A METHOD FOR PRELIMINARY COST COMPARISON OF RESIDUAL WASTE DISPOSAL AT A NEW IN-DISTRICT LANDFILL VERSUS DISPOSAL AT ANOTHER LANDFILL

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INTRODUCTION

Territorial local authorities (TLAs) and private companies in the business of waste disposal to landfill are finding it more and more difficult to obtain resource consents for landfill sites.

There is a general recognition that as environmental controls become more stringently applied, so landfill disposal costs will inevitably rise.

For individual TLAs the decision of whether to go through the process of finding a suitable landfill site, obtaining resource consents for it, developing and operating it, or to look to other landfill service providers (either within or outside of the territory) for disposal facilities is a complex issue.

This paper presents a method to enable TLAs to determine at a preliminary level whether or not the establishment of their own landfill will be economically feasible compared to using a landfill operated by others.

BACKGROUND

Over the past few years MWH New Zealand Ltd. (MWH) has assisted a number of TLAs to evaluate options for the disposal of residual waste. In doing so, MWH has developed a methodology based on a financial spreadsheet that enables TLAs to make a direct comparison between disposing of residual waste at their own new landfill or sending it to another landfill for disposal.

Examples of TLAs that MWH has assisted include the following:

- West Coast Region (Grey, Buller & Westland DCs)
- Taranaki Region (New Plymouth, South Taranaki & Stratford DCs)
- Southland Region (Invercargill CC, Southland & Gore DCs)
- Wellington Region (Wellington, Porirua, & Hutt CCs)
- Wairarapa Region (Masterton, South Wairarapa & Carterton DCs).

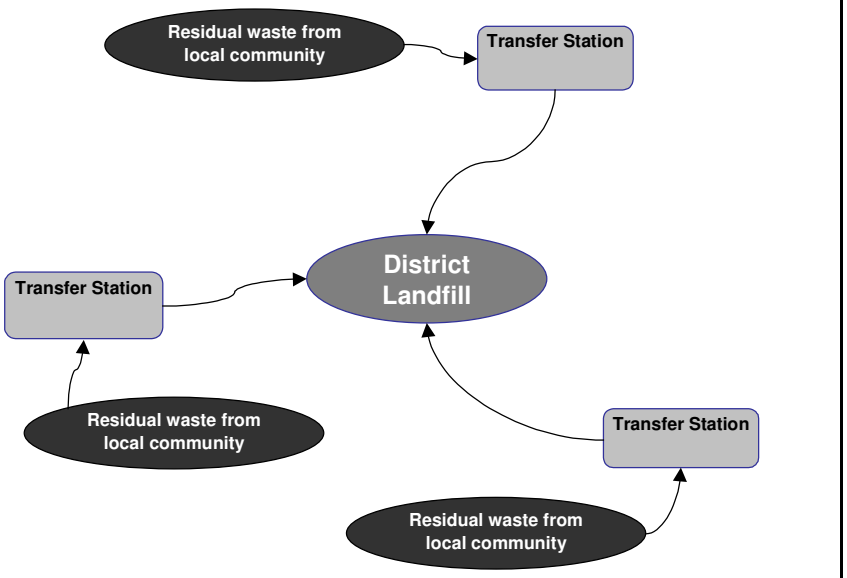
As subsequent studies have been undertaken MWH has incorporated aspects of other financial models into MWH's model in order to improve the accuracy and relevance of the

model. An example of this is the incorporation of results generated by the Ministry for the Environment Landfill Full Cost Accounting Model (MfE Landfill FCA Model 2002) to determine landfill development, operational, closure and aftercare costs.

COMPARISON OF IN-REGION VERSUS OUT-OF-REGION

Whilst many TLAs are still in the process of developing the infrastructure for the management of residual waste, a typical waste management model for a TLA that intends to dispose of residual waste at its own landfill may look like that shown below in Figure 1.

Figure 1: Typical TLA Residual Waste Management System with own Landfill



In general terms, the costs associated with the development and operation of such a system will include:

- Waste collection and transfer costs (private, commercial and council) from point of waste generation to the local transfer station.
- Transfer station development and operation costs.
- Waste transfer costs from local transfer stations to landfill.
- Landfill development, operation and aftercare costs.

