

Millbrook Proposed District Plan Change Preliminary & Detailed Site Investigation

For

Millbrook Country Club Limited

February 2015



*Davis Consulting Group Limited
Arrow Lane,
Arrowtown 9302
03 409 8664
Document ID: 14088*

**Millbrook Ltd,
Proposed Landuse Change,
Preliminary & Detailed Site Investigation**

Document Status

Version	Purpose of Document	Prepared By	Reviewer	Review Date
A	Draft for review	FR	RL	8 Jan 2014
O	FINAL	FR	GD	23 Feb 2014

TABLE OF CONTENTS

	Page No.
EXECUTIVE SUMMARY	III
1.0 INTRODUCTION	1
1.1 Purpose	1
1.2 Scope of Work	1
1.3 Limitations	2
2.0 SITE LOCATION AND DESCRIPTION	3
2.1 Site Location	3
2.2 Site History	4
2.2.1 Contaminants Commonly Associated with the Landuse	4
2.3 Additional Site Information	4
2.4 Site Condition and Surrounding Environment	5
2.5 DCG's Previous Investigations within the Wakatipu Basin	8
2.6 Geology and Hydrogeology	11
2.6.1 Hydrogeology	11
2.6.2 Hydrology	12
3.0 SAMPLING AND ANALYSIS PLAN	13
3.1 Data Quality Objectives	13
3.2 Sampling and Analysis Plan	13
3.3 Sampling Rationale	14
3.4 Soil Sampling Methodology	14
3.5 Analytical Parameters	14
3.6 Soil Sample Field and Laboratory QA/QC	14
3.7 Soil Guideline Values	15
3.8 Soil Analytical Result Review	16
4.0 INVESTIGATION RESULTS	17
4.1 Analytical Results	17
4.1.1 Arsenic and Copper Results	17
4.1.2 Organochlorine Pesticide (OCP) Results	18
4.2 QA/QC Results	19
4.2.1 Field Duplicates	19

4.2.2	Laboratory Procedures	20
4.3	Risk Assessment	20
	SUMMARY	21
	REFERENCES	22

LIST OF FIGURES

Figure No.		Page No.
1	Site Location Plan	3
2	Site Layout Plan	6
3	Proposed Site Plan	7
4	Site Hazard Plan	7
5	Previous Reporting by DCG Previous Reporting by DCG within the Wakatipu Basin	11
6	Soil Sample Plan	13

LIST OF TABLES

Table No.		Page No.
1a	DCG's Previous Investigations within the Wakatipu Basin Results	9
1b	DCG's Previous Investigations within the Wakatipu Basin Results Continued	10
2	Soil Guidelines	16
3	Soil Sample Summary Table	17
4	Arsenic and copper results (mg/kg) Millbrook Extension	18
5	Dieldrin results (mg/kg) Millbrook Extension	19
6	Duplicate percentage difference	19

LIST OF PLATES

Plate No.		Page No.
Plate 1		6

LIST OF APPENDICES

Appendix A	Davis Consulting Group Contaminated Land Experience
Appendix B	Historical Certificate of Title
Appendix C	Soil Profile Logs
Appendix D	ORC Bore Search
Appendix E	Laboratory analytical certificate and results, and chain of custody documentation.

EXECUTIVE SUMMARY



Millbrook Country Club Limited (MCC) are proposing to extend Millbrook Resort by changing the landuse of the neighbouring property located at 902 Malaghans Road, Arrowtown (Lot 1 DP 310442, Lot 1 DP 313841 and Lots 1-3 DP 27269 SECS 29 57 Blk VI Shotover SD). The site contains a wool shed and footbath, and a mobile sheep dipping plant also operated on the site. Furthermore, the farm may have received the broadacre application of agrichemicals such as fertilisers and persistent pesticides. Given hazardous substances have been used on the property the site is subject to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES), given the proposed change in landuse of the site. In order to characterise the risk to human health from the proposed plan change MCC engaged Davis Consulting Group Limited (DCG) to undertake a Preliminary and Detailed Site Investigation (PSI and DSI) to review the landuse history of the site, identify any potential contaminant risks and document an investigation completed to characterise the nature of soil contamination in the vicinity of the sheep dip and footbath.

Based on the findings of the investigation DCG concludes the following:

- Hazardous activities that have occurred on the site include the broadacre application of agrichemicals (fertilisers and possibly pesticides) and the use of hazardous substances in the operation of a footbath and mobile sheep dip;
- Based on liaison with the former owners of the property, DCG understands a portable sheep dip was bought on to the property twice a year to treat stock until 1981;
- DCG identified the potential contaminants of concern associated with the portable sheep dip and permanent foot bath to be arsenic, copper and organochlorine pesticides;
- Arsenic and copper levels in all soil samples analysed returned concentrations below the adopted guideline value;
- Dieldrin was detected adjacent to the footbath exceeding the NES soil contaminant standard, indicating that there is a risk to human health based on rural residential activity on the site;
- Based on a number of investigations completed by DCG in the Wakatipu Basin we consider it highly unlikely that persistent pesticides (DDT and dieldrin) and heavy metal concentrations associated with the broadacre application of these agrichemicals would result in contaminant concentrations exceeding the NES soil contaminant standards.

In summary, DCG considers the site is suitable for residential activity provided remedial work is undertaken in the vicinity of the footbath situated in the stockyards adjacent to the woolshed.

1.0 INTRODUCTION

1.1 Purpose

Millbrook Country Club Limited (MCC) is proposing to extend Millbrook Resort by changing the landuse of the neighbouring property located at 902 Malaghans Road, Arrowtown (Lot 1 DP 310442, Lot 1 DP 313841 and Lots 1-3 DP 27269 SECS 29 57 Blk VI Shotover SD). Pastoral farming has been the main landuse of the property. Activities such as the broadacre application of agrichemicals and the use of hazardous substances for the treatment of sheep have occurred on the property along with the operation of the permanent footbath.

The identification of potential hazardous activities occurring on the site triggers the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES), given the proposal to change the landuse of the property. In order to meet the requirements of the NES, MCC commissioned Davis Consulting Group Limited (DCG) to undertake a Preliminary and Detailed Site Investigation (PSI and DSI) to review the landuse history of the site, identify any potential contaminant risks and document the investigation completed to characterise the nature of soil contamination in the vicinity of the sheep dip and footbath. DCGs experience in the provision of contaminated land services is provided in Appendix A.

1.2 Scope of Work

The scope of work completed during the PSI and DSI included the following:

- Review of the site history including review of property file and historic certificate of title;
- Discussions with the previous site owner;
- Completion of a site inspection to examine the condition of the property and potential risks to human health;
- Consideration of the risk to human health based on the proposed landuse change of the site;
- Review of previously completed PSIs by DCG within the Wakatipu Basin;
- Document an investigation completed into soil quality in the vicinity of a sheep dip and foot bath identified on the site;
- Preparation of a PSI and DSI report in accordance with the requirements of the Contaminated Land Management Guidelines (CLMG) No. 1.

1.3 Limitations

The findings of this report are based on the Scope of Work outlined above. DCG performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental science profession. No warranties, express or implied, are made. Subject to the Scope of Work, DCG's assessment is limited strictly to identifying the risk to human health based on the historical activities on the site. The confidence in the findings is limited by the Scope of Work.

The results of this assessment are based upon site inspections conducted by DCG personnel, information from interviews with people who have knowledge of site conditions and information provided in previous reports. All conclusions and recommendations regarding the properties are the professional opinions of DCG personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, DCG assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside DCG, or developments resulting from situations outside the scope of this project.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Location

The site is located immediately to the west of Millbrook Resort at 902 Malaghans Road, Arrowtown and is legally described as Lot 1 DP 310442, Lot 1 DP 313841 and Lots 1-3 DP 27269 SECS 29 57 Blk VI Shotover SD (see Figure 1 for site location). The area of the site is approximately 66.8 hectares.

Coordinates for the site are E 2177939.2, N 5575839.7.

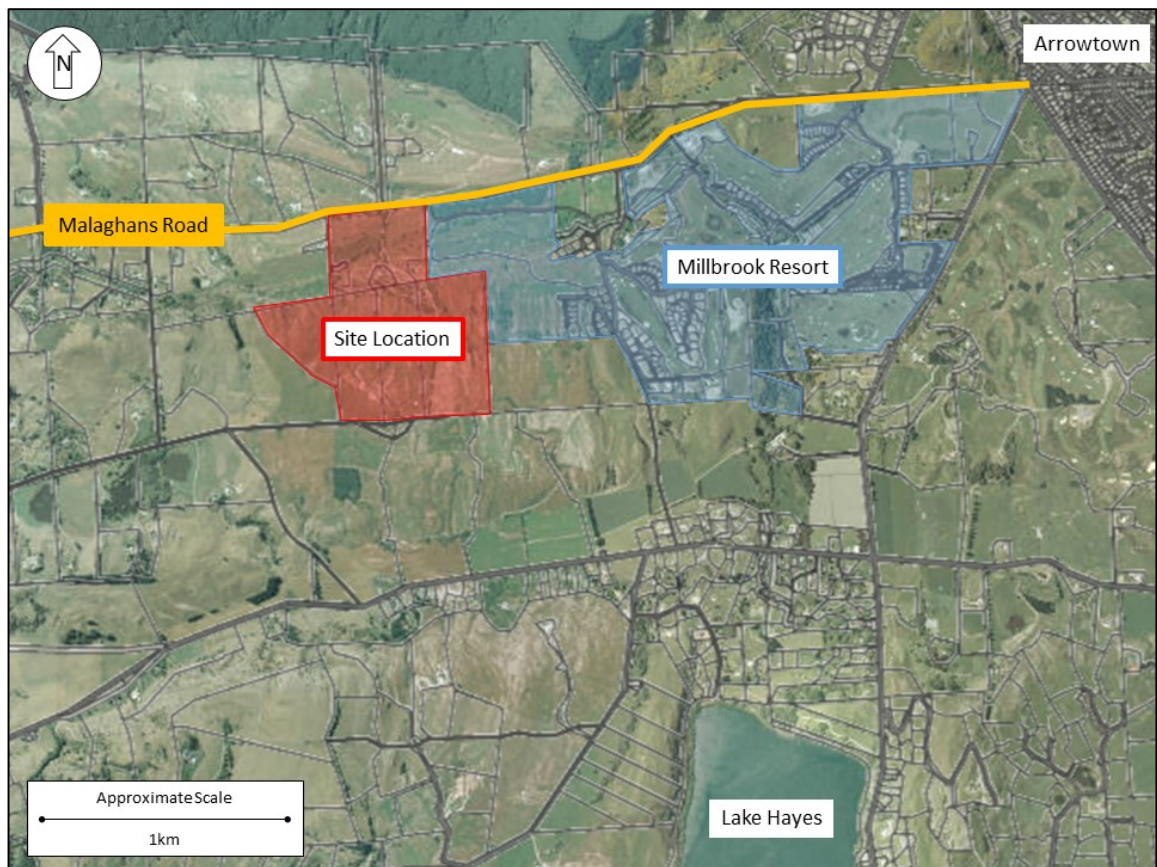


Figure 1: Site Location Plan.

2.2 Site History

The site has had a long history of pastoral farming activity dating back to the late 1800s when John Butel farmed the property (McDonald, 2010). At this time the land was most likely used for growing crops and grazing dairy cows. According to the Queenstown Lakes District Council (QLDC) property file for the site, prior to purchase by MCC, the area was owned by Ian and Phillipa MacAuley, John Pritchard and Bruce Cunningham. Mr MacAuley has operated the property as a sheep and deer farm. Mr MacAuley stated that the property had not been fertilized in the last 10 years and prior to that fertilizer was only applied on an irregular basis. The property did not contain a sheep dip, however contractors would bring a portable sheep dip to the property twice a year to dip the sheep until 1981. This was completed on the east side of the sheep yards using a product with diazinon as the active ingredient (Figure 2). A foot bath was located within the sheep yards which used a zinc copper sulphate. An offal pit is also located on the farm which is still open and primarily used for dead stock and vegetation. The pit is approximately 5 years old and is burnt off once a year. The historical certificates of title are located in Appendix B.

2.2.1 Contaminants Commonly Associated with the Landuse

Based on the Contaminated Land Management Guidelines Schedule B, the hazardous substances that may be associated with the former sheep dip, footbath and farming operations on the site include a range of organochlorine pesticides and trace metals associated with both pesticide and fertiliser use.

2.3 Additional Site Information

The CLMG No 1 requires information associated with fuel storage facilities, spill loss history, recorded discharges and onsite and offsite disposal locations. DCG requested a search of the Otago Regional Council (ORC) records for Landuse and Site Contamination Status, Resource Consents, and Resource Management Act (RMA) incidents for the site. The ORC stated that there are no records held on the Otago Regional Council's "Database of Selected Landuses" for the site regarding on or off-site disposal locations, recorded discharges, or spill loss history. A review of the QLDC property files revealed no activities considered to be hazardous under the NES.

The following provides a summary of information that the CLMG No. 1 (MfE, 2003a) indicates should be included in a PSI/DSI report:

- Presence of Drums – One rusted drum was present on site, however it was empty with no surrounding surface soil staining.
- Wastes – Other than the offal pit mentioned in Section 2.2 no other wastes were observed.
- Fill Materials - No imported fill was observed on site.
- Odours – No odours were noted.
- Flood Risk – According to the QLDC hazard maps there is no flood risk to this site.
- Surface Water Quality – An irrigation water race flows through the north of the site (Figure 2). There are some small wetlands present on site.
- Site boundary condition – The site boundaries appear to be fenced.
- Visible Signs of Contamination – No visible signs of contamination other than some dark staining around foot bath.
- Local Sensitive Environments – the nearest sensitive environment is Mill Creek, while the open water race flowing through the site could also be considered a sensitive environment.

2.4 Site Condition and Surrounding Environment

Figure 2 presents the current site layout plan. The site contains one dwelling, a hay shed, sheep yards, footbath and a woolshed with the remaining area consisting of hummocky grassland dominated by short exotic pasture grass species (Plate 1). Proposed plans for the site can be found in Figure 3 and include proposed residential housing and a golf course.

The landuse northeast of the site is zoned as Millbrook Resort Zone, which is part of Millbrook Resort. All other neighbouring properties are zoned Rural General including the subject site itself.

According to the QLDC hazard maps, an active alluvial fan runs through the north of the site as well as risk of liquefaction as indicated in Figure 4.

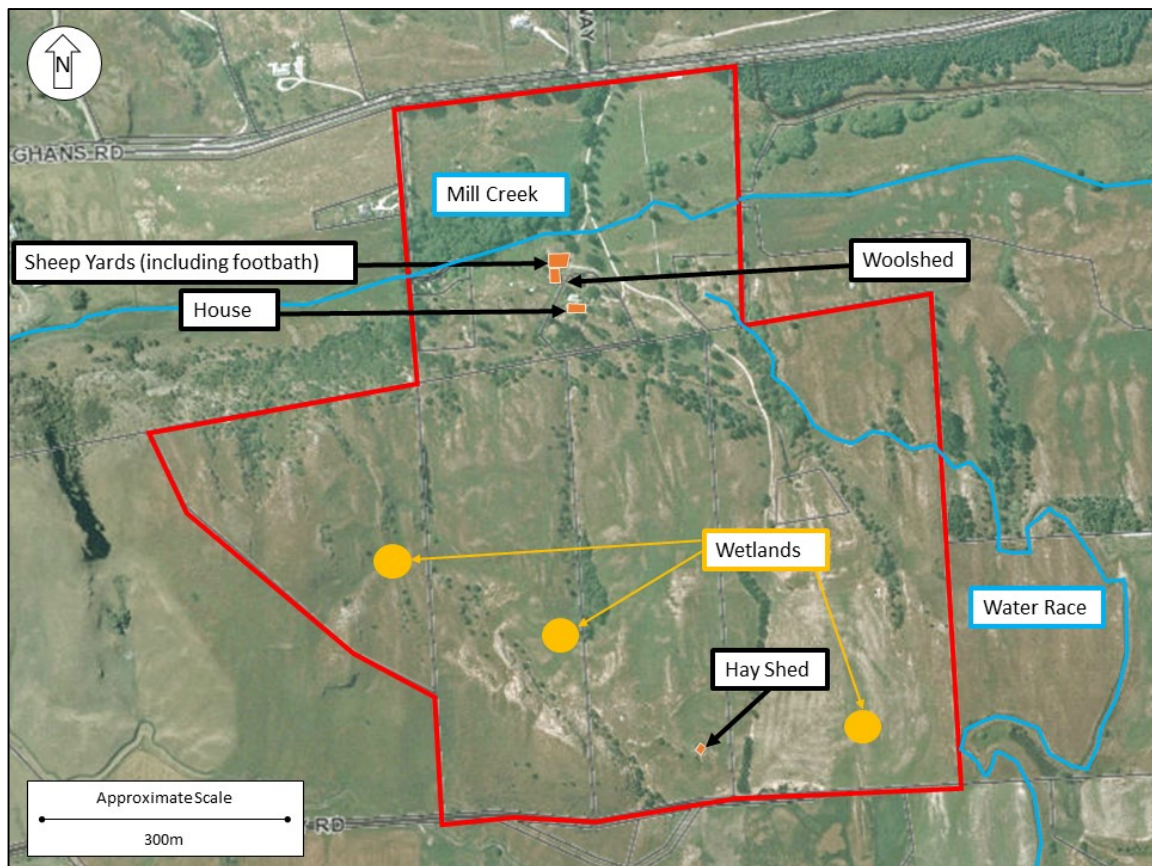
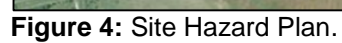
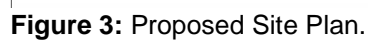


Figure 2: Site Layout Plan



Plate 1: Left - Looking east from west side of property; Right - Looking east at hay shed.



