

# PRELIMINARY SITE INVESTIGATION

## WAIRAKEI INTERNATIONAL GOLF COURSE WAIRAKEI

PROJECT NO. EAM2202-01

PREPARED FOR  
TW GROUP

PREPARED BY  
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NOVEMBER 2021

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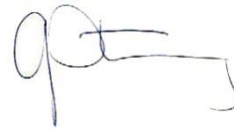
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## 1 INTRODUCTION

EAM NZ Limited (EAM) has been engaged by TW GROUP to undertake a Preliminary Site Investigation (PSI), at Wairakei International Golf course (hereon in referred to as the Site). It is our understanding that a parcel of land in the northern extent of the property is proposed for residential subdivision.

This PSI has been undertaken to provide a contamination assessment of the Site and to evaluate human health risks at the Site. A phased approach has been adopted for this investigation with an initial investigation, assembling background information to identify potential sources of contamination from past and present activities. This information is then used to develop a conceptual Site model and investigation strategy.

This report provides the following information:

- Background information.
- Site history.
- A conceptual Site model.
- Site visit and sampling
- Laboratory results.
- Conclusions and recommendations.

This investigation has been carried out in accordance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES).

### 1.1 SCOPE

The following scope of work was completed:

- Review of available information from Taupo District Council, namely, the Listed Land Use Register (LLUR), historical aerial photographs, and available environmental reports.
- Review of the environmental setting of the site
- Collection of soil samples at varying depths (where deemed necessary).
- Analysis of soil samples at an accredited laboratory for:
  - Heavy metals
  - OCP
- Preparation of a PSI report, including presentation and interpretation of results in accordance with the requirements of the NESCS and with the current edition of the MfE Contaminated Land Management Guidelines No. 1 and No. 5.

This assessment has been undertaken by a Suitably Qualified Environmental Practitioner (SQEP) with experience in the field of contaminated land assessments. The SQEP holds a BSc Degree in Environmental Science.

## **1.2 LIMITATIONS**

This report: has been prepared by EAM for TW Group and may only be used and relied on by Taupo District Council for the purpose agreed between EAM and TW GROUP as set out in section 1.1 of this report. EAM otherwise disclaims responsibility to any person other than TW GROUP arising in connection with this report. EAM also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by EAM in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. EAM has no responsibility or obligation to update this report to account for events or changes occurring after the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by EAM described in this report (refer section(s) 1.3 of this report). EAM disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the site conditions, such as the location of buildings, services, and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. EAM does not accept responsibility arising from, or in connection with, any change to the site conditions. EAM is also not responsible for updating this report if the site conditions change.

EAM has prepared this report based on information provided by TW Group and others who provided information to EAM (including Government authorities), which EAM has not independently verified or checked beyond the agreed scope of work. EAM does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

## **1.3 ASSUMPTIONS**

EAM has made the following assumptions during the preparation of this report:

- Information obtained from third parties and TW Group is complete and accurate.
- The observed and inferred conditions are representative of the actual conditions associated with HAIL sites and / or other sites not directly assessed.
- That the future land use of the site will remain residential.

## 2 SITE DETAILS

### 2.1 SITE DESCRIPTION

The Site is located at 1/527 Wairakei Drive, Wairakei. The legal description for the property is Lot 1 DP 426900 and occupies a total area of 145.57 ha.

Figures 1 and 2 of Appendix A illustrate the property location and the site concept development plan.

## 3 ENVIRONMENTAL SETTING

The topography of the site and surrounding area is hilly and undulating. Located at approximately 400masl the site gently climbs in topography from east to west.

The site is located within the Wairakei Geothermal field, which resides within volcanic strata of the Taupo Volcanic Zone. This Quaternary basin is up to 3 km deep and comprises a stacked sequence of tuffs, volcano-clastics, and ignimbrites. The New Zealand Geothermal Association describes the upper geological formation as a hydrothermally altered (argillic) layer of Upper Quaternary lacustrine mudstones, breccias, ignimbrites, and tuffs.

Soils at the Site are described by Landcare Research (2020) as being moderately well draining Pumice Soils. Pumice Soils are Sandy or gravelly, dominated by pumice, or pumice sand with a high content of natural glass, low clay contents, low soil strength, high macroporosity, deep rooting depth and rapid drainage. They are however able to store large amounts of available water for vegetation. The parent materials are weakly weathered with low macronutrient reserves and trace element deficiencies. They occur predominantly in the central North Island covering 7% of New Zealand.

The nearest significant surface water source is the Waikato River, located approximately 500m to the east of the site eastern boundary. The Waikato River is a major water source for the Upper and Central North Island of New Zealand. Approximately 1km, and 1.5km north of the site, are the Kiriohineki Stream and the Wairakei Stream, respectively. Both streams drain easterly into the Waikato River, where they eventuate some 1500mm north-east of the site.

## 4 PROPERTY HISTORY

A desktop study was undertaken to gain an understanding of the history of the site. The review looks to determine potential contaminants which may be present at the site because of past and present land uses. The following information was sourced to establish the history of the site:

- Taupo District Council Property Search
- Historical Aerial Photographs
- Site Visit

### 4.1 TAUPO DISTRICT COUNCIL PROPERTY SEARCH

TDC did not have this Site listed on their Contaminated Site Register.

### 4.2 HISTORICAL AERIAL PHOTOGRAPHS

Historical aerial photographs of the site, from 1952 through to 1996, were sourced from Retrolens and from 2021 from Google Maps. Aerial photographs for the years 1952, 1964, 1972, 1982, 1996 and 2021 are presented in Appendix B.

The earliest historical imagery available is from 1952 which shows the site as a mixture of thick native vegetation with areas of open land. Imagery from 1964 shows the same configuration, and sometime between 1964 and 1972 the site is cleared. The new roadway from Taupo through to the Wairakei Roundabout is visible along the eastern boundary.

Imagery from 1982 and 1996 shows the site replanted in trees. There is an absence of available imagery for the site between 1996 and 2021, with imagery from Retrolens ceasing after 1996. There is a lack of aerial imagery available from Taupo District Council for the last two decades, with the area not included in aerial capture.

Imagery from Google maps in 2021 show the site in its current setting. Most of the site has been cleared, except for the land to the west. The east of the site is utilised for farmland, with a small deer shed and fenced paddocks visible. A water storage pond is observed on the western boundary amongst established vegetation.

### 4.3 SITE VISIT

A site visit was completed on 9<sup>th</sup> November 2021. Site photographs are presented in Appendix C. The entrance to the site is through the electronic gates at the Wairakei International Golf Course. The proposed site boundary commences to the north of the practice green.

The eastern third of the site is currently utilised for agriculture, with the land fenced into paddocks with tall deer fencing. A mob of deer and a herd of goats currently occupy these paddocks. A deer shed constructed of timber, ply, wire, and corrugated iron is located within this area. A reticulated water system is visible, providing stock water to small troughs. In this area are two large piles of rubble and concrete slabs. The soil is mounded and uneven around these areas suggesting potential burial, or movement of soil. No waste material was observed other than concrete rubble and slabs.

To the west of this area, the site becomes overgrown with bracken, blackberry, grass, and weeds, before migrating into established vegetation and large trees. A cluster of beehives are present. A group of three water tanks, and another individual tank are observed higher up on the site, likely to gravity feed down to the areas of lower topography.

The western most extent of the site is thickly planted with a mixture of established eucalyptus and conifer stands. Native vegetation fills the understory. A large water storage pond is located on the western boundary, which is to be outside of the proposed site plans. Cleared tracks extend throughout the site for vehicle access.

Aside from the deer shed, there are no buildings or features on the site aside from stock fencing. The outer boundary on the north, east and western sides are predator free-fence line.

## 5 CONCEPTUAL SITE MODEL

### 5.1 RATIONALE

The overall rationale for the site investigation was to determine whether historical activities on the Site may have caused soil contamination that would affect the proposed land use. The following is an analysis of potential contaminants, receptors, and pathways between potentially contaminated soils, and the proposed Industrial land use.

