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WHANGANUI DISTRICT COUNCIL
Te Kaunihera a Rohe o Whanganui

18 January 2017

Reuters Homes Limited
c/- Reuters Construction Limited
165A Great North Road
Otamatea
Whanganui 4501

Emailed 18 Jan 2017.

Dear Reuters Homes Limited

Resource Consent Application: 25 Springvale Rd WHANGANUI
Application No: RCLU16/0024
Property No: 69870

In accordance with Section 127 of the Act, the Whanganui District Council has reviewed the previous condition 3 of consent. This consent required that the material transported from 25 Springvale Road and deposited on the site at 105 Seafield Road be tested for contamination.

Through discussions with the owner of 105 Seafield Road, it was established that the material was dumped on their dairy farm property legally described as Part Lot 2 B 166, in a paddock which is used for pastoral purposes to the north of the existing rotary dairy shed, not the property at 105 Seafield Road legally described as Lot 1 DP 391652. The reason their rural residential property at 105 Seafield Road was mentioned throughout this consent is because as at the time when the fill was dumped on their farm, they did not live on the farm, instead lived at this separate property (105 Seafield Rd) and this was their postal address. For clarity, the fill did not go on 105 Seafield Road as detailed in a number of the documents associated with this consent.

If the land that is potentially or actually affected by contamination is production land, the regulations do not apply. In this case, the land where the material was dumped is utilised for productive purposes, therefore the NES regulations does not apply.

In accordance with Section 127 of the Act, the Whanganui District Council agrees to the request for the removal of previous Condition 3 of this consent approval. Please note that the amendment does not change the original date of issue.

I refer to the resource consent application to Change of use in accordance with the 2011 NES at 25 Springvale Rd WHANGANUI. The application was necessary because the site was formally a horticultural site and therefore a HAIL site.

The application has been considered as a non-notified application, and the following consent **granted**.

I am pleased to inform you That pursuant to Sections 9, 104, 104A and 108 of the Resource Management Act 1991, the Whanganui District Council grants consent for a controlled activity to change the use of and to remove material from 25 Springfield Road, Whanganui, which is legally described as Lot 2 DP 474904 held in Computer Freehold Register 654695 and Lot 1 DP 474904 held in Computer Freehold Register 654696, subject to the following conditions:

1. The activity shall be undertaken in accordance with the information and plans submitted in support of this proposal, held on Council File RCLU16/0024 and stamped Planning Approved.

2. The consent holder shall contact Council's Resource management Team on (06) 349 0001 at least 2 working days prior to any further physical work commencing on the site and advise the date the work shall commence.

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WHANGANUI DISTRICT COUNCIL
Te Kaunihera a Rohe o Whanganui

3. Any further off-site disposal of soil shall be at an appropriately licensed receiving facility. A report shall be provided to Council detailing the areas and volume of soil removal from the site and certification of receipt from the receiving facility detailing quantity and nature of removed material and disposal location.

4. Charges set in accordance with Section 36(1) (c) of the Resource Management Act 1991 shall be paid to the consent authority for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under Section 35 of the Act.

   Section 36(1)(c) of the Act provides that the Council may from time to time fix charges payable by the holders of resource consents.

Advice notes:

1. Approval is given for changing the use of the site from horticultural to residential. Approval of this consent does not infer suitability of the material for deposition at any other site. Any further application for consent will be subject to the provisions of both the Whanganui District Plan and the National Environmental Standard for the Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (2011).

After considering Part II of the Resource Management Act 1991, the following are the reasons for this decision:

1. The environmental effects of this proposal are considered to be less than minor in extent for the reasons given in this report.
2. The proposal is not contrary to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.
3. The proposal meets the requirements of the Resource Management Act 1991.

The full planning report is available from Council on request. Please note that under section 125 of the Resource Management Act 1991, your consent will lapse in five years unless you give effect to it before then.

It is very important that you understand and comply with all the conditions of your consent. If you have any questions or concerns about any aspect of your consent or its conditions, I would be happy to discuss them with you.

Please feel free to contact me on (06) 349 – 0001, if you have any questions or concerns.

Yours faithfully

Johanna Verhoek
Resource Management Planner

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18 Jan 2017.
superseded - condition 3 cancelled in accordance with section 127 of the Act
Posted & emailed
10 Jan 2016.

10 January 2017

Reuters Homes Limited
c/- Reuters Construction Limited
165A Great North Road
Otamatea
Whanganui 4501

Dear Reuters Homes Limited

Resource Consent Application: 25 Springvale Rd WHANGANUI
Application No: RCLU16/0024
Property No: 69870

I refer to the resource consent application to Change of use in accordance with the 2011 NES at 25 Springvale Rd WHANGANUI . The application was necessary because the site was formally a horticultural site and therefore a HAIL site.

The application has been considered as a non-notified application, and the following consent **granted**.

I am pleased to inform you That pursuant to Sections 9, 104, 104A and 108 of the Resource Management Act 1991, the Whanganui District Council grants consent for a controlled activity to change the use of and to remove material from 25 Springfield Road, Whanganui, which is legally described as Lot 2 DP 474904 held in Computer Freehold Register 654695 and Lot 1 DP 474904 held in Computer Freehold Register 654696, subject to the following conditions:

1. The activity shall be undertaken in accordance with the information and plans submitted in support of this proposal, held on Council File RCLU16/0024 and stamped Planning Approved.

2. The consent holder shall contact Council's Resource management Team on (06) 349 0001 at least 2 working days prior to any further physical work commencing on the site and advise the date the work shall commence.

3. A verification report shall be undertaken by a suitably qualified person within 3 months of the granting of this consent in relation to the material that has been deposited at 105 Seafield Road for the purposes of showing that the material that has been deposited there has not generated a contaminated site by its deposition. Note: a discharge permit may be required from Horizons Regional Council based on the outcomes of the verification report.

4. Any further off-site disposal of soil shall be at an appropriately licensed receiving facility. A report shall be provided to Council detailing the areas and volume of soil removal from the site and certification of receipt from the receiving facility detailing quantity and nature of removed material and disposal location.

5. Charges set in accordance with Section 36(1) (c) of the Resource Management Act 1991 shall be paid to the consent authority for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under Section 35 of the Act.

   Section 36(1)(c) of the Act provides that the Council may from time to time fix charges payable by the holders of resource consents.

Advice notes:

1. Approval is given for changing the use of the site from horticultural to residential. Approval of this consent does not infer suitability of the material for deposition at any other site. Any further application for consent will be subject to the provisions of both the Whanganui District Plan and the National

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Environmental Standard for the Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (2011).

After considering Part II of the Resource Management Act 1991, the following are the reasons for this decision:

1. The environmental effects of this proposal are considered to be less than minor in extent for the reasons given in this report.
2. The proposal is not contrary to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.
3. The proposal meets the requirements of the Resource Management Act 1991.

The full planning report is available from Council on request. Please note that under section 125 of the Resource Management Act 1991, your consent will lapse in five years unless you give effect to it before then.

It is very important that you understand and comply with all the conditions of your consent. If you have any questions or concerns about any aspect of your consent or its conditions, I would be happy to discuss them with you.

Please feel free to contact me on (06) 349 – 0001, if you have any questions or concerns.

Yours faithfully

Verhoek

Johanna Verhoek
Resource Management Planner

WHANGANUI DISTRICT COUNCIL

RESOURCE CONSENT REPORT

Date: **23 December 2016**

Subject: **RESOURCE CONSENT APPLICATION**

File number:	RCLU16/0024
Application Received:	05 May 2016
Applicant:	Reuters Construction Ltd
Legal Description:	Lot 2 DP 474904 held in Computer Freehold Register 654695 and Lot 1 DP 474904 held in Computer Freehold Register 654696

1.0 INTRODUCTION

A resource consent for a subdivision of the site was granted on 27 September 2013 (Sub13/035). Subsequent to the subdivision consent being granted, resource consent is now being sought to change the use of the site from its previous use to a residential site and to remove approximatley 12,000m^2 of soil from the site. The Detailed Site Investigation (DSI) which was undertaken in July 2015 which found two samples in the south west corner of the site as containing arsenic at levels above the soil quality values set out in the NES standard relating to protect human health. A further investigation was carried out to assess the extent of heavy metal contamination in the soil. On the basis of this an addendum report was produced on 20 August 2015. The addendum report considered that the levels shown in the initial samples was likely from wood shavings, some of which may have been treated wood, and that the soil itself was free of arsenic. The addendum report also concluded that the use of the soil was highly unlikely to create a risk to human health and concluded the soil quality should not affect the granting of consent.

In conjunction with the subdivision consent, works were undertaken on the site to remove peat from the southern end of the site and to deposit sand. In 2015, when 80% of the peat and sand exchange had taken place the applicant applied for a variation to the consent and was advised that an NES approval was required before building consent could be issued.

Subsequent to the lodgement of the consent application, a review was undertaken of the July 2015 report and August 2015 addendum by Graeme Proffitt of Pattle Delemore Partners Ltd which identified a number of concerns with the 2015 report and addendum. The review recommended that further information be sought in relation to six matters.

In order to progress the development of the site Dr Ben Keet of Geo & Hydra – K8 Ltd was subsequently engaged by Reuters Development to undertake a site validation report which involved taking samples from a number of locations and an area of peat. The report concludes that *"concentration of all contaminants considered for the purpose of this site validation report is below the normal background concentrations. Therefore, the circumtances in Regulation 5(9) are met and the NES regulations do not apply."*

The application is necessary as consent is required under the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (2011)* as a Controlled Activity as the validation report has used the residual Soil Contaminant Standard (SCS) set by the NES to determine that for the contaminants considered the results are below background levels.

2.0 DISTRICT PLAN

Whanganui District Plan
The site is zoned **Residential** within the Whanganui District Plan.

Permitted Activities in the Residential zone include:

- *Residential activities;*
- *Network utilities as provided for by chapter 22*
- *Community activities;*
- *Reserves and open space;*
- *Relocated buildings and temporary relocatable buildings that comply with Chapter 19;*
- *Temporary military training activities that comply with Chapter 19.*

The previous activity on the subject site was a market garden and horticultural centre, and would have operated under existing use rights pursuant to the Resource Management Act 1991.

The former use of the site for a market garden and horticultural centre is a listed HAIL activity and the change in use from this to residential generates the need to consider the risk of contamination of soils from the storage and use of hazardous substances on the site. As is required by the legislation, the remediation of potentially contaminated or formally contaminated sites is also identified as an issue for consideration within the Whanganui District Plan. Defined in section 8.1.3 of the District Plan, contaminated sites are explained as:

'sites where hazardous substances occur in concentrations which are likely to pose an immediate or long term hazard to human health or the environment. Sites of this nature may have been used in the past, or are being used, for industrial processing, storage of hazardous substances, or dumping of hazardous wastes. This has implications for the Horizons Regional Council, Whanganui District Council, land owner, occupier, polluter and neighbouring land owners/occupiers.'

The relevant policy of the Whanganui District Plan is:

Policy 18.2.1 Contaminated soils
Ensure that land affected by contaminants in soil is appropriately identified and assessed at the time of being developed and if necessary managed, which may include remediation, or containment, to make land fit for the purpose for which the land is proposed to be used.

The standards of the Residential Zone require that in relation to earthworks the standards in Chapter 14 must be complied with. The standards of Chapter 14 set out that earthworks that meet the performance standards and earthworks for the replacement and/or removal of a fuel storage system are permitted activities. The applicant is seeking consent for the removal of 12,000m^2 of material from the site. The

proposal meets the maximum area of earthworks standard, and therefore the activity undertaken is assessed as a **Controlled Activity** under the NES for Assessing and Managing Contaminants in Soil to Protect Human Health.

3.0 SECTION 95 OF THE RMA

Section 95A of the Resource Management Act 1991 (RMA) states that notification is at the consent authority's discretion unless the applicant requests notification, special circumstances apply or effects are more than minor.

The applicant has not requested that this consent be notified. No special circumstances apply which require the notification of this consent.

To determine if the effects are more than minor for the purpose of notification, Section 95D states a consent authority:

> *"(a) must disregard any effects on persons who own or occupy—*
> *(i) the land in, on, or over which the activity will occur; or*
> *(ii) any land adjacent to that land; and*
> *(b) may disregard an adverse effect of the activity if a rule or national environmental standard permits an activity with that effect; and*
> *(c) in the case of a controlled or restricted discretionary activity, must disregard an adverse effect of the activity that does not relate to a matter for which a rule or national environmental standard reserves control or restricts discretion; and*
> *(d) must disregard trade competition and the effects of trade competition; and*
> *(e) must disregard any effect on a person who has given written approval to the relevant application."*

In assessing the environmental effects of the proposed activity, the NES for Assessing and Managing Contaminants in Soil to Protect Human Health, limits those factors over which Council has control to the effect of the proposed activity being the excavation and reinstatement of the contaminated site.

The proposal, in terms of the NES for Assessing and Managing Contaminants in Soil to Protect Human Health is considered to be a Controlled Activity as it meets the standrds set out in 9(3). In this instance the matters that control has been retained over are the adequacy of the DSI including site sampling, laboratory analysis and risk assessment.

Clause 9(5) sets out that the consent authority must not give public notification of an application for resource consent to do any of the activities.

As the earthworks are for the purpose of removing peat and providing a suitable building medium and were necessary to meet the conditions of the approved subdivision it is considered that the adverse effects on the wider environment will be less than minor in extent, apart from the fact that full notification of the proposal is precluded. The works are of a nature and scale that is generally associated with residential development of a site and no special circumstances exist that would require notification.

3.1 Adverse Effects Assessment

As a Controlled Activity the assessment of the activity under consideration is limited to those matter that control has been retained over. All actual and potential adverse effects must be assessed. Having said this, Section 95D(c) gives the consent authority discretion to disregard any adverse effects of the activity on the environment unless the Plan or National Environmental Standard permits an activity with that effect.

As stated above it is my opinion that the adverse effects of the proposal on the wider environment will be less than minor in extent due to the nature and scale of the proposed works. Therefore Council is not required to publicly notify the application under Section 95A (2) (a) apart from the fact that notification of the application is precluded by the NES.

Section 95B of the Act outlines the next step if public notification is not required under Section 95A.

Section 95B states that

'(1) If a consent authority does not publicly notify an application for a resource consent for an activity, it must decide (under sections 95E and 95F) if there are any affected persons or affected order holders in relation to the activity.

(2) The consent authority must give limited notification of the application to any affected person unless a rule or national environmental standard precludes limited notification of the application'.

Section 95E states who the Council can consider an affected party –

"(1) A consent authority must decide that a person is an affected person, in relation to an activity, if the activity's adverse effects on the person are minor or more than minor (but are not less than minor).

(2) The consent authority, in making its decision,—

(a) may disregard an adverse effect of the activity on the person if a rule or national environmental standard permits an activity with that effect; and

(b) in the case of a controlled or restricted discretionary activity, must disregard an adverse effect of the activity on the person that does not relate to a matter for which a rule or national environmental standard reserves control or restricts discretion; and

(c) must have regard to every relevant statutory acknowledgement made in accordance with an Act specified in Schedule 11.

(3) Despite anything else in this section, the consent authority must decide that a person is not an affected person if—

(a) the person has given written approval to the activity and has not withdrawn the approval in a written notice received by the authority before the authority has decided whether there are any affected persons; or

(b) it is unreasonable in the circumstances to seek the person's written approval."

The works are necessary to enable the provision of suitable ground conditions for the development of the site in accordance with the approved residential subdivision that was previously approved in 2013, which will result in the use of the site changing from horticultural use to residential. It is my opinion that for the purposes of notification, there are no parties that have an interest in the activity that are greater than the public in general. This is due to the nature and scale of the proposed works being of a scale that is anticipated with residential development of the site and the final use being in accordance with the zoning of the site.

4.0 CONCLUSION

1. It is my opinion that this application meets the requirements of Section 95A-E in that the adverse effects on the environment of the proposed activity will be less than minor and there are no parties that can be identified as having an interest, which differentiates them from the public generally.

2. No special circumstances exist in relation to the application which requires it to be notified.

5.0 SECTION 95 RECOMMENDATION

That for the reasons concluded above, this application shall be processed without notice.

pp Grinlinton-Hancock

Michelle Grinlinton-Hancock **Date:** 10 **January 2016**
Consultant Resource Management Planner

That the recommendation above be adopted under delegated authority.

C. Almond.

Charlotte Almond **Date:** 10 **January 2016**
General Manager - Strategy

6.0 CONSIDERATION OF APPLICATION (SECTION 104)

In terms of Section 104(1) of the Act, when considering an application for resource consent, the consent authority must, subject to Part II, have regard to:

"(a) any actual and potential effects on the environment of allowing the activity; and
(b) any relevant provisions of—
(i) a national environmental standard:
(ii) other regulations:
(iii) a national policy statement:
(iv) a New Zealand coastal policy statement:
(v) a regional policy statement or proposed regional policy statement:
(vi) a plan or proposed plan; and
(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application."

The actual and potential effects on the environment of allowing the activity include those that relate to removal of the 12,000m^3 of material from the site and the potential for harm to humans through contaminated soils.

The relevant provisions of the NES need to be considered in determining the effects of the proposal with respect to Section 104(1) (b) above. The NES limits matters of consideration to:

Section 9 Controlled activities: *Subdividing or changing use*

(4) The matter over which control is reserved is the adequacy of the detailed site investigation, including -

a) Site sampling:

b) Laboratory analysis:
c) Risk assessment:

A DSI and an addendum to the DSI was commissioned in 2015, subsequent review of that DSI identified areas of concern with that DSI. Following on from that a site verification report has been completed that undertook additional sampling. The sampling done as part of the site verification report resulted in a further 169 samples being taken, 498 analyses being completed and 2988 results being presented. In terms of risk assessment the overall risk to human health has been assessed and no concerns have been raised in this regard.

Although testing has been undertaken on the subject site it is noted that at the time of lodgement of this application, 80% of the works had been undertaken with the material having been taken to Cave's Farm at 105 Seafield Road. No assessment appears to have been made of the material that has been placed at this site. It is considered given the results from the testing at 25 Springfield that the potential risk of contamination is likely to be low, however verification testing of this material should be undertaken to provide such evidence to ensure that the removal of the material has not resulted in the creation of a contaminated site at 105 Seafield Road and to determine that a discharge consent was not required for the deposition of the materal at Seafield Road.

There are no other matters that are relevant or necessary to determine the proposal in question as per Section 104(1) (b) &(c).

When considering an application for a resource consent for a Controlled Activity under Section 104A, a consent authority—

"After considering an application for a resource consent for a controlled activity, a consent authority—

(a) must grant the resource consent, unless it has insufficient information to determine whether or not the activity is a controlled activity; and
(b) may impose if it grants the application, may impose conditions under section 108.'

Under the Section 95 assessment of the adverse effects of the activity, only those matters which Council had discretion over in the NES, were considered. This assessment identified that all adverse effects will be less than minor for the reasons outlined in Section 3.0 of this report. Therefore, it can be concluded that any actual and potential effects on the environment will be minor.

7.0 CONCLUSION

The proposed land use consent application meets the requirements of the Whanganui District Plan, The National Environmental Standard for Assessing and Managing Contaminants in Soils to Protect Human Health 2011 and the Resource Management Act 1991, and is recommended for approval.

8.0 RECOMMENDATION

That pursuant to Sections 9, 104, 104A and 108 of the Resource Management Act 1991, the Whanganui District Council grants consent for a controlled activity to change the use of and to remove material from 25 Springfield Road, Whanganui, which is legally described as Lot 2 DP 474904 held in Computer Freehold Register 654695 and Lot 1 DP 474904 held in Computer Freehold Register 654696, subject to the following conditions:

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4. Any further off-site disposal of soil shall be at an appropriately licensed receiving facility. A report shall be provided to Council detailing the areas and volume of soil removal from the site and certification of receipt from the receiving facility detailing quantity and nature of removed material and disposal location.

5. Charges set in accordance with Section 36(1) (c) of the Resource Management Act 1991 shall be paid to the consent authority for the carrying out of its functions in relation to the administration, monitoring and supervision of this resource consent and for the carrying out of its functions under Section 35 of the Act.

   Section 36(1)(c) of the Act provides that the Council may from time to time fix charges payable by the holders of resource consents.

Advice notes:

1. Approval is given for changing the use of the site from horticultural to residential. Approval of this consent does not infer suitability of the material for deposition at any other site. Any further application for consent will be subject to the provisions of both the Whanganui District Plan and the National Environmental Standard for the Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (2011).

After considering Part II of the Resource Management Act 1991, the following are the reasons for this decision:

1. The environmental effects of this proposal are considered to be less than minor in extent for the reasons given in this report.

2. The proposal is not contrary to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

3. The proposal meets the requirements of the Resource Management Act 1991.

Report written by:



Michelle Grinlinton-Hancock
Consultant Resource Management Planner

Date: 10 January 2016

Reviewed by:



Charlotte Almond

General Manager - Strategy

Date: 10 January 2016

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solutions for your environment

28 June 2016

Jason Kaye
Whanganui District Council
PO Box 637
WHANGANUI 4500

Dear Jason

REVIEW OF DETAILED SITE INVESTIGATION – 19-25 SPRINGVALE ROAD, WHANGANUI

1.0 Introduction

You have requested review of two site investigation reports related to 19-25 Springvale Road, Whanganui, prepared by Geo & Hydro – K8 Limited for Reuters Construction Limited. The two reports are:

- *Detailed site investigation, proposed residential subdivision*, dated 20 July 2015
- *ADDENDUM to a detailed site investigation, proposed residential subdivision*, dated 20 August 2015.

The investigation reports are intended to assess possible site contamination at the property which it is understood was a former market garden and then nursery, with both outdoor and glasshouse growing. It is further understood that the property is to be subdivided and developed for residential use. Given the past use, the provisions of the National Environmental for Assessing and Managing Contaminants in Soil to Protect Human Health (the NESCS) apply. As such, detailed site investigations (DSI) should be carried out in accordance with the Ministry for the Environment's (MfE) *Contaminated Land Management Guidelines No. 5 - Site Investigation and Analysis of Soils* (CLMG5) and *Contaminated Land Management Guidelines No. 1 - Reporting on Contaminated Sites in New Zealand.* This review has been carried out in light of these two documents.

To assist the review I have drawn on information from the Assessment of Environmental Effects (AEE) prepared as part of an application for land use consent for the property. I have not reviewed any aspect of the AEE, except to note that the application does not address soil disturbance or disposal activities required by the NESCS. However, these may have been addressed by some other consent application.

2.0 Report Review

The reports combined fall short of the requirements of CLMG5 and CLMG1. In arriving at this conclusion I have considered the two reports together against the general aims of the two guidelines, rather than against the rather prescriptive reporting requirements of, in particular, CLMG1. I note that the council is free to exercise discretion when judging the reports against the requirements of the NESCS and the guidelines. My intention is therefore to determine whether sufficient information is provided to gain an adequate understanding of the site, the investigation details and whether the site has been adequately characterised to assess the possible risk to the health of future residents from soil contaminants.

In summary, I do not think it is possible to arrive at the report conclusions from the information provided. I have the following concerns.

2.1 The detailed site investigation report

1. While some site history is provided, additional description should have been provided on potentially contaminated locations (or lack of locations) such as agrichemical storage, possible fuel storage for equipment and whether the glasshouses were heated and, if so, whether the form of heating could have resulted in soil residues (e.g. fuel oil or coal ash).

2. There is no conceptual site model and little sampling rationale provided. The report discusses contaminants of concern. However, I disagree with the statement that the time when nursery use commenced (mid-1970s) was "well past the lead-arsenate and DDT spray eras ...". In fact lead arsenate was still being used in the 1970s and while DDT use was generally stopped in the 1960s, it was still available for some restricted uses in the 1970s. I note from the AEE that market garden activities, with possible pesticide use, were being carried out on part of the site from the early 1960s. The market garden area has not been identified in the DSI.

3. There is insufficient information in the report with respect to how the samples were collected and how deep the samples were taken from. While the sampling methods and depth may have been adequate, there is no means of ascertaining from the information provided whether this is the case. For the soil stockpiles, there is no information on where in the piles the samples were taken from, and therefore no means of judging whether the samples properly represent the stockpiles. There is also no information on where within the glasshouses the glasshouse samples were taken. Multiple samples would generally be expected for each glasshouse, and if there was chemical or fuel storage, multiple samples would be expected at those locations as well.

4. Large parts of the site were not sampled without any explanation given. For example, no samples were taken from the large area of land surrounding where the stockpiles are shown to be on the figure on page 17, and few samples were taken in the areas surrounded by samples 18, 19 and 30 and samples 21, 23, 24 and 29.

5. A portable XRF analyser was used to screen the samples for metal contaminants. When an XRF is used for health risk assessment (i.e. comparing results against health-based soil guideline values) it is best practice to remove samples from the ground and prepare the samples so they are properly homogenised. This is to obtain the best accuracy from the device. This may involve drying and sieving samples depending on the nature of the soil. However, it is not clear whether the samples were in situ or ex situ and if ex situ, what sample preparation was carried out. For the samples that have elevated arsenic, the three XRF determinations carried out on each sample are sufficiently different to suggest that sample homogenisation was inadequate.

6. The report claims that the XRF will provide results within 5 – 10% of the laboratory results. No attempt has been made to justify this claim. For risk assessment, best practice is to perform a regression analysis between the laboratory sample results and the equivalent XRF results so as to confirm the XRF is producing accurate results. This has not been attempted. Unfortunately, the XRF samples submitted for laboratory analysis cannot be identified in the report (yellow shaded results do not show up in the copy I received) and the sample identification numbers in the tabulated data are not the same as on the laboratory report. If I am correct in my tentative matching up of XRF and laboratory results it would appear that the XRF arsenic results are generally lower than the laboratory results, although not so different as to suggest that more samples would exceed the arsenic residential criterion than the three identified.

7. It is apparent from the AEE that a large amount of earthworks was carried out prior to the sampling been carried out, several thousand cubic metres of soil having both been removed from, and introduced to, the site. This has very large implications for planning the broad-area sampling programme and interpreting the results. However, this has not been acknowledged in the DSI. The earthworks could have removed previous surface contamination. Many of the XRF samples suggest the soil has no contamination (i.e. the results are at or close to expected background (natural) concentrations). However, there is no information in the DSI as to whether the samples were taken from areas that have undergone earthworks. It is therefore not clear whether many of the results represent uncontaminated underlying soil, clean fill imported from off-site, or the surface in its original state which has no apparent contamination.

8. Both the DSI and AEE indicate there was a large amount of soil stored on the site at the time of sampling. There is no information as to the stockpiled soil's origin on the site, dimensions of the piles and estimated volumes. Knowing where the soil came from on the site, and the depth of excavation at its origin is important to interpreting the results of sampling at the original locations (assuming these areas are part of the reported sampling) and interpreting the stockpile results. Further, knowing the volume would indicate whether the amount of soil pile sampling was adequate to characterise the stockpile for whatever use it is to be put to (which is not clear from either the DSI or AEE). On-site reuse of stockpiled soil has possible human health implications if the soil is contaminated, and possible NESCS or regional council discharge consent implications if the soil is to go off site (or if contaminated soil has already been disposed of off-site).

9. The report suggests elevated arsenic results are due to treated sawdust or wood shavings, although it is not explicit how this would be. If the report is intending to suggest that fragments of treated wood were being detected in the samples, then I do not accept that explanation, as concentrations of arsenic in treated wood are orders of magnitude higher than that detected in the XRF samples. However, if the report is intending to suggest that leaching from treated wood has affected the soil, then that may be an explanation. However, it is curious that copper is not also elevated as would be expected with effects from CCA treated wood. It would have been helpful if a sample of the wood fragments shown in the photographs in the addendum report had been analysed for arsenic. This would have been a simple matter with the XRF analyser and would have clarified whether in fact the wood was treated as suggested.

10. As it is not clear whether the laboratory samples analysed for cadmium were from the original ground surface or a modified surface, I cannot confirm the report conclusion that cadmium contamination is not of concern. Elevated cadmium may exist in the stockpiles (an XRF analyser is unable to reliably detect cadmium to low enough detection limits) or in soil that has been removed from the site. In general, only land that has been very intensively farmed over several decades would have cadmium concentrations high enough to be of concern.

2.2 Addendum to detailed site investigation

1. The sample nomenclature used for both areas that were sampled more intensively is confusing. It is not clear in which direction the sample numbers increase. However, given all the results appear to be at background this has no effect on interpretation.

2. The photographs of "wood chips" appear to include twigs and other natural wood fragments, not treated wood. Without testing the wood fragments there can be no confidence that removing wood fragments from the later sample explains why the original sample had excessive arsenic

but not the later sample (note also my previous comment that CCA treated wood would also have elevated copper).

3.0 Conclusion and Recommendations

Based on the results, there appears to be little contamination at the sampled locations, and where elevated arsenic was detected, the extent appears to have been limited. However, I am not convinced sufficient sampling has been carried out to properly characterise the site and stockpiles. The lack of information on where soil has been removed from, or new soil has been placed, make it impossible to decide whether the acceptable results are a result of earthworks or reflect the true condition of the site.

If areas of the site that have insufficient sampling are in fact original ground, then additional sampling and analysis is required to properly characterise the site. If the site was indeed contaminated before soil removal, contaminated soil may have been removed from the site and contaminated wherever it was deposited.

I recommend:

- Information be sought on the detail of the earthworks, including where soil has been removed and the depth of that removal, and where soil has been replaced, and the depth of that replacement, so as to be able to properly interpret the results.
- That the council seek a reinterpretation of the results in light of the earthworks information.
- Depending on the above, that additional sampling be requested in areas which have had insufficient sampling if these areas are still original ground, or original ground with only a thin layer (<500 mm) of new soil placed on top. This should include further consideration of locations such as the glasshouses, possible chemical storage and possible fuel storage, in addition to the broad-acre areas.
- If the stockpiled soil is to be reused on site, that information be sought that demonstrates the soil is fit for that purpose, that is, the sampling frequency and sample locations within the stockpiles are sufficient to demonstrate that the soil will be acceptable after spreading at its new location (typically, the equivalent of several samples per residential lot after spreading).
- If the stockpiled soil is to be disposed of offsite, that information be sought to demonstrate that sufficient sampling has been carried out to demonstrate it is acceptable at whatever location the soil is disposed of to.
- If soil is to be disposed of off-site, that the necessary land use and discharge consents (through the regional council) are obtained, if not already obtained. (In similar situations elsewhere, retrospective soil disturbance consent has been required by the territorial authority for soil already removed from a HAIL site.)

4.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Whanganui District Council. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Whanganui District Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different

purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours sincerely

PATTLE DELAMORE PARTNERS LIMITED

Prepared by



Graeme Proffitt

Technical Director Contaminated Land

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Reuters Construction Ltd
Attn. Bernard Reuters
165A Great North Road
Wanganui

Project:	WASR-25
Location:	25 Springvale Road, Wanganui
Land Nos.	47215 and 47220
Area:	Approx. 2.6 Ha
Ref.:	WASR-25– Add DSI
Version:	v2
Date:	20 August 2015

Subject: ADDENDUM to a detailed site investigation, proposed residential subdivision.
Purpose: To accompany application of resource/building consent.

Dear Bernard,

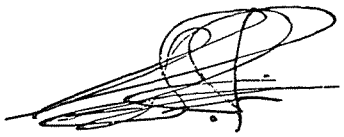
EXECUTIVE SUMMARY

A further investigation to the detailed site investigation has been carried out on the west side of the approx. 2.6 Ha area, property located at 19 - 25 Springvale Road, Wanganui with the land nos. 47215 and 47220. The purpose was to assess the extent of the arsenic contamination identified in the DSI report. On-site and laboratory analysis show that contamination in the initial samples was likely due to the presence of wood shavings or chips, some of which may have been treated wood. The soil itself, however, is free of arsenic. Therefore, overall the contaminants of concern are found in the samples taken at concentrations **below** the soil quality values set by the National Environmental Standards (NES) to protect human health.

Therefore any use of this soil is highly unlikely to create a risk to human health.

In conclusion, the soil quality should not affect granting of the consent.

Regards,



Drs. Ben Keet SQEP, FRSC, MRSNZ, MinstD
Senior Contaminated Land Auditor

Disclaimer

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Document quality control

Project manager: Drs. Ben Keet

Report author: Drs. Ben Keet

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Distribution of copies

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Last saved: 20/08/2015 2:36:53 p.m.

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Location

The location of the property is shown on the map below.

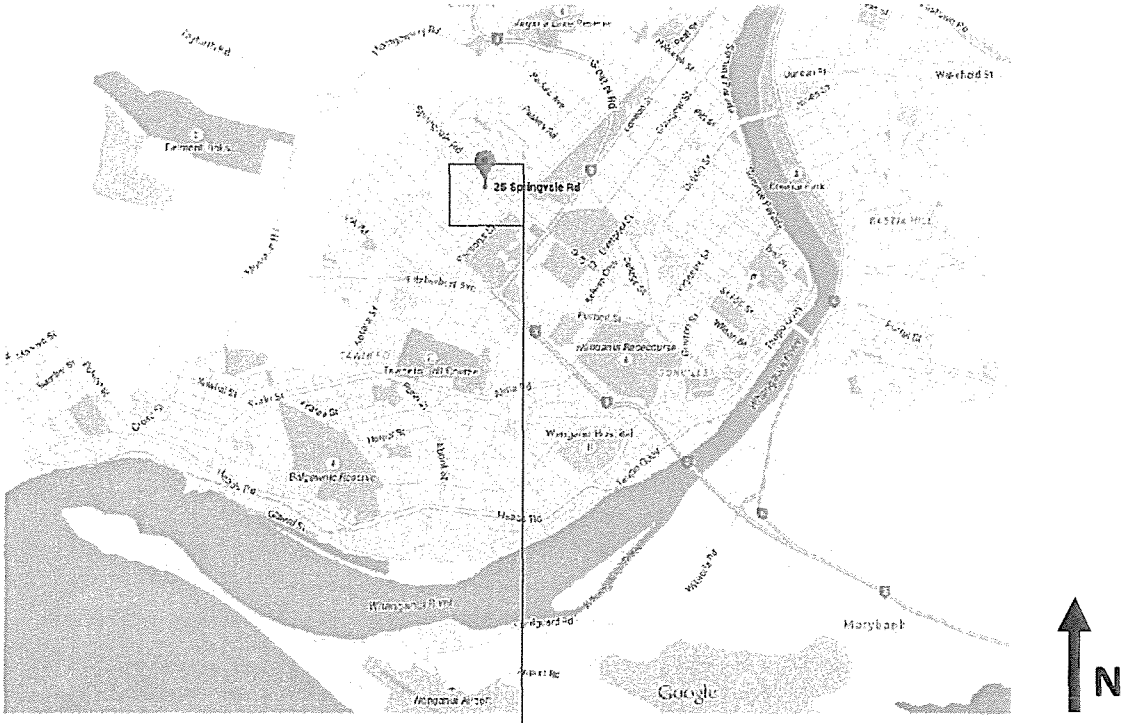


Figure 1 Location overview map

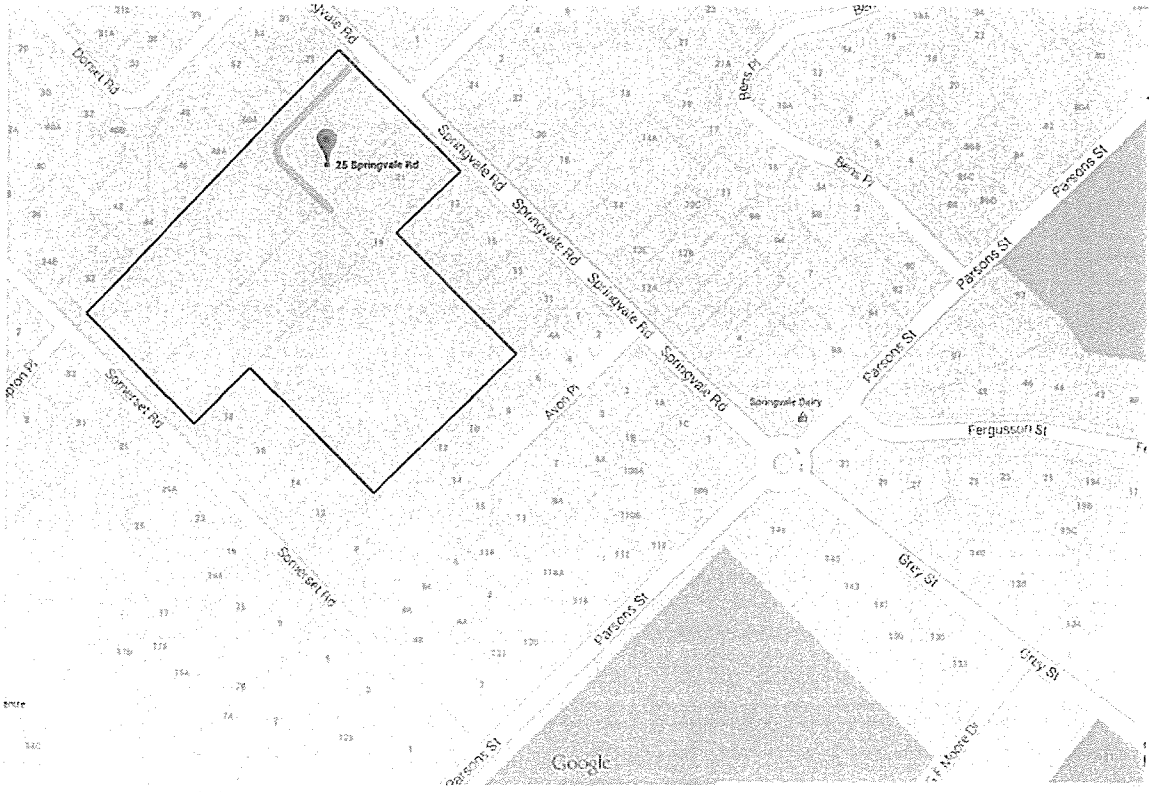
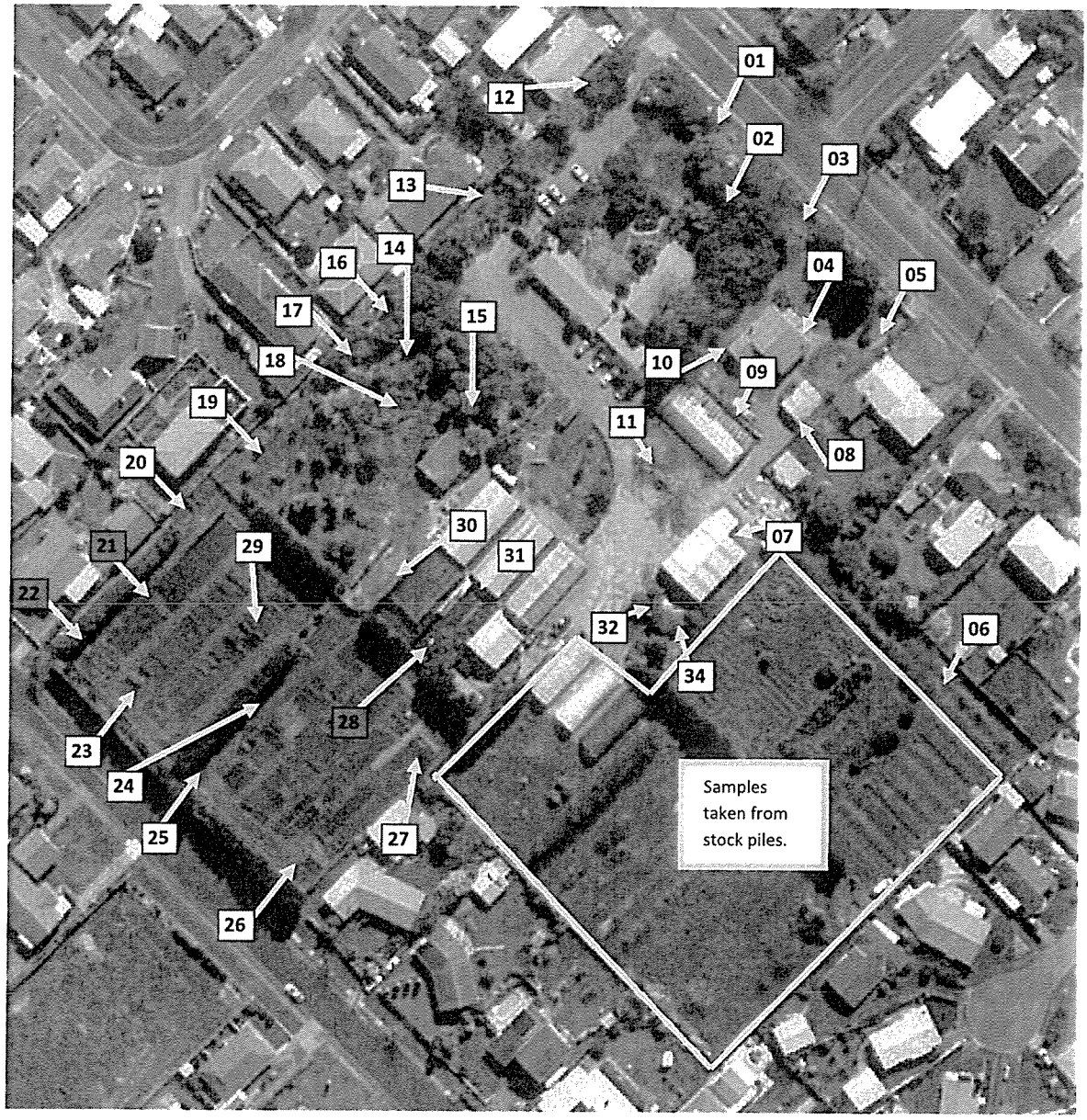


Figure 2 Detail of the location showing the site boundary in red.

Areas of concern based on samples taken for DSI report

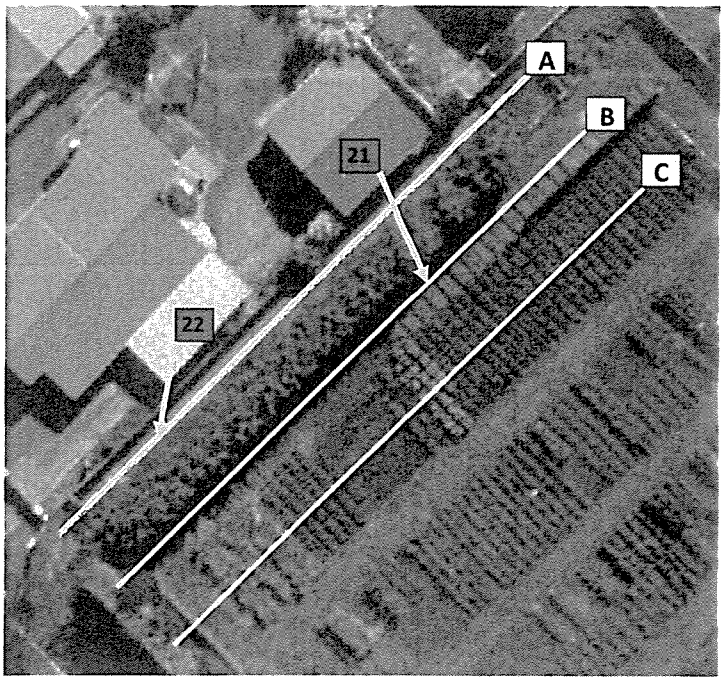
Samples 21, 22, and 28 labeled in red below had arsenic concentrations just exceeding residential standards.



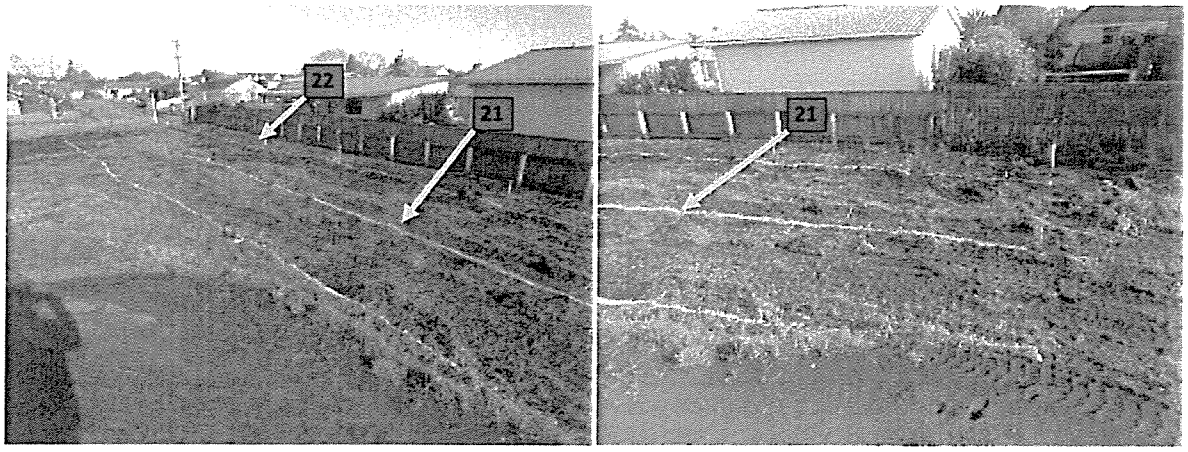
Each of these three areas has been investigated using the X-Ray Fluorescence (XRF) analyser for screening purposes. Comparative studies have shown analysis to be within 5 – 10 % of laboratory analysis[1] (see Appendix A for a detailed break-down). A validation sample has been taken from each of these areas for laboratory analysis.

[1] US EPA (2006) 'Field Portable X-Ray Fluorescence Spectroscopy - http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/6200.pdf (downloaded 22-2-13)

Area of samples 21 and 22



In the area of samples 21 and 22, three lines were set up (A, B and C). The first two, closest to the fence, ran over the original sampling points and a third one ran five meters into the site. At every 5 meter interval, the soil was analysed on site. The position of the three rows in white is shown on the pictures below and in yellow on the aerial shot above. Test results are provided on the next page.



Location of sample 28 in relation to a new sampling grid.

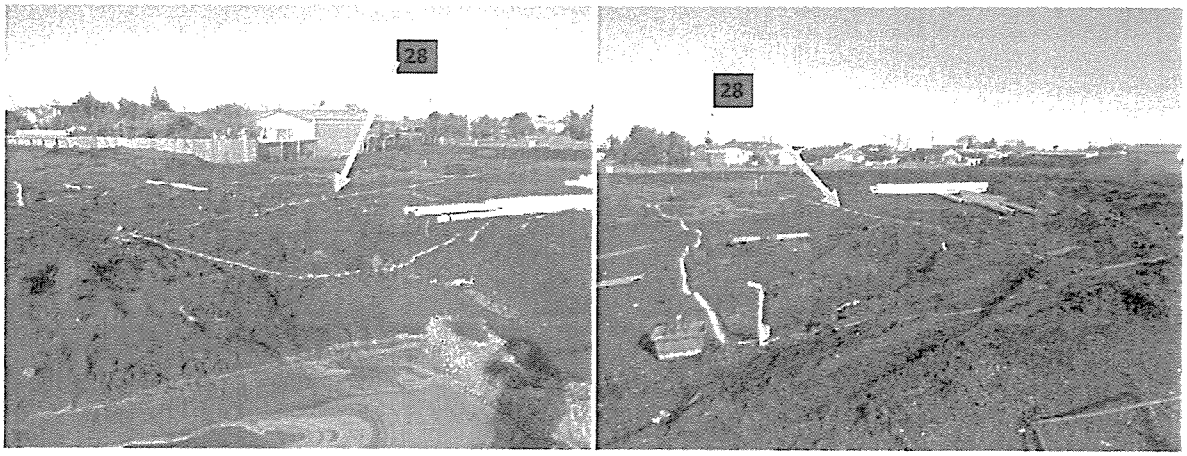
Sample No.	As mg/kg d.w.	Sample No.	As mg/kg d.w.
21 +22-line A-1	3	21 +22-line B-6	4
21 +22-line A-2	4	21 +22-line B-7 = 21R	3
21 +22-line A-3 = 22R	3	21 +22-line B-8	6
21 +22-line A-4	3	21 +22-line B-9	7
21 +22-line A-5	4	21 +22-line B-10	5
21 +22-line A-6	4	21 +22-line C-1	9
21 +22-line A-7	4	21 +22-line C-2	3
21 +22-line A-8	4	21 +22-line C-3	8
21 +22-line A-9	4	21 +22-line C-4	8
21 +22-line A-10	4	21 +22-line C-5	4
21 +22-line B-1	4	21 +22-line C-6	3
21 +22-line B-2	3	21 +22-line C-7	6
21 +22-line B-3	3	21 +22-line C-8	3
21 +22-line B-4	3	21 +22-line C-9	3
21 +22-line B-5	4	21 +22-line C-10	4
NES res	20	NES res	20

The laboratory test results for arsenic in samples 21R and 22R show 2 and 6 mg/kg, respectively, which compares well with the XRF analysis. Wood chips were excluded from the second round of testing (see picture below).



Wood chips on surface near sample point 21 (lab sample 21R).

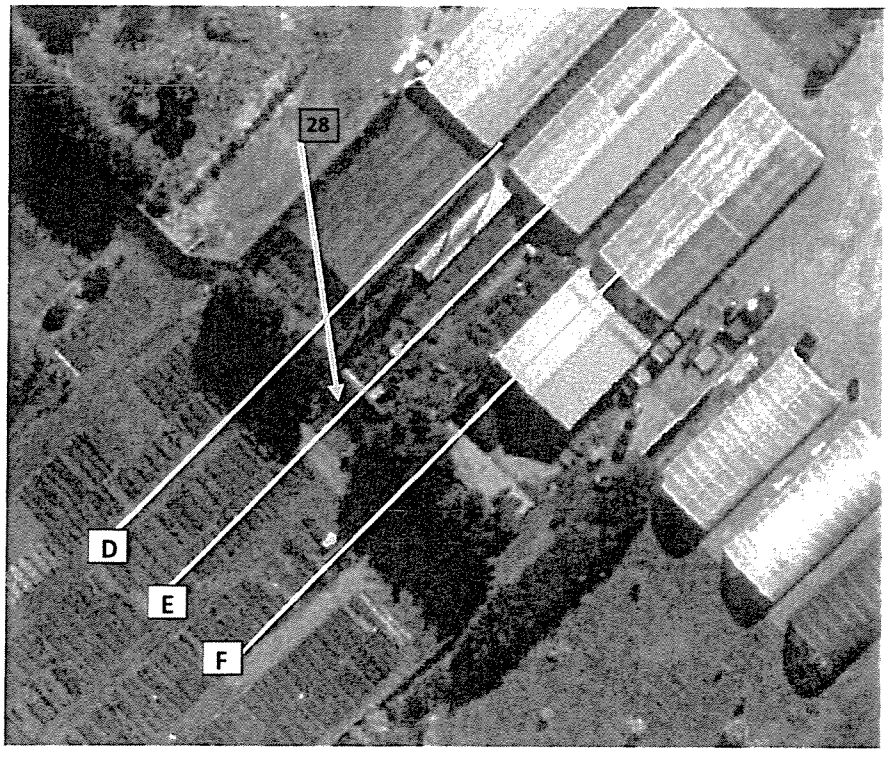
Area of sample 28



Area of 28 looking South

Area of 28 looking West

In the area of sample 28, three lines were also set up (A, B and C). The middle line runs over the original sampling point 28 and the other two - five meters to each side. At every 5 meter interval the soil was analysed on site. The position of the three rows is shown in white on the pictures above and in yellow on the aerial picture below. Test results are provided on the next page.



Location of sample 28 in relation to a new sampling grid.

Sample No.	As mg/kg d.w.	Sample No.	As mg/kg d.w.
28-line D-1	3	28-line E-6	6
28-line D-2	3	28-line E-7	5
28-line D-3	7	28-line E-8	6
28-line D-4	6	28-line E-9	3
28-line D-5	3	28-line E-10	8
28-line D-6	3	28-line F-1	3
28-line D-7	8	28-line F-2	4
28-line D-8	7	28-line F-3	8
28-line D-9	3	28-line F-4	3
28-line D-10	3	28-line F-5	4
28-line E-1	4	28-line F-6	7
28-line E-2	7	28-line F-7	6
28-line E-3	3	28-line F-8	4
28-line E-4	4	28-line F-9	3
28-line E-5 = 28R	5	28-line F-10	3
NES res	20	NES res	20

The laboratory test results for arsenic in sample 28R show 4 mg/kg which compares well with the XRF analysis. Wood chips were excluded from the second round of testing (see picture below).



Wood chips on surface near sample point 28.

Interpretation of Analysis Results

Arsenic

Arsenic is often the result of sprays used up until the mid-1960s; however, it can also result from the spreading of ashes or sawdust of treated wood. Lead is often the result of paint flakes from houses, sheds or fences, old sprays and the use of ash of painted wood as fertiliser which contains lead-paint pigments, or the use of lead-based paint on the sports field to create lines.

All test results for arsenic show near background levels with very little, if any, residues in the soil. Some minor fluctuations are likely caused by treated wood sawdust resulted from the fence and shed construction.

The laboratory corroboration analyses of arsenic and lead show good correlation.

The full laboratory report is presented in Appendix B.

CONCLUSION

The concentration of all the contaminants analysed for in the samples is under the level set for rural residential soils provided in the NES guidelines.

It can therefore be concluded that it is highly unlikely that there will be a risk to human health.

RECOMMENDATION

Based on the absence of soil contamination resource, building consent can be granted.

Compliance and Guidelines used:

This assessment complies with the "Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011" Ref No. 2011/361, downloaded 8/7/2012 from: http://www.legislation.govt.nz/regulation/public/2011/0361/latest/DLM4052228.html?search=ts_regulation_contaminants_resel&p=1&sr=1

The work carried out for this soil assessment complies with the guidelines set out in (last downloaded 8 July 2012): http://www.mfe.govt.nz/publications/rma/users-guide-nes-for-assessing-managing-contaminants-in-soil/guide-nes-for-assessing-managing-contaminants-in-soil.pdf

With technical specifications contained in (last downloaded 8 July 2012):

- Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils (Revised 2011): http://www.mfe.govt.nz/publications/hazardous/contaminated-land-mgmt-guidelines/guideline-1.pdf
- Contaminated Land Management Guidelines No. 1 - Reporting on Contaminated Sites in New Zealand (Revised 2011) http://www.mfe.govt.nz/publications/hazardous/contaminated-land-mgmt-guidelines-no5/guideline-5.pdf
- For the Ecological threshold levels used NEPM table 5-A http://esdat.net/Environmental%20Standards/Australia/NEPM%20Tables.pdf
- For asbestos: WA's 'Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia – May 2009 http://www.public.health.wa.gov.au/cproot/3763/2/Guidelines%20for%20Asbestos-Contaminated%20Sites%20-%20May%202009.pdf

Appendices:

A The use of an X-ray fluorescence (XRF) Analyser
B Laboratory analysis report (3 pages)
C Site Photographs

Brief Biography

Drs. Ben Keet SQEP (NES), FRSC, MRSNZ, MinstD, MBA (exp. 11/2015)
Senior Environmental Auditor
Bioremediation Specialist

Ben studied Physics and Hydrogeology in Amsterdam. He holds a 1st class honours doctoral degree in hydrogeology specialising in isotope hydrochemistry. Ben exceeds all requirements for a Suitably Qualified and Experienced Person (SQEP) for all categories under the NES (New Zealand).
He is a Fellow of the Royal Society of Chemistry - UK (requiring 15 years of significant contributions to the field of chemistry), a Member of the Royal Society of NZ and a full member of the Institute of Directors NZ. In November 2015, he will finish an Executive MBA study at Massey University.

Experience

5 years teaching groundwater modelling and medical physics at the Free University Amsterdam

5 years petroleum reservoir engineering and management with Shell International (NL, UK, Algeria).

27 years experience in contaminated land management and was directly responsible for over 4500 projects in ten different countries, starting in NZ with the investigation of 70% of all oil terminals in the ports of NZ, many Carter Holt Timber treatment sites and the first investigation of the Mapua FFC site. Between '88 - '91, designed and managed remediation projects on six major and several small petroleum contaminated sites. He was responsible for the start-up of four offices in Australia, for over 800 service station assessment and remedial projects throughout Australia and for remediation of Sydney Airport's largest underground kerosene spill (>1 million litres).

Since '93, in both the EU and the US, Ben has been responsible for the Luxembourg International Airport environmental audit including deep groundwater aquifer decontamination. He is responsible for the investigation, pilot testing, designing and implementing novel remediation techniques on multiple defence properties, mainly air force bases in Europe and the US, a variety of chemical plants of AKZO Nobel, DOW, Sika, Philips, etc. and for well over 1000 site assessments and 400 complex in-situ biological remedial programs. Ben holds several patents in the field of environmental engineering and sustainability.

Ben was appointed as one of four Accredited Environmental Auditors in the Grand Duchy of Luxembourg during the period between '94 - '04 and from 2005 audits reports for regional councils in New Zealand, such as Environment Waikato and has carried out peer reviews or validation studies, such as for Greater Wellington Regional Council. He is the author of several major reports for Ministry for the Environment (MfE) on brominated flame retardants and chemicals in E-waste (available on the MfE website); he has edited the MfE guidelines for local councils on Sheep-dips and the MfE Handbook on Natural Attenuation of Petroleum Hydrocarbons.

Ben has taught hundreds of courses and workshops in New Zealand, Australia, Europe and the Middle East to environmental professionals and government organisations. More info on: www.benkeet.com

Appendix A: The use of X-ray fluorescence (XRF) Analyser.

Comparison with Laboratory Results

Field XRF analysis yields 'wet weight' a (w.w.) result, i.e. the sample is 'diluted' with water. Laboratory results and guideline standards are given as dry weight (d.w) also called dry matter (dm) concentrations. The results from XRF analysis therefore have to be corrected by the percentage of soil moisture in order to be compared with the guideline values and laboratory results. The soil moisture content of the samples nearest to those analysed in the lab is used. All results in the report are corrected for soil moisture (as the laboratory does) and are given in mg/kg d.w.

A difference between laboratory results and those obtained from XRF analysis is that the XRF analyses a small *near surface area* of the sample, whereas a *small volume* of the sample will be extracted for laboratory analysis (2 gram). Sample heterogeneity is accounted for with the XRF analysis by analysing the sample on more separate positions (different places in the sample bags) and if needed determining an average concentration. In the laboratory the sample is mechanically mixed and sieved (2 mm) before the sub-sample is taken. For example, larger paint flakes are omitted in laboratory analysis, but the XRF results would be higher if the flakes are close to the surface in the sample. On the other hand, the XRF results are moderated by the air gaps often associated with flat grains such as paint flakes effectively diluting the sample, which in turn reduces the concentration read on the instrument.

Therefore compaction of the sample is important as the more soil grains are present in the near surface area in front of the XRF analyser's X-ray window; the more fluorescence generated and emitted back to the detector and the higher the concentration read. When using the XRF on-site in an in situ mode care has to be been taken to analyse soil which was either not yet excavated or when measuring a loose sample like on a mixed pile of soil, selecting a well compacted area, like a spot inside the wheel tracks of earthmoving machinery, to gain consistent readings. When analysing soil in bags or in the field care has been taken to compress each bag or sample before analysis to obtain similar compaction for each bag / sample analysed. As there is most likely not 95% compaction everywhere in the bag, some variability can be expected.

International Use of XRF

The United Stated Environmental Protection Agency has produced a number of guidelines and method statements for the use of XRF devices. In the USA, portable XRF devices are used in the field for initial site characterisation and the identification of contamination patterns, as well as to make informed decisions on sample selection for further analysis. Method Statement 6200 has been published by the EPA under the Resource Conservation and Recovery Act (RCRA) to provide guidance and regulation for field-portable XRF analysis (www.epa.gov). In the absence of NZ guidance, this document is considered during the current project.

Next Appendix B: Laboratory reports (1 page)

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Hamilton 3240, New Zealand

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Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Geo & Hydro Ltd	**Lab No:**	1461592 SPv1
Contact:	Dr B Keet	**Date Registered:**	12-Aug-2015
	C/- Geo & Hydro Ltd	**Date Reported:**	18-Aug-2015
	32 Keirunga Road	**Quote No:**	
	HAVELOCK NORTH 4130	**Order No:**	
		Client Reference:	WASP-25R
		Submitted By:	Dr B Keet

Sample Type: Soil

		Sample Name:	WASP-25R-21R	WASP-25R-22R	WASP-25R-28R		
		Lab Number:	1461592.1	1461592.2	1461592.3		
Total Recoverable Arsenic	mg/kg dry wt		2	6	4	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-3
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

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: ben@benkeet.com

Reuters Construction Ltd
Attn. Bernard Reuters
165A Great North Road
Wanganui

Project:	WASR-25
Location:	19 - 25 Springvale Road, Wanganui
Land Nos.	47215 and 47220
Area:	Approx. 2.6 Ha
Ref.:	WASR-25– DSI
Version:	v2
Date:	20 July 2015

Subject: Detailed site investigation, proposed residential subdivision.
Purpose: To accompany application of resource/building consents

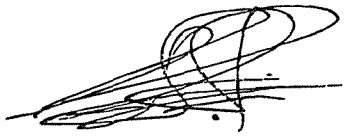
Dear Bernard,

EXECUTIVE SUMMARY

A detailed site investigation has been carried out on an approx. 2.6 Ha property, located at 19 - 25 Springvale Road, Wanganui with the land nos. 47215 and 47220. Based on the site's history as a nursery, it was decided to take and analyse soil samples.

In two of the samples taken, arsenic is found at concentrations **above** the soil quality values set out in the National Environmental Standard (NES) to protect human health. It is recommended that the area of the SW corner of the site is further investigated to assess the extent of the heavy metal concentration in the soil.

Regards,



Drs. Ben Keet SQEP, FRSC, MRSNZ, MinstD
Senior Contaminated Land Auditor

Disclaimer

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Location

The location of the property is shown on the map below.

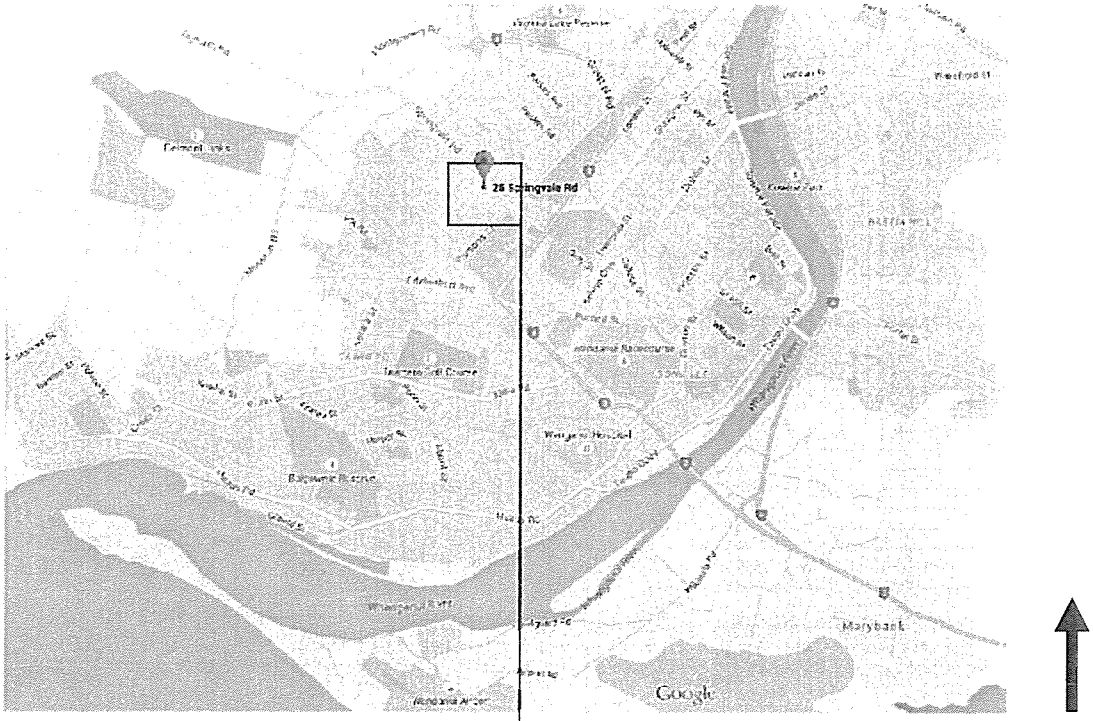


Figure 1 Location overview map

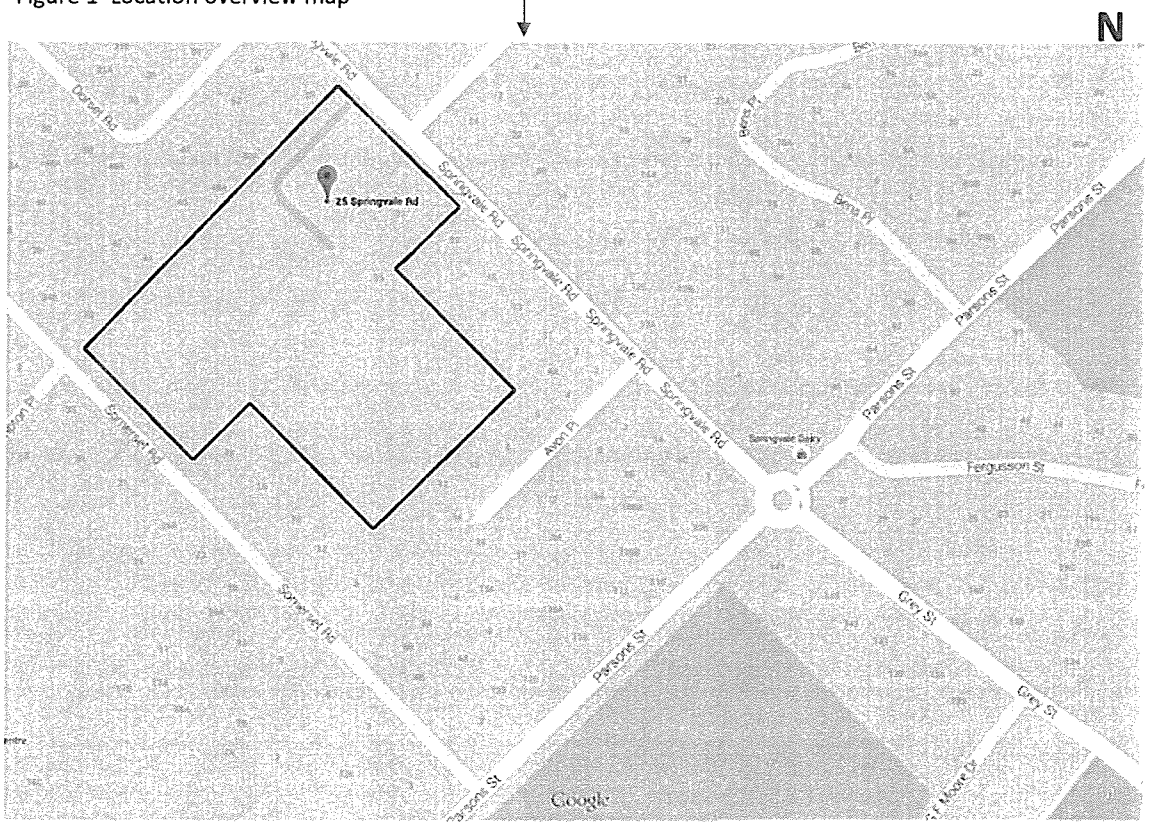
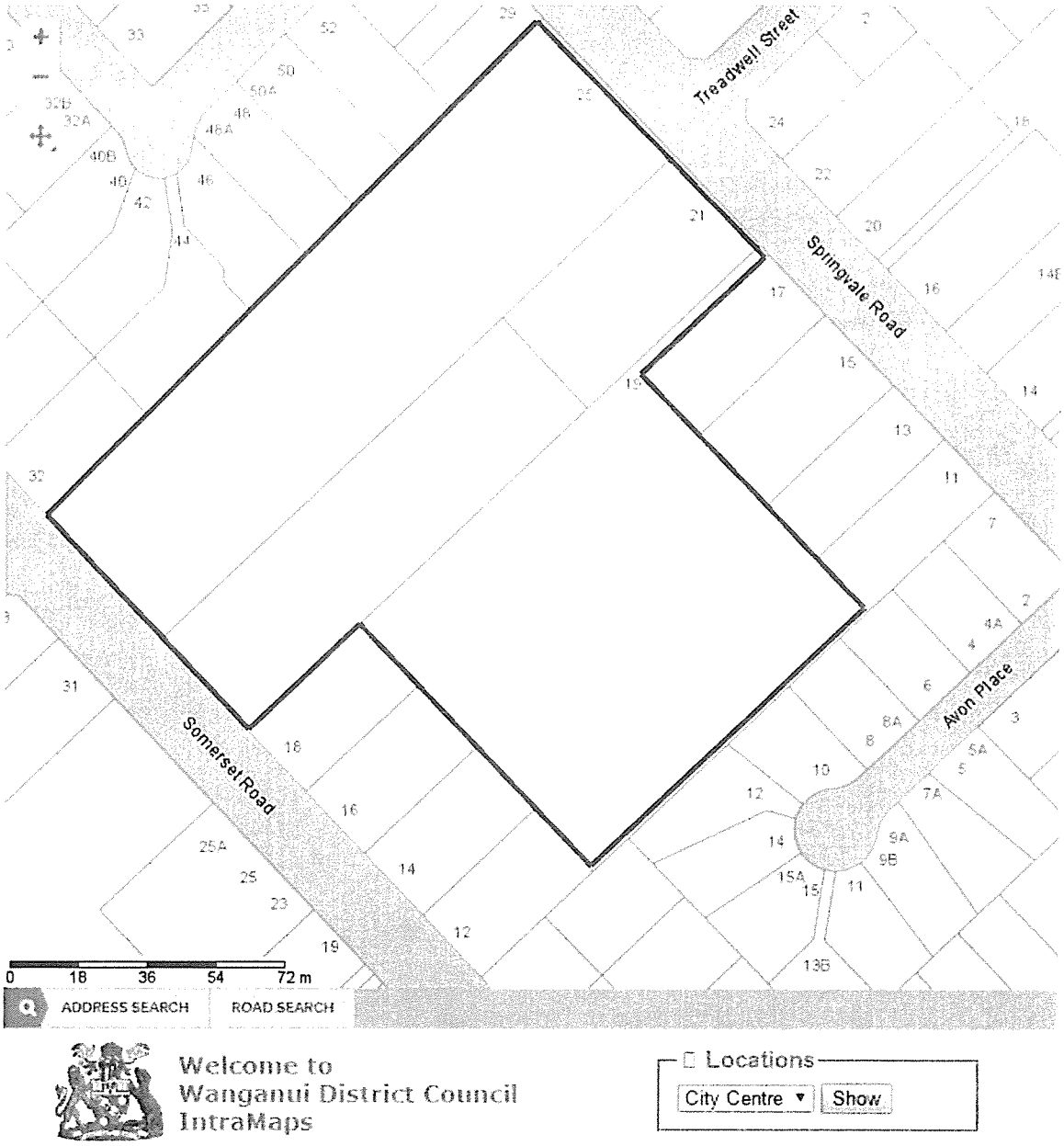


Figure 2 Detail of the location showing the site boundary in red.

Wanganui DC GIS plan



Site history

The area under investigation was used mainly for residential purposes with pastoral and market garden use until the early 1960s. The aerial photo below was taken in 1962 and shows two of the early residential buildings which are still present on site.



By 1974 little has changed, although the market garden areas in the south east appear unused by now and are overgrown with weeds.

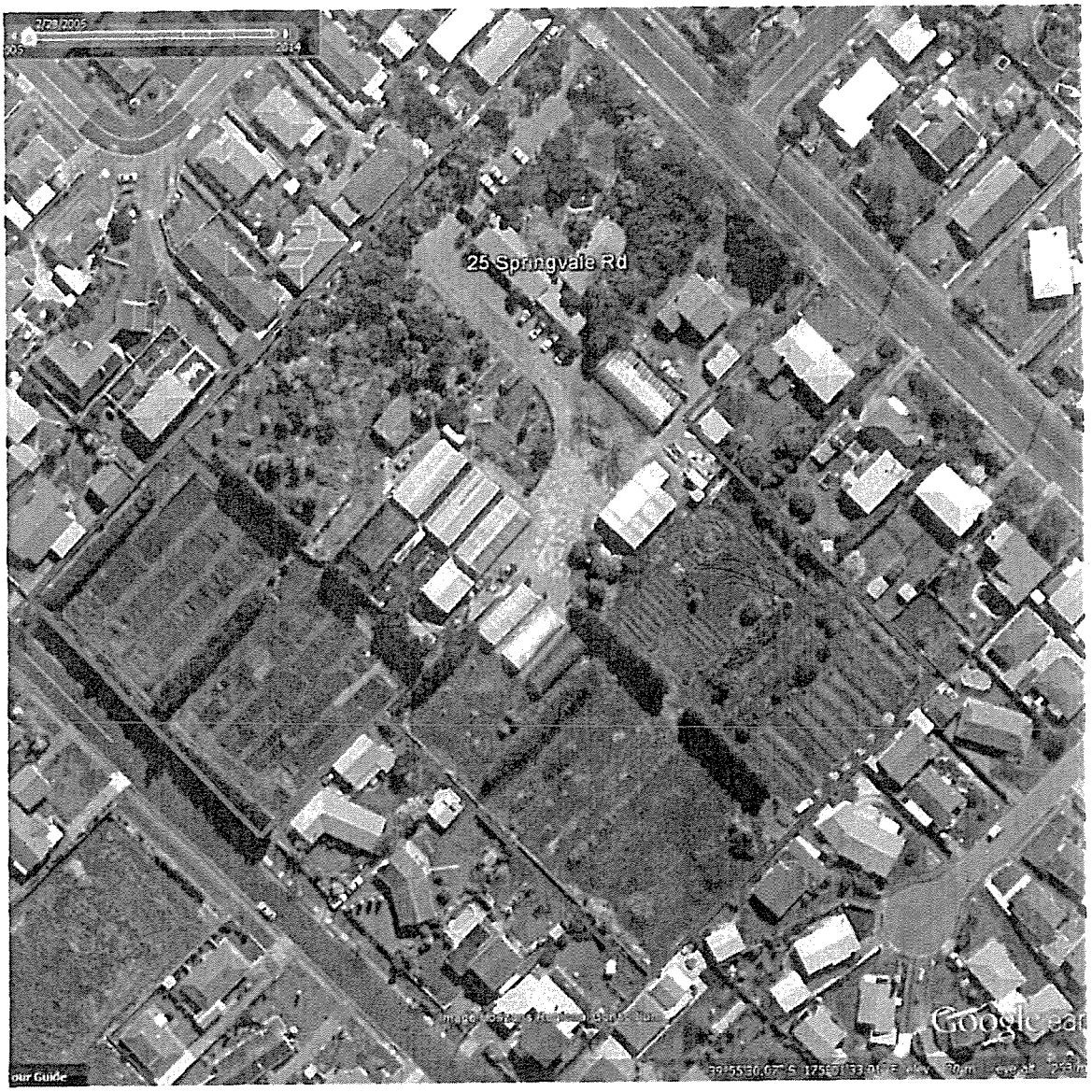


It should be noted that 1974 is well past the era during which persistent pesticides such as DDT , lead-arsenate or Dieldrin were used.

By 1996 clearly the nursery has been established with windbreaks planted and glasshouses are built.



By 2005 the nursery operation is in full production.



It appears that by 2010 the nursery has essentially ceased to exits.



In the aerial photograph from 2011, most of the areas have returned to pasture; however, the glasshouses and sheds are still present.



Not much has changed as of 2012.



The situation is still quite similar in 2013.



Once again, as shown in the 2013 photograph, the site area remains unaltered.



By 2014 the removal of wind breaks and shade houses has started.



During the remainder of 2014/15 all glasshouses are removed and earthworks started to redevelop the area. This operation was halted by the council until an assessment of the soil quality was made. The current situation on site can be seen in the site photographs taken during soil sampling (Appendix C).

Current Soil Standards

From 1 January 2012, the National Environmental Standard for contaminated soil has come into force. This standard requires for example soil on land used for residential purposes to have arsenic concentrations of 20 mg/kg or below (see lines with red arrow in soil quality table below).

Table 2: Summary of soil contaminant values for inorganic substances (mg/kg)

	Arsenic	Boron[1]	Cadmium (pH 5)[2]	Chromium[1]		Copper[1]	Inorganic lead	Inorganic mercury compounds[3]
				III	VI			
Rural residential / lifestyle block 25% produce	17[4]	NL	0.8	NL	290	NL	160	200
Residential 10% produce	20	NL	3	NL	460	NL	210	310 ←
High-density residential	45	NL	230	NL	1,500	NL	500	1,000
Recreational	80	NL	400	NL	2,700	NL	880	1,800
Commercial / industrial outdoor worker / maintenance	70	NL	1,300	NL	6,300	NL	3,300	4,200

1 SCVs for boron, chromium III and copper are much greater than the soil concentration at which plant health will be affected. Plant and other environmental effects may need to be considered separately.

2 Default value is for pH 5. See Appendix 1 of the *Methodology Report*[22] for SCVs at other soil pH values.

3 The inorganic mercury SCV does not apply to elemental (pure) mercury.

4 Derived value replaced with 99th percentile of national dataset of background concentrations as described in the *Methodology Report*.

Note: NL = No Limit. Derived value exceeds 10,000 mg/kg.

Table 3: Summary of soil contaminant values for organic compounds (mg/kg unless shown otherwise)

Scenario	BaP[1] (mg/kg)	DDT (mg/kg)	Dieldrin[2] (mg/kg)	PCP[3] (mg/kg)	Dioxin (µg/kg TEQ)[4]	
					TCDD	Dioxin-like PCBs[5]
Rural residential / lifestyle block 25% produce	6	45	1.1	55	0.12	0.09
Residential 10% produce	10	70	2.6	55	0.15	0.12 ←
High-density residential	24	240	45	110	0.35	0.33
Recreational	40	400	70	150	0.60	0.52
Commercial / industrial outdoor worker / maintenance	35	1,000	160	360	1.4	1.2

Potential Contaminants of Concern

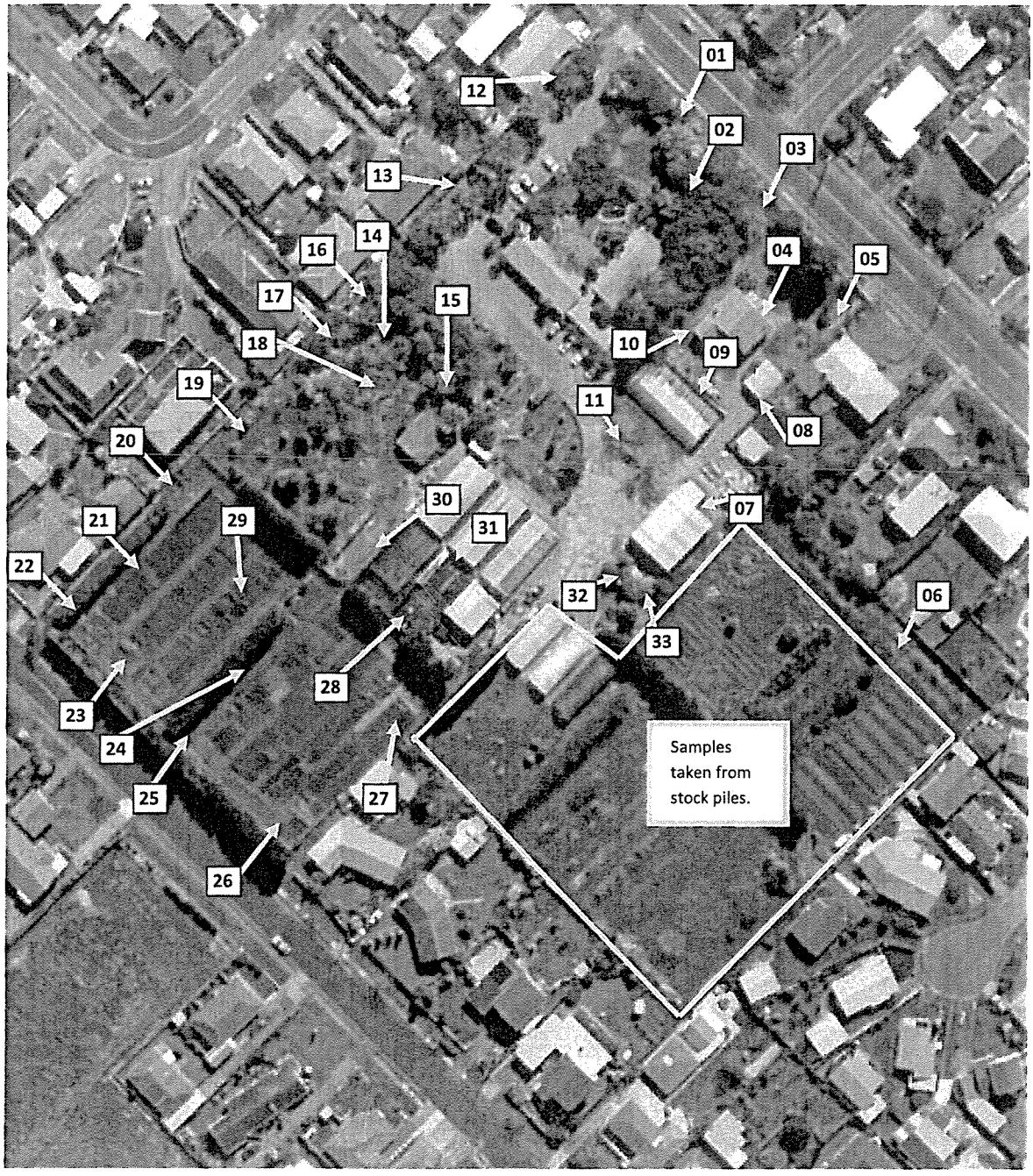
The property was used mainly as pasture until the mid 1970s. During the subsequent 25 years, a nursery and garden centre business operated. This period is well past the lead-arsenate and DDT spray eras and these persistent pesticides would not be expected. The following remarks can be made concerning the 12 priority contaminants:

Priority Contaminant	Common use	Expected Y / N	Reason	Samples needed?
Arsenic	Related to CCA wood and sheep dipping, orchard sprays applied between 1900 and 1970	Possible	Arsenic possibly related to storage of fence posts.	Yes
Boron	Timber treatment	No	No such activity	No
Cadmium	Residue from Super phosphate fertiliser	Possible	As residue from super phosphate	Yes
Chromium	Electroplating, pigments, treated timber	No	No such activity, often related to arsenic	No
Copper	Foot-rot bath, organic spray, treated wood	No	No such activity, often related to arsenic	No
Lead	Lead-based paint Orchard sprays, Glasshouse paints	Possible	Around pre-1980 houses and sheds	Yes
Mercury	Old pesticides (sheep), industrial	No	No such activity	No
BaP (poly aromatic hydrocarbons)	Residue from Creosote, waste engine oil and burning of waste	No	No sign in any aerial photo or in the field of burning or waste areas	No
DDT	Insecticide from the 1950s and 1960s.	Yes	DDT could have been used in early day as phrills.	Yes
Dieldrin	Often related to sheep dips and grass grubs.	Possible	Unlikely, but comes with OCP lab suite.	Yes
PCP	Fungicide, anti sap-staining agent in timber industry	No	No such activity	No
Dioxins	Related to PCP, or formed during low temperature incineration of plastics	No	No sign on any aerial photo of burning or waste areas	No
Other	Organophosphate pesticides/herbicides for new plantings	Trace	The short half-life ensures full breakdown in short time frames (weeks – months).	No

Sample selection for analysis and heavy metal screening results

At the time of sampling most of the buildings and glass houses associated with the nursery operation had been removed. Some of the topsoil was stockpiled, especially from the south eastern area.

Samples were taken at the positions indicated below with the top soil pile ex the SE area sampled from the stockpile. Additional samples were taken from inside the glasshouses.



Each of the 59 samples taken have been analysed for heavy metals using an X-Ray Fluorescence (XRF) analyser for screening purposes. Comparative studies have shown analysis to be within 5 – 10 % of laboratory analysis[1]. At each position, the sample was analysed three times resulting in 171 analyses being completed using the XRF analyser (for detail of use: see Appendix A). The results are presented in the tables below. The yellow highlighted sample numbers correspond to those sent to the lab for corroborative heavy metal analyses.

Sample No.	Cu	Zn	As	Pb
		mg/kg d.w.		
1	11	78	13	31
1	23	46	6	44
1	6	49	4	37
2	7	70	6	28
2	4	64	6	37
2	5	67	4	43
3	7	107	3	140
3	9	127	4	81
3	7	112	11	69
4	10	45	9	4
4	3	58	5	45
4	8	45	12	21
5	4	56	5	28
5	6	76	4	12
5	8	83	5	29
6	8	36	3	9
6	7	77	3	37
6	9	58	2	7
7	4	112	4	40
7	9	113	3	52
7	9	101	4	39
8	7	69	5	29
8	6	67	4	23
8	6	49	5	10
9	4	61	3	22
9	8	54	3	41
9	3	46	4	28
10	10	45	4	58
10	10	72	7	24
10	3	140	5	180
11	9	93	4	66
11	4	128	11	150
11	6	75	3	23
NES SQV Residential			20	210
NEPM Aus- Standard Res	1000	7000	100	300

[1] US EPA (2006) 'Field Portable X-Ray Fluorescence Spectroscopy - http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/6200.pdf (downloaded 22-2-13)

Table (cont.)

Sample No.	Cu	Zn	As	Pb
		mg/kg d.w.		
12	9	108	3	147
12	10	77	5	148
12	12	94	3	134
13	10	49	8	44
13	3	56	5	25
13	8	78	6	33
14	9	59	9	64
14	12	39	9	74
14	6	59	2	32
15	8	53	3	69
15	5	47	8	92
15	3	46	5	45
16	10	33	4	24
16	4	54	9	12
16	8	63	4	14
17	8	18	11	28
17	8	26	4	29
17	8	20	8	27
18	8	59	3	23
18	7	52	7	10
18	5	49	6	14
19	4	24	7	27
19	4	21	5	28
19	3	12	6	18
20	6	64	6	28
20	3	67	6	27
20	6	58	5	22
21	2	10	19	29
21	8	6	31	7
21	4	21	43	17
22	4	34	27	18
22	9	23	24	10
22	7	44	27	23
23	2	29	12	18
23	4	14	12	45
23	6	13	9	19
24	2	56	5	43
24	3	32	2	18
24	6	44	9	20
NES SQV Residential			17	160
NEPM Aus- Standard Res	1000	7000	100	300

Table (cont.)

Sample No.	Cu	Zn	As	Pb
		mg/kg d.w.		
25	9	7	3	21
25	6	17	5	20
25	10	18	6	11
26	5	54	6	30
26	7	37	3	66
26	8	28	2	43
27	4	41	3	29
27	11	42	4	26
27	10	28	4	30
28	7	11	25	32
28	3	24	22	25
28	8	39	17	29
29	4	40	5	19
29	7	25	3	17
29	6	24	8	25
30	8	30	4	24
30	3	12	6	25
30	7	23	7	4
31	7	54	5	24
31	7	46	10	29
31	6	42	3	12
32	7	42	3	7
32	9	48	5	20
32	8	23	5	14
33	4	105	12	21
33	10	133	9	38
33	3	125	5	29
stock pile 1	3	43	6	11
stock pile 1	3	41	5	29
stock pile 1	10	64	3	40
stock pile 2	5	48	6	21
stock pile 2	8	36	3	25
stock pile 2	5	49	4	24
stock pile 3	11	17	3	22
stock pile 3	3	33	9	9
stock pile 3	7	71	5	15
stock pile 4	5	24	9	19
stock pile 4	2	33	7	10
stock pile 4	3	50	8	20
NES SQV Residential			17	160
NEPM Aus- Standard Res	1000	7000	100	300

Table (cont.)

Sample No.	Cu	Zn	As	Pb
		mg/kg d.w.		
stock pile 5	10	33	4	30
stock pile 5	9	49	4	24
stock pile 5	5	31	2	23
stock pile 6	9	34	3	29
stock pile 6	8	31	5	8
stock pile 6	11	38	10	20
GLASS HSE 2 - 1	6	62	8	30
GLASS HSE 2 - 1	8	40	10	15
GLASS HSE 2 - 1	7	58	6	16
GLASS HSE 2 - 2	11	33	6	29
GLASS HSE 2 - 2	3	30	5	28
GLASS HSE 2 - 2	14	32	3	19
GLASS HSE 3 - 1	7	44	5	25
GLASS HSE 3 - 1	10	47	6	21
GLASS HSE 3 - 1	3	46	4	33
GLASS HSE 3 - 2	4	56	9	36
GLASS HSE 3 - 2	4	61	15	20
GLASS HSE 3 - 2	8	64	5	58
FRONT OF SHED1 - 1	10	120	11	40
FRONT OF SHED1 - 1	9	77	7	36
FRONT OF SHED1 - 1	11	17	13	22
FRONT OF SHED1 - 2	10	170	4	45
FRONT OF SHED1 - 2	4	146	12	51
FRONT OF SHED1 - 2	8	59	2	11
FRONT OF SHED2 - 3	10	115	5	46
FRONT OF SHED2 - 3	3	77	7	11
FRONT OF SHED2 - 3	5	51	5	23
FRONT OF SHED2 - 4	6	66	6	19
FRONT OF SHED2 - 4	5	58	3	5
FRONT OF SHED2 - 4	7	35	5	5
OPEN SHED RIGHT SIDE - 1	9	60	9	42
OPEN SHED RIGHT SIDE - 1	21	69	11	127
OPEN SHED RIGHT SIDE - 1	34	14	11	65
OPEN SHED RIGHT SIDE - 2	7	111	7	37
OPEN SHED RIGHT SIDE - 2	6	141	3	67
OPEN SHED RIGHT SIDE - 2	6	109	6	44
NES SQV Residential			17	160
NEPM Aus- Standard Res	1000	7000	100	300

Table (Cont.)

Sample No.	Cu	Zn	As	Pb

		mg/kg d.w.		
SPRAY FILLER 1	6	73	9	41
SPRAY FILLER 1	8	77	5	33
SPRAY FILLER 1	3	87	9	45
SPRAY FILLER 2	11	107	7	15
SPRAY FILLER 2	5	132	15	18
SPRAY FILLER 2	5	152	6	12
SPRAY FILLER 3	11	68	5	30
SPRAY FILLER 3	3	95	12	29
SPRAY FILLER 3	8	72	9	38
SPRAY FILLER 4	10	128	9	59
SPRAY FILLER 4	9	125	13	20
SPRAY FILLER 4	6	123	7	88
HALLS 15 - 18 1	7	84	9	63
HALLS 15 - 18 1	11	42	5	58
HALLS 15 - 18 1	8	100	8	55
HALLS 15 - 18 2	9	91	5	50
HALLS 15 - 18 2	4	74	2	29
HALLS 15 - 18 2	12	83	3	47
HALLS 15 - 18 3	8	55	5	15
HALLS 15 - 18 3	4	67	2	9
HALLS 15 - 18 3	4	71	3	5
HALLS 15 - 18 4	7	54	4	35
HALLS 15 - 18 4	10	38	4	5
HALLS 15 - 18 4	6	42	5	11
NES SQV Residential			17	160
NEPM Aus- Standard Res	1000	7000	100	300

Comparison with Laboratory Analysis Results and Interpretation

Arsenic and Lead

Arsenic is often the result of sprays used up until the mid-1960s; however, it can also result from the spreading of ashes or sawdust of treated wood. Lead is often the result of paint flakes from houses, sheds or fences, old sprays and the use of ash of painted wood as fertiliser which contains lead-paint pigments, or the use of lead-based paint on the sports field to create lines.

Three samples have arsenic over 20 mg/kg d.w., the limit for residential land use and these are samples 21, 22 and 28 all from the SW corner of the site. They may be related to treated wood sawdust or wood shavings as a result of planting bed or fence constructions and on closer inspection may be not wide spread. However with three samples over the limit, a further investigation is warranted.

None of the soils analysed for lead exceed the residential soil quality value of 210 mg/kg .

The laboratory corroboration analyses of arsenic and lead show good correlation.

Copper and Zinc

Copper and zinc are analysed as they often indicate some past activity. Copper and zinc may result from:

Copper	a result of (organic) sprays and residues of other fungicides and anti-foot-rot baths
Zinc	a residue from modern pesticides as well as the result of corrosion of galvanised farm implements, fence lines, galvanised steel sheeting on sheds, anti-foot-rot baths etc.

In this case, copper is present in near background concentration on the whole area investigated. Zinc is elevated only near the buildings, as can be expected. However all the concentrations found are well below the NEPM (Australian) residential guidelines.

Cadmium

Cadmium is often a residue of super phosphate from the time that New Zealand imported phosphate rock high in cadmium and other heavy metals (before 2000). The concentrations of cadmium, fluorine and uranium in rock phosphate imported after 2000 are somewhat lower. The XRF analyser is not sensitive to cadmium and the NES limits are low (3 mg/kg for residential properties). Therefore, a laboratory analysis for this metal is included. The results of the ten samples analysed show low concentrations (the range is < 0.10 - 0.26 mg/kg) see also the laboratory report in appendix B.

∑DDT

DDT is the generic name for a group of DDT-like pesticides which are produced together as well as the break-down of which, which produces the other DDT like chemicals (DDT → DDD → DDE) with half-life ranging from 5 to 30 years[2].

One composite sample has been analysed for OrganoChlorine Pesticides (OCPs).

The limit for the sum of all DDT-like chemicals combined is set by the NES at 70 mg/kg for residential soils. For this property, the analysis results show a very low concentration.

The maximum found in all of the four composite samples is 0.95 mg/kg in the sample taken in the spray filler area. This is well below 8 % of the guideline value for composites made from 4 samples: 14 mg/kg (DDT).

Dieldrin

Dieldrin was often used in sheep-dips and for grass grub control. In all six composite samples taken dieldrin was found at below the detection limit of the laboratory (< 0.01 mg/kg) which is well below the residential standard, which is 0.65 mg/kg for composite samples made up out of 4 individual samples, indicating Dieldrin was not used on this property.

The full laboratory report is presented in Appendix B.

[2] http://www.atsdr.cdc.gov/toxprofiles/tp35.pdf

CONCLUSION

The concentration of all the contaminants analysed for in the samples, except arsenic in three samples taken in the SW corner, is under the level set for residential soils provided in the NES guidelines. The samples can be influenced by treated wood sawdust or wood shavings; however this has to be further assessed.

It can therefore be concluded that there is a possible risk a risk to human health in the SW corner.

RECOMMENDATION

It is recommended that the SW corner is further investigated to assess the extent of the arsenic concentration in the soil and if the volume of soil contaminated is significant that this soil is remediated.

Compliance and Guidelines used:

This assessment complies with the "Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011" Ref No. 2011/361, downloaded 8/7/2012 from:
http://www.legislation.govt.nz/regulation/public/2011/0361/latest/DLM4052228.html?search=ts_regulation_contaminants_resel&p=1&sr=1

The work carried out for this soil assessment complies with the guidelines set out in (last downloaded 8 July 2012): http://www.mfe.govt.nz/publications/rma/users-guide-nes-for-assessing-managing-contaminants-in-soil/guide-nes-for-assessing-managing-contaminants-in-soil.pdf

With technical specifications contained in (last downloaded 8 July 2012):

- Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils (Revised 2011): http://www.mfe.govt.nz/publications/hazardous/contaminated-land-mgmt-guidelines/guideline-1.pdf
- Contaminated Land Management Guidelines No. 1 - Reporting on Contaminated Sites in New Zealand (Revised 2011) http://www.mfe.govt.nz/publications/hazardous/contaminated-land-mgmt-guidelines-no5/guideline-5.pdf
- For the Ecological threshold levels used NEPM table 5-A http://esdat.net/Environmental%20Standards/Australia/NEPM%20Tables.pdf
- For asbestos: WA's 'Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia – May 2009 http://www.public.health.wa.gov.au/cproot/3763/2/Guidelines%20for%20Asbestos-Contaminated%20Sites%20-%20May%202009.pdf

Appendices:

A The use of an X-ray fluorescence (XRF) Analyser
B Laboratory analysis report (3 pages)
C Site Photographs

Brief Biography

Drs. Ben Keet SQEP (NES), FRSC, MRSNZ, MinstD, MBA (exp. 11/2015)
Senior Environmental Auditor
Bioremediation Specialist

Ben studied Physics and Hydrogeology in Amsterdam. He holds a 1st class honours doctoral degree in hydrogeology specialising in isotope hydrochemistry. Ben exceeds all requirements for a Suitably Qualified and Experienced Person (SQEP) for all categories under the NES (New Zealand).
He is a Fellow of the Royal Society of Chemistry - UK (requiring 15 years of significant contributions to the field of chemistry), a Member of the Royal Society of NZ and a full member of the Institute of Directors NZ. In November 2015, he will finish an Executive MBA study at Massey University.

Experience

5 years teaching groundwater modelling and medical physics at the Free University Amsterdam

5 years petroleum reservoir engineering and management with Shell International (NL, UK, Algeria).

27 years experience in contaminated land management and was directly responsible for over 4500 projects in ten different countries, starting in NZ with the investigation of 70% of all oil terminals in the ports of NZ, many Carter Holt Timber treatment sites and the first investigation of the Mapua FFC site. Between '88 - '91, designed and managed remediation projects on six major and several small petroleum contaminated sites. He was responsible for the start-up of four offices in Australia, for over 800 service station assessment and remedial projects throughout Australia and for remediation of Sydney Airport's largest underground kerosene spill (>1 million litres).

Since '93, in both the EU and the US, Ben has been responsible for the Luxembourg International Airport environmental audit including deep groundwater aquifer decontamination. He is responsible for the investigation, pilot testing, designing and implementing novel remediation techniques on multiple defence properties, mainly air force bases in Europe and the US, a variety of chemical plants of AKZO Nobel, DOW, Sika, Philips, etc. and for well over 1000 site assessments and 400 complex in-situ biological remedial programs. Ben holds several patents in the field of environmental engineering and sustainability.

Ben was appointed as one of four Accredited Environmental Auditors in the Grand Duchy of Luxembourg during the period between '94 - '04 and from 2005 audits reports for regional councils in New Zealand, such as Environment Waikato and has carried out peer reviews or validation studies, such as for Greater Wellington Regional Council. He is the author of several major reports for Ministry for the Environment (MfE) on brominated flame retardants and chemicals in E-waste (available on the MfE website); he has edited the MfE guidelines for local councils on Sheep-dips and the MfE Handbook on Natural Attenuation of Petroleum Hydrocarbons.

Ben has taught hundreds of courses and workshops in New Zealand, Australia, Europe and the Middle East to environmental professionals and government organisations. More info on: www.benkeet.com

Appendix A: The use of X-ray fluorescence (XRF) Analyser.

Comparison with Laboratory Results

Field XRF analysis yields 'wet weight' a (w.w.) result, i.e. the sample is 'diluted' with water. Laboratory results and guideline standards are given as dry weight (d.w) also called dry matter (dm) concentrations. The results from XRF analysis therefore have to be corrected by the percentage of soil moisture in order to be compared with the guideline values and laboratory results. The soil moisture content of the samples nearest to those analysed in the lab is used. All results in the report are corrected for soil moisture (as the laboratory does) and are given in mg/kg d.w.

A difference between laboratory results and those obtained from XRF analysis is that the XRF analyses a small *near surface area* of the sample, whereas a *small volume* of the sample will be extracted for laboratory analysis (2 gram). Sample heterogeneity is accounted for with the XRF analysis by analysing the sample on more separate positions (different places in the sample bags) and if needed determining an average concentration. In the laboratory the sample is mechanically mixed and sieved (2 mm) before the sub-sample is taken. For example, larger paint flakes are omitted in laboratory analysis, but the XRF results would be higher if the flakes are close to the surface in the sample. On the other hand, the XRF results are moderated by the air gaps often associated with flat grains such as paint flakes effectively diluting the sample, which in turn reduces the concentration read on the instrument.

Therefore compaction of the sample is important as the more soil grains are present in the near surface area in front of the XRF analyser's X-ray window; the more fluorescence generated and emitted back to the detector and the higher the concentration read. When using the XRF on-site in an in situ mode care has to be been taken to analyse soil which was either not yet excavated or when measuring a loose sample like on a mixed pile of soil, selecting a well compacted area, like a spot inside the wheel tracks of earthmoving machinery, to gain consistent readings. When analysing soil in bags or in the field care has been taken to compress each bag or sample before analysis to obtain similar compaction for each bag / sample analysed. As there is most likely not 95% compaction everywhere in the bag, some variability can be expected.

International Use of XRF

The United Stated Environmental Protection Agency has produced a number of guidelines and method statements for the use of XRF devices. In the USA, portable XRF devices are used in the field for initial site characterisation and the identification of contamination patterns, as well as to make informed decisions on sample selection for further analysis. Method Statement 6200 has been published by the EPA under the Resource Conservation and Recovery Act (RCRA) to provide guidance and regulation for field-portable XRF analysis (www.epa.gov). In the absence of NZ guidance, this document is considered during the current project.

Next Appendix B: Laboratory reports (3 pages)
Appendix C: Site Photographs (taken during soil sampling)

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Hamilton 3240, New Zealand

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Geo & Hydro Ltd	**Lab No:**	1439008 SPv1
Contact:	Dr B Keet	**Date Registered:**	16-Jun-2015
	C/- Geo & Hydro Ltd	**Date Reported:**	24-Jun-2015
	32 Keirunga Road	**Quote No:**	
	HAVELOCK NORTH 4130	**Order No:**	
		Client Reference:	WASR-25
		Submitted By:	Dr B Keet

Sample Type: Soil

	Sample Name:	1 WASR-25-2	2 WASR-25-3	3 WASR-25-5	4 WASR-25-21	5 WASR-25-22
	Lab Number:	1439008.1	1439008.2	1439008.3	1439008.4	1439008.5
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	6	7	3	37	26
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.18	< 0.10	0.11	0.18
Total Recoverable Lead	mg/kg dry wt	33	89	19.0	16.5	34

	Sample Name:	6 WASR-25-28	7 WASR-25-33	8 WASR-25-2H-Stockpile4	9 WASR-25-Frt of Shed1-2	10 WASR-25-Spray-F-4
	Lab Number:	1439008.6	1439008.7	1439008.8	1439008.9	1439008.10
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	24	11	8	12	12
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.12	< 0.10	< 0.10	0.26
Total Recoverable Lead	mg/kg dry wt	19.0	23	15.7	41	35

	Sample Name:	11 WASR-25-Halls1 5-18-1	12 WASR-25-Halls1 5-18-3	13 WASR-25-7-9	14 WASR-25-23-26	15 WASR-25-Spray-F-1-4
	Lab Number:	1439008.11	1439008.12	1439008.13	1439008.14	1439008.15
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	7	3	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	-	-	-
Total Recoverable Lead	mg/kg dry wt	41	4.3	-	-	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
alpha-BHC	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
beta-BHC	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
delta-BHC	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
cis-Chlordane	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
trans-Chlordane	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	-	< 0.04	< 0.04	< 0.04
2,4'-DDD	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
4,4'-DDD	mg/kg dry wt	-	-	0.012	< 0.010	0.011
2,4'-DDE	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
4,4'-DDE	mg/kg dry wt	-	-	0.143	0.025	0.34
2,4'-DDT	mg/kg dry wt	-	-	0.017	< 0.010	0.087
4,4'-DDT	mg/kg dry wt	-	-	0.170	0.035	0.49
Dieldrin	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Endosulfan I	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Endosulfan II	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010

ilac-MRA IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Soil						
	Sample Name:	11 WASR-25-Halls1 5-18-1	12 WASR-25-Halls1 5-18-3	13 WASR-25-7-9	14 WASR-25-23-26	15 WASR-25-Spray-F-1-4
	Lab Number:	1439008.11	1439008.12	1439008.13	1439008.14	1439008.15
Organochlorine Pesticides Screening in Soil						
Endosulfan sulphate	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Endrin	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Endrin aldehyde	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Endrin ketone	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Heptachlor	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010
Methoxychlor	mg/kg dry wt	-	-	< 0.010	< 0.010	< 0.010

	Sample Name:	16 WASR-25-Halls1 5-18-1-4	17 WASR-25-2H-Stockpile4			
	Lab Number:	1439008.16	1439008.17			
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
alpha-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
beta-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
delta-BHC	mg/kg dry wt	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	< 0.010	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.010	< 0.010	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	< 0.04	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.010	< 0.010	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.010	< 0.010	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.010	< 0.010	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.010	0.36	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.010	0.086	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.010	0.47	-	-	-
Dieldrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan I	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan II	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Endrin ketone	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Heptachlor	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.010	< 0.010	-	-	-
Methoxychlor	mg/kg dry wt	< 0.010	< 0.010	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-12
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082).. Tested on dried sample	0.010 - 0.04 mg/kg dry wt	13-17
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-12
Total Recoverable Arsenic	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	2 mg/kg dry wt	1-12
Total Recoverable Cadmium	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.10 mg/kg dry wt	1-12

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Recoverable Lead	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	0.4 mg/kg dry wt	1-12

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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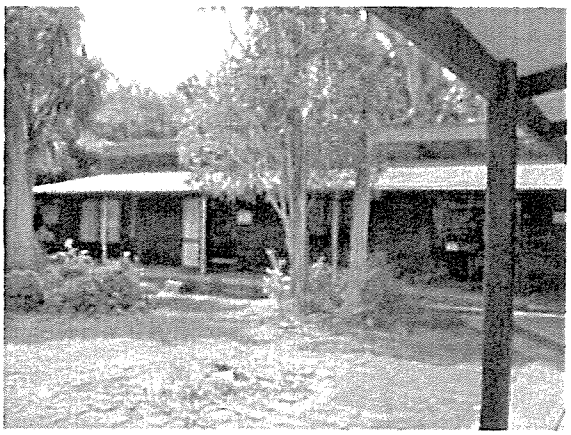
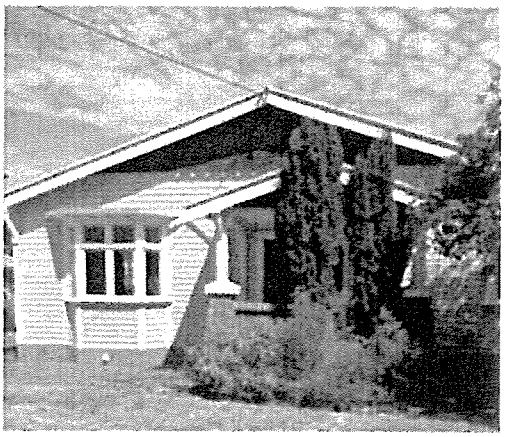
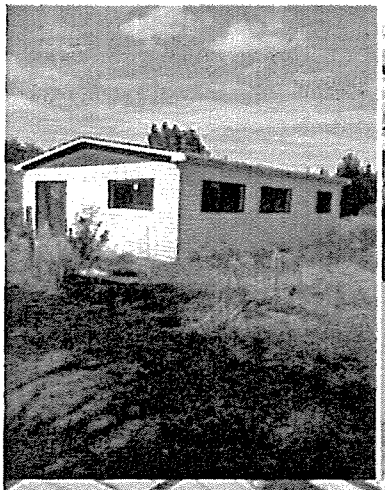
Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

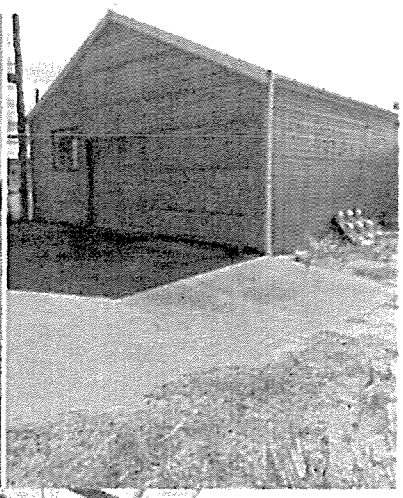
Appendix C: Site Photographs (soil sampling)

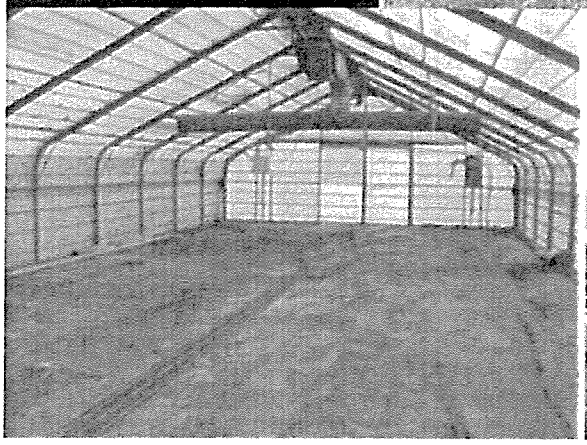
Images of buildings that were on site: School house, Residence, Quinn Building, Potting shed, Glass house and garage.

