Remediation Action Plan for Contaminated Soils Located at 73 McLauchlan Street, Blenheim

January, 2015

SUSTAINABLE ENVIRONMENTAL ENGINEERING LTD

Remediation Action Plan for Contaminated Soils Located at 73 McLauchlan Street, Blenheim

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

The Lot (*Lot 33 DP 416)* is located on the western side of McLauchlan Street, Blenheim, Marlborough and is 2,378m^2 in size. The owner proposes to subdivide the Lot creating four new residential lots as shown below on Figure 1. The proposed residential properties, sealed driveways, paths and areas of garden patio etc will take up approximately 75% to 80% of the site. The remaining areas will be garden (shown in green). The houses will be constructed using pod foundations. The owner proposes to construct the development in two stages. Stage one will involve development of the two houses on the westernmost part of the Lot followed at a later date by development of the two houses on the easternmost part of the Lot.

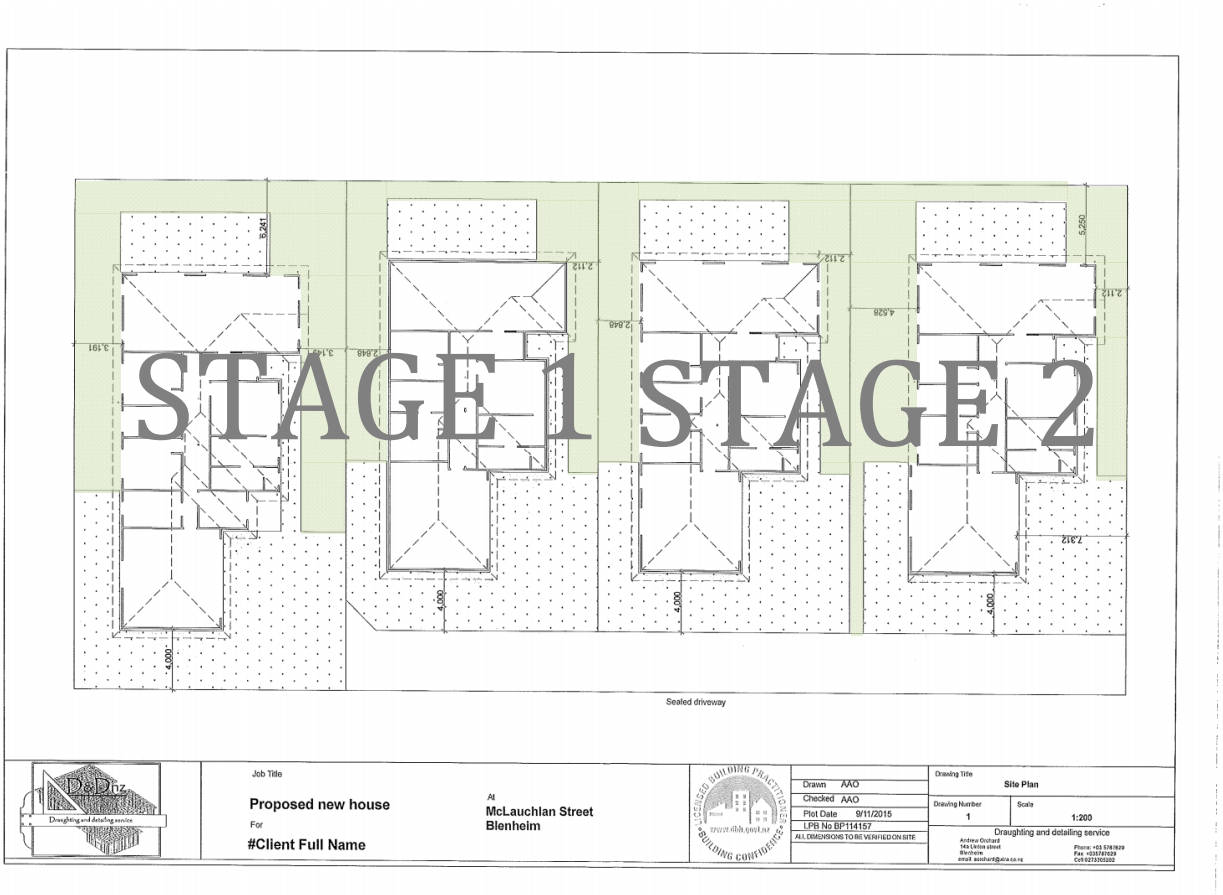


Figure 1: Subdivision Scheme Plan.

The site has been identified as being on Marlborough District Council's (MDC) HAIL register and therefore required a site investigation to be undertaken prior to any development of the site being undertaken.

As part of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, MDC requested a site investigation be undertaken on the site. Sustainable Environmental Engineering Limited (SEE Ltd) was commissioned by the owners of the site to undertake a Preliminary Site Inspection (PSI) and Detailed Site Investigation (DSI) on site to determine if historical activities on site have contaminated the land and, if so, what risk it poses to human health, groundwater or the wider local environment.

SEE Ltd undertook the PSI and DSI and produced a report titled 'Preliminary Site Inspection and Detailed Site Investigation at 73 McLauchlan Street, Blenheim' dated August 2015 which should be read in conjunction with this Remediation Action Plan. The following information summarises the findings:

The PSI identified the following activities as potentially creating contamination onsite:

1. Glasshouses;
2. Old residential building (early 1900s);
3. Former vegetable beds; and
4. Ash pile.

A DSI was carried out based on the findings from the PSI. Due to the complex nature of the site and the different historical activities identified for the site, the site was divided into 7 distinct zones as follows:

Zone 1	The residential property and an area 1.5m around its perimeter;
Zone 2	The area north of the dwelling which historically was used as vegetable gardens, including the ash pile;
Zone 3	The western part of the site incorporating the two glasshouses;
Zone 4	The former chicken coops and attached buildings;
Zone 5	The area incorporating all the outbuildings including the large shed and associated areas, workshop and the potting shed;
Zone 6	Garage and driveway; and
Zone 7	Areas of lawn.

A combination of systematic and targeted sampling was used across the site. Contaminated soils were found in each of the zones, with the exception of Zone 6 where it was not possible to take soil samples due to the area being covered entirely in hardstand.

The DSI identified that zones 1, 3 and 5 were heavily contaminated with lead, up to ten times the relevant NES SCS. Zones 2 and 4 were moderately to heavily contaminated with arsenic two to three times the relevant NES SCS. The elevated concentrations of arsenic and lead in the soil pose a potential risk to human health and need to be remediated to ensure that the site is suitable for residential development. A combination of excavation and disposal of the contaminated soils to landfill and mixing with clean soil is proposed in order to remediate the site. The ash pile in its current state is unsuitable for disposal at Bluegums Landfill and must be treated (e.g. stabilised with cement) prior to disposal or disposed of to an alternative appropriate facility (e.g. Christchurch).

The following remedial options have been suggested to the owner of the land.

Option 1	Excavate all contaminated soils on site to a maximum depth of 300mmbgl and disposal of it to Bluegums landfill.
Option 2	Cover the contamination present on site with the house, driveways, pathways and patio areas. Excavate the soils in the garden areas to a maximum depth of 300mmbgl and refill with clean inert soil.

In order to minimise excavation, transportation and Bluegums Landfill dumping fees the owner opted for Option 2.

1.2 Remediation Objectives

The overall objectives of the proposed remediation works are to ensure that:

- the contaminated soil identified on site is remediated/managed in an acceptable manner and that the site is fit for purpose as a residential development.
- any material taken off site is disposed of at Bluegums landfill.

1.3 Proposed Remediation

The owner proposes to construct the development in two stages. Stage one will involve development of the two houses on the westernmost part of the Lot followed at a later date by development of the two houses on the easternmost part of the Lot. Thus it is also proposed to carry out the remediation of the site in two stages to coincide with the stages involved for the building of the new houses. The processes detailed below describe the remediation work being carried out at each for each of the two stages of development.

1.3.1 Stage 1 - Ash pile

The ash pile (approximately 3 - 5m^3) will need to be removed and disposed of at an approved facility. The results of the TCLP analysis undertaken on the ash pile indicate that arsenic concentrations present in the resulting leachate are higher than the Bluegums Landfill criteria and as such must be treated before it can be disposed of at Bluegums Landfill. The most cost effective treatment methodology to reduce the mobility of the contamination contained within the ash is likely to be cement stabilisation. Cement stabilisation involves adding cement to the ash to produce more chemically stable constituents and reduce the mobility of contamination. Stabilisation is a useful technique for treating wastes before disposal to landfill. The principal cement typically used for stabilisation is Portland cement. Very approximately, binder dosages are normally between 5 and 15%. Binder dosages vary considerably with the nature of the material. An alternative option is to dispose of the ash at a Class A landfill (Christchurch).

1.3.2 Stages 1 and 2 - Excavate soil for house foundations, the sealed driveways, paths and patio areas.

The proposed residential properties, sealed driveways, concrete paths and patio areas etc will take up approximately 75% to 80% of the site.

All the earth excavated for the construction of foundations, driveways, patio areas and paths will be taken directly to Bluegums landfill. Toxicity Characteristic Leaching Procedure (TCLP) analysis undertaken on the contaminated soil has indicated that it meets the Bluegums landfill criteria and a certificate of acceptance issued. Any contaminated soils left underneath these features will remain in-situ. Once constructed the walls of the foundations for the houses will constrain any lateral migration of contaminants. If access underneath the house is required as part of the construction and ongoing maintenance (services/plumbing etc) the contaminated soils must be covered with a geo-textile.

The buildings, driveways, patio areas and paths will provide an impermeable barrier to any contamination left insitu below. Management conditions will be put on the titles stating that these areas must not be disturbed/removed.

1.3.3 Stages 1 and 2 - Excavate soil in proposed garden areas.

The soils in all the areas proposed to be garden will be excavated to a maximum depth of 300mm bgl and the soil disposed of at Bluegums landfill. Toxicity Characteristic Leaching Procedure (TCLP) analysis undertaken on the contaminated soil has indicated that it meets the Bluegums landfill criteria and a certificate of acceptance issued. Validation sampling of the base of the excavation in these areas will be undertaken to determine if concentrations of contaminants meet the relevant NES SCS's. If the validation sampling indicates that contaminant concentrations are below the NES SCS's clean inert soil will be brought onto site to fill the excavations. If the contaminant concentrations exceed the NES SCS's **either** further soil will be excavated

and taken to Bluegums Landfill until the base of the excavation is proven to be clean or a geo-membrane will be placed on the base of the excavation and clean inert soil placed on top of it.

1.3.4 Demolition materials

All materials (wood etc) identified as containing elevated concentrations of metals from the glasshouses, old sheds and cladding on the dwelling must be disposed of at a suitably licensed facility. The structures should be demolished with care, ensuring that potential contamination associated with the structures is not spread around the site.

1.4 Extent of Contamination

The extent of the contamination on site is shown on the drawing attached in Appendix 1.

2. REMEDIATION APPROACH

Consideration of all potential issues relating to occupational health and safety of personnel and site environmental management has been made in preparing this document. All of the steps detailed below should be overseen by a Suitably Qualified Environmental Practitioner (SQEP). All validation sampling and reporting should be undertaken by a SQEP. All XRF work should be undertaken by someone with a current licence for using ionising radiation.

2.1 Works Programme

The following section details the proposed remedial methodology and outlines the actual or potential effects of the works and the management procedures proposed.

2.1.1 Part of Stage 1 of the Redevelopment - Ash pile

The following remediation tasks will be undertaken:

1. Establishment of contractor.
2. Induction of Remediation Action Plan.
3. Induction of Health and Safety Plan.
4. Establish exclusion zones.
5. Establish excavation and traffic management procedures.
6. Installation of damping down measures for controlling dust.
7. Mark out areas of contaminated ash and underlying soil to be excavated.
8. Excavate the ash pile in Zone 2 and the underlying soils to a maximum depth of 300mm bgl. Carefully load ash and soil into an awaiting skip. Cover the ash in the skip with a tarpaulin and transport it directly to a secure contractors yard for treatment. The ash material must not be mixed with any other excavated soils from site.
9. Mix the contaminated ash and soil with 6% to 8% cement. The cement will help to stabilise the contaminants reducing the concentrations of metals in the leachate.
10. Take samples of the ash/soil/cement mix and send to Hill Laboratories for TCLP analysis. If the results of analysis meet the Bluegums Landfill TCLP criteria transport the ash/cement mix to Bluegums Landfill.
11. If the results of analysis fail the Bluegums Landfill TCLP criteria add further cement up to a maximum of 10% volume into the mix and retest until chemical analysis indicates that it is suitable for disposal.
12. If the ash/soil/cement still mix fails to meet the Bluegums Landfill TCLP criteria transport it to a Class A landfill (Christchurch).
13. ALTERNATIVLY the ash pile could be disposed of directly to a Class A landfill

2.1.2 Stage 1 and 2 of the redevelopment - Excavation of soils for pod foundations and areas of driveway and concrete paths and patios

The following remediation tasks will be undertaken:

1. Undertake points 1 to 6 in section 2.1.1 above.
7. Mark out the areas where the foundations and areas of driveway, paths and concrete patio areas will be constructed and soils excavated.