### 5.1.1 POTENTIALLY RELEVANT SENSITIVE HUMAN AND ECOLOGICAL RECEPTORS

The Site is proposed for rural residential (25% produce) land use, which is considered the most sensitive of land uses. The MFES National Environmental Standard (NES) for soil contaminants, considers that residential landowners may use the land for activities such as vegetable gardening or fruit trees. These activities pose a risk to the consumer/landowner's where contaminated soils are involved in an exposure pathway.

The following potential receptors were identified as being relevant to the Site:

- Earthworks, construction, maintenance, and excavation contractors who may encounter potentially contaminated soil during the proposed works via inhalation (dusts).
- Future residents at the Site via inhalation (dusts) and/or ingestion of contaminated soil.

### 5.1.2 EXPOSURE PATHWAYS

A human health risk can only occur when there is a direct link between contaminant source and receptor. Potential complete pathways for this Site may include:

- Dermal (skin) contact with soil, for gardening, construction.
- Direct contact and inhalation of dusts and soil during construction and site works.
- Consumption of foods grown in contaminated soils.
- Consumption of soils, particularly by small children.

## 5.2 SOIL SAMPLE COLLECTION

Four soil samples were collected from two locations at the site. Samples were collected from these two locations due to the presence of large slabs of partially buried concrete and rubble in two separate areas. Not knowing the source of the rubble, samples were collected for preliminary analysis. Soils were collected from 0-150mm and 150-300mm at each location.

Samples were collected directly into laboratory supplied containers and containers were placed in a chilly bin with ice packs for transport. Samples were couriered to an IANZ accredited laboratory (Hills Laboratories) under standard chain of custody protocols.

### 5.2.1 FIELD QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Quality Assurance and Quality Control procedures undertaken during sampling included the following:

- Changing of disposable gloves after each sample.
- Decontamination and rinsing of augur between each sample.
- Collection of soil samples in new, clean, appropriately labelled sample bags.
- Use of chain of custody procedures and forms.
- Use of IANZ accredited laboratories with in-house QA/QC procedures for the analyses requested.

### 5.2.2 HAZARDOUS SUBSTANCES AND POTENTIAL CONTAMINANTS OF CONCERN

For the purposes of this investigation, the following contaminants were considered.

- Metals



- Organo-Chlorine Pesticides (OCP)

Presence of the rubble and concrete may indicate a structure or building formerly present at the location. It could also be relocated material from another location on the site. To establish whether potential contamination may result from this material, metals and OCP were analysed as a precautionary measure.

## 6 ASSESSMENT CRITERIA

The following soil assessment criteria have been selected for the site.

### 6.1 THE NATIONAL ENVIRONMENTAL STANDARD FOR ASSESSING AND MANAGING CONTAMINANTS IN SOIL TO PROTECT HUMAN HEALTH (NESCS)

The NESCS sets national standards for contaminants in soil to protect human health. It contains a national set of soil contaminant standards (SCS) for 12 priority contaminants for five standard land use scenarios. The land use category selected for this investigation was Residential (10% Produce) as described in the NES CS User Guide.

### 6.2 THE NATIONAL ENVIRONMENTAL PROTECTION MEASURE

In the absence of New Zealand specific risk-based human health criteria for beryllium, nickel and zinc, the Australian National Environment Protection Measure 2013 (NEPM) guidelines have been adopted for this investigation. The intention of the NEPM is to enable safe use of contaminated land to ensure that contaminated land is appropriately assessed prior to development. The NEPM covers a range of land uses. For the purposes of this assessment, the NEPM Health-based Investigation Level A (Residential land use) have been selected based on the land use and Site attributes.

### 6.3 BACKGROUND CONCENTRATIONS OF HEAVY METALS

Established background concentrations are based on the analysis of soil sample sets collected from major soil types in the Taupo Region for selected heavy metals. If concentrations of contaminants are found to be at or less than typical background concentrations, then the NES CS does not apply.

## 7 ANALYTICAL RESULTS

The following sections discusses the analytical results by analyte and compares against the adopted human health guideline criteria. In this case, the most appropriate SCS is likely to be those for the NES land use scenario of Residential (25% Produce). The NES description of this land use is as follows:

*“Including home grown produce consumption (25%). Applicable to the residential vicinity of farmhouses for the protection of farming families, but not the productive parts of agricultural land”.*

The analytical results are summarised in Table 1 in Appendix D, along with the laboratory reports. The results of analysis have been compared directly against appropriate (where available) Soil Contaminant Standards (SCS) from the NES Priority contaminants list (MfE, 2012).

### 7.1 METALS

Laboratory analysis reported all metals well within the guideline standards for the NES Soil Contaminant Standards for rural residential (25% produce) land use.

## 7.2 ORGANOCHLORINE PESTICIDES

Laboratory analysis reported trace DDT concentrations in the composite samples formed by the four samples. Trace concentrations are well below the NES rural residential standards.

## 7.3 BACKGROUND SOIL CONCENTRATIONS

Analytical results reported all soil metal concentrations below the uncontaminated background soil concentrations or the Wairakei region. Taupo geothermal areas are associated with high arsenic concentrations because of geothermal activity, with background soil concentrations for the area reported by Landcare Research LRIS portal as 16mg/kg. The arsenic concentrations reported by the laboratory are below the detection limits in sample location 1 and are 3mg/kg in sample location 2. Soils at the site are considered representative of a background soil.

## 7.4 RISK ASSESSMENT

A hazard – pathway – receptor pollution linkage is considered to aid assessment of risk associated with results of the site investigation.

For contaminated soils to pose a risk to a receptor, a complete pathway must exist between the contamination source and the identified receptor(s). If there is an incomplete pathway, then there is no risk. In this instance the results show that a risk to human health at this site is highly unlikely to exist.

# 8 CONCLUSIONS AND RECOMMENDATIONS

From this investigation, due consideration was given to the full range of potential contaminants that might be expected to occur at this site. The following key points summarise this investigation:

- A detailed site history was undertaken to review the historical land use at the site.
- The site has been utilised for trees and farmland since at least 1952.
- Soil samples were collected from two locations of interest at the site.
- Results reported metal concentrations below the NES soil contaminant standards for the land use scenario of residential (25% produce).
- One, four-part composite samples was analysed for Organochlorine Pesticides with results reporting concentrations within the NES rural residential standards.

The assessment has identified that the soils at this site are highly unlikely to represent a risk to human health. No further work is required.

## 9 REFERENCES

MfE 2011 Contaminated Land Management Guidelines No.1 Reporting on Contaminated Sites in New Zealand. Ministry for the Environment.

MfE 2012 Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Ministry for the Environment.

MfE 2011 Contaminated Land Management Guidelines No.5; Site Investigation and Analysis of Soil. Ministry for the Environment.

Hawkes Bay Region: Background Soil Concentrations for Managing Soil Quality, Landcare Research, 2014.