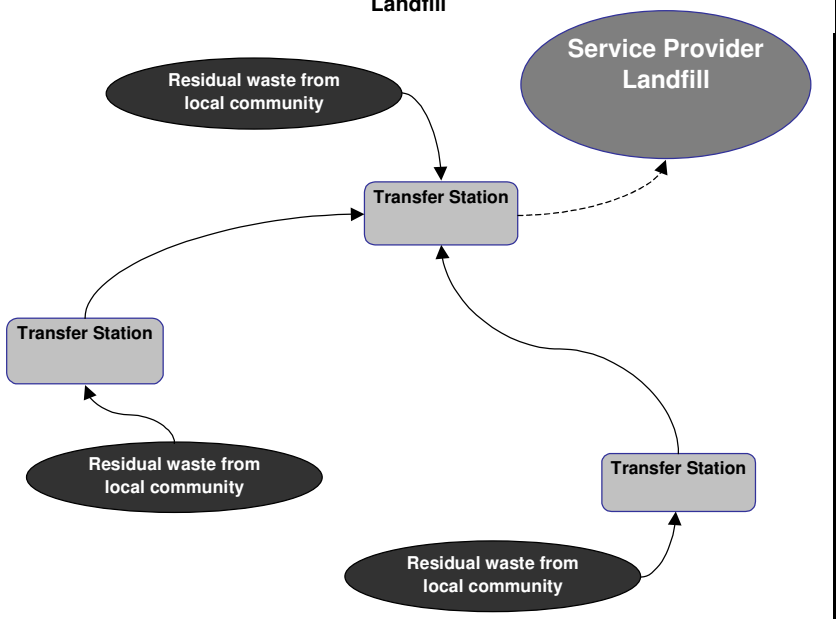
By comparison, if the same TLA was contemplating setting up the infrastructure to collect residual waste and send it to a service provider landfill (either in or outside of the TLA), a picture of the residual waste management model may look like that shown in Figure 2 on the following page.

Typical costs associated with the development and operation of the system will include:

- Waste collection and transfer costs (private, commercial and council) from point of waste generation to the local transfer station.
- Transfer station development and operation costs.

- Waste transfer costs from local transfer stations to central transfer station.
- Waste transfer costs from central transfer station to service provider landfill.
- Disposal charges for residual waste at service provider landfill.

Figure 2: Typical TLA Residual Waste Management System using Service Provider Landfill



In comparing the two systems it is clear that some of the costs are common and so can be disregarded for comparison purposes. One must remain aware, however, that it is the difference in costs between the systems that is being derived, rather than all the costs of all components of the systems.

MODELLING RESIDUAL WASTE DISPOSAL WITH OWN LANDFILL

In modelling the cost differences between the two systems the following costs were considered for the situation where waste is to be disposed at a landfill developed and operated by the TLA:

- Waste transfer costs from local transfer stations to landfill.
- Landfill development, operation and aftercare costs.

Waste transfer distances can be approximated by calculating the position of the waste centroid for the TLA, and assuming that all of the TLA waste is transferred the distance from the waste centroid to the prospective district landfill.

Waste transfer costs were evaluated using the procedures detailed in the Transfund Project Evaluation Manual (2002 update). Assumptions included the following:

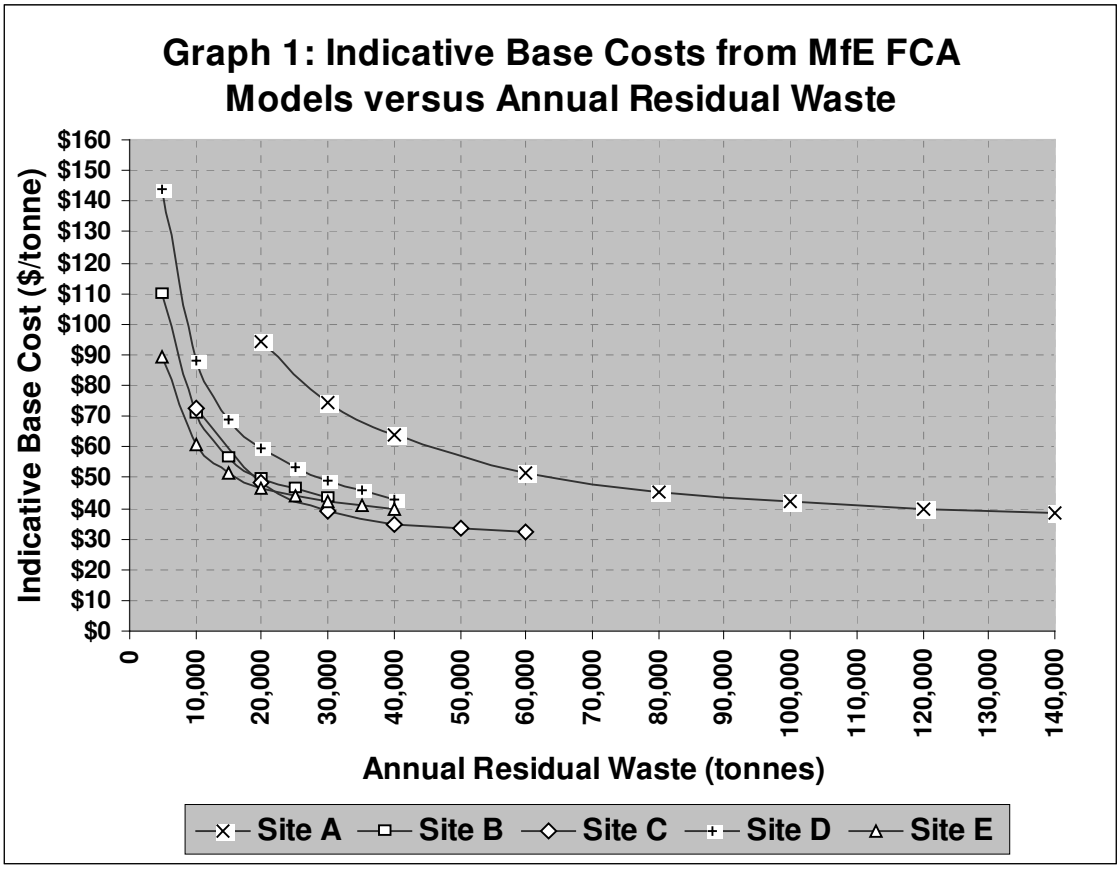
- All loads are 6 tonnes transported by Medium Commercial Vehicles.
- For 20% of the transfer distance the average speed will be 40km/h, with the balance being at 70km/h.
- The grade of roads is considered to be flat.

- A nominal increase in costs has been allowed for road roughness.

MWH has modelled a number of landfill sites using the MfE Landfill FCA Model. The results of this work have been summarised and presented as Graph 1 relating Indicative Base Costs[1] (IBC $/tonne) against annual waste tonnages. Note that no mark-up has been made on the IBCs and they exclude GST.

A number of important points may be made with respect to the curves in the graph:

- As waste tonnages decrease so the IBC increases significantly. Take Site A, for example. It has an average waste tonnage of 72,000tpa giving an IBC of about $48/t. Reducing the waste quantities to 30% of that figure (21,600tpa) increases the IBC to about $91/t.
- Site C is the only existing (operational) site and it has the lowest IBCs for the range from 60,000tpa down to about 22,000tpa. The reason for this is that costs were based on actual construction rates for the first cell of the landfill, whereas all the other landfill costs were based on estimated costs, i.e. there is more risk in calculating quantities for hypothetical sites, hence the assumed construction costs and contingencies are higher.
- No land costs were included for Site E and so it has the lowest pre-development costs. Consequently, for the lower tonnage range (22,000tpa down to 5,000tpa) it has the lowest IBC.



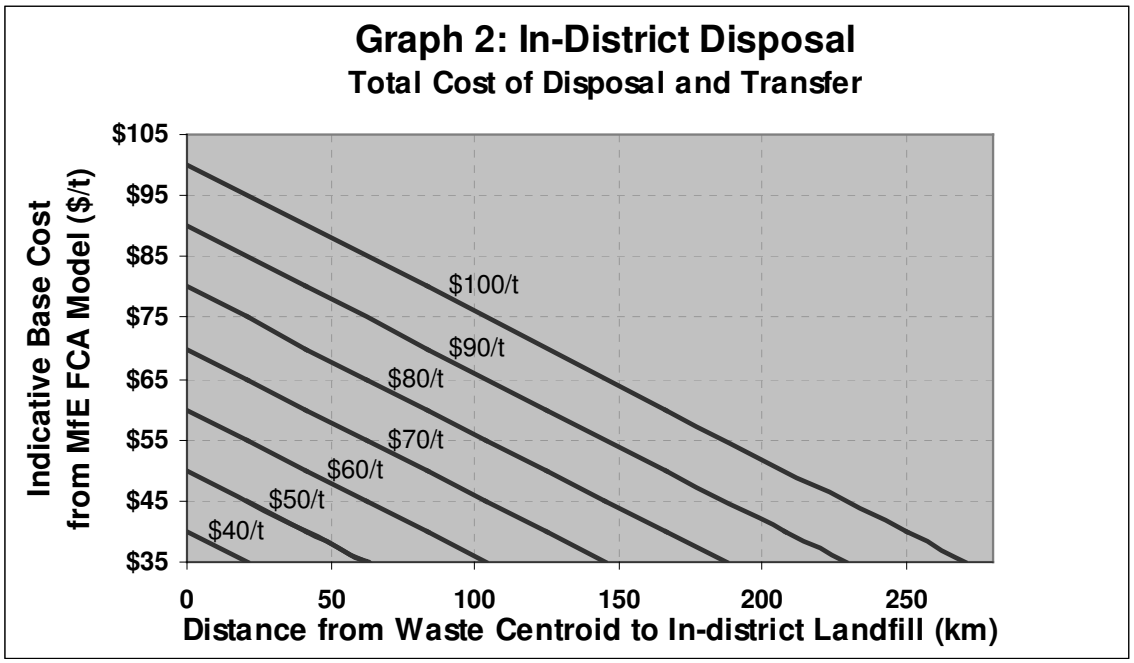
[1] The Indicative Base Cost of disposal is the base unit cost of disposal derived by the FCA model. The IBC gives an indication of the actual dollar cost of providing residual waste disposal to a landfill.

Table 1 provides a summary of the landfill sites that have been modelled using the MfE FCA Model. The information is intended to serve as a guide for TLAs wishing to establish their own landfills. By looking at the characteristics of the sites, TLAs can match approximately their proposed own landfill circumstances against those modelled. In so doing an estimate of the IBC that may be applicable for their own site can be obtained, without having to go through the whole exercise of modelling the site in detail.

Table 1: Summary of Site Characteristics

	Site A	Site B	Site C	Site D	Site E
Average tpa	72,000	15,200	36,600	20,400	20,000
Gross Airspace	3,800,000	1,000,000	900,000	2,200,000	1,000,000
Planning / Pre-development Costs	$2,500,000	$1,200,000	$2,200,000	$2,000,000	$300,000
Topography	Large, steep valley	Old river meander	Medium, forested gully	Rolling hills	Inter-dunal depression
Natural containment	Thin layer of in-situ clays	Mudstones	Fine ash layers	Fine ash layers	Nil – sand base
Liner System	Geomembrane on GCL	Geomembrane on in-situ clay	Geomembrane on in-situ clay	Recompacted in-situ clay	Geomembrane on GCL
Leachate disposal	Proposed on-site	Proposed on-site	Existing to sewer	Proposed tanker off-site	Proposed on-site
Groundwater Control	Under-drainage layer	Subsoil pipes proposed	Existing Subsoil drains	Subsoil pipes proposed	Not required
Stormwater Control	Pipe culvert under landfill	Minimal requirements	Peripheral drains	Peripheral drains	Minimal requirements
Gas collection	Allowed for	Not considered	Not considered	Not considered	Not considered

MWH has developed a graph that combines the waste transfer and landfill costs and provides the "total" cost of disposing of waste at a landfill run by the TLA. This is shown in Graph 2 below.



The total cost of waste transfer and disposal is read off the graph by determining the intersection of an appropriate IBC and the distance from the waste centroid to the proposed In-district landfill. For example, an IBC of $65/t with a haulage distance of approximately 100km would give an all up cost of around $90/t.

MODELLING RESIDUAL WASTE USING AN OUTSIDE LANDFILL SERVICE PROVIDER

Costs that are not common to the disposal of waste at one's own landfill include:

- Waste transfer costs from local transfer stations to central transfer station.
- Waste transfer costs from central transfer station to service provider landfill.
- Disposal charges for residual waste at service provider landfill.

The costs of transferring waste from local transfer stations to a central transfer station may be modelled approximately using the method described above. The distance from the waste centroid to a central transfer station may be calculated and from this the costs to transfer the waste may be derived.

Waste transfer costs were also modelled using the Transfund Evaluation Manual with the only difference being that all loads from the central transfer station to landfill are assumed to be 20 tonnes.

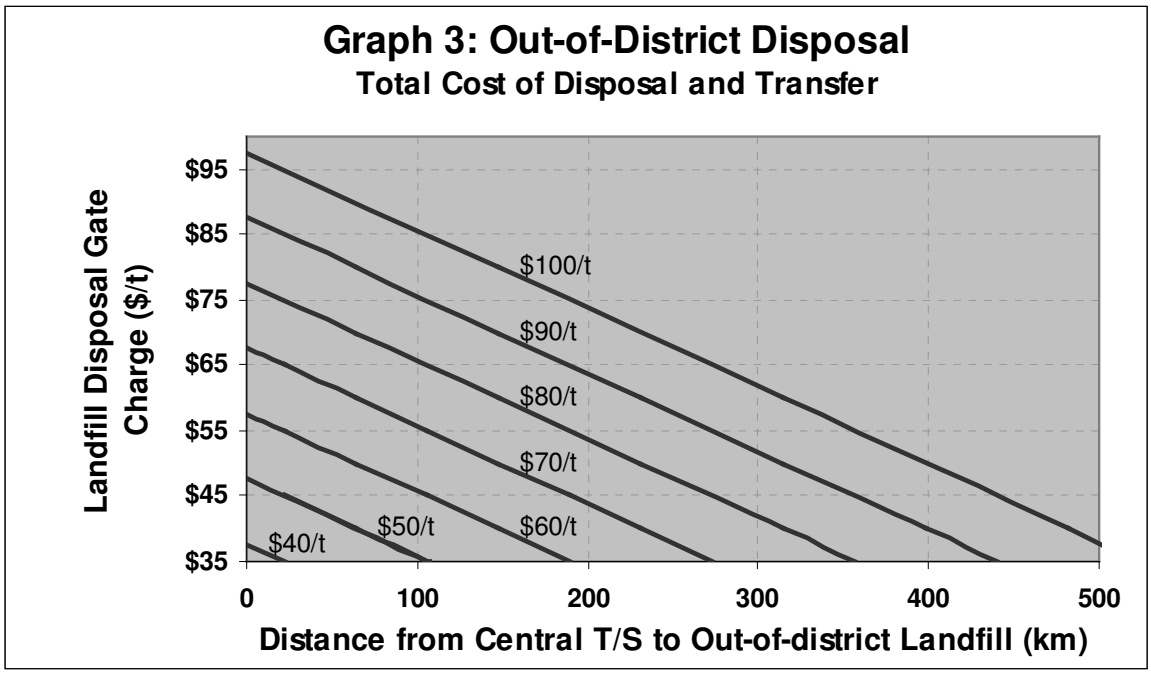
Whilst the model takes into account the total distance from Waste Centroid to Central Transfer Station to Landfill, the distance from the Waste Centroid to Central Transfer Station was assumed to be 10km.

Landfill disposal charges may be assumed from various charges that are applied at landfills and transfer stations throughout New Zealand. Table 2 on the following page provides a range of such charges.

Table 2: List of Commercial User Charges at Selected New Zealand Landfills and Transfer Stations excluding GST (August 2003)

Location	Type of Facility	At-The-Gate Charge
Auckland (Greenmount)	Landfill	$85.00/t
Auckland (Redvale)	Landfill	$87.37/t
Auckland (Rosedale)	Landfill	$54.00/t
Christchurch City	Landfill/transfer station	$86.22/t
Dannevirke	Landfill/transfer station	$12.00/m³
Feilding	Landfill (unlined)	$40/t over 600kg
Geraldine	Transfer station	$41.78/t
Hamilton	Landfill	$50.70/t
Hutt Valley (Silver Stream)	Landfill (unlined)	$48.89/t
Levin	Landfill (unlined)	$35.00/t
Nelson City	Landfill	$39.11/t
Porirua	Landfill (unlined)	$37.78/t
Queenstown	Landfill/transfer station	$66.67/t
Taumarunui	Landfill	$17.78/m³
Tauranga	Transfer station	$87.11/t
Temuka	Transfer station	$41.78/t
Timaru (Redruth)	Landfill	$41.78/t
Wanganui	Transfer station	$75.56/t
Wellington Northern	Landfill (unlined)	$44.44/t
Wellington Southern	Landfill (unlined)	$58.22/t

As was done for the TLA-owned landfill situation, MWH developed a graph that combines the total transfer costs and disposal charges to an outside service provider. This is shown as Graph 3 on the following page.



The graph is interpreted in the same manner described above for the In-district disposal option. For example, if it is contemplated sending waste to a landfill with a disposal fee of $65/t approximately 100 kilometres away from a central transfer station, then the total Out-of-district disposal cost will be approximately $80/t.