8. Excavate soil in the areas identified in point 7 above, load it directly onto awaiting trucks and dispose of the soil at Bluegums Landfill.

9. Construct the pod foundations for the house and place a geo-textile over the contaminated soil beneath the house to create a barrier and ensure that it cannot be disturbed in the future.

10. Construct house, driveways and concrete paths and patios which will minimise the potential migration of contaminants in the insitu soil beneath them and risk to future users of the site.

11. Place management conditions on the title stating that the house, areas of driveway, paths and entertaining areas cannot be removed or disturbed.

12. Excavate the soil in the proposed garden areas to a maximum depth of 300mm bgl, load it directly onto awaiting trucks and dispose of the soil at Bluegums Landfill.

13. Undertake validation sampling on the base of the excavations made for the proposed garden areas. Soil sampling will be undertaken on a 1m grid using an XRF. 10% of the soil samples analysed using the XRF will be sent to Hill laboratories to confirm the results of the XRF analysis.

14. If the laboratory validation sampling undertaken on the base of the excavation indicates that the soil **meets the NES SCSs** and other relevant guidelines (detailed in Section 2.7 of this report) place 300mm of proven, clean inert topsoil in the void and grass.

15. If the laboratory validation sampling undertaken on the base of the excavation indicates that the soil **does not meet the NES SCSs** or other relevant guidelines place a geo-textile over the base of the excavation and place 300mm of proven, clean inert topsoil in the void and grass.

16. If the geo-textile is required in the garden areas MDC are likely to place management conditions on the title stating that the geo-textile must not be compromised and that trees cannot be grown on site as the roots could penetrate the geo-textile and damage it.

17. Write validation report for MDC stating the volumes of soils removed and that the site has been remediated/managed to the required standard.

2.2 Health and Safety

Prior to remedial works commencing on site a site-specific risk assessment and detailed safe working plan will be prepared by:

- The contractors employed to undertake the works.

This document will specify the requirements for all personnel and contractors/subcontractors and visitors on site during the remediation project and outline all the environmental and occupational health and safety controls.

The project manager shall induct all employees and contractors working at the site as to the potential hazards at the site and the procedures that should be implemented to avoid or mitigate potential adverse effects to human health and the environment.

The main hazards relating to the contamination on site include:

- Inhalation and ingestion of contaminated soil/dust
- Dermal contact

In order to minimize the likelihood of any short or long term risk to any personnel likely to come into contact with the contaminated soils/dust during the remediation works the following PPE must be worn at all times when working in the exclusion zone. The contractor shall provide its workers with the following PPE:

- Approved safety footwear;
- Hard hat;
- Safety visibility vest;
- Nitrile Gloves; and
- Dust masks.

The excavator operator will be in a sealed air conditioned cab and will not need to wear a dust mask or gloves etc.

All meal breaks are to be taken away from the exclusion zones; all personnel directly involved with the contaminated soil will wash their hands and mouth areas prior to eating, drinking or smoking.

2.2.1 Roles and Responsibilities

During the remedial works the following parties listed in Table 1 below are responsible for identifying potential risks to human health and the local environment and complying with environmental controls set out below.

Table 1: Roles and Responsibilities

Team Member	Contact Details	Responsibility
Property owner	Kristen Andrews	Site Owner
Construction Company	Crafar Crouch Construction Limited Wither Road Extension, Blenheim Telephone number 03 578 3475	Contractor and general public Health and Safety
Environmental Consultant:	TBA	Environmental Consultant
Regulatory Agency	Marlborough District Council	

2.2.2 Emergency Contacts

The following emergency contacts (Table 2) must be notified immediately if a problem resulting from identified contamination on site occurs.

Table 2: Emergency contact details

Contact	Contact Details
Nearest Hospital	Wairau Hospital, Witherlea, Blenheim, 7201
The National Poisons Centre	0800 POISON/0800 764766
Contaminated Land Consultant	TBA

2.3 Establishment and Site Preparation

The first on-site work will involve the installation of facilities and establishment of environmental controls. This will include:

- An exclusion zone (taped) to ensure no unauthorized persons enter the remediation area without wearing the necessary PPE;
- Dust suppression system (hose with fine mist);
- Erosion and Sediment Control measures;
- Loading and transportation procedure and routes for trucks; and
- Washing facilities.

2.4 Site Security

Access to the site and the contaminated area will be restricted during the remediation project. All personnel coming on to the site shall sign in a dedicated project manager.

2.5 Excavation of Materials

Excavation works will not commence at the site until all the environmental controls have been put in place.

All soils excavated to

- construct the foundations for the houses
- to create the driveways, paths and entertaining areas (concrete patios)
- form the grassed areas

Will be loaded directly onto an awaiting truck and taken to Bluegums landfill for disposal. No excavations will take in excessive winds. Whilst loading the truck the exactor driver will minimise his drop heights to minimise the amount of dust created.

2.5.1 Part of Zone 2 - The Ash pile

The ash pile will be excavated, placed in a skip and covered with a tarpaulin and transported to a suitable contractors yard for further treatment.

2.6 Haulage and Disposal of Contaminated Materials

2.6.1 Bluegums Landfill

All soil removed from site (excluding the ash pile) will be transported directly to Bluegums Landfill. All trucks will be inspected prior to leaving the loading area to ensure that no loose contaminated material leaves the site. All material leaving the site will be tracked. Weighbridge dockets must be provided to the Project Manager for each load, which includes the disposal location and the weight of the load. The contaminated soil on the trucks will be covered with a tarpaulin.

2.7 Validation Sampling

Validation sampling will be undertaken on the base of the excavations made remediate the garden areas. The objective of the validation sampling is to determine whether the concentrations of metals in the residual soils in the base of the excavations made to remediate the garden areas are below the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health - Soil Contaminant Standards for Health (SCSs $_{(health)}$) for the residential 10% produce scenario as set out below.

Table 3: National Environmental Standards for the residential 10% produce scenario

CONTAMINANT	NES (SCSs $_{(health)}$) for the residential 10% produce scenario
Arsenic	20 mg/kg
Cadmium	3 mg/kg
Chromium	460 mg/kg
Copper	>10,000 mg/kg
Lead	210 mg/kg
Mercury	310 mg/kg
Nickel	400 mg/kg[i]
Zinc	7,400 mg/kg[ii]

An XRF will be used to determine the concentrations of metals present in the base of the excavation. Soil samples will be analysed on a 1m grid. 10% of the soil samples will be sent to Hill Laboratories to confirm the findings of the XRF. If metal concentrations are below the relevant NES SCS's, proven clean inert soil will be placed in the excavation and the surface grassed.

If concentrations of contaminants in the soil exceed the relevant NES SCS' s **either** further soil will be excavated until it meets the NES SCS's or a geo-textile will be laid over the contaminated soil and clean inert soil placed on top of it.

At the completion of the validation works and in receipt of the final laboratory results, a site validation report will be prepared by a SQEP outlining the remediation works undertaken and the results of remnant soil quality at the site. The report shall be prepared in accordance with the Ministry for the Environment Contaminated Land Management Guidelines: Reporting on Contaminated Sites in New Zealand (MfE, 2003).

[i] In the absence of any New Zealand guideline values for nickel and zinc, the Australian Health Investigation Levels (roundwaHILs) for residential <10% produce from the document entitled 'Guideline on the Investigation Levels for Soil and Gter (National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013)) Schedule B1' were used. The HILs residential scenario includes residential property with garden/accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children's day care centres, preschools and primary schools.

3. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The following sections deal with the potential adverse effects, which could have a negative impact on the environment and/or human health as a result of the remediation project. Based on the Assessment of Environmental Effects, we do not expect the proposal to have any significant negative effect on the local and wider environment, recreational values or visual amenity of the site. The remediation of the land will have a beneficial effect on the local environment. The sections below outline how these effects will be controlled.

3.1 Site Management Plan

Site management during remediation will include:

- Operating hours;
- Noise and dust control;
- Health and Safety measures;
- Traffic management; and
- Fuel leaks/spills.

3.2 Operating Hours

The project will take approximately 2 weeks to complete. The operating hours for the remediation project are from 8am until 6pm – Monday through to Saturday. No works will be undertaken on Sunday or during public holidays.

3.3 Noise Control

The operation of excavation plant and truck movement to and from the site will increase the background noise levels during the course of the remedial project. The noise arising from the activities will comply with the Wairau Awatere Resource Management Plan Section 32.1.3.6 set out below:

All activities shall be conducted so as to ensure that noise arising from such activities does not exceed the following noise limits at or within the boundary of any other site zoned Urban Residential:

55 dBA L_{10}	0700 hrs - 2200 hrs Monday to Friday
	and 0700 hrs - 1200 hrs Saturday;
45 dBA L_{10} , and 70 dBA L_{max}	At all other times including any public holiday

Provided on any day between 0700 hrs - 2200 hrs the L_{max} limit shall not apply.

3.4 Visual Amenity

The visual effects of the remedial works will be minimal.

3.5 Dust

Contaminated dust created during the excavation and loading processes has the potential to impact on the local environment. In order to mitigate against contaminated dust creating a human health issue and potentially spreading onto neighbouring properties a hose with fine mist sprayer will be used to dampen down the dust during the excavation and loading process if required.

The contaminated soil will be excavated and loaded directly onto awaiting trucks. The drop heights will be minimised in order to limit any dust creation. Once loaded, the trucks will transport the contaminated fill directly to Bluegums Landfill.

No excavation will take place in excessive winds.

3.6 Stormwater, Erosion and Sediment Control

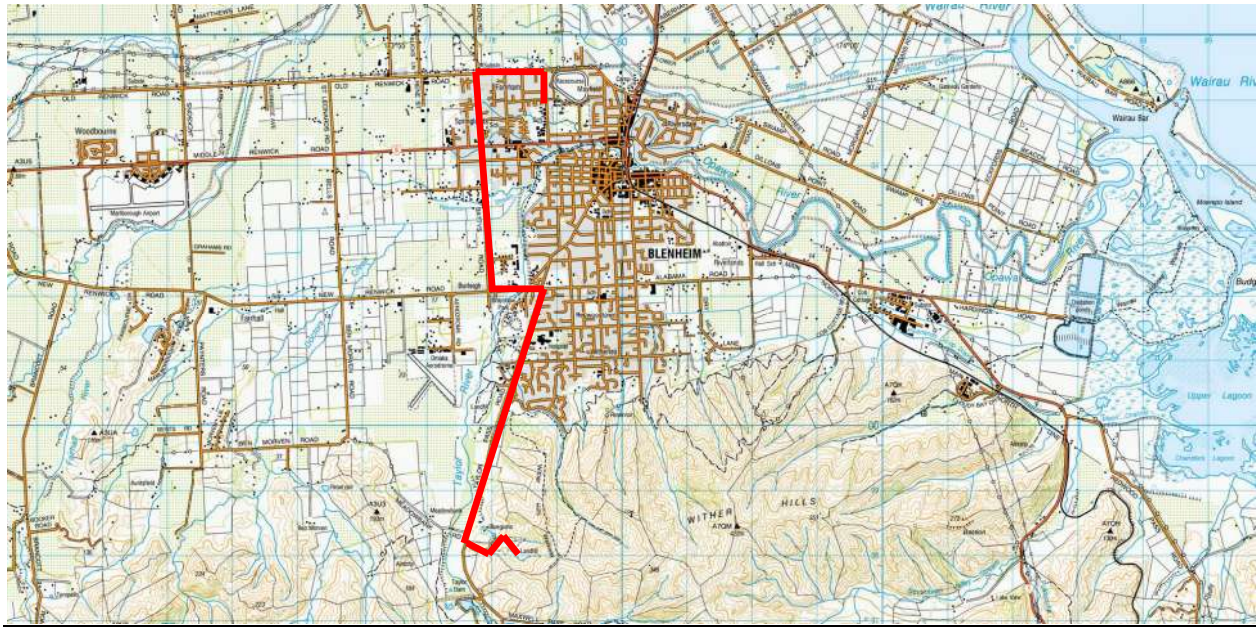
If, during the excavation and loading process, any soil is spilt it will be brushed back into the excavation immediately. Before leaving the site all trucks including tyres will be swept down to ensure contaminated soil does not leave the site. The land is flat and there is unlikely to be any runoff from the site in storm events. If runoff does start to mobilise, then measures must be undertaken by the contractor to ensure that no sediment flow enters the Council stormwater network via adjacent road sumps. No soil will be stockpiled on site.

There are no nearby surface water (streams) that could be contaminated by stormwater from the site.

3.7 Traffic Management

During the course of the remediation project the numbers of heavy vehicles using the local road network will be temporarily increased. In order to ensure that disruption is kept to a minimum the following route (marked in red) for cartage of the spoil to Bluegums Landfill will be taken (Figure 2).

Figure 2: The route (marked in red) for cartage of the spoil to Bluegums Landfill



The truck driver shall liase with the dump attendant as to where to dump the contaminated material. Once dumped the truck driver will ensure that there is no spoil on the deck edges or drawbars of the truck. All spoil will be transported on a truck with a water tight dumping body. Trucks will park on site. They will wait with their engines switched off.

3.8 Contamination Site Indicators

If, during the earthworks, any of the following are identified, the work should stop immediately and a SQEP and a representative from MDC informed.

- Potentially hazardous fill materials such as ash, coal, clinker, wood waste, slag, industrial wastes, putrescibles.
- Drums, bottles or other containers containing liquids or solids that may be hazardous.
- Unusual colour or appearance of soil/fill or groundwater.
- Chemical odours, including 'rotten-egg' smells.
- Oily or tarry soils/fill, flowing oil or oily water.
- Vapour, smoke, or flames from soils/fill.
- Fibrous materials such as asbestos.

In the unlikely event that, during the earthworks, any of the above contamination site indicators are noted, all works must be stopped, the area cordoned off with high visibility tape and a SQEP and MDC representative contacted. If the SQEP considers the material poses an immediate risk to human health or the environment, the works will be stopped and a solution to the problem sought. If human contact with the material has occurred, by either dermal contact, inhalation or ingestion, then medical attention may be required. If the SQEP considers the material does not pose an unnecessary risk to human health and the environment, the material may be excavated and placed into a skip, covered and sampled in order to determine its disposal location.

3.9 Fuel Leaks and Spills

With the exception of fuel for the excavation plant it is not necessary to have any hazardous liquids on site during the remediation project. Contingency measures must be implemented by the contractor for the unlikely event of a spill or leak. An emergency spill kit should be kept on site for the duration of the project.

4. STATUTORY REQUIREMENTS

This section of the report outlines the statutory framework by which the RAP has been developed. The following matters are addressed in this section of the report:

Resource Management Act

Awatere Wairau Resource Management Plan

Ministry for the Environment - National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

4.1 Resource Management Act (RMA 1991)

The proposal for remediation of the contamination on site has due regard to the purpose and principals of the Resource Management Act (RMA 1991) which is to promote the sustainable management of natural and physical resources. By remediating the site to ensure suitability of the site for residential use and undertaking the works in accordance with health and safety and earthworks procedures the proposal meets the following sub-sections 5(2):

Sustaining the potential of natural and physical resources to meet the reasonable foreseeable needs of future generations; and

Safeguarding the life supporting capacity of air, water, soil and ecosystems; and

Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

4.2 Ministry for the Environment - NES for Assessing and Managing Contaminants in Soil to Protect Human Health

The proposed activity is a controlled activity and requires resource consent as the Council will want to ensure that the transport, disposal and tracking of soil and other materials taken away in the course of the activity, goes to an appropriate disposal facility, and there is minimal risk to people during the transportation of the soil (for example, from spills or dust emissions).

In addition Section 2.3.3 of the NES states that resource consent is also required as the volume of soil being removed exceeds the allowable volumes i.e. the volume of soil removed (up to a total limit of 5 m^3 (in-situ volume) per 500 m^2 of land per year) – provided that the soil is disposed of at a facility authorised to receive such material.

5. CONCLUSIONS

The DSI undertaken by SEE Ltd identified that large volumes of contaminated soils were present on site resulting from the past historic land uses and remediation was required to ensure that the Lot was suitable for residential use.

The overall objectives of the proposed remediation works are to ensure that:

- the contaminated soil identified on site is remediated/managed in an acceptable manner and that the site is fit for purpose as a residential development.
- any material taken off site is disposed of at a suitable location e.g. Bluegums Landfill

The proposed remediation/management methodology outlined in this document provides the means by which the objectives can be achieved. Resource consent is required for the remedial works.

Proposed Remediation

The owner proposes to construct the development in two stages. Stage one will involve development of the two houses on the westernmost part of the Lot followed at a later date by development of the two houses on the easternmost part of the Lot. The proposed remediation will coincide with this recevelopment work as described in section 1.3 of this report.

The ash pile (approximately 3 - 5m^3) will need to be removed and disposed of at an approved facility. The results of the TCLP analysis undertaken on the ash pile indicate that arsenic concentrations present in the resulting leachate are higher than the Bluegums Landfill criteria and as such must be treated before it can be disposed of at Bluegums Landfill. The most cost effective treatment methodology to reduce the mobility of the contamination contained within the ash is likely to be cement stabilisation. Cement stabilisation involves adding cement to the ash/soil mix to produce more chemically stable constituents and reduces the mobility of contamination. Stabilisation is a useful technique for treating wastes before disposal to landfill. The principal cement typically used for stabilisation is Portland cement. Very approximately, binder dosages are normally between 5 and 15%. Binder dosages vary considerably with the nature of the material. An alternative option is to dispose of the ash at a Class A landfill (Christchurch). Excavate soil for house foundations, the sealed driveways, paths and patio areas.

The proposed residential properties, sealed driveways, paths and patio areas etc will take up approximately 75% to 80% of the site. All soil excavated on site for the construction of foundations, driveways, patio areas and paths will be taken directly to Bluegums landfill. Any contaminated soils underneath these features will remain in situ. The buildings, driveways, patio areas and paths will provide an impermeable barrier to any contamination below. MDC are likely to put management conditions on the titles stating that these areas must not be disturbed/removed.

The soils in all the areas proposed to be grassed will be excavated to a maximum depth of 300mm bgl and the soil disposed of at Bluegums landfill. Validation sampling of the base of the excavation in these areas will be undertaken to determine if concentrations of contaminants meet the relevant NES SCS's. If the validation sampling indicates that contaminant concentrations are below the NES SCS's clean inert soil will be brought onto site to fill the excavations. If the contaminant concentrations exceed the NES SCS's **either** further soil will be excavated and taken to Bluegums Landfill or a geo-membrane will be placed in the base of the excavation and clean inert soil placed on top of it.