<https://soils-maps.landcareresearch.co.nz> (2020)

## APPENDIX 1- FIGURES



FIGURE 1. SITE LAYOUT AND BOUNDARY

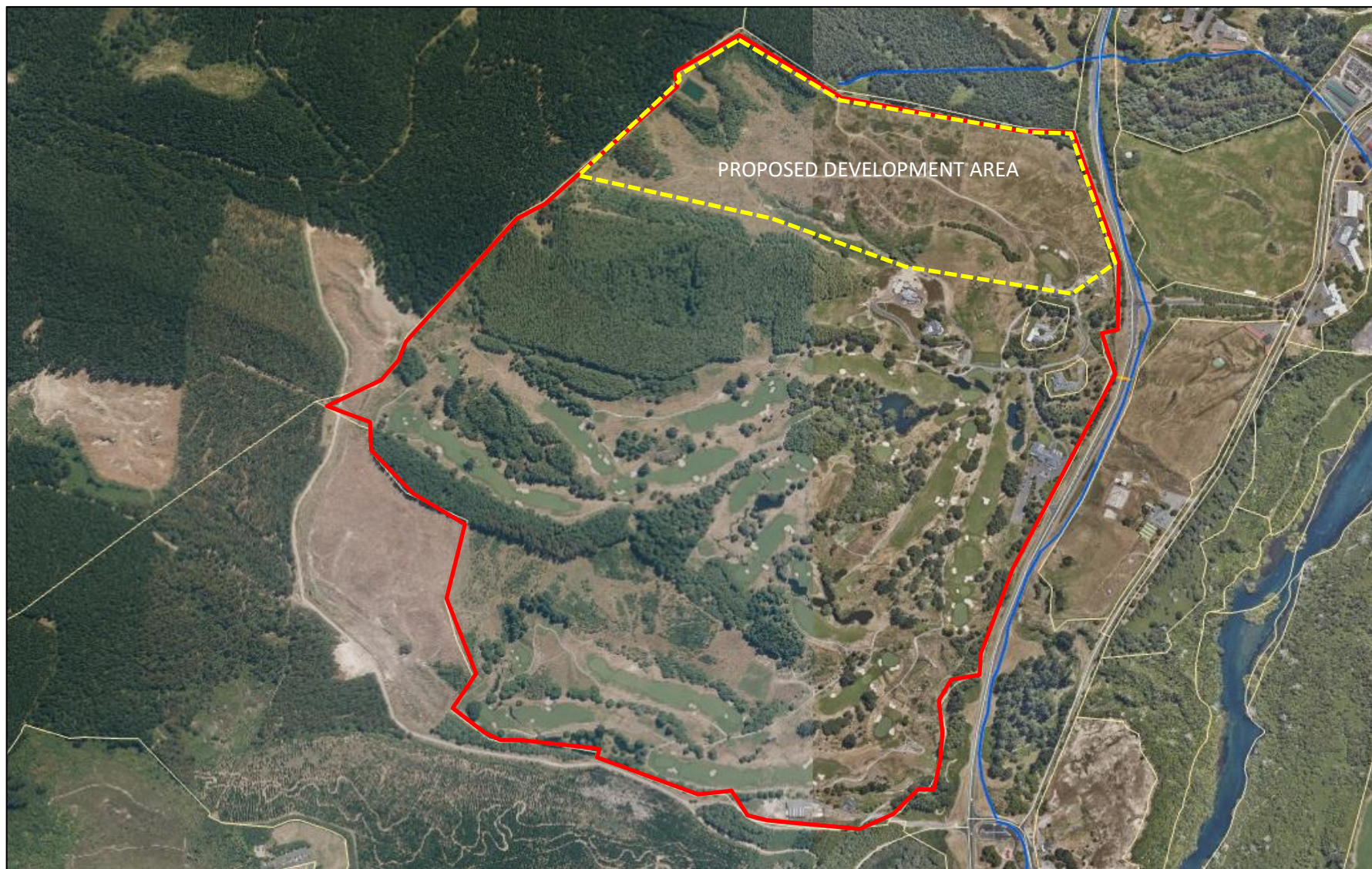




FIGURE 2. SITE CONCEPT PLAN



Wairakei International Golf Course | Concept Plan: Preferred Option (Mixed Density Layout)

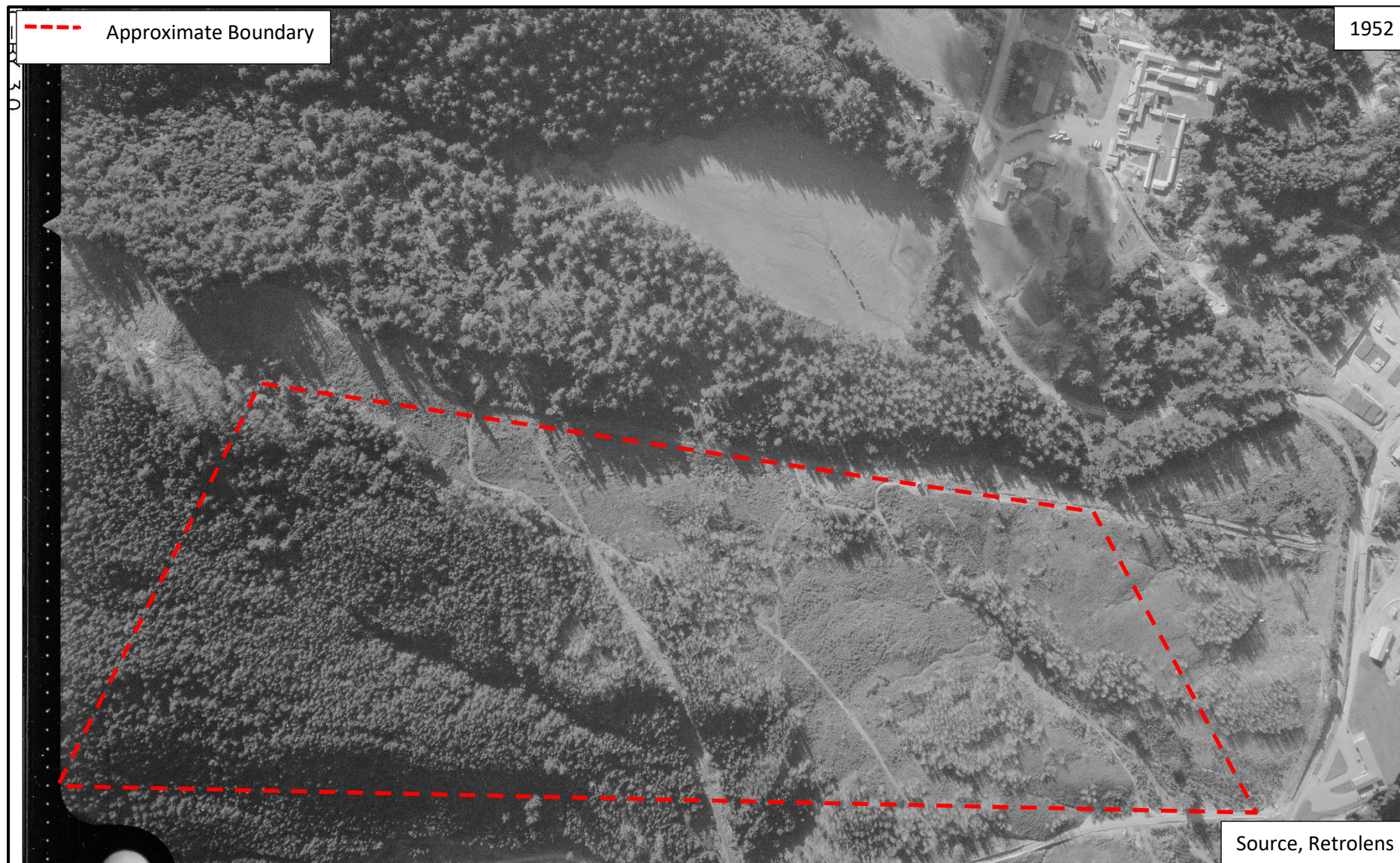


FIGURE 3. SOIL SAMPLE LOCATIONS



## APPENDIX B -AERIAL PHOTOGRAPHY

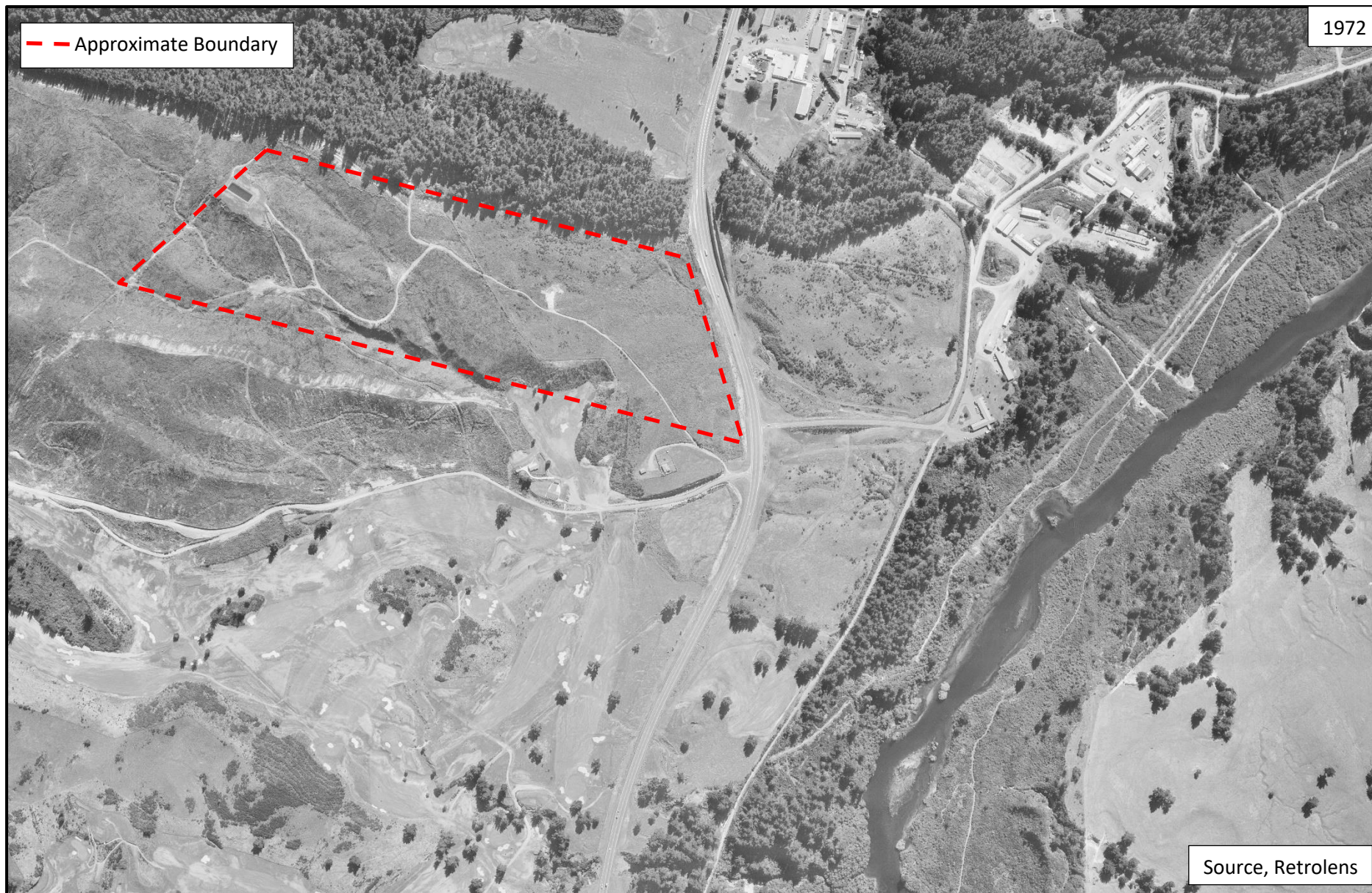




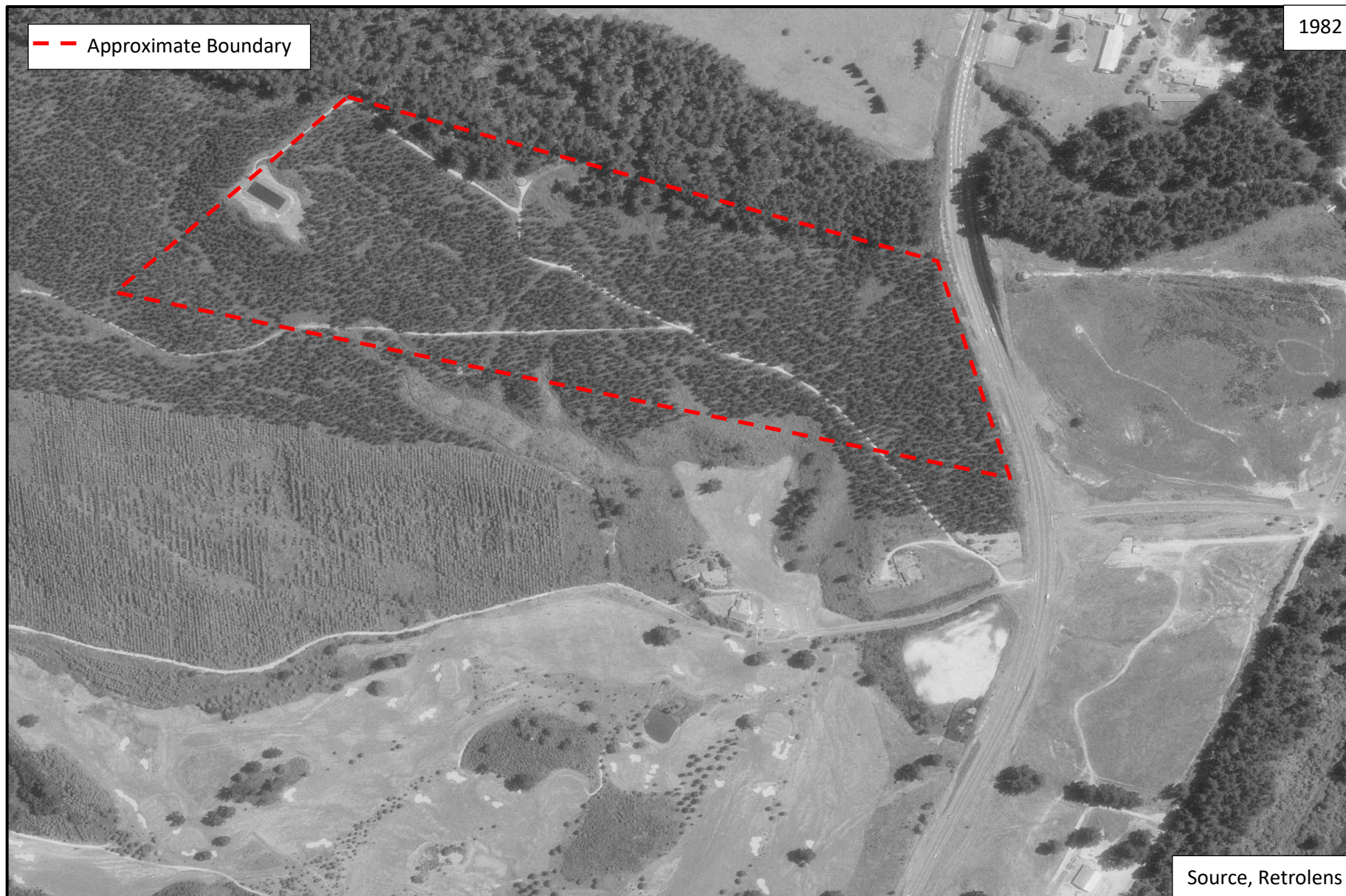








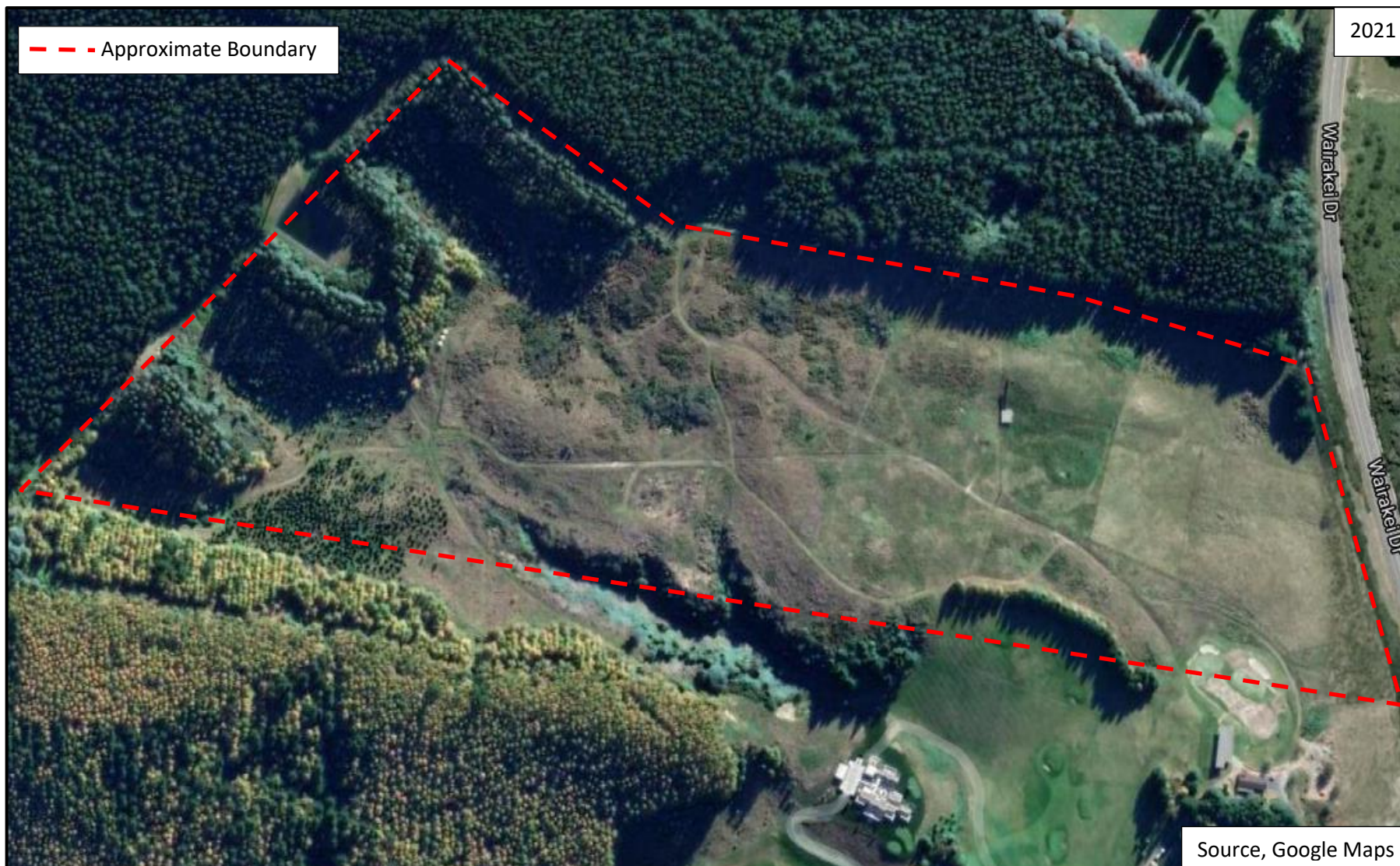












## APPENDIX C-SITE PHOTOGRAPHS



PHOTO 1. DEER SHED AND PASTURES



PHOTO 2. RUBBLE REMAINS FROM FORMER BUILDING STRUCTURES



PHOTO 3. PHOTOGRAPH LOOKING WEST.





PHOTO 4. WATER TANKS, BEEHIVES AND VEGETATION



PHOTO 5. PREDATOR FREE FENCELINE BOUNDARY



PHOTO 6. EUCALYPTUS PLANTATION



## APPENDIX D- ANALYTICAL RESULTS

**PRELIMINARY SITE INVESTIGATION: WAIRAKEI INTERNATIONAL GOLF COURSE, WAIRAKEI**

TABLE 1. SUMMARY OF ANALYTICAL RESULTS AND COMPARISON WITH SOIL GUIDELINE VALUES

	Individual Test	NES Rural Residential (25% produce)	Taupo Background Soils	NEPM	Rubble Pile #1 0-150 mm	Rubble Pile #1 150-300mm	Rubble Pile #2 0-150mm	Rubble Pile #2 150-300mm	Composite of all samples
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals	Total Recoverable Arsenic	17	16	-	< 2	< 2	3	3	-
	Total Recoverable Cadmium	0.8	0.49	-	0.11	< 0.10	< 0.10	< 0.10	-
	Total Recoverable Chromium	>10,000	67	-	4	< 2	3	2	-
	Total Recoverable Copper	>10,000	42	-	6	4	4	3	-
	Total Recoverable Lead	160	24	-	27	6.8	4.5	6.3	-
	Total Recoverable Nickel	-	33	400	< 2	< 2	< 2	< 2	-
	Total Recoverable Zinc	-	129	7400	85	45	23	19	-
Organochlorine Pesticides	Aldrin	1.1	-	-	-	-	-	-	< 0.015
	alpha-BHC	-	-	-	-	-	-	-	< 0.015
	beta-BHC	-	-	-	-	-	-	-	< 0.015
	delta-BHC	-	-	-	-	-	-	-	< 0.015
	gamma-BHC (Lindane)	-	-	-	-	-	-	-	< 0.015
	cis-Chlordane	-	-	50	-	-	-	-	< 0.015
	trans-Chlordane	-	-	-	-	-	-	-	< 0.015
	2,4'-DDD	-	-	-	-	-	-	-	< 0.015
	4,4'-DDD	-	-	-	-	-	-	-	< 0.015
	2,4'-DDE	-	-	-	-	-	-	-	< 0.015
	4,4'-DDE	-	-	-	-	-	-	-	0.072
	2,4'-DDT	-	-	-	-	-	-	-	< 0.015
	4,4'-DDT	-	-	-	-	-	-	-	0.026
	Total DDT Isomers	45	-	-	-	-	-	-	0.1
	Dieldrin	1.1	-	-	-	-	-	-	< 0.015
	Endosulfan I	-	-	270	-	-	-	-	< 0.015
	Endosulfan II	-	-	-	-	-	-	-	< 0.015
	Endosulfan sulphate	-	-	-	-	-	-	-	< 0.015
	Endrin	-	-	10	-	-	-	-	< 0.015
	Endrin aldehyde	-	-	-	-	-	-	-	< 0.015
	Endrin ketone	-	-	-	-	-	-	-	< 0.015
Heptachlor	-	-	6	-	-	-	-	< 0.015	
Heptachlor epoxide	-	-	-	-	-	-	-	< 0.015	
Hexachlorobenzene	-	-	10	-	-	-	-	< 0.015	
Methoxychlor	-	-	300	-	-	-	-	< 0.015	





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**Job Information Summary**

<b>Client:</b>	EAM NZ Limited	<b>Lab No:</b>	2769444
<b>Contact:</b>	J Strong C/- EAM NZ Limited 233B Thompson Road RD 10 Hastings 4180	<b>Date Registered:</b>	17-Nov-2021 1:16 pm
		<b>Priority:</b>	High
		<b>Quote No:</b>	72316
		<b>Order No:</b>	
		<b>Client Reference:</b>	Wairakei GC
		<b>Add. Client Ref:</b>	
		<b>Submitted By:</b>	Karen Toulmin
		<b>Charge To:</b>	EAM NZ Limited
		<b>Target Date:</b>	22-Nov-2021 4:30 pm

Samples				
No	Sample Name	Sample Type	Containers	Tests Requested
1	Rubble Pile #1 0-150 09-Nov-2021 10:00 am	Soil	cpBag	Composite Environmental Solid Samples; Heavy Metals, Screen Level
2	Rubble Pile #1 150-300 09-Nov-2021 10:00 am	Soil	cpBag	Composite Environmental Solid Samples; Heavy Metals, Screen Level
3	Rubble Pile #2 0-150 09-Nov-2021 10:00 am	Soil	cpBag	Composite Environmental Solid Samples; Heavy Metals, Screen Level
4	Rubble Pile #2 150-300mm 09-Nov-2021 10:00 am	Soil	cpBag	Heavy Metals, Screen Level; Composite Environmental Solid Samples
5	Composite of Rubble Pile #1 0-150, Rubble Pile #1 150-300, Rubble Pile #2 0-150 and Rubble Pile #2 150-300mm	Soil	OrgComp	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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-4
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	5
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	5
Composite Environmental Solid Samples	Individual sample fractions mixed together to form a composite fraction.	-	1-4



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**Certificate of Analysis**

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<b>Client:</b> EAM NZ Limited	<b>Lab No:</b> 2769444	SPv1
<b>Contact:</b> J Strong	<b>Date Received:</b> 17-Nov-2021	
C/- EAM NZ Limited	<b>Date Reported:</b> 24-Nov-2021	
233B Thompson Road	<b>Quote No:</b> 72316	
RD 10	<b>Order No:</b>	
Hastings 4180	<b>Client Reference:</b> Wairakei GC	
	<b>Submitted By:</b> Karen Toulmin	

Sample Type: Soil						
Sample Name:	Rubble Pile #1 0-150 09-Nov-2021 10:00 am	Rubble Pile #1 150-300 09-Nov-2021 10:00 am	Rubble Pile #2 0-150 09-Nov-2021 10:00 am	Rubble Pile #2 150-300mm 09-Nov-2021 10:00 am	Composite of Rubble Pile #1 0-150, Rubble Pile #1 150-300, Rubble Pile #2 0-150 and Rubble Pile #2 150-300mm	
Lab Number:	2769444.1	2769444.2	2769444.3	2769444.4	2769444.5	
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	68
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	3	3	-
Total Recoverable Cadmium	mg/kg dry wt	0.11	< 0.10	< 0.10	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	4	< 2	3	2	-
Total Recoverable Copper	mg/kg dry wt	6	4	4	3	-
Total Recoverable Lead	mg/kg dry wt	27	6.8	4.5	6.3	-
Total Recoverable Nickel	mg/kg dry wt	< 2	< 2	< 2	< 2	-
Total Recoverable Zinc	mg/kg dry wt	85	45	23	19	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	-	-	< 0.015
alpha-BHC	mg/kg dry wt	-	-	-	-	< 0.015
beta-BHC	mg/kg dry wt	-	-	-	-	< 0.015
delta-BHC	mg/kg dry wt	-	-	-	-	< 0.015
gamma-BHC (Lindane)	mg/kg dry wt	-	-	-	-	< 0.015
cis-Chlordane	mg/kg dry wt	-	-	-	-	< 0.015
trans-Chlordane	mg/kg dry wt	-	-	-	-	< 0.015
2,4'-DDD	mg/kg dry wt	-	-	-	-	< 0.015
4,4'-DDD	mg/kg dry wt	-	-	-	-	< 0.015
2,4'-DDE	mg/kg dry wt	-	-	-	-	< 0.015
4,4'-DDE	mg/kg dry wt	-	-	-	-	0.072
2,4'-DDT	mg/kg dry wt	-	-	-	-	< 0.015
4,4'-DDT	mg/kg dry wt	-	-	-	-	0.026
Total DDT Isomers	mg/kg dry wt	-	-	-	-	0.10
Dieldrin	mg/kg dry wt	-	-	-	-	< 0.015
Endosulfan I	mg/kg dry wt	-	-	-	-	< 0.015
Endosulfan II	mg/kg dry wt	-	-	-	-	< 0.015
Endosulfan sulphate	mg/kg dry wt	-	-	-	-	< 0.015
Endrin	mg/kg dry wt	-	-	-	-	< 0.015
Endrin aldehyde	mg/kg dry wt	-	-	-	-	< 0.015
Endrin ketone	mg/kg dry wt	-	-	-	-	< 0.015
Heptachlor	mg/kg dry wt	-	-	-	-	< 0.015
Heptachlor epoxide	mg/kg dry wt	-	-	-	-	< 0.015



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 \* or any comments and interpretations, which are not accredited.

Sample Type: Soil					
<b>Sample Name:</b>	Rubble Pile #1 0-150 09-Nov-2021 10:00 am	Rubble Pile #1 150-300 09-Nov-2021 10:00 am	Rubble Pile #2 0-150 09-Nov-2021 10:00 am	Rubble Pile #2 150-300mm 09-Nov-2021 10:00 am	Composite of Rubble Pile #1 0-150, Rubble Pile #1 150-300, Rubble Pile #2 0-150 and Rubble Pile #2 150-300mm
<b>Lab Number:</b>	2769444.1	2769444.2	2769444.3	2769444.4	2769444.5
Organochlorine Pesticides Screening in Soil					
Hexachlorobenzene	mg/kg dry wt	-	-	-	< 0.015
Methoxychlor	mg/kg dry wt	-	-	-	< 0.015

### 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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-4
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-4
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	5
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	5
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	1-4

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

Testing was completed between 22-Nov-2021 and 24-Nov-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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



Ara Heron BSc (Tech)  
Client Services Manager - Environmental





**EAM**

ENVIRONMENTAL  
CONSULTANTS

# PRELIMINARY SITE ASSESSMENT WITH NATIONAL ENVIRONMENTAL STANDARD FOR ASSESSING AND MANAGING CONTAMINANTS IN SOIL TO PROTECT HUMAN HEALTH



## WAIRAKEI INTERNATIONAL GOLF COURSE, TAUPO

PROJECT NO. EAM400-REP-01

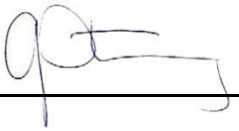
PREPARED FOR  
WAIRAKEI INTERNATIONAL GOLF COURSE

PREPARED BY  
JASON STRONG

JULY 2014

**Report prepared by:**

Jason Strong (MSc), (PhD Candidate)  
**Principal Environmental Scientist**  
EAM NZ Limited



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## EXECUTIVE SUMMARY

EAM NZ Limited has been engaged by Wairakei International Golf Course to undertake a preliminary site investigation for their property located at 527/1 State Highway 1 Wairakei Taupo, pursuant to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES).

A review of the site history for the “piece of land” (the area of the proposed hotel site) under this assessment was carried out with no specific contaminant source being identified.

However, due to the site being utilized as a golf course over the past 34 years there is the possibility that soil concentrations of various inorganic (metals) and organic (pesticides and herbicides) contaminants such as are elevated.

Therefore considering the reviewed historical information and current knowledge of the site the “piece of land” reviewed in this assessment requires further consideration as a contaminant source, and therefore a hazard-pathway-receptor pollution linkage, could exist;

Further investigation and soil sampling is considered necessary at this site as it is considered more likely than not that soils pose a risk to human health. This work should occur prior to any earthworks taking place at the site.

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## 1.0 INTRODUCTION

### 1.1 BRIEF

Wairakei International Golf Course (WIGC) is proposing to establish a twenty one unit hotel (and reception building) on their property located at 527/1 State Highway 1 Wairakei, Taupo, (Figures 1 and 2). As part of their application for resource consent to carry out this activity it has been requested that a Preliminary Site Investigation (P.S.I) pursuant to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES) is undertaken.

EAM NZ Ltd has been engaged by WIGC to carry out this P.S.I on their behalf.

This report provides the following information:

- A review of site history;
- Risk assessment; and
- Conclusions
- Recommendations.

Notwithstanding the Report Limitations set out in Appendix 2, we confirm that Taupo District Council can rely on this report for the purposes of determining compliance with the NES guidelines with respect to the development identified in this assessment.

### 1.2 SITE DESCRIPTION AND LOCATION

The site is located at 527/1 State Highway 1 Wairakei, approximately seven kilometres to the north of Taupo Central Business District (Figure 1). The total area of the property is approximately 146 hectares with legal description being Lot 1 DP 426900 (CT ref 505925).

Surficial (native) soils at this site are best described as having shallow low organic topsoil (<75mm) that is underlain by porous free draining pumice sands to depth.

