Table 7: Site Information Summary

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
1	Hills Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	closed	Well maintained. Some further work in progress
2	Whitford Bridge (Park)	Grass cover	Good ground cover in grass over all areas including at interface with Turanga Creek. There are signs of herbicide spraying and soil erosion along one part of the site close to swampy area	No significant risk identified	Closed	Part of the site is well developed as a Park. Another part is used as horse paddock for Pony Club. The site is well maintained.
3	Pah Rd	Grass cover	Significant vegetation at interface with estuary. No signs of erosion or slips	No significant risk identified	closed	Well maintained
4	Ngati Otara Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	closed	Well maintained
5	Riverina Ave	Grass cover	Vegetation along the foreshore. But herbicide spraying leading to signs of erosion and instability along the edges of the Estuary	Herbicide spraying along the edges of the Estuary may pose ecological risk. No other significant risk identified	Closed	Generally well maintained as a Park
6	Riverhills Park	Grass cover	No visual signs of instability or soil erosion. Well developed as a Park and sports ground.	No significant risk identified	Closed	Considerable herbicide spraying along the edge to the estuary. This may pose some ecological risk. Otherwise well maintained
7	Leabank Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve and sports field

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
8	Miro Rd	Grass cover	Recent clay capping. No visual signs of instability or soil erosion. Well developed as a Park	No significant risk identified	Closed	Well maintained as a reserve. Some further work in progress
9	Dale Crescent	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve
10	Kingfisher Pl.	Grass cover	Herbicide spraying along interface with estuary. There is very little vegetation. Evidence of soil erosion and slumping along the interface with estuary.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
11	Coxhead Rd	Grass cover	Good ground cover in grass over all areas including at interface with Stream. No signs of erosion or slips	No significant risk identified	Closed	Well developed and maintained as a Park with mature trees. Stormwater drainage runs through the site and is discharged into the Stream
12	Oruarangi Rd	Grass cover	Good ground cover in vegetation over all areas including at interface with Oruarangi Stream. No signs of erosion or slips	There is poor fencing to the site. Hence a significant amount of rubbish is still being dumped at the site, including household waste. The site is close to residential area and may pose a significant risk to public health, particularly to children.	Closed	Undeveloped, overgrown with grass and shrubs. Site maintenance work is currently being carried out by MCC.
13	Gt. South Rd	Grass cover	No signs of instability. Significant dumping of commercial & industrial rubbish, including discharge of oil & grease, along the interface with the estuary.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
14	Robert Allan Rd	Grass cover	No visible signs of instability or soil erosion. Reclaimed estuary area still very swampy in parts. Underground stormwater drain discharges at the interface with the estuary.	No significant risk identified	Closed	No signs of rubbish and well Maintained
15	Roscommon Rd	Grass cover	Good ground cover in grass over all areas including at interface with Puhinui Stream. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs. Stormwater discharge into the Puhinui Stream
16	Tiraumea Reserve	Grass cover	Vegetation along the foreshore. Generally no visual signs of instability or soil erosion.	Some herbicide spraying along the edges of the Estuary that may pose ecological risk. No other significant risk identified	Closed	Well maintained as a reserve
17	Old Quarry Rd	Grass cover	Herbicide spraying along interface with Stream. In some places spraying is right down to the edge of Stream. Has potential for erosion in this context.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
18	Udys Rd	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve
19	Norana Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the foreshore, the interface with the Manukau Harbour.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained
20	Ennis Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to a tributary of Pakuranga Stream.	No significant risk identified. Some herbicide spraying to get rid of noxious weeds	Closed	Well Maintained
21	Kiwi Esplanade	Grass cover	Some vegetation at interface with Manukau Harbour shoreline. No signs of erosion or slips	No significant risk identified	closed	Well maintained

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
22	Riverhills School	Grass cover	No visual signs of instability or soil erosion. Adjacent to Stream and Estuary.	No significant risk identified	Closed	Well maintained as a reserve
23	Millen Ave	Grass cover	No visual signs of instability or soil erosion. Adjacent to Tamaki Estuary	No significant risk identified	Closed	Well maintained as a reserve with some mature trees
24	Ti Rakau Park	Grass cover	No visual signs of instability or soil erosion.	No significant risk identified	Closed	Well maintained as a reserve and sports ground
25	Harania Ave	Grass cover	Mostly open space with vegetation at interface with the Stream. No signs of erosion or instability.	No significant risk identified	Closed	Well maintained
26	Botany Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
27	Tanners Rd	Grass cover	Top fill cap is about 2 metres and well grassed	No significant risk identified	Closed	Well maintained
28	Clifton Rd	Grass cover	This is a small reclaimed area developed as a boat ramp. The landfill is surrounded by Turanga Estuary on three sides and is subject to natural forces from tidal flows. There is good ground cover in grass. There are also some rocks along the edges with the Estuary. This provides some protection from erosion. No visual signs of erosion or slips were identified.	No significant risk identified	Closed	This site could be enhanced with planting of trees and removing some of the exposed solid waste. This includes items such as steel wire / rods left exposed in the sandy beach area at the boundary with the Estuary.
29	Bairds Rd	Grass cover	No signs of instability. Significant dumping of domestic rubbish along the interface with the road and Stream.	No significant risk to people but the rubbish dumping may pose ecological risk.	Closed	Not well maintained, but maintenance work is currently being carried out by MCC
30	Riverlea Rd	Grass cover	No visual signs of instability or soil erosion. Good vegetation cover along the foreshore	No significant risk identified	Closed	Well maintained as a reserve
31	Harania Inlet	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified	Closed	A small Park, well maintained as a reserve

No.	Site	Cover	Stability	Health & Safety	Open	Maintenance
32	Beach Rd	Grass cover	Herbicide spraying along interface with Manukau Harbour. There is evidence of soil erosion along the shoreline.	No significant risk to people but the herbicide spraying may pose ecological risk.	closed	Well maintained, except for the herbicide spraying
33	Bells Rd	Grass cover	Generally no visual signs of instability or soil erosion. Adjacent to stream	No significant risk identified	Closed	A small Park, well maintained as a reserve
34	Elm Park	Grass cover	No visual signs of instability but weed spraying along the steep slopes are prone to erosion. The Park itself is not a landfill. It is only the strip of land along the edge of a tributary of Pakuranga Stream, that was used as a landfill.	No significant risk to people identified, but the herbicide spraying may pose ecological risk.	Closed	Well Maintained
35	Hilltop Rd	Grass cover	Good ground cover in grass over all areas. Deep topsoil layer and no signs of landfill rubbish. A small Stream starts at the bottom end of the landfill. No signs of erosion or slips	No significant risk identified	Closed	Undeveloped, overgrown with grass and shrubs.
36	Allenby Rd	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
37	Manukau Yacht Club	Grass cover	No visual signs of instability or soil erosion	No significant risk identified	Closed	Well Maintained
38	Mangemangeroa Bridge	Grass & shrub cover	Good ground cover in dense bush over all areas including the steep slopes. Without the vegetation this site would be highly prone to erosion & slips. No signs of erosion or slips were identified. At down-slope boundary the landfill adjoins the Mangemangeroa River.	No significant risk identified	Closed	This site has significant natural vegetation that is essential for protection from soil erosion & slips. The steep slopes and deep valleys limit the options for any further development of the site.
39	Omana Park	Grass cover	Generally no visual signs of instability or soil erosion.	No significant risk identified arising from the old landfill.	Closed	Generally well maintained as a reserve and sports field

8.3 Type of Fills and Landfill Area

The old landfills have a range of fill material including clean-fill, non-household refuse, inorganic refuse, etc., and the details are shown in Table 8. A large number of the landfills mainly contain clean-fill and many are less than 0.5 hectare in size.

Table 8: Old Landfills – Use, Type of Fill & Area

No	Site	Current Use	Fill Type	Area
1	Hills Rd	Park	Sewage Treatment Plant, Municipal Tip	2 (ha)
2	Whitford Bridge	Reserve ,Pasture	Municipal Tip, Demolition material	3
3	Pah Rd	Park	Municipal Tip	0.5
4	Ngati Otara Park	Park	Municipal Tip	0.6
5	Riverina Ave	Park	Cleanfill	0.3
6	Riverhills Park	Sports Field	Cleanfill,	1.5
7	Leabank Park	Sports Field	Cleanfill	2
8	Miro Rd	Waste Land	Inorganic Refuse, Cleanfill, Domestic Waste	2
9	Dale Crescent	Open Space	Cleanfill and Gravel	1
10	Kingfisher Pl.	Reserve	Inorganic Fill	0.05
11	Coxhead Rd	Reserve	Municipal Tip	0.4
12	Oruarangi Rd	Refuse Collection Area	Inorganic Refuse, Sewage Sludge, Green Waste	0.2
13	Gt. South Rd	Reserve	Cleanfill, Domestic Waste	0.3
14	Robert Allan Rd	Open Space	Cleanfill	0.2
15	Roscommon Rd	Road Reserve	Non Household Refuse	0.2
16	Tiraumea Reserve	Reserve Access	Unknown	0.2
17	Old Quarry Rd	Reserve	Municipal Tip, Cleanfill, Green Waste	0.1
18	Udys Rd	Reserve	Cleanfill, Non-Household Refuse	0.2
19	Norana Rd	Reserve	Inorganic Refuse, Green Waste	0.2
20	Ennis Ave	Reserve	Cleanfill, Demolition Material	0.05
21	Kiwi Esplanade	Reserve	Cleanfill, Demolition Material, Inorganic Refuse	0.1
22	Riverhills School	Road Reserve	Unknown	-
23	Millen Ave	Reserve	Cleanfill	0.05
24	Ti Rakau Park	Reserve	Cleanfill	4
25	Harania Ave	Park	Non-Household Refuse	0.3
26	Botany Rd	Reserve	Non-Household Refuse	0.1
27	Tanners Rd	Marae	Bin Disposal, Cleanfill	0.05
28	Clifton Rd	Reserve	Demolition Material, Inorganic Refuse	0.05
29	Bairds Rd	Reserve	Non-Household Refuse	0.05
30	Riverlea Rd	Reserve	Non-Household Refuse	0.05
31	Harania Inlet	Reserve	Non-Household Refuse	0.05

No	Site	Current Use	Fill Type	Area
32	Beach Rd	Reserve	Non-Household Refuse	0.05
33	Bells Rd	Reserve	Non-Household Refuse	0.05
34	Elm Park	Park	Cleanfill,	-
35	Hilltop Rd	Road Reserve	Inorganic Refuse	0.05
36	Allenby Rd	Playground	Cleanfill, Car Bodies	-
37	Manukau Yacht Club	Road Reserve	Cleanfill, Demolition Material, Green Waste	0.8
38	Mangemangeroa Bridge	Road Reserve	Illegal Dumping, Non-Household Refuse	0.3
39	Omana Park	Park	Cleanfill, Demolition Material	0.2

The landfill fill-type and size are some of the factors that have been used in assessing the environmental risk associated with specific landfills in this report. But it should also be noted that these were not the sole reasons for determining whether the landfill should be exempt from resource consent process.

8.4 Leachate Discharge & Risk Factor

Generally, the levels of environmental contaminants were found to be below or close to the detection limits of the various parameters. Furthermore, they were found to be well below levels of concern in terms of any significant adverse environmental effect.

The results from the organic tips show leachate being produced in some cases thirty years after closure though not in strong concentrations. The oldest site shows no measurable leachate. The leachate producing lives of landfills are affected by a number of factors including temperature, composition of fill and the rate of water ingress into refuse. The volume of leachate produced will depend on these factors and the size of the fill. These factors vary from site to site and generally take forty to seventy years to stabilise.

As many of the old landfill sites are getting to ages of thirty years or so, it is reasonable to suggest that the effects of the landfills will not persist for too long into the future.

The water quality results also show variations in baseline water quality, both between different sites and at the same site at different times. These variations may well be due to climatic, seasonal or tidal factors, or from variable contaminant loading from other sources. Furthermore, the water quality results also confirm that seawater intrusion is influencing leachate at many of the sites.

The concentrations of contaminants, volume of leachate produced and the sensitivity of the receiving environment are some of the critical factors in assessing the environmental risk level from a landfill.

In this context the Leachate Risk Factors (LRF) derived for the MCC Old Landfills listed in Table 9, are used as one of the key indicators for identifying

sites that may pose significant risk to the environment and may require resource consent for discharge of leachate.

The details of the methodology used to derive the LRF values are described in Section 5 of this report. It should be emphasized again however, that the derived LRF values are based on worst case scenario, in that the highest contaminant levels measured in the leachate from respective landfills were used for the calculations.

For example, the Lead levels in leachates from Hills Road landfill ranged from <0.02 to 1.20 mg/L. The Lead concentration level used for calculation of LRF value was 1.20 mg/L. Similarly, the LRF values for Cadmium, Chromium, Ammonia and Nitrate in Hills Road landfill leachates were calculated.

The LRF values shown in Table 9, is a composite of all LRF values of individual contaminants for each of the landfills. As described in Section 5 of this report the maximum acceptable value (MAV) of LRF for any landfill is

Table 9: Aggregated Leachate Risk Factors for MCC Old Landfills

LANDFILL	LEACHATE RISK FACTORS
Hills Rd	61.4
Whitford Bridge	1.4
Pah Rd	28.6
Ngati Otara	5.3
Riverina Ave	0.7
Riverhills	0.8
Leabank	0.3
Miro Rd	7.9
Dale Cres	7.5
Kingfisher Ave	0.3
Coxhead Rd	1.4
Oruarangi Rd	0.2
Grt South Road	6.0
Robert Allan Rd	18.9
Old Quarry Rd	0.5
Ennis Ave	0.1
Kiwi Esplanade	0.7
Riverhills School	0.0
Ti Rakau Dr	0.1
Harania Rd	4.8
Bairds Rd	0.1
MAV for combined effects of five contaminants	5.0
MAV - Maximum Acceptable Value	

less than 5. This means that, if the contaminant concentrations in the leachate are less than the environmental guideline values, then the risk to the environment from the leachate may be considered to be not significant.

On the above basis, seven of the landfills listed above are identified as those that may pose a significant risk to the environment and hence require resource consents for discharge of leachate to the receiving environment. In terms of leachate toxicity the other landfills listed above, do not pose a risk to the environment.

It should be noted that the LRF values are one of a number of key factors in assessing the risk to the environment from the MCC Old Landfills. Other issues discussed in this section of the report must also be taken into account in the final assessment of which landfills may require resource consents from the ARC.

8.5 Proximity to Watercourses

Eight of the 39 landfills are a significant distance away from any watercourses. Twenty six landfills are however close to streams or creeks, and 5 landfills interface with Manukau Harbour.

From the landfill bore water data, surface water and stream monitoring data, it is noted that even for the sites in close proximity to watercourses, there is no significant, in fact barely detectable, levels of landfill leachate impacting on the respective adjacent watercourse.

Hence any risk from adverse environmental effects, from discharge of leachate to adjacent watercourses, are not considered to be significant for most of the MCC Old Landfills. However, a small number of the old landfills identified in Section 8.4 of this report (highlighted in Table 9) require further considerations in this regard.

In this context, other factors such as size of the landfill, type of fill and age may eliminate any significant risk from the respective landfill regarding adverse effect from discharge of leachate to watercourses. For example, "Robert Allen Road Landfill", has clean-fill only and is only about 0.25 ha in area. Any risk from relatively low volumes of leachate discharge from this landfill to the adjacent watercourse, are likely to be not significant.

Another key factor is the existing condition of the watercourses adjacent to the landfill. In practically all cases, the levels of contaminants in the receiving watercourses are significantly higher then those in the respective landfill leachate itself. The ANZECC Committee in developing the "Australia and New Zealand Guidelines for Fresh & Marine Water Quality" has recognised this issue.

Hence, in situations where the receiving water has significantly higher levels of contaminants entering the watercourse from other sources, then a higher

priority should be given to those sources, and the resources directed to that and not on the respective landfill. In this context the significance of adverse environmental effect from the landfill is very low compared to the major cause of contaminants in the respective watercourse. Therefore in terms of environmental risk assessment, the risk from the leachate discharge from the MCC Old Landfills to the respective watercourses may be considered to be not significant relative to other risks to that environment.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.6 Hydraulics, Water Levels & Rainfall

None of the MCC Old Landfills are close to any aquifer of significance to any water resource. A large number of the landfills are subject to coastal influences, such as salt-water intrusion in the groundwater. It is possible therefore that over the years, the salt water may have acted as a flush and have already removed any contaminants that were present in the respective landfills.

The relatively high rainfall levels in the Manukau Catchment act as a carrier of contaminants from the landfills to the receiving waters. But the high volumes of ground and surface waters resulting from rainfalls, also result in significant dilution of contaminants in the landfill leachate. This is reflected in the low levels of leachate contaminants measured in the respective landfills and downstream waters.

Again, in the above context, the risk from MCC Old Landfills, to the respective surrounding environments are likely to be not significant.

Specific issues related to individual landfills are discussed in Appendix E of this report.

8.7 Assessment of Gas Emissions

Drilling showed a range of filled materials, from substantial concentrations of refuse to clean-fill. The results are summarised in the individual site reports in Appendix E of this document.

Gas was principally monitored during drilling to ensure that gas concentrations in the boreholes were lower than the lower explosive limit (LEL), the concentration of gas required to support combustion. At no times did the gas levels recorded in any bore exceed the LEL.

8.8 Assessment of the Surrounding Environments

Most sites are in residential areas. Miro Rd is in the Mangere light industrial area along Mahunga Drive and is adjacent to a marae with elderly housing and a school. The Whitford Bridge and Mangemangeroa Bridge sites are in semi-rural settings.

The Mangemangeroa Bridge and Whitford Bridge sites are surrounded by steep country. All other sites are surrounded by flat to slightly rolling land.

Sites that are now recreational parks have high public visibility and their visual impacts are generally positive. The landfill sites that are in esplanade and drainage reserves, though usually in sensitive residential areas, generally are not that visible and their impact is assessed to be not significant. The Roscommon Rd site has a negative visual impact. However, it is not easily recognisable as an old landfill site, even though the whole area has a generally unkempt appearance.

8.8.1 Use of Condition Index

For the purposes of preliminary investigation and prioritisation of the landfills by MCC, a condition index was developed for each site. The condition index, involves assigning a score to each site in a number of key result areas, including:

- groundwater resources
- freshwater ecology
- recreational uses of water
- shellfish
- settlement
- tapu & mana
- physical contact
- terrestrial ecology
- marine ecology
- fishing
- gas exposure
- slope stability
- mauri
- miscellaneous public health

Generally, the MCC Old Landfills are well maintained as a Public Park or Reserve with good ground cover in grass and a variety of plants. The Condition Index values were used as one of the indicators together with other factors such as Leachate Strength (see Section 5), landfill size, fill-type, Leachate Risk Factor, etc., to assess actual or potential risk to the environment and/or to public health and safety.

Assessments of potential effects of specific landfills on their neighbouring environment are discussed in Appendix E in terms of these key indicators.

8.8.2 Ecosystems

The aquatic and terrestrial ecology of streams and rivers at all of the landfill sites has been degraded over time by urban and industrial development. Verbal

reports of long term residents and MCC staff indicate that fish life, water quality and riverbed conditions have been severely altered over the years. In this context the relatively small discharges, if any, from the old landfills, are insignificant compared to other contributors to the neighbouring aquatic systems.

Nevertheless, both, the Manukau Harbour, and the Tamaki River including the Tamaki Estuary (whose catchment includes the remaining sites), supports significant shellfish banks and fisheries. Moreover, inlets into these mangrove communities in the estuaries, remain significant fish breeding grounds and reservoirs of local ecosystem diversity. Hence any risk to the aquatic environment must be minimised.

Nearly all the landfill sites considered in this study either border on or discharge into streams that flow into either the Manukau Harbour or the Tamaki River, both of which are significantly polluted (Snelder and Trueman, 1995). Most of the likely effects of landfills considered in this report relate to the release of leachate from the landfills into surrounding surface water and groundwater.

There are two very important qualifications of the Leachate Strength results. Firstly, the methodology used takes no account of dilution prior to measurement. The greater the groundwater flow through a site, the more the leachate will be diluted and the less the measured concentration of the contaminants will be. By not taking account of the potential for dilution it is effectively assumed that the dilution factor is the same at each site.

Secondly, no control groundwater readings were taken upstream of the landfill sites to determine whether the presence of leachate indicators is actually due to the landfill itself or due to some other source.

Hence a greater significance is given to the Leachate Risk Factors in assessment of potential environmental effects of the landfills on the ecosystems compared to the Leachate Strength values.

8.8.3 Activities

Freshwater streams, which are close to the old landfill sites, are generally too small for water recreation. Furthermore, most of these streams are estuarine and have significant pollution levels due to other environmental factors such as urban surface water run-offs. Hence these streams are not used extensively for water recreation. It is noted that the Otara Lake, downstream of Hills Road is being considered for upgrading for water sports.

8.9 Risk to Public Health & Safety

A number of the sites are located adjacent to or very near schools and kindergartens. Generally, these sites do not pose a significant public health

risk, but some sites may have increased potential for such problems where the soil is exposed due to surface erosion.

For example, there are schools or kindergartens very close to the landfill at Elm Park, Ti Rakau Park, Ngati Otara and Udys Rd. Furthermore, a number of landfill sites have now become public reserves, which increases the risk of public health and safety problems through physical contact with refuse. It is therefore important that the landfill sites continue to be maintained and any surface erosion or exposures are covered and grassed.

Extensive site visits carried out indicate that the MCC Old Landfills are generally well maintained and no public health problems arising from the sites have been reported prior to or during the period of close monitoring since 1994. This indicates that, public health risk from these old landfills, are not significant.

8.10 Maori Values

The Maori values of tapu and mana may be offended at the Miro Rd and Ngati Otara sites where marae buildings border the landfill. There is potential for the Maori value of mauri to be offended at nearly all the sites where there is a waterway adjacent to the landfill.

8.11 Assessment of Surface Water

Notwithstanding the limitations of the physico-chemical criteria for surface water quality assessment, it has been used as a broadbrush tool in the early phase in conjunction with qualitative assessments. It was based on the assumption that leachate discharges from landfills enter the nearest watercourse and that the impact of the landfill may be assessed by comparing concentrations of contaminants upstream and downstream of the landfill.

Internationally recognised ambient standards have been used as an absolute measure of the effect of the landfills on surface water quality.

The results of surface water sampling and analysis have shown that the effects of the landfills on adjacent waterways are negligible. For surface water, elevated levels of contaminants (as compared against expected background levels) have only been measured at 'on-site' sampling locations, such as springs and in settled pools. However, these levels are still well below the guideline values for surface waters and are not likely to have any significant adverse effect on the impacted waterways.

To take into account any adverse impact of leachate on receiving streams, for relevant landfill sites, upstream and downstream water samples were taken and concentrations of leachate indicators analyzed. Generally the data available indicate no significant contamination of the streams from the landfill leachates. However, where there are marked increases in conductivity between the

upstream and downstream water samples, this may be due to impact of leachate from the respective landfill site. The leachate concentration levels are generally low and are not considered to have any significant adverse effect on the environment.

Given the relatively small size of the leachate discharges into the receiving waters, it is not surprising that in most cases even the limits of detection were not exceeded.

8.12 Safeguard & Mitigation

All necessary precautions and mitigation measures will be taken as per conditions of discharge permit.

Where risks have been identified, mitigation measures have been initiated. For example the landfills at Hill Rd (Mayfield Park) and Miro Road have recently been clay capped.

As practically all MCC Old Landfills are Parks or Reserves, any landfill surface erosion and exposure is also managed to ensure grass and /or plant cover of the area.

Generally the maintenance of the old landfills is of high quality and where issues of environmental significance arise, environmental risk management mechanism are already in place to take the necessary mitigation action.

8.13 Consultation

The assessment of MCC Old Landfills has been carried out in close consultation with the ARC and as part of that process, this report is based on the agreed criteria for the "Assessment of Environmental Effects" and identification of the landfills that may require resource consents from the ARC.

In terms of public consultation the approach has been to consult with those that have some relevant knowledge of the old landfill, such as longer-term residents and various Council employees. The investigations to date have not yet uncovered any serious problems.

An informal report was made to the Otara Community Board in 1996.

Where it was necessary to carry out investigations on adjacent properties, the owners /residents were informed and the issues explained. This involved initial letters followed by discussions with property owners. For example, it was necessary to consult with affected parties in order to carry out physical works at Hills Road and Miro Road Landfills.

Other consultations undertaken so far in this project are:

- All known current and retired long-service staff were consulted about the existence and location of sites and knowledge of the known sites.
- An article was placed in local papers (Manukau Courier and Eastern Courier) asking former employees and residents to contact a nominated staff member.
- There has been consultation undertaken with the parties affected (principally neighboring businesses and interested environmental groups) for the Miro Rd land use consent application.

Extensive consultation was also entered with the Te Puea Marae committee with regards to the Miro Road. This also included consultation with the Huakina Development Trust over the entire project. The expectations outlined by the Huakina in consultation regarding the former landfill sites coincide with the general approach adopted by the MCC.

Further consultations will be undertaken with the neighbouring community, as part of any discharge permit application process.

8.14 Future Monitoring

The extensive period of monitoring already carried out between 1994 to 1999, show that the levels of environmental contaminants at the old landfill sites, generally to be below or close to the detection limit values for the parameters measured. For most of the sites, any potential adverse impact on neighbouring areas or water bodies are likely to be insignificant and hence may not require any further monitoring of the sites.

8.15 Conclusions

Manukau City Council has carried out extensive monitoring over a long period of time (since 1994) to identify environmental risks associated with the Old Landfill Sites in the MCC Catchment. The evaluations used a number of methodologies, to ascertain actual and/or potential environmental effects from the landfills. These included;

- use of Condition Index (see Section 8.8.1)
- calculation of Leachate Strength (see Section 5.1)
- site inspections & assessments (see Section 8.2)
- calculation of Leachate Risk Factor (see Sections 5.3 & 8.4)

Some of the methodologies such as Condition Index and Leachate Strength, have been described in detail in previous reports to the ARC. The key criteria for assessment of environmental effects in this report are more focused on the LRF values and site inspections and assessments.

Taking into consideration all factors addressed in this report, the key conclusions are that:

- No significant adverse effects from discharge of landfill leachates, were identified on the water quality of receiving waters adjacent to the respective landfills.
- Many of the old landfills have clean fill with minimal organic matter and do not produce or are not likely to produce any significant volumes of leachate in the future.
- The environmental risk for actual or potential adverse effects, from very low levels of contaminants present in a small number of the landfill leachates, are generally considered to be not significant.

However, seven landfills were identified as having contaminant levels in the leachates that may pose some risk to the environment. These landfills are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Dale Crescent
- Great South Road
- Robert Allen Road

It is noted that the worst case scenarios were considered in calculation of the LRF values (see Sections 5.3 & 5.4). The highest contaminant levels measured in the respective bore hole leachates were used in the calculations of the LRF values. Furthermore, the contaminant concentrations used are total levels in the sample and not just the soluble fraction. This further adds to the worst case scenario methodology used for calculation of the LRF values.

Considering the fact that Dale Crescent has clean-fill and gravel only, and is not in close proximity to any watercourses, any environmental risk from this site is considered to be not significant. Hence, the Dale Crescent site should be excluded from any need for resource consents.

Similarly, the Robert Allan Road landfill has clean-fill only, and is a relatively small site (0.25 ha), which is well maintained by MCC. Although this site is in close proximity to a watercourse, no adverse environmental effects were identified. Hence, it is considered that this site should also be excluded from any need for resource consents.

In our assessments, only five of the MCC Old Landfill sites may require further consideration by ARC as to whether there is any justification for any resource consents for the sites. These sites are:

- Hills Road (Mayfield Park)
- Pah Road
- Ngati Otara
- Miro Road
- Great South Road

It is noted again that a number of environmental issues have been identified in relation to the above five landfills and these issues, are currently being addressed by the Manukau City Council. These issues have resulted in clay capping of landfills, cleaning localised rubbish dumping within landfill sites and re-vegetation of landfill surfaces subject to localised soil erosion or susceptible to slips.

Public health and safety issues such as the potential for landfill gas effects, has been measured to some degree by measuring the gas levels relative to the lower explosion level (LEL) values. While gas is being produced, the low concentration of organic matter in the refuse and the reduced organic decomposition due to the ageing of the landfill sites significantly limit gas production. There are no visible signs of landfill gas production, such as cracks in the ground or grass discoloration, at any of the sites.

Site visits and assessments generally showed no indication of any potential risks to public health and safety associated with the MCC Old Landfills. The site visits included assessments of odour, ground cover and the risk posed by direct physical contact with landfill surface, dust levels, and indicators of soil erosion and slips. Where signs of any soil erosion and rubbish dumping was identified, MCC has taken immediate action to mitigate the situation as part of the daily management of the landfills. Hence any potential for adverse environmental effects is avoided.

Although no detailed assessment of the potential for slope stability at the old landfill sites has been carried out, the length, grade and width of the slope have been examined to get a measure of the potential for slope stability. Generally, any risk to public health and safety from the old landfill sites, are considered to be not significant.

9. Scope and Limits of Investigations

This report is based on Manukau City Council investigations and information prepared for the purpose of this commission. Previous reports in relation to the Old Landfills prepared for Manukau City Council by ESR Environmental Limited and Groundsearch EES Limited, were made available to GHD Limited and they have also been used as sources of information. The assessments made and the conclusions drawn are based on the data and information provided from the above sources. Gutteridge Haskins and Davey Pty Ltd (GHD) accepts no responsibility for other use of the data.

Where drill hole or test pit logs, laboratory tests, geophysical tests and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the investigation locations tests points and sample points and is not warranted in respect to the conditions that may be encountered across the site at other than these locations. It is emphasized that the actual characteristics of the subsurface materials may vary significantly between adjacent test points and sample intervals and at locations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

An understanding of the subsurface site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which has been modified in any way as outlined above.