All materials (wood etc) identified as containing contamination from the glasshouses, old sheds and cladding on the dwelling must be disposed of at a suitably licensed facility. The facility should be informed of the nature of the demolition materials i.e. it is painted with paint containing highly elevated concentrations of lead and the necessary paperwork gained prior to its disposal. The structures should be demolished with care, ensuring that potential contamination associated with the structures is not spread around the site.

This RAP should not be used as a standalone document but should supplement the earthwork operator's own health and safety protocols for their employees and contractors.

It is envisaged that a specialized contaminated land consultant would supervise the remediation works and associated sub-contractors, and undertake validation sampling and reporting.

Disclaimer

This report has been prepared solely for the benefit of you as our client and the relevant Local Authority with respect to the particular brief given to us, and data or opinions contained in it may not be used in other contexts or for any other purpose without our prior review and agreement.

This disclaimer shall apply notwithstanding that the report may be made available to any other person in connection with any application for permission or approval, or pursuant to any requirement of law.

This report is based on conditions found on site at the time of the site investigation and is consistent with standards currently being applied. The soil sampling undertaken provides an understanding of the conditions present but conditions may vary considerably over relatively small areas due to the nature of the site and the contamination.

Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by SEE Ltd for incomplete are inaccurate data supplied by others.

Mark Davies

CONTAMINATED LAND ENGINEER

SEE Ltd

6. REFERENCES

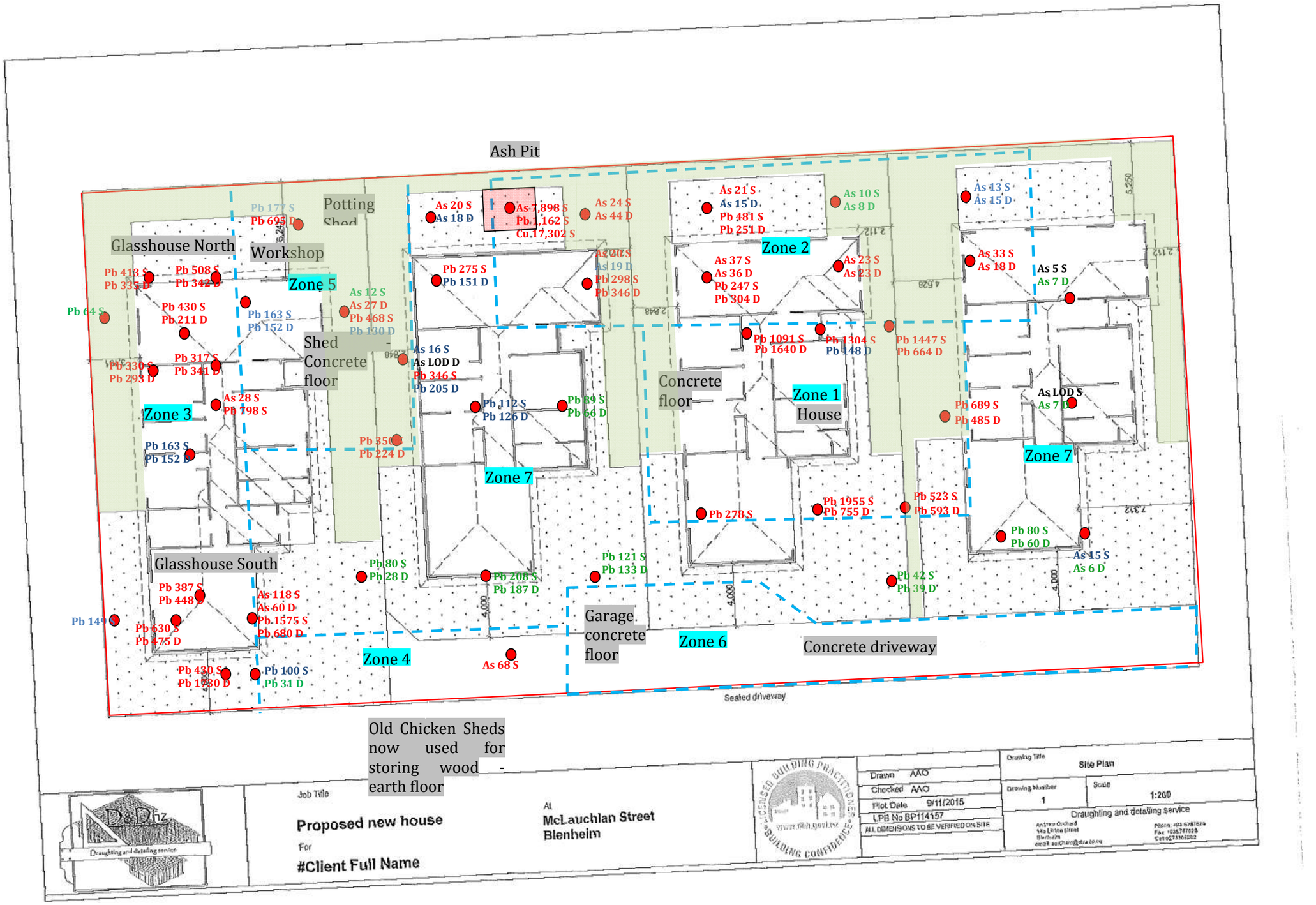
MfE (2011) National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health dated November 2011

MfE (2001) Ministry for the Environment, Contaminated Land Management Guidelines No's 1 to 5, dated April 2001.

MfE (2003) Ministry for the Environment, Contaminated Land Management Guidelines. Guidelines for reporting on contaminated sites in New Zealand.

APPENDIX 1

Site Plan


Ash Pit
Potting Shed
Glasshouse North
Workshop
Zone 5
Shed - Concrete floor
Zone 3
Zone 7
Zone 2
Concrete floor
Zone 1
House
Zone 7
Glasshouse South
Zone 4
Garage concrete floor
Zone 6
Concrete driveway
Sealed driveway
Old Chicken Sheds now used for storing wood - earth floor
Pb 177 S
Pb 695 D
As 20 S
As 18 D
As 7,898 S
Pb 1,162 S
Cu 17,302 S
As 24 S
As 44 D
As 21 S
As 15 D
Pb 481 S
Pb 251 D
As 10 S
As 8 D
As 13 S
As 15 D
Pb 413 S
Pb 335 D
Pb 508 S
Pb 342 D
Pb 275 S
Pb 151 D
As 37 S
As 36 D
Pb 247 S
Pb 304 D
As 23 S
As 23 D
As 33 S
As 18 D
As 5 S
As 7 D
Pb 64 S
Pb 430 S
Pb 211 D
Pb 163 S
Pb 152 D
As 12 S
As 27 D
Pb 468 S
Pb 130 D
As 19 D
Pb 298 S
Pb 346 D
Pb 1091 S
Pb 1640 D
Pb 1304 S
Pb 148 D
Pb 1447 S
Pb 664 D
Pb 330 S
Pb 293 D
Pb 317 S
Pb 341 D
As 16 S
As LOD D
Pb 346 S
Pb 205 D
As 28 S
Pb 798 S
Pb 112 S
Pb 126 D
Pb 89 S
Pb 66 D
Pb 689 S
Pb 485 D
As LOD S
As 7 D
Pb 163 S
Pb 152 D
Pb 350 S
Pb 224 D
Pb 278 S
Pb 1955 S
Pb 755 D
Pb 523 S
Pb 593 D
Pb 80 S
Pb 60 D
As 15 S
As 6 D
Pb 80 S
Pb 28 D
Pb 208 S
Pb 187 D
Pb 121 S
Pb 133 D
Pb 42 S
Pb 39 D
Pb 387 S
Pb 448 D
As 118 S
As 60 D
Pb 1575 S
Pb 680 D
Pb 149 S
Pb 630 S
Pb 475 D
Pb 420 S
Pb 1230 D
Pb 100 S
Pb 31 D
As 68 S
Job Title
Proposed new house
For
#Client Full Name
At
McLauchlan Street
Blenheim
Drawn AAO
Checked AAO
Plot Date 9/11/2015
LPB No BP114157
ALL DIMENSIONS TO BE VERIFIED ON SITE
Drawing Title
Site Plan
Drawing Number
1
Scale
1:200
Draughting and detailing service

APPENDIX 2

Hill Laboratories - TCLP Analysis

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Hamilton 3240, New Zealand

Tel +64 7 858 2000
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Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Sustainable Environmental Engineering Limited	**Lab No:**	1454523	SPv1
Contact:	Mark Davies	**Date Registered:**	24-Jul-2015	
	C/- Sustainable Environmental Engineering Limited	**Date Reported:**	07-Aug-2015	
	6 Pukenui Road	**Quote No:**		
	RD 1	**Order No:**		
	PICTON 7281	**Client Reference:**	Mcglaulin	
		Submitted By:	Mark Davies	

Sample Type: Soil

Sample Name:		MC XRF 230 0-75	MC XRF 238 75-150	MC XRF 239 Ash	MC XRF 250 0-75	MC XRF 255 75-150
Lab Number:		1454523.1	1454523.2	1454523.3	1454523.4	1454523.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	56	-	-
TCLP Weight of Sample Taken	g	-	-	60	-	-
TCLP Initial Sample pH	pH Units	-	-	9.5	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	6.3	-	-
TCLP Extractant Type*		-	-	Acetic acid solution at pH 2.88 +/- 0.05	-	-
TCLP Extraction Fluid pH	pH Units	-	-	2.9	-	-
TCLP Post Extraction Sample pH	pH Units	-	-	6.2	-	-
Total Recoverable Arsenic	mg/kg dry wt	33	44	-	16	14
Total Recoverable Lead	mg/kg dry wt	198	198	-	1,580	2,000
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	16,700	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	7.6	-	-
Total Recoverable Chromium	mg/kg dry wt	-	-	2,900	-	-
Total Recoverable Copper	mg/kg dry wt	-	-	8,400	-	-
Total Recoverable Lead	mg/kg dry wt	-	-	2,600	-	-
Total Recoverable Nickel	mg/kg dry wt	-	-	26	-	-
Total Recoverable Zinc	mg/kg dry wt	-	-	2,100	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	-	-	< 0.04	-	-
Acenaphthylene	mg/kg dry wt	-	-	< 0.04	-	-
Anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	0.05	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	0.08	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	0.07	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Chrysene	mg/kg dry wt	-	-	< 0.04	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Fluorene	mg/kg dry wt	-	-	< 0.04	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	0.07	-	-
Naphthalene	mg/kg dry wt	-	-	< 0.2	-	-
Phenanthrene	mg/kg dry wt	-	-	< 0.04	-	-
Pyrene	mg/kg dry wt	-	-	< 0.04	-	-

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ANALYSIS REPORT

Client:	Sustainable Environmental Engineering Limited	**Lab No:**	1454523	SPv1
Contact:	Mark Davies	**Date Registered:**	24-Jul-2015	
	C/- Sustainable Environmental Engineering Limited	**Date Reported:**	07-Aug-2015	
	6 Pukenui Road	**Quote No:**		
	RD 1	**Order No:**		
	PICTON 7281	**Client Reference:**	Mcglaulin	
		Submitted By:	Mark Davies	

Sample Type: Soil

Sample Name:		MC XRF 230 0-75	MC XRF 238 75-150	MC XRF 239 Ash	MC XRF 250 0-75	MC XRF 255 75-150
Lab Number:		1454523.1	1454523.2	1454523.3	1454523.4	1454523.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	56	-	-
TCLP Weight of Sample Taken	g	-	-	60	-	-
TCLP Initial Sample pH	pH Units	-	-	9.5	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	6.3	-	-
TCLP Extractant Type*		-	-	Acetic acid solution at pH 2.88 +/- 0.05	-	-
TCLP Extraction Fluid pH	pH Units	-	-	2.9	-	-
TCLP Post Extraction Sample pH	pH Units	-	-	6.2	-	-
Total Recoverable Arsenic	mg/kg dry wt	33	44	-	16	14
Total Recoverable Lead	mg/kg dry wt	198	198	-	1,580	2,000
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	16,700	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	7.6	-	-
Total Recoverable Chromium	mg/kg dry wt	-	-	2,900	-	-
Total Recoverable Copper	mg/kg dry wt	-	-	8,400	-	-
Total Recoverable Lead	mg/kg dry wt	-	-	2,600	-	-
Total Recoverable Nickel	mg/kg dry wt	-	-	26	-	-
Total Recoverable Zinc	mg/kg dry wt	-	-	2,100	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	-	-	< 0.04	-	-
Acenaphthylene	mg/kg dry wt	-	-	< 0.04	-	-
Anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	0.05	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	0.08	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	0.07	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Chrysene	mg/kg dry wt	-	-	< 0.04	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Fluorene	mg/kg dry wt	-	-	< 0.04	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	0.07	-	-
Naphthalene	mg/kg dry wt	-	-	< 0.2	-	-
Phenanthrene	mg/kg dry wt	-	-	< 0.04	-	-
Pyrene	mg/kg dry wt	-	-	< 0.04	-	-