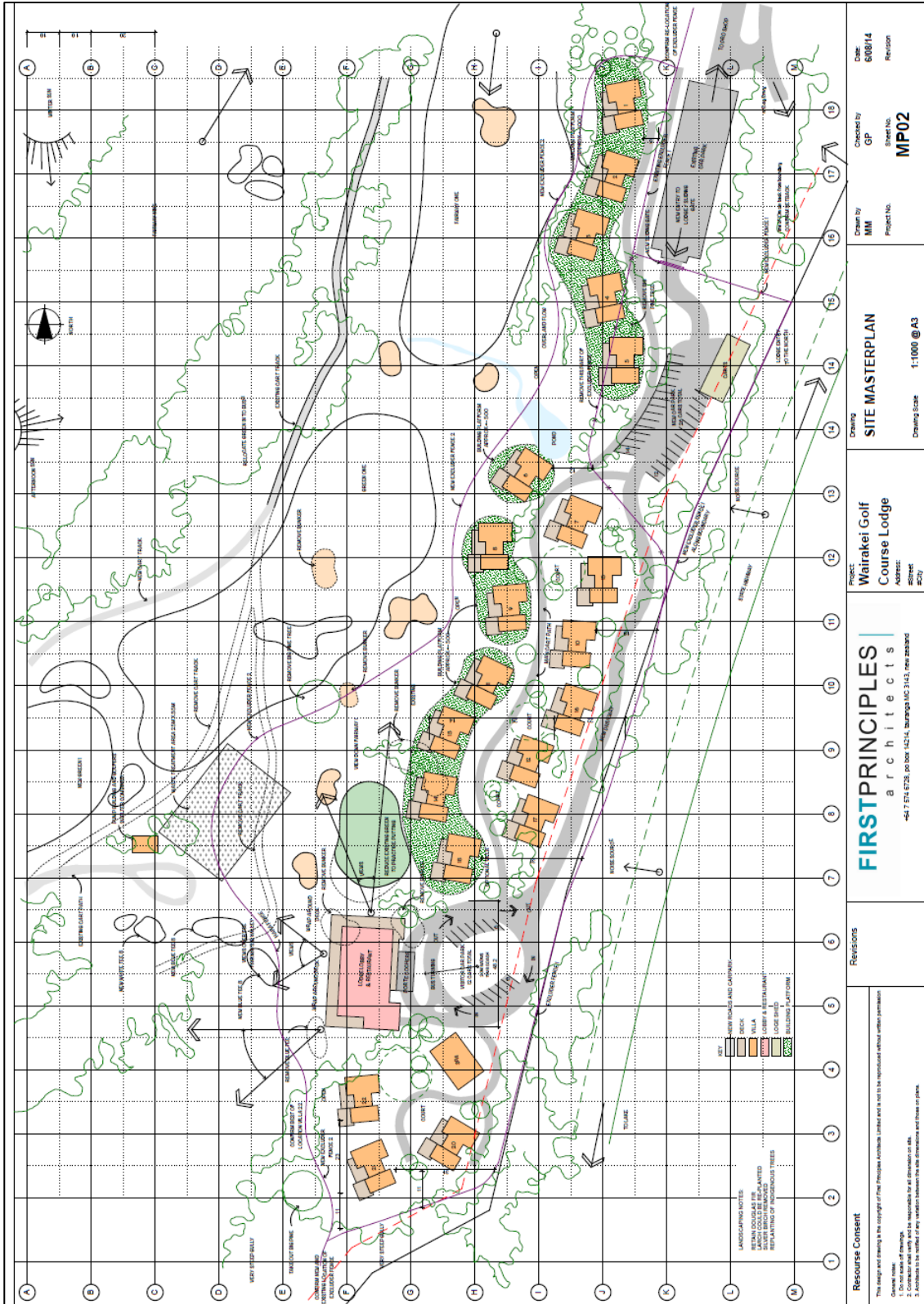
Located approximately five hundred metres to the east of the site is the Waikato River.

FIGURE 1: SITE LOCATION





FIGURE 2: LAYOUT OF PROPOSED HOTEL



## 2.0 REVIEW OF SITE HISTORY

The following resources were utilised to aid in assessing the likelihood of historic contaminants being present within the site;

- Communication with staff of WIGC;
- A search of land database and historical records held at Taupo District Council (TDC);
- A search of land database and historical records held at Waikato Regional Council (WRC);
- Review of historical photographs of the site provided by New Zealand Aerial Mapping Limited (NZAM).

### 2.1 SITE WALK OVER

The findings of a site walk-over survey at the proposed hotel site, undertaken on 18 March 2014, are discussed below.

The proposed hotel footprint largely encompasses the current "First Hole" of the WIGC (Figures 3, 4 and 5). The topography of the site and surrounds is gentle undulating land. Land use immediately surrounding the golf course site is predominantly pastoral agriculture, forestry and geothermal power generation.

A storm water drainage swale is located approximately two thirds of the way up the first hole fairway along the eastern boundary and discharges parallel to State Highway 1 (Figure 5).

### 2.2 ANECDOTAL INFORMATION

Discussion was held with the Course Manager Nigel Lloyd regarding the history of the site. The course was opened in 1970 with construction taking place between 1967 and 1969. Soils for the golf course greens are imported Tauranga beach sand. Mr Lloyd indicated that during his employment at WIGC only fertiliser has been spread on the greens and fairways and that no chemical sprays have been utilised to the best of his knowledge.

### **2.3 COUNCIL RECORDS**

The Waikato Regional Council (WRC) maintains a register of properties known to be contaminated on the basis of chemical measurements, or potentially contaminated on the basis of past land use. This register (called the Land Use Information Register). It is noted by WRC that this register is still under development and should not be regarded as comprehensive.

The WIGC property is currently listed on the WRC Land Use Information Register, with a classification of 'Verified Hazardous Activities and Industries List (HAIL) - with no sampling'.

It is maintained by WRC that the WIGC property is listed because of its verified past and current land use for 'storage tanks or drums for fuel and chemicals' associated with the WIGC. None of these however were ever known to have been used or stored on the 'piece of land' pertaining to this assessment.

However, WRC note that they do not have any specific information or reports regarding the presence or otherwise of hazardous substances in the soil at this property; and the information regarding fuel storage was provided to them by Taupo District Council (TDC) in the form of historic dangerous goods licence information.

Additionally, WRC highlight that it is highly likely that pesticides have been stored at the WIGC site for the purposes of green-keeping and that the long term, frequent use of superphosphate fertilisers may potentially result in elevated levels of cadmium.

### **2.4 HISTORICAL AERIAL MAPPING**

A review of historic aerial photographs was carried out by EAM NZ Ltd. A series of maps was provided by NZAM for the years 1941, 1963, 1977, 1997 and these are presented in Figures 6, 7, 8, 9 and 10.

These photographs show that the property was bare pasture land up until the beginning of construction of the WIGC (1967). Additionally, these historic photographs indicate that the proposed parcel of land under this assessment has only been utilised for the playing of golf and there is no evidence of any sheds (possible chemical storage) or other buildings ever being present within the area of the proposed development.

### **2.5 SUMMARY OF SITE HISTORY REVIEW**

This historic site review for the "piece of land" under has identified the possible presence of soil contaminants associated with the site being used as a golf course. These include metals (from fertiliser use) as well as herbicides and pesticides. No areas were identified as potential hotspots as there is no evidence of sheds (or any other buildings), spray pads, or chemical/fuel storage occurring at the proposed hotel site.



