exception of the proportions of households with young children (relatively high in host communities) and the proportions of dwellings which are rented (relatively low in host communities). Analysis of comparisons for each individual site leads to two further observations: (a) even where the pooled results for one indicator (e.g. educational status) point to a statistically significant difference for the whole sample, there is still considerable variation within the sample of sites, and (b) there appears to be a trend over time - a greater incidence of significant disadvantage in earlier siting decisions and a lower incidence in more recent decisions.

Only descriptive analyses for the seventh variable - median household income - were undertaken since formal statistical analysis requires additional distributional information not provided routinely in census products. For the 22 sites, six host communities had lower median household incomes than their corresponding source communities, whereas 16 host communities had higher median household incomes. The average host/source community ratio for median household income over the whole sample is 1.08 (ranging from 0.73 to 1.47), indicating that host communities around landfill sites typically have not been lower-income communities than their corresponding source communities.

Comparing selected host communities with short-listed alternative host communities (N=12):

Systematic bias towards relatively disadvantaged host communities in site selection is, however, evident when host communities are compared with ‘alternative host communities’. A pooled analysis for twelve cases was carried out, which reveals consistent bias towards relatively disadvantaged candidate host communities in the short-list situation, as shown in Table 2 and Figure 3. The twelve cases include eight where decisions were made under the Resource Management Act (1991)

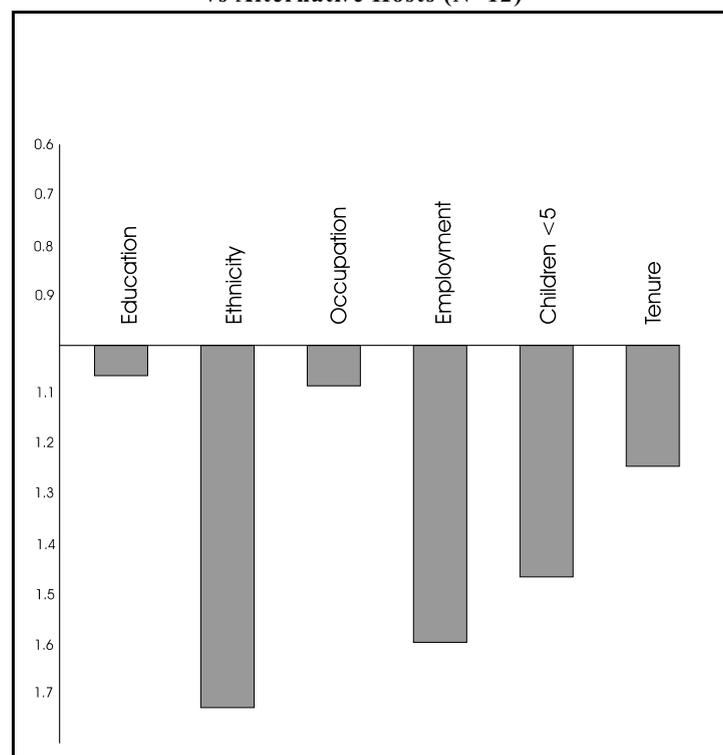
Table 2: Pooled results for comparing selected host communities with alternative host communities (N=12)

| | Education | Ethnicity | Occupation | Employment | Children | Tenure |
|------------------------------------|-----------|-----------|------------|------------|----------|---------|
| Pooled R | 1.06 | 1.72 | 1.08 | 1.59 | 1.46 | 1.24 |
| Host-alternative relativity | disadv. | disadv. | disadv. | disadv. | disadv. | disadv. |
| Chi-square | 31.76 | 153.69 | 52.80 | 22.78 | 43.91 | 21.67 |

Not only is the pattern of relative disadvantage more uniform (when compared with Table 1), the differences between selected host and alternative host communities (as shown by the Pooled Ratio values) are sizeable in four out of the six variables.

Analysis of individual sites shows much less variation than was the case for the host-source community comparisons, although there is the suggestion of a similar trend over time.

Figure 3: Pooled Ratios (R-Values) - Host Communities vs Alternative Hosts (N=12)



The pattern of systematic bias is reinforced further in the comparison of median household incomes between selected and alternative host communities. In eight out of the twelve cases, the median household income level for the selected host community was lower than the alternative candidate host communities, and the average ratio of median household incomes is 0.94 (ranging from 0.60 to 1.45), indicating that selected host communities typically have been lower-income communities than those which were not selected from the shortlist.