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ANALYSIS REPORT

Client:	Sustainable Environmental Engineering Limited	**Lab No:**	1454523	SPv1
Contact:	Mark Davies	**Date Registered:**	24-Jul-2015	
	C/- Sustainable Environmental Engineering Limited	**Date Reported:**	07-Aug-2015	
	6 Pukenui Road	**Quote No:**		
	RD 1	**Order No:**		
	PICTON 7281	**Client Reference:**	Mcglaulin	
		Submitted By:	Mark Davies	

Sample Type: Soil

Sample Name:		MC XRF 230 0-75	MC XRF 238 75-150	MC XRF 239 Ash	MC XRF 250 0-75	MC XRF 255 75-150
Lab Number:		1454523.1	1454523.2	1454523.3	1454523.4	1454523.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	56	-	-
TCLP Weight of Sample Taken	g	-	-	60	-	-
TCLP Initial Sample pH	pH Units	-	-	9.5	-	-
TCLP Acid Adjusted Sample pH	pH Units	-	-	6.3	-	-
TCLP Extractant Type*		-	-	Acetic acid solution at pH 2.88 +/- 0.05	-	-
TCLP Extraction Fluid pH	pH Units	-	-	2.9	-	-
TCLP Post Extraction Sample pH	pH Units	-	-	6.2	-	-
Total Recoverable Arsenic	mg/kg dry wt	33	44	-	16	14
Total Recoverable Lead	mg/kg dry wt	198	198	-	1,580	2,000
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	-	-	16,700	-	-
Total Recoverable Cadmium	mg/kg dry wt	-	-	7.6	-	-
Total Recoverable Chromium	mg/kg dry wt	-	-	2,900	-	-
Total Recoverable Copper	mg/kg dry wt	-	-	8,400	-	-
Total Recoverable Lead	mg/kg dry wt	-	-	2,600	-	-
Total Recoverable Nickel	mg/kg dry wt	-	-	26	-	-
Total Recoverable Zinc	mg/kg dry wt	-	-	2,100	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	-	-	< 0.04	-	-
Acenaphthylene	mg/kg dry wt	-	-	< 0.04	-	-
Anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	0.05	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	0.08	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	0.07	-	-
Benzo[k]fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Chrysene	mg/kg dry wt	-	-	< 0.04	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	< 0.04	-	-
Fluoranthene	mg/kg dry wt	-	-	< 0.04	-	-
Fluorene	mg/kg dry wt	-	-	< 0.04	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	0.07	-	-
Naphthalene	mg/kg dry wt	-	-	< 0.2	-	-
Phenanthrene	mg/kg dry wt	-	-	< 0.04	-	-
Pyrene	mg/kg dry wt	-	-	< 0.04	-	-

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Sample Type: Soil						
Sample Name:		MC XRF 260 0-75	MC XRF 267 0-75	MC XRF 288 0-75	MC XRF 300 0-75	MC XRF 311 75-150
Lab Number:		1454523.6	1454523.7	1454523.8	1454523.9	1454523.10
Organonitro&phosphorus Pesticides Screen in Soil by GCMS						
Prochloraz	mg/kg	-	-	-	< 0.4	-
Procymidone	mg/kg	-	-	-	< 0.07	-
Prometryn	mg/kg	-	-	-	< 0.04	-
Propachlor	mg/kg	-	-	-	< 0.07	-
Propanil	mg/kg	-	-	-	< 0.2	-
Propazine	mg/kg	-	-	-	< 0.04	-
Propiconazole	mg/kg	-	-	-	< 0.05	-
Pyriproxyfen	mg/kg	-	-	-	< 0.07	-
Quizalofop-ethyl	mg/kg	-	-	-	< 0.07	-
Simazine	mg/kg	-	-	-	< 0.07	-
Simetryn	mg/kg	-	-	-	< 0.07	-
Sulfentrazone	mg/kg	-	-	-	< 0.4	-
TCMTB [2-(thiocyanomethylthio) benzothiazole,Busan]	mg/kg dry wt	-	-	-	< 0.14	-
Tebuconazole	mg/kg	-	-	-	< 0.07	-
Terbacil	mg/kg	-	-	-	< 0.07	-
Terbufos	mg/kg	-	-	-	< 0.07	-
Terbumeton	mg/kg	-	-	-	< 0.07	-
Terbuthylazine	mg/kg	-	-	-	< 0.04	-
Terbuthylazine-desethyl	mg/kg	-	-	-	< 0.07	-
Terbutryn	mg/kg	-	-	-	< 0.07	-
Thiabendazole	mg/kg	-	-	-	< 0.4	-
Thiobencarb	mg/kg	-	-	-	< 0.07	-
Tolylfluanid	mg/kg	-	-	-	< 0.04	-
Triazophos	mg/kg	-	-	-	< 0.07	-
Trifluralin	mg/kg	-	-	-	< 0.07	-
Vinclozolin	mg/kg	-	-	-	< 0.07	-

Sample Name:		MC XRF 281 (Shed) 0-75				
Lab Number:		1454523.11				
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	68	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	100	-	-	-	-

Sample Type: Aqueous						
Sample Name:		MC XRF 239 Ash [TCLP Extract]	MC XRF 288 0-75 [TCLP Extract]			
Lab Number:		1454523.12	1454523.13			
Individual Tests						
Total Arsenic	g/m³	-	0.025	-	-	-
Total Lead	g/m³	-	0.050	-	-	-
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	66	-	-	-	-
Total Cadmium	g/m³	0.0052	-	-	-	-
Total Chromium	g/m³	1.13	-	-	-	-
Total Copper	g/m³	0.42	-	-	-	-
Total Lead	g/m³	0.0117 #1	-	-	-	-
Total Nickel	g/m³	0.022	-	-	-	-
Total Zinc	g/m³	0.75	-	-	-	-

Analyst's Comments

#1 It should be noted that the blank TCLP extract contained an elevated level of Lead (0.0038g/m3 c.f. detection limit of 0.0021g/m3). This has not been corrected for on the sample TCLP extract concentration. This should be kept in mind when interpreting these results.