FIGURE 3: VIEW SOUTH TOWARDS THE FIRST HOLE GREEN AT WAIRAKEI INTERNATIONAL GOLF COURSE



FIGURE 4: VIEW NORTH TOWARDS THE FIRST HOLE FAIRWAY AT WAIRAKEI INTERNATIONAL GOLF COURSE



FIGURE 5: VIEW OF STORMWATER DRAINAGE CHANNEL/SWALE ON EASTERN BOUNDARY THE FIRST TEE AT WAIRAKEI INTERNATIONAL GOLF COURSE





FIGURE 6: AERIAL (1941) PHOTO SHOWING GENERAL AREA OF WAIRAKEI INTERNATIONAL GOLF COURSE



FIGURE 7: AERIAL (1963) PHOTO SHOWING GENERAL AREA OF WAIRAKEI INTERNATIONAL GOLF COURSE

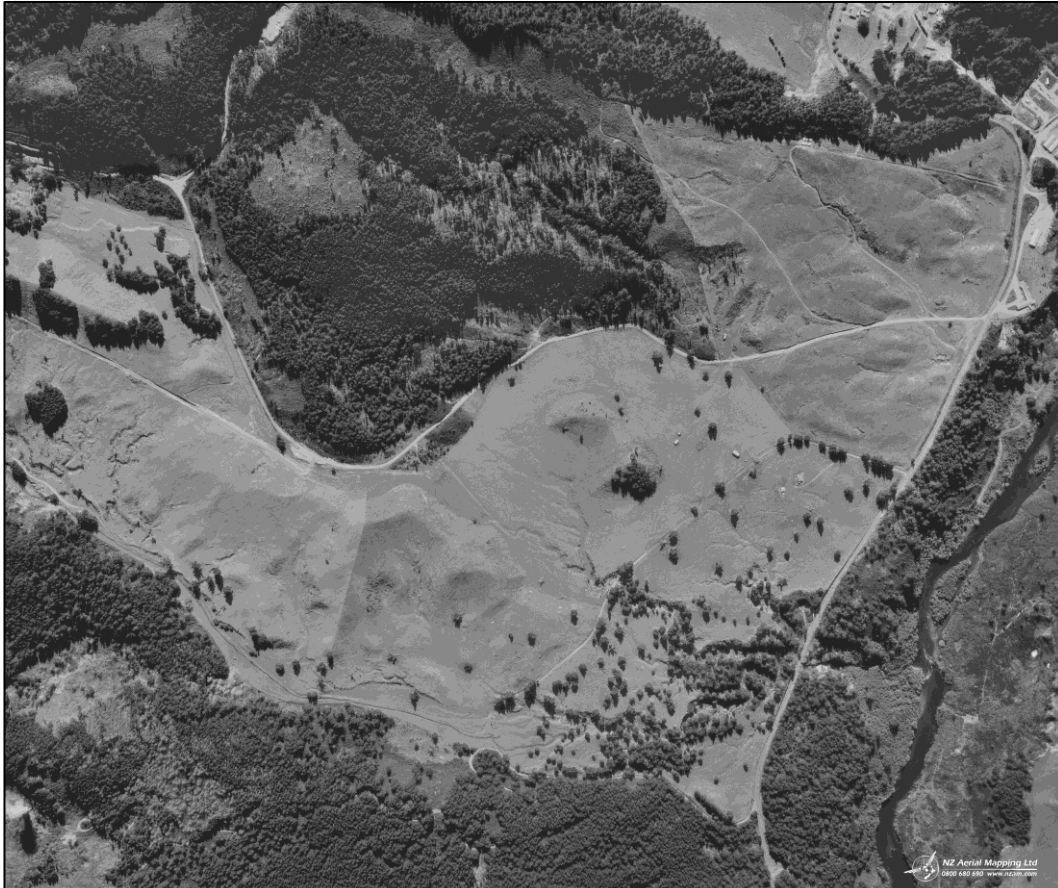




FIGURE 8: AERIAL (1977) PHOTO SHOWING GENERAL AREA OF WAIRAKEI INTERNATIONAL GOLF COURSE



FIGURE 9: AERIAL (1997) PHOTO SHOWING GENERAL AREA OF WAIRAKEI INTERNATIONAL GOLF COURSE





FIGURE 10: AERIAL (2014) PHOTO SHOWING GENERAL AREA OF WAIRAKEI INTERNATIONAL GOLF COURSE



### 3.0 NES PRIORITY CONTAMINANTS

The NES legislation has identified a number of priority contaminants and provides standards for these contaminants within soil for the protection of human health under a series of potential land use scenarios. A number of these priority contaminants are inorganic substances and these include Arsenic, Boron, Cadmium, Chromium III & VI, Copper, Inorganic Mercury and Inorganic Lead. Others relate to organic compounds and include Benzo(a)pyrene (BaP), Dichlorodiphenyltrichloroethane (DDT), Dieldrin, Pentachlorophenol (PCP) and Dioxins.

It is not necessary to test for all of these contaminants if the history of the site suggests the past use is unlikely to have resulted in specific contamination with the identified priority contaminants.

On the basis of the assessment site being used as a golf course the priority contaminants of concern are heavy metals particularly arsenic, copper, lead and cadmium as well as a wide range of organic compounds such as acidic herbicides, organophosphates and organochlorine pesticides such as DDT and Endosulphan.

The NES considers various land use scenarios which include residential, recreational and commercial/industrial. Soil contaminant standards (SCS) are attached to each and are based on the sensitivity of the particular land use with residential being more sensitive than commercial/industrial.

For the purposes of this assessment the most suitable land use scenario provided under the NES is High Density Residential and the definition is shown in Table 1.

**TABLE 1: SUMMARY OF APPLICABLE LAND USE SCENARIOS (MFE 2012)**

Land use scenario	Description
High-density residential	Urban residential with limited soil contact, including small ornamental gardens but no vegetable garden (no home grown produce consumption): applicable to urban townhouses, flats and ground floor apartments with small ornamental gardens, but no high rise apartments.

Collection of a series of soil samples is recommended within the area of the proposed hotel development to show compliance with the adopted NES land use scenario.

Sampling of soils within the area of the proposed hotel development was not carried out during this PSI. The client (WIGC) indicated that the intrusive methodology of removing soil cores within the green in particular would cause significant disruption for course players.

It is therefore recommended that soil samples be collected, analysed (for metals and organic compounds) and compared against the adopted NES land use scenario soil contaminant standards prior to any earthworks taking place at the site.

The results of soil analysis will also aid in determining the suitability of use for any soils to be removed from the site (if any).

## 4.0 RISK ASSESSMENT

A conceptual model is considered in the form of a hazard – pathway – receptor pollution linkage. This model aids assessment of risk associated with results of the site investigation. The focus of the NES is protection of human health so only this aspect is considered and not the potential effect on the surrounding environment.

Historical information and current knowledge of the site has identified that the “piece of land” reviewed in this assessment requires further consideration as a contaminant source and therefore a hazard-pathway-receptor pollution linkage could exist. Further investigation and soil sampling is considered necessary at this site as it is considered more likely than not that soils pose a risk to human health.

## 5.0 CONCLUSIONS

A review of the site history for the “piece of land” (the area of the proposed hotel site) under this assessment was carried out with no specific contaminant source being identified.

However, due to the site being utilized as a golf course over the past 34 years there is the possibility that soil concentrations of various inorganic (metals) and organic (pesticides and herbicides) contaminants such as are elevated.

Therefore considering the reviewed historical information and current knowledge of the site the “piece of land” reviewed in this assessment requires further consideration as a contaminant source, and therefore a hazard-pathway-receptor pollution linkage, could exist;

Further investigation and soil sampling is considered necessary at this site as it is considered more likely than not that soils pose a risk to human health. This work should occur prior to any earthworks taking place at the site.

## 6.0 REFERENCES

MfE 2012 Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Ministry for the Environment.



## APPENDIX 1

### REPORT LIMITATIONS

EAM NZ Ltd has provided this Document, and is subject to the following limitations:

I. This Document has been prepared for the particular purpose outlined in EAM's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

II. The scope and the period of EAM NZ Ltd's Services are as described in EAM NZ's proposal, and are subject to restrictions and limitations. EAM NZ Ltd did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by EAM NZ Ltd in regards to it.

III. Conditions may exist which were undetectable given the limited nature of the enquiry EAM NZ Ltd was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

IV. In addition, it is recognized that the passage of time affects the information and assessment provided in this Document. EAM NZ Ltd's opinions are based upon information that existed at the time of the production of the Document. It is understood that the services provided allowed EAM NZ Ltd to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

V. Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

VI. 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 EAM for incomplete or inaccurate data supplied by others.

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