3.2 Distance from town boundaries

There has been much debate in recent site selection exercises on the question of ‘how far out of town a landfill should be put, in order to protect

(urban) residents from the negative impacts of landfill operations?’ This is clearly an urban perspective, given that urban consumers generate by far the largest proportion of the solid waste disposed of in any landfill. It is not a view that attaches much importance to the rights of (relatively small numbers of) rural dwellers to maintain their existing rural amenity values in the face of a landfill proposal.

The research explored this question by estimating the distance to the nearest town or city boundary. In some cases, landfills have been developed inside urban boundaries, or immediately

adjacent to the boundary. In addition to these cases, the sample of landfill sites has been analysed using three bands of distance, as shown in Table 3.

Table 3: Relationship of NEW landfill site to town or city boundary - time series

| Era of opening | Inside | Adjacent | 0-1km | 1-5km | >5km | Sub-sample total |
|----------------|--------|----------|-------|-------|------|------------------|
| 1972-91 | 1 | 1 | 4 | 3 | 1 | 10 |
| 1992- | 2 | | 2 | 1 | 6 | 11 |

Note: Seven of the landfill siting decisions in the full sample favoured extensions to existing operations.

There is a trend evident in recent years towards locating landfills at greater distances from urban boundaries. Prior to 1992, only one-in-ten new sites in the sample was located more than 5km outside the nearest urban boundary, whereas since 1992, over half the new sites chosen have been more than 5km away. This trend also appears to correlate with the shift to landfills that prohibit public access in favour of restricted access to dedicated waste transfer vehicles and a relatively small number of commercial vehicles licensed to take waste directly to a landfill rather than to a transfer station.

3.3 Separation from existing dwellings

Much effort is often expended in trying to find 'isolated' sites - in the sense that they provide adequate physical separation between the proposed landfill and existing dwellings, whether they be isolated rural dwellings or more consolidated urban settlement. Separation distances (see Table 4) were estimated as direct, straight-line distances, even though in some cases there was no direct line of sight from dwelling to facility site for reasons of local topography.

Table 4: Separation distances for landfills at time of site selection

| Era of opening | 0-500m | 500-1000m | 1-2km | 2-3km | 3-4km | Sub-sample total |
|----------------|--------|-----------|-------|-------|-------|------------------|
| 1972-91 | 2 | 3 | 5 | | | 10 |
| 1992- | 2 | 2 | 4 | 2 | 1 | 11 |

The results indicate increasing separation distance for more recent siting decisions. Prior to 1992, no new landfill sites in the sample had separation distances greater than 2km. Since 1992, just over one quarter of new sites sampled had separation distances greater than 2km.

3.4 Site visibility

The extent of visibility was assessed in terms of the numbers of dwellings with direct line of sight. Thus visibility can be used as one indicator of how many neighbouring residents are likely to experience off-site effects including the perceived or real possibility of noise, odour, dust or litter effects under certain conditions.

In 44% of the cases sampled, the actual working face of the landfill during its expected lifetime would be visible from dwellings which existed at the time of site selection. In the majority of these cases (8 out of 12), there were relatively few dwellings with direct line of site - the average

number of dwellings in such cases was 2.75. The remaining cases involved deliberate decisions to site a new facility inside or adjacent to the urban boundary. When comparing pre- and post 1991 landfill sites, it appears that the proportion of landfill sites where the working face was visible to neighbours off-site was higher than was previously the case (53% post 1991 compared with 33% pre-1991). However, the numbers of dwellings involved was typically fewer (average = 2.33).

3.5 Pre-existing land uses

Table 5: Predominant existing land uses on or near sites chosen for landfill operations (N=27)

| Land-use type | the landfill site itself | neighbouring land |
|--|--------------------------|-------------------|
| existing landfill/clear fill site | 5 | 2 |
| farming, grazing | 18 | 19 |
| undeveloped or wasteland; river margins; sand-hills, coastal area; old quarry, shingle extraction site | 11 | 1 |
| oxidation ponds/electrical sub-station; industry, orchards | - | 6 |
| trees, forestry, plantation | 4 | 5 |
| residential, lifestyle block; recreation or wildlife reserve | - | 12 |

The predominance of farming activity on selected sites and their neighbouring land reflects the desire for sites remote from settlement or dwellings. Land in what may be perceived as low-grade uses (waste land; sand-hills, exposed coastal areas) or land already highly modified and degraded (quarries, shingle extraction pits) has also been used, for similar reasons. Other land-uses (e.g. oxidation ponds, electrical sub-stations, industrial areas, orchards) provide buffering between a landfill and more distant neighbours. The value of established forest plantations in providing visual screening is also evident.