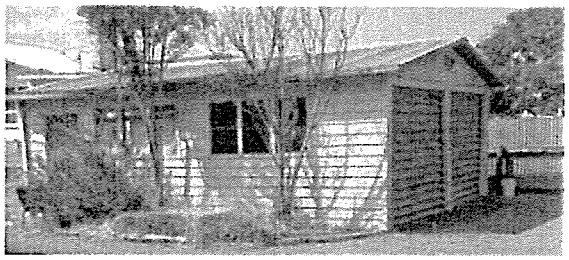












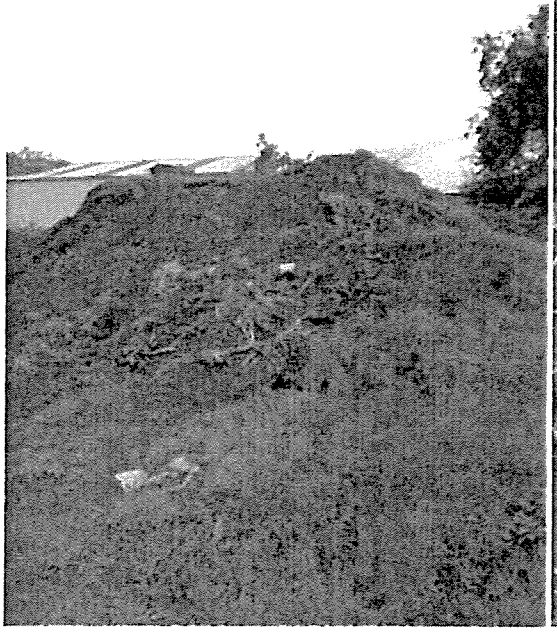
Soil sampling

Samples 1 – 10





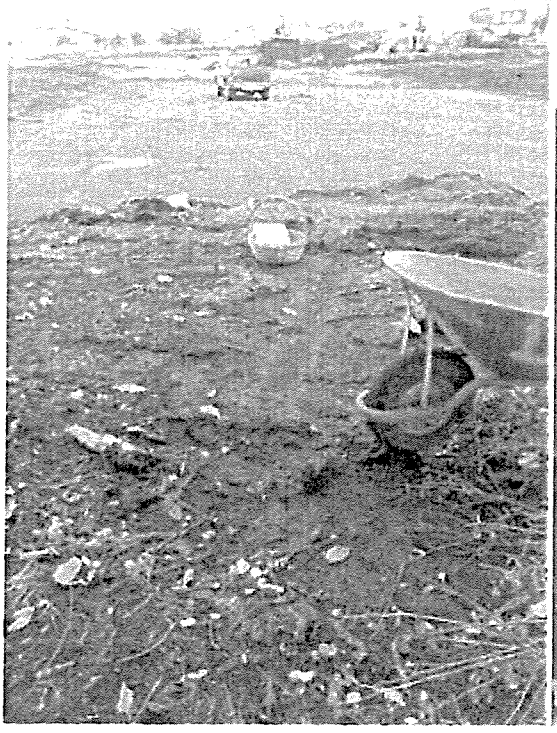












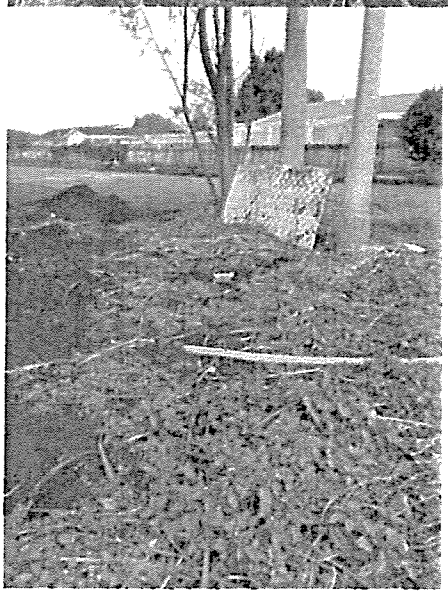














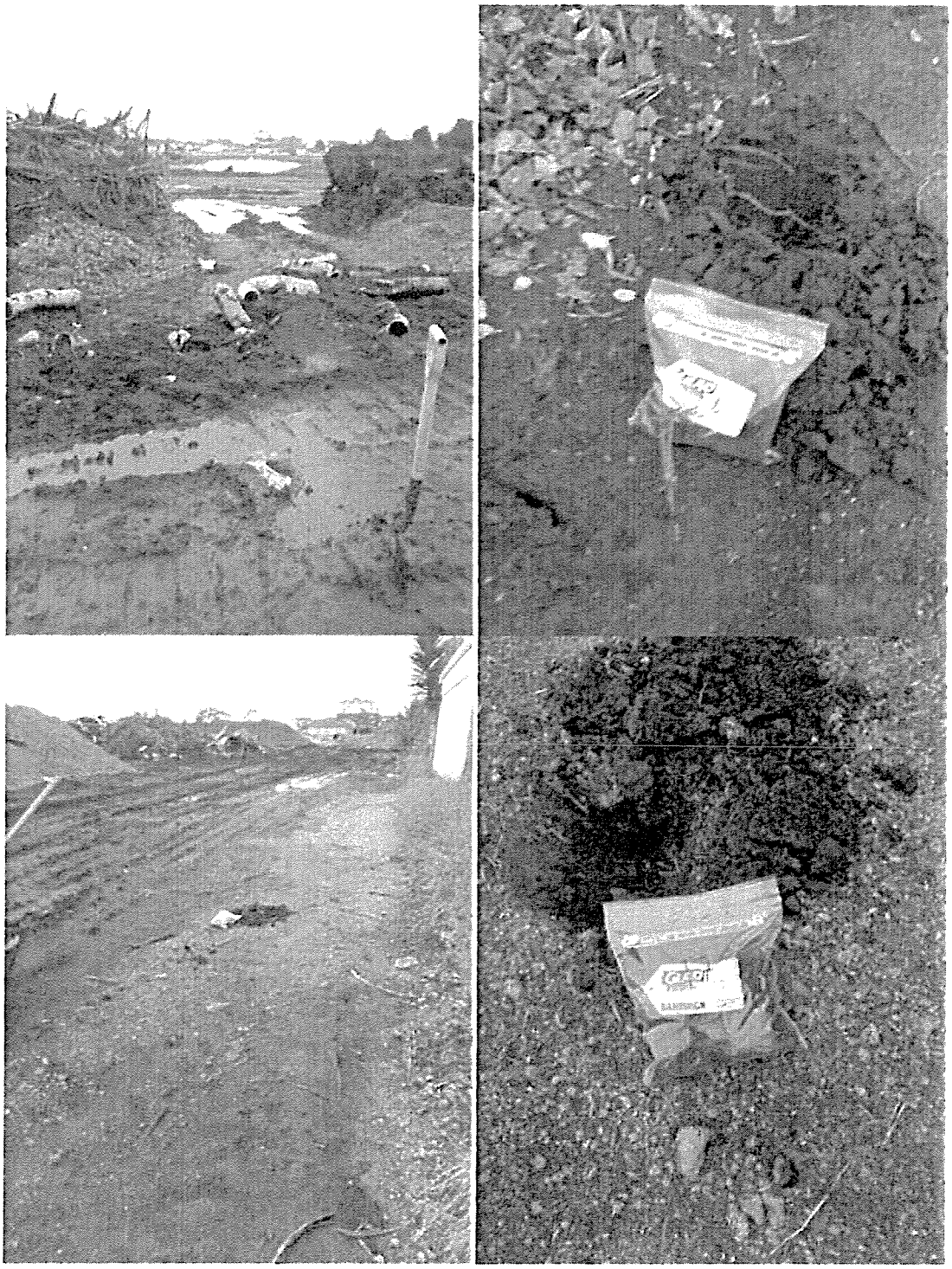
Samples 11 – 20





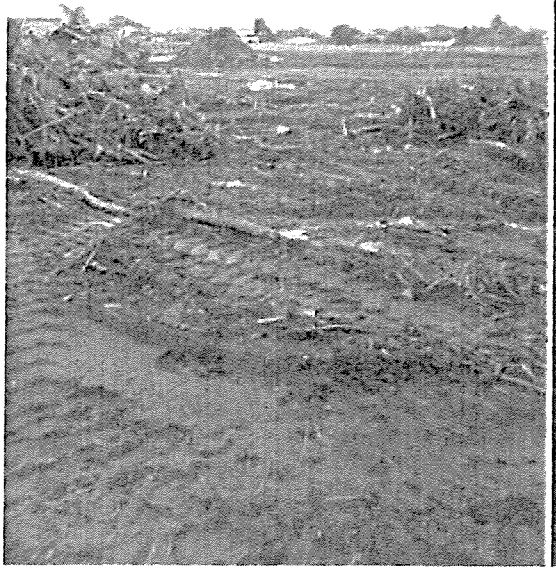






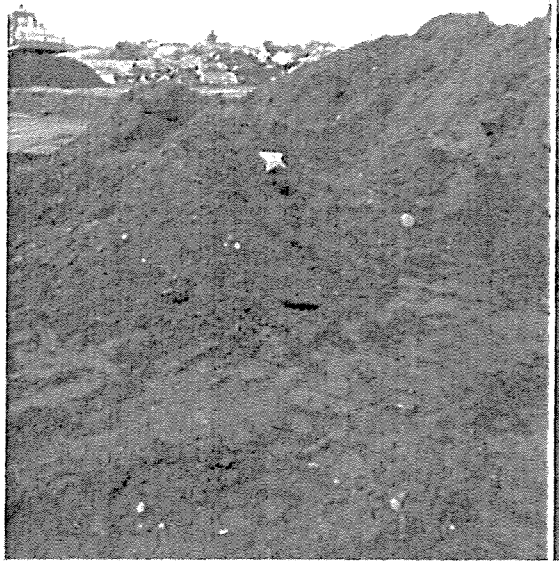
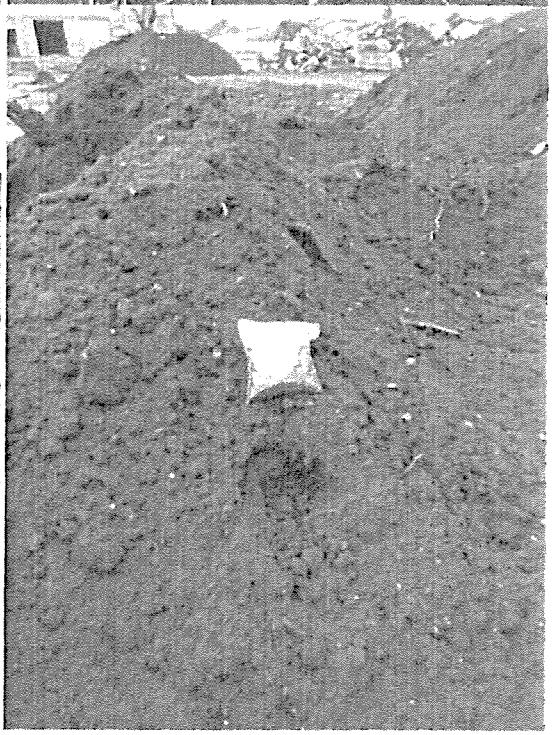



SANDWICH

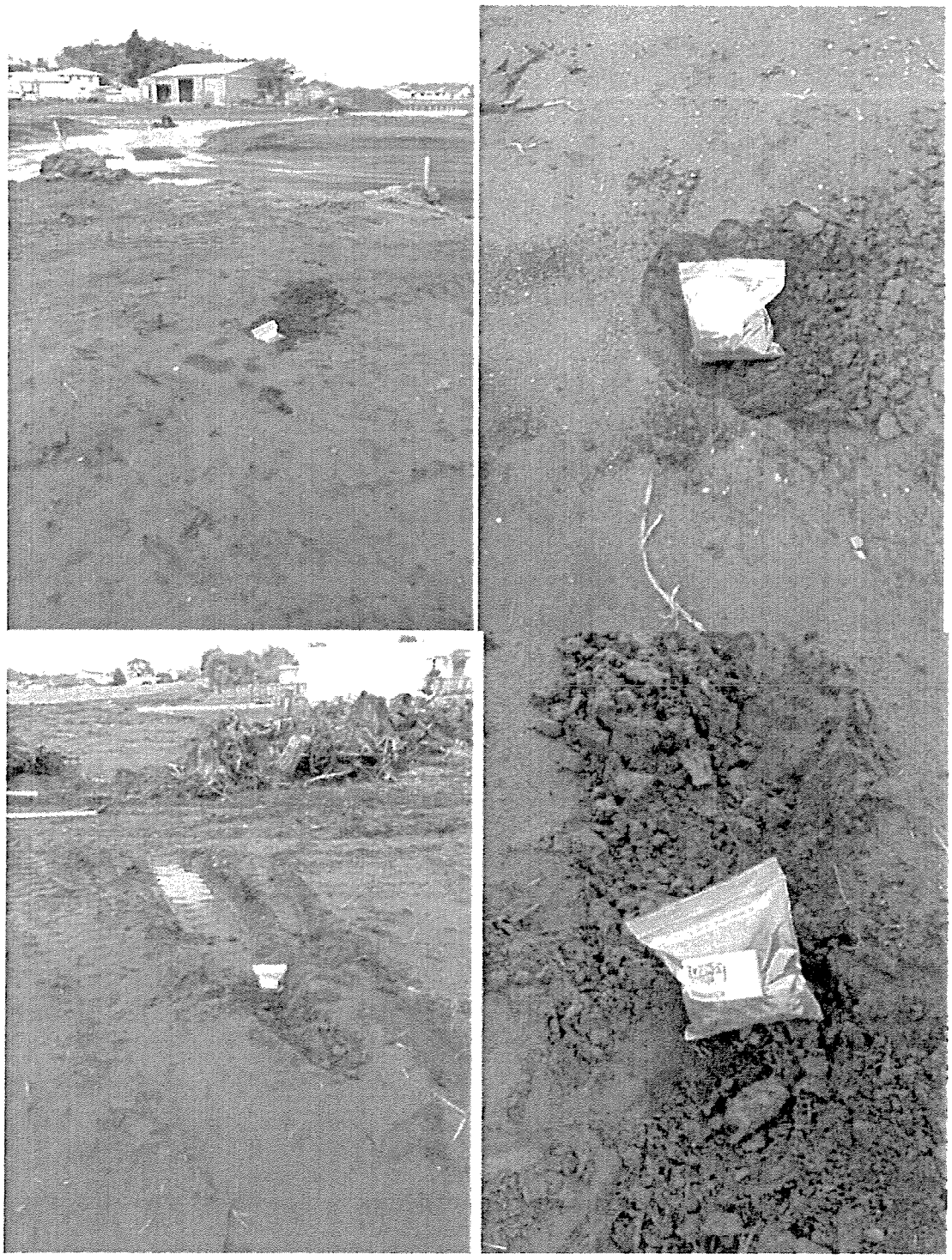


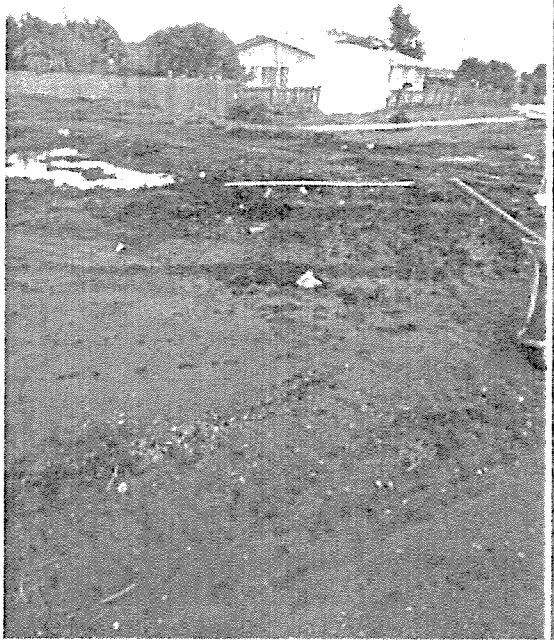




Samples 21 – 30












GLAD



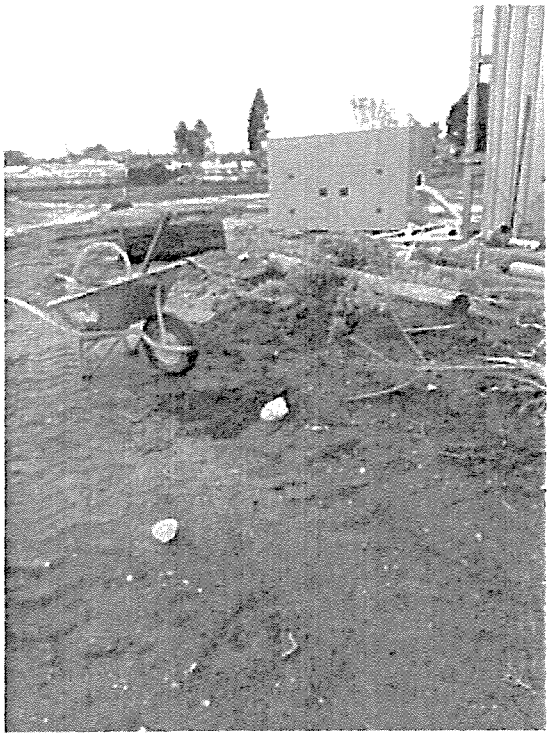


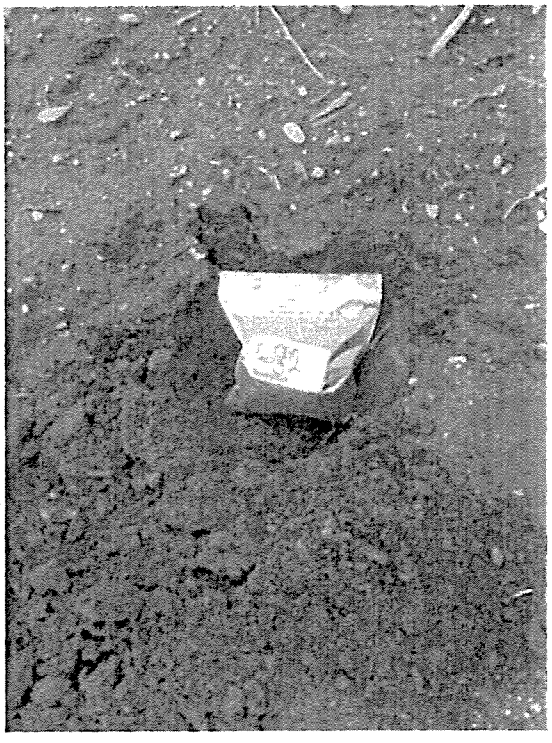


Samples 30 – 34





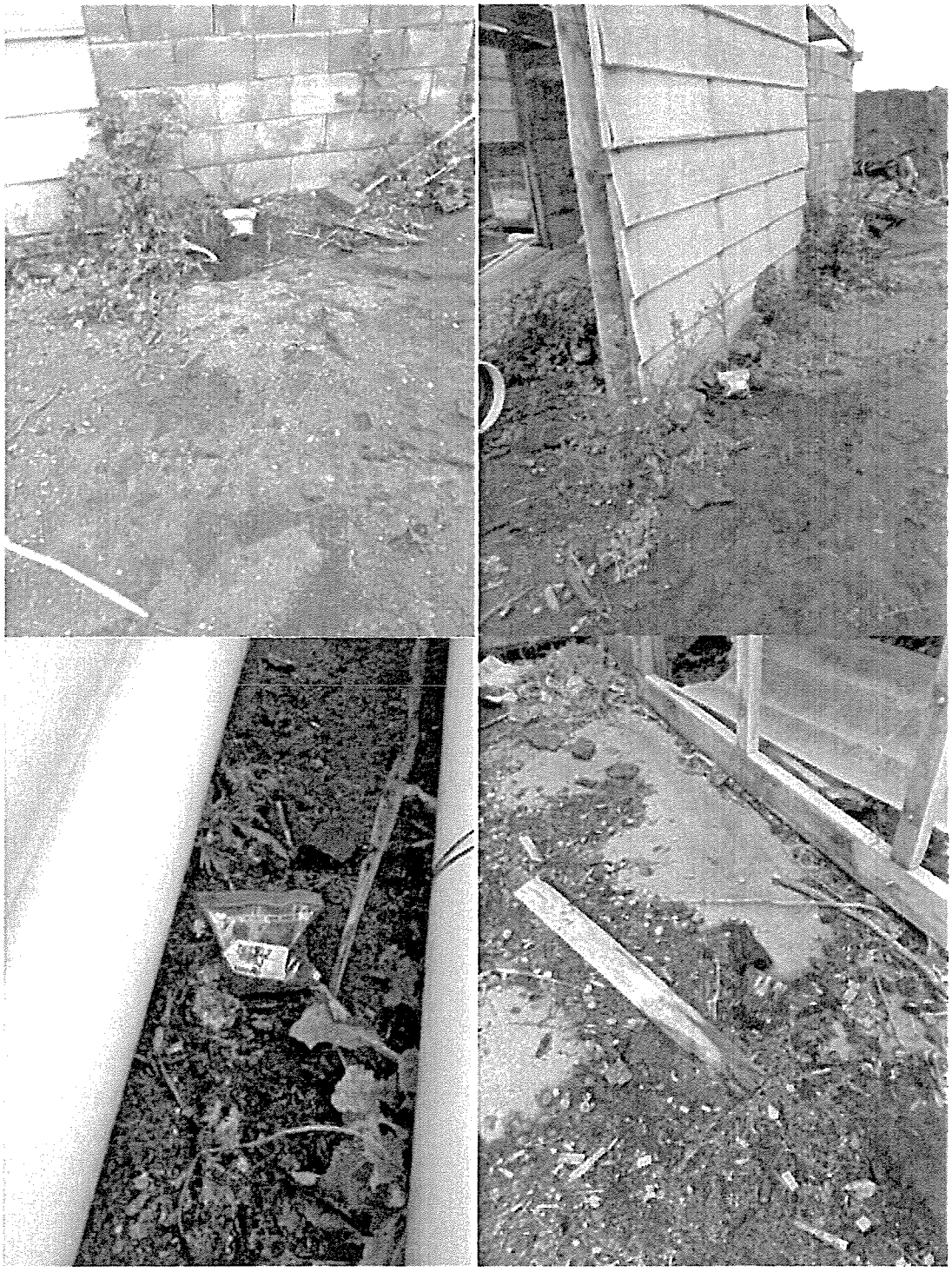








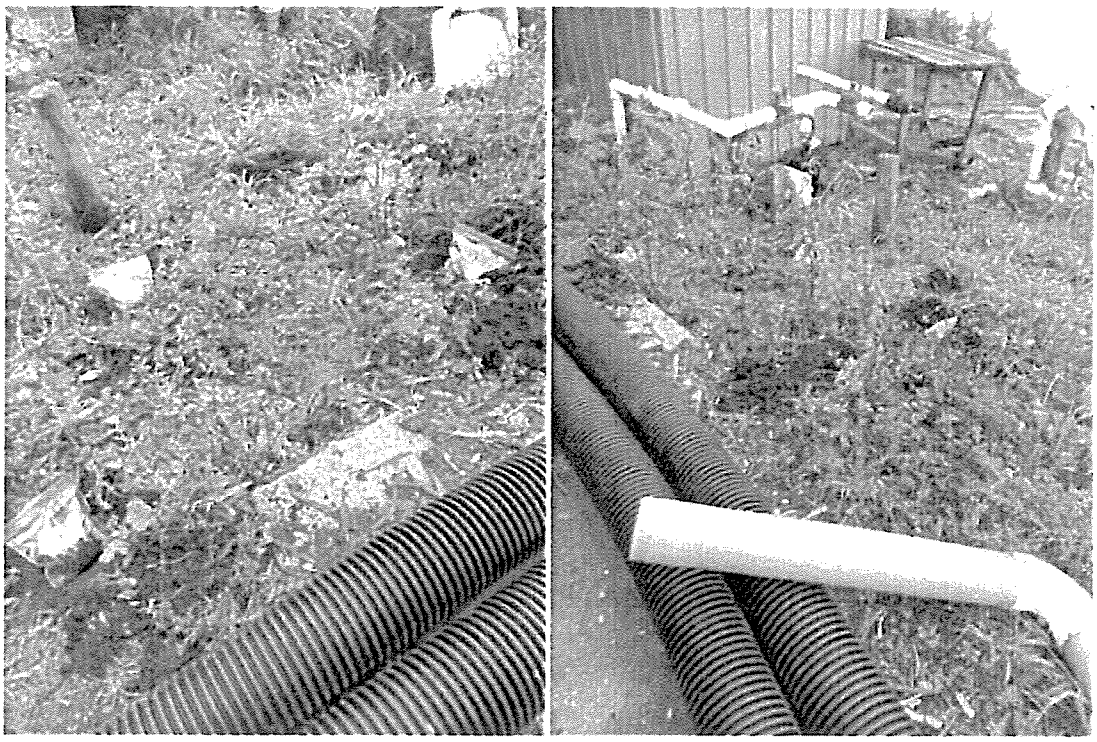
Sampling near / in sheds :






Pinch & Slide
SANDWICH

Sprayer filler - spray filler pole soil samples



South East square area - stock pile samples







Area of former glass houses

