

Investigation of alleged agricultural waste disposal sites in New Plymouth



AUGUST 2001



**STAGE
TWO**

**Investigation of alleged
agrchemical waste disposal
sites in New Plymouth**

Technical Report 2001-42

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Executive summary

This report represents the completion of Stage Two of the Council's investigations into allegations of the existence of dump sites arising from the inappropriate disposal of agricultural waste from the Ivon Watkins Dow (now Dow AgroSciences Limited) plant on Paritutu Road, New Plymouth. The disposal of such wastes, contaminated in particular with dioxin as a byproduct of the manufacture of herbicides 2,4,5-T and 2,4-D was alleged to have occurred between 1960 and 1980.

Stage One of the Council's investigations was the establishment of the possible locations of such sites. The Council conducted some 80 interviews with interested people who believed they had information as to the location of such sites. The co-operation Council received from the public and interested parties, particularly the Dioxin Investigation Network and the Dioxin Investigation Action Group, was excellent. On 2 May 2001, Council considered the Stage One report and resolved on the basis of that report, to 'commence Stage Two investigations and sampling with urgency'. The report identified 36 sites for further investigation and sampling. The process by which the sites were identified was robust and open such that no party since the release of the Stage One report has queried or questioned the list of sites.

The purpose of Council in undertaking this investigation and the aims of Stage Two are most important. The allegations of inappropriate disposal of dioxin contaminated wastes were made most forcefully and publicly with intense media interest and speculation. The allegations were not simply of soil contamination but of substantial dump sites containing drums of toxic waste material. These allegations gave rise to considerable community disquiet and deserved immediate attention. The Council recognised its responsibilities under the Resource Management Act 1991 for the disposal of contaminants to land and water even if historical. The Council had previously in 1993/1994 investigated similar allegations of inappropriate disposal of dieldrin and aldrin pesticides in the 1960s and 1970s.

The purpose of Council's action in Stage Two of this investigation was firstly to ascertain whether there was any environmental risk arising from any of the identified alleged dump sites and secondly to ascertain whether any inappropriate dumping or disposal had occurred. If the investigation identified any such dumps with associated contamination and environmental risk, then appropriate action to clean up and remediate these sites would be considered as Stage Three of the investigation.

The sites identified for further investigation in Stage Two fell readily into four groupings. The first grouping covered eleven sites currently or historically held by IWD. All of these sites were known to and had been previously investigated by the Council. Five of the sites were the known dump sites rehabilitated in the 1980s.

The second grouping was of six sites where alleged historic surface contamination from stormwater from the IWD plant had occurred. The allegations associated with these sites did not involve dumping or burial of contaminated waste.

The third grouping of seven sites were known municipal landfills and sewage discharge outfalls operating during the period 1960 to 1980. With each of these sites there is no direct link to IWD. If disposal of contaminated wastes occurred it was in all probability in accordance with the standards of the time and undertaken by a range of parties ie, contractors, councils and the Company.

The fourth grouping of twelve sites centres on alleged substantial dump sites and alleged contaminated seepages. This grouping was of sites generally not known or previously investigated by the Council and was identified in the course of the Stage One interviews.

Details of the Stage Two investigations are set out in the report and associated appendices. The sampling and procedural protocols developed prior to the field work commencing were reviewed by DIN/DIAG, Ministry for the Environment and an independent consultant. The range of methods included detailed site inspections, analysis of aerial photographs and other historical records, probing with augers and the use of an excavator on two sites, the use of ground penetrating radar and sampling of soils, sediments, surface and groundwaters, leachate and marine biota. The particular methods used at each site varied as to the nature of the allegation, for example ground penetrating radar was not used on sites where the issue was potential contamination from stormwater runoff. Analysis of the samples was undertaken by AgriQuality NZ Ltd.

The methods to be used and samples taken were discussed with DIN/DIAG representatives before field work commenced and DIN/DIAG representatives accompanied Council staff and contractors in the field. The co-operation of all parties, DIN/DIAG, and particularly the owners and occupiers of the alleged sites was very much appreciated.

While this report contains the detailed results, summarising in terms of the four groupings of sites is valuable.

With respect to the first grouping of eleven sites on land currently or historically held by IWD the Council found no evidence of environmental risk arising from any of the sites. The investigations showed that the five known dump sites cleaned up in the 1980s harboured no further buried material and were effectively rehabilitated. The results for the two sites where IWD previously manufactured and stored herbicides gave no cause for concern. The four sites on the current Dow AgroSciences site on Paritutu Road showed some minor contamination of groundwater (already known) but no evidence of the alleged significant dumpsites or burial of waste. The known contamination presents no environmental risk.

The second grouping of six sites potentially contaminated by stormwater runoff from the IWD site included four residential sections. All were investigated and sampled with particular focus on the soil and sediment. Council is pleased to advise these property owners that the results indicate no contamination of the soil and hence no environmental risk.

The third grouping of seven sites consisted of the known landfills and outfalls operating at the time (1960s-1980s). Extensive sampling of sediment, surface and groundwater emanating from current and closed landfills did not indicate any environmental risk. As noted, if disposal of agrichemical wastes did occur at these locations, it was properly authorised in respect of the standards of the time. These sites will continue to be monitored as part of the Council's existing monitoring of closed and current landfills. With respect to the outfall sites, the results of the sampling of the adjacent marine biota indicate dioxin levels in accord with background levels elsewhere in New Zealand as measured by the Ministry for the Environment.

With respect to the results of the investigation of the fourth grouping of twelve sites consisting of alleged dump sites (9) and seepages (3), none of the seepages provided any evidence of inappropriate disposal of agrichemical waste or any environmental risk.

Much attention will naturally focus on the previously unknown alleged dump/drum disposal sites identified through the Stage One process. All these sites were investigated, at several, at DIN/DIAG's request, particular samples and analysis were undertaken. At two of the sites excavation was undertaken to investigate and confirm analysis provided by the ground penetrating radar. In no case was any evidence found of inappropriate disposal of agrichemical wastes contained in drums or otherwise. The sampling undertaken further confirmed no environmental risk arising from any of the sites.

In conclusion the results of the Council's Stage Two investigation indicate:

- At the five sites where disposal of agrichemical wastes is known to have occurred in the 1960s to 1980s the clean up and rehabilitation was found to be effective with no evidence of any additional unknown waste.
- There is no existence of any disposal of agrichemical wastes at any of the other 31 sites investigated.
- There is no evidence of environmental risk at any site, or in the marine environment in the vicinity of those sites that were on the coast.

The Council at this point has no evidence that any further action is required at any of the sites investigated. Council would like to acknowledge the input and assistance from members of DIN and DIAG and the residents groups. The co-operation of site owners and occupiers was also appreciated.

1. Introduction

This report has been prepared by the Taranaki Regional Council to describe the investigations conducted at a number of sites during the 2001 calendar year, arising from allegations that agrichemical wastes from Ivon Watkins Dow (IWD) were dumped at a number of sites around the New Plymouth area, in particular the Spotswood/ Ngamotu suburb, from the 1960's to the 1980's. The report describes the nature of investigations carried out at each site, and the findings of those investigations.

In the second half of 2000, concerns about a range of historical dioxin contamination issues began to be expressed by and on behalf of some residents in the area surrounding the site currently occupied by Dow AgroSciences.

The concerns culminated in a public meeting being held by New Plymouth District Council on 14 February 2001. At that meeting the Taranaki Regional Council's responsibilities in the matter were identified as:

- investigating alleged disposal of dioxin contaminated wastes; and
- air discharge monitoring since 1991.

The Council has reported the results and findings of its air quality monitoring annually. Summaries of the air quality information were also presented at meetings of the Consents and Regulatory Committee of the Council on 14 February and 21 March, specifically to address the concerns being raised publicly. At the same meetings, the Council confirmed its intention that a full investigation would be undertaken by the Taranaki Regional Council into the alleged historical disposal sites and that the findings would be reported publicly. The investigation was to be completed in three stages as follows:

- Stage One - identification of the alleged historical dump sites and confirmation of inspection and sampling methods;
- Stage Two - undertaking inspection and sampling, reporting of results; and
- Stage Three - recommended response actions.

This report presents the findings of Stage Two of the investigation, in fulfilment of the Council's commitment.

Although the Company is referred to as IWD, it should be noted this was the name of the owner of the agrichemical plant for only part of its life. Originally the Company was known as Ivon Watkins Limited and then Ivon Watkins Dow Limited, and from 1990 to 1998 it was known as DowElanco (NZ) Ltd. It is only since 1998 that the Company has been known as Dow AgroSciences (NZ) Ltd. However, for simplicity the Company is referred to as IWD throughout this report, its name during the period of interest.

2. Background

2.1 Statutory requirements

Following the inception of the Taranaki Regional Council in 1989 and the coming into force of the Resource Management Act in 1991, the Council became responsible for regulating discharges to land, water, and air.

Prior to this time the Council's predecessor, the Taranaki Catchment Commission, was responsible for regulating discharges to water under the Water and Soil Conservation Act, 1967. The Taranaki Catchment Commission had no responsibility for discharges to land or to air. The control of the use of land was essentially a town and country planning matter for the respective city, county, borough or district councils, and discharges to air a matter for the Department of Health.

2.2 IWD Paritutu Road site

IWD have occupied the site on Paritutu Road, in Spotswood/Ngamotu, since 1960. (Both names for the suburb tend to be used interchangeably). This site was used for the manufacture of a variety of agrichemicals. Of particular note is that the manufacture of the herbicide 2,4,5-T was discontinued in 1988 and manufacture of 2,4-D was discontinued in 1997. Manufacture of all agrichemicals at the plant was discontinued in 1998. Currently only blending and packaging of agrichemicals takes place at the site.

In 1993 IWD conducted a comprehensive assessment of their Paritutu site. This investigation found two locations where soil and groundwater had been contaminated through operations on site. The nature of the contamination was determined to be leakage during product storage and not as the result of deliberate disposal of wastes.

A comprehensive site investigation and monitoring programme has been in place since the discovery of these two contaminated areas at the Paritutu Road site. IWD have kept the Council fully informed of the results and methodology used for these site investigations. The status of this work is publicly reported via the Council's annual compliance monitoring reports for the site.

The results of the study have confirmed that no detectable concentrations of any contaminants have or are likely to migrate from these areas. The levels of detection used for the analyses are far below guideline values for environmental concern. Council staff have in addition continued to survey the Back Beach foreshore in the vicinity of the plant as a precaution since 1994, and have found no evidence of any discharge of agrichemical residues.

2.3 IWD Buller Street site

IWD occupied a site at 14 to 24 Buller Street, New Plymouth as their manufacturing plant from about 1941 until 1959/60 when the Company moved to its current site on Paritutu Road.

The Buller Street site was investigated by the Taranaki Regional Council in October 1995 as a potentially contaminated site. Investigations included water and soil samples from and around the site and from a stormwater discharge from below Woolcombe Terrace.

Extremely low concentrations of DDT were found in site soils, far below any soil quality guidelines for environmental concern as a contaminated site.

IWD advised the Council in 1997 that, to the best of their records, there was no disposal of wastes at this site as Company practice at that time was to use municipal landfills. Based on this information, and the results of the Council's previous investigations at this site, the Council did not conduct further work on this property within the context of the study being reported.

2.4 Waireka landfill site

In 1975 and 1976 IWD disposed of various drums and bags of wastes by burial at two locations on their Waireka experimental farm. This disposal operation was undertaken with the approval of the Health Department as the relevant authority at the time. One of the locations identified in Stage One of this investigation by residents are these burial sites.

Discharges from the Waireka burial sites on to the beach near the Waireka Stream mouth were the subject of investigation in late 1982, after discharges of leachate-contaminated groundwater were noticed on the foreshore. IWD sought and were granted a water right regulating the management of the discharge, and subsequently installed a leachate collection and treatment system to intercept, treat and dispose of this discharge.

In 1986 IWD removed the entire contents of the two burial sites, together with associated contaminated soil, into a purpose built secure containment facility also located on the Waireka experimental farm. This secure facility, referred to as the Waireka landfill, still exists at the Waireka site inland from the two original burial sites.

The Waireka burial sites and associated discharges have held consents and been monitored since 1983, originally by the Taranaki Catchment Commission, and currently by the Council. The secure landfill is also licensed as a land use activity, previously by the Taranaki County Council and now by the New Plymouth District Council.

The level of contaminants now present in groundwater at the burial sites is now so low that the collection of leachate has been discontinued with Council approval. The resource consent for this discharge is in the process of being surrendered. Other than occasional odour at a couple of locations on the cliff face, there are no adverse environmental or ecological effects arising from the two burial sites.

Nevertheless, because of renewed concerns about potential contaminated discharges from the site, further investigations were carried out below the Waireka site as part of the present study. The work and results are detailed within this report.

Because there has never been any discharge from the secure Waireka landfill facility, IWD holds no resource consent issued by the Council, nor is it required to. Nevertheless Council staff have monitored for the possibility of either discharges to air or loss of leachate control from the secure Waireka landfill facility. No evidence of any escape has been found.

The environmental performance of the remedial measures undertaken at the two burial sites and the environmental performance of the Waireka landfill is a matter of public record through the Council's annual compliance monitoring reports. In summary this

monitoring has found no evidence of any leakage at the Waireka landfill and there are no adverse environmental or ecological effects arising from the two remediated burial sites.

2.5 Beach Road (“Ngahoro”) site

It is a matter of public record that during 1974 IWD disposed of wastes in an area at the end of Beach Road near where the tank farm is now located. These wastes, together with associated contaminated soils were returned to the IWD main Centennial Drive site on Paritutu Road for disposal in 1981.

Council officers have inspected and monitored this area and the foreshore below it, since 1996 and found no evidence of any agrichemical residues remaining in the area. Nevertheless, because of renewed concerns about potential discharges from the site, further investigations were carried out below the Ngahoro site as part of the present study. The work and results are detailed within this report.

2.6 Monitoring by Taranaki Regional Council

2.6.1 1991-1999

Since 1991 and the implementation of the RMA the Taranaki Regional Council has monitored all discharges to the environment from Dow AgroSciences at both its properties on Paritutu Road (formulations plant) and at Waireka Road (Waireka experimental farm). Dow AgroSciences has an excellent record of compliance since that time. There have been no incidents of unauthorised disposal (“dumping”), nor any allegations of such having occurred since the Council began monitoring in 1991. The concerns raised by members of the public appear to be associated with activities of IWD held to have occurred during the 1960’s and 1970’s.

In the summer of 1994/95 a Council project sought to identify and investigate every old or informal rubbish disposal site in Taranaki. The investigations included site assessments and surveys and the sampling of any receiving waters. In the New Plymouth district organochlorine scans were also undertaken. Approximately 106 sites were identified throughout Taranaki and investigated.

At least five of those sites investigated in 1994/95 were among those recently identified as possible IWD disposal sites by concerned members of the public. One of these sites (Marfell Park) was the municipal landfill for New Plymouth at the time. Consequently it is highly likely that IWD did dispose of plant wastes at this site, as was common practice for other industries at that time.

The 1994/95 study found no evidence of the disposal of pesticides or agrichemical residues at any of the sites. The study found no evidence of pesticide residues remaining at any site and no indication of any pesticide residues in associated receiving waters. Five of the sites investigated were later identified by concerned members of the public during Stage One of these investigations.

2.6.2 2000-2001

In March 2000 the Council received a collection of comments and documents from Mr Andrew Gibbs referring to a number of sites of actual or alleged historical disposal of IWD plant wastes (1960s-1980s). Four of these sites (Buller Street, Waireka landfill, Beach

Road, and Marfell Park) had already been investigated by the Council between 1993 and 1995. Three additional sites where the disposal of IWD plant wastes may allegedly have occurred were also identified by Mr Gibbs, namely: the gully beside and west of Paritutu, the Herekawe/Rangitake Drive area, and the netball courts beside the Waiwhakaiho River. These sites were accordingly investigated in May 2000 by Tonkin and Taylor Ltd, who have considerable experience in contaminated site investigations, on behalf of the Council. Soil and/or water samples were collected from each of these sites. In addition, the Council's marine biologist inspected the foreshore in the vicinity of Paritutu Rock. The Council routinely undertakes freshwater surveys at the other two sites.

At no sites were there any immediate evidence of any pesticides found, nor evidence of dumping or burial of agrichemical wastes (other than at sites already known, as described above in Sections 2.4 and 2.5). No traces of agrichemicals were found in any of the collected samples. Mr Gibbs was advised of these findings in July 2000.

In November 2000 an article in a local newspaper reported further sites where IWD had allegedly disposed of contaminated wastes. This information had been provided to the newspaper by several people including Mr Gibbs.

The Council subsequently contacted Mr Gibbs offering to investigate any new alleged site identified. Accordingly six sites were subsequently visited by Council staff and Mr Gibbs in December 2000. Most of these sites were already known to the Council and had been previously investigated between 1993 and 1995.

Following media publicity and information provided by concerned members of the public during January and February 2001, the Taranaki Regional Council gave a public commitment to undertake a detailed investigation of environmental risks arising from sites where it was alleged that herbicide contaminated wastes were disposed.

3. Structure of investigations

3.1 Stage One investigations

Based on this Council's experience during the 1991 investigation into the alleged historical stockpiling and dumping of dieldrin, it was decided to undertake interviews of all persons who proffered information (Stage One), and to collate the information gathered to identify potential sites for further investigation (Stage Two). Given that this investigation was dealing with events that may have occurred up to forty years ago, recollections of localities and details can become uncertain, more so as the landscape may have changed dramatically.

In order to facilitate the investigation and to make it convenient for the interested parties in New Plymouth to have input, weekly operational meetings of Council staff were held in the Taranaki Emergency Management offices at Robe Street, New Plymouth. The meetings were attended by members of the Dioxin Investigation Network (DIN), the Dioxin Investigation Action Group (DIAG), Greens, Surfriders, Vietnam Veterans, Paritutu Property Rights Group, and the Paritutu Community Residents Group. Without their co-operation the investigation could not have proceeded. They brought to the Council the names of people they believed to be able to provide information relating to alleged dumping or discharging of wastes from IWD.

From late December 2000 onwards approximately 80 interviews were conducted. A list of the interviewees and names provided to the Council is attached to this report as Appendix I. Written records of the interviews are held in the Council files. These will be archived in due course, along with all other material relating to this investigation.

Sites had to be identified by an interviewee with sufficient clarity to avoid confusion. It was preferable that two persons separately identified the site.

Council staff subsequently visited every site, where possible with the interviewee, to confirm details of identification, to demarcate the site, and to log its suspected location by instrumental measurement (global positioning system, or GPS).

In addition to the names presented to Council staff by the various groups and following completion of the interviews, an advertisement was placed in the Daily News on Saturday, 7 April 2001 calling for any further interested parties to contact Council, as a check that all efforts had been made to contact those who potentially held information. The advertisement solicited no further response.

The interviews and preliminary site visits identified 38 sites where it was alleged that inappropriate historical disposal of dioxin contaminated waste had occurred. Thirty six of these were investigated in more detail following the methodologies outlined below. Of the original 38, two sets of two sites were found to be duplicates, referred to by different names.

A map showing all sites investigated is attached to this report as Appendix II.

3.2 Stage Two investigations

The Stage Two programme was developed in consultation with the DIAG/DIN representatives. It was designed as a comprehensive screening of the possible sites. It was not intended to be an exhaustive investigation of each site. Further study of

particular sites would be considered in Stage Three of the investigation of each site in the event that a risk is indicated, based on results being above guideline or known background values. For a Stage Three investigation, the Council would review the need for further, more detailed site-specific investigations e.g. core drilling and sampling, groundwater sampling, more intensive soil sampling, and/or biological surveys.

It should be clearly understood that the primary aim of the programme is to identify and address possible environmental risk from alleged dump sites. It is not intended to conclusively prove or disprove whether dioxin-containing wastes are present within a site, nor to provide data on concentrations of dioxin in surface soils generally throughout the suburb of Spotswood. Council has recommended that that issue is the subject of a separate investigation should the Ministry of Health see fit.

The Council focused on whether there is an actual or plausible environmental risk at any of the sites. It is considered that the primary route of exposure would be by release from any buried reservoir, via leaching into groundwater and thence into the surface environment. Therefore the site inspections and the sampling regime had as its fundamental focus, any seeps, drains, pipes, or other forms of leachate discharge. These were to be analysed for a range of contaminants that would indicate the possible presence of dioxins, as well as being environmental contaminants in their own right (namely acid herbicides and organochlorine pesticides).

Analysis for 2,3,7,8 TCDD was also undertaken in a number of situations. The analysis for 2,3,7,8 TCDD is based in part on the much higher cost of analysis for a full suite of dioxins, in part on the fact that 2,3,7,8 TCDD is the dioxin of most concern from a health perspective, and in part on the fact that 2,3,7,8 TCDD is the primary 'marker' of dioxin contamination in 2,4,5-T.

Once the collation of information and statements from witnesses was completed, on-site investigations, including detailed site inspections, geophysical surveys using ground penetrating radar (GPR) and electromagnetic induction systems, and appropriate sampling of identified site soil cover, discharges, receiving water courses, and sediments, was implemented. Depending on site-specific considerations, Council staff collected surface soil samples, samples of each discharge of leachate or groundwater, samples of soil over which any leachate discharge has flowed, samples from any stream below each site and sediment from receiving water courses. Marine biota were surveyed and sampled where appropriate.

A sampling and analytical protocol was agreed between the Council, the various action groups, Ministry for the Environment, and New Zealand's foremost dioxin scientists, to ensure the protocols were scientifically defensible and rigorous, and met the various needs and concerns of each party as far as practicable. The protocols are attached to this report as Appendix III.

Occupational health and safety issues involved in the investigation were addressed in the sampling protocols.

The archives of Taranaki Regional Council (formerly Taranaki Catchment Commission and Taranaki Catchment Board) and New Plymouth District Council (including the former North Taranaki County Council) were searched as part of the investigation.

No additional sites were identified as a result of the searches. Some information was gained in relation to the extent of the sites under investigation that had been local authority landfills.

Aerial photograph series of the New Plymouth area for 1958-59, 1974-76-77, and 1994 were viewed in detail in order to assist in the identification and determination of possible dump locations.

One location in particular, a large concrete bunker on the former IWD dairy farm at Ngahoro, was identified and investigated. The investigation confirmed that the bunker was constructed by a petroleum exploration company in the 1960s and contained drilling muds for some years. In the 1970s the drilling muds were disposed of and the bunker was used as a silage pit by sharemilkers on the property. The bunker was subsequently broken up and the site is beneath a current methanol storage tank on one of the tank farm sites (see the notes on Site Zk below).

No other additional sites were identified by this method.

While it was held by Council officers that previous monitoring and investigations at some of the sites of interest had been properly conducted, members of DIAG and DIN expressed the desire for repeat testing in some cases. The Council extended an invitation to these groups to have a representative on site during the surveys and sampling to improve understanding, and to provide confirmation that samples were collected from the areas of particular concern. Representatives of DIAG/DIN were present throughout the sampling and survey programme. All samples collected were split so that DIAG/DIN and any owner or occupier could hold sub samples for independent analysis as they wished.

It is not known whether any independent analyses were carried out, and no such results are reported in this document.

Ground penetrating radar/soil conductivity profiling (GPR) enables the rapid location and delineation of buried containers and soil contamination at depths of 5-20 metres. The members of DIAG and DIN consulted with, confirmed that if subsurface surveys indicated no grounds supporting an allegation of material buried on a site, then they would accept that result as evidence that that site was not a dumpsite. Some sites were under investigation as sites of alleged surface discharge of wastes, not of burial of wastes, and these sites were not the subject of GPR survey.

The investigation was designed so that the leachate/ground water and stream samples were analysed for acid herbicides (which would capture any 2,4-D, 2,4,5-T, MCPA, MCPB, mecoprop, dichlorprop, triclopyr, 2,4-DB, bentazone, fenoprop, or picloram) and for organochlorine pesticides (which would capture DDT and its decomposition products, lindane, dieldrin, endrin, and a number of other compounds). Dioxin occurs as a trace contaminant of some of these substances therefore the absence of these substances in a sample indicates there is no justification for testing for dioxins.

The soil and sediment samples of most interest to DIAG/DIN and Council staff were analysed for the 2,3,7,8 TCDD isomer of dioxin, as this is the most significant dioxin associated with 2,4,5-T.

It is important to note that the Council had a broader interest than dioxin alone and wished to confirm or eliminate the presence of a range of agrichemicals and hence associated environmental risks, at each site.

It is recognised that the absence of acid herbicides in a water or leachate sample, or even of dioxin in a surface soil or sediment sample, cannot be taken as absolutely guaranteeing that no dioxin is present within a soil body nearby. Dioxins tend to bind to soil and are therefore relatively immobile, while acid herbicides are more mobile. The

only way to achieve that level of certainty would have been to fully excavate every suspect site. This was unrealistic. The investigation methodology adopted was targeted at determining whether there was any plausible environmental risk arising from discharges or pathways into the environment. From the work done at the Waireka site, where the contents of the dump were removed almost twenty years ago, modern analytical methods can still detect traces of acid herbicide residues within the groundwater at levels below parts per billion, it is considered that the collection and analysis of discharge and surface samples is a robust methodology for investigating the concerns raised about relatively large scale buried dumps.

The offer was made to DIAG and DIN that regardless of the outcome of the acid herbicide and organochlorine screens, that at the sites of most concern to the group, analysis for TCDD in soils and sediments would be performed as they specified. The group requested surface soil analysis at Sites C (Pylon 3), P (42 Rangitake Drive), and Zi (Pylon 4).

Those groups also expressed a particular interest in dioxin levels in shellfish at up to five coastal sites where dumping or discharges may have occurred. The usefulness of shellfish as bioaccumulators of persistent toxins is well recognised. In addition, the health and state of the shellfish could serve as an indicator of possible biotoxic effects from a range of possible contaminants. Therefore an intertidal marine survey and sampling was carried out at five specific coastal sites related to known or alleged discharge points.

4. Findings of site investigations

4.1 Introduction

The 36 sites identified for investigation can be considered in four groupings.

The first grouping centres on alleged sites on land currently or historically held by IWD. There are eleven such alleged sites. Four of these involved allegations of inappropriate practice in the past, on the current Dow AgroSciences premises on Paritutu Road. Four other sites may be referred to as the Ngahoro suite, these relate to former dumpsites in the area south of the Omata Tank Farm that were already rehabilitated. They were known or found and cleaned-up by IWD in the late 1970's to mid 1980's. The remaining three sites in this grouping are the Waireka dumpsites and the original Ivon Watkins Buller Street factory and Tarahua Street warehouse. All were well known to Council and have been previously investigated as part of its resource consent monitoring or contaminated sites work.

The second grouping results from alleged impacts of stormwater emanating from the IWD Paritutu Road site in the past. Six sites were identified for further investigation including four residential sections. The allegations did not involve dumping or burial but related more to residential development at locations where contaminated stormwater is alleged to have given rise to contaminated soil.

The third grouping involves seven sites that are essentially associated with municipal waste disposal systems. These are largely known historical and existing municipal landfills and sewerage outfalls. All locations identified were known to Council through its previous work on landfill contaminated sites completed in 1994/95. With each of these sites there is no direct link to IWD, that is, if disposal occurred it was in all probability authorised in accordance with the standards of the time and undertaken by a range of parties i.e.; contractors, councils and perhaps the Company.

The fourth grouping is broader being essentially anything that does not fit in the previous three categories. Nine of these twelve alleged sites involved allegations of disposal by burial of dioxin contaminated waste, the remaining three involved cliff face seepages. In general these sites were of interest because they were identified in the course of the interviews undertaken and Council was not aware of them previously.

4.2 Sites and investigation details

Table 1 presents a summary of each of the 36 sites investigated and the nature of the investigations carried out at each site. Further details on the analyses conducted (acid herbicides, organochlorine pesticides, 2,3,7,8 TCDD) is provided in Appendix V.

Details of the sites and investigations are contained in Appendices to this report as follows:

Appendix I of this report presents a record of interviews conducted in Stage One of this investigation.

Appendix II contains a map of site locations identified in Stage One.

Appendix III contains the sampling protocols followed by staff in conducting the studies.

Appendix IV presents the report prepared by GPR Geotechnical Services Ltd on there findings of the geophysical investigations (Ground penetrating radar and electro-magnetic induction surveys).

Appendix V describes the sampling undertaken at each site.

Appendix VI describes the marine studies and sampling.

Appendix VII describes the findings of the site inspections.

Appendix VIII records the results of further excavations carried out at two sites.

Appendix IX presents the results of the acid herbicide, organochlorine pesticide, and 2,3,7,8 TCDD (dioxin) analyses conducted by AgriQuality for the Council.

Table 1 Sites and investigation details

	Archive inspection and Photographic perusal	GPR	Detailed inspection	Sampling and analysis	Marine biota
A Lawry Street - GPS 2600700E-6237180N. On the corner of Lawry Street and Devon Street West, and west of the garden centre on Devon Street West. The site is on the western bank of the Mangaotukutuku Stream.		*	*	*	
B Seaview Road - GPS 2600656E-6237096N. This alleged site is on the corner of Seaview Road and Devon Street West, behind the Shell service station and across from site-A. The site is on the eastern bank of the Mangaotukutuku Stream.		*	*	*	
C Pylon 3 - GPS2598377E-6237586N. The alleged site is immediately north/west of the IWD premises and is on both sides of Centennial Drive and includes an area approximately 100m x 150m in the Paritutu Centennial Park. The pipeline corridor transverses part of the site. There is an alleged discharge emanating from the cliffs below this site.	*	*	*	*	
Ca Centennial Drive - GPS2598535E-6237713N. This alleged site was addressed as part of the Council's dieldrin investigation in 1991 . Further work was therefore limited to a confirmatory detailed inspection			*		
D 34 Rangitake Drive - GPS2598513E-6236679N. The alleged site is at the rear of the property at 34 Rangitake Drive. Prior to residential development this site was above a small tributary of the Herekawe Stream that allegedly received stormwater from the IWD premises. At least three previous owners identified the site. Alleged burial	*	*	*	*	
Da 44 Rangitake Drive. As above.	*	*	*	*	
E Omata Reserve (east of the Methanex tank farm) - GPS2598382E-6236657N. The alleged site is on New Plymouth District Council reserve land on the eastern side of the Methanex tank farm. The site was identified by DIAG, previous occupiers do not support the allegations.	*	*	*		
F IWD-1 - GPS2598663E-6237173N. An alleged disposal site on the IWD premises.	*	*	*	*	
G Marfell Park - GPS2600682E-6236037N (identified by Andrew Gibbs and Ian McLeod), GPS2600734E-6236179N (identified by Trevor Fleming). This site was a known municipal landfill prior to being closed, grassed and used as playing fields in the late 1970's. Dumping of 200 litre drums was alleged. The Mangaotukutuku Stream is close by. Also wastes from the unblocking of the City sewerage system at the corner of Ngamotu Road and Centennial Drive were allegedly disposed of here. The wastes were identified as being phenol based	*		*	*	
H Ngamotu Domain - GPS2599875E-6237183N. This site is a known past municipal landfill. The site has also been covered, grassed and is used as playing fields. Wastes from the unblocking of the city sewerage system were disposed of at this site.	*		*		
I 7A Squire Place – GPS2600021E-6337111N. A stormwater pipe that allegedly could have contained leachate from the Ngamotu Domain landfill discharges at this location	*		*		
J Belt Road – GPS260143E-6238019N. This site is at the end of Belt Road (over the railway line to the right) on the coast. This is another site where wastes from the unblocking of city sewerage was disposed of. The wastes allegedly flowed over the cliffs and into the sea.			*	*	*
K Victoria Road, Oakura – GPS2593182E-6232055N. This site is the first farmlet up Victoria Road off SH45			*		
L 23C Tahurangi – GPS2598732E-6236974N. This is a residential site on Tahurangi Place. Prior to residential development it is alleged a stormwater pipe used to discharge from the IWD premises onto farm land where this property is situated.	*		*	*	
M Beach Road-1 – GPS2597532E-6235427N. This alleged site is at the end of Beach Road to the west and has been linked with the known and rehabilitated Ngahoro dump. A small spring is nearby.		*	*	*	
N Waireka rehabilitated dumpsite – GPS2596874E6234237N. This records the identification by a number of interviewees of the known rehabilitated dump sites (2) at Waireka. The sites are the subject of ongoing monitoring since 1986.					*
O Pioneer Road – GPS2599214E-6237257N. Further investigation showed this site was the road leading to the Ngamotu Domain (Site H)					

	Archive inspection and Photographic perusal	GPR	Detailed inspection	Sampling and analysis	Marine biota
P 26A Rangitake Drive – GPS2598481E-6236717N. This alleged site is at the rear of a residential property at 26A Rangitake Drive. Prior to residential development this alleged site was adjacent to a small tributary of the Herekawe Stream that may have received stormwater from the IWD premises.	*	*	*	*	*
Q Rifle Range Road/Bewley Road – GPS2606429E-6239250N. This alleged site is located on Rifle Range Road next to the Waiwhakaiho River. Part of the developed area was a Taranaki County Council dump. The old landfill site has resource consents and is monitored.	*		*		
R Beach Road-2 – GPS2598038E-6235117N. This alleged site is on the old IWD dairy farm on Beach Road approximately 750 metres from the sea and was identified arising from the extraction of chemicals from old dumpsites during the early 1980's.	*	*	*	*	
T Colson Road Landfill – GPS2607397E-6237616N. This is a present municipal landfill and has been in use since the early 1970's. It is alleged that IWD waste products have been disposed of in this landfill during past years. This landfill has resource consents and is monitored.				*	
U IWD-2 - Another alleged dumpsite on the IWD premises. The allegation refers to a concrete bunker used as an anisol storage facility.	*	*	*	*	
V Centennial-2 – GPS2598524E-6237853N. This alleged site is the discharge point of the former stormwater line from the office blocks of the IWD premises. The stormwater system was apparently accessed during spills that occurred on site and was seen to be frothing before the mid 1980's.	*		*	*	*
W Herekawe Stream – GPS2598309E-6236771N. This is the current stormwater discharge from the Dow AgroSciences premises. The discharge has resource consents and is monitored.				*	*
X Roto Street – GPS2600775E-6234738N. This alleged site is located on a recent subdivision. The land was previously owned by a plant nursery. The allegation is that drums containing chemical had been dumped. A drain flows from the south-west end of the subdivision.	*	*	*	*	
Z Ngahoro – GPS2597661E-6235515N. This is a known site on the old IWD dairy farm. In February 1981, 230 drums of waste were removed from this site and returned to Ivon Watkins-IWD Ltd for incineration or recycling. About 1000m ² of soil was relocated from this site to the Waireka facility. It has been alleged that between thirty and fifty empty drums and assorted rubbish were left behind and covered with 1.5 to 3 metres of clean soil.	*	*	*	*	
Za 60 Marama Crescent – GPS2598529E-6236990N. This site is located at the rear of a residential property at 60 Marama Crescent. Recently part of a drum was dug up.	*	*	*		
Zb Buller Street – GPS2603497E-6238487N. The site of the original Ivon Watkins Limited.	*		*		
Zc Tarahua Road - GPS2604173E-6235524N. This is a former warehouse of the original Ivon Watkins Ltd. The site is either sealed, metalled or concreted and was referred by the present owners	*		*		
Zd Tasman Sea – Adjacent to old Elliot Street sewer outfall					*
Ze Tank 3500 – GPS2597888E-6235965N. This is a known site on the old IWD dairy farm that has been confused with Ngahoro but is separate. The site was discovered by the then Ministry of Works during the construction of tanks at the tank farm in April/May 1985. IWD were advised and clean-up was undertaken in 1985	*	*	*		
Zf IWD-3 - Another alleged dumpsite on the IWD premises. The allegation refers to dumping of waste in a deep bunker.	*	*	*	*	
Zg IWD-4 - Another alleged dumpsite on the IWD premises. The allegation refers to drums punctured near the current incinerator.	*	*	*	*	
Zh Car Park – GPS2597919E-6236297N. This alleged site is near the car park west of the Herekawe Stream on a walking track to the beach and is often referred to Council as a chemical discharge and was included for completeness in this investigation.	*		*	*	*
Zi Herekawe cliff (Pylon 4) – GPS2598205E-6237049N. This alleged site is to the east of the Herekawe Stream and is a cliff discharge that is seen by surfers. It is also referred to as a chemical discharge.	*		*	*	
Zk Jury site – GPS2598766E-6236388N. This alleged site is at the end of Norwich Avenue and was originally a concrete bunker site on the former Jury farm in close proximity to the old Ngamotu Tavern. Old concrete is still visible. There is no waterbody nearby.	*		*		

4.3 Interpretation of results of chemical analyses

The findings of the investigations at each site are set out in Section 4.4 of this report. Details include the results of chemical analyses. The full results of the chemical analysis are attached to this report in Appendix IX.

The New Zealand soil criteria for dioxin are set out in Table 2 below. They have been prepared by the Ministry for the Environment and Ministry of Health (Health and Environmental Guidelines for Selected Timber Treatment Chemicals, 1997). Whether these soil criteria are appropriate is not a matter for the Council to determine. They are the criteria in use in New Zealand at the moment, and any query over their appropriateness is a matter for the Ministries of Health or Environment or ERMA to determine.

Table 2 NZ soil criteria for dioxin

	Agricultural	Residential	Industrial unpaved	Industrial paved	Industrial maintenance
Dioxins, ng I-TEQ kg ⁻¹	10	1500	18 000	90 000	21 000

In interpreting reported numerical values for the levels of dioxin in the environment, it is critical to note the units used. Generally, trace levels of substances in the environment are measured at levels of parts per million and expressed as milligrammes per kilogramme (mg kg⁻¹ for solids such as soils, or mg L⁻¹ for liquids). For even lower levels, the units are parts per billion- a thousand times lower. These quantities are expressed as microgrammes per kilogramme (ug kg⁻¹). However, for dioxin, environmental levels are so low and the limits of detection with modern instrumentation so good, that even smaller units have to be used. Dioxin concentrations are generally at levels of parts per trillion- a thousand times lower again, and expressed as nanogrammes per kilogramme (ng kg⁻¹, as in Table 2 above), or even parts per quadrillion, a thousand times lower again, and expressed as picogrammes per kilogramme (pg kg⁻¹).

$$1 \text{ pg kg}^{-1} = 0.001 \text{ ng kg}^{-1} = 0.000 \text{ 001 ug kg}^{-1} = 0.000 \text{ 000 001 mg kg}^{-1}.$$

There are two ways of indicating the significance of levels of dioxins in the environment. There are 75 different individual congeners or forms of dioxin, each differing according to the number and position of chlorine atoms around the basic structure. The most toxic are those with 4 chlorine atoms attached; of these, the most toxic is 2,3,7,8 TCDD. To enable an evaluation of complex mixtures of dioxins, a system of toxic equivalents has been developed (I-TEQ). Each individual dioxin is assigned a factor representing its toxicity in relation to 2,3,7,8 TCDD, which is assigned a value of 1. The dioxin 2,3,7,8 TCDD is the only congener assigned this value; the others have factors ranging from 0.5 down to 0.001. Most data and criteria reported in international literature report concentrations of dioxins in terms of I-TEQ units, rather than actual measured concentrations of individual congeners.

In this study, only 2,3,7,8 TCDD was analysed for. It is the most significant dioxin in terms of its toxicity. It is the primary dioxin of interest when the possible source is 2,4,5-T herbicide. And when present it would tend to dominate the I-TEQ value for a complete analysis, because of its comparatively high I-TEQ factor.

4.4 Findings at each site

Sites were identified and described in Stage One of this investigation. Following is a resume of activity and the findings at the sites, in relation to Stage Two. Detailed site inspections were conducted at each site discussed below, unless otherwise noted.

A Lawry Street

This site is alleged to have been used as an unauthorised dumping area prior to development of the property.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed that the majority of the site consists of fill material typical of a refuse tip. The data showed no evidence of a drum dumpsite. The site was already known to have been filled prior to subdivision.

Samples of soil, streambed sediment, and the stream water were collected at this site (4005, 4006, 4007, 4008). The streambed sample was analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:- no 2,3,7,8 TCDD was detected in the streambed sediment sample. The limit of detection was at a level of 8 parts per trillion. The limit of detection is far below the current residential guideline for NZ of 1500 ppt. There is no NZ guideline for recreational areas, which would typically be higher than for a residential area.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.

B Seaview Road

This site is alleged to have been used as an unauthorised dumping area prior to development of the property.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal soil strata across most of the site, with a small amount of fill material in one area. The data showed no evidence of a drum dumpsite. The site was already known to have been filled prior to development.

The streambed result reported above for Site A is below this site also.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.

C Pylon 3

This site was alleged to have been a casual dumping area prior to construction of Centennial Drive and development of the current industrial area. The site is probably the one where it is alleged a fenced off area containing liquid waste was sited.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed undisturbed soil strata across most of the site (a very large area). Data along and across Centennial Drive showed the presence of underground pipelines

running to the Port. At the southern end of the area, anomalous data gave some evidence of the possibility of disturbed subsurface strata and buried objects.

Following the receipt of this information, staff of the Council carried out an excavation within the area identified by the GPR operator as being the most critical area. This excavation found no evidence of disturbed subsurface layers, but instead found a natural iron pan, a hard impermeable layer of iron-rich minerals. There was no evidence of a drum dumpsite or of the disposal or burial of any wastes. The detailed record of the excavations is presented in Appendix VIII.

Samples of surface soil and sediment from beneath 2 areas of seep patches and from within the mouth of a pipe were collected at this site (4030, 4031, 4032, 4058). They were analysed for acid herbicides and organochlorine pesticides (seeps sediments) and for 2,3,7,8 TCDD (surface soil). The latter sample was collected at the request of DIAG/DIN. The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in the sediments. The limits of detection were 0.1-0.5 parts per million. No acid herbicides were detected in the sediments. The limit of detection was 0.1 parts per million.

The surface soil sample was collected as requested by DIAG/DIN from an area of undisturbed land. 2,3,7,8 TCDD was detected at a level of 29 parts per trillion in the surface soil sample. This result is consistent with the measurements of dioxin levels in this area made by the Department of Health in 1985, and by the Ministry for the Environment on Mount Moturoa in 1996. The level is far below the current residential guideline for NZ of 1500 ppt. There is no NZ guideline for recreational areas, which would normally be higher than for a residential area.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site.

Ca Centennial Drive

This site was alleged to have been a casual dumping area prior to construction of Centennial Drive and development of the current industrial area.

This site has previously been investigated by the Council in 1991, in regard to the collection and disposal of dieldrin in the 1960s and 1970s. Following a further detailed site inspection, it was considered there was no justification for any additional studies.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.

D 34 Rangitake Drive

This site was alleged to have been a casual dumping area prior to subdivision and was in the path of a tributary alleged to have carried stormwater from the IWD site.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across most of the site. Anomalous data in one area indicated the possibility of a few buried objects. The data showed no evidence that the site had been used as a drum dumpsite or for disposal of other buried refuse. The section is known to have been filled prior to subdivision.

Samples of soil and sediment from beneath seep patches and from the bed of the Herekawe Stream were collected at and below this site (4049, 4050, 4051, 4052). They were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in sediments taken on two different parts of the site, nor in sediments from the bed of the Herekawe Stream approximately 15 metres downstream of the property. The limits of detection were 0.1-0.5 parts per million. No acid herbicides were detected in any of the samples, at a detection limit of 0.1 ppm.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agrichemical wastes. Council staff will liase with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.

Da 44 Rangitake Drive/ Rangitake Drive carriageway

This section was an alleged casual dumpsite prior to subdivision.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across most of the site. Anomalous data in one area indicated the possibility of a few buried objects. The data showed no evidence of a drum dumpsite or other buried refuse. The section is known to have been filled prior to subdivision.

A GPR survey was also conducted along the length of the carriageway of Rangitake Drive. The detailed record is presented in Appendix IV. The survey showed normal soil strata data along the street, with underground services. The data showed no evidence of a drum dumpsite or other buried refuse.

Samples of surface soil were collected at the request of DIAG/DIN at this site (4060). They were analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:-2,3,7,8 TCDD was not detected in the surface soil sample. The limit of detection was less than 5 parts per trillion . This limit is far below the current residential guideline for NZ of 1500 ppt.

From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agrichemical wastes. Council staff will liase with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.

E Omata Reserve

This section was an alleged casual dumpsite in the 1970's.

Two GPR surveys were conducted at this site, to cover separate areas. The detailed records are presented in Appendix IV. The surveys showed normal soil strata data across all of the site. The data showed no evidence of previous site excavations, a drum dumpsite, or other buried refuse.

Samples taken in the Rangitake Drive sites relate also to this site.

Following a detailed site inspection, and based on the information provided by site owners that rejected any suggestion that the site had been used in the manner alleged, it was considered there was no justification for any additional studies.

From the investigations carried out by the Council at this site, there is no evidence to support the claims made concerning inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.

F IWD-1 South eastern corner of property

A site identified as an alleged disposal site by former staff.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal soil strata data across all of the site, and showed no evidence of previous site excavations, a drum dumpsite, or other buried refuse.

Samples of groundwater were collected from two groundwater monitoring bores within and on opposite sides of the area, maintained on the property (4062, 4065). They were analysed for acid herbicides and for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:-no acid herbicides were detected in Bore 21, to the west of this area, or in Bore 1, to the east. The limits of detection were 0.1 parts per billion. No 2,3,7,8 TCDD was detected in either bore. The limit of detection was 3-9 parts per quadrillion.

These results are at or below background levels of these chemicals. They show no evidence of burial or disposal of agrichemical wastes at this site.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.

The site is routinely monitored by the Council as part of an ongoing compliance monitoring programme.

G Marfell Park

A former authorised municipal landfill that received IWD liquid wastes during sewerage system maintenance.

A GPR survey was not conducted at this site. The site is a known previous municipal refuse disposal site.

Samples of leachate/stormwater from the park, soil from a point of seepage from the corner of Grenville and Endeavour Streets, sediment from beneath the point of discharge of leachate and stormwater into the Mangatuku Stream, and a sample from the stream were collected at this site (4000, 4001, 4002, 4057). They were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:- no acid herbicides were detected in the seepage, at a limit of detection of 0.1 parts per million, or organochlorine pesticides, at a detection limit of 0.1-0.3 ppm.

No organochlorine pesticides were detected in the leachate flowing from the drain. The limit of detection was 1-2 parts per billion. No acid herbicides, other than 2,4-D at a level of 3 parts per billion, were detected in the leachate flowing from the drain. The limit of detection was 1 ppb.

The New Plymouth District Council had collected a sample of the discharge from the park just prior to the present study being undertaken, and had had a complete dioxin analysis undertaken. The full results are presented in Appendix IX (referred to as Cook Street). No 2,3,7,8 TCDD was detected. The limit of detection was 2 parts per quadrillion. Other dioxins (non 2,3,7,8 TCDD) were detected, at 9.3 ppq. This indicates a source or sources other than agricultural wastes.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural-contaminated wastes at this site. There is no evidence of contamination of the site by such wastes, or of an environmental risk.

The site is routinely monitored by the Council as part of an ongoing compliance monitoring programme.

H Ngamotu Domain

A former authorised municipal landfill that received IWD liquid wastes during sewerage system maintenance.

A GPR survey was not conducted at this site. It is a known landfill. The issue of concern related to liquid wastes.

Samples of streambed sediment and discharges were collected at this site (4004, 4022, 4023, 4024). They were analysed for acid herbicides and organochlorine pesticides (discharges). The results are presented in full in Appendix IX. The results are as follows:- no acid herbicides were detected in the discharges. The limit of detection was 0.1 parts per billion. No organochlorine pesticides were detected in the discharges, at a limit of detection of 0.1 parts per million.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural-contaminated wastes at this site. There is no evidence of contamination of the site by such wastes, or of an environmental risk.

I 7A Squire Place

A site where a stormwater culvert discharges, above Ngamotu Domain (site H). An alleged contaminated soil disposal site.

A GPR survey was not conducted at this site.

A sample of sediment from below the discharge was collected at this site (4003). It was analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:- no 2,3,7,8 TCDD was detected in the sediment sample. The limit of detection was 10 parts per trillion. This limit is far below the current residential guideline

for NZ of 1500 ppt. There is no NZ guideline for recreational areas, which would be higher than for a residential area.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.

J Belt Road

A former unauthorised discharge area that received liquid wastes from the Paritutu area during sewerage system maintenance.

A GPR survey was not conducted at this site, as the issue was disposal of liquid wastes onto the ground.

Samples of surface soil were collected at this site (4026, 4043). The second sample was collected following clarification of the location of the alleged disposal site by DIAG/DIN. It was analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:-no 2,3,7,8 TCDD was detected in the surface soil sample. The limit of detection was at a level of less than 9 parts per trillion. The limit of detection is far below the current residential guideline for New Zealand of 1500 ppt. There is no New Zealand guideline for recreational areas, which would be higher than for a residential area.

The marine ecology on the foreshore in the vicinity of the site was surveyed. Samples of biota were collected for analysis for 2,3,7,8 TCDD. The results are presented in Appendix VI.

The marine ecology was found to be in a healthy state, and the levels of 2,3,7,8 TCDD similar to those found by the Ministry for the Environment in its survey of background levels of dioxins in marine biota around New Zealand.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural-contaminated wastes at this site. There is no evidence of site contamination, or of an environmental risk, either on the site or in the adjoining marine environment.

K Victoria Road, Oakura

A farmlet that received 200 litre drums of offspec chemical for weed control.

A GPR survey was not conducted at this site, as the issue was discharge of liquid agricultural chemicals onto land.

A detailed site inspection by Council staff found no reason to conduct further investigations. From the investigations carried out by the Council at this site, while there was unorthodox weed control operations, there is no evidence of inappropriate burial of agricultural wastes at this site.

L 23C Tahurangi Place

An alleged stormwater discharge point off the IWD site prior to subdivision.

A GPR survey was not conducted at this site, as the issue in hand was that of stormwater discharge, not drum disposal.

Samples of surface soil from the rear of the property and from beneath the house were collected and analysed for 2,3,7,8 TCDD and for acid herbicides (4053, 4054). The results are presented in full in Appendix IX. The results are as follows:-no acid herbicides were detected in either of the samples. The limits of detection were 0.1 parts per million. No 2,3,7,8 TCDD was detected in either of the two soil samples. The limit of detection was 4-6 parts per trillion. This detection limit is below the New Zealand agricultural guideline, of 10 ppt, and far below the residential guideline, of 1500 ppt.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.

M Beach Road-1

An alleged dumping site of 200 litre drums. This site may have been confused with the Ngahoro Site (site Z), where drums were dumped and have since been removed.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across the majority of the site. In one part of the site the GPR data showed anomalies consistent with pipes, at a considerable depth (4 metres). The data showed no evidence of a drum dumpsite or other buried refuse.

A sample of sediment from a swampy area was collected at this site (4009, 4010). The sediment sample was analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:- 2,3,7,8 TCDD was detected at 2.0 parts per trillion.

This result is well below the NZ agricultural soil standard of 10 ppt..

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.

N Waireka rehabilitated dumpsite

The IWD dumpsite rehabilitated during the mid 1980s..

A GPR survey was not conducted at this site. The site was comprehensively examined and remediated during the early 1980s

Samples of whelks were collected and analysed for the presence of acid herbicides and for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. No acid herbicides were detected, at a detection limit of 0.1 parts per million.

The marine ecology in the vicinity of the outfall was surveyed. Samples of biota were collected for analysis for 2,3,7,8 TCDD. The results are presented in Appendix VI. The marine ecology was found to be in a healthy state, and the levels of 2,3,7,8 TCDD similar to those found by the Ministry for the Environment in its survey of background levels of dioxins in marine biota around New Zealand.

A sample of the leachate collected in a rock pool beneath the seepage discharge area was collected and analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. No 2,3,7,8 TCDD was detected. The limit of detection was 8 parts per quadrillion.

From the investigations carried out by the Council at this site, there is no evidence of an environmental risk arising from the low level continuing discharge of groundwater and leachate at this site.

O Pioneer Road

Another identification of the Ngamotu Domain site (see site H).

P 26A Rangitake Drive

This section was in the path of a small tributary of the Herekawe Stream which carried stormwater from the IWD site prior to subdivision and was also an alleged casual dumpsite.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across most of the site. Anomalous data in one area indicated the possibility of a few buried objects, while data from another area indicated buried refuse or similar small objects. The data showed no evidence of a drum dumpsite. The section is known to have been filled prior to subdivision.

Samples of soil and sediment from beneath seep patches were collected at this site (4044, 4045, 4046, 4047). They were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in sediments taken on two different parts of the site, nor in sediments from the bed of the Herekawe Stream approximately 30 metres downstream of the property. The limits of detection were 0.1-0.3 parts per million. No acid herbicides were detected in any sample, at a limit of detection of 0.1 ppm.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agricultural wastes. Council staff will liaise with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.

Q Rifle Range Road/Bewley Road

A former authorised municipal landfill alleged to have received IWD wastes.

A GPR survey was not conducted at this site, as it is a known past refuse disposal site covering a wide area.

Samples of leachate seepage, groundwater, and sediments were collected at several points across this site (4035, 4037, 4038, 4039, 4040, 4041, 4042). These included sampling all observed seepage points. They were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in the groundwater sample. The limits of detection were 1-2 parts per billion. No acid herbicides were detected in the same sample. The limit of detection was 0.1 ppb. No organochlorine pesticides were

detected in the sediment samples (limit of detection 0.1-0.5 parts per million). No acid herbicides were discovered in the sediment samples. The limits of detection were 0.1 parts per million.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite, or of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of contamination of the site by agrichemicals, or of an environmental risk.

The site is routinely monitored by the Council as part of an ongoing compliance monitoring programme.

R Beach Road-2

A dumping site of 200 litre drums that have since been removed.

A GPR survey was conducted at this site. The area to be studied was pinpointed by the nature of the allegations. The detailed record is presented in Appendix IV. The survey showed normal data across all of the site. The data showed no evidence of buried drums or other buried refuse. The site is flat, and has been recontoured. There was no sign of discharges to the environment from the site.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site since the removal of known wastes and remediation. There is no evidence of site contamination, or of an environmental risk.

S not assigned- combined with Site I

T Colson Road landfill

Current municipal landfill for New Plymouth alleged to have received agrichemical wastes.

The landfill is routinely inspected and sampled by the Council as part of an ongoing compliance monitoring programme.

The New Plymouth District Council had collected a sample of the leachate discharge from the landfill just prior to the present study being undertaken, and had had a complete dioxin analysis undertaken. The full results are presented in Appendix IX. No 2,3,7,8 TCDD was detected. The limit of detection was 2 parts per quadrillion. No other dioxin congeners were detected. The limits of detection were 1-10 ppq.

From the routine ongoing monitoring carried out by the Council at this site, there is no evidence of the use of the site as a drum dumpsite, or of the inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of contamination of the site by agrichemicals, or of an environmental risk.

U IWD-2 South west area of property

A site identified as an alleged storage site for wastes, by former staff.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal soil strata data across the site, together with a significant underlying rock formation. The formation was already known from previous site studies. The data showed no evidence of previous site excavations, a drum dumpsite, or other buried refuse.

Samples of groundwater were collected from two groundwater monitoring bores, one at each end of and within this site (4063, 4068). The results are presented in full in Appendix IX. The results were as follows:-of the eleven acid herbicides analysed for, no acid herbicides were detected in Bore 43, to the east, except for picloram at a level of 0.1 parts per billion. No acid herbicides were detected in Bore 6, to the northwest, except for picloram at a level of 16 parts per billion. A repeat analysis of the sample from Bore 6 gave a result of 9.1 parts per billion.

There is no NZ Drinking Water Standard for picloram. However, the level detected in the groundwater is comparable with the NZ Drinking Water standards for various other acid herbicides (2,4-D 30 ppb, 2,4 DB 100 ppb, MCPA 2 ppb, mecoprop 10 ppb, dichlorprop 100 ppb, 2,4,5-T 10 ppb). The direction of flow is towards the northwest. Sampling of cliff face seeps at Site Zi, downflow of this site, did not detect any acid herbicides except for picloram at a level of 0.2 ppb. Given this result, and the processes of natural attenuation and degradation, it is considered that there are no grounds for environmental concern for picloram at this level.

No 2,3,7,8 TCDD was detected in either bore. The limit of detection was 2-3 parts per quadrillion.

Other than for picloram, these results are at or below normal background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of agrichemical wastes at this site. There is no evidence of an environmental risk.

The site is routinely monitored by Council staff, as part of an ongoing compliance monitoring programme

V Centennial-2

The former stormwater discharge point to the Tasman Sea from the office block area of IWD.

A GPR survey was not conducted at this site.

Samples of the discharge from the pipe, and sediment beneath the discharge, were collected at this site (4033,4034). They were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in the discharge, nor in the sediments from beneath the flow. The limits of detection were 0.01-0.2 parts per billion for the discharge, and 0.1-0.5 parts per million for the sediment. No acid herbicides were detected in the discharge except for 2,4,5-T at a level of 0.4 parts per billion. The limit of detection was 0.1 ppb. No acid herbicides were detected in the sediments. The limit of detection was 0.1 parts per million.

Except for the 2,4,5-T result (which is well below the NZ drinking water standard of 10 ppt), these results are at or below background levels of these chemicals.

The marine ecology in the vicinity of the outfall was surveyed. Samples of biota were collected for analysis for 2,3,7,8 TCDD. The results are presented in Appendix VI.

The marine ecology was found to be in a healthy state. The levels of 2,3,7,8 TCDD found in the biota were slightly elevated above those found by the Ministry for the Environment in its survey of background levels of dioxins in marine biota around NZ. However, the levels were similar to those found in seafood in the Ministry's study of dioxin intake in New Zealand diets.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate discharge of agricultural wastes at this site. There is no evidence of an environmental risk.

W Herekawe Stream

The current stormwater discharge point from Dow AgroSciences. It is routinely monitored by the Council. Additional investigations were conducted as part of this study.

A GPR survey was not conducted at this site.

A sample of the discharge from the pipe was collected at this site. It was analysed for acid herbicides. The results are presented in full in Appendix IX. The results are as follows:-no acid herbicides were detected in the sample. The limits of detection were 0.1 parts per million.

These results are at or below background levels of these chemicals, and validate data routinely supplied by the Company to the Council, in addition to the Council's own test results on other occasions.

The marine ecology in the vicinity of the stream mouth was surveyed. The results are presented in Appendix VI. The marine ecology was found to be in a healthy state.

Additional information on this site is reported annually by the Council in its compliance monitoring programme report for the Herekawe catchment.

From the investigations carried out by the Council at this site, there is no evidence of any effects arising from inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination, or of an environmental risk.

X Roto Street

An alleged dumpsite on the former plant nursery site.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed that the majority of the site consists of fill and debris material. The data showed no evidence of a drum dumpsite. The section is known to have been filled prior to subdivision.

Samples of soil (two areas), streambed sediment, seepage, and stream flow were collected at this site (4016, 4017, 4018, 4019, 4020, 4021). They were analysed for acid

herbicides and organochlorine pesticides (seeps). The results are presented in full in Appendix IX. The results are as follows:-no organochlorine pesticides were detected in the seep. The limits of detection were 0.01-0.2 parts per billion. No acid herbicides were detected in the seep. The limits of detection were 0.1 ppb.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of drums or disposal of agrichemical wastes at this site. There is no evidence of contamination of the seep, or of an environmental risk.

Y not assigned- combined with Site Q

Z Ngahoro

A known dumping site of 200 litre drums, that was rehabilitated in the 1980s.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across the top part of the site, and an anomalous area that is consistent with a previous excavation. This corresponds to the known use of this site for a drum disposal area in the 1970s and early 1980s, as described in Section 3 of this report. The data showed no evidence of a current drum dumpsite or other buried refuse.

Samples of soil and sediment from two swampy areas, to the northwest and southwest, were collected at this site. They were analysed for 2,3,7,8 TCDD. The results are presented in full in Appendix IX. The results are as follows:-2,3,7,8 TCDD was detected at a concentration of 330 parts per trillion in the northwest sample. This result is consistent with the known previous use of this site for disposal of agrichemical manufacturing wastes in the 1970s and early 1980s. The area of contamination is confined.

From the investigations carried out by the Council at this site, there is no new evidence of inappropriate disposal of agrichemical wastes at this site, other than that already known and remediated. There is no evidence of a significant environmental risk.

Za 60 Marama Crescent

An alleged casual dumpsite.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed in situ soil strata data across all of the site that was surveyed. There is a recent open excavation on the site.

The data showed no evidence of previous site excavations, a drum dumpsite, or other buried refuse.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site.

Zb Buller Street

The site of the original Ivon Watkins Limited.

This site has been previously investigated by the Council, including soil sampling and analysis. DDT at levels from less than 0.01 up to 1.3 parts per million were detected in soil. No 2,4,5-T was detected, and 2,4 D was detected in one soil sample only, at 0.8 ppm. No DDT or acid herbicide was detected in a sample of stormwater.

A GPR survey was not conducted at this site.

Samples of marine biota were collected for analysis for 2,3,7,8 TCDD from the vicinity of the old Elliot Street sewerage outfall, which would have been in use at the time this site was occupied by IWD. The marine ecology in the vicinity of the outfall was surveyed. These results are presented in the report on Site Zd below.

These results are marginally above background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination above recognised guidelines, or of an environmental risk.

Zc Tarahua Road

The site of a former Ivon Watkins Limited warehouse.

Following a detailed site inspection and discussion with the current owner, no further investigations were considered justified or were undertaken. The site is effectively capped by buildings and paved areas, such that there is no risk pathway even if contamination did exist.

Zd Tasman Sea - old Elliot Street outfall

The outfall off Elliot Street that included stormwater discharge from Buller Street.

The marine ecology in the vicinity of the outfall was surveyed. Samples of biota were collected for analysis for 2,3,7,8 TCDD. The results are presented in Appendix VI.

The marine ecology was found to be in a healthy state. The levels of 2,3,7,8 TCDD were slightly elevated above those at the control sites for this study and those found by the Ministry for the Environment in its survey of background levels of dioxins in marine biota around New Zealand. This is to be expected for a municipal sewage discharge, and the level detected is typical of those reported elsewhere.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate disposal of agricultural wastes through the outfall. Dioxin levels in marine biota are in accord with background levels elsewhere. There is no evidence of an environmental risk.

Ze Tank 3500

A known disposal site of 200 litre drums, that was rehabilitated in the 1980s..

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across most of the site. Anomalous data in one area indicated the possibility of a large excavation or depression approximately 55 by 20 metres, to a maximum depth of 3 metres, and with strong anomalies indicating foreign objects, possibly metallic in nature. The GPR data was further confirmed by an electro-

magnetic induction survey to study the conductivity of the soil. The site was in the vicinity of the known Ngahoro dump site.

Following the receipt of this information, staff of the Council carried out three excavations within the area identified by the GPR operator as being the most critical area. This excavation found a bed of logs and stumps at a depth of 3 metres, in all three excavations. There was no evidence of a drum dumpsite or of the disposal or burial of any wastes. The detailed record of the excavations is presented in Appendix VIII.

No discharges from the area into the environment in the vicinity were found.

From the investigations carried out by the Council at this site, there is no evidence of ongoing site contamination, or of an environmental risk, since the site was remediated.

Zf IWD-3 South eastern corner of site, north of Site F

A site identified by former staff as an alleged disposal site.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal soil strata data across the majority of the site. In one area there was evidence of a previous excavation and buried debris or fill material. This corresponds to the alleged placement of wastes in this vicinity. There was no evidence of a drum dumpsite.

Samples of groundwater were collected from two groundwater monitoring bores maintained on the property. They were analysed for acid herbicides and for 2,3,7,8 TCDD. The results are presented in full in Appendix VII. The results are as follows:-no acid herbicides were detected in Bore 4, to the west of this area, or in Bore 3, to the east. The limits of detection were 0.1 parts per billion.

No 2,3,7,8 TCDD was detected in either bore. The limit of detection was 2-4 parts per quadrillion.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of drums at this site. There is no evidence of site contamination, or of an environmental risk.

The site is routinely monitored by the Council as part of an ongoing compliance monitoring programme.

Zg IWD-4 Western area, middle of site

An alleged site where drums were punctured by gun shots, identified by former staff.

No GPR survey was conducted in the area, as the allegations concerned the discharge of liquids onto the ground rather than burial, there are underground services in the area that would dominate GPR data, and iron pans in the vicinity would also interfere with the GPR data.

Site investigations conducted by plant staff since 1994, and reported on an ongoing basis to the Council, have separately identified two areas of ground with low levels of product contamination in this area. The contamination is believed to have come from leakage

from stored material, but the source of the discharge (whether deliberate or not) cannot be verified. The area is not a process area.

Samples of groundwater were collected from two groundwater monitoring bores, downflow of this site (4064, 4069). The results are presented in full in Appendix IX. The results were as follows:-of the eleven acid herbicides analysed for, 2,4 DB was detected at 0.1 parts per billion, fenoprop at 0.2 ppb, and picloram at 0.6 ppb, in Bore 49A. In Bore 46A, 8 acid herbicides were detected at concentrations of less than 1.3 ppb, and picloram at 11 ppb. These results confirm the data that has been supplied to the Council since 1994, and reported publicly through the Council's annual compliance reports for the site. They show no evidence of burial or disposal of agrichemical wastes at this site. Monitoring since 1994 has shown the levels to be steadily decreasing. Given this result, and the processes of natural attenuation and degradation, it is considered that there are no grounds for environmental concern..

No 2,3,7,8 TCDD was detected in either bore. The limits of detection were 10-20 parts per quadrillion.

From the investigations carried out by the Council, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. Where there is evidence of groundwater contamination, there is no evidence of an environmental risk.

The site is routinely monitored by the Council as part of an ongoing compliance monitoring programme.

Zh Car park, Herekawe Stream

A site near the carpark near the Herekawe stream where cliff face seeps have been the subject of regular complaints to the Council.

A GPR survey was not conducted at this site.

A sample of sediment from immediately beneath the cliff face seepage was collected at this site. It were analysed for acid herbicides and for organochlorine pesticides. The results are presented in full in Appendix IX. The results are as follows:-no acid herbicides were detected in the sample. The limits of detection were 0.1 parts per million. No organochlorine pesticides were detected at this site. The limits of detection were 0.1-0.3 ppm.

These results are at or below background levels of these chemicals.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of contamination of the seep, or of an environmental risk.

Zi Herekawe cliff site (Pylon 4)

An alleged casual dumpsite.

A GPR survey was conducted at this site. The detailed record is presented in Appendix IV. The survey showed normal data across most of the site. Anomalous data in one area indicated the possibility of a couple of large objects or rock formations. The data showed no evidence of previous site excavations, a drum dumpsite, or other buried refuse.

Samples of seepage, sediment from 2 areas beneath the seepage zone, and surface soil were collected at this site. The seepage was analysed for acid herbicides and for organochlorine pesticides. The surface soil was analysed for 2,3,7,8 TCDD. This latter sample was collected from undisturbed soil, as requested by DIAG/DIN. The results are presented in full in Appendix IX. The results are as follows:- no organochlorine pesticides were detected in the seepage sample, at a limit of detection of 0.01-0.2 parts per billion. No acid herbicides were detected in the seepage sample, at a limit of detection of 0.1 ppb, except for picloram at a level of 0.2 ppb. 2,3,7,8 TCDD was detected in the surface soil sample at a level of 8.1 parts per trillion. The New Zealand agricultural guideline is 10 ppt, and the residential guideline is 1500 ppt.

From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of an environmental risk.

Zk Jury site

An alleged site relating to the existence of a large concrete bunker.

A GPR survey was not conducted at this site. Following a detailed site inspection, it was considered that there were no grounds to pursue investigations on this site any further.

Photographic analysis identified where a large bunker on the former IWD farm had been located. The bunker probably relates to this allegation (see page 7).

From the investigations carried out by the Council at this site, it was concluded that the original allegations concerned other sites rather than this one. There is no evidence of inappropriate burial or disposal of agricultural wastes at this site.

5. Summary

This report represents the completion of Stage Two of the Council's investigations into allegations of the existence of dump sites arising from the inappropriate disposal of agricultural waste from the Ivon Watkins Dow plant on Paritutu Road, New Plymouth. The disposal of such wastes, contaminated in particular with dioxin as a byproduct of the manufacture of herbicides 2,4,5-T and 2,4-D was alleged to have occurred between 1960 and 1980.

Stage One of the Council's investigations was the establishment of the 36 possible locations of such sites for further investigation.

The purpose of Council's action in Stage Two of this investigation was firstly to ascertain whether there was any environmental risk arising from any of the identified potential dump sites and secondly to ascertain whether any inappropriate dumping or disposal had occurred.

The sites identified for further investigation in Stage Two fell readily into four groupings. The first grouping covered 11 sites currently or historically held by IWD. All of these sites were known to and had been previously investigated by the Council, indeed five of the sites were the known dump sites rehabilitated in the 1980s.

The second grouping was of six sites where alleged historic surface contamination from stormwater from the IWD plant had occurred. The allegations on these sites did not involve dumping or burial of contaminated waste.

The third grouping of seven sites were known municipal landfills and sewage discharge outfalls operating during the period 1960 to 1980. With each of these sites there is no direct link to IWD. If disposal of contaminated wastes occurred it was in all probability in accordance with the standards of the time and undertaken by a range of parties ie, contractors, councils and the company.

The fourth grouping of twelve sites centres on alleged substantial dump sites and alleged contaminated seepages. This grouping was of sites generally not known or previously investigated by the Council and was identified in the course of the Stage One interviews.

Table 3 contains the recommendations and conclusions with respect to each site sorted by the groupings identified.

Table 3 Summary of recommendations

Group 1 IWD premises (current and historical)	
F	IWD-1 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.
U	IWD-2 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of agricultural wastes at this site. There is no evidence of an environmental risk.
Zf	IWD-3 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of drums at this site. There is no evidence of site contamination, or of an environmental risk.
Zg	IWD-4 From the investigations carried out by the Council, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. Where there is evidence of groundwater contamination, there is no evidence of an environmental risk.
M	Beach Road-1 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.
N	Waireka Rehabilitated Dumpsite From the investigations carried out by the Council at this site, there is no evidence of an environmental risk arising from the low level continuing discharge of groundwater and leachate at this site.
R	Beach Road-2 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site since the removal of known wastes and remediation. There is no evidence of site contamination, or of an environmental risk.
Z	Ngahoro From the investigations carried out by the Council at this site, there is no new evidence of inappropriate disposal of agricultural wastes at this site, other than that already known and remediated. There is no evidence of a significant environmental risk.
Ze	Tank 3500 From the investigations carried out by the Council at this site, there is no evidence of ongoing site contamination, or of an environmental risk, since the site was remediated.
Zb	Buller Street From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination above recognised guidelines, or of an environmental risk.

Zc	Tarahua Road Following a detailed site inspection and discussion with the current owner, no further investigations were considered justified or were undertaken. The site is effectively capped by buildings and paved areas, such that there is no risk pathway even if contamination did exist.
Group 2 Alleged IWD stormwater discharges	
D	34 Rangitake Drive From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agricultural wastes. Council staff will liaise with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.
Da	44 Rangitake Drive From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agricultural wastes. Council staff will liaise with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.
L	23C Tahurangi Place From the investigations carried out by the Council at this site, there is no evidence of inappropriate disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.
P	26A Rangitake Drive From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite or for the inappropriate burial or disposal of agricultural wastes. Council staff will liaise with the site owner if any further work to determine the nature of the objects shown in the GPR data is desired. There is no evidence of site contamination, or of an environmental risk.
V	Centennial-2 From the investigations carried out by the Council at this site, there is no evidence of inappropriate discharge of agricultural wastes at this site. There is no evidence of an environmental risk.
W	Herekawe Stream From the investigations carried out by the Council at this site, there is no evidence of any effects arising from inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination, or of an environmental risk.
Group 3 Municipal waste disposal systems	
G	Marfell Park (landfill) From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural-contaminated wastes at this site. There is no evidence of contamination of the site by such wastes, or of an environmental risk.
H	Ngamotu Domain (landfill) From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural-contaminated wastes at this site. There is no evidence of contamination of the site by such wastes, or of an environmental risk.
O	Pioneer Road Another identification of the Ngamotu Domain site (see site H).
I	7A Squire Place From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of site contamination, or of an environmental risk.
Q	Rifle Range Road/Bewley Road (landfill) From the investigations carried out by the Council at this site, there is no evidence of the use of this site as a drum dumpsite, or of inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination of the site by agriculturals, or of an environmental risk.
T	Colson Road landfill From the routine ongoing monitoring carried out by the Council at this site, there is no evidence of the use of the site as a drum dumpsite, or of the inappropriate burial or disposal of agricultural wastes at this site. There is no evidence of contamination of the site by agriculturals, or of an environmental risk.

Zd	Tasman Sea (Elliot Street outfall) From the investigations carried out by the Council at this site, there is no evidence of inappropriate disposal of agrichemical wastes through the outfall. Dioxin levels in marine biota are in accord with background levels elsewhere. There is no evidence of an environmental risk.
Group 4 Alleged burial/seepages	
A	Lawry Street From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.
B	Seaview Road From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.
C	Pylon 3 From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site.
Ca	Centennial Drive From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.
E	Omata Reserve From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of site contamination, or of an environmental risk.
J	Belt Road From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical-contaminated wastes at this site. There is no evidence of site contamination, or of an environmental risk, either on the site or in the adjoining marine environment.
K	Victoria Road, Oakura A detailed site inspection by Council staff found no reason to conduct further investigations. From the investigations carried out by the Council at this site, while there was unorthodox weed control operations, there is no evidence of inappropriate burial of agrichemical wastes at this site.
Za	60 Marama Crescent From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site.
Zk	Jury site From the investigations carried out by the Council at this site, it was concluded that the original allegations concerned other sites rather than this one. There is no evidence of inappropriate burial or disposal of agrichemical wastes at this site.
X	Roto Street From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial of drums or disposal of agrichemical wastes at this site. There is no evidence of contamination of the seep, or of an environmental risk.
Zh	Car park From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of contamination of the seep, or of an environmental risk.
Zi	Herekawe cliff site (Pylon 4) From the investigations carried out by the Council at this site, there is no evidence of inappropriate burial or disposal of agrichemical wastes at this site. There is no evidence of an environmental risk.

In conclusion the results of the Council's Stage Two investigation indicate:

- There is no evidence that any disposal of agrichemical wastes at sites (other than those already known as disposal sites) has led to environmental contamination. In particular, no contamination was found at or near any residential property.

- At the known sites, this investigation has confirmed what was already known or expected to be the situation, in respect of the presence and levels of some agrichemical contaminants.
- There is no evidence of environmental risk at any site, or in the marine environment in the vicinity of those sites that were on the coast.
- No new drum dumpsites have been found.

The Council at this point has no evidence that any further action is required at any of the sites investigated.

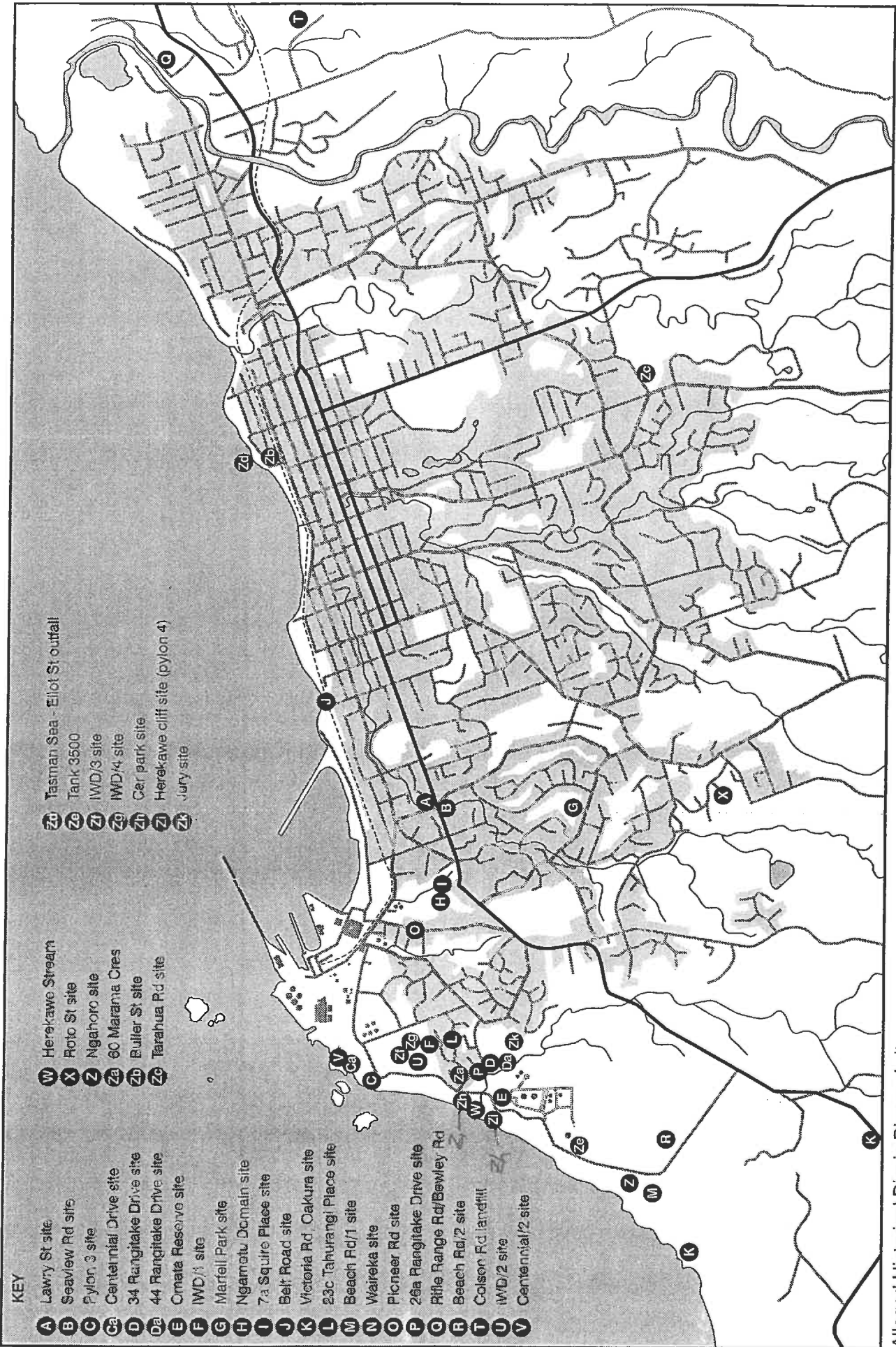
Appendix I
Record of interviews

Contact ID	Name	Officer	Date of contact	Site reference
001	Andrew Gibbs	Brian Calkin	14-12-01	A-J
002	Douglas and Geoffrey Black	Brian Calkin	16-02-01	K-Victoria Rd
003	Joanne Ngaia	Brian Calkin	22-02-01	L-23C Tahurangi
004	Steve Tooley	Brian Calkin	22-02-01	M-Ngahoro
005	Moturoa Primary School	Bruce Pope	23-02-01	N/A
006	Wayne Baker	Bruce Pope	01-02-01	Fa-Paritutu-2
007	Kennedy's Gardens	Bruce Pope	01-02-01	N/A
008	Eric Schwass	Bruce Pope	23-02-01	P-26A Rangitake
009	Trevor Humphries	Brian Calkin	27-02-01	H & J
010	Ted Burrows	Brian Calkin	27-02-01	Zb-Buller
011	Ross McDonald	Bruce Pope	23-02-01	Q-Rifle Range
012	Ian McLeod	Bruce Pope	22-02-01	Da, M, T & Y
013	Ian Wishart	Brian Calkin	07-03-01	N/A
014	Sam Lowe	Bruce Pope	23-02-01	R-Beach Road
015	Belt Road Motor Camp	Brian Calkin	22-02-01	J-Belt Road
016	Neil Herdson	Bruce Pope	22-02-01	N-Waireka
017	Hilton Alsop	Bruce Pope	26-02-01	N/A
018	Grant Webster, Aim Demolition	Brian Calkin	22-02-01	Zd
019	Julie Warren	Bruce Pope	26-02-01	N/A
020	Ian Barnes	Bruce Pope	22-02-01	N/A
021	Murray Wells	Bruce Pope	22-02-01	N/A
022	David Law	Bruce Pope	22-02-01	S (now included with I)
023	New Plymouth District Council	Brian Calkin Catherine Law	28-05-01	Various
024	Mrs Clarke	Brian Calkin	Not traced	Not traced
025	Kathryn Parker	Brian Calkin	01-03-01	C
026	Paddy Burt	Brian Calkin	22-02-01	C, Da, J & various
027	Frances George	Brian Calkin	28-02-01	N-Waireka
028	Ray Looney	Bruce Pope	deceased	deceased

029	Pam Broughton	Bruce Pope	Not traced	No information
030	Trevor Fleming	Bruce Pope	28-02-01	G-Marfell
031	Les Balsom	Bruce Pope	14-03-01	N/A
032	Ashley Heydon	Bruce Pope	05-03-01	N/A
033	Brian Martin	Brian Calkin	deceased	deceased
034	Tim Wells	Brian Calkin	28-02-01	N/A
035	Brian Grant (Kibby's)	Brian Calkin	28-02-01	M & N
036	Bruce Pope	Brian Calkin	28-02-01	F-Paritutu-Dow
037	Chris Burr	Bruce Pope	05-03-01	N/A
038	Maurice Vickers	Brian Calkin	05-03-01	F-Paritutu Dow
039	Noel Pickford	Brian Calkin	05-03-01	N/A
040	Jenny ?	Brian Calkin	01-03-01	Not traced
041	Gerry Gerard	Bruce Pope	01-03-01	M-Ngahoro
042	Brian Gundersen	Bruce Pope	01-03-01	No information
043	Bill Wanstall	Bruce Pope	01-03-01	M-Ngahoro
044	Cheryl Dormer	Bruce Pope	05-04-01	No information
045	Stuart Glen	Bruce Pope	12-04-01	No information
046	Tom Dean	Bruce Pope	12-04-01	No information
047	John Goldworthy	Bruce Pope	12-04-01	No information
048	Bullocks Wanganui	Brian Calkin	27-03-01	N/A
049	Brian Neilson	Bruce Pope	09-03-01	F-Paritutu
050	Dale Feelan	Bruce Pope	09-03-01	X-Roto
051	W & M Usher	Brian Calkin	28-03-01	D-Rangitake
052	Don Sarten	Brian Calkin	08-04-01	F & D
053	Roebucks	Brian Calkin	29-06-01	No information
054	Noel Krutz	Bruce Pope	19-03-01	Z-Ngahoro 2
055	Chris Hickey	Bruce Pope	02-04-01	Z-Ngahoro-2
056	Athol Rowe	Bruce Pope	20-03-01	U-Centennial 3
057	Roy Drake	Bruce Pope	20-03-01	Y (now included with Q)

058	Kerry Tatley	Bruce Pope	26-03-01	N/A
059	Peter O'Donnell	Brian Calkin	20-03-01	U
060	Jason Eade	Bruce Pope	03-04-01	N/A
061	Margeret Sullivan (Jnr)	Bruce Pope	03-04-01	N/A
062	Frank Ferrier	Bruce Pope	03-04-01	N/A
063	Melanie Bovey	Bruce Pope	04-04-01	L-Tahurangi
064	Mrs Scrivener	Bruce Pope	23-04-01	No information
065	Jason Ray	Bruce Pope	20-03-01	Y (now included with Q)
066	Doctor Mike Patric	Brian Calkin	11-04-01	N
067	Colin Mercer	Brian Calkin	06-04-01	N
068	Dorothy Doig	Brian Calkin	1st meeting	D, L & P
069	Margaret Scannell	Brian Calkin	11-04-01	D
070	Gabrielle Alsop	Brian Calkin	10-04-01	Various
071	Dot Browning	Bruce Pope	Not traced	No information
072	Mrs Askew	Bruce Pope	20-04-01	No information
073	Patricia Austin	Brian Calkin	10-04-01	General
074	Brian Williams	Brian Calkin	10-04-01	I & S
075	Geoff Smales	Brian Calkin	10-04-01	No information
076	Maori lady, Waitara	Brian Calkin	Not traced	Not traced
077	Maureen Wakeman	Brian Calkin	17-04-01	No information
078	Noel Hayman	Brian Calkin	17-04-01	G
079	Jane ?	Brian Calkin	Not traced	Not traced
080	Eva Jury	Brian Calkin	20-04-01	Zk
081	Raywyn Baylis	Bruce Pope	20-04-01	General
082	Isabell O'Donell	Brian Calkin	Not traced	No information
083	Bert Squire	Bruce Pope	08-05-01	I
084	Bruce Coxhead	Bruce Pope	16-08-01	R

Appendix II
Map



Alleged Historical Dioxin Disposal sites.

Appendix III
Sampling protocols

Taranaki Regional Council: Sampling protocols for dioxin investigations at alleged historical sites

This protocol has been prepared by Gary Bedford, Technical Services Manager, Brian Calkin, Inspectorate Manager, and John Williams, Laboratory Manager, Taranaki Regional Council.

Date of preparation: 5 June 2001

This version supersedes all earlier versions

Objective

These sampling and analytical protocols relate to part of an investigation that the Taranaki Regional Council is conducting into determining the whereabouts and possible environmental risk of alleged 'dioxin dumps' in the New Plymouth area. As part of a suite of investigative techniques, the Council has determined to collect water and soil samples, as appropriate, at sites identified to Council staff as possibly having been used for the dumping or disposal of agrichemical-related wastes. The sampling programme is designed as part of an initial screening of the possible sites, and is not intended to be a comprehensive or exhaustive site investigation. Further study - e.g. background sampling, analysis of individual samples, the collection of additional samples at a greater intensity, etc, would be considered in the event that a risk is indicated based on average results being above guideline or known background values.

The Council is focusing on whether there is an actual or plausible environmental risk at any of the sites. It is considered that the primary route of exposure would be by release from any buried reservoir, via leaching into groundwater and thence into the surface environment. Therefore the sampling regime has as its fundamental requirement, that any seeps, drains, pipes, or other forms of leachate discharge must in all cases be sampled. These will be analysed for a range of contaminants that would indicate the possible presence of dioxins, as well as being environmental contaminants in their own right (namely acid herbicides and organochlorine pesticides).

For the sake of cost effectiveness, at each site visited, samples will also be simultaneously collected (depending on site specific factors) of surface soils, receiving waters such as flows in streams or drains, sediment from within water courses, and from soil surfaces over which seeps/ leachate flows.

Should the analysis of seep and leachate samples, or other physical evidence, indicate the probability that a site is likely to have been used for the dumping of dioxin-containing wastes, then the Council will consider the value of having any or all site samples analysed for 2,3,7,8 TCDD. The analysis for 2,3,7,8 TCDD is based in part on the much higher cost of analysis for a full suite of dioxins, in part on the fact that 2,3,7,8 TCDD is the dioxin of most concern from a health perspective in any case, and in part on the fact that 2,3,7,8 TCDD is the primary 'marker' of dioxin contamination in 2,4,5-T.

In addition, the Council would review the need for further, more detailed site-specific investigations e.g. core drilling and sampling, groundwater sampling, more intensive soil sampling, and/or biological surveys, at any site where chemical analysis of leachate indicates the presence of a dioxin-containing reservoir of wastes.

It should be clearly understood that this is a targeted programme to identify possible environmental risk from alleged dump sites. It is not intended to conclusively prove or disprove whether dioxin-containing wastes are present within a site, nor to provide data on concentrations of dioxin in surface soils generally throughout the suburb of Spotswood.

Contents of protocol

This protocol covers container preparation, soil sampling, water sampling, analysis, and field sheet usage. It also includes a description of each site that gives the basis of the sampling regime to be used at each site. It also lists the compounds to be analysed for by AgriQuality.

These protocols have been based on and should be read in conjunction with the Council's existing practices and the Ministry for the Environment's "Health and environmental guidelines for selected timber treatment chemicals"(1997). Some matters have also been drawn from the protocols used by the Ministry in its national organochlorine programme (1995-1998).

Container preparation

To ensure the integrity of the sample, all sample bottles and jars used must be clean. The Council has received pre-cleaned containers from AgriQuality. The Council will also be providing containers, cleaned using the protocol set out below. All containers received from AgriQuality will be returned to them, as part of the contractual arrangement for analysis. Because the scope of sampling is larger than originally envisaged, the Council will send additional samples to the laboratory in its own containers, as well as providing duplicates of some samples to DIAG and site occupiers. The Council will provide containers for this purpose.

The Council will also provide duplicates of all samples to Dow AgroSciences (attention Marie Gibbs). The Company is undertaking to provide its own containers.

In order to validate the preparation of its own containers, the Council will forward field blanks in its own containers for analysis, as well as using AgriQuality's containers.

The cleaning procedure is as follows::

All solvents must be either of Analar grade or distilled-in-glass. Solvents must be stored in, and dispensed from, glass wash bottles that have also been cleaned by this protocol.

- A glass bottle/jar is washed/soaked with warm water and detergent
- The bottle/jar is rinsed three times with tap water and once with distilled or de-ionised water
- The bottle/jar is rinsed three times with acetone and allowed to drain well between rinses
- The bottle/jar is rinsed three times with hexane and allowed to drain well between rinses
- The bottle/jar is allowed to dry well on a drainage rack

The caps/lids of the sample containers must be either teflon lined or lined with aluminium foil. Domestic or catering grade aluminium foil is suitable for this purpose. The foil must first be rinsed before use with acetone followed by hexane and allowed to drain dry.

Aluminium foil may also be used at times during the sample collection procedure. In such cases, the aluminium foil must first be rinsed with Analar grade or distilled-in-glass acetone followed by Analar grade or distilled-in-glass hexane and allowed to drain dry. All aluminium foil must be washed following this procedure, regardless of whether the foil comes into direct contact with the sample or not.

Field work

Ensure personal diaries record each site visit and that they are kept up-to-date. A Council field sheet must be used to document every sample. An example is attached as Appendix 1. These have been prepared having regard to the Ministry for the Environment's national organochlorine programme.

Copies of all field sheets are to be given to Flo Tolland, Administration Officer (Inspectorate). Originals are to be given to John Williams, Laboratory Manager.

Before commencing field work, staff should refer to the check list (Appendix 2) to ensure they have all the necessary equipment at hand.

Site sampling plans

A preliminary sampling plan for each site is attached to this document (Appendix 6). Prior to commencement of the sample collection phase consideration will be given to GPR results, and an intensive on-site examination by Council sampling and/or inspectorate staff undertaken to confirm, mark and document all sampling points associated with each dump site.

Sampling strategy

The sampling strategy selected and the data generated from this investigation target at each site, the site media and locations that are considered most likely to indicate the presence of dioxin-containing wastes or other agrichemical wastes, and that pose the greatest potential to result in exposure to such wastes. This will involve sampling one or more of the following:

soil, leachate, sediments, surface water, groundwater seepage, and marine biota.

Sampling programme

This section provides detailed information pertaining to the sampling programme with which all sampling personnel must be familiar. It covers all aspects of the sampling strategy, sample size and identification, the collection procedure, sample packaging and shipping, chain of custody record information and quality assurance and quality control requirements. These protocols should be read in conjunction with Section 3 of the Ministry for the Environment's 'Health and environmental guidelines for selected timber treatment chemicals' (1997). This protocol adds to, or, where there is a conflict, supersedes the MfE guideline.

It is critical to this programme that:

- All information and procedures provided are carefully followed.
- Sample integrity is maintained at all times. In particular, every precaution should be taken to minimise sample contamination in the field.

- There is accurate traceability of samples throughout all stages of the programme. Particular care should therefore be given to all aspects of sample identification and documentation and chain of custody (Appendix 3)
- All aspects of the sampling programme, especially deviations to the sampling procedure or problems in the field, are thoroughly documented on the field sheet.

The potential for field contamination of a sample can be minimised by carefully following the procedures documented. In addition, the following precautions should be observed:

- Minimise contact of the sample during the collection process, and exposure of the sample to materials other than the sample containers once collected.
- Avoid contact of the sample with plastic materials at all times.

Sample replication

The Council is providing duplicates of some samples to DIAG and site occupiers. The Council will provide containers for this purpose.

The Council will also provide duplicates of all samples to Dow AgroSciences (attention Marie Gibbs, or Ann Coles, or Julie Tidswell). The Company is undertaking to provide its own containers.

Soil sampling

Purpose

The purpose of the soil sampling is that, where analysis of leachate or seepage for acid herbicides or organochlorines indicates the likely presence of a dioxin source within the site, then the soil sample(s), which would have been collected at the same time, will be analysed for the specific dioxin 2,3,7,8 TCDD to determine whether there is an exposure pathway via surface soil from that source, and any consequent health risk that may arise to any regular or longterm user of the site. To this end, the question to be answered is that of the overall average concentration of dioxin on the site, or any particular sub-area of a larger site. Therefore analysis of composited soil samples will be carried out.

This approach is not designed nor intended to find and isolate any particular 'hotspot' that may be present at one point within an entire site, but it is intended to be able to detect differences in exposure levels between sites and background levels, or between sub-areas of larger sites. The need for and design of a study to determine the full range of contaminant concentrations and to detect 'hotspots' would be considered subsequently (e.g. a surface grid sampling regime with every plug individually analysed).

If there are site-specific considerations that suggest that surface soil have been contaminated by the disposal of dioxin-containing wastes, then regardless of whether these sites have leachate or seepage points and the results of analysis of those points, then surface soil will be analysed for 2,3,7,8 TCDD. In particular, at the sites of most concern to the local dioxin investigation group (up to 5, to be nominated by the group), analysis for TCDD in surface soils and/or sediments will be performed in any case.

Sampling methodology

All soil samples collected will be a composite of a number of individual cores. In all cases, cores will be 2.5 cm in diameter, taken to a 7.5 cm depth. As far as practicable, all plugs should be of a uniform size (depth).

Collect samples at least 5 metres distance from any man made wooden object or structure (for example fences posts, telegraph poles, foundations) at the sampling site¹.

The number of individual plugs of soil to be collected at each site will be determined by site-specific characteristics at the time of sampling, but must comply with the general requirements as set out below.

Enough individual plugs should be collected across a site to give a reasonable intensity of coverage. Taking into account areas that should not be sampled because of other potential sources of contamination, as described above in the first paragraph, plugs should be taken at points spread across the entire site and representing site usage(s).

Given that it is intended to analyse several plugs combined as one large representative soil sample, for a large site there should not be so many plugs that any contaminated soil in the proximity of a single dump on that site is diluted down to background levels by an overwhelming number of plugs sampled from elsewhere on the site.

Therefore it is proposed that a minimum of 4 and a maximum of 6 plugs be collected from any single site (or sub-area of a site, as described further below), and combined into a single container. Plugs should only be combined into a single container to be treated as a single sample when collected from an area of similar character or likelihood of exposure. All plugs at the one site can be taken without decontaminating the sampling probe between plugs. However, where a site has been subdivided for the purposes of soil sampling as described below, then separate composites from each part of the site should be made, and a clean probe used for each new part of the site.

On a large site, the site should be divided into sectors each of no more than 400m², (e.g. a square of no more than 20x 20 m), and one plug should be collected from within each sector. If the entire site is larger than 6 sectors x 400 m² per sector, then the site should be sub-divided and each sub-division treated as a separate site, for the purposes of soil sampling (i.e. 4-6 plugs collected from each sub-area). The site may also be sub-divided for the purpose of surface soil sampling on the basis of topographical features or access considerations e.g. a number of small plateaux down the side of a hill should be considered as separate potential dump sites, even if all in the same general locality, or where a stream or other feature that would have restricted the discharge of wastes to part of a site is present.

The sampling probe and rod for removing the soil plug from the probe must be decontaminated between each new site.

Collection of soil samples and equipment preparation

Soil samples are to be collected into the 1 litre wide-mouth screw capped glass jars provided, precleaned using the rigorous cleaning procedure detailed above. To ensure the integrity of

¹ Wooden structures of this type may have used pentachlorophenol (PCP) treated timber. PCP contains dioxin impurities.

the sample, it is important that samples are collected only in the jars supplied. The lids of the jars should be lined with aluminium foil (hexane rinsed). It is important to ensure this foil lining remains in place and unbroken.

To avoid sample contamination, the lid of the jar should only be opened immediately prior to the collection of the sample. Once the sample has been collected the lid should be secured firmly.

The plug of soil can be pushed from the probe into the sample container using a rod covered with aluminium foil, cleaned as described below.

All cores from each site (i.e. up to six cores) should fit comfortably into each 1 litre jar.

All sampling equipment used, including a stainless steel soil corer (25 mm diameter), stainless steel scissors for trimming grass over the sample and a stainless steel spoon for compacting samples in the jar are to be cleaned thoroughly by washing in water (detergent and warm water, then rinsing in tap water, then final rinse in deionised water) followed by rinsing with acetone and hexane. Equipment is to be cleaned at the commencement of a day's sampling, and between sampling stations. Solvents used in the field for decontamination of equipment between sites is to be recovered and returned to the Council premises.

At each new site for investigation, the previously cleaned stainless steel soil corer is to be used to collect 5 cores, all of which are discarded, before the next plug becomes the first plug from that site to be retained for analysis. This procedure adds one more 'cleaning' step to the process. It is based on the field sampling protocols used by the Ministry for the Environment's national organochlorine programme.

Prior to sample collection, any grass over the sampling area to be trimmed to ground level, fresh and weakly decomposed pasture litter removed, and particular care taken to avoid any possible contamination of the sample. Procedures to achieve this include:

- no contact of the sample with plastic material;
- minimising any direct contact of the sample during the sampling processes with any item other than the soil corer and the rod used to expel the plug from the probe into the sample container;
- avoiding any exposure of the samples once collected with any materials other than the sampling containers;
- rigorous cleaning procedure of the soil corer and other sampling items between the collection of soil cores from different sampling locations.

Soil cores will be 25 mm in diameter, and should be taken to a depth of 75 mm. Following collection, each soil core should immediately be placed in a pre-cleaned glass collection jar. Once all soil cores are collected from a sampling site, the sample is to be given a unique identification number, the jar labelled, and a custody seal fixed over the screw cap. Jars are to be placed in a chillbin with frozen pads to keep samples cool.

Instructions for interim storage and dispatch for analysis are set out below.

Water sampling

All sample collection jars to be pre-cleaned in the same manner as the soil sampling equipment (water, acetone, hexane) prior to use, and used with aluminium foil (hexane rinsed) lined lids.

Grab samples should be taken from the middle of any stream or open drain, in the flowing reaches, in glass one litre bottles. Samples are to be taken facing upstream to the flow, and with the bottles fully submerged whenever possible.

Each grab sample is to be obtained, where practical, by field sampling personnel entering the drain and moving slowly upstream to a suitable position within the drain whilst facing upstream at all times. From this position and holding a sample bottle by the main body of the vessel, and at arm's length, the bottle is to be immersed, uncapped, filled to the neck, and recapped whilst still under water. Avoid the collection of any disturbed sediment from earlier movements within the watercourse.

Each sample is to be given a unique identification number, the jars labelled, and a custody seal fixed over the screw cap. Jars are to be placed in a chillibin with frozen pads to keep samples cool.

Instructions for interim storage and dispatch for analysis are set out below.

Sediment sampling

Sediment samples will be collected from water courses downstream of potential points of discharge of contaminants originating from each burial site. The reasoning is that sediments will probably have higher concentrations of organic contaminants than would occur within the receiving water column, and have the potential to affect benthic communities.

Material will be sampled from beneath and/or adjacent to site drainage points including seeps and any leachate tracks. For larger streams, sediments deposited downstream of alleged or known burial sites will be collected.

Cleaning of equipment used and precautions taken in sampling will as set out in these protocols.

Sediment samples shall be collected either by (i) using the soil core sampler, or (ii) forcing the sample container directly into and along the sediment bed, so as to scoop up sediment, or (iii) sampling using a small glass jar (cleaned as per these protocols) and transferring the contents to a clean glass jar, if needs be several times in order to capture a sufficiently large or representative sample.

Sediment samples should contain only the minimum of water. Without losing any fine sediment material, the container should be filled with sediment, or free water decanted off in the field.

Individual sediment samples from different locations within one stream bed are not to be combined.

The labelling and interim handling of sediment samples is to be as for soil samples.

Leachate sampling

All leachate points identified at each dump site will be sampled in this investigation. Such points are considered to be primary exposure pathways for mobile contaminants. If there are multiple leachate discharge points on one site, each is to be treated separately.

Equipment preparation and sample collection/handling will be consistent with these protocols.

Chain of custody and transportation for all samples

Following collection, each sample to be given a unique identification number, and each individual bottle labelled, and a custody seal fixed over the screw cap. Each sample to be packed in a polystyrene box/chillibin, frozen chilli pads added, and the box delivered to NZ Couriers, 493A Devon Street East, New Plymouth, along with a chain of custody form (Appendix 3). Samples are to be sent by overnight courier to the analytical laboratory (AgriQuality). Address for courier delivery is Ultra Trace Laboratory, AgriQuality, Gracefield Research Centre, 71 Gracefield Road, Gracefield, Lower Hutt (attention Scott Leathem).

Each sample will also be logged in the Taranaki Regional Council's sample register, in compliance with the Council's standard procedures as set out in the Chemistry Laboratory's documentation.

Container label (example)

Sample Description: _____
_____ Sample No.: _____
Date: _____ Submitted By: _____

<i>For Laboratory Use Only</i>
Laboratory Number: _____ Date: _____

Quality assurance and quality control

Specific quality control measures are to be included with the sampling activities. This involves collection of duplicates and blank samples. Duplicate samples will give an indication of sampling and analytical precision, and various types of blank samples including equipment rinsate and field blanks, an indication of sampling bias.

At least one quality control sample (duplicate or blank) is to be collected or prepared for every site visited.

Equipment rinsate blanks are analyte-free deionised water used to rinse the sample equipment and thereby demonstrating the effectiveness or otherwise of the equipment cleaning procedures outlined in this protocol. These blanks are to be collected after the cleaning process but prior to reuse for sampling.

In addition to the above, one or two sampling containers will be returned to the testing laboratory unopened so as to demonstrate the cleanliness of prepared bottles supplied by either the Council or the testing laboratory itself.

Field blanks in the context of this investigation are to be ambient media similar to the sample matrix. Samples collected from documented local control sites will be used as field blanks by exposing them to the sampling environment at the sampling site. This may be soil at one site and upstream surface water at another.

A control sample should be collected of surface soil from either Marsland Hill, Churchill Heights, or Brooklands Park, New Plymouth. These sites were sampled in the MfE national organochlorine programme, and a dioxin analysis of soil from one of these sites should confirm the analytical results of this current investigation.

These blanks will reflect ambient incidental or accidental sample contamination during sampling and analytical process.

Instructions will be given to the laboratory in regard to which samples are to be tested. The Council will include some of the quality control samples in its analytical requirements.

AgriQuality will not be advised which samples have been prepared as quality control samples and which samples are discharge or field samples.

Sample processing requirements

Specific instructions will be provided to the analytical laboratory in regard to processing and testing of samples submitted as part of this investigation.

All samples must be retained by the laboratory until specific instructions to dispose of them are provided by the Council.

Soil samples

One litre jars containing 4-6 cores will be submitted to the laboratory. The contents of these jars will be composited and processed in accordance with the laboratory's own procedures.

Sediment samples

Excess water in sediment samples that separates after standing overnight is to be decanted off and discarded. In doing so, any fine sediment layer must not be disturbed.

Instructions for disposal are the same as for soil samples.

Water samples

Surface and groundwater samples containing particulate matter are to be processed as is, i.e., without filtration or decanting.

Duplicate samples

Duplicate samples will not be identified as such when submitted to the laboratory. They are treated and tested as separate samples. Field sheets must however clearly identify the nature of each sample, including all quality control samples of any sort.

Rinsate and field blanks

About 10% of both rinsate and field blanks will be tested initially. Any decision as to the testing of the remainder will be based on whether or not any contamination problems are identified or any suspect field sample results obtained.

Analytical regime

The details of the compounds that will be analysed for, and the limits of detection for each compound, are attached to this document (Appendix 4). The limit of detection to be used for the 2,3,7,8 TCDD analysis is 10 ppt in soils, and 1 ppt in water samples.

Initially only the leachate/groundwater and any stream samples would be analysed. The purpose is to identify whether any agrichemical wastes have been buried at the site as a reservoir for dioxins as well as an environmental risk in their own right. At sites for which there are no leachate/seepage samples, and for sites nominated for dioxin analysis of surface soils by the dioxin action group, and at any site where site specific features indicate the likelihood of surface soil having been contaminated by the burial of dioxin-containing wastes, then TCDD analysis of soil will be required.

The analysis will be for acid herbicides (which will capture any 2,4-D, 2,4,5-T, MCPA, MCPB, and a number of other compounds) and for organochlorine pesticides (which will capture DDT and its decomposition products, lindane, dieldrin, endrin, and a number of other compounds). Method references are given in Appendix 5.

Should evidence of the presence of any of these compounds arising from burial or disposal be found, then all the samples for that site e.g. soil and sediment samples, as well as the leachate/groundwater and stream samples, will be analysed for the 2,3,7,8 TCDD isomer of dioxin, as the most significant dioxin associated with 2,4,5-T. In this way, information on acid herbicides and organochlorine pesticides and dioxins at that site will be gained.

The Council has also made the offer to the dioxin investigation group that regardless of the outcome of the acid herbicide and organochlorine screens, then at the sites of most concern to the group analysis for TCDD in soils and sediments will be performed in any case.

Health and safety

Health and safety of personnel is of prime importance in the implementation of any sampling programme.

Routine procedures outlined in the Council's Workplace Health and Safety Guidelines and Operating Manual for Field Staff, must be adhered to.

This includes:

- (a) two personnel on site;
- (b) use of personal protective equipment as appropriate, e.g. eye protection, use of gloves, overalls and suitable footwear;
- (c) being aware of the potential physical and chemical hazards associated with each sampling site (note: because these sites are not familiar to the Council, staff must accept responsibility for their own safety including assessing each site for possible hazards and being aware that not all hazards can be identified beforehand).
- (d) access to a first aid kit and RT or cellphone in case of emergency;
- (e) use of experienced personnel for sampling.
- (f) This particular programme involves the use of solvents for on-site cleaning of equipment, therefore access to a respirator will be necessary.

Appendix 1

**Taranaki Regional Council field sheet
(every sample to be recorded on the sheet for the property studied)**

Dioxin Investigation

Site Name: _____

Weather: _____ Job No: _____

Sampled By: _____ Project: _____

Witness: _____ Date: _____

Sample Description	Sampling Point	Time (actual)	Conditions/Comments/ Instructions to Lab/Deviations from protocols/Difficulties/Sampling depth, flow	TRC Sample ID No.

Samples Handed to Courier Firm:

By: _____ Registration Check

Date: _____ Time: _____ By: _____ Date: _____

Appendix 2

Dioxin investigation field check list

Appendix 3
Chain of custody sheet

Appendix 4

Limits of detection for analyses by AgriQuality

Where these contaminants have been dumped and are leaching into the environment it could be expected that the acid herbicides and the OC pesticides would be present in reasonably high levels - tens to hundreds of parts per billion or higher. We understand the Regional Council, to have assurance that the compounds are either not present or at levels that do not pose risk, requires testing detection limits of at least 1 ppb or better for water samples, and 10 ppb or better for soils.

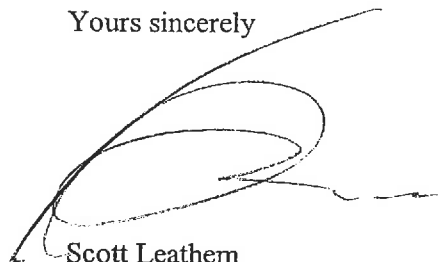
Any dioxins in soil as a result of dumping or leaching would most likely be present in the low ppb range. An approach that would give the Regional Council assurance that dioxins are not a risk would be to assess dioxin levels against an appropriate standard. After consultation with the Ministry for the Environment it has been suggested that the guidelines for the timber treatment industry may be appropriate. These guidelines are set for dioxins in soil at 10 ppt TEQ. Any analytical approach for these compounds will therefore need to achieve detection limits of at least ten times less than this level, that is 1 ppt or better.

AgriQuality Environmental has available various accredited testing methods and capabilities that would support such a testing programme:

- For known contaminated sites, we have an OC pesticide screen that will detect these compounds down to 200 ppb levels in water.
- For uncharacterised sites, we can offer both acid herbicide and OC pesticide screens capable of detecting such compounds down to 0.1 ppb in waters and 1 ppb on soils. Lower detection limits for OC pesticides to 0.01-0.2 ppb levels are also available, should the Council desire this.
- As 2378 TCDD is the major dioxin contaminant in 2,4,5-T, testing for this dioxin, rather than a full dioxin congener suite, could be applied in the first instance. This screen is capable of detecting 2378 TCDD down to 1-10 ppt in soils.
- Where 2378 TCDD is found, and it becomes an issue as to whether or not the source of this dioxin is 2,4,5-T, a full dioxin congener suite could be applied to resolve this issue.

I have appended more detailed information of these tests. This information includes details of our standard pricing but we are willing to negotiate pricing with you. We look forward to the opportunity to work with you on this project and if you have any other questions, please contact me.

Yours sincerely



Scott Leathem
Team Leader
UltraTrace™ Laboratory
AgriQuality Environmental

Appendix: Methodology, Limits of Detection & Standard Pricing

Acid Herbicides

Individual Compounds and Detection Limits (LODs):

Acid Herbicide	Aqueous LOD	Soil LOD
Mecoprop	0.1 µg/L	0.1 mg/kg
MCPA	0.1 µg/L	0.1 mg/kg
Dichlorprop	0.1 µg/L	0.1 mg/kg
2,4-D	0.1 µg/L	0.1 mg/kg
triclopyr	0.1 µg/L	0.1 mg/kg
MCPB	0.1 µg/L	0.1 mg/kg
2,4,5-T	0.1 µg/L	0.1 mg/kg
2,4-DB	0.1 µg/L	0.1 mg/kg
bentazone	0.1 µg/L	0.1 mg/kg
picloram	0.1 µg/L	0.1 mg/kg
fenoprop	0.1 µg/L	0.1 mg/kg

The standard price per sample exclusive of GST is:

Aqueous	\$195.00
Soil	\$210.00

Organochlorine Pesticides (OCs)

Individual Compounds and Detection Limits:

OC Pesticide	Aqueous (µg/L)	Soil (mg/kg)
Hexachlorobenzene	0.1	0.1
Lindane	0.1	0.1
Heptachlor	0.1	0.1
Aldrin	0.1	0.1
heptachlor epoxide	0.1	0.1
Procymidone	0.2	0.2
α-chlordane	0.1	0.1
pp-DDE	0.1	0.1
Dieldrin	0.1	0.1
pp-DDD	0.1	0.1
pp-DDT	0.2	0.2
Methoxychlor	0.2	0.2
cis permethrin	0.2	0.2
trans permethrin	0.2	0.2
alpha-BHC	0.1	0.1
beta-BHC	0.1	0.1
delta-BHC	0.1	0.1
endosulfan I	0.1	0.1
endosulfan II	0.1	0.1
endosulfan sulfate	0.1	0.1
endrin	0.1	0.1
endrin aldehyde	0.1	0.1
endrin ketone	0.1	0.1

Appendix 5

Analytical protocols in use by AgriQuality

AgriQuality New Zealand Limited
Huarangi Aotearoa

Gracefield Research Centre
Gracefield Road
PO Box 30 547
Lower Hutt
New Zealand

AgriQuality Environmental
Phone: 64 4 570 8822
Fax: 64 4 569 4500

Email: <alwoodj@agriquality.co.nz>

Facsimile



To: Gary Bedford

Fax: 06 765 5097

Company: Taranaki Regional Council

Date: May 30, 2001

From: Moana Mackey

Pages (including this page): 1

This message is intended for the person or organisation named above. It contains confidential and perhaps legally privileged information. If you have received it in error, please notify the sender and destroy this document. If you are not the intended recipient, you are notified that any use, distribution or reproduction is prohibited.

Gary,

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) Screen

Limits of detection:

Aqueous samples 0.1-1 ppt
Solid samples 1-10 ppt

Solid samples are analysed according to USEPA Method 8290.
Aqueous samples are analysed according to USEPA Method 1613A.

The holding time for both aqueous and solid samples is one year.

Acid herbicide screen

Aqueous samples are analysed according to APHA 6640.
Soil samples are analysed by an in house method based on APHA 6640.

The holding time for aqueous samples is seven days.
The holding time for soil samples is fourteen days.

Organochlorine pesticides (OCs):

Solid samples are extracted by Soxhlet extraction (USEPA 3540) or pressurised fluid extraction (USEPA3545) or ultrasonication (USEPA 3550).
Aqueous samples are extracted by liquid/liquid extraction (USEPA 3510).

The holding time for both aqueous and soil samples is three months.

I hope this covers everything. Let me know if you require any further information.

Kind regards

Moana Mackey
UltraTrace™ Laboratory
AgriQuality Environmental

DELIVERED

30/5/01

Gary B

31/5/01

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(0100)

Appendix 6

Site descriptions and sampling strategy

Investigation of Alleged Historical dioxin disposal – Stage two

Stage two of the investigation is commencing and a methodology for processing each site is necessary. In order to achieve this methodology a checklist has been developed so that issues for each site can be considered. After determining each site in relation to the checklist the methods of sampling/investigation will be one or more of the following type:

- Archive inspection (AI)
- Photographic perusal
- GPR
- Detailed physical inspection (DPI)
- Soil sampling
- Leachate sampling
- Surface water sampling
- Stream sediment sampling
- Bank face beneath leachate sampling
- Marine biota sampling

The checklist to decide on the sampling/investigation method and to record an audit trail is as follows:

- Historical site activity
- Current site activity
- Proximity of streams
- Surface soil exposure
- Terrain
- Potential for leachate to water
- Ground water depth
- Proximity of bore water
- Point source area
- Other potential exposure pathways

A- Lawry St site	Corner of Lawry St and Devon St West
Historical site activity	Unlicensed dumping area – 1960/70's
Current site activity	Mowed roadside available to public
Terrain	Flat area with 45 degree slope to a stream. Not consolidated. Slope covered with woody plants.
Proximity of streams	Mangoatukutuku Stream to the north-west
Surface soil exposure	In lawn, easily available to public
Potential for leachate to water	Ample potential – needs detailed inspection
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	Approximately 10 metres x 5 metres
Other potential exposure pathways	Sediment in stream
Type of investigation	GPR, DPI, soil, leaching, surface water, stream sediment and bank face beneath leachate
B-Seaview Road site	Corner of Seaview Road and Devon St West
Historical site activity	Unlicensed dumping area – 1960/70's
Current site activity	Fallow
Terrain	45 degrees slope to a stream
Proximity of streams	Mangoatukutuku Stream to the west
Surface soil exposure	Over grown, difficult for public to access
Potential for leachate to water	Ample potential – needs detailed inspection
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	Approximately 10 metres x 10 metres
Other potential exposure pathways	Sediment in stream
Type of investigation	GPR, DPI, soil, leaching, surface water, stream sediment, bank face beneath leachate

C – Pylon 3 site	Centennial Drive
Historical site activity	Pipeline construction, pylon construction, tarsealing and contouring and grassing fro public use – 1960's
Current site activity	Part recreational area
Terrain	Flat in public area. Rolling the remaining
Proximity of streams	Nil. On coast with cliffs to Tasman Sea
Surface soil exposure	Ample in public area
Potential for leachate to water	Yes to the cliffs of the Tasman Sea
Ground water depth	Unknown at this stage
Proximity of bore water	Nil
Point source area	200 metres x 200 metres
Other potential exposure pathways	No
Type of investigation	Photographic perusal, GPR, DPI, soil, leaching, bank face beneath leachate
Ca – Centennial Drive	Centennial Drive – not being investigated
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	

D – 34 Rangitake Drive	34 Rangitake Drive
Historical site activity	Allegedly received stormwater from IWD premises prior to residential development and alleged dumping area – 1960/70's
Current site activity	Residential
Terrain	Sloping to a stream
Proximity of streams	Unnamed tributary of the Herekawe Stream at the rear western end
Surface soil exposure	Yes
Potential for leachate to water	Yes, requires detailed inspection
Ground water depth	At stream level
Proximity of bore water	Nil
Point source area	¼ Acre
Other potential exposure pathways	Possible illegal dumping area
Type of investigation	Archive inspection, photographic perusal, GPR, DPI, soil, leaching?, surface water, stream sediment, bank face beneath leachate?
E – Omata Reserve	East of the Methanex Tank farm
Historical site activity	Alleged drum dumping area (received fill from tank farm construction). Fallow
Current site activity	Fallow, not easily available to public
Terrain	Rolling to steep down to unnamed trib of the Herekawe Stream
Proximity of streams	Unnamed trib of the Herekawe Stream to the east
Surface soil exposure	Minimal
Potential for leachate to water	Yes, requires investigation
Ground water depth	At stream level
Proximity of bore water	Unknown – possible at the tank farm
Point source area	10 metres x 10 metres
Other potential exposure pathways	Nil
Type of investigation	Photographic perusal, GPR, DPI, soil, leaching, surface water, stream sediment, bank face beneath leachate

F – IWD/1 site	On the Dow AgroSciences land – company will investigate
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	GPR
G – Marfell Park	Marfell Park, Omata Road
Historical site activity	Licensed landfill – 1960's
Current site activity	Playing fields
Terrain	Flat, sloping bank 45 metres to a stream on north-eastern side
Proximity of streams	Small stream to a wetland on north-eastern side
Surface soil exposure	Yes, recreational
Potential for leachate to water	Yes, needs detailed inspection
Ground water depth	At stream level
Proximity of bore water	Nil
Point source area	5 metres x 5 metres, a specific point
Other potential exposure pathways	Sediment
Type of investigation	Archive inspection, photographic perusal, DPI, leaching, surface water, stream sediment, bank face beneath leachate,

H – Ngamotu Domain	Ngamotu Domain, Pioneer Road
Historical site activity	Licensed landfill
Current site activity	Playing fields
Terrain	Flat, sloping bank 45 metres to a stream on north-eastern side
Proximity of streams	Small stream to a wetland on north-eastern side
Surface soil exposure	Yes, recreational
Potential for leachate to water	Yes, needs detailed inspection
Ground water depth	At stream level
Proximity of bore water	Nil
Point source area	5 metres x 15 metres, identified as a specific point
Other potential exposure pathways	Sediment
Type of investigation	Archive inspection, photographic perusal, DPI, leaching, surface water, stream sediment, bank face beneath leachate
I – 7A Squire Place	7A Squire Place
Historical site activity	Fallow – 1960's
Current site activity	Residential
Terrain	Gentle bank slope to stream
Proximity of streams	Small stream on the eastern side
Surface soil exposure	Minimal
Potential for leachate to water	Yes
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	200 metres x 5 metres
Other potential exposure pathways	Sediment in stream area
Type of investigation	Archive inspection, leaching, surface water, stream sediment, bank face beneath leachate

J – Belt Road	At the end of Belt Road, to the east
Historical site activity	Fallow, dump area for sludge from sewerage cleaning – 1960's
Current site activity	Part mowed area available to public
Terrain	Flat and cliff site
Proximity of streams	Nil, includes the cliff to the Tasman Sea
Surface soil exposure	Been grassed in one area and possible
Potential for leachate to water	Negligible
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	50 metres x 50 metres
Other potential exposure pathways	Nil
Type of investigation	DPI, soil
K – Victoria Road	Victoria Road, Oakura
Historical site activity	Farming, gorse covered area – 1960's
Current site activity	Farming
Terrain	45 degree slope
Proximity of streams	Wetlands 200 metres away
Surface soil exposure	Area since been turned over and grassed into good grazing land
Potential for leachate to water	Nil, too historical
Ground water depth	3 metres
Proximity of bore water	Nil
Point source area	200 metres x 50 metres
Other potential exposure pathways	Nil
Type of investigation	No further investigation

L – 23C Tahurangi Plc	23C Tahurangi Place
Historical site activity	Alleged stormwater discharge off IWD site – 1970's
Current site activity	Residential
Terrain	Gentle rolling
Proximity of streams	No stream nearby
Surface soil exposure	Gardens and residential
Potential for leachate to water	Minimal
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	¼ Acre
Other potential exposure pathways	Nil
Type of investigation	Archive inspection, Soil
M – Beach Road/1	At the end of Beach Road to the west
Historical site activity	Farming and possible Ngahoro site, the subject of alleged full drum on pallets dumping – 1960's
Current site activity	Farming
Terrain	Hilly
Proximity of streams	Unnamed small stream to the Tasman Sea on north-eastern side
Surface soil exposure	Nil
Potential for leachate to water	Possible
Ground water depth	Stream level
Proximity of bore water	Unknown
Point source area	20 metres x 20 metres
Other potential exposure pathways	Minimal chance
Type of investigation	GPR, surface water

N - Waireka	Waireka Road, Omata - company will investigate
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	Marine biota
O - Pioneer Road	No further action, used as a name for Ngamotu Domain
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	

P – 26A Rangitake Dv	26A Rangitake Drive
Historical site activity	Allegedly received stormwater from IWD premises prior to residential development also alleged drum dump area – 1970's
Current site activity	Residential
Terrain	Sloping to a stream
Proximity of streams	Unnamed tributary of the Herekawe Stream at the rear western end
Surface soil exposure	Yes
Potential for leachate to water	Yes, requires detailed inspection
Ground water depth	At stream level
Proximity of bore water	Nil
Point source area	¼ Acre
Other potential exposure pathways	Possible illegal dumping area
Type of investigation	Archive inspection, GPR, DPI, soil
Q – Rifle Range Road/Bewley Road	Next to the Waiwhakaiho River, Waiwhakaiho
Historical site activity	Site of the former Taranaki County Council licensed landfill. Known contaminated site. 1970's
Current site activity	Heavy industrial
Terrain	Flat and banked to the river
Proximity of streams	Waiwhakaiho River northern end
Surface soil exposure	Minimal – heavy industry covers most of the site
Potential for leachate to water	Yes, detailed inspection required
Ground water depth	River level
Proximity of bore water	Unknown
Point source area	Not specifically sourced
Other potential exposure pathways	Nil, other than leachate possibilities
Type of investigation	Archive inspection, DPI, leachate sampling

R – Beach Road	Beach Road
Historical site activity	Former IWD dairy farm, identified by T.V. camera presence during removal of previous dumpsite – 1960's
Current site activity	Farming
Terrain	Flat
Proximity of streams	Nil, 750 metres near Tasman Sea
Surface soil exposure	Nil
Potential for leachate to water	Minimal
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	20 metres x 20 metres
Other potential exposure pathways	Nil
Type of investigation	GPR, soil
T – Colson Road Landfill	Colson Road, already monitored, no action on this site
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	

U – IWD/2	On the Dow AgroSciences land – company will investigate
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	GPR
V – Centennial/2	Centennial Drive
Historical site activity	Former discharge point for the now unused stormwater system from the office area of IWD – 1960's
Current site activity	Nil, the pipe is still evident.
Terrain	At the base of the cliffs to the west of Paritutu
Proximity of streams	Possible small stream nearby, base of cliff by Tasman Sea
Surface soil exposure	Possible below outlet pipe
Potential for leachate to water	No
Ground water depth	Not relevant
Proximity of bore water	No
Point source area	The Tasman Sea
Other potential exposure pathways	Possible leachate
Type of investigation	Photographic perusal, DPI, soil

W - Herekawe Stream	Herekawe Stream
Historical site activity	Receives batch discharge water from IWD plant since late 1980's
Current site activity	Recreational Stream
Terrain	Flat sandy. There is not a reef off this stream
Proximity of streams	-
Surface soil exposure	Nil
Potential for leachate to water	Nil
Ground water depth	Not relevant
Proximity of bore water	Nil
Point source area	The stream
Other potential exposure pathways	The Tasman Sea
Type of investigation	Possible marine biota sampling
X - Roto Street	Off Roto Street
Historical site activity	Nursery. Alleged drum dump area - 1970's
Current site activity	Residential
Terrain	Flat
Proximity of streams	Leachate goes to a surface drain and to a pump station, which is pumped to the Mangaotukutuku Stream
Surface soil exposure	Possible
Potential for leachate to water	Yes
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	40 metres x 20 metres
Other potential exposure pathways	minimal
Type of investigation	Photographic perusal, GPR, DPI, soil, leaching?, surface water, stream sediment, bank face beneath leachate?

Z – Ngahoro	End of Beach Road/Centennial Drive
Historical site activity	Farming. The original Ngahoro site that was removed to IWD factory and contaminated soil to Waireka – 1960's
Current site activity	Farming
Terrain	Generally flat
Proximity of streams	Nil
Surface soil exposure	Minimal
Potential for leachate to water	Nil
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	20 metres x 20 metres
Other potential exposure pathways	nil
Type of investigation	GPR, Soil
Za - 60 marama Cres	60 Marama Crescent
Historical site activity	Farming. Drum part alleged to have been found.
Current site activity	Residential
Terrain	Gentle rolling
Proximity of streams	Minimal
Surface soil exposure	Minimal
Potential for leachate to water	Nil
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	¼ Acre
Other potential exposure pathways	nil
Type of investigation	Archive inspection, GPR, soil

Zb – Buller Street	Buller Street
Historical site activity	Site of the original Ivon Watkins factory – 1950's
Current site activity	Commerce
Terrain	Flat
Proximity of streams	Nil
Surface soil exposure	Covered by offices
Potential for leachate to water	Leaching to the Tasman Sea
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	Unknown
Other potential exposure pathways	Nil
Type of investigation	Archive inspection, DPI, marine sampling in conjunction with Elliott St
Zc – Tarahua Road	Tarahua Road
Historical site activity	Warehouse – used by the original Ivon Watkins Limited – covered by building concrete or gravel – 1950's
Current site activity	Sales venue
Terrain	flat
Proximity of streams	Nil
Surface soil exposure	Nil
Potential for leachate to water	Nil
Ground water depth	Nil
Proximity of bore water	Unknown
Point source area	0.5 hectare
Other potential exposure pathways	nil
Type of investigation	No investigation at this site

Zd – Tasman Sea	Tasman Sea
Historical site activity	Recreation – 1960 on
Current site activity	Recreation
Terrain	Water
Proximity of streams	Receives coastal streams
Surface soil exposure	Nil
Potential for leachate to water	Yes
Ground water depth	Not applicable
Proximity of bore water	Nil
Point source area	5 point sources from receiving areas - Elliott St, Belt Road, Paritutu Rock, Herekawe Stream and Waireka dumpsites
Other potential exposure pathways	Nil
Type of investigation	Marine biota
Ze – Tank 3500	Off the tank farm road, Centennial Drive
Historical site activity	Former IWD dairy farm, identified by former engineer Steve Tooley – 1960's
Current site activity	Farming
Terrain	Flat
Proximity of streams	Nil, 250 metres near Tasman Sea
Surface soil exposure	Nil
Potential for leachate to water	Minimal
Ground water depth	Unknown
Proximity of bore water	Unknown
Point source area	20 metres x 20 metres
Other potential exposure pathways	Nil
Type of investigation	GPR

Zf – IWD/3	On the Dow AgroSciences land – company will investigate
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	GPR
Zg – IWD/4	On the Dow AgroSciences land – company will investigate
Historical site activity	
Current site activity	
Terrain	
Proximity of streams	
Surface soil exposure	
Potential for leachate to water	
Ground water depth	
Proximity of bore water	
Point source area	
Other potential exposure pathways	
Type of investigation	GPR

Zh – Car Park	Centennial Drive, near the car park west of the Herekawe Str
Historical site activity	Fallow. Has been the subject of sampling before (iron) – 1960's
Current site activity	Fallow
Terrain	Cliff face adjacent to Tasman Sea
Proximity of streams	Not relevant
Surface soil exposure	Not relevant, except for below the leaching discharge point
Potential for leachate to water	This is the reason for inclusion – leaching from cliff
Ground water depth	At source
Proximity of bore water	Nil
Point source area	1 metre x 1 metre
Other potential exposure pathways	Tasman Sea
Type of investigation	Photographic perusal, DPI, leaching, bank face beneath leachate,
Zi – Herekawe cliff	Centennial Drive, east of the Herekawe Stream and off the mowed area near the corner of Rangitake Street (off Sartens)
Historical site activity	Fallow, alleged drum dumping area – 1960's
Current site activity	Fallow
Terrain	Rolling
Proximity of streams	Not relevant
Surface soil exposure	Minimal
Potential for leachate to water	Possible ground water
Ground water depth	Unknown, except for known leachate discharge depth on the cliff face to the Tasman Sea
Proximity of bore water	Nil
Point source area	100 metres x 50 metres plus 1 metre x 1 metre at cliff face
Other potential exposure pathways	nil
Type of investigation	DPI, leaching, bank face beneath leachate, marine biota (in Zd)

Zk – Jury site	At the end of Norwich Avenue
Historical site activity	Farming – known concrete bunker site – 1950's
Current site activity	Fallow
Terrain	Rolling
Proximity of streams	Nil
Surface soil exposure	Possible
Potential for leachate to water	Minimal
Ground water depth	Unknown
Proximity of bore water	Nil
Point source area	5 metres x 5 metres, pieces of concrete are still visible
Other potential exposure pathways	nil
Type of investigation	GPR, DPI, soil,

Sites Table: Sampling and reasons

	Archive inspection	Photographic persual	GPR	DPI	Soil	Leaching	Surface Water	Stream	Bank face	Marine biota
<p>A Lawry Street site - GPS 2600700E-6237180N. On the corner of Lawry Street and Devon Street West, and west of the garden centre on Devon Street West. The site is on the western bank of the Mangaotukutuku Stream. Proposed inspection/sampling method – GPR, water and soil samples</p>			*	*	*	*	*	*	*	
<p>B Seaview Road site - GPS 2600656E-6237096N. This alleged site is on the corner of Seaview Road and Devon Street West, behind the Shell service station and across from site-A. There are doubts about this site as no person has positively stated that wastes were dumped there. The site is on the eastern bank of the Mangaotukutuku Stream. Proposed inspection/sampling method – GPR, water and soil samples</p>			*	*	*	*	*	*	*	
<p>C Pylon 3 site - GPS2598377E-6237586N. The alleged site is immediately north/ west of the IWD premises and is on both sides of Centennial Drive and includes an area approximately 100m x 150m in the Paritutu Centennial Park. The pipeline corridor transverses part of the site. There is an alleged discharge emanating from the cliffs below this site. Proposed inspection/sampling method – GPR, water and soil samples</p>		*	*	*	*	*			*	

<p>Ca Centennial Drive site - GPS25985535E-6237713N. This alleged site was addressed as part of the Council's dieltrin investigation in 1991 and is not under consideration for this investigation. Proposed inspection/sampling method – nil</p>										
<p>D 34 Rangitake Drive - GPS2598513E-6236679N. The alleged site is at the rear of the property at 34 Rangitake Drive. Prior to residential development this site was above a small tributary of the Herekawe Stream that allegedly received stormwater from the IWD premises. At least three previous owners identified the site. Alleged burial Proposed inspection/sampling method – GPR, water and soil samples</p>	*	*	*	?	*	*	?			
<p>E Omata Reserve (east of the Methanex tank farm) - GPS2598382E-6236657N. The alleged site is on New Plymouth District Council reserve land on the eastern side of the Methanex tank farm. It has been planted by the New Plymouth District Council in previous years. The site was identified by Andrew Gibbs, previous occupiers do not support the allegations. Proposed inspection/sampling method – GPR, water and soil samples</p>	*	*	*	*	*	*	*			
<p>F IWD 1 site - GPS2598663E-6237173N. An alleged disposal site on the IWD premises. This site will be investigated following discussions with DowAgroSciences. Proposed inspection/sampling method – To be confirmed</p>		*								

<p>G Marfell Park - GPS2600682E-6236037N (identified by Andrew Gibbs and Ian McLeod), GPS2600734E-6236179N (identified by Trevor Fleming). This site was a known municipal landfill prior to being closed, grassed and used as playing fields in the late 1970's. Dumping of 200 litre drums is alleged. The Mangaotukutuku Stream is close by. Also wastes from the unblocking of the City sewerage system at the corner of Ngamotu Road and Centennial Drive were disposed of here. The wastes were identified as being phenol based.</p> <p>Proposed inspection/sampling method – Water samples</p>	*	*	*	*	*	*	*	*	*	*	*	*
<p>H Ngamotu Domain - GPS2599875E-6237183N. This site is also a known past municipal landfill. The site has also been covered, grassed and is used as playing fields. Wastes from the unblocking of a city sewerage were disposed of at this site.</p> <p>Proposed inspection/sampling method – Water sampling</p>	*	*	*	*	*	*	*	*	*	*	*	*
<p>I 7A Squire Place – GPS2600021E-6337111N. A stormwater pipe that allegedly could have contained leachate from the Ngamotu Domain landfill discharges at this location.</p> <p>Proposed inspection/sampling method – Water and soil samples</p>	*											
<p>J Belt Road – GPS260143E-6238019N. This site is at the end of Belt Road (over the railway line to the right) on the coast. This is another site where wastes from the unblocking of city sewerage was disposed of. The wastes allegedly flowed over the cliffs and into the sea. Identified by Andrew Gibbs, Trevor Humphries and Paddy Burt.</p> <p>Proposed inspection/sampling method – Soil samples and marine sampling</p>												
<p>K Victoria Road, Oakura – GPS2593182E-6232055N. This site is the first farmlet up Victoria Road off SH45. No further action is envisaged on this site.</p> <p>Proposed inspection/sampling method – nil</p>												

<p>Q Rifle Range Road/Bewley Road – GPS2606429E-6239250N. This alleged site is located on Rifle Range Road next to the Waiwhakaoho River. Part of the developed area was a Taranaki County Council dump. The old landfill site has resource consents and is monitored. Proposed inspection/sampling method – One water sample (dioxin) in conjunction with site-Y</p>	<p>*</p>			*				<p>Dioxin, O/C's. Already done other tests eg; PCP's</p>
<p>R Beach Road – GPS2598038E-6235117N. This alleged site is on the old IWD dairy farm on Beach Road approximately 750 metres from the sea and was identified by Sam Lowe during the extraction of chemicals from old dumpsites during the early 1980's. Proposed inspection/sampling method – GPR and soil samples.</p>	<p>*</p>		*	*				
<p>T Colson Road Landfill – GPS2607397E-6237616N. This is a present municipal landfill and has been in use since the early 1970's. It is alleged that IWD waste products have been disposed of in this landfill during past years. This landfill has resource consents and is monitored. Proposed inspection/sampling method – One water sample (dioxin)</p>	<p>Nil – NPDC already done dioxin on leachate</p>							
<p>U IWD/2 - Another alleged dumpsite on the IWD premises that will be investigated following discussions with Dow AgroSciences. The allegation refers to a concrete bunker used as an anisol storage facility. Proposed inspection/sampling method – To be confirmed</p>	<p>*</p>		*					
<p>V Centennial/2 – GPS2598524E-6237853N. This alleged site is the discharge point of the former stormwater line from the office blocks of the IWD premises. The stormwater system was apparently accessed during spills that occurred on site and was seen to be frothing before the mid 1980's. Proposed inspection/sampling method – Soil sample and marine survey (refer Zd)</p>	<p>*</p>		*	*				

<p>W Herekawe Stream – GPS2598309E-6236771N. This is the current stormwater discharge from the IWD premises. The discharge has resource consents and is monitored. Proposed inspection/sampling method – Water sample and marine sample (refer Zd)</p>		<p>See site D</p>		
<p>X Roto Street – GPS2600775E-6234738N. This alleged site is located on a recent subdivision. The land was previously owned by Duncan and Davies Nurseries, Westown. The allegation is that drums containing chemical had been dumped. A drain flows from the south-west end of the subdivision. Proposed inspection/sampling method – GPR, water and soil samples</p>	<p>*</p>		<p>*</p>	<p>*</p>
<p>Z Ngahoro – GPS2597661E-6235515N. This is a known site on the old IWD dairy farm. In February 1981, 230 drums of waste were removed from this site and returned to Ivon Watkins-IWD Ltd for incineration or recycling. About 1000m² of soil was relocated from this site to the Waireka facility. It has been alleged that between thirty and fifty empty drums and assorted rubbish were left behind and covered with 1.5 to 3 metres of clean soil however, the company has stated that all wastes were removed from the site. This site will be investigated to confirm clean-up was completed in 1985. Proposed inspection/sampling method – GPR, water and soil samples</p>	<p>*</p>		<p>*</p>	<p>*</p>
<p>Za 60 Marama Crescent – GPS2598529E-6236990N. This site is located at the rear of a residential property at 60 Marama Crescent. Recently part of a drum was dug up. The site was identified by the current owner. Proposed inspection/sampling method – GPR and soil samples</p>	<p>*</p>		<p>*</p>	<p>*</p>
<p>Zb Buller Street – GPS2603497E-6238487N. The site of the original Ivon Watkins Limited. Proposed inspection/sampling method – nil</p>	<p>*</p>		<p>*</p>	<p>*</p>

<p>Zc Tarahua Road - GPS2604173E-6235524N. This is a former warehouse of the original Ivon Watkins Ltd. The site is either sealed, metalled or concreted and was referred by the present owners. No further action is warranted on this site. Proposed inspection/sampling method - nil</p>								
<p>Zd Tasman Sea - The Tasman Sea has been the concern of surfers and warrants marine surveys at a number of sites, they are: I Adjacent to Waireka dumpsites II Adjacent to the Herekawae Stream III Adjacent to Paritutu Rock IV Adjacent to Belt Road V Adjacent to Eliot Street Proposed inspection/sampling method - marine sampling</p>						<p>At Waireka: TCDD, acid herbicides at Eliot St: O/C's, TCDD (near Buller St site, in use at time) All other sites: TCDD only Two for control site: TCDD, acid herbicides, O/C's benzopyrene (PAHs)</p>		
<p>Ze Tank 3500 - GPS2597888E-6235965N. This is a known site on the old IWD dairy farm that has been confused with Ngahoro but is separate. The site was discovered by the then Ministry of Works during the construction of tanks at the tank farm in April/May 1985. IWD were advised and clean-up was undertaken. This site will be investigated to confirm clean-up in 9185. Proposed inspection/sampling method - GPR</p>								
<p>Zf IWD-3 - Another alleged dumpsite on the IWD premises that will be investigated following discussions with Dow AgroSciences. The allegation refers to dumping of waste in a deep bunker. Identified by Maurice Vickers. Proposed inspection/sampling method - To be confirmed</p>								
<p>Zg IWD/4 - Another alleged dumpsite on the IWD premises that will be investigated following discussions with Dow AgroSciences. The allegation refers to drums punctuated by shots near the current incinerator. Identified by various parties. Proposed inspection/sampling method - To be confirmed</p>								

<p>Zh Car Park – GPS2597919E-6236297N. This alleged site is near the car park west of the Herekawe Stream on a walking track to the beach and is often referred to Council as a chemical discharge and needs to be included for completeness in this investigation. Proposed inspection/sampling method – Water sample</p>		*		*		*			*	In Zd	
<p>Zi Herekawe cliff site – GPS2598205E-6237049N. This alleged site is to the east of the Herekawe Stream and is a cliff discharge that is seen by surfers. It is also referred to as a chemical discharge and will be sampled for completeness. Proposed inspection/sampling method – Water sample</p>			*		*				*	In Zd	
<p>Zk Jury site – GPS2598766E-6236388N. This alleged site is at the end of Norwich Avenue and was originally a concrete bunker site on the former Jury farm in close proximity to the old Ngamotu Tavern. Old concrete is still visible. There is no waterbody nearby. Proposed inspection/sampling method – Soil samples</p>			*	*		*					

Appendix IV

GPR report

**Geophysical Survey
to investigate
Alleged Agrichemical Wastes
Storage and Disposal sites.**

***New Plymouth
August 2001***

**Report Prepared for
Taranaki Regional Council**

By

GPR Geotechnical Services

Introduction

Geophysical investigative surveys were commissioned by the Taranaki Regional Council to be carried out at a total of 19 sites in the New Plymouth environs. The surveys were a component of a suite of investigative techniques utilized by the Council to assess a number of sites.

The purpose of these surveys was to carry out non-intrusive investigations to determine the possible presence of buried drums or similar containers in the designated search areas.

The geophysical surveys carried out utilised Ground Penetrating Radar (GPR) and Electromagnetic Induction (EM) techniques to obtain sub-surface information.

The surveys were carried out during the period 14th May 2001 to 21st June 2001.

Surveys were conducted with a staff member of the Council and either one or two representatives of the Local Dioxin Investigation Action Group in attendance.

Each locality investigated was scanned with GPR to obtain an effective, practical and economical search of the designated site. When considered potentially useful an EM survey was also carried out at sites in order to provide further information on soil electrical properties which may have been affected by buried objects or contamination.

A drawing has been produced for each location investigated to show the location and extent of the survey carried out. Sub-metre Global Positioning System (GPS) location way points (WP) were also collected where considered prudent to accurately record survey site locations.

This report gives an overview of the geophysical surveys carried out, a summary of the resultant data with a conclusion for each investigated site. Each location has been described and reported on separately and in sequence to form the body of this report. Also included are "thumbnail" annotated radargrams showing typical GPR data results obtained for each site.

EM data collected at the Tank 3500 site off Centennial Drive have been included in the appropriate section of this report.

Appendix A of this report lists the GPS way point details.

Geophysical Equipment

A GSSI SIR System-2 Ground Penetrating Radar Control unit together with a 200MHz antenna was used for the GPR survey. The GPR antenna consists of a transmitter that sends out pulses of electromagnetic energy and a receiver that detects the return signal reflected from boundaries where adjacent materials have contrasting dielectric properties.

Signals returned to the antenna are displayed on a screen in real time and stored on a hard drive for subsequent processing and interpretation. Anomalies on the radar file record (radargram) can indicate voids, stratigraphic changes, buried objects, services, changes in water content, etc.

Data collected with GPR is downloaded onto a PC for processing using software called RADAN and an interpretation of resultant data made.

A Geonics EM 31 (Electromagnetic Induction) instrument was used to obtain information on changes in the electrical properties of the soil. The EM 31 consists of a transmitter which generates a high frequency magnetic field and a receiver which detects the generated magnetic field and compares this field to the field created by eddy-currents circulated in the ground. A data logger records the quadrature response which is proportional to the electrical conductivity of the soil as well as the in-phase response which is proportional to the magnetic field strength.

Data collected with the EM 31 is downloaded onto a PC and processed using specialised 3D software to produce an overall result for the site surveyed.

Original data and records for all work and findings presented here are held by GPR Geotechnical Services.

SUMMARY

Two thirds of the locations investigated showed no significant anomalies which might indicate the presence of burial pits containing drums or other containers.

At seven sites investigated, anomalies were detected, ranging from evidence of a pit containing large buried objects at one site, to evidence of a few large buried objects. Further investigation would be required in order to determine the nature of these detected buried objects and/or anomalies.

LOCATIONS INVESTIGATED

TRC Site A - Lawry/Devon Streets.....	Page 6
TRC Site B - Seaview Road.....	Page 7
TRC Site C - Pylon 3.....	Page 8
TRC Site D - 34 Rangitake Street.....	Page 10
TRC Site E - Omata Reserve off Centennial Drive.....	Page 11
TRC Site ^{Da} - House No 44 Rangitake Street.....	Page 12
TRC Site ^{Da} - Rangitake Street	Page 13
TRC Site P - 26A Rangitake Street	Page 14
TRC Site M - Gully off Beach Road	Page 15
TRC Site X - Roto Street.....	Page 16
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Dow AgroScience premises - Paritutu Street Site 1 adjacent to Wellsite No 1	Page 24
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Locations investigated continued....

Dow AgroScience premises – Paritutu Street

Site 3 adjacent to Wellsite Nos 6 and 43 Page 26

Appendix A (GPS Way Point details Page 27

TRC Site A – Lawry/Devon Streets.

Location:

This site is situated on the corner of Devon Street West and Lawry Street known as Westwill Corner. It consists of an open grassed area between Lawry Street and the Peak Plants Garden Centre.

GPR Survey:

GPR scan lines were run in a South to North direction perpendicular to Devon Street. Refer Fig. 1a. Lines were at a spacing of approximately five metres to cover the whole site from Lawry Street to the Peak Plants Garden Centre western boundary fence. GPR radargram file references are Files 78 through to 89. Two GPS positions were captured to record the extent of this survey. These are way points (WP)1 and WP 2.

Data Results:

GPR data showed scattered diffractions indicating that the majority of the area scanned consists of fill material. This result is typical of a general landfill area. Refer Fig 1b.

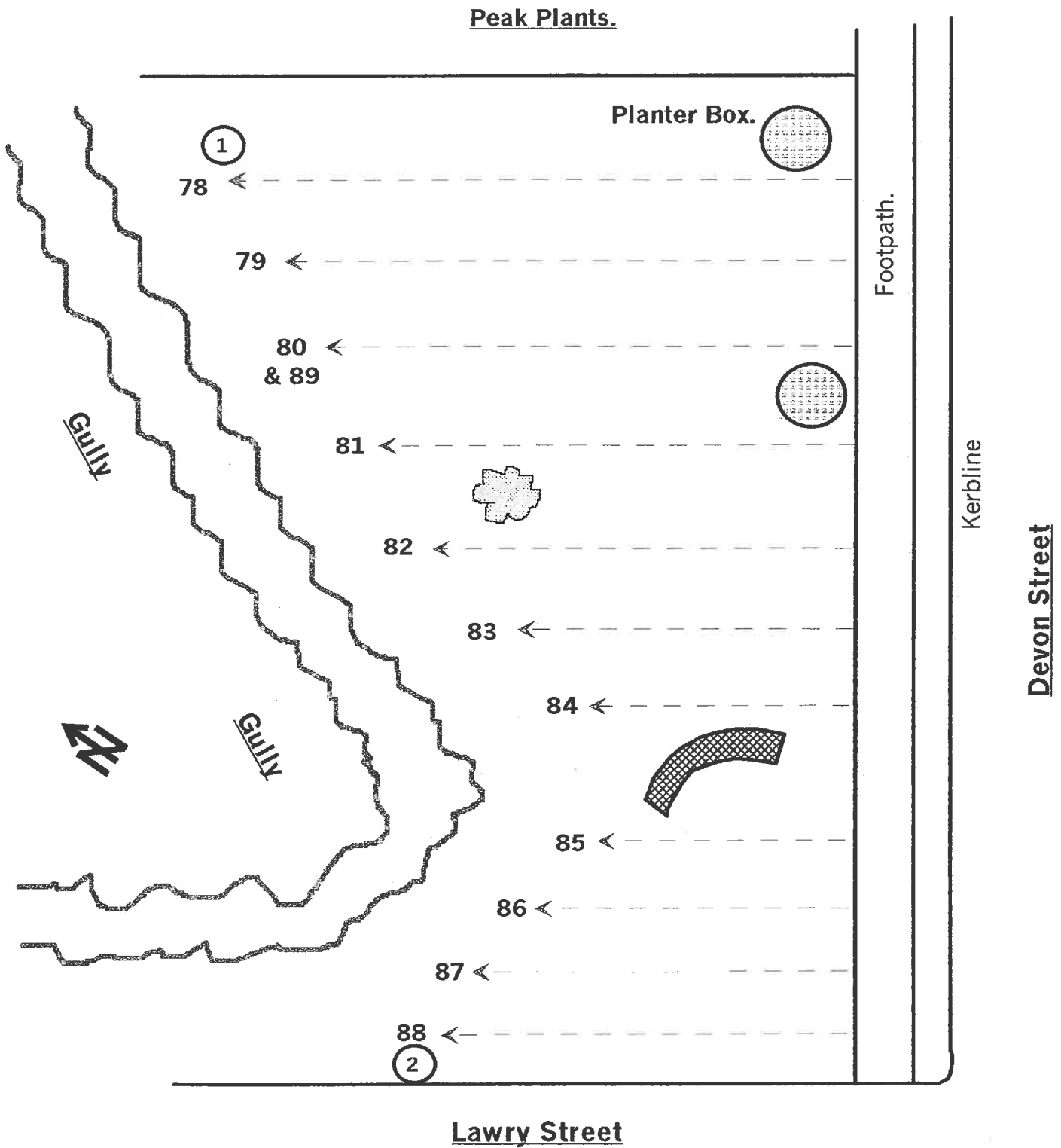
File 81 and File 84 show evidence of landfill with buried debris. The original soil slope to the gully at the north end of this site can also be seen on these files.

File 87 at the western edge of the site shows what is apparently an original soil slope from Devon Street with fill material above.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

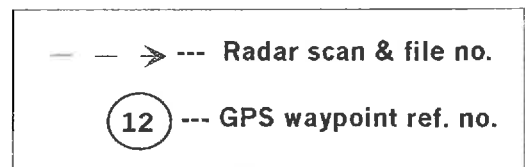
TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Lawry / Devon Streets - Site A.
 May 2001



Note: Not to Scale.

Radar Scan lines at 5 metre (approx) spacing.

Figure 1a

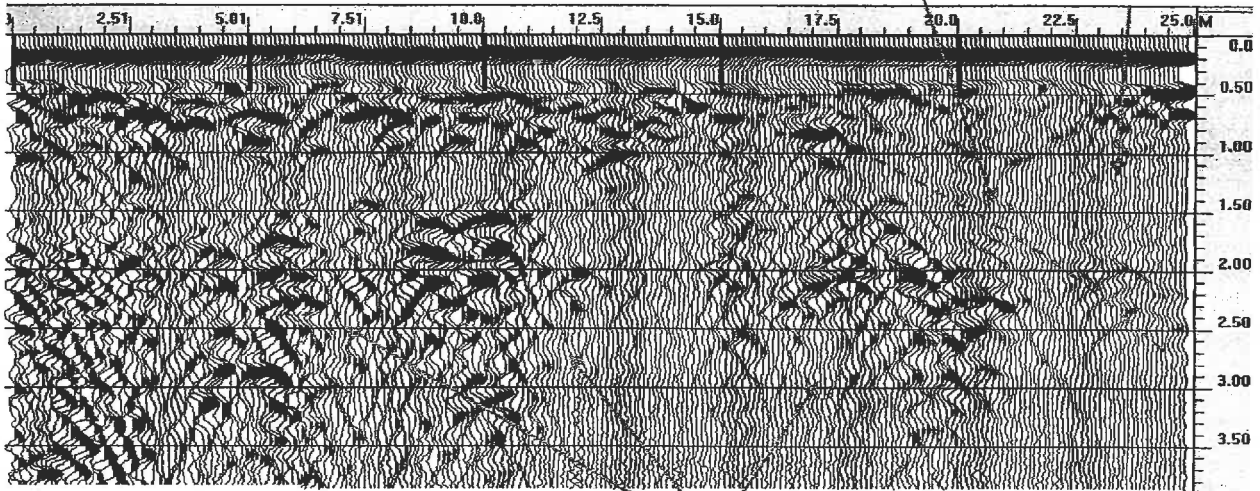


LAWRY STREET SITE

Site A - Lawry Street
File 81

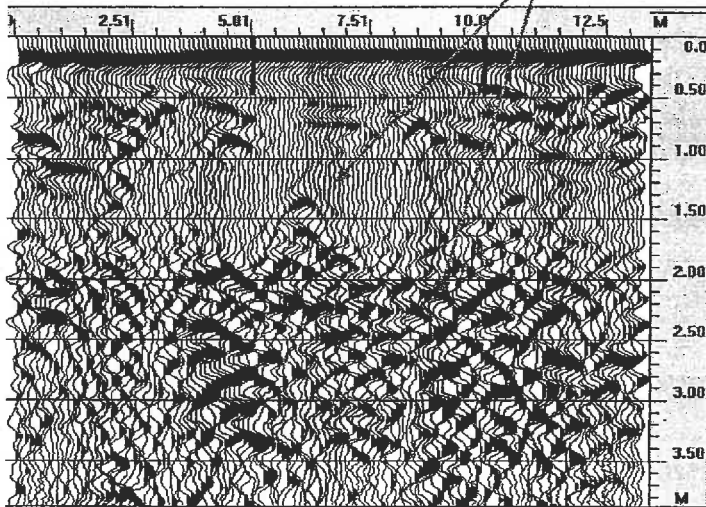
Original soil slope to Gully

Fill material



Site A - Lawry Street
File 84

Evidence of buried debris



Site A - Lawry Street
File 87

Likely original soil slope line to gully.

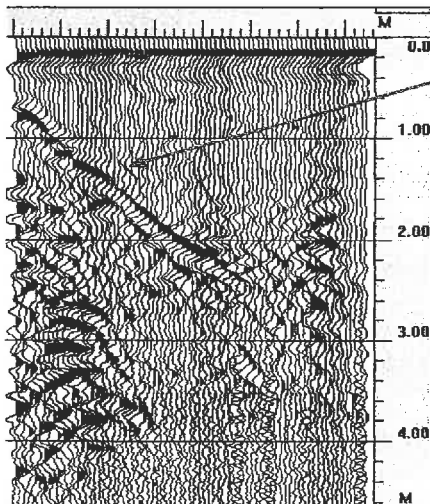


Figure 1b

TRC Site B – Seaview Road

Location:

This site is situated on the corner of Devon Street West and Seaview Road. It consists of an area directly behind and to the north-west of the Shell Service Station adjacent to the creek.

GPR Survey:

GPR scan lines were taken in various directions to cover the area between the service station and the spray paint workshop directly behind it. Refer Fig. 2a. There was a limited amount of space on this site for a GPR survey. GPR radargram file references are File 90 through to 93.

Two GPS positions were captured to record the extent of this survey. These are WP 3 and WP 4.

Data Results:

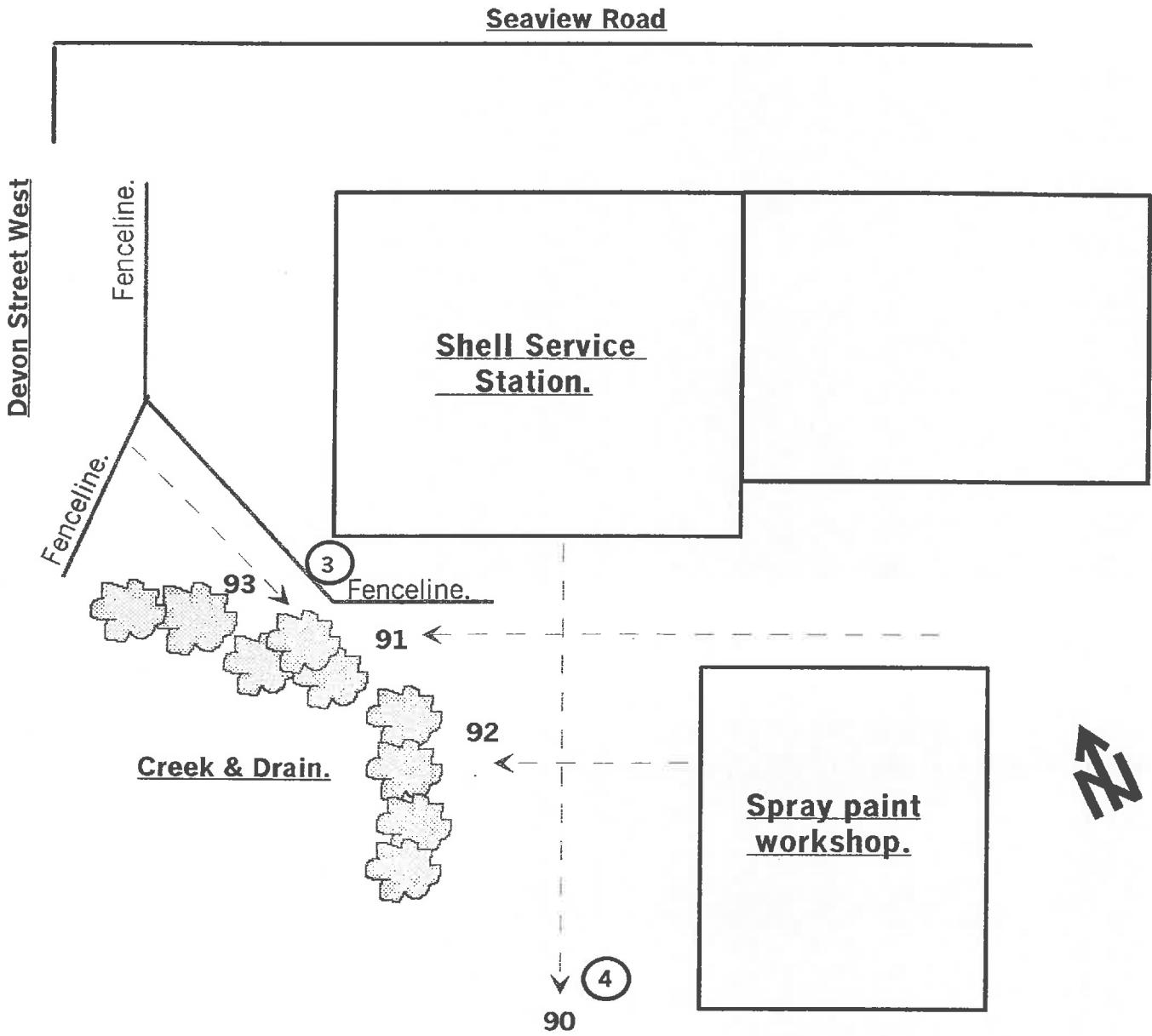
GPR data collected from this site showed normal soil strata which indicated the likely original soil slope to the creek. The remainder of the site showed small scattered diffractions consistent with fill material. This result is typical of a general landfill area. Refer Fig 2b.

File 91 and File 93 show evidence of the original soil slope down towards the creek.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Seaview Road - Site B.
May 2001



Note : Not to Scale

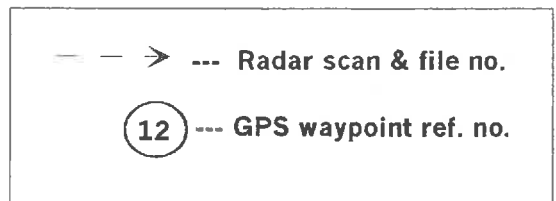
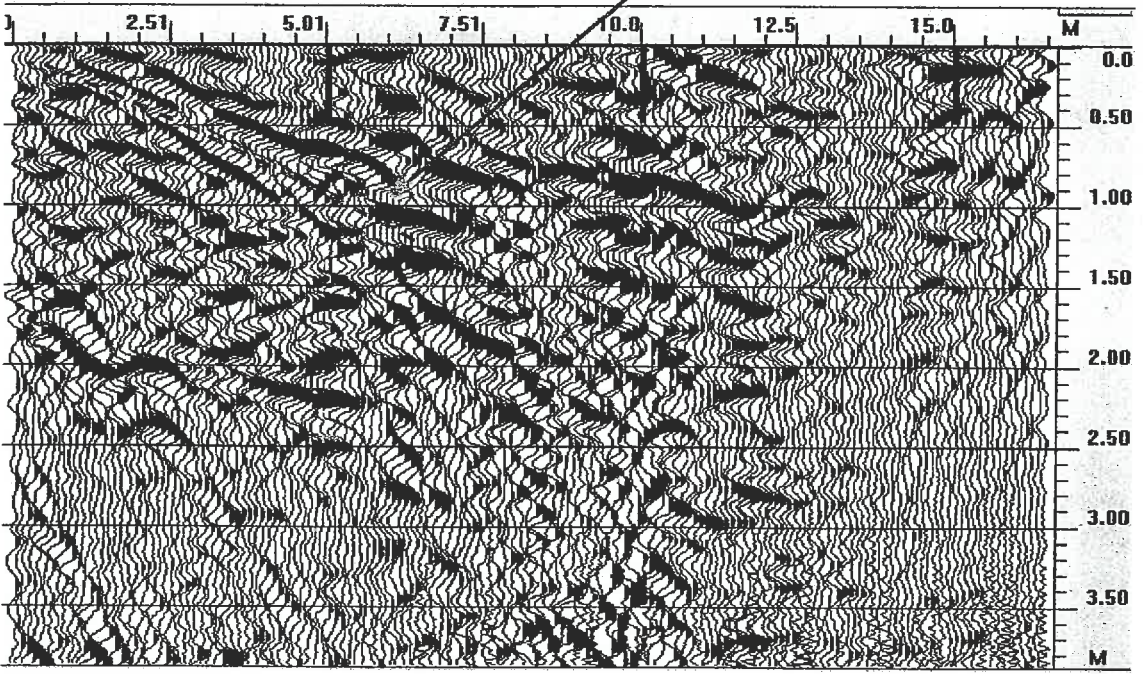


Figure 2a

SEAVIEW ROAD SITE

Site B - Seaview Road
File 91

Original soil slope to Creek



Site B - Seaview Road
File 93

Original soil slope to Creek

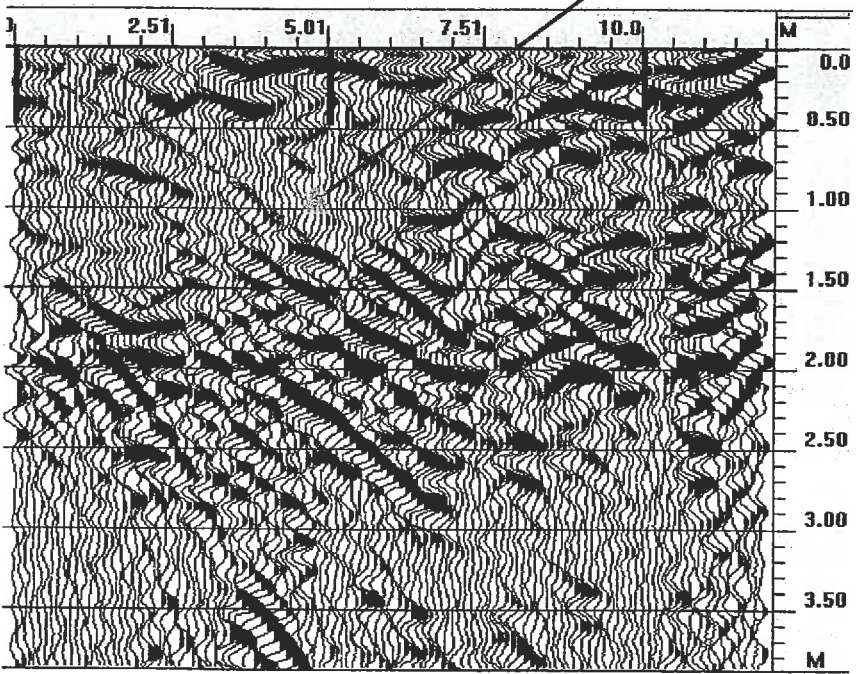


Figure 2b

TRC Site C – Pylon 3

Location:

This site covers the area immediately around Transpower EHV Transmission line Pylon 3. It also includes approximately 250 metres of Centennial Drive as well as the area between Centennial Drive and the clifftop facing the sea from north of the carpark to the small bush-covered outcrop at the southern end. This total area is the largest of the areas surveyed.

GPR Survey:

A large number of GPR scan lines were run in a variety of directions in all of the areas where it was practical to carry out a scan. The survey effectively covers the whole area. Refer Fig. 3a. GPR radargram file references are Files 60 and 107 through to 153.

Six GPS positions were captured to record the extent of this survey. These are WPs 5, 6, 7, 8, 9, and 10.

Data Results:

In the area immediately surrounding Pylon 3, the area consisted of raised undulating terrain which dictated where survey lines could be carried out. Typical GPR results are shown on Fig. 3b and show generally horizontal or undulating undisturbed soil strata lines. No significant anomalies were detected.

GPR data collected along and across Centennial Drive showed the installed underground pipelines running towards the port.

The majority of the GPR data collected in the area between Centennial Drive and the clifftop showed generally horizontal to undulating undisturbed soil strata with no significant anomalies evident. A number of underground stormwater drain pipes were detected running between Centennial Drive and the coastline. Refer Fig. 3c.

TRC Site C - Pylon 3 - continued

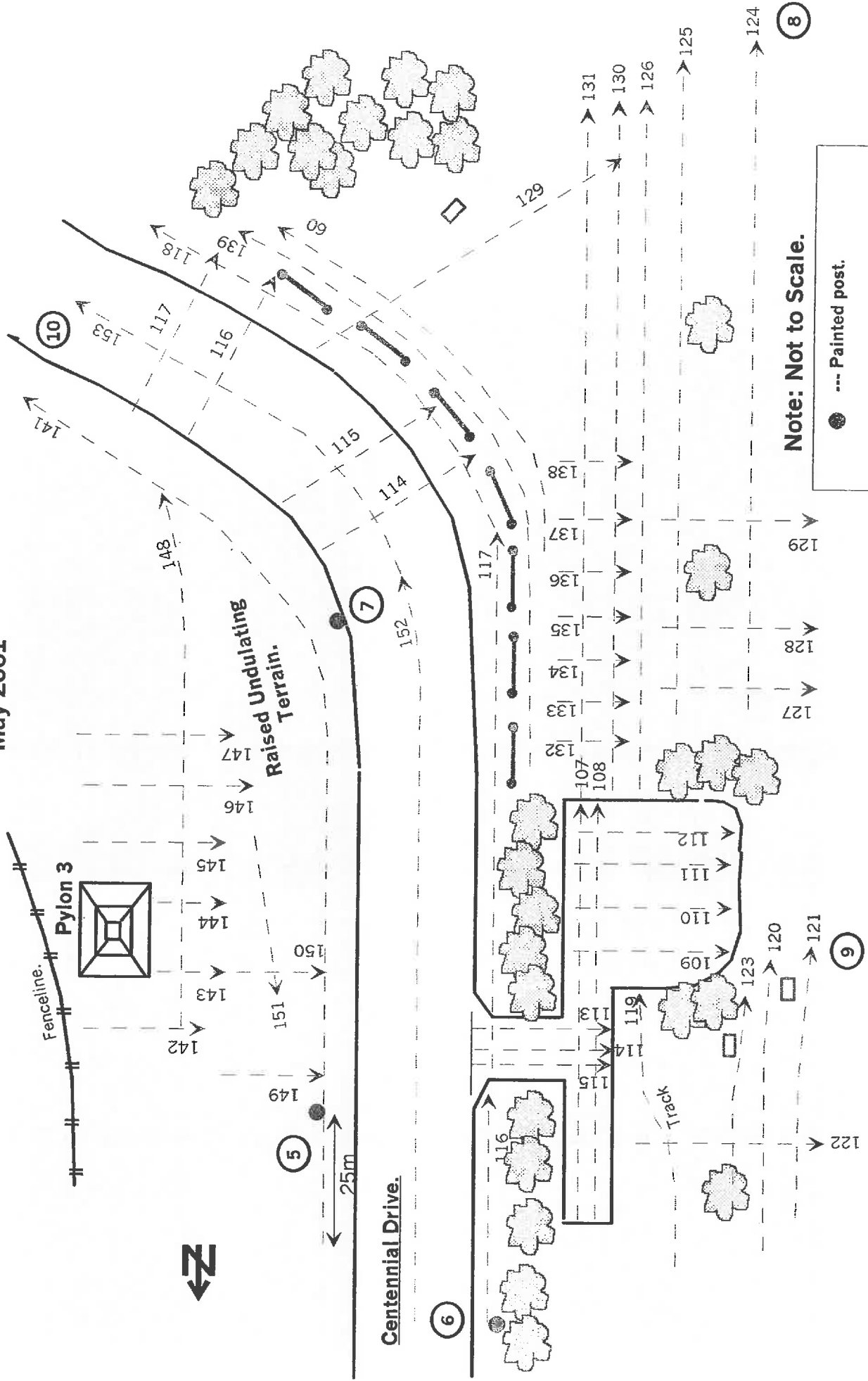
At the southern end of the area between Centennial Drive and the cliff top, an anomalous area was detected. Refer Fig. 3d. which shows the results seen on Radargram File 139 and File 60. This anomaly shows some evidence of disturbed subsurface strata with diffractions from likely buried objects.

Conclusions:

The majority of the data collected at this site revealed generally undulating soil strata with a large number of gas and drainage pipelines.

The most significant anomaly detected can be seen on Radargram Files 139 and 60. Further investigation would be necessary to determine the cause of this anomaly.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Centennial Drive near Pylon 3. - Site C
 May 2001



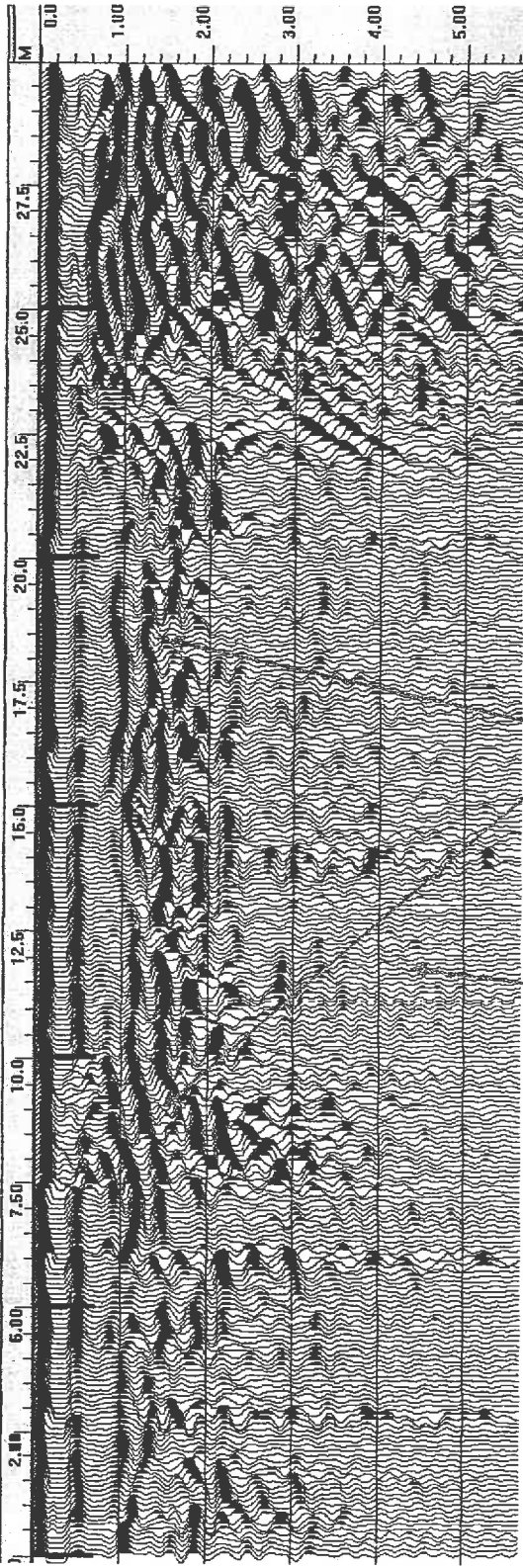
Note: Not to Scale.

- --- Painted post.
- --- Radar scan & file no.
- --- GPS waypoint ref. no.

Figure 3a

PYLON 3 SITE - CENTENNIAL DRIVE

Site C - Pylon 3
File 147



Continuous undisturbed soil strata

No evidence of buried objects.

Site C - Pylon 3
File 151

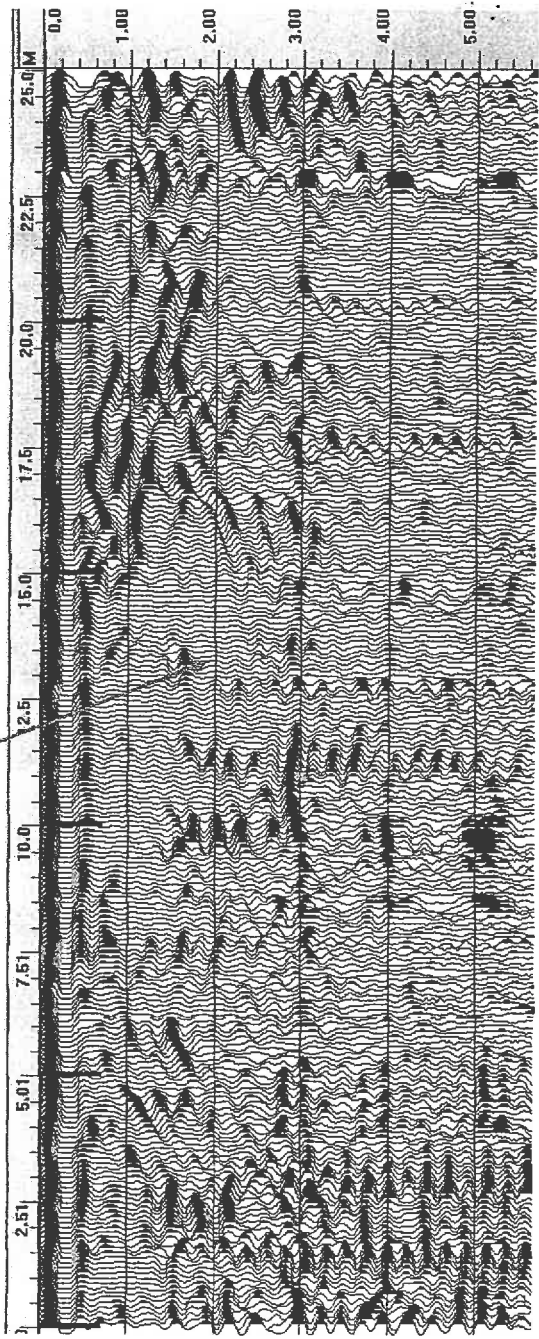
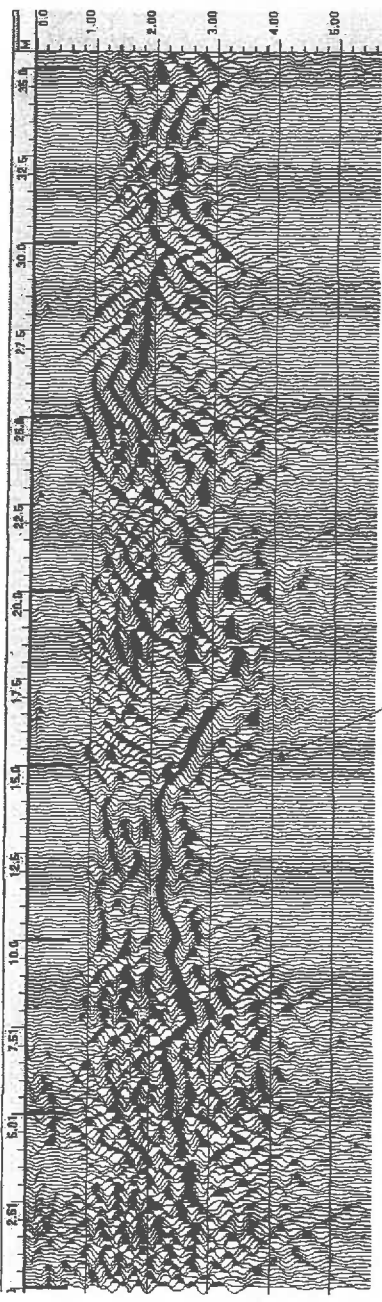


Figure 3b

PYLON 3 SITE - CENTENNIAL DRIVE

Site C - Pylon 3
File 121



No apparent evidence of buried objects.

Site C - Pylon 3
File 126

Underground Pipeline

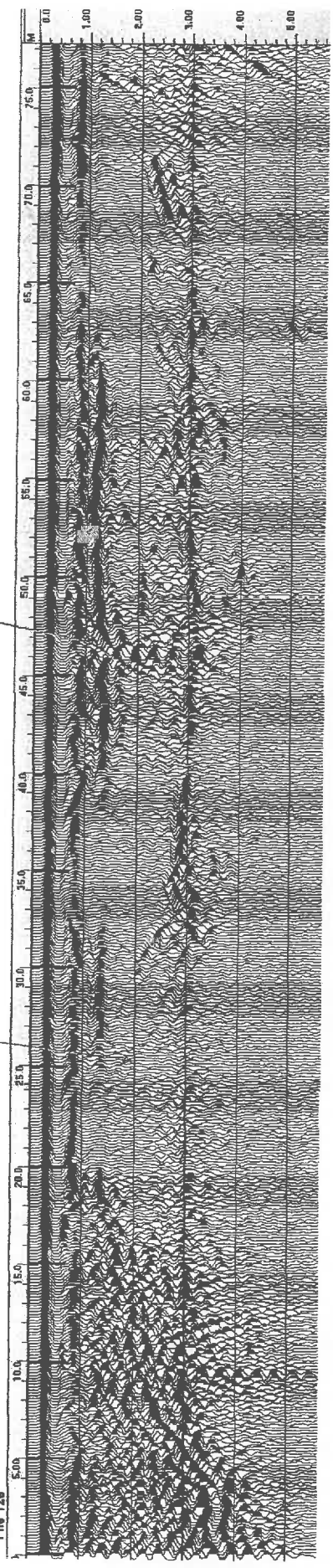
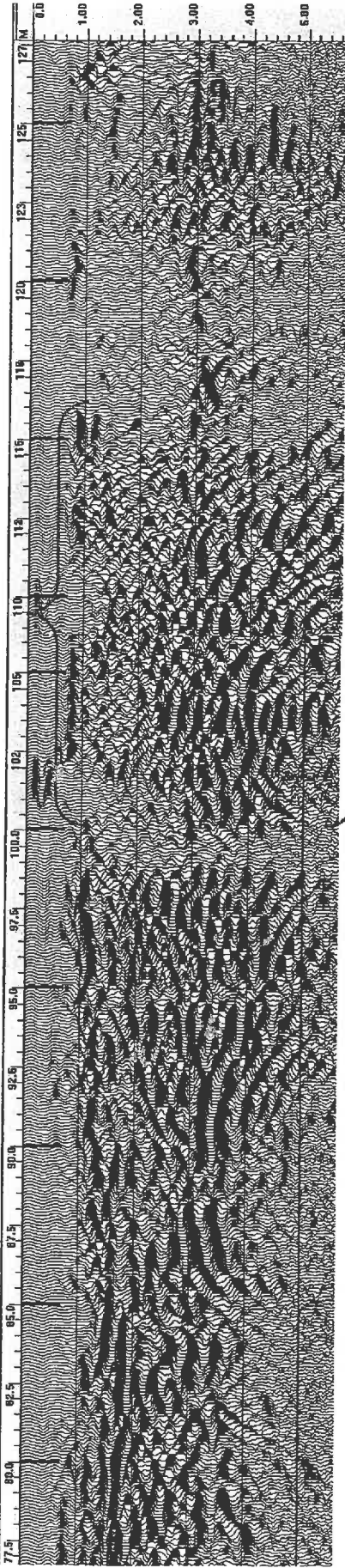


Figure 3c

Pylon 3 Site

Site C - Pylon 3
File 139



Anomalous area - disturbed subsurface strata.

Same location (different scale)

Site C - Pylon 3
File 60

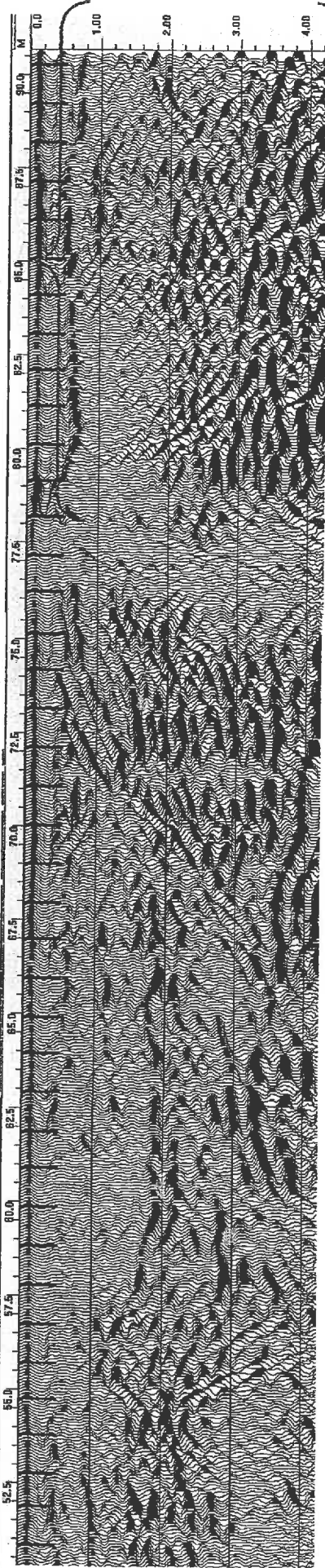


Figure 3d

Anomalous area - disturbed subsurface strata.

TRC Site D – 34 Rangitake Street.

Location:

This site consisted of the front and back garden lawn areas of house No 34 Rangitake Street.

GPR Survey:

GPR scan lines were run across the front lawn immediately behind the house, under the rear piled area of the house and the lower lawn area at the rear of the section. Refer Fig. 4a. GPR radargram file references are Files 57 through to 63. GPS positions were not considered necessary for residential sites.

Data Results:

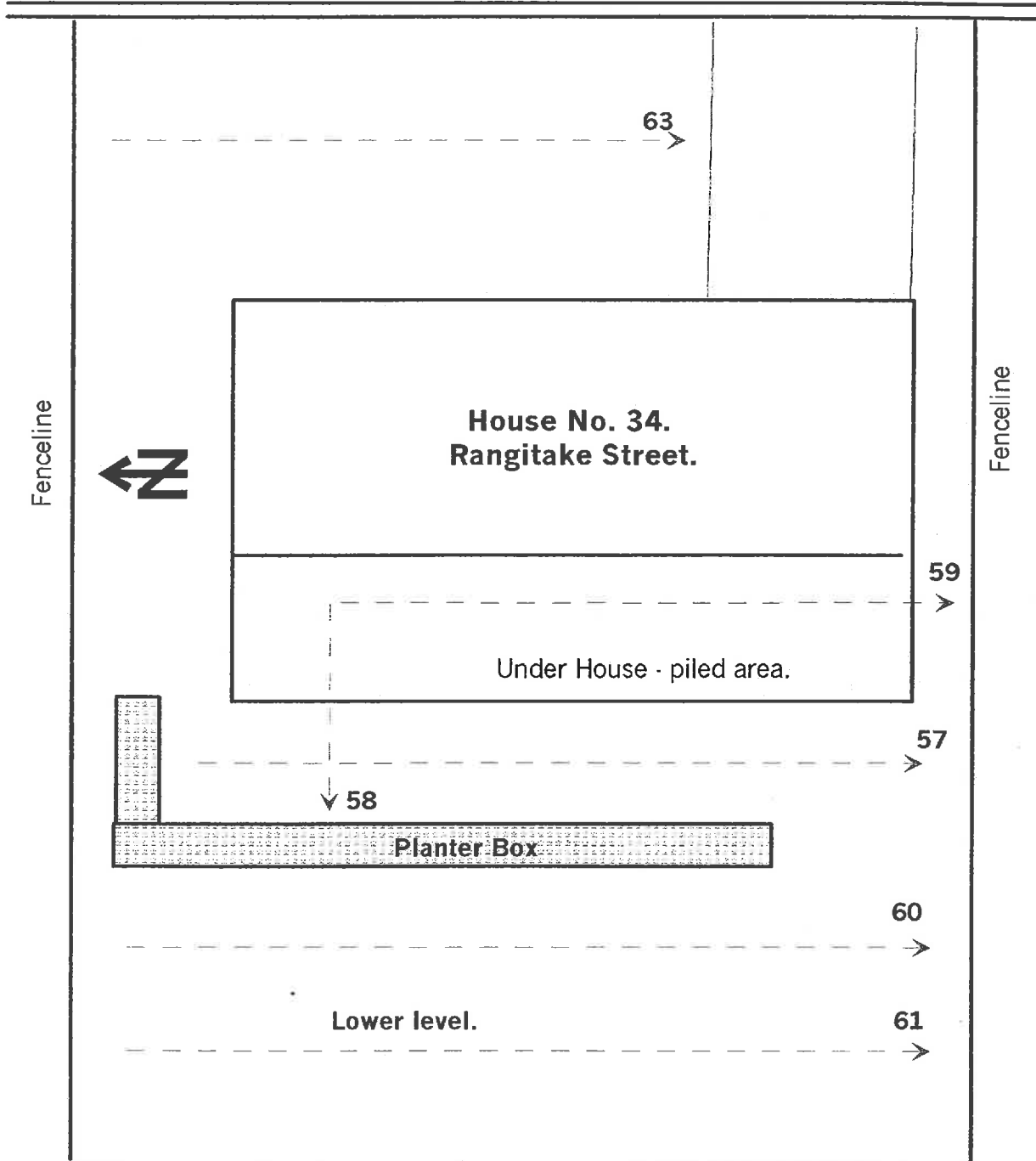
GPR Radargrams Files, 57, 58, 59 and 63 showed normal soil strata with no obvious or significant anomalies. At the rear of the section on the lower lawn area, however, significant diffractions were detected on the southern end of the lawn. These are consistent with reflections from a few large buried objects. These can be seen on Radargram File 60 and 61. Refer Fig 4B.

Conclusions:

The data collected from this site did not reveal significant anomalies in the majority of the section. The data from one end of the rear lower lawn area, however, does indicate anomalies which are consistent with large buried objects such as drums. Further investigation would be necessary to determine the nature of the anomaly.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
34 Rangitake Street - Site D
May 2001

Rangitake Street.



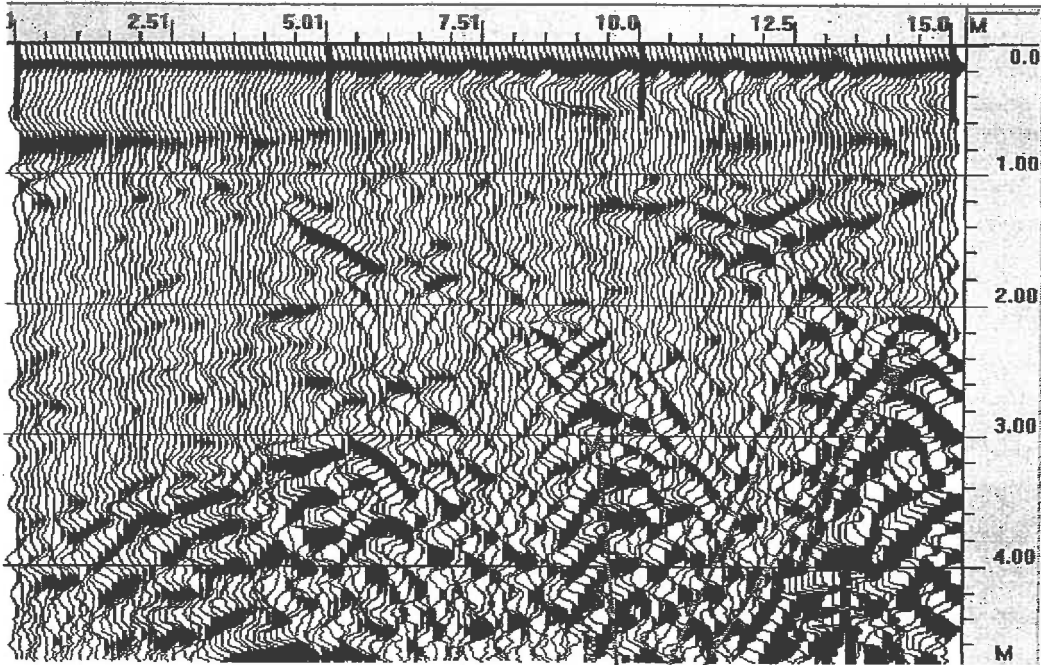
Note : Not to Scale



Figure 4a

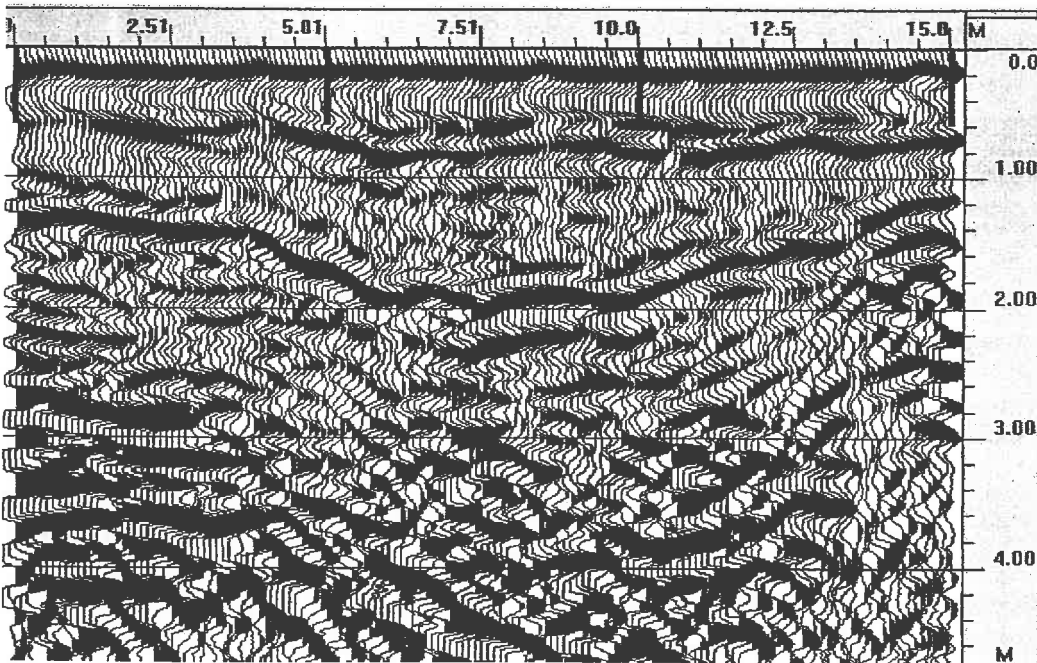
34 Rangitake Street

Site D - 34 Rangitake Street
File 60



Diffractions - possible large buried objects.

Site D - 34 Rangitake Street
File 61



Figur 4b

TRC Site E – Omata Reserve off Centennial Drive

Location:

This site is situated in the Omata Reserve area on the seaward side off Centennial Drive north of Herekawe Drive.

GPR Survey:

GPR scan lines were run in north to south and east to west directions to cover this site of approximately 20 metres x 20 metres. Refer Fig. 5a. GPR radargram file references are Files 69 through to 73.

GPS position WP27 was captured to record the location of this survey.

Data Results:

GPR data showed unbroken soil strata lines with no obvious anomalies or signs of previous excavation. Refer Fig 5b which shows typical radargrams collected at this site.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Omata Reserve - Site E - Off Centennial Drive.
May 2001

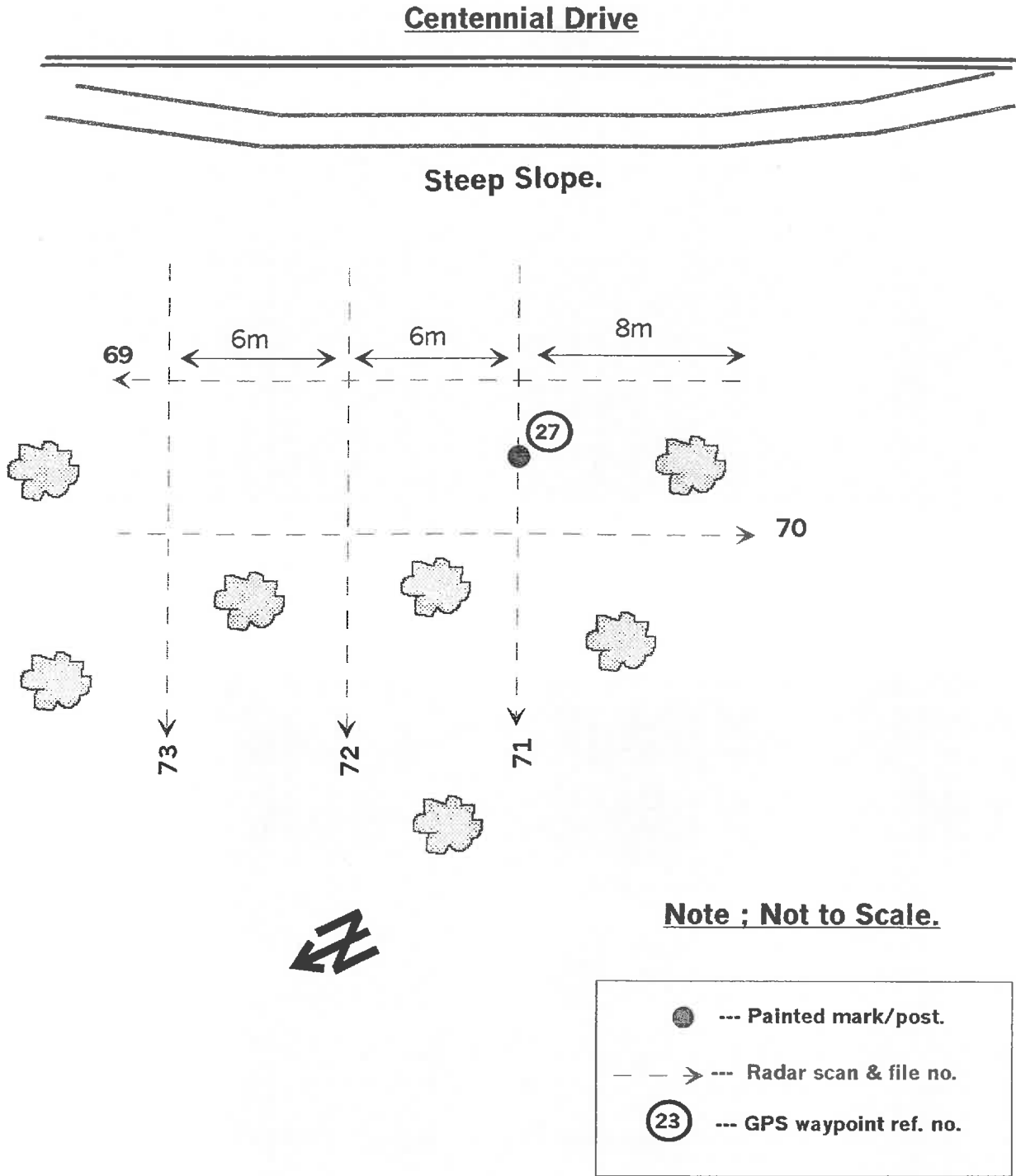
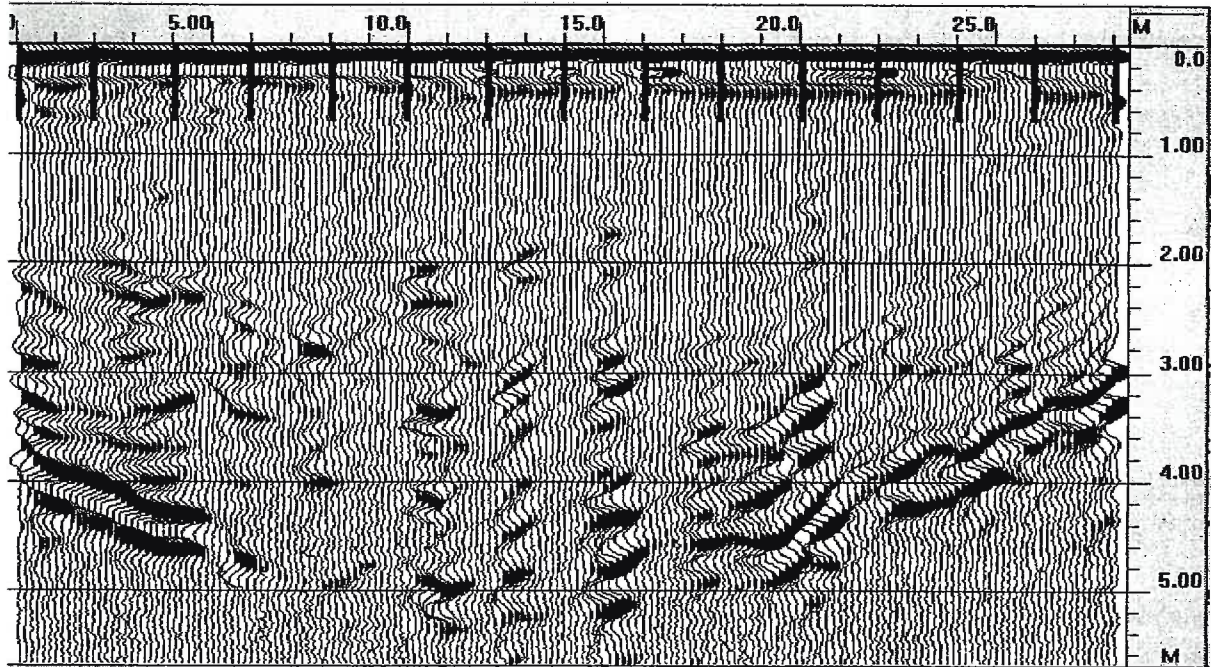


Figure 5a

Omata Reserve - Centennial Drive

Site E - Omata Reserve
File 72



No anomalous areas apparent in Radargrams.

Site E - Omata Reserve
File 73

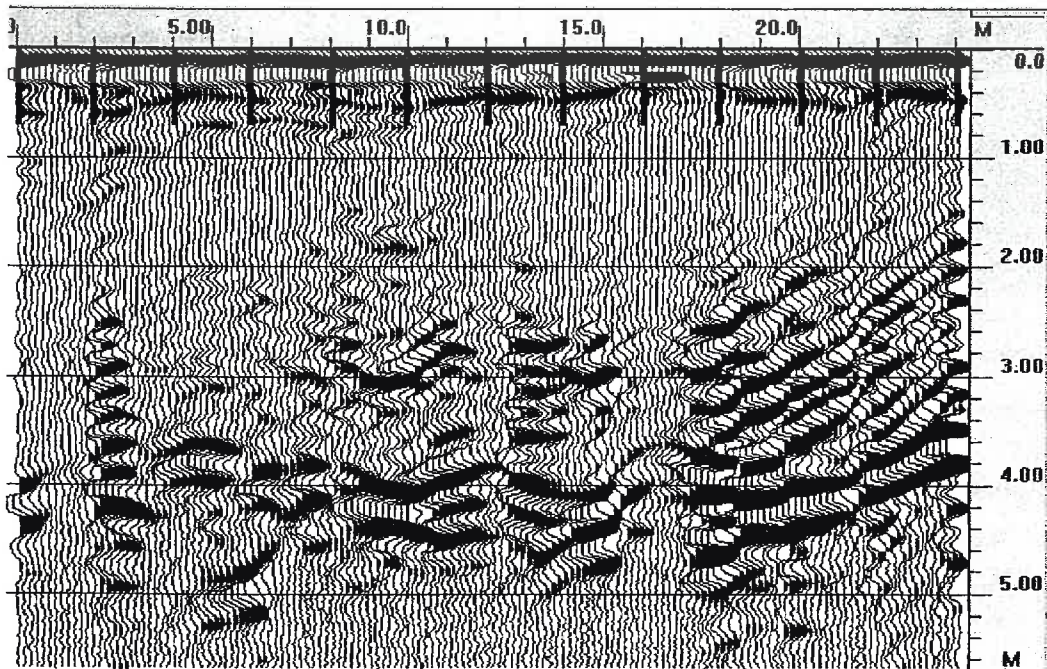


Figure 5b

TRC Site – House No 44 Rangitake Street

Location:

This site covers the front and back garden areas of House No 44 Rangitake Street. The area at the far rear of House No 44 was fenced off and severely overgrown with vegetation and was therefore not able to be surveyed at this stage. Also included is the vacant lot immediately north of House No 44.

GPR Survey:

GPR scan lines were run in a north to south direction in the front and rear gardens of House No 44. GPR scan lines were run in an east to west direction to cover the vacant lot adjacent to House 44. Refer Fig. 6a. GPR radargram file references are Files 97 through to 105.

GPS position WP11 was captured to record the extent of the survey on the vacant section.

Data Results:

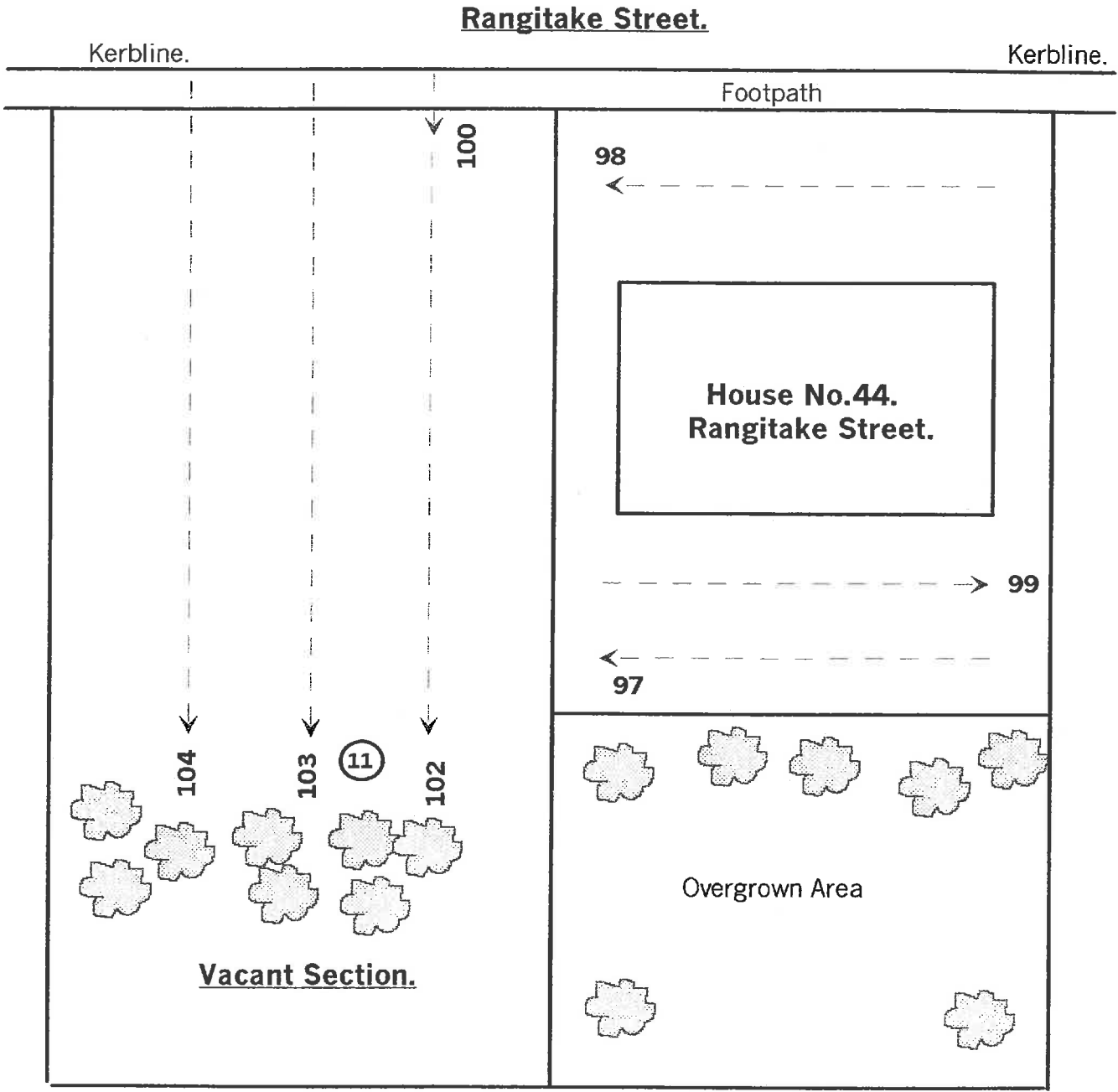
GPR data showed strong diffractions in the rear garden of House No 44. These strong diffractions are likely to have been caused by a few large buried objects. Refer Fig 6b.

No significant anomalous areas were detected in the front garden of House No 44 or on the adjacent vacant lot. Refer Fig 6c which shows the results of a typical scan taken across the adjacent vacant section.

Conclusions:

Further investigation of the rear garden of House No 44 would be necessary to determine the nature of the anomaly.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 44 Rangitake Street. - Site Da
 May 2001



Note : Not to Scale

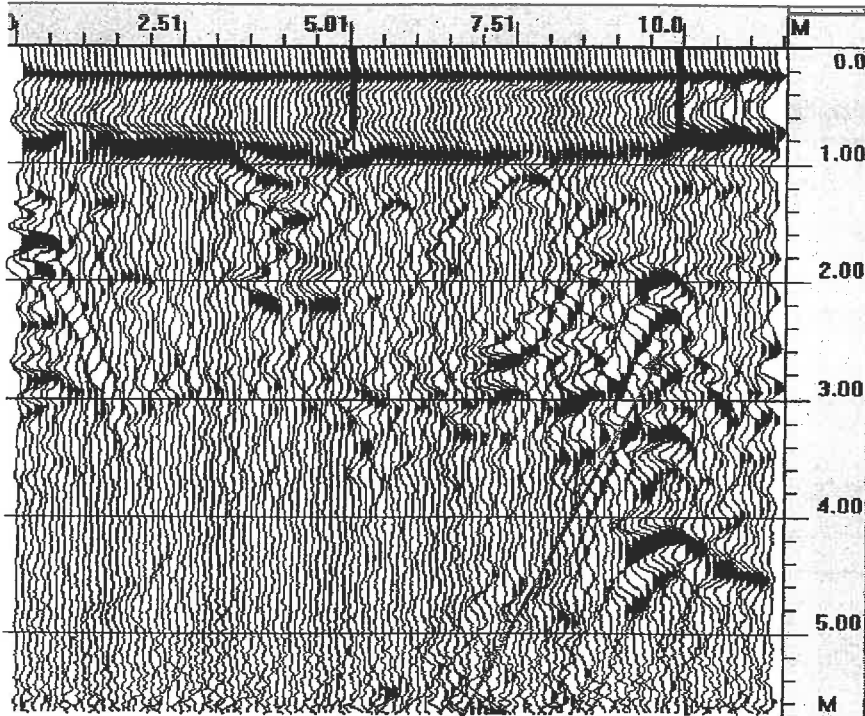


--->	--- Radar scan & file no.
(12)	--- GPS waypoint ref. no.

Figure 6a

44 Rangitake Street.

44Rangitikei Street
File 99



Strong diffractions - possible large buried objects

44Rangitikei Street
File 97 (Rev.)

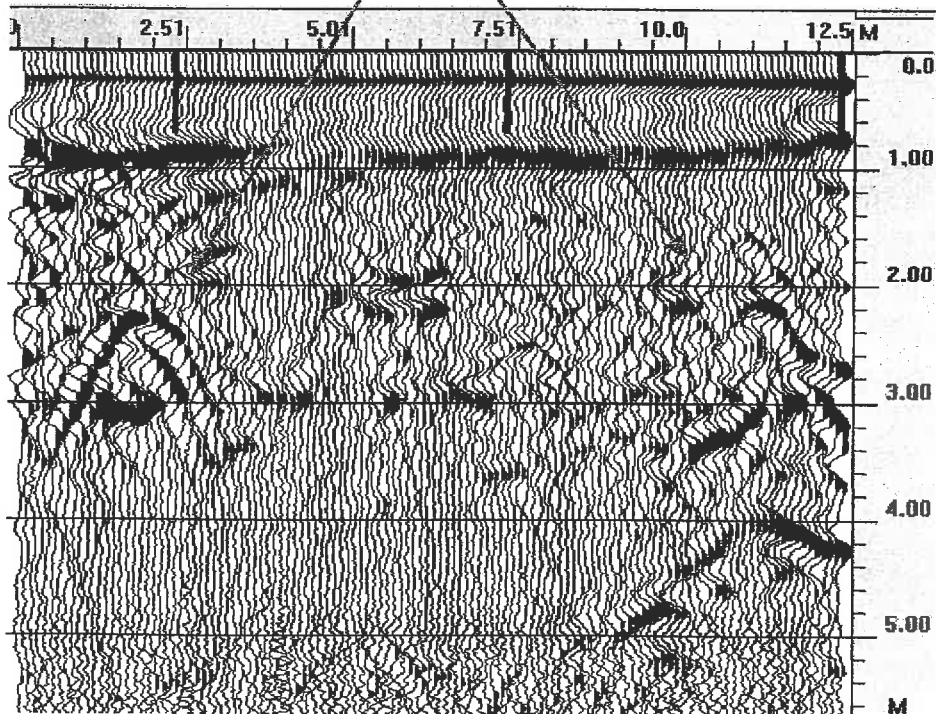


Figure 6b

TRC Site – Rangitake Street

Location:

This site covers Rangitake Street from the end of the cul-de-sac as far as Herekawe Drive.

GPR Survey:

GPR scan lines were run from the farm gate at the southern gate at the southern end of Rangitake Street along the street as far as Herekawe Drive approximately one metre into the roadway measured from the kerbface. Refer Fig. 7a. GPR radargram file reference is Files 118.

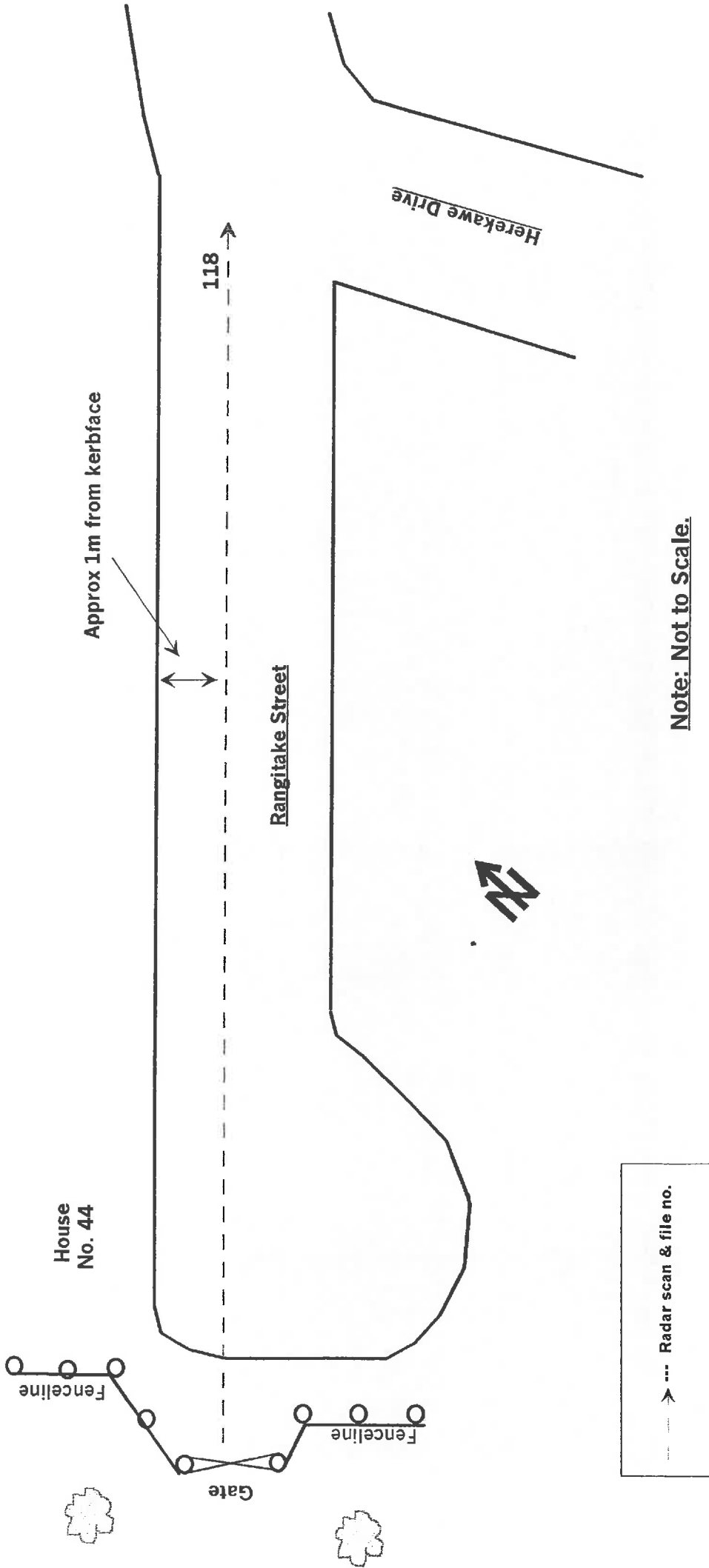
Data Results:

GPR data along this street showed various underground services' location. No significant anomalies were detected.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Rangitake Street
May 2001

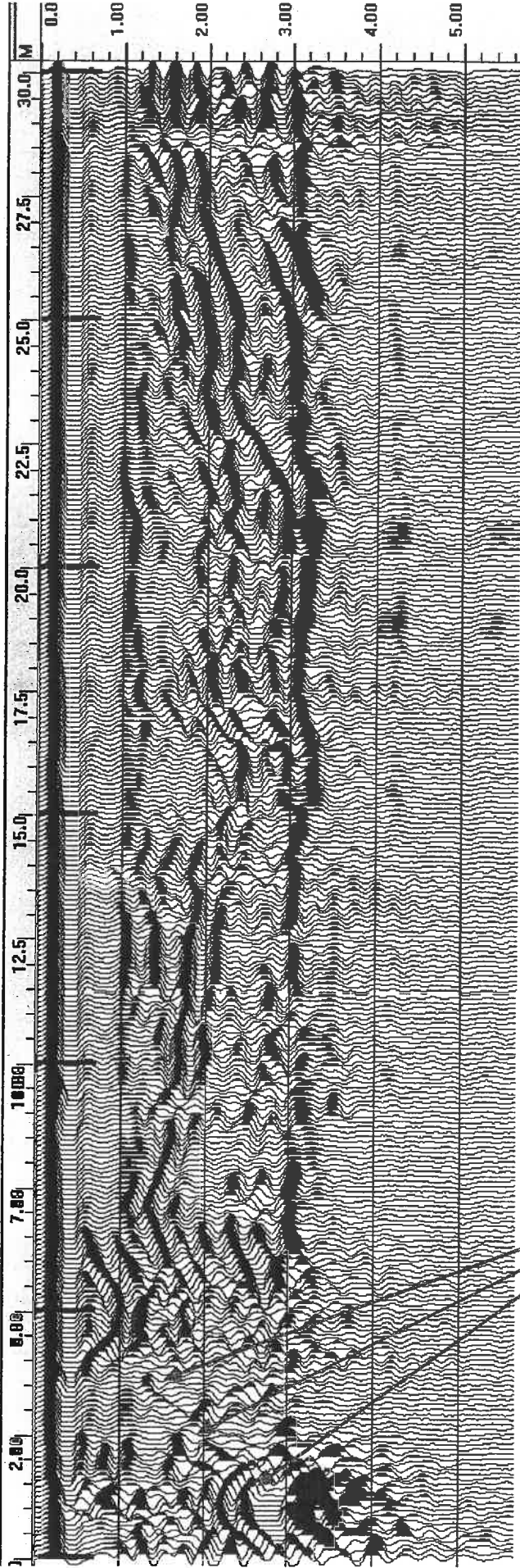


Note: Not to Scale.

Figure 7a

44 Rangitikei Street - Adjacent vacant section.

44 Rangitikei Street.
File 103



Underground services in footpath.

Figure 6c

TRC Site P – 26A Rangitake Street.

Location:

This survey covered the front, rear, both sides and a portion of the driveway of 26A Rangitake Street.

GPR Survey:

GPR scan lines were run in north to south and east to west directions to completely cover the area around House No 26A. Refer Fig 8a. GPR radargram file references are Files 48 through to 56.

The lower back garden has been terraced and was extremely wet at the time of the survey due to ground water movement.

GPS position WP12 was captured to record the extent of this survey.

Data Results:

GPR scans across the rear garden area revealed diffractions due most likely to several large buried objects. Refer Fig. 8b. Radargram File 51. In addition, GPR scans across the front of the house (refer radargram File 55 - Fig. 8b) appears to show evidence of disturbed subsurface strata with multiple diffractions due most likely to buried objects.

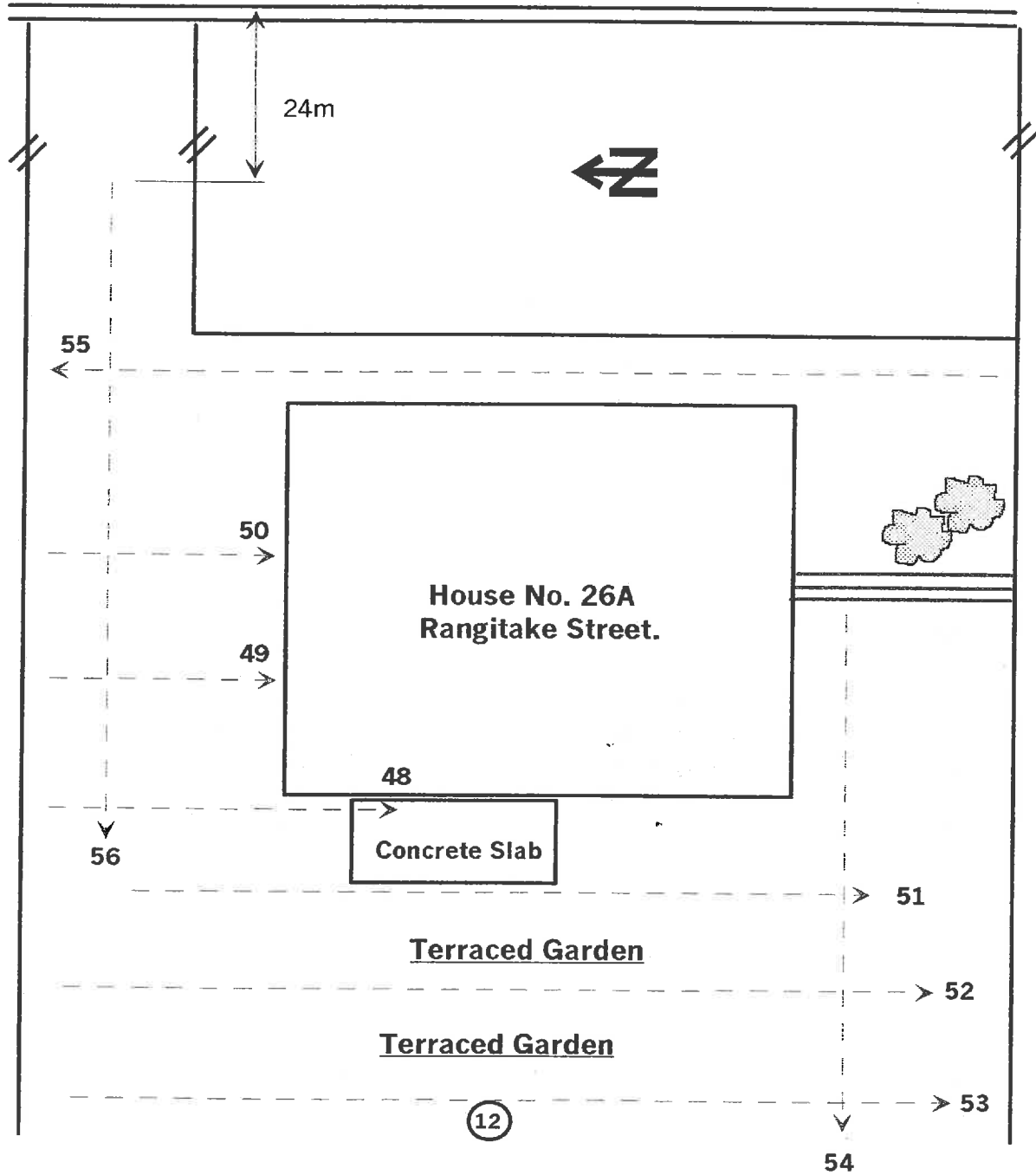
The remainder of the GPR data collected on this site did not show any other significant anomalies.

Conclusions:

Further investigation of the area immediately in front of the house and behind would be necessary to determine the nature of the anomalies.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
26A Rangitake Street - Site P
May 2001

Rangitake Street.



Note : Not to Scale

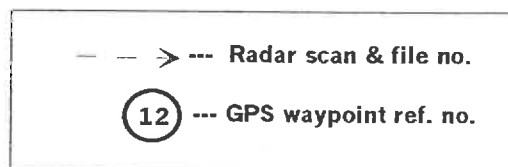
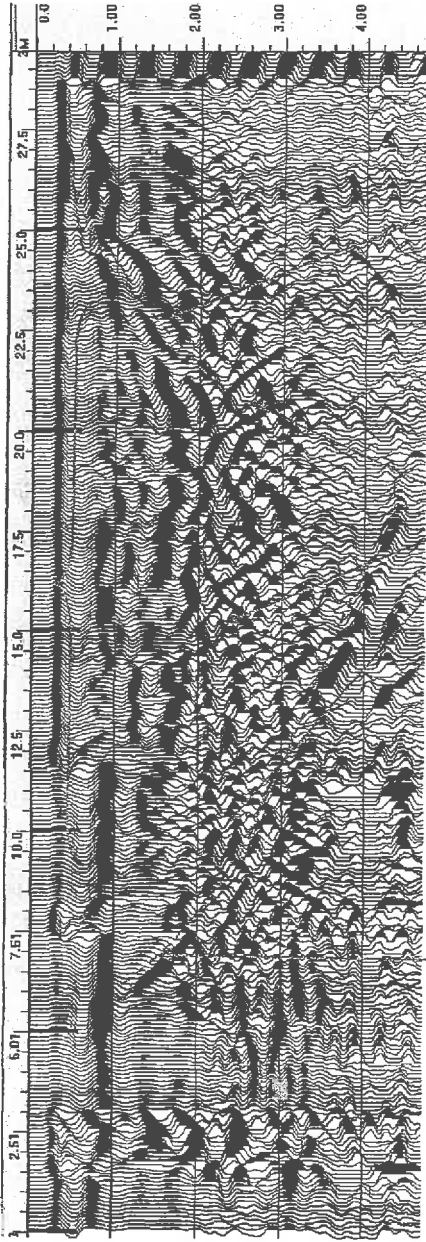


Figure 8a

26A Rangitake Street

26A Rangitake Street
File 66

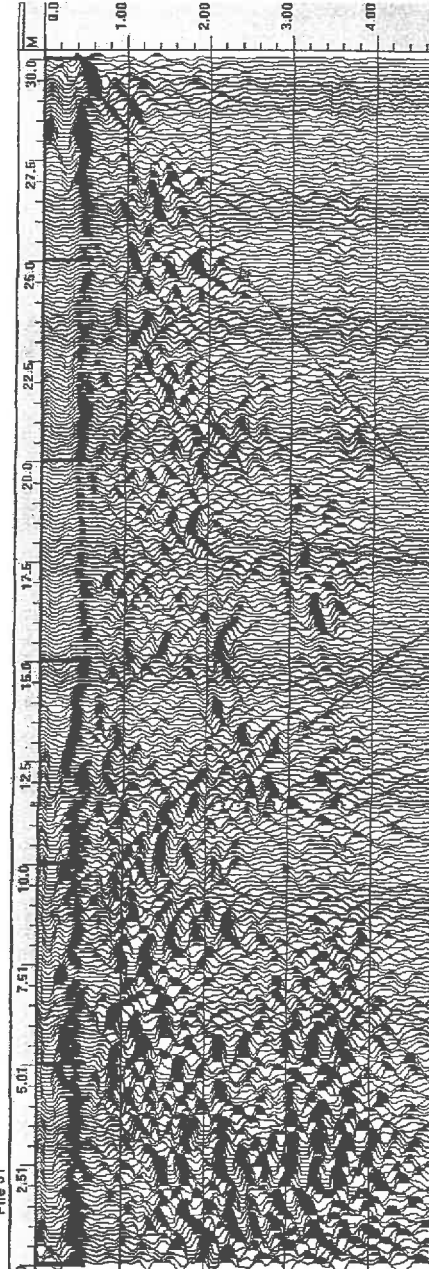


Possible edge of anomalous area

Diffractions - possible buried objects.

Possible edge of anomalous area.

26A Rangitake Street
File 61



Diffractions - possible buried objects.

Figure 8b

TRC Site M – Gully off Beach Road

Location:

This site is situated on farmland at the bottom of a gully adjacent to the Clay Pigeon Shooting Club premises off Centennial Drive. It consists of a narrow walking track running alongside a swamp area and is backed by a steep hillside on the southern side.

GPR Survey:

GPR scan lines were run along the walking track in a west to east direction as well as down and across the adjacent hillside. Refer Fig. 9a. GPR radargram file references are Files 43 through to 46.

GPS position WP26 was captured to record the location of this survey.

Data Results:

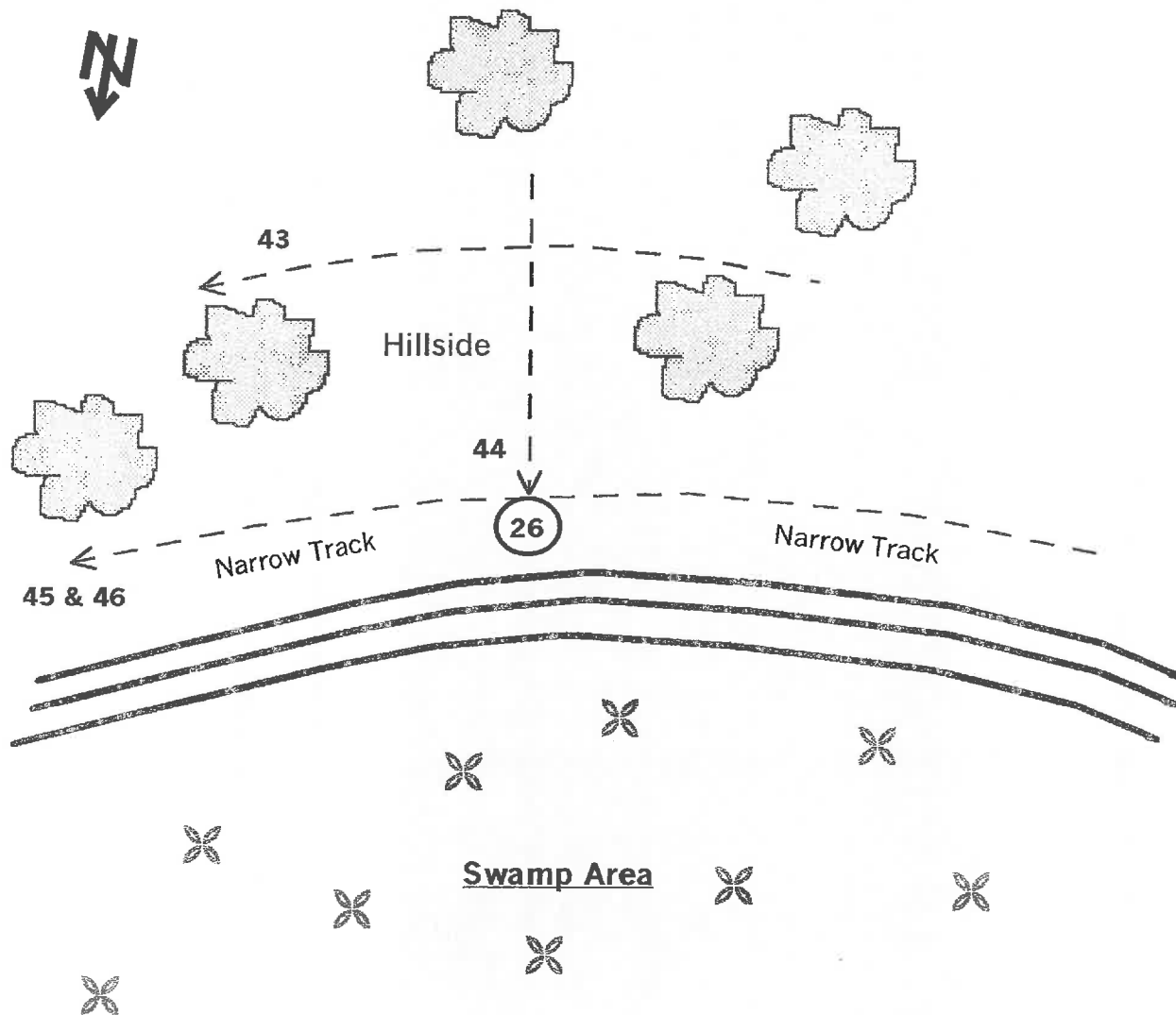
GPR data revealed normal undulating soil strata with no significant anomalies over the majority of this site.

The GPR scan lines along the track, (Radargram File 45 and 46) however, showed significant diffractions from large, round objects. The type of diffraction seen here is normally associated with pipelines. However, no physical evidence of pipelines could be seen on this site.

Conclusions:

Further investigation would be necessary to determine if the diffractions detected are due to buried pipelines or large buried objects.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Site M- Gully off Centennial Drive
May 2001



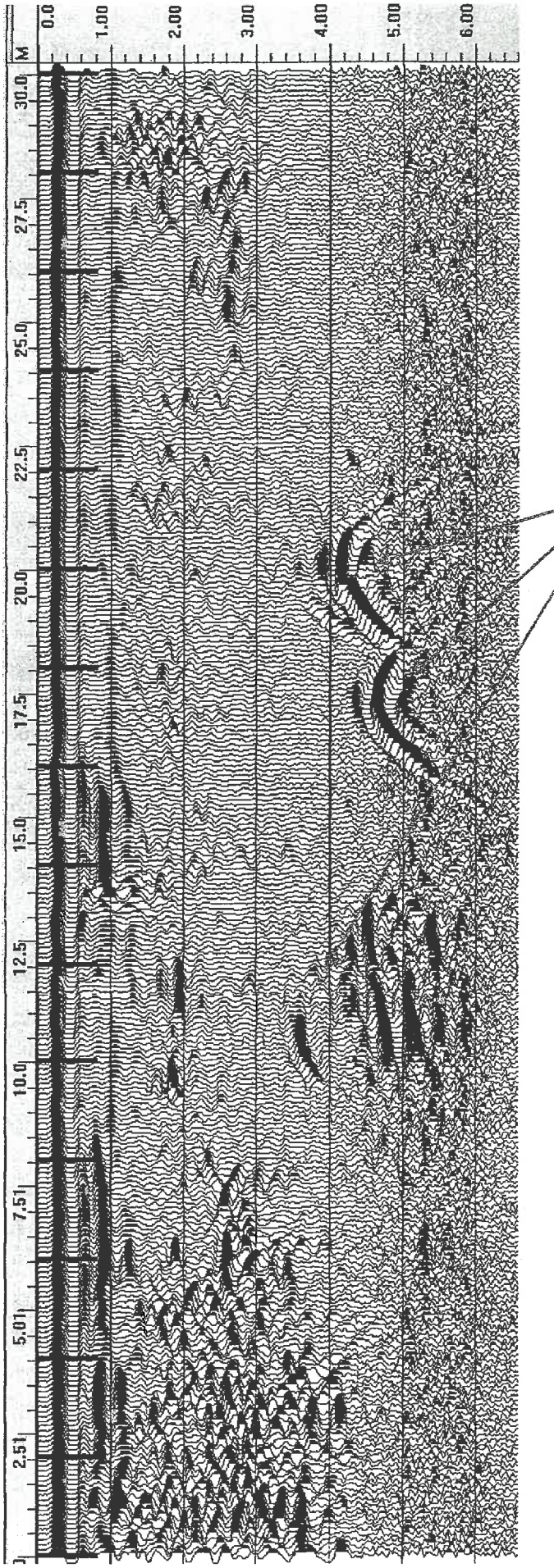
---> Radar scan & file no.
⑫ --- GPS waypoint ref. no.

Note: Not to Scale.

Figure 9a

Site M - Gully off Centennial Drive.

Site M - Gully
File 46



Diffractions indicate possible buried pipelines or other round objects

Figure 9b

TRC Site X – Roto Street

Location:

This site is situated off Roto Street up a gravel track and is surrounded by trees and vegetation. It appears to have been a small gully that has been used as a landfill site. Evidence of rubbish and debris could be seen on the surface at this site.

GPR Survey:

GPR scan lines were run in north to south and east to west directions to cover this site and a portion of the gravel track leading to it. Refer Fig. 10a. GPR radargram file references are Files 74 through to 77.

Two GPS positions, WP13 and WP14 were captured to record the extent and location of this survey.

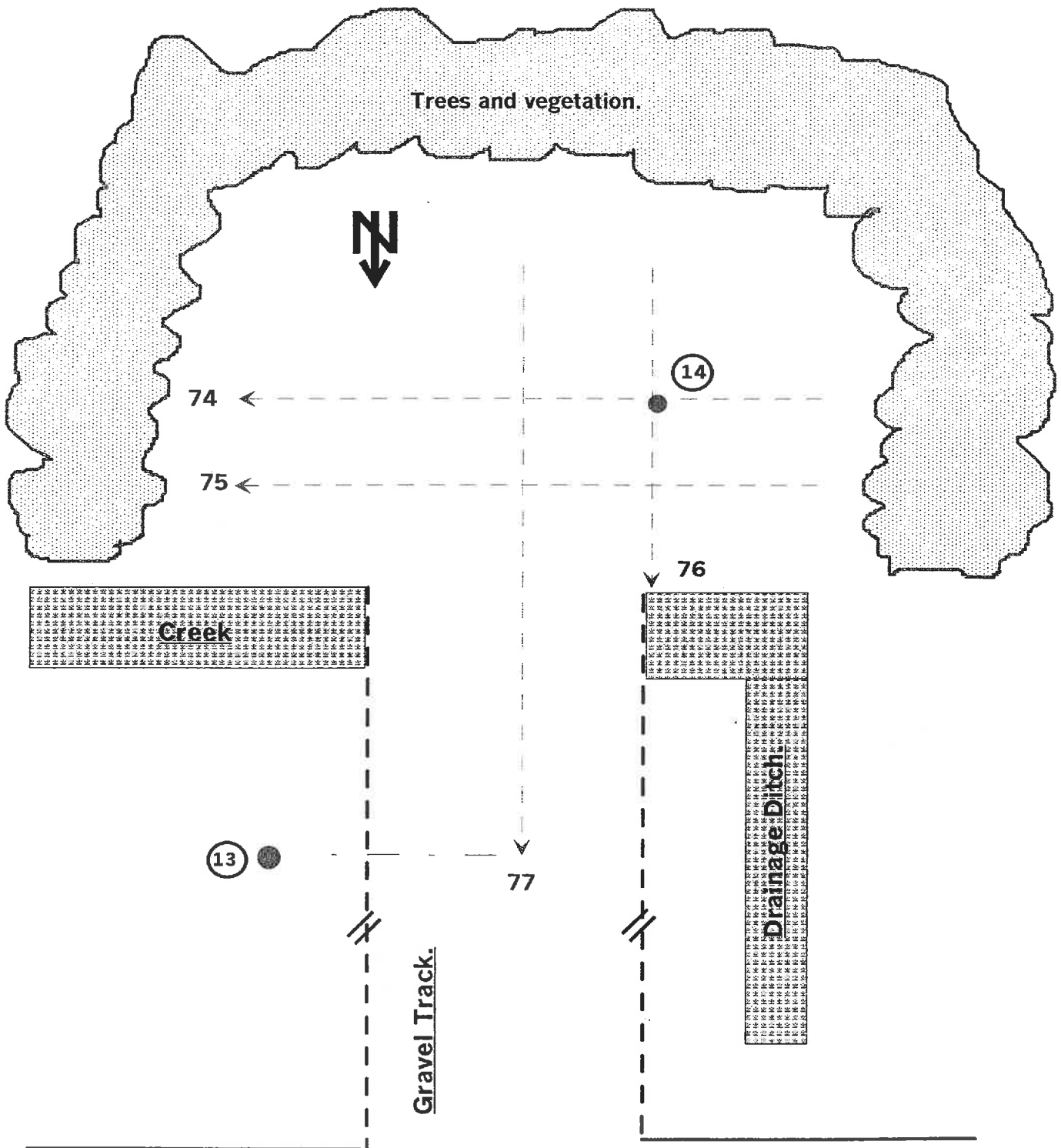
Data Results:

GPR data showed scattered diffractions indicating that the majority of the area scanned consists of fill and debris material. This result is typical of a general landfill area. The original ground level can be seen at the end of the GPR scan lines. Refer Fig 10b and radargram File 75.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Roto Street - Site X.
 May 2001



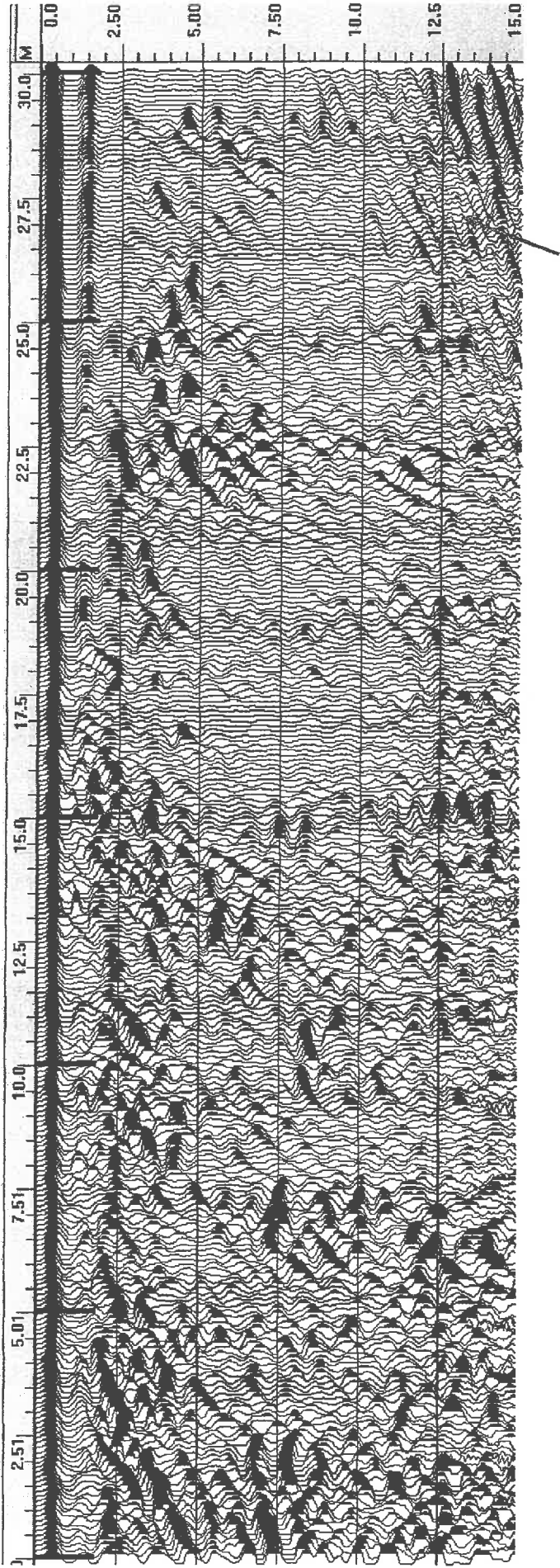
Note: Not to Scale.

- --- Painted Peg/ Mark.
- > --- Radar scan & file no.
- ⑫ --- GPS waypoint ref. no.

Figure 10a

Site X - Roto Street

Site X - Roto Street
File 75



Multiple diffractions and disturbed strata
Typical rubbish dump reflections

Original embankment soil strata

Figure 10b

TRC Site R – Beach Road

Location:

This site is in a farm paddock on the north side of Beach Road near the junction with Centennial Drive.

GPR Survey:

GPR scan lines were run in east to west and north to south directions. Scans were spaced at approximately five metres to ensure an adequate search of this site. Refer Fig. 11a. GPR radargram file references are Files 35 through to 40.

GPS position WP18 was captured to record the location of this survey.

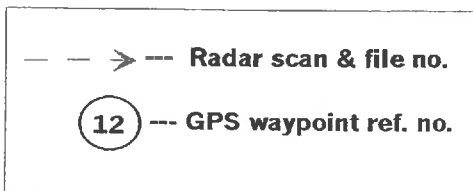
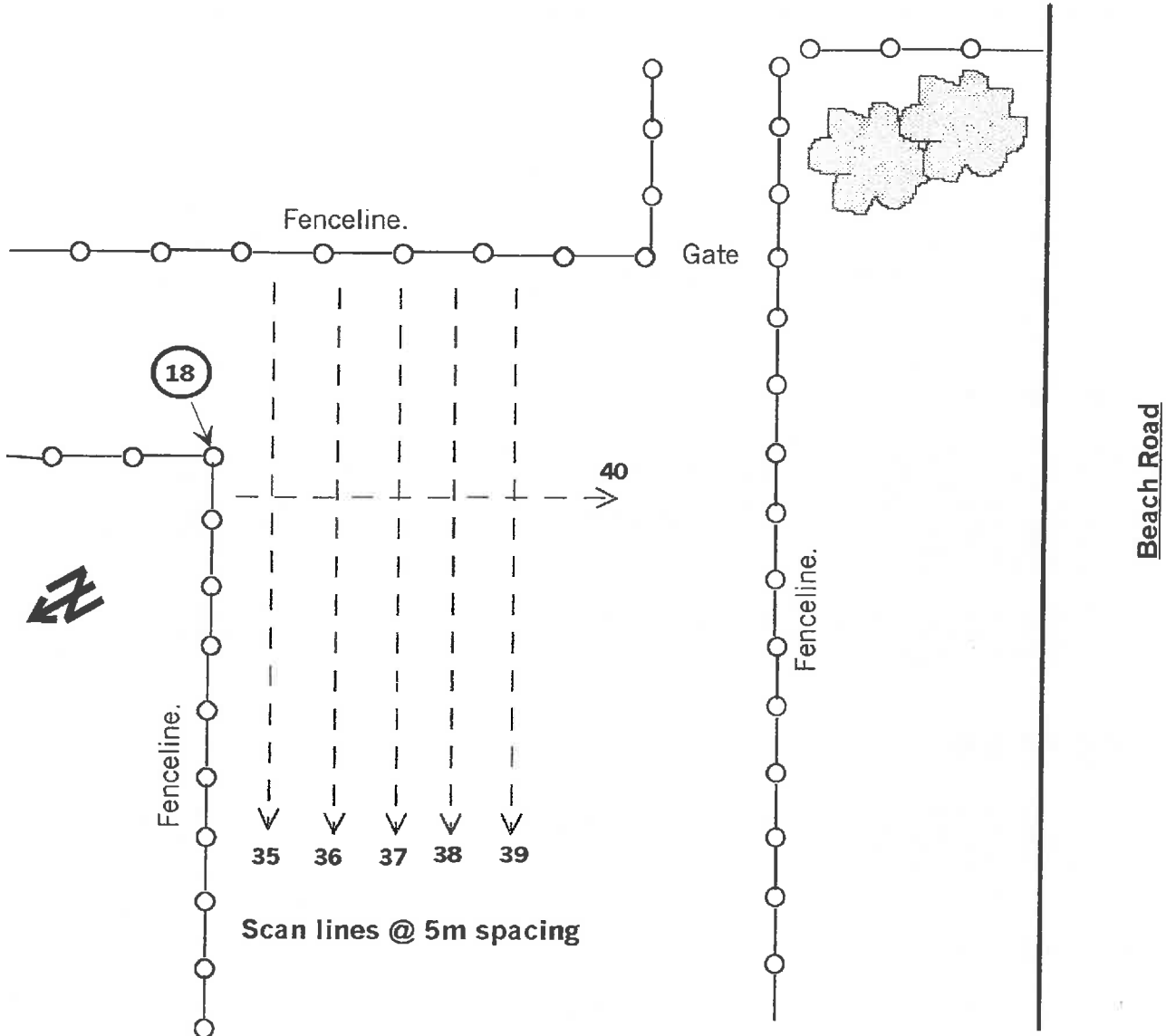
Data Results:

GPR data showed normal undulating soil strata in the area surveyed. No significant anomalies were detected.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Site R off Beach Road.
 May 2001



Note: Not to Scale.

Figure 11a

TRC Site – Omata Reserve beside Herekawe Stream

Location:

This site is situated on a hillside leading down from the Omata Tank premises towards the Herekawe Stream on the east side of Centennial Drive. The whole site was covered with dense vegetation which had to be cleared to allow GPR survey lines.

GPR Survey:

GPR scan lines were run in south to north and east to west directions. Scan lines were only possible where vegetation had been sufficiently cleared. Refer Fig. 12a. GPR radargram file references are Files 154 through to 157.

A GPS position, WP25, was captured at the start point of this survey to record the location.

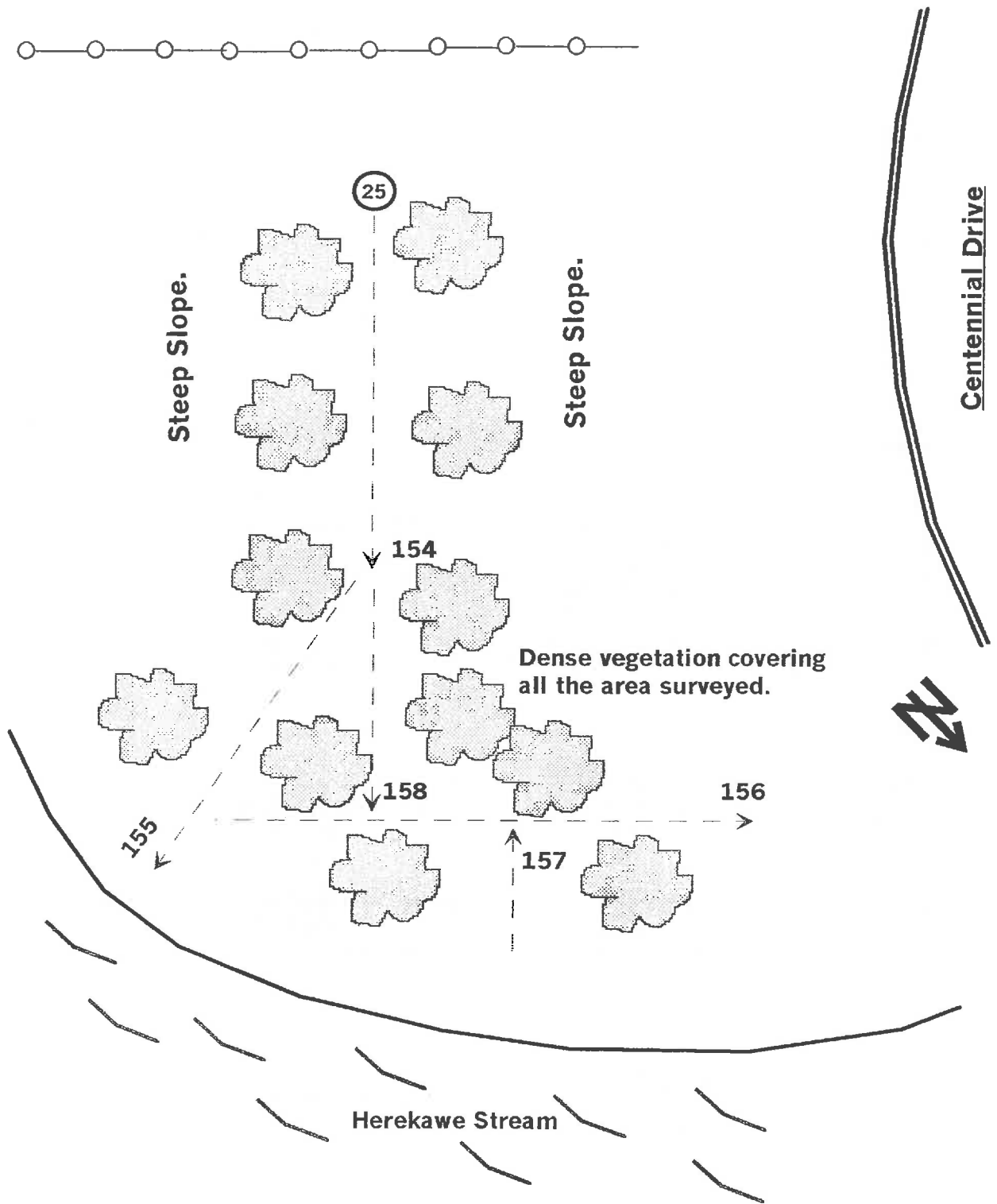
Data Results:

GPR data showed normal undulating soil strata in the area surveyed. No significant anomalies were detected.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Omata Reserve - Beside Herekawe Stream
 May 2001



---> --- Radar scan & file no.
 (23) --- GPS waypoint ref. no.

Note ; Not to Scale.

Figure 12a

TRC Site Z – Ngahoro off Centennial Drive

Location:

This site is situated on the seaward side of Centennial Drive approximately 100 metres from the Beach Road corner. It consists of a road level paddock and a steep slope down to a lower level paddock.

GPR Survey:

GPR scan lines were run north to south and east to west directions to cover the upper and lower surveyed areas. Lines were spaced at approximately five metres. Refer Fig. 13a. GPR radargram file references are Files 19 through to 26 and 31 through to 34.

GPS position WP20 was captured to record the location of this survey.

Data Results:

GPR data collected at the upper level showed normal undulating soil strata with no significant anomalies detected. Refer Fig. 13b and radargram File 28.

GPR data taken from a point part-way down the slope and across the lower level did show an anomalous area consistent with a previous excavation. Refer Fig.13b and radargram File 32.

Conclusions:

The only significant anomaly detected at this site showed what appears to be evidence of a previous excavation. However, the data shows no evidence of buried drums.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Ngahoro - Site Z - Off Centennial Drive.
 May 2001

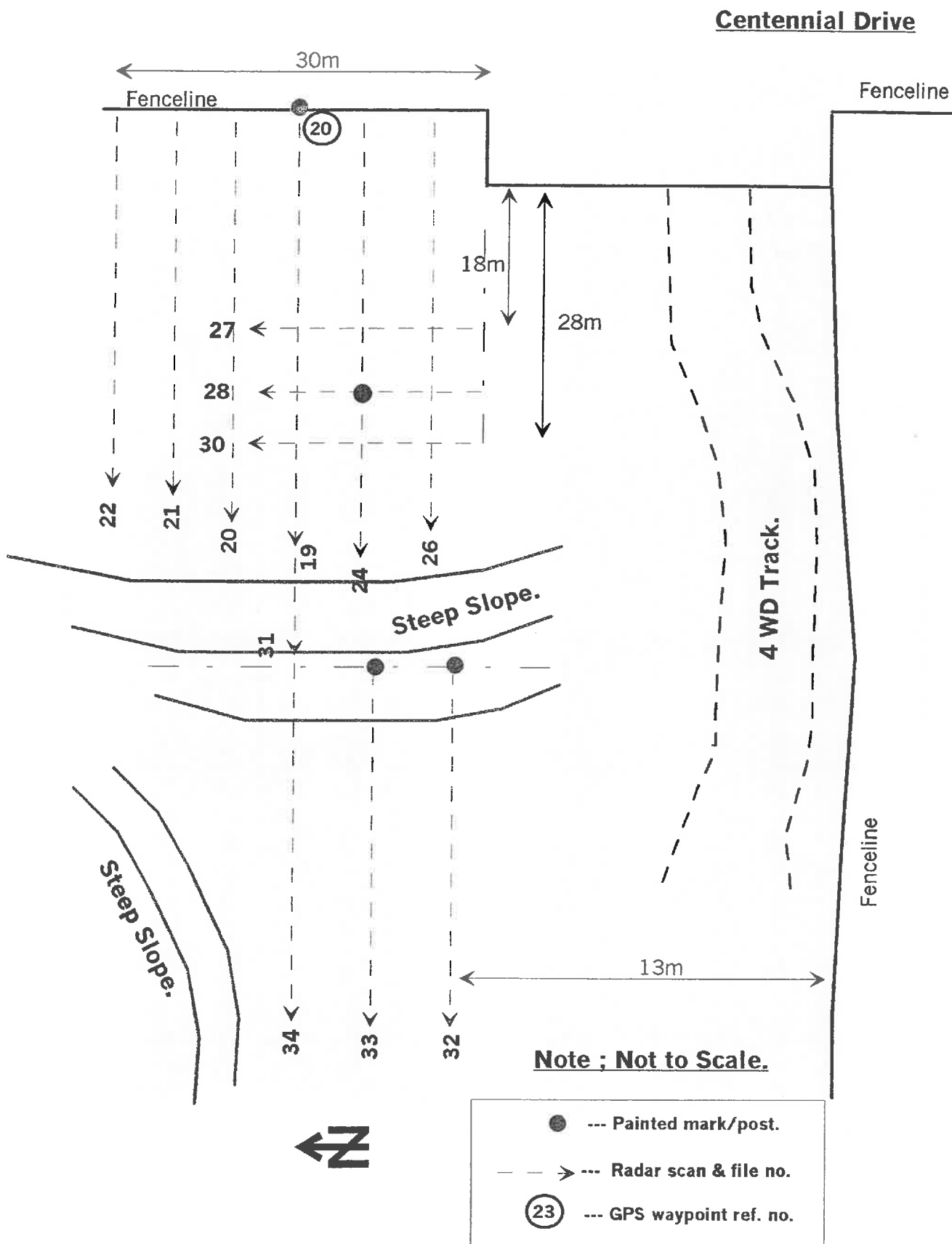


Figure 13a

Ngahoro - Site Z - Centennial Drive.

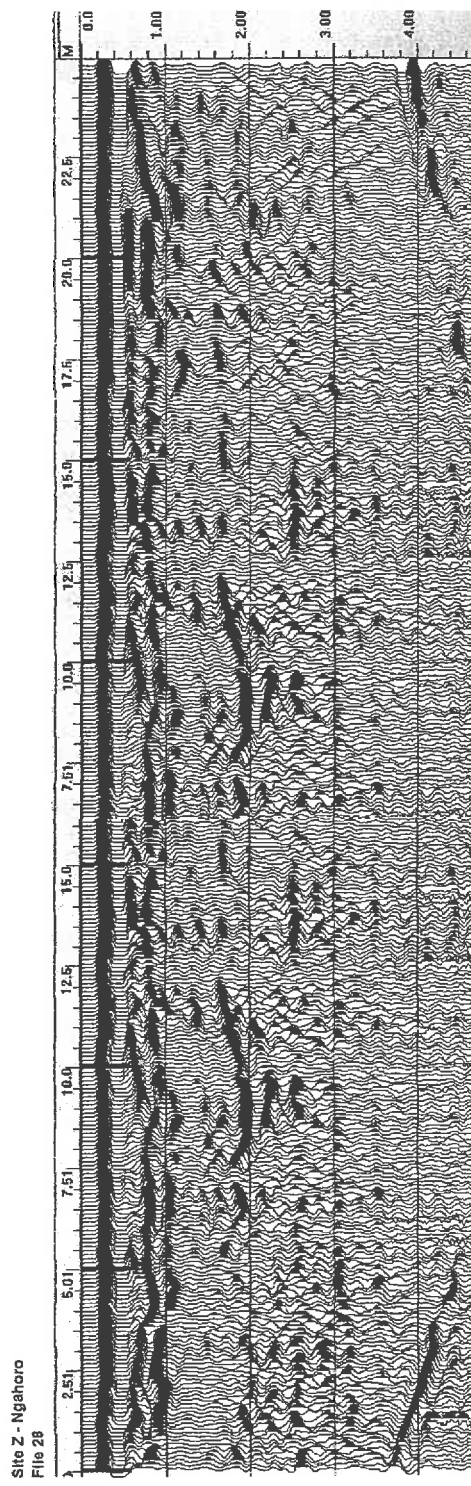
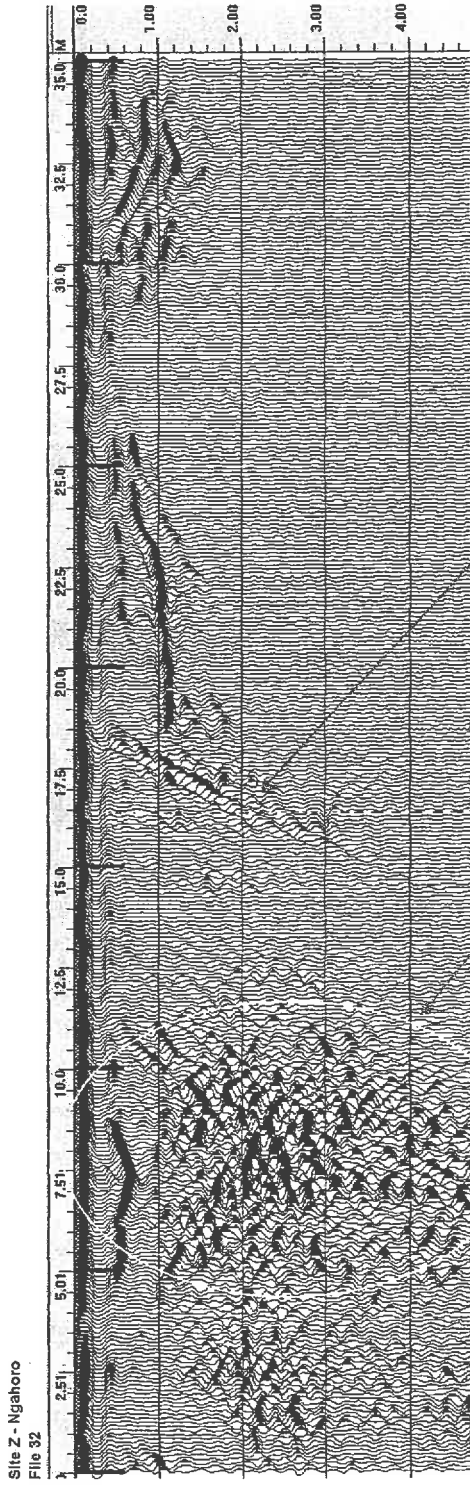


Figure 13b

TRC Site Za – 60 Marama Crescent

Location:

This site is situated in the rear garden lawn area of House No 60, Marama Crescent.

GPR Survey:

GPR scan lines were run in a north to south direction across the lawn as well as in an east to west direction down the length of the lawn. Refer Fig. 14a. GPR radargram file references are Files 64 through to 68.

Data Results:

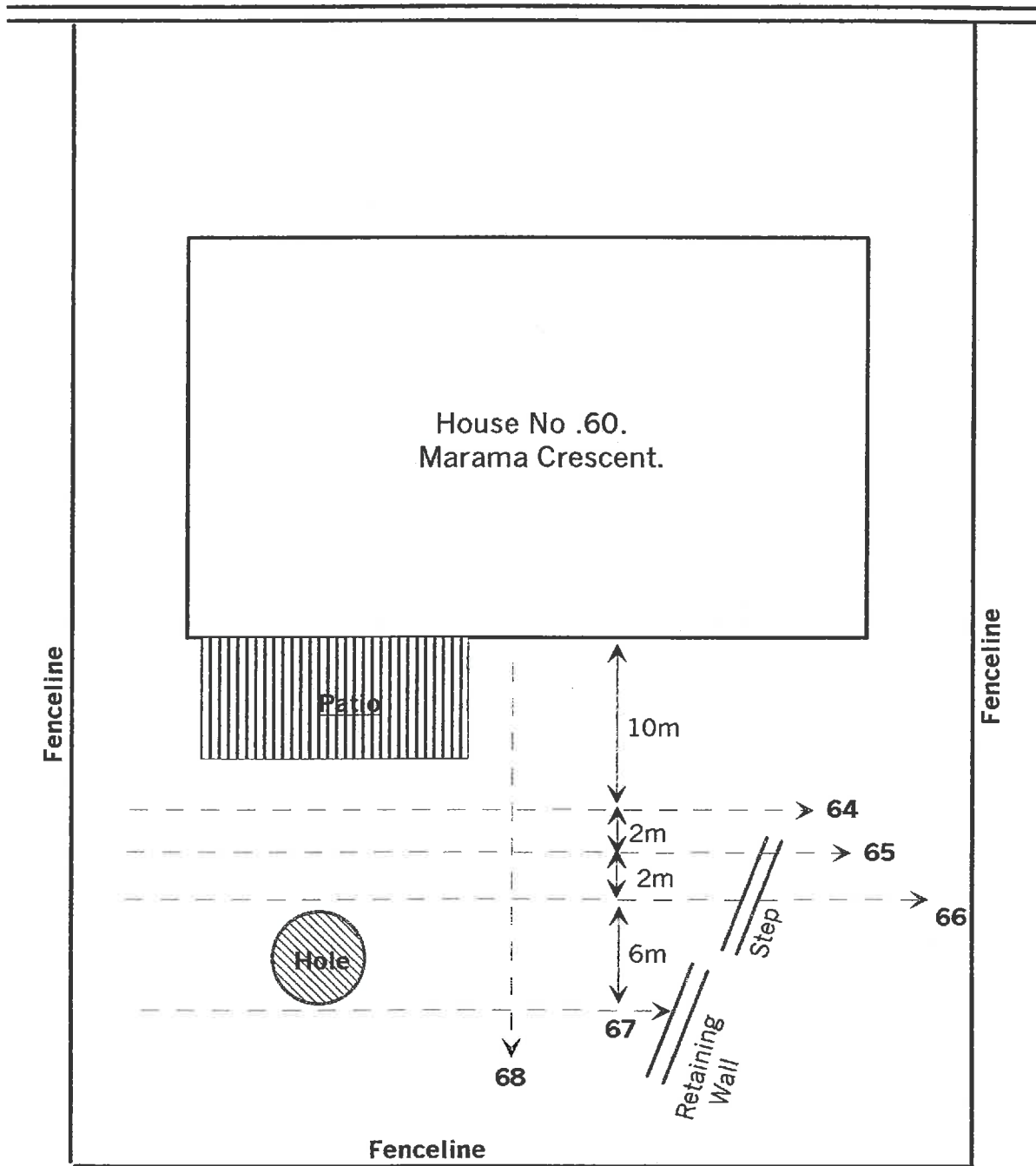
GPR data collected from this site showed normal undulating soil strata with no evidence of excavation or significant anomalies. Refer Fig 14b.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
60 Marama Crescent - Site Za
May 2001

Marama Crescent.



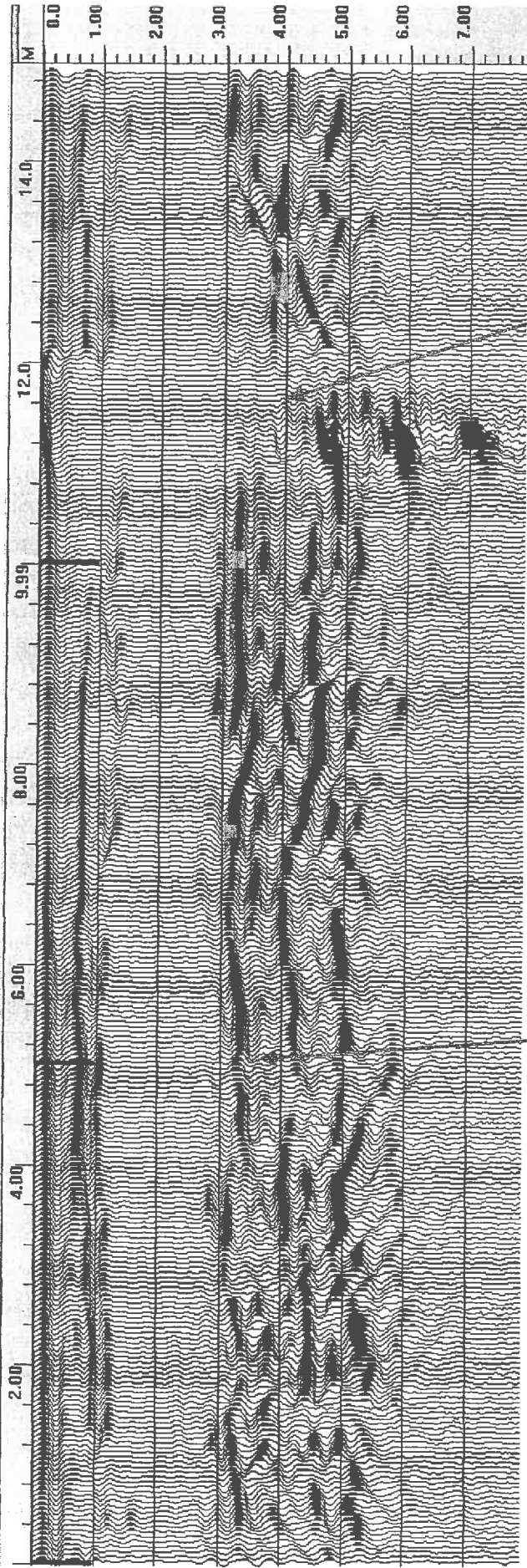
Note : Not to Scale

---> --- Radar scan & file no.

Figure 14a

60 Marama Crescent

Site Za - 60 Marama Crescent
File 66



Horizontal soil strata - undisturbed ground.

Garden Step

Figure 14b

TRC Site Ze – Tank 3500 Centennial Drive

Location:

This site is situated on the inland side of Centennial Drive in a paddock just south of Tank 3500 of the Omata Tank Farm.

GPR Survey:

The surveyed area measured approximately 40 metres by 120 metres and included the sealed roadway between Tank 3500 and the open paddock area. GPR scan lines were taken in north to south and east to west directions at approximately five metre spacings. Refer Fig. 15a. GPR radargram file references are Files 1 through to 18 and 94 through to 96.

Three GPS positions were captured, WPs 15, 16 and 17 to record the location of this survey.

EM (Electromagnetic Induction) survey:

EM data was collected in an east to west direction over the same grid as the GPR survey with lines at approximately five metre spacings.

Data Results:

GPR data collected from this site showed an anomalous area consistent with a profile of a large excavation or filled depression extending around 55 metres in length, 20 metres width and a maximum depth of around three metres. Strong reflections can be seen at the bottom of this area indicating possible foreign material and/or suspected metal, perhaps the remains of steel drums. Also seen in the apparent area are some diffractions indicating the presence of a few large objects. Refer Fig 15b.

The EM data showed no significant change to soil electrical conductivity values in the quadrature response. The in-phase response, however, normally affected primarily by the magnetic field strength, indicates a large anomaly in the vicinity of the detected area. This response may be due either to a significant amount of metal in this area or a material having magnetic properties. The boundary of this anomaly correlates well with the GPR edge of the area. Refer Fig. 15c.

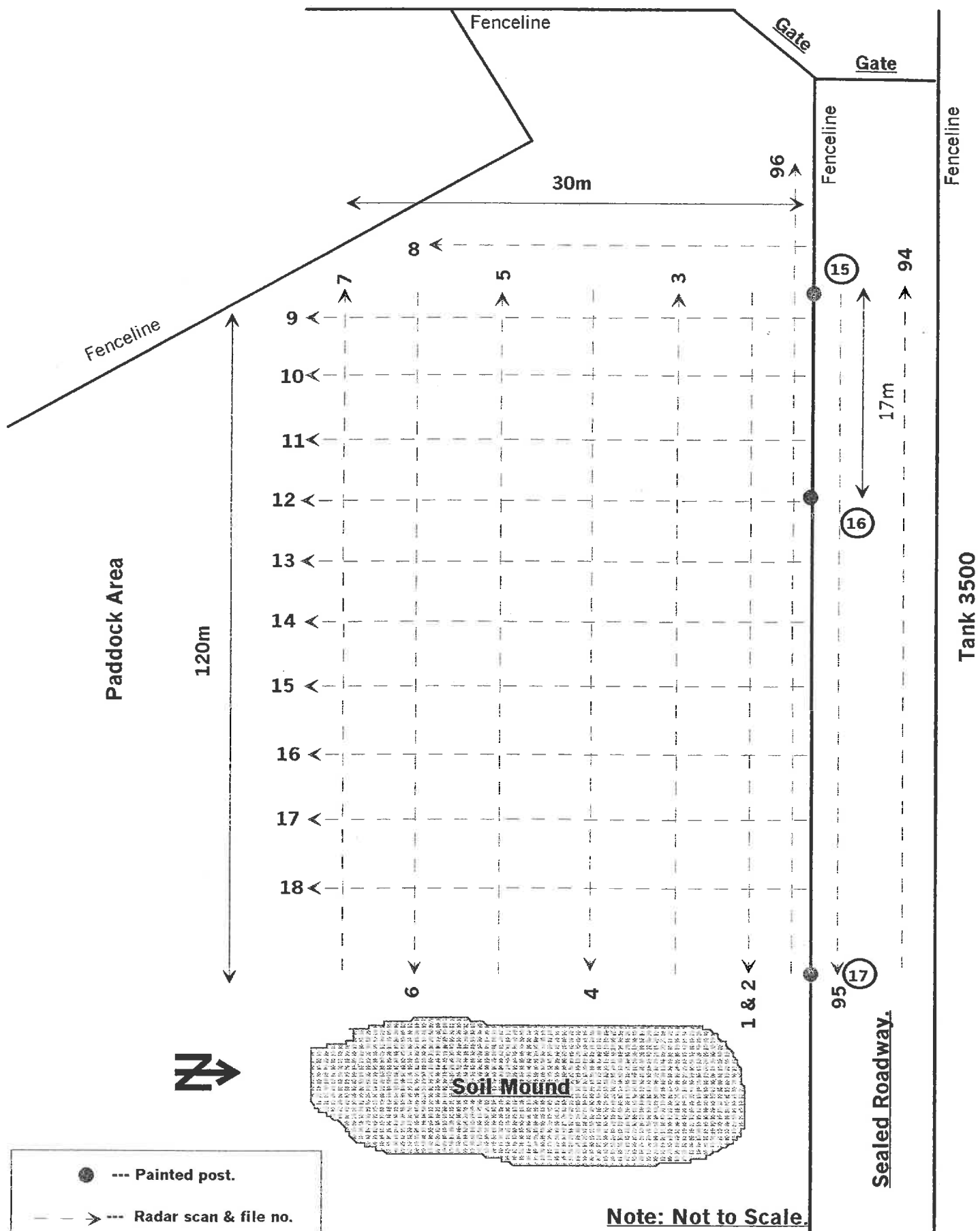
TRC Site Ze – Tank 3500 Centennial Drive – continued

Conclusions:

The anomalous area detected using both GPR and EM techniques appear to show a large pit containing foreign material. Further investigation of this site would be necessary to determine the nature of the material and/or objects detected in the area.

TARANAKI REGIONAL COUNCIL
 Ground Penetrating Radar Survey.
 Centennial Drive Tank 3500 - Site Ze
 May 2001

Centennial Drive



Note: Not to Scale.

Figure 15a

Site Ze - Tank 3500 - Centennial Drive.