2.5 DCG's Previous Investigations within the Wakatipu Basin

DCG has completed a number of Preliminary and Detailed Site Investigations throughout the Wakatipu Basin to consider the impact of the broadacre application of fertilisers and pesticides to soil quality. The following provides a list of the investigations DCG has completed to date:

- T20 Commercial/Retail Development, Hawthorn Drive, Frankton, Preliminary Site Investigation;
- T31 Commercial/Retail Development, Hawthorn Drive, Frankton, Preliminary Site Investigation;
- Daycare Facilities and Residential Apartments, Copper Beech Avenue, Frankton, Preliminary Site Investigation;
- Glenda Drive Subdivision, Frankton, Preliminary Site Investigation for Shotover Park Ltd;
- Hazeldine Landuse Change, Slope Hill, Wakatipu Basin Road, Preliminary Site Investigation;
- Gibbston Vines Subdivision, Lower Shotover, Preliminary Site Investigation;
- 26 Slopehill Rd, Queenstown, Preliminary Site Investigation;
- 17 Mountain View Road, Dalefield, Preliminary Site Investigation.

The location of the soil samples collected for the above investigations are provided in Figure 5 and the laboratory results are presented in Table 1a and Table 1b. In summary the results show the following:

- Arsenic concentrations range from 3 mg/kg to 16 mg/kg and are all below the soil contaminant standard of 20 mg/kg;
- Cadmium concentrations range from <0.01 mg/kg to 2.1 mg/kg and are all below the soil contaminant standard of 3 mg/kg;
- Dieldrin concentrations range from <0.01 mg/kg to 0.07 mg/kg and are all below the soil contaminant standard of 2.6 mg/kg; and
- Total DDT concentrations range from <0.01 mg/kg to 0.35 mg/kg and are all below the soil contaminant standard of 70 mg/kg.

All other persistent pesticide and heavy metal concentrations were also below tier 1 soil contaminant standards for residential activity. Based on these results DCG considers it is highly unlikely that the historical broadacre application of agrichemicals would have resulted in an impact to soil quality that would present a risk to residential activity. We therefore do not consider it is necessary to undertake intrusive investigations to characterise the soil quality of the wider site and have focussed the investigation on contamination associated with the sheep dipping area and footbath.

Table 1a: DCG's Previous Investigations within the Wakatipu Basin Results

	Daycare/Residential Apartments, Copper Beech Road, Frankton PSI		T20 Commercial/Residential Development, Hawthorn Drive, Frankton - PSI		T31 Commercial/Retail Development, Hawthorn Drive, Frankton - PSI		Glenda Drive, Frankton Subdivision		Hazeldine				Soil Guideline Value ¹	Soil Guideline Value ²
Sample ID	SS(0.1) 12034#1	SS(0.1) 12034#2	SS(0.1) 12034#3	SS(0.1) 12034#4	SS(0.1) 12034#5	SS(0.1) 12034#6	SS(0.1) 12034#7	SS(0.1) 12034#8	SS1(0.1)	SS2(0.1)	SS3(0.1)	SS4(0.1)		
Arsenic	6	9	8	3	3	3	3	3	9	9	11	10	20	
Cadmium	0.75	1.96	2.1	0.3	0.2	0.19	0.18	<0.10	0.13	<0.10	<0.10	<0.10	3	
Chromium	19	19	18	14	15	14	16	14	11	10	9	12	>10,000	
Copper	34	44	43	22	47	24	23	30	9	12	19	13	>10,000	
Nickel	48	42	9	3	3	3	12	4	8	9	12	12		400
Lead	8	8	45	17.6	25	24	23	17	14.6	14.5	19.2	17.1	210	
Zinc	450	138	360	65	55	61	55	36	49	51	50	68		7400
Dieldrin	0.023	0.031	0.014	0.014	0.036	0.03	0.02	0.07	<0.011	<0.010	<0.010	<0.010	2.6	
Total DDT	0.032	0.138	0.023	0.018	0.044	0.037	0.02	0.031	0.358	0.108	<0.010	<0.010	70	

< denotes concentration below laboratory detection limits

¹ Appendix B Soil Contaminant Standards in New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health 2012 (MfE, 2012).

² Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater in National Environment Protection (Assessment of Site Contamination) Measure 2013 Volume 2 (NEPC, 2013).

Table 1b: DCG's Previous Investigations within the Wakatipu Basin Results continued

	Gibbston Vines Subdivision		26 Slopehill Rd			17 Mountain View Road		Soil Guideline Value ¹	Soil Guideline Value ²
Sample ID	SS (0.1) 12037 # 1	SS (0.1) 12037 # 2	SS (0.2) 13007 #1	SS (0.2) 13007 #2	SS (0.1) 13007	SS(0.2)13023 P1, SS(0.2)13023 P2 and SS(0.2)13023 P3	SS(0.2)13023 P4, SS(0.2)13023 P5 and SS(0.2)13023 P6		
Arsenic	8	8	14	16	8	4	4	17	
Cadmium	<0.10	0.12	0.28	1.02	0.11	-	-	0.8	
Chromium	11	14	11	12	12	10	10	>10,000	
Copper	9	10	14	14	11	8	6	>10,000	
Nickel	8	15	11	11	11	8	7		400
Lead	13.5	13.7	17.3	20	17.5	15.2	14.2	160	
Zinc	45	640	73	220	70	40	31		7400
Dieldrin	<0.010	<0.010	<0.010	0.014	<0.010	-	-	1.1	
Total DDT	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	45	
< denotes concentration below laboratory detection limits									
¹ Appendix B Soil Contaminant Standards in New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health 2012 (MfE, 2012).									
² Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater in National Environment Protection (Assessment of Site Contamination) Measure 2013 Volume 2 (NEPC, 2013).									

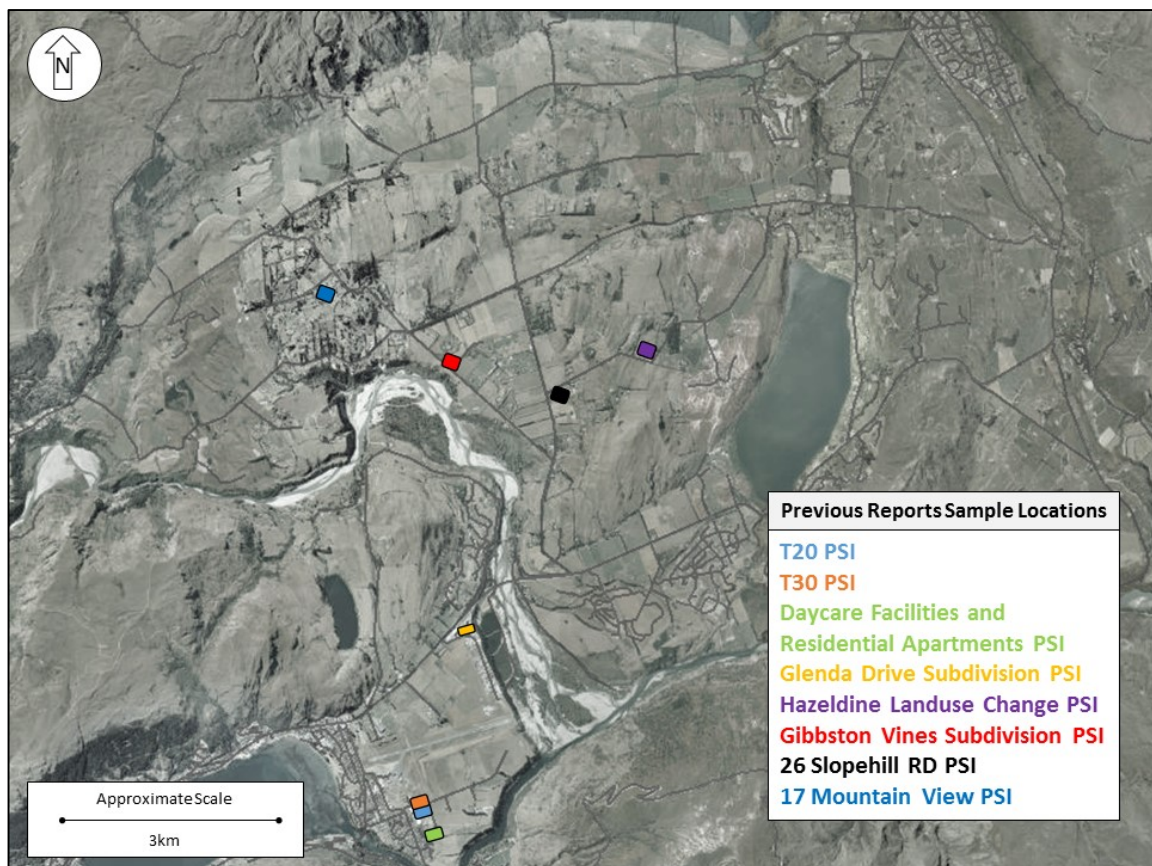


Figure 5: Previous Reporting by DCG within the Wakatipu Basin

2.6 Geology and Hydrogeology

The subject site is situated 1.6 km to the northwest of Lake Hayes, on a geology of till and associated outwash and contemporaneous fan gravels pelitic schist, variably segregated veined and foliated (Turnbull 2000). Alluvial fans feature to the northern end of the site resulting in an alluvial hazard area as well as liquefaction risk sediments (Figure 4). The surface soils were described during the collection of soil samples for the investigation; see Appendix C for the soil profile logs.

2.6.1 Hydrogeology

The site investigation did not include a groundwater assessment. The site is located within the Wakatipu Basin Aquifer system, with part of the site adjacent to Mill Creek within the Upper Mill Creek Aquifer (ORC, 2014). Groundwater level at the site is unknown but depth to water of the consented wells range between 1.2m and 12m (see Appendix D for bore locations).

The location of groundwater bores within a 1 km radius of the site (held by the Otago Regional Council) is provided in Appendix D. A total of nine bores have been drilled within 1 km of the centre of the site. The well uses include eight for domestic use and one for scheme.

2.6.2 Hydrology

Mill Creek is the dominant hydrological feature within the property and flows in an easterly direction in the north of the site. A number of gullies drain into Mill Creek however the catchments are small and it is unlikely surface water flow occurs in these gullies.

3.0 SAMPLING AND ANALYSIS PLAN

The following sets out the sampling and analysis completed to characterise the nature of contaminants associated with the portable sheep dip and footbath.

3.1 Data Quality Objectives

The data quality objectives (DQOs) of the PSI were to:

- Characterise the nature of any contamination associated with the sheep dip and footbath; and
- Determine the risk of any soil contamination encountered onsite to human health, based on the proposed residential landuse.

3.2 Sampling and Analysis Plan

The sampling and analysis plan was designed to address the specific objectives, namely the characterisation of contaminants in soil adjacent to the foot bath and sheep yards where a portable sheep dip was historically used. Figure 6 shows the location of soil samples collected adjacent to the yards and foot bath; these samples were analysed for arsenic, copper and organochlorine pesticides (OCP).



Figure 6: Sample Location Plan

3.3 Sampling Rationale

Samples from each of the 15 locations in Figure 6 were analysed individually for arsenic and copper then composited into 5 groups for OCP analysis. The sampling depth of 0-0.1m for these sample sites is considered appropriate due to the nature of the potential contaminants present, such as organochlorine pesticides and heavy metals, which generally bind strongly to soils and are unlikely to leach to significant depths.

3.4 Soil Sampling Methodology

Soil sampling was undertaken with the use of a spade. The following procedures were applied during the soil sampling process to gain representative samples:

- Field personnel wore a fresh pair of nitrile gloves between sampling events.
- Soil samples were transferred to 250 mL glass jars with Teflon lids, as supplied by Hill Laboratories.
- All soil samples were unambiguously marked in a clear and durable manner to permit clear identification of all samples in the laboratory.
- All samples were immediately placed in a cooled chilly bin to reduce the potential for volatilisation should volatile contaminants be present.

3.5 Analytical Parameters

The laboratory analytical suite determined for the site investigation is in recognition of our understanding of the current and historical use of the subject site. DCG understands the site was subject to sheep dip and foot bath activities, thus the following hazardous contaminants were analysed for their presence on site:

- Arsenic and Copper; and
- Organochlorine pesticides (including 4,4-DDE, 2,4-DDT and Dieldrin).

The laboratory methods utilised for the analysis are provided in the laboratory report (see Appendix E).

3.6 Soil Sample Field and Laboratory QA/QC

The field QA/QC procedures performed during the soil sampling are listed as follows:

- Use of standardised field sampling forms and methods;
- Samples were transferred under chain of custody procedures;
- All samples were labelled to show point of collection, project number, and date;
- Headspace in sample jars was avoided;
- The threads on the sampling jars were cleaned to avoid VOC loss;
- All samples were stored in a cooled chilly bin containing ice while in the field.

All soil samples were kept refrigerated until couriered to Hill Laboratories. Hill Laboratories is IANZ accredited for the analysis of heavy metals and pesticides. Hill conduct internal QA/QC in accordance with IANZ requirements.

3.7 Soil Guideline Values

Soil guideline values (SGVs) selected for application on this project are provided in Table 1. The selection of these guidelines is consistent with the principles of the Contaminated Land Management Guidelines No. 2: Hierarchy and Application in New Zealand of Environmental Guideline Values (MfE, 2003b).

The arsenic, copper and organochlorine pesticide soil guideline values adopted for the site assessment were based on either the Soil Contaminant Standards (New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health, 2012) or Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater (National Environment Protection (Assessment of Site Contamination) Measure 2013). Guidelines for residential landuse 10% produce have been adopted for this site investigation based on the proposed residential landuse. Where the National Environmental Protection Measures (2013) were adopted, the most conservative values were selected for the purposes of this assessment.

Table 2: Soil Guidelines

Analyse	Guideline
Arsenic, Copper and Organochlorine Pesticides	<ol style="list-style-type: none">1. Appendix B Soil Contaminant Standards <i>in</i> New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health 2012 (MfE, 2012).2. Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater <i>in</i> National Environment Protection (Assessment of Site Contamination) Measure 2013 (NEPC, 2013).

3.8 Soil Analytical Result Review

Following the receipt of laboratory data, a detailed review of the data was performed to determine its accuracy and validity. All laboratory data was checked for analytical and typographical errors.

Once the data quality was established the soil data was checked against the Sampling Program DQOs.

4.0 INVESTIGATION RESULTS

4.1 Analytical Results

The soil sample locations are provided in Figure 6 and summarised in Table 3 below.

Table 3: Soil Sample Summary Table

Sample Identification	Sample Depth (m)	Analysis	Composite	Notes
MB(0.1)#1	0-0.1	Arsenic and Copper	OCP	Surface sample
MB(0.1)#2	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#3	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#4	0-0.1	Arsenic and Copper	OCP	Surface sample
MB(0.1)#5	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#6	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#7	0-0.1	Arsenic and Copper	OCP	Surface sample
MB(0.1)#8	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#9	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#10	0-0.1	Arsenic and Copper	OCP	Surface sample
MB(0.1)#11	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#12	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#13	0-0.1	Arsenic and Copper	OCP	Surface sample
MB(0.1)#14	0-0.1	Arsenic and Copper		Surface sample
MB(0.1)#15	0-0.1	Arsenic and Copper		Surface sample

4.1.1 Arsenic and Copper Results

The arsenic and copper results are presented in Table 4 and summarised as follows:

- Arsenic and copper levels in all samples analysed returned concentrations below the adopted guideline value.

The levels of arsenic and copper are consistent across most of the samples analysed and are expected to be indicative of background concentrations.

Table 4: Arsenic and copper results (mg/kg) Millbrook Extension

Sample ID	Arsenic	Copper
MB(0.1)#1	12	38
MB(0.1)#2	10	20
MB(0.1)#3	10	22
MB(0.1)#4	12	25
MB(0.1)#5	11	26
MB(0.1)#6	12	23
MB(0.1)#7	10	19
MB(0.1)#8	9	13
MB(0.1)#9	7	15
MB(0.1)#10	6	12
MB(0.1)#11	8	14
MB(0.1)#12	8	13
MB(0.1)#13	7	13
MB(0.1)#14	6	10
MB(0.1)#15	8	14
Guideline ¹	20	>10,000
¹ Appendix B Soil Contaminant Standards in New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health 2012 (MfE, 2012) Residential 10% produce		

4.1.2 Organochlorine Pesticide (OCP) Results

The OCP results are presented in Table 5 and summarised as follows:

- Dieldrin concentrations were below laboratory detection limits in composite samples 'C7-8-9', 'C10-11-12' and 'C13-14-15';
- Composite soil sample C1-2-3 has a dieldrin concentration of 0.083 mg/kg, which is below the adopted guideline value; and
- Composite soil sample 'C4-5-6' exceeded the adopted guideline value of 0.86 mg/kg for dieldrin, with a concentration of 1.18 mg/kg.

All other organochlorine pesticide results were reported below laboratory detection limits and have not been presented within this document, however they are provided in Appendix E.

Table 5: Dieldrin results (mg/kg) Millbrook Extension

Samples	Composite Sample ID	Dieldrin
MB(0.1)#1	MB(0.1)C1-2-3	0.083
MB(0.1)#2		
MB(0.1)#3		
MB(0.1)#4	MB(0.1)C4-5-6	1.18
MB(0.1)#5		
MB(0.1)#6		
MB(0.1)#7	MB(0.1)C7-8-9	<0.010
MB(0.1)#8		
MB(0.1)#9		
MB(0.1)#10	MB(0.1)C10-11-12	<0.010
MB(0.1)#11		
MB(0.1)#12		
MB(0.1)#13	MB(0.1)C13-14-15	<0.010
MB(0.1)#14		
MB(0.1)#15		
Guideline ¹		0.86
¹ Appendix B Soil Contaminant Standards in New Zealand 'Users' Guide: NES for Assessing & Managing Contaminants in Soil to Protect Human Health 2012 (MfE, 2012) Residential 10% produce, because the soil sample analysed is a composite containing 3 samples the guideline value has been adjusted and divided by three. BOLD RED denotes guideline exceedance.		

4.2 QA/QC Results

4.2.1 Field Duplicates

One field duplicate soil sample was collected during the site investigation and was analysed to review the reproducibility of the sampling procedures and laboratory analysis. The duplicate relative percentage difference is presented below in Table 6. The duplicate and analysis are listed as follows:

- MB (0.1) #10 - analysed for arsenic and copper;
- DUP1 - analysed for arsenic and copper

Table 6: Duplicate relative percentage difference

Analyte (mg/kg)	MB (0.1) #10	DUP1	% Difference
Arsenic	6	6	0
Copper	12	12	0

An acceptable percentage difference between duplication samples is less than 30 to 50 % (MfE, 2004). DUP1 and 'MB(0.1)#10' had a percentage difference of 0 %. The QAQC analysis indicates the sampling and analysis undertaken was reproducible.

4.2.2 Laboratory Procedures

Hills Laboratories did not complete specific in-house QA/QC analysis such as spike recoveries or laboratory duplicates during the processing of the soil samples. The Chain of Custody form and the Hills Laboratory results are provided in Appendix E.

4.3 Risk Assessment

Based on the investigation results there has been some impact to soils to the south of the footpath that could be a risk to human health if regularly exposed to these soils over a long duration (years). It is expected that the area of impact is relatively localised and confined to the area within the yards to the south of the footpath. DCG recommends that the extent of the impacted soils is delineated and remedial measures undertaken to remove this risk from site.

The risk from the former portable sheep dip operation is considered to be low as the soil samples collected in the vicinity of this activity returned concentrations either below the laboratory detection limits or below the concentration that may be considered a risk to human health based on the proposed residential use of the site.

5.0 SUMMARY

Based on the findings of the Preliminary and Detailed Site Investigations, the following conclusions are made:

- Hazardous activities that have occurred on the site include the broadacre application of agrichemicals (fertilisers and possibly pesticides) and the use of hazardous substances in the operation of a footbath and mobile sheep dip;
- Based on liaison with the former owners of the property DCG understands a portable sheep dip was bought on to the property twice a year to treat stock until 1981;
- DCG identified the potential contaminants of concern associated with the portable sheep dip and permanent foot bath to be arsenic, copper and organochlorine pesticides;
- Arsenic and copper levels in all samples analysed returned concentrations below the adopted guideline value;
- Dieldrin was detected adjacent to the footbath exceeding the NES soil contaminant standard indicating that there is a risk to human health based on rural residential activity on the site; and
- Based on a number of investigations completed by DCG in the Wakatipu Basin we consider it highly unlikely that persistent pesticides (DDT and dieldrin) and heavy metal concentrations associated with the broadacre application of these agrichemicals would result in contaminant concentrations exceeding the NES soil contaminant standards.

In summary DCG considers the site is suitable for residential activity provided remedial work is undertaken in the vicinity of the footbath situated in the stockyards adjacent to the woolshed.

REFERENCES

Ministry for the Environment (2003a) *Contaminated Land Management Guidelines No. 1: Reporting on Contaminated Sites in New Zealand*.

Ministry for the Environment (2003b) *Contaminated Land Management Guidelines No. 2: Hierarchy and Application in New Zealand of Environmental Guideline Values*.

Ministry for the Environment (2012) *Users' Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health*. Wellington: Ministry for the Environment.

National Environment Protection Council (NEPC) (1999) *National Environment Protection (Assessment of Site Contamination) Measure - Schedule B (1) Guideline on Investigation Levels for Soil and Groundwater*. National Environment Protection Council.

Otago Regional Council (2014) *Otago Regional Council's "Database of Selected Landuses"*

Turnbull, I.M. (compiler) (2000) *Geology of the Wakatipu area*. Institute of Geological & Nuclear Sciences 1:250 000 geological map 18. 1 sheet + 72 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Ltd.

Appendices

Appendix A

Davis Consulting Group Contaminated Land Experience



Davis Consulting Group Contaminated Land Experience

Glenn Davis is the director of Davis Consulting Group and has over 15 years post graduate experience working as an Environmental Scientist. Glenn has accumulated a significant volume of work experience in the contaminated land field undertaking preliminary site investigations (PSIs), detailed site investigations (DSIs) and remediation projects in New Zealand, Australia, Asia, the United Kingdom and Ireland. The following provides a summary of Glenn Davis's experience.

Davis Consulting Group (2007 – present): Principal Environmental Scientist – completed multiple preliminary and detailed site investigations in Otago and Southland predominantly for the land development industry. In addition to undertaking investigation and remedial work DCG advises the Southland Regional Council on contaminated land matters including the review of consultant reports and consent applications. Key projects DCG has undertaken include:

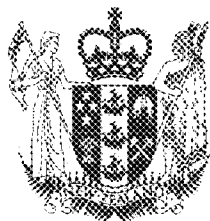
- Review of groundwater contamination associated with the former Invercargill gasworks site including the completion of a groundwater investigation and completion of an environmental risk assessment report to support a discharge consent application;
- Completion of site investigations on former landfills in Invercargill to consider the suitability of the sites for commercial/industrial development;
- Management of the removal of an underground fuel tank in Gore and subsequent groundwater investigation; and
- Completion of a number of detailed site investigations in the Te Anau area to consider the suitability of former farm land for residential development.

RPS Australia (2003 – 2006): Supervising Environmental Scientist managing multiple detailed site investigations in the land development industrial and operated as an environmental specialist for Chevron on Barrow Island monitoring and managing a number of large contaminated groundwater plumes.

URS Ireland (2001 – 2003): - Senior Environmental Scientist undertaking multiple PSIs and DSIs on services stations and train station throughout Ireland. Glenn was also involved in the design and operation of a number of large scale remediation projects, predominantly associated with the removal of hydrocarbon contaminated soil and recovery of hydrocarbons impacting groundwater.

ERM Australia (1998 – 2000) – Working as a project level environmental scientist Glenn completed in excess of 30 detailed site investigations and remedial projects on service stations, concrete batching plants, and transport depots.

Appendix B
Historical Certificates of Title



COMPUTER FREEHOLD REGISTER UNDER LAND TRANSFER ACT 1952



R. W. Muir
Registrar-General
of Land

Historical Search Copy

Identifier 40955
Land Registration District Otago
Date Issued 01 November 2002

Prior References

OT19A/129 OT19A/425

Estate	Fee Simple
Area	64.6656 hectares more or less
Legal Description	Lot 1 Deposited Plan 310442 and Lot 1 Deposited Plan 313841 and Section 29, 57 Block VI Shotover Survey District

Original Proprietors

Philippa Anne MacAuley as to a 1/4 share
Ian Gordon MacAuley as to a 1/4 share
Philippa Anne MacAuley, John Steven Pritchard and Bruce Young Cunningham as to a 1/4 share
Ian Gordon MacAuley, John Steven Pritchard and Bruce Young Cunningham as to a 1/4 share

Interests

The right of way easement created by Transfer 904356.8 is subject to Section 243 (a) Resource Management Act 1991

Subject to a right (in gross) to convey water over part marked Y-Z-AA on diagram attached to Transfer 839039 in favour of Arrow Irrigation Company Limited created by Transfer 839039 - 22.9.1993 at 10:09 am

980634.2 Mortgage to Rabobank New Zealand Limited - 22.12.1999 at 10:55 am

Subject to Section 243 (c) Resource Management Act 1991 (see DP 27269)

4838 Order in Council imposing Building Line Restriction - 17.3.1939 at 10.00am (affects Mooney Road frontage)

Subject to a right of way and right to convey telecommunications and transmit electricity over part marked A on DP 24886 created by Transfer 904356.8 - 25.3.1996 at 9:16 am

Subject to Section 241(2) Resource Management Act 1991 (affects DP 310442)

Appurtenant hereto is a right to take water and to convey electricity and water created by Easement Instrument 5390598.4 - 1.11.2002 at 12:29 pm

The easements created by Easement Instrument 5390598.4 are subject to Section 243 (a) Resource Management Act 1991

5413110.1 Departmental Dealing to correct the surname of Phillipa Anne MacAuley and Ian Gordon MacAuley to Phillipa Anne Macauley and Ian Gordon Macauley - 25.11.2002 at 10:30 am

8235843.1 Discharge of Mortgage 980634.2 - 24.7.2009 at 9:42 am

9840351.1 CAVEAT BY TERENCE YOUNG - 15.9.2014 at 12:09 pm

9734534.1 Change of Name of Phillipa Anne Macauley to Philippa Anne Macauley, Phillipa Anne Macauley to Philippa Anne Macauley - 25.9.2014 at 10:00 am

9862983.1 Lapse of Caveat 9840351.1 pursuant to Section 145A Land Transfer Act 1952 - produced 22.10.2014 at 4.24 pm and entered 10.12.2014 at 7.00 am

9904209.1 CAVEAT BY MILLBROOK COUNTRY CLUB LIMITED - 21.11.2014 at 3:42 pm

Subject to a right of way over part Lot 1 DP 310442 marked A, B, C, D on DP 27269 and over part Section 57 Block VI Shotover Survey District marked D on DP 27269, a right to convey water over part Lot 1 DP 310442 marked e-n, D, e-o, l-m, k-j on DP 27269 and over part Section 57 Block VI Shotover Survey District marked D, l-m on DP 27269 and a right to convey power and telecommunications over part Lot 1 DP 310442 marked A, f-g, h-i,

Identifier**40955**

D, j-k on DP 27269 and over part Section 57 Block VI Shotover Survey District marked D, j-k on DP 27269 created by Easement Instrument 9932213.1 - 17.12.2014 at 2:30 pm

Appurtenant hereto is a right to convey power and electricity created by Easement Instrument 9932213.1 - 17.12.2014 at 2:30 pm

Some of the easements created by Easement Instrument 9932213.1 are subject to Section 243 (a) Resource Management Act 1991 (see DP 27269)

The easements created by Easement Instrument 9932213.1 satisfy the Section 243 (c) Resource Management Act 1991 memorial

9935301.1 CAVEAT BY TERENCE YOUNG - 18.12.2014 at 1:44 pm

Appendix C
Soil Profile Logs



SOIL PROFILE LOGS

PROJECT NUMBER: 14088

FIELD STAFF: FR

DATE: 1/04/2014

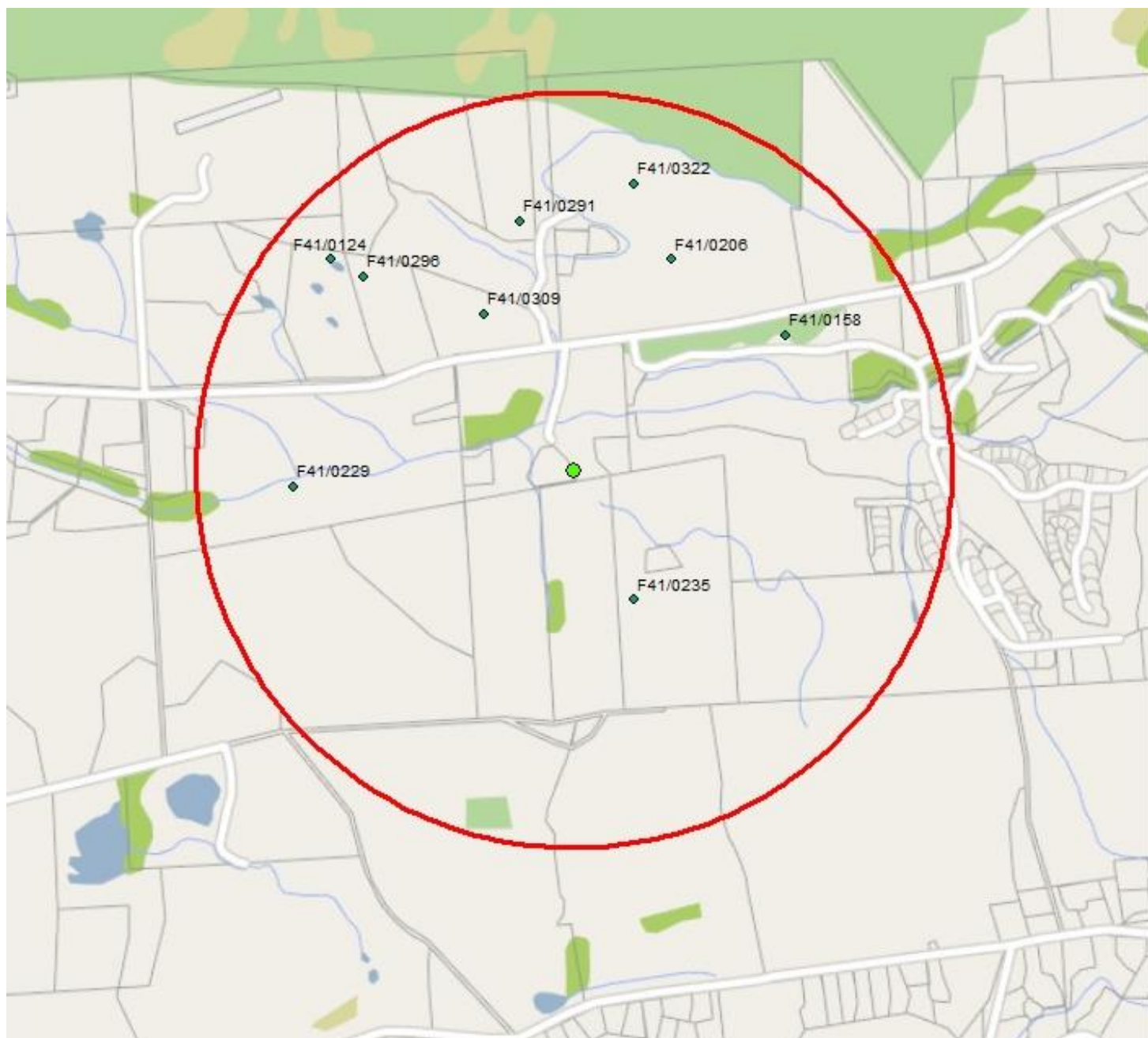
SITE NAME: Millbrook Extension

METHOD: Spade

WEATHER: Fine

Sample Location	Coordinates		Sample Depth	Sample ID	Soil Lithology
1	1267859	5014160	0-0.1	MB(0.1)#1	moderately dry brownish grey silty CLAY with one cobble
2	1267860	5014159	0-0.1	MB(0.1)#2	dark brown/black (possible staining) silty CLAY
3	1267863	5014160	0-0.1	MB(0.1)#3	light greyish brown silty CLAY
4	1267855	5014161	0-0.1	MB(0.1)#4	greyish brown fine sandy SILT with gravels
5	1267857	5014162	0-0.1	MB(0.1)#5	greyish brown fine sandy SILT with gravels
6	1267859	5014160	0-0.1	MB(0.1)#6	moderately dry brownish grey silty CLAY with one cobble
7	1267862	5014149	0-0.1	MB(0.1)#7	greyish brown fine sandy SILT with gravels
8	1267872	5014150	0-0.1	MB(0.1)#8	greyish brown silty GRAVEL with fine sand
9	1267889	5014153	0-0.1	MB(0.1)#9	light greyish brown clayey SILT with some gravels
10	1267869	5014176	0-0.1	MB(0.1)#10	light greyish brown sandy SILT
10	1267869	5014176	0-0.1	Dup 1	light greyish brown sandy SILT
11	1267880	5014172	0-0.1	MB(0.1)#11	light greyish brown sandy SILT
12	1267893	5014170	0-0.1	MB(0.1)#12	light greyish brown sandy SILT
13	1267866	5014162	0-0.1	MB(0.1)#13	friable brownish grey silty CLAY
14	1267876	5014162	0-0.1	MB(0.1)#14	greyish brown silty GRAVEL with fine sand
15	1267892	5014157	0-0.1	MB(0.1)#15	light greyish brown sandy SILT

Appendix D
ORC Bore Search



Appendix E

Laboratory analytical certificate and results, and chain of custody documentation



Chain of Custody

Sheet 1 of 2

Date Collected:

1/4/14

Sampling Conditions (brief description of weather conditions/flow rates etc)

Dry

Laboratory use

Your Address: Davis Consulting Group Ltd.
 Arrow Lane
 Arrowtown 9302

Samples Filtered and/or Preserved?