Extending the use of existing landfill sites is sometimes preferred on the grounds that the existing host community has already adapted to the presence of the landfill operation. Later-generation landfills tend to operate to higher standards, thereby leading to reduction in off-site effects experienced within the host community. Prior ownership of the land may be a consideration in such cases. The appearance of land uses such as lifestyle blocks and recreation and wildlife reserves reflect both the higher operational standards of modern sanitary landfills, as well as the potential future uses of the land, once land-filling is complete.

4 DISCUSSION AND CONCLUSIONS

The patterns and trends observed in this research are summarised as follows:-

- criteria for landfill siting are focussed around the desire to balance 'distance from residential areas' (reflecting costs to host communities) against 'proximity to waste sources' (reflecting costs to source communities). Protection of high standards of water quality is a universal priority in all host communities.

- there are now fewer, larger landfill facilities.
- in landfill siting there is a clear trend towards greater separation distances from residential areas with the emphasis on more rural locations where farming is the predominant land use on or around the site. Although the number of sites where the working face of the landfill is visible to neighbours is proportionately higher in recent cases, there are typically fewer dwellings involved.
- a simple comparison of host communities with source communities suggests that there is no systematic bias towards relatively disadvantaged host communities in the site selection process for landfills.
- but comparison of selected host communities with alternative candidate host communities suggests that during the process of site selection, more powerful candidate communities are consistently more effective in avoiding final selection.

Overall, these trends reflect deliberate attempts to try to minimise the impacts of solid waste facilities on the residents of host communities - seeking more remote sites, or sites with a degree of screening provided by topography or tree planting. While the planning process therefore appears to be sensitive to issues of physical effects, the social-demographic analysis suggests there is an additional feature of the planning process to consider. There appear to be political influences in decision making, a conclusion that supports host community concerns expressed about the fairness of the siting decisions taken.

The findings suggest a systematic bias in the outcomes of site selection decisions, but not necessarily a deliberate attempt to use the planning process to inflict social injustice on disadvantaged communities. However, the findings suggest that it would be prudent to examine the planning and site selection procedures to ensure that decision-making criteria are more transparent. This will be particularly important in situations where profiling of candidate host communities reveals systematic differences in the socio-economic status of the various candidate host communities. Transparency in decision making requires that the criteria and analytical logic used in site selection decisions are made explicit.

Presently, the screening procedure usually involved in site selection means that often only one site is subject to detailed planning investigations. Perhaps several of the alternative candidate sites need to be subject to more rigorous investigation so that a genuine comparison can be made prior to final site selection. This would make the critical discriminating criteria clearer, and avoid the suspicion that other considerations such as socio-economic status and political influence were decisive, but hidden, factors.

Aspects of public consultation are worth considering as well. Firstly, ensuring adequate representation of alternative host communities in the public consultation process, so that the communities are involved in the short-listing and comparative assessments. This means that communities must have input to the choice of site selection criteria, and decision making logic in order to give credibility and transparency to the site selection process.

It is no longer an easy task to find 'un-inhabited' spaces in the countryside. Since the Resource Management Act was passed, rural land in many parts of the country has been opened up for a variety of non-traditional activities, particularly land that is within the desired commuting radius from urban centres. The challenge certainly exists to ensure that facilities such as landfills are sited, designed and operated in such a way that they would not cause unacceptable effects on the

host community, regardless of the socio-economic status of the community concerned. This assumption is implicit in the fact that site selection criteria often do not mention socio-economic status as a discriminating criterion. It is reasonable to assume that the concerns expressed by potential host communities about social justice in site selection are motivated by a desire to see that socio-economic status is not being used implicitly as a selection criterion. Similarly, this issue reflects concerns that disadvantaged communities are less well positioned to exert political influence in the site selection process.

Ongoing research - actual effects of landfills on their host communities?

Community concerns about fairness are triggered both by perceptions of the planning process and by perceptions of the effects the facility can be expected to have on the host community. The latter aspect provides the focus for the next stage of this research programme. From the sample of facilities analysed and reported here, seven have been selected for case study investigation. The case studies will assess the short-term operational effects and long-term developmental effects of these facilities as experienced by the host communities. The results of the case studies will be documented for widespread dissemination and reference in New Zealand. Thus the results will provide an information resource for all parties in future site selection exercises, as well as to people in other professions such as real estate and land valuation. We hope to be able to report the results of the case study research to a future WasteMINZ conference.

5 REFERENCES

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6 ACKNOWLEDGEMENTS

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