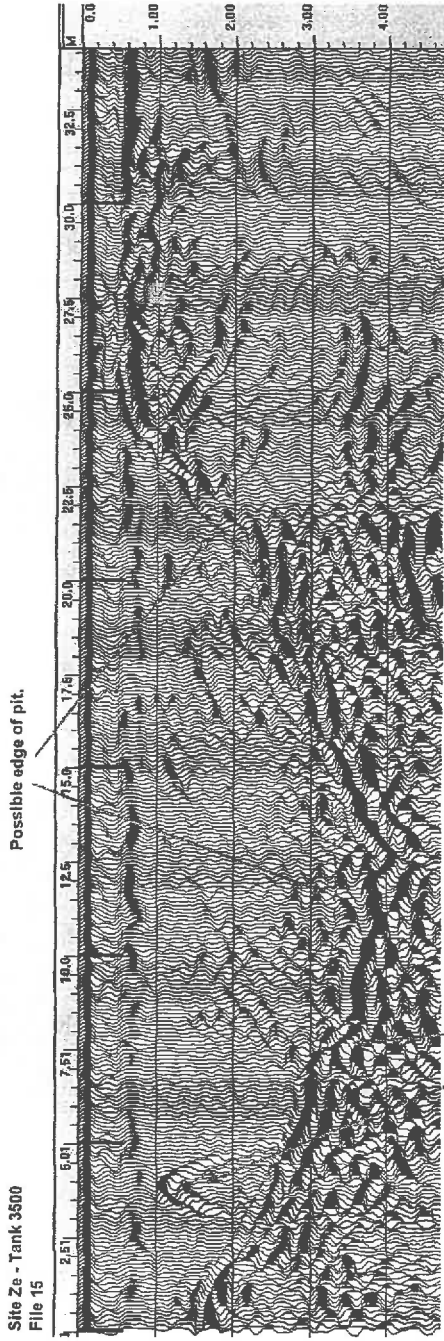
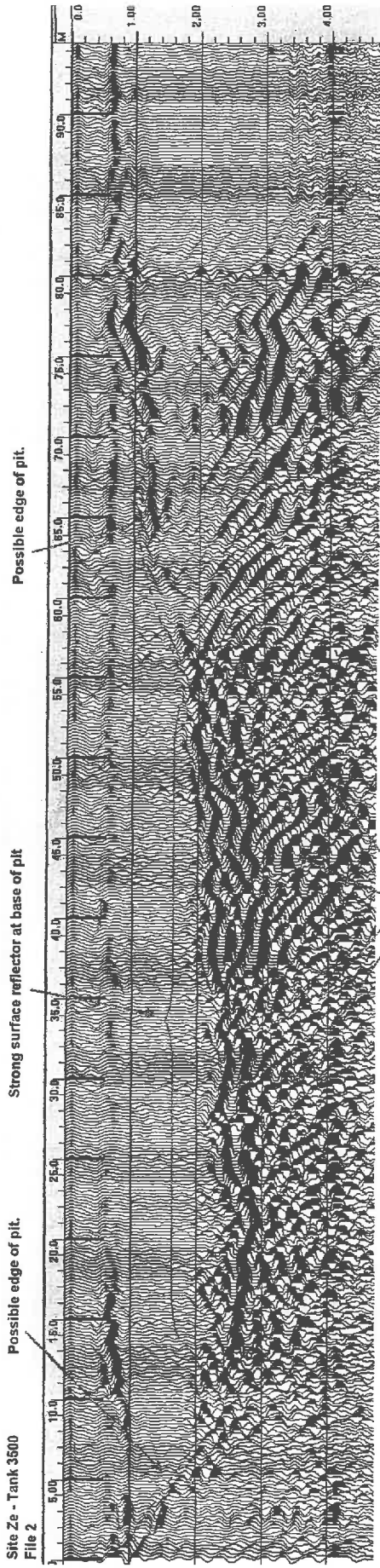
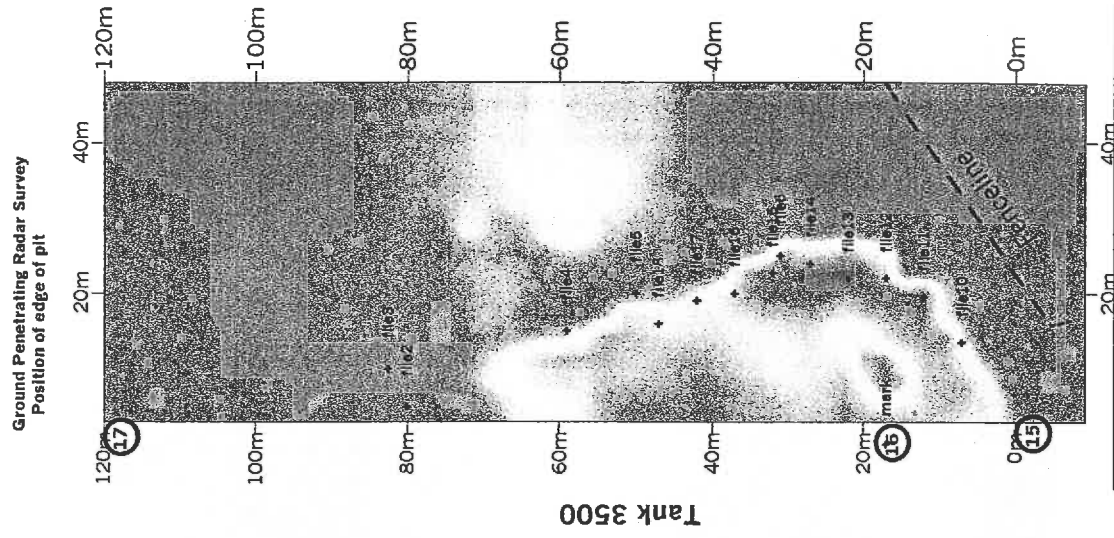
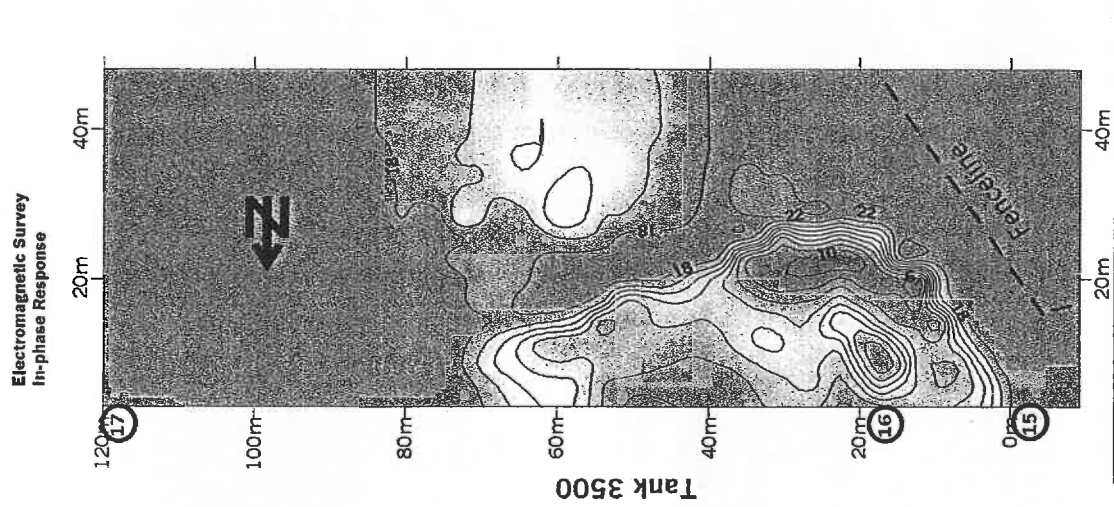
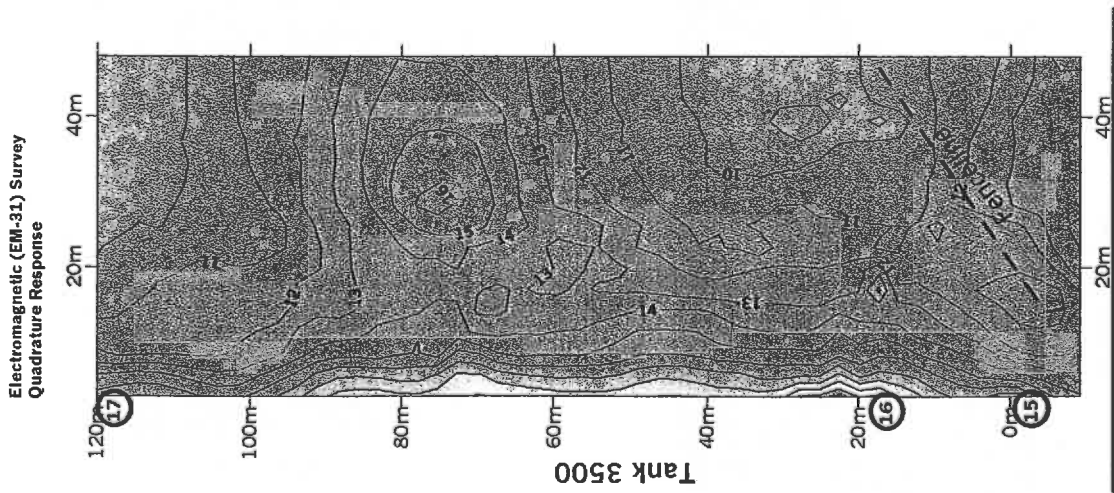


Figure 15b

**TARANAKI REGIONAL COUNCIL
GPR / EM-31 SURVEY (3 Views)
SITE Ze (TANK-3500)
May 2001**



Pylon 4 – Centennial Drive

Location:

This site is situated on the seaward side of Centennial Drive in the vicinity of Transpower pylon No 4. It consists of a grassed raised knob of land covering an area approximately 30 metres by 30 metres.

GPR Survey:

GPR scan lines were run in various directions to adequately search this site. Scan lines were run along the top of the raised knob of land, around the base and from the knob to the outlying areas. Refer Fig. 16a. GPR radargram file references are Files 110 through to 113.

GPS position WP19 was captured to record the location of this site.

Data Results:

GPR data collected from this site showed normal undulating soil strata over the majority of the area surveyed. The scan line along the top of the knob of land, however, shows two to three anomalous areas. These anomalies could be due to either large buried objects or an unusual rock formation in this area. Refer Fig 16b.

Conclusions:

Further investigation would be necessary to determine the nature of the anomalies detected.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Adjacent to Pylon 4 - Off Centennial Drive.
May 2001

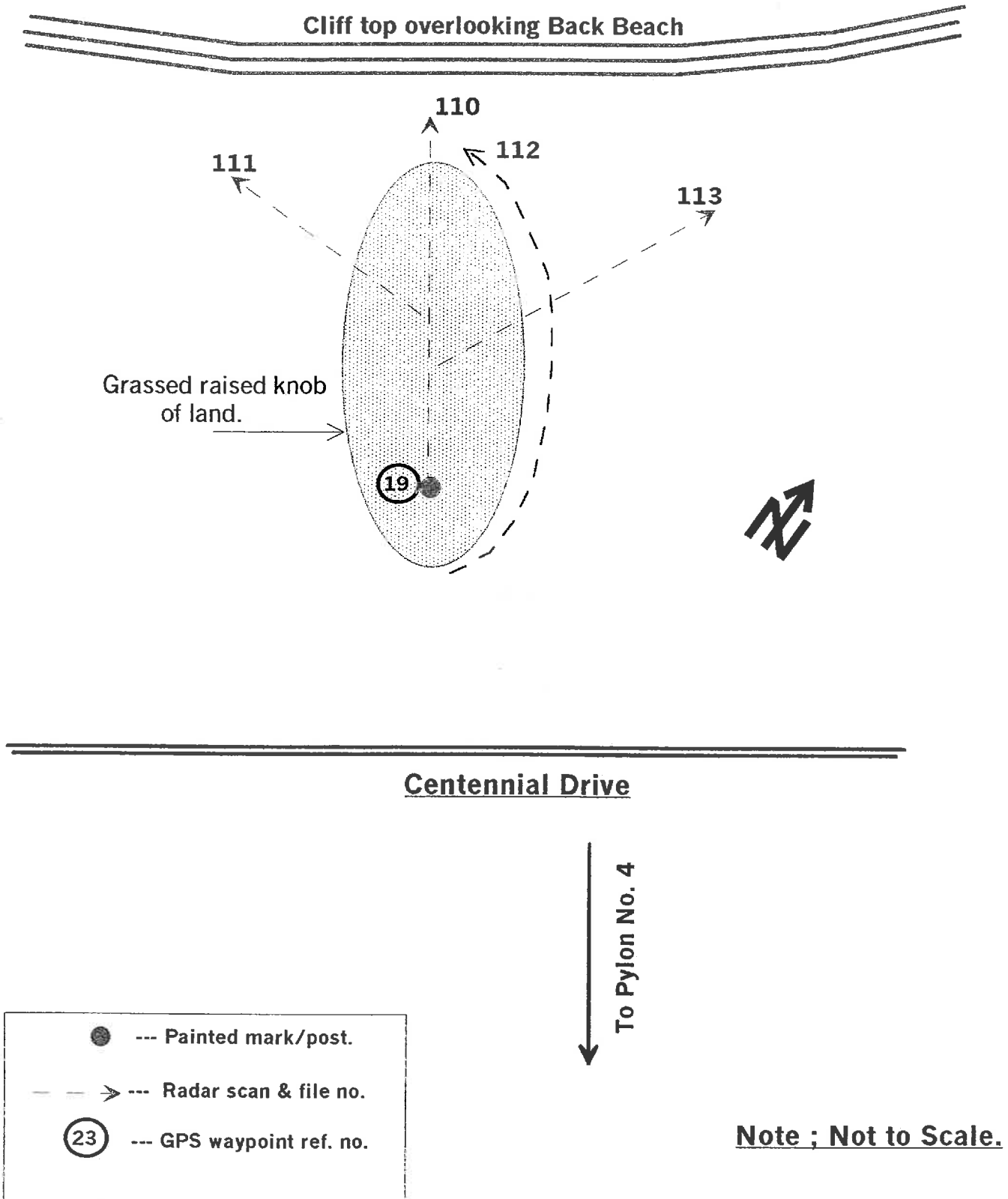
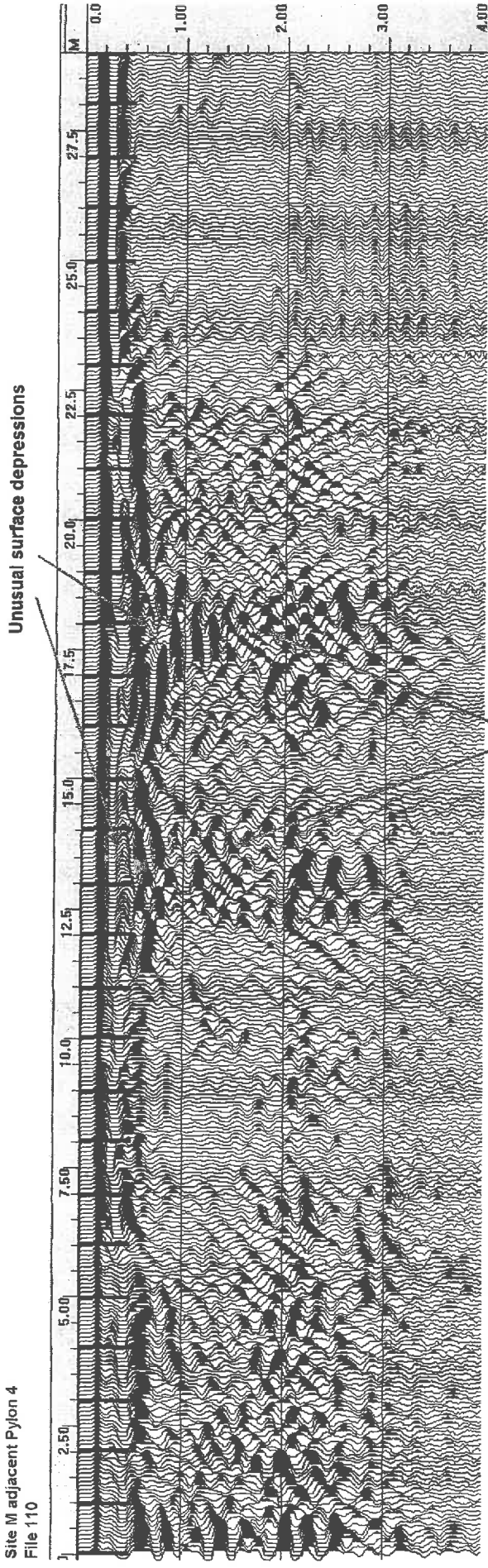


Figure 16a

Adjacent to Pylon No. 4 off Centennial Drive.

Site M adjacent Pylon 4
File 110



Anomalous areas - possible buried objects or unusual rock formation.

Figure 16b

Dow AgroScience premises – Paritutu Street

Site 1 adjacent to Wellsite No 1.

Location:

This site is situated north of Wellsite No 1 and covers an area 30 metres by 50 metres approximately and is in the south-east corner of the Dow AgroScience premises.

GPR Survey:

GPR scan lines were taken in an east to west direction at approximate five metre spacings. Refer Fig. 17a. GPR radargram file references are Files 30 through to 36.

Data Results:

GPR data collected from this site showed normal undulating soil strata with no evidence of excavation or buried objects. Refer Fig 17b and Radargram File 33.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Dow AgroSciences - Paritutu Road. - Site 1.
May 2001

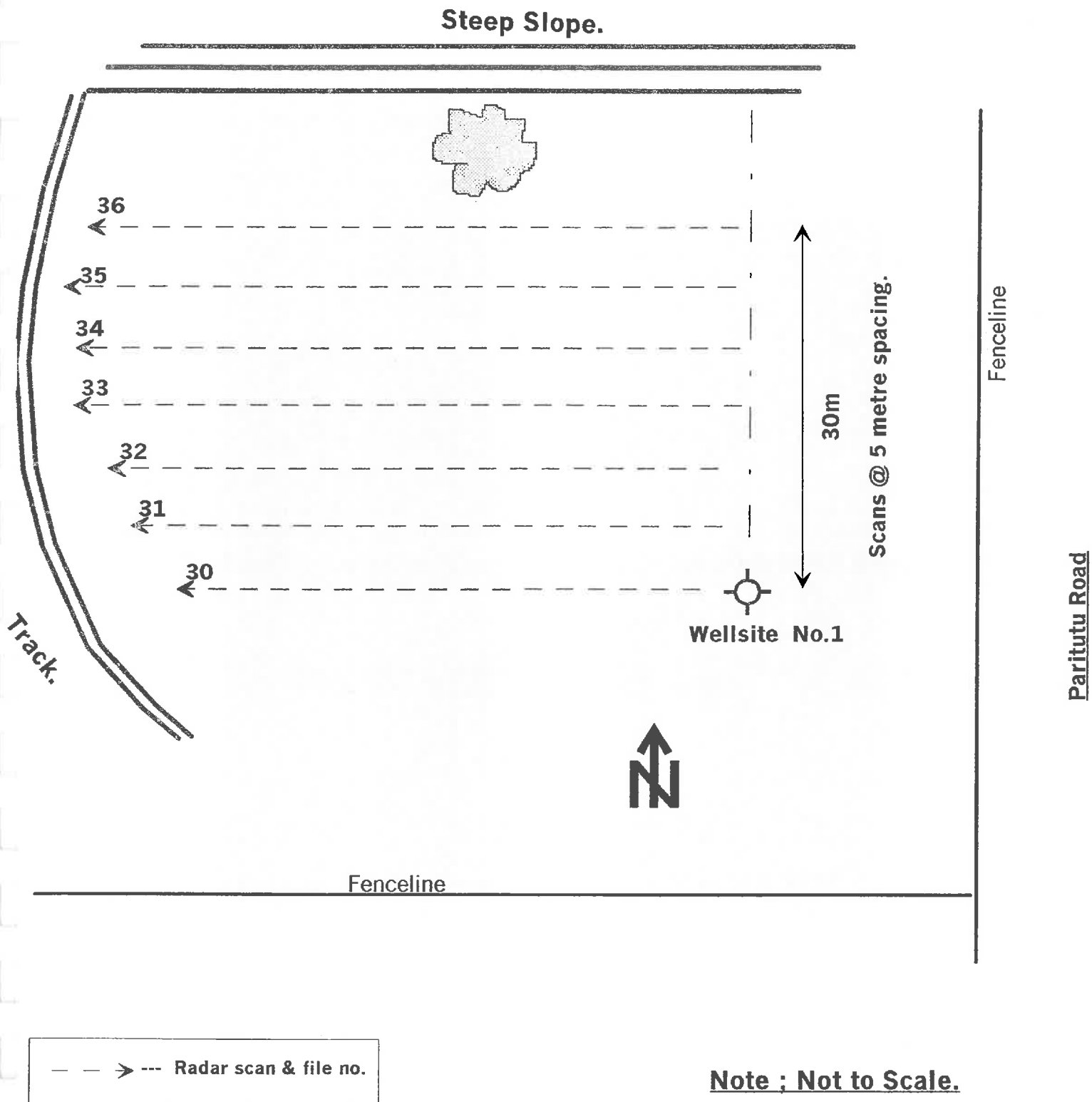
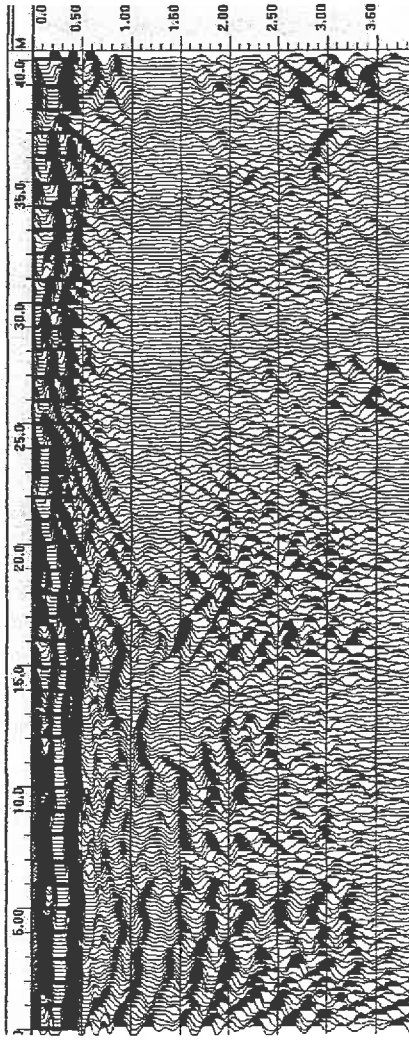


Figure 17a

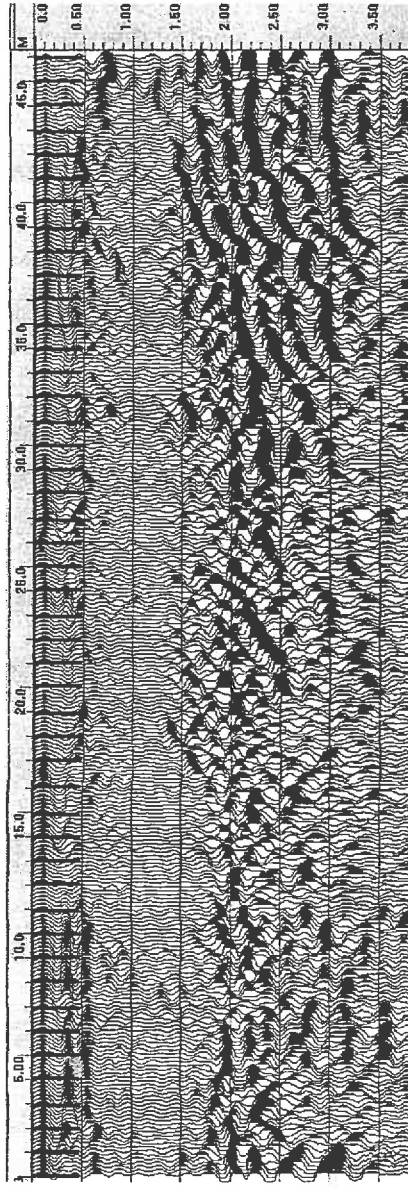
Dow AgroScience Premises - Paritutu Road - New Plymouth.

Site 1 Dow AgroScience
File 33



No apparent evidence of excavation or buried objects

Site 2 Dow AgroScience
File 40



Possible excavation and buried debris (fill material) in this area

Figure 17b

Dow AgroScience premises – Paritutu Street

Site 2 adjacent to Wellsite No 4.

Location:

This site is situated adjacent and to the west of Wellsite No 4 and covers an area 30 metres by 50 metres approximately and is situated in the central section of the Dow AgroScience premises.

GPR Survey:

GPR scan lines were taken in an east to west direction at approximate five metre spacings. Refer Fig. 18a. GPR radargram file references are Files 37 through to 43.

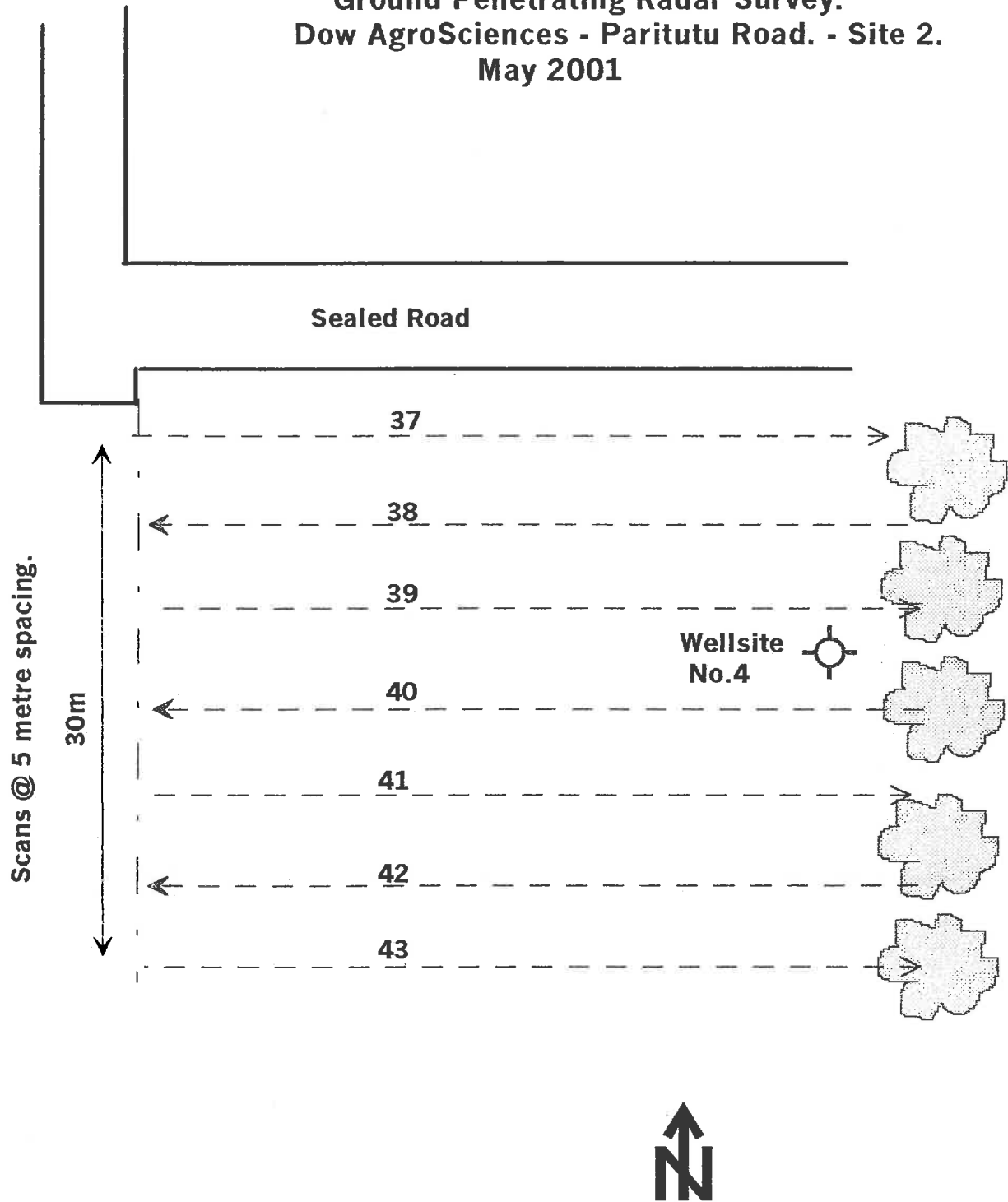
Data Results:

GPR data collected from this site showed normal undulating soil strata for the majority of the area surveyed. There is a detected area which shows possible excavation and buried debris or fill material over an area of approximately 15 metres by 15 metres. No evidence was seen of large buried objects however. Refer Fig 17b and Radargram File 40.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Dow AgroSciences - Paritutu Road. - Site 2.
May 2001



---> Radar scan & file no.

Note ; Not to Scale.

Figure 18a

Dow AgroScience premises – Paritutu Street

Site 3 adjacent to Wellsites Nos 6 and 43.

Location:

This site is situated between Wellsite No 6 and Wellsite No 43 and covers an area 70 metres by 70 metres approximately and is on the western side of the Dow AgroScience premises.

GPR Survey:

GPR scan lines were taken in an east to west direction at approximate five metre spacings. Refer Fig. 19a. GPR radargram file references are Files 44 through to 58.

Data Results:

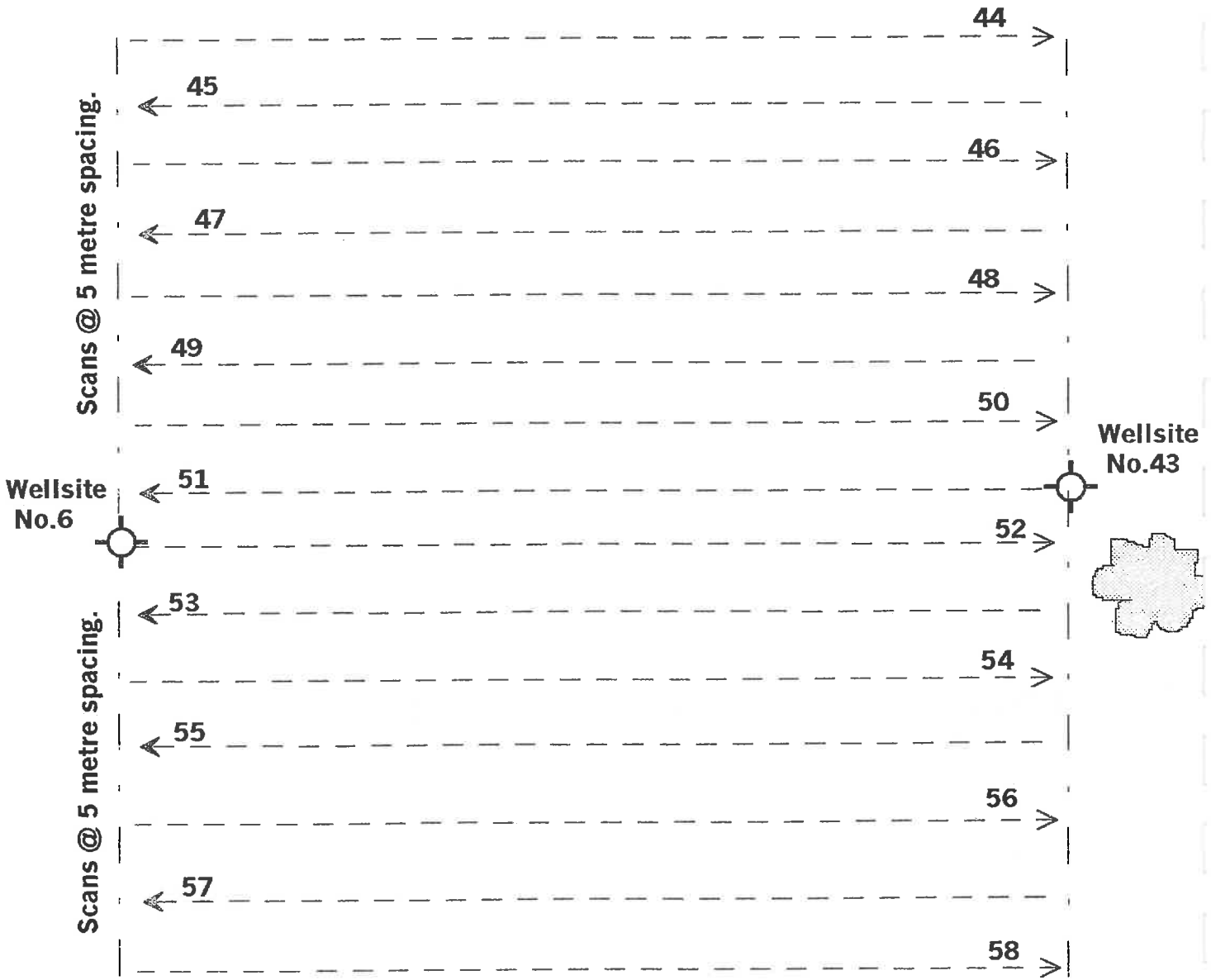
GPR data collected from this site showed normal undulating soil strata together with an interesting underlying rock formation. Refer Fig. 19b and Radargram File 53 and 57.

Conclusions:

All of the data collected from this site did not show evidence of a drum burial site.

TARANAKI REGIONAL COUNCIL
Ground Penetrating Radar Survey.
Dow AgroSciences - Paritutu Road. - Site 3.
May 2001

Southern Hemisphere



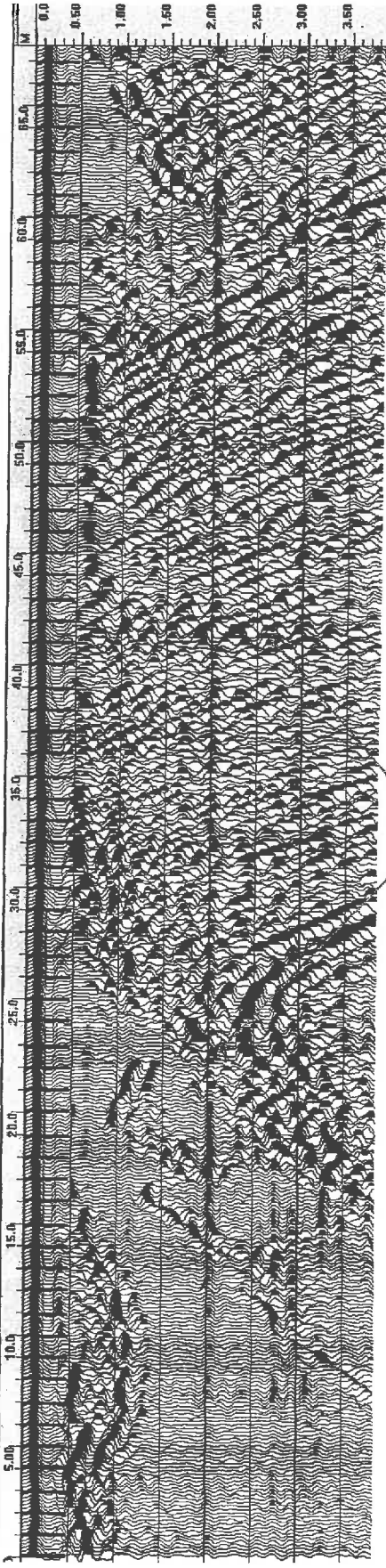
---> Radar scan & file no.

Note ; Not to Scale.

Figure 19a

Dow AgroScience Premises - Paritutu Road - New Plymouth.

Site 3 Dow AgroScience
File 53



Natural underlying rock structure

Site 3 Dow AgroScience
File 57

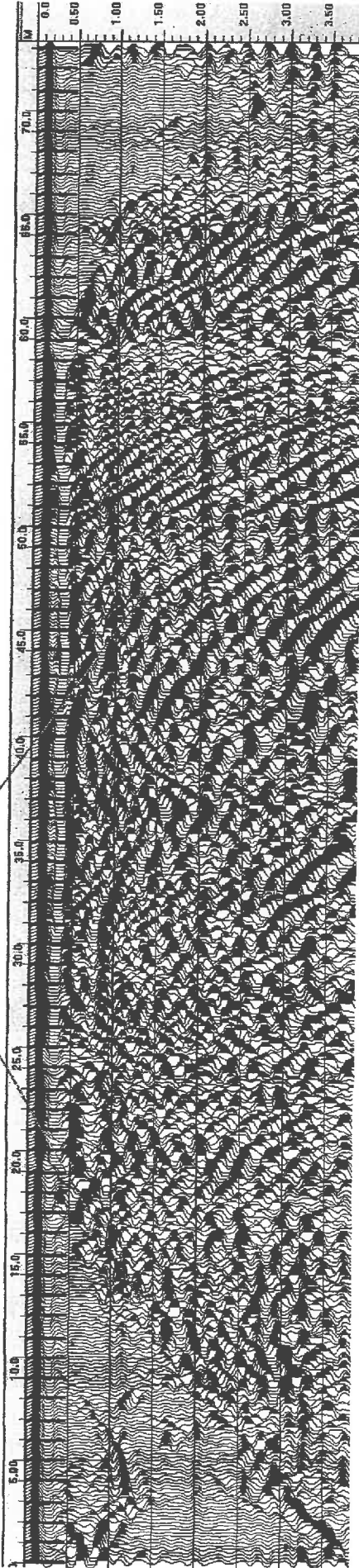


Figure 19b

Taranaki Regional Council

Appendix A

GPS Waypoints (WP) May-01

WP	Easting	Northing	Elevation (m)
"wp01"	2600716.813	6237184.376	24.004
"wp02"	2600655.654	6237145.277	23.955
"wp03"	2600648.474	6237108.863	24.318
"wp04"	2600650.809	6237083.623	21.673
"wp05"	2598533.323,	6237594.056,	47.836,
"wp06"	2598614.056,	6237664.256,	47.821,
"wp07"	2598463.988,	6237553.395,	45.044,
"wp08"	2598412.517,	6237539.994,	39.722,
"wp09"	2598475.561,	6237671.869,	36.707,
"wp10"	2598480.288,	6237493.285,	46.901,
"wp11"	2598545.538	6236606.539	16.817
"wp12"	2598487.75	6236720.99	11.778
"wp13"	2600787.111	6234770.833	57.446
"wp14"	2600754.043	6234731.078	62.663
"wp15"	2597876.072	6235984.153	47.344
"wp16"	2597887.225	6235970.848	47.647
"wp17"	2597954.593	6235891.162	48.725
"wp18"	2598050.789	6235125.89	66.356
"wp19"	2598421.773,	6237257.011,	46.362,
"wp20"	2597696.408	6235509.427	50.654
"wp25"	2598430.768	6236658.568	21.176
"wp26"	2597594.017	6235344.729	34.395
"wp27"	2598389.185	6237067.578	31.515