Priority: High Priority

CoC to be emailed back: Yes

Phone Number: 03 409 8664

Email Address: Fiona@davisconsultinggroup.co.nz

Project No/Property Name: Millbrook 14027

Who Sampled: Fiona

Samples Released By (Signature): [Signature]

Samples Received By (Signature):

Date and Time Released: 2/4/14 0945

Date and Time Received:

Sample ID	Date	Time	Matrix	Analytes					
				TPH/BTEX	PAH	Metals ¹	pH	OCFs	
MB(0.1)#1	1/4/14	1400	Soil			✓			
MB(0.1)#2		1405	Soil			✓			
MB(0.1)#3		1420	Soil			✓			
MB(0.1)C1-2-3		1418	Soil					✓	
MB(0.1)#4		1435	Soil			✓			
MB(0.1)#5		1440	Soil			✓			
MB(0.1)#6		1446	Soil			✓			
MB(0.1)C4-5-6		1446	Soil					✓	
MB(0.1)#7		1501	Soil			✓			
MB(0.1)#8		1510	Soil			✓			
MB(0.1)#9		1524	Soil			✓			
MB(0.1)C7-8-9	✓	1530	Soil					✓	

Temperature On Arrival

19.4°C

Temperature was measured on one or more arbitrarily chosen samples in this batch.

Note:

1 Metals Analysis to include Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Lead and Zinc



Received by: Lisa Bailey

Job No: 1257696
 Date Recv: 03-Apr-14 05:30



Chain of Custody

Sheet 2 of 2

Date Collected:

1/4/14

Sampling Conditions (brief description of weather conditions/flow rates etc)

Dry

Your Address: Davis Consulting Group Ltd.
 Arrow Lane
 Arrowtown 9302

Samples Filtered and/or Preserved?

Priority: High Priority

CoC to be emailed back: Yes

Phone Number: 03 409 8664

Email Address: fiona@davisconsultinggroup.co.nz

Project No/Property Name: Millbrook 14027

Who Sampled: fiona

Samples Released By (Signature): [Signature]

Samples Received By (Signature):

Date and Time Released: 2/4/14 0945

Date and Time Received:

Sample ID	Date	Time	Matrix	Analytes					
				TPH/BTEX	PAH	Metals ¹	pH	OCBs	
MB(0-1)#10	1/4/14	1539	Soil			✓			
MB(0-1)#11		1534	Soil			✓			
MB(0-1)#12		1603	Soil			✓			
MB(0-1)C10-11-12		1602	Soil					✓	
MB(0-1)#13		1620	Soil			✓			
MB(0-1)#14		1625	Soil			✓			
MB(0-1)#15		1630	Soil			✓			
MB(0-1)C13-14-15		1539	Soil			✓			
MB(0-1)C13-14-15		1630	Soil					✓	
			Soil						
			Soil						
			Soil						

Note:

1 Metals Analysis to include Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Lead and Zinc

Laboratory use



Job Information Summary

Page 1 of 2

Client:	Davis Consulting Group Limited	Lab No:	1257696
Contact:	Fiona Rowley	Date Registered:	03-Apr-2014 3:25:50 pm
	C/- Davis Consulting Group Limited	Priority:	High
	PO Box 2450	Quote No:	
	Wakatipu	Order No:	
	QUEENSTOWN 9349	Client Reference:	Millbrook 14027
		Add. Client Ref:	
		Submitted By:	Fiona Rowley
		Charge To:	Davis Consulting Group

Samples

No	Sample Name	Sample Type	Containers	Tests Requested
1	MB (0.1) #1 01-Apr-2014 2:00 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
2	MB (0.1) #2 01-Apr-2014 2:05 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
3	MB (0.1) #3 01-Apr-2014 2:20 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
4	MB (0.1) C1-2-3 01-Apr-2014 2:18 pm	Soil	GSoil300	Organochlorine Pesticides Screening in Soil
5	MB (0.1) #4 01-Apr-2014 2:35 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
6	MB (0.1) #5 01-Apr-2014 2:40 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
7	MB (0.1) #6 01-Apr-2014 2:46 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
8	MB (0.1) C4-5-6 01-Apr-2014 2:46 pm	Soil	GSoil300	Organochlorine Pesticides Screening in Soil
9	MB (0.1) #7 01-Apr-2014 3:01 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
10	MB (0.1) #8 01-Apr-2014 3:10 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
11	MB (0.1) #9 01-Apr-2014 3:24 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
12	MB (0.1) C7-8-9 01-Apr-2014 3:30 pm	Soil	GSoil300	Organochlorine Pesticides Screening in Soil
13	MB (0.1) #10 01-Apr-2014 3:39 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
14	MB (0.1) #11 01-Apr-2014 3:54 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
15	MB (0.1) #12 01-Apr-2014 4:03 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
16	MB (0.1) C10-11-12 01-Apr-2014 4:02 pm	Soil	GSoil300	Organochlorine Pesticides Screening in Soil
17	MB (0.1) #13 01-Apr-2014 4:20 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
18	MB (0.1) #14 01-Apr-2014 4:25 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
19	MB (0.1) #15 01-Apr-2014 4:30 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
20	MB DUP #1 01-Apr-2014 3:39 pm	Soil	GSoil300	Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn
21	MB (0.1) C13-14-15 01-Apr-2014 4:30 pm	Soil	GSoil300	Organochlorine Pesticides Screening in Soil

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, 5-7, 9-11, 13-15, 17-20
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	0.10 - 4 mg/kg dry wt	1-3, 5-7, 9-11, 13-15, 17-20
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	4, 8, 12, 16, 21

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3, 5-7, 9-11, 13-15, 17-20



ANALYSIS REPORT

Page 1 of 4

Client:	Davis Consulting Group Limited	Lab No:	1257696	SPV1
Contact:	Fiona Rowley	Date Registered:	03-Apr-2014	
	C/- Davis Consulting Group Limited	Date Reported:	10-Apr-2014	
	PO Box 2450	Quote No:		
	Wakatipu	Order No:		
	QUEENSTOWN 9349	Client Reference:	Millbrook 14027	
		Submitted By:	Fiona Rowley	

Sample Type: Soil						
Sample Name:	MB (0.1) #1 01-Apr-2014 2:00 pm	MB (0.1) #2 01-Apr-2014 2:05 pm	MB (0.1) #3 01-Apr-2014 2:20 pm	MB (0.1) C1-2-3 01-Apr-2014 2:18 pm	MB (0.1) #4 01-Apr-2014 2:35 pm	
Lab Number:	1257696.1	1257696.2	1257696.3	1257696.4	1257696.5	
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	12	10	10	-	12
Total Recoverable Copper	mg/kg dry wt	38	20	22	-	25
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	-	< 0.010	-
alpha-BHC	mg/kg dry wt	-	-	-	< 0.010	-
beta-BHC	mg/kg dry wt	-	-	-	< 0.010	-
delta-BHC	mg/kg dry wt	-	-	-	< 0.010	-
gamma-BHC (Lindane)	mg/kg dry wt	-	-	-	< 0.010	-
cis-Chlordane	mg/kg dry wt	-	-	-	< 0.010	-
trans-Chlordane	mg/kg dry wt	-	-	-	< 0.010	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	-	-	< 0.04	-
2,4'-DDD	mg/kg dry wt	-	-	-	< 0.010	-
4,4'-DDD	mg/kg dry wt	-	-	-	< 0.010	-
2,4'-DDE	mg/kg dry wt	-	-	-	< 0.010	-
4,4'-DDE	mg/kg dry wt	-	-	-	< 0.010	-
2,4'-DDT	mg/kg dry wt	-	-	-	< 0.010	-
4,4'-DDT	mg/kg dry wt	-	-	-	< 0.010	-
Dieldrin	mg/kg dry wt	-	-	-	0.083	-
Endosulfan I	mg/kg dry wt	-	-	-	< 0.010	-
Endosulfan II	mg/kg dry wt	-	-	-	< 0.010	-
Endosulfan sulphate	mg/kg dry wt	-	-	-	< 0.010	-
Endrin	mg/kg dry wt	-	-	-	< 0.010	-
Endrin aldehyde	mg/kg dry wt	-	-	-	< 0.010	-
Endrin ketone	mg/kg dry wt	-	-	-	< 0.010	-
Heptachlor	mg/kg dry wt	-	-	-	< 0.010	-
Heptachlor epoxide	mg/kg dry wt	-	-	-	< 0.010	-
Hexachlorobenzene	mg/kg dry wt	-	-	-	< 0.010	-
Methoxychlor	mg/kg dry wt	-	-	-	< 0.010	-
Sample Name:	MB (0.1) #5 01-Apr-2014 2:40 pm	MB (0.1) #6 01-Apr-2014 2:46 pm	MB (0.1) C4-5-6 01-Apr-2014 2:46 pm	MB (0.1) #7 01-Apr-2014 3:01 pm	MB (0.1) #8 01-Apr-2014 3:10 pm	
Lab Number:	1257696.6	1257696.7	1257696.8	1257696.9	1257696.10	
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	11	12	-	10	9
Total Recoverable Copper	mg/kg dry wt	26	23	-	19	13
Organochlorine Pesticides Screening in Soil						



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:		MB (0.1) #5 01-Apr-2014 2:40 pm	MB (0.1) #6 01-Apr-2014 2:46 pm	MB (0.1) C4-5-6 01-Apr-2014 2:46 pm	MB (0.1) #7 01-Apr-2014 3:01 pm	MB (0.1) #8 01-Apr-2014 3:10 pm
Lab Number:		1257696.6	1257696.7	1257696.8	1257696.9	1257696.10
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	< 0.010	-	-
alpha-BHC	mg/kg dry wt	-	-	< 0.010	-	-
beta-BHC	mg/kg dry wt	-	-	< 0.010	-	-
delta-BHC	mg/kg dry wt	-	-	< 0.010	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	-	< 0.010	-	-
cis-Chlordane	mg/kg dry wt	-	-	< 0.010	-	-
trans-Chlordane	mg/kg dry wt	-	-	< 0.010	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	-	< 0.04	-	-
2,4'-DDD	mg/kg dry wt	-	-	< 0.010	-	-
4,4'-DDD	mg/kg dry wt	-	-	< 0.010	-	-
2,4'-DDE	mg/kg dry wt	-	-	< 0.010	-	-
4,4'-DDE	mg/kg dry wt	-	-	< 0.010	-	-
2,4'-DDT	mg/kg dry wt	-	-	< 0.010	-	-
4,4'-DDT	mg/kg dry wt	-	-	< 0.010	-	-
Dieldrin	mg/kg dry wt	-	-	1.18	-	-
Endosulfan I	mg/kg dry wt	-	-	< 0.010	-	-
Endosulfan II	mg/kg dry wt	-	-	< 0.010	-	-
Endosulfan sulphate	mg/kg dry wt	-	-	< 0.010	-	-
Endrin	mg/kg dry wt	-	-	< 0.010	-	-
Endrin aldehyde	mg/kg dry wt	-	-	< 0.010	-	-
Endrin ketone	mg/kg dry wt	-	-	< 0.010	-	-
Heptachlor	mg/kg dry wt	-	-	< 0.010	-	-
Heptachlor epoxide	mg/kg dry wt	-	-	< 0.010	-	-
Hexachlorobenzene	mg/kg dry wt	-	-	< 0.010	-	-
Methoxychlor	mg/kg dry wt	-	-	< 0.010	-	-

Sample Name:		MB (0.1) #9 01-Apr-2014 3:24 pm	MB (0.1) C7-8-9 01-Apr-2014 3:30 pm	MB (0.1) #10 01-Apr-2014 3:39 pm	MB (0.1) #11 01-Apr-2014 3:54 pm	MB (0.1) #12 01-Apr-2014 4:03 pm
Lab Number:		1257696.11	1257696.12	1257696.13	1257696.14	1257696.15
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	7	-	6	8	8
Total Recoverable Copper	mg/kg dry wt	15	-	12	14	13
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.010	-	-	-
alpha-BHC	mg/kg dry wt	-	< 0.010	-	-	-
beta-BHC	mg/kg dry wt	-	< 0.010	-	-	-
delta-BHC	mg/kg dry wt	-	< 0.010	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.010	-	-	-
cis-Chlordane	mg/kg dry wt	-	< 0.010	-	-	-
trans-Chlordane	mg/kg dry wt	-	< 0.010	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	< 0.04	-	-	-
2,4'-DDD	mg/kg dry wt	-	< 0.010	-	-	-
4,4'-DDD	mg/kg dry wt	-	< 0.010	-	-	-
2,4'-DDE	mg/kg dry wt	-	< 0.010	-	-	-
4,4'-DDE	mg/kg dry wt	-	< 0.010	-	-	-
2,4'-DDT	mg/kg dry wt	-	< 0.010	-	-	-
4,4'-DDT	mg/kg dry wt	-	< 0.010	-	-	-
Dieldrin	mg/kg dry wt	-	< 0.010	-	-	-
Endosulfan I	mg/kg dry wt	-	< 0.010	-	-	-
Endosulfan II	mg/kg dry wt	-	< 0.010	-	-	-
Endosulfan sulphate	mg/kg dry wt	-	< 0.010	-	-	-
Endrin	mg/kg dry wt	-	< 0.010	-	-	-
Endrin aldehyde	mg/kg dry wt	-	< 0.010	-	-	-

Sample Type: Soil						
Sample Name:		MB (0.1) #9 01-Apr-2014 3:24 pm	MB (0.1) C7-8-9 01-Apr-2014 3:30 pm	MB (0.1) #10 01-Apr-2014 3:39 pm	MB (0.1) #11 01-Apr-2014 3:54 pm	MB (0.1) #12 01-Apr-2014 4:03 pm
Lab Number:		1257696.11	1257696.12	1257696.13	1257696.14	1257696.15
Organochlorine Pesticides Screening in Soil						
Endrin ketone	mg/kg dry wt	-	< 0.010	-	-	-
Heptachlor	mg/kg dry wt	-	< 0.010	-	-	-
Heptachlor epoxide	mg/kg dry wt	-	< 0.010	-	-	-
Hexachlorobenzene	mg/kg dry wt	-	< 0.010	-	-	-
Methoxychlor	mg/kg dry wt	-	< 0.010	-	-	-
Sample Name:		MB (0.1) C10-11-12 01-Apr-2014 4:02 pm	MB (0.1) #13 01-Apr-2014 4:20 pm	MB (0.1) #14 01-Apr-2014 4:25 pm	MB (0.1) #15 01-Apr-2014 4:30 pm	MB DUP #1 01-Apr-2014 3:39 pm
Lab Number:		1257696.16	1257696.17	1257696.18	1257696.19	1257696.20
Individual Tests						
Total Recoverable Arsenic	mg/kg dry wt	-	7	6	8	6
Total Recoverable Copper	mg/kg dry wt	-	13	10	14	12
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	-	-	-	-
alpha-BHC	mg/kg dry wt	< 0.010	-	-	-	-
beta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
delta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	-	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	-	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
Dieldrin	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan I	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan II	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.010	-	-	-	-
Endrin	mg/kg dry wt	< 0.010	-	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.010	-	-	-	-
Endrin ketone	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.010	-	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.010	-	-	-	-
Methoxychlor	mg/kg dry wt	< 0.010	-	-	-	-
Sample Name:		MB (0.1) C13-14-15 01-Apr-2014 4:30 pm				
Lab Number:		1257696.21				
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.010	-	-	-	-
alpha-BHC	mg/kg dry wt	< 0.010	-	-	-	-
beta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
delta-BHC	mg/kg dry wt	< 0.010	-	-	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.010	-	-	-	-
cis-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
trans-Chlordane	mg/kg dry wt	< 0.010	-	-	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	-	-	-	-
2,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-

Sample Type: Soil						
Sample Name:		MB (0.1) C13-14-15 01-Apr-2014 4:30 pm				
Lab Number:		1257696.21				
Organochlorine Pesticides Screening in Soil						
4,4'-DDD	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDE	mg/kg dry wt	< 0.010	-	-	-	-
2,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
4,4'-DDT	mg/kg dry wt	< 0.010	-	-	-	-
Dieldrin	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan I	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan II	mg/kg dry wt	< 0.010	-	-	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.010	-	-	-	-
Endrin	mg/kg dry wt	< 0.010	-	-	-	-
Endrin aldehyde	mg/kg dry wt	< 0.010	-	-	-	-
Endrin ketone	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor	mg/kg dry wt	< 0.010	-	-	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.010	-	-	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.010	-	-	-	-
Methoxychlor	mg/kg dry wt	< 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%.	-	1-3, 5-7, 9-11, 13-15, 17-20
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	4, 8, 12, 16, 21
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-3, 5-7, 9-11, 13-15, 17-20
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, 5-7, 9-11, 13-15, 17-20
Total Recoverable Copper	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, 5-7, 9-11, 13-15, 17-20

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.



Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental Division