EXAMPLE TO ILLUSTRATE THE METHOD

Background

To illustrate the use of the method a real example has been described below. For reasons of commercial sensitivity the TLA and towns within the district have not been named.

The TLA has a population of approximately 30,000 and has three main centres each of which generates a residual waste quantity given in Table 3 on the following page. The TLA has an existing landfill near the main centre that is due to be closed within a short period of time. So the TLA is faced with the decision whether or not to proceed with the development of a new landfill, or send residual waste out of the district to a privately owned landfill.

The two smaller towns in the district have transfer stations and a new transfer station will be constructed at the main centre irrespective of whether or not disposal is to its own or a private landfill.

Step 1

Determine the centroid of residual waste in the TLA.

The centroid of waste generation has been calculated by taking moments for the three main centres in a longitudinal and latitudinal direction about a map reference point (residual waste quantity x distance west and residual waste quantity x distance north of a reference point).

Table 3: Calculation of Waste Centroid

Centre	Residual Waste (tpa)	Distance west of reference point	Distance north of reference point	Distance west x Residual Waste	Distance north x Residual Waste
A	14,100	18km	42km	253,800	592,200
B	2,000	18km	58km	36,000	116,000
C	400	8km	50km	3,200	20,000
Waste Centroid	16,500			293,000	728,200
		=293,000/16,500 = 17.8km	= 728,200/16,500 =44.1km		

Plotting the above position on a map indicates that the waste centroid is about 11km from the prospective landfill site. Assuming the distance from the waste centroid to the central transfer station is 10km gives a distance of 1km from the central transfer station to the landfill site.

Step 2

From Table 1 determine which of the five sites best matches the prospective landfill site.

The prospective landfill site is best matched by Site E.

Step 3

Using Graph 1, and knowing that the annual residual waste tonnage is 16,500 tonnes, determine a suitable IBC for the prospective in-district landfill.

From Graph 1, the landfill would have an IBC of approximately $54/t.

Step 4

Add a mark-up to the IBC, if applicable.

For a TLA operation a mark-up of approximately 10% is considered reasonable, giving a disposal cost of approximately $60/t.

Step 5

Determine the In-district disposal cost from Graph 2.

With a transfer distance of 11km from the waste centroid to the landfill, and an estimated disposal cost of $60/t (marked up IBC), the total in-district disposal cost is determined to be approximately $62/t.

Step 6

Determine the cost per tonne charged by another landfill service provider (Table 2 could be used as a guide).

Alternatively, knowing the distance to a particular landfill, one could work out what the maximum user charge could be for that landfill to ensure that it is competitive with the in-district disposal option.

In this case it is considered that it would be more useful to know the latter information.

Using Graph 3, and knowing that the distance from a Central Transfer Station to the landfill would be about 70km, it can be determined that disposal charges should be no more than approximately $50/t to match the in-district disposal option.

DISCUSSION

The proposed method can very readily provide an approximation of the costs of transfer and disposal to either a TLA-owned or other landfill service provider. The costs of the TLA-owned landfill encompass all the costs required to consent, develop, operate and close the landfill.

Graph 1 shows how the unit costs of developing and operating a landfill increase significantly as the residual waste tonnage decreases. In contrast to this, the costs of disposing of refuse at another landfill service provider are directly proportional to the transfer distance and the waste tonnage.

The implication of this is that if residual waste quantities should decrease, then it is more risky to commit to developing and operating one's own landfill, compared to sending refuse to another landfill, provided one has negotiated with the service provider for a reasonable term with constant disposal charges.

TLAs that are looking for disposal options will be in a better position to negotiate a long term and stable arrangement with another service provider if they do it in good time before their options run out. In other words, leaving the decision to the last moment will leave the TLA at the mercy of the open market.

Bearing in mind that a period of at least five years may be required for the process of obtaining resource consents and developing a landfill, the option of disposing elsewhere should be investigated at the same time as consideration is given to finding a new landfill site.

ACKNOWLEDGEMENTS

I would like to acknowledge a number of TLA clients who have permitted me to make use of information derived from various waste disposal costing studies that MWH has carried out in the past few years.

REFERENCES

Ministry for the Environment (2002), “Landfill Full Cost Accounting Guide for New Zealand"” Wellington, New Zealand, ISBN: 0-478-24059-7

Transfund New Zealand (2002 update), “Project Evaluation Manual”, Manual No. PFM2, Wellington, New Zealand, ISBN: 0-478-10568-1