Vickery Coal Project

Environmental Impact Statement

APPENDIX O

LAND CONTAMINATION ASSESSMENT

Resource Strategies

WHITEHAVEN COAL

FINAL

FINAL REPORT

Stage 1 & 2 Land Contamination Assessment - Vickery Coal Project

Prepared for: Whitehaven Coal Limited

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Stage 1 & 2 Land Contamination Assessment - Vickery Coal Project

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EXECUTIVE SUMMARY

The former Vickery Coal Mine is owned by Whitehaven Coal Limited (Whitehaven) and is located approximately 25 kilometres north of Gunnedah in New South Wales (NSW). Whitehaven proposes to develop the Vickery Coal Project (the Project) which would involve the development of an open cut mining operation and associated infrastructure. The Project would operate at a rate of up to 4.5 million tonnes of run-of-mine coal per annum, for a period of approximately 30 years.

An initial Land Contamination Assessment was undertaken in the form of a Stage 1 – Preliminary Investigation as detailed in the *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land* (NSW Department of Urban Affairs and Planning/Environmental Protection Authority [DUAP/EPA], 1998).

Following the Stage 1 Preliminary Investigation, a Stage 2 – Detailed Investigation was required in accordance with the *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land* (DUAP/EPA, 1998).

The study area was limited to Mining Lease Application (MLA) 1, MLA 2, MLA 3, the two sections of road realignments associated with Blue Vale Road and Shannon Harbour Road that lie outside Coal Lease (CL) 316, the two sections of the pipeline corridor that lie outside CL 316 and the private haul road and Kamilaroi Highway overpass (the Site). The majority of the Site is currently used for agricultural activities.

The objectives of the Stage 1 Preliminary Investigation were to identify any past or present potentially contaminating activities, to provide a preliminary assessment of any contamination and provide a basis for a more detailed investigation (i.e. Stage 2 Detailed Investigation).

The site history review and site inspections identified four potentially contaminated sites that required further investigation, within MLA1, MLA2 and MLA3 and the private haul road and Kamilaroi Highway overpass corridor, as follows:

- Site MLA1-1 – Abandoned well now backfilled with refuse.
- Site MLA2-1 – Sheep dip and shearing shed (disused) with water storage dam.
- Site MLA3-1 – General refuse and fuel storage containers.
- Private haul road and Kamilaroi Highway overpass – Above ground storage tank (AST) and generator.

Intrusive investigations were undertaken to assess the level of contamination at MLA1-1, MLA2-1 and MLA3-1 on the 16, 17 and 18 January 2012. A historical review and site inspection undertaken at the private haul road and Kamilaroi Highway overpass area and was sufficient to provide adequate information for inclusion in the Remediation Management Plan (RMP).

Laboratory analysis of soil samples collected from MLA1-1 identified one marginal exceedance of the Ecological Investigation Level (EIL) criteria for zinc within the surface soils. No other laboratory exceedances were identified within samples collected from this site. Following the site history review, site inspection and intrusive investigations, no further investigations were required at this site was required.

There were no exceedances of the site assessment criteria at MLA3-1. Following the site history review and a site inspection of the private haul road and Kamilaroi Highway overpass area, no further works are recommended for this area. In the event that during construction of the private haul road and Kamilaroi Highway overpass soils from the adjacent allotment are disturbed (AST and generator area), there is an inclusion in the RMP for unexpected contamination and is adequate for the management of the soils.

Laboratory analysis of soil samples collected from MLA2-1 (sheep dip and surrounding infrastructure) identified 19 exceedances of arsenic concentrations above the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) Health-based Investigation Level-A (HIL-A) and/or EIL guidelines. Arsenic concentrations ranged from 35 milligrams per kilogram (mg/kg) to 2860 mg/kg. Further, there were three NEPM EIL exceedances for zinc. Ten (10) samples identified organochlorine pesticides (OCs) present. None of these samples displayed levels above the site assessment criteria. Based on results from the Stage 1 Preliminary Investigation, a Stage 2 Detailed Investigation was required for this site.

The objectives of the Stage 2 Detailed Investigation were to define the nature, extent and degree of contamination; to assess potential risk posed by contaminants to health and the environment; and to obtain sufficient information to develop a RMP.

The Stage 2 Detailed Investigation for MLA2-1 was undertaken on 20 – 24 February 2012. The Stage 2 Detailed Investigation included soil and water sampling.

During the Stage 2 Detailed Investigation a surface water sample was collected from the water storage dam and was analysed for total metals and OCs and Organophosphorous Pesticides (OC/OPs). Field measurements of Dissolved Oxygen, Electrical Conductivity, Total Suspended Solids, and pH were taken using a water quality meter. The laboratory analysis showed that the water sample marginally exceeded the site assessment criteria for total copper and total zinc. The water from the storage dam is suitable for use as a dust suppressant.

A water sample was collected from under the sheep dip. The dip had been backfilled with building rubble and gravel and it is likely that rain had penetrated the materials and a small amount of water had accumulated on the bottom of the dip. The sample was analysed for total metals and OC/OPs. The sample displayed exceedances for all total metals analysed.

There were no OC/OPs identified above the laboratory's limit of reporting in the water samples analysed.

An analysis of the suitability of the data contained in the report was undertaken. Field and laboratory data underwent rigorous data quality assurance (QA) and quality control (QC) assessments. Following the analysis of the field and laboratory QA/QC the results contained within this report are considered suitable for reporting purposes.

Results from the Stage 1 and 2 investigations at MLA2-1 identified 28 exceedances of arsenic concentrations above NEPM EIL guidelines, with 10 samples exceeding NEPM HIL-A guidelines. Eleven (11) samples identified OCs present; however these samples did not display levels above the site assessment criteria. Sampling within the area as part of the Stage 2 Detailed Investigation delineated the arsenic contamination laterally and vertically.

The proposed use for MLA2-1 is for mining and mining-related activities. The nature of the activities requires the majority of MLA2-1 to be excavated. Soils are to be removed to allow for coal extraction. The location of the area for soil storage or use once removed from site is unknown. Considering the proposed site use and the limited knowledge on the end use of soils, the results from the Stage 1 and Stage 2 investigations indicate that there may be some potential risk to on-site workers during soil removal and to the environment if soils are inappropriately stored. On this basis a RMP was developed.

On the basis of the above, and with the implementation of the proposed management measures, it is considered that the Site would be suitable for the land use change proposed as part of the Project.

1 INTRODUCTION

The Vickery Coal Mine is owned by Whitehaven Coal Limited (Whitehaven) and is located approximately 25 kilometres (km) north of Gunnedah in New South Wales (NSW) (**Figure 1**). Open cut and underground mining activities were conducted at the Vickery Coal Mine between 1991 and 1996. The mine has subsequently been closed and rehabilitated and is currently under care and maintenance.

The Vickery Coal Project (the Project) would involve the development of an open cut coal mine and associated infrastructure at the site of the historical Vickery Coal Mine and would facilitate a run-of-mine coal production rate of up to 4.5 million tonnes per annum for a period of 30 years. The general arrangement of the Project is shown on **Figure 2**.

A detailed description of the Project is provided in Section 2 of the Main Report of the Environmental Impact Statement (EIS).

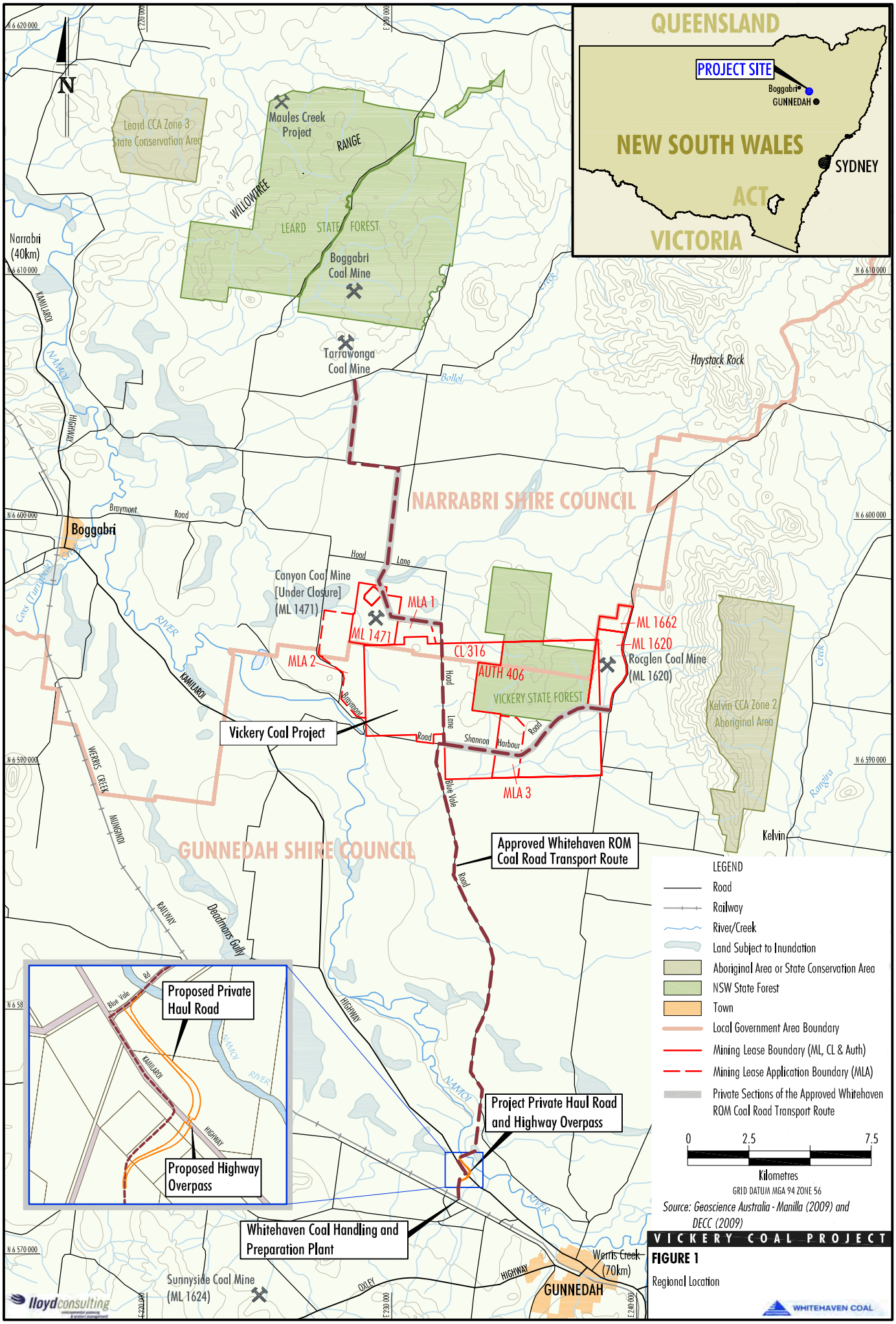
A Land Contamination Assessment is required as part of the EIS. An initial Land Contamination Assessment was undertaken in the form of a Stage 1 Preliminary Investigation as detailed in the *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land* (NSW Department of Urban Affairs and Planning/Environmental Protection Authority [DUAP/EPA], 1998).

Following the Stage 1 Preliminary Investigation, a Stage 2 Detailed Investigation was conducted in accordance with the *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land* (DUAP/EPA, 1998).

This Land Contamination Assessment has been prepared for the area within Mining Lease Application (MLA) 1, MLA 2, MLA 3, the two sections of road realignments associated with Blue Vale Road and Shannon Harbour Road that lie outside Coal Lease (CL) 316, the two sections of the pipeline corridor that lie outside CL 316 (**Figure 2**) and the private haul road and Kamilaroi Highway overpass (**Figure 3**) (the Site). The CL 316, Mining Lease 1471 and Authorisation 406 areas (**Figure 2**) have not been assessed in this study as they are existing coal mining land use areas and therefore no change of use would occur as a result of the Project.

1.1 Objectives and Scope of Works

The objectives of the Stage 1 Preliminary Investigation were to identify any past or present potentially contaminating activities, to provide a preliminary assessment of any contamination and provide a basis for a more detailed investigation (i.e. Stage 2 Detailed Investigation).



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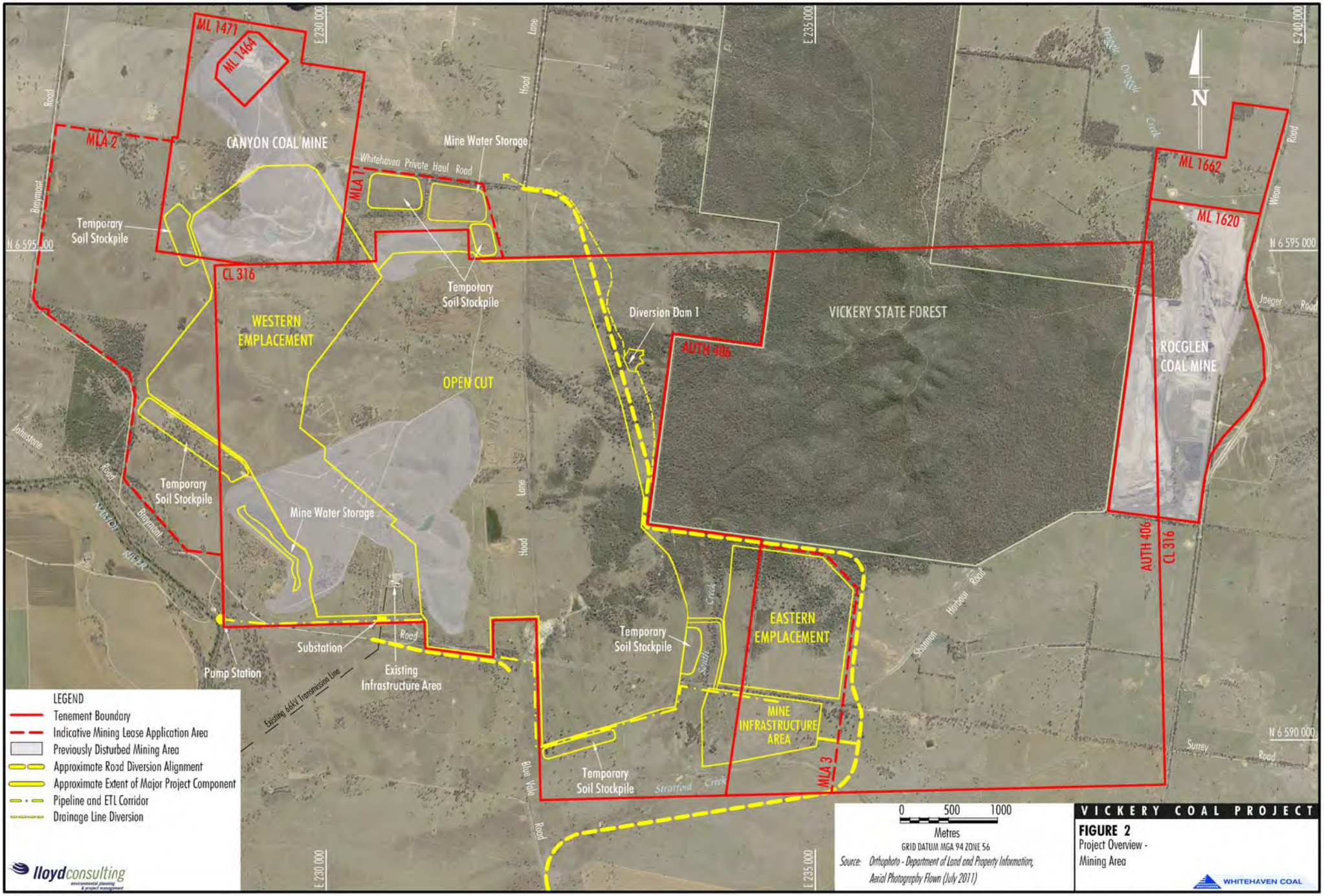

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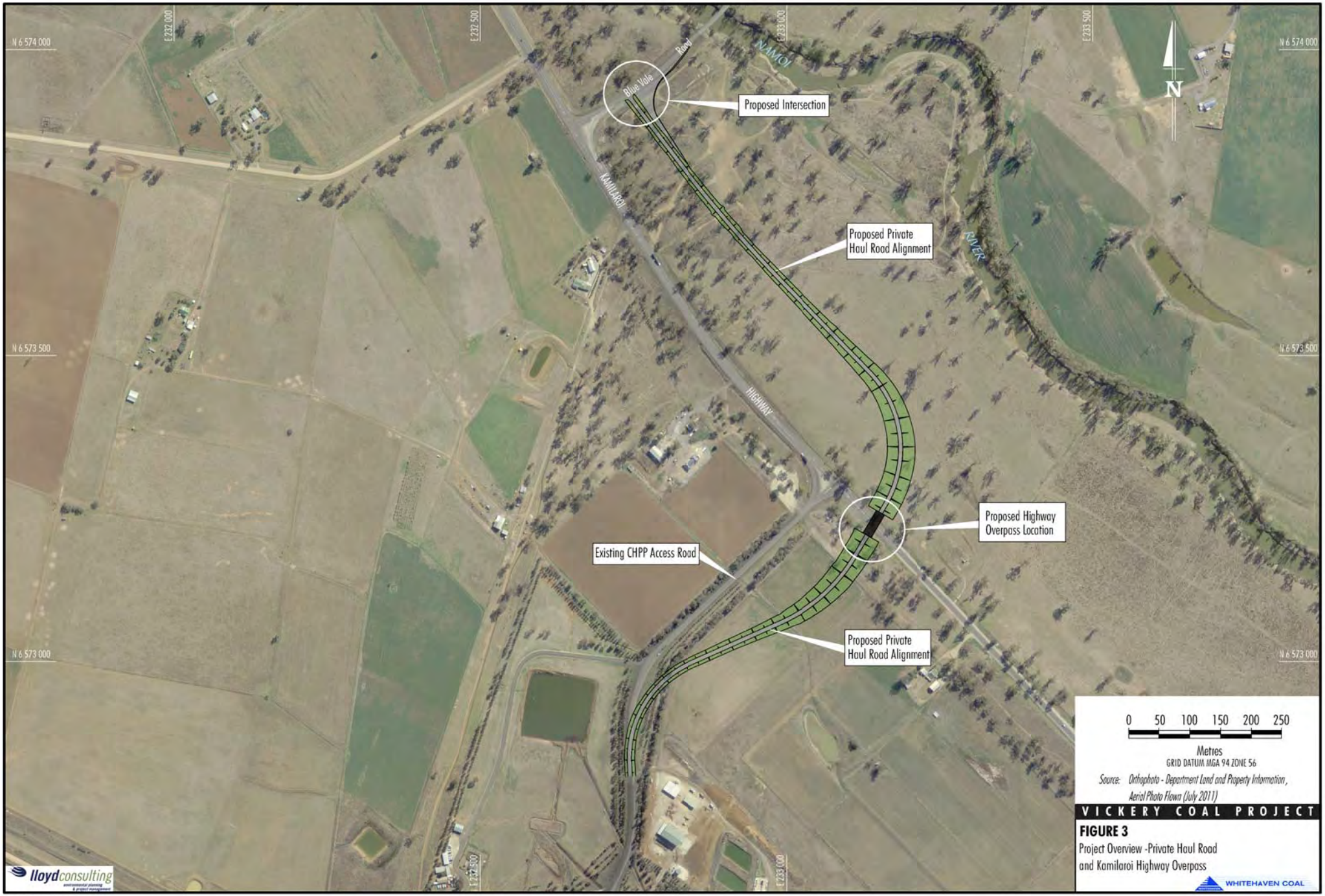

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The scope of work conducted for the Stage 1 Preliminary Investigation is as follows:

- A review of the Site's environmental setting, history and records in order to identify potentially contaminating historical activities (both on-site and off-site). This comprised:
  - a review of available historical aerial photographs to identify use and development of the Site and adjacent sites over time;
  - a review of Narrabri Shire Council and Gunnedah Shire Council Planning Certificates; and
  - a review of available geology and hydrogeology information for the area.
- An initial site inspection to identify potentially contaminated areas.
- Preliminary sampling and analysis of potentially contaminated areas.
- Review of laboratory documentation.
- Reporting of results and undergoing a quality assurance (QA) and quality control (QC) review.
- Identification of contaminated areas where further investigation is recommended (i.e. Stage 2 Detailed Investigation).

The objectives of the Stage 2 Detailed Investigation were to define the nature, extent and degree of contamination; to assess potential risk posed by contaminants to health and the environment; and to obtain sufficient information to develop a Remediation Management Plan (RMP).

The scope of work conducted for the Stage 2 Detailed Investigation is as follows:

- Sampling and analysis of areas that were identified as contaminated during the Stage 1 Preliminary Investigation to delineate the extent of the contamination both laterally and vertically.
- Review of laboratory documentation.
- Reporting of results and performing a QA and QC review.
- Preparation of a RMP for areas where management measures are required.

1.2 Methodology

The Land Contamination Assessment was undertaken in general accordance with the following guidance documents:

- *Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land* (DUAP/EPA, 1998).
- *National Environment Protection Council Schedule B(2) – Guideline on Data Collection, Sample Design and Reporting* (National Environment Protection (Assessment of Site Contamination) Measure [NEPM], 1999a).

- AS4482. 1 - 2005: *Guide to Sampling and Investigation of Potentially Contaminated Soil (Part 1: Non-volatile and Semi volatile Compounds).*
- AS4482.2-1999 *Guide to sampling and investigating of potentially contaminated soil (Part 2: Volatile compounds).*

1.3 Report Structure

The report has been structured in the following way:

Section 1: Outlines the Project background and the assessment scope works;

Section 2: Provides a Site description;

Section 3: Presents the Site history;

Section 4: Details the Stage 1 Preliminary Investigation;

Section 5: Provides details of the Stage 1 soil sampling and analysis;

Section 6: Provides details of the Stage 2 Detailed Investigation;

Section 7: Presents a Quantitative Risk Assessment;

Section 8: Discusses QA and QC measures;

Section 9: Outlines a RMP;

Section 10: Provides a discussion of the Stage 1 and Stage 2 investigation works and results and offers concluding comments and recommendations; and

Section 11: Lists references used in this report.

The Narrabri Shire Council and Gunnedah Shire Council Planning Certificates are included in **Appendix A**, borelogs are included in **Appendix B**, Dial Before You Dig (DBYD) details are in **Appendix C**, historical aerial photographs are in **Appendix D**, soil results table are included in **Appendix E**, soil and surface water laboratory analysis results and calibration certificate (for water quality meter) are included in **Appendix F**, Relative Percent Difference (RPD) calculations are included in **Appendix G**.

2 SITE DESCRIPTION

This section provides a description of the Site. A more detailed description of the Project area (including the Site) is provided in Section 2 of the Main Report of the EIS.

2.1 Site Details

The Project is located approximately 25 km north of Gunnedah in NSW. Whitehaven also owns and operates the Tarrawonga and Rocglen Coal Mines which are located approximately 10 km to the north and 5 km east of the Project respectively. Whitehaven also continues to maintain the Canyon Coal Mine site which is currently under care and maintenance (operations ceased in 2009) located to the immediate north of the Project.

The Site consists of MLA 1, MLA 2, MLA 3, the two sections of road realignments associated with Blue Vale Road and Shannon Harbour Road that lie outside CL 316, the two sections of the pipeline corridor that lie outside CL 316 and the private haul road and Kamilaroi Highway overpass (**Table 2-1**). The majority of the Site consists of cleared agricultural land as well water storage dams. A derelict farmhouse, holding pens, a water storage dam and a shed were located within MLA 1. MLA 2 contained a derelict sheep shearing shed, holding pens, sheep dip and water storage dam. MLA 3 contained no infrastructure.

The Site is located partially within the Narrabri Local Government Area and Gunnedah Shire Council on land zoned Zone 1 (a) (General Rural) under the Narrabri Local Environment Plan (LEP) and Gunnedah LEP 2012.

One lot within the private haul road and Kamilaroi Highway overpass corridor is currently privately owned, and another lot is Crown Land. The private lot is currently in the process of being subdivided to allow for the construction and use of the road infrastructure. Whitehaven is in discussions with the NSW Lands Department regarding forming an agreement to access the Crown Land. All other land within the Site is wholly owned by Whitehaven.

Table 2-1 Areas of Investigation

Area of Investigation	Lot Number
MLA 1	Portion of Lot 2 on DP1038308 Portion of Lot 3 on DP1038308 Portion of Lot 5 on DP1018347
MLA 2	Portion of Lot 39 on 754929
MLA 3	Portion of Lot 23 on DP754929 Portion of Lot 2 on DP219923
Blue Vale Road Realignment	Portion of Lot 2 on DP1102940 Portion of Lot 23 on DP754929 Portion of Lot 2 on DP1102940 Portion of Lot 2 on DP219923 Portion of Lot 7 on DP1018347
Pipeline Corridor East	Portion of Lot 1 on DP1018347
Pipeline Corridor West	Portion of Lot 1 on DP219923 Portion of Lot 1 on DP1102940
Private Haul Road and Kamilaroi Highway Overpass	Lot 1 on DP1034511 Lot 7052 on DP1119794 Lot 111 on DP55503 Lot 678 on DP705086

2.2 Land Use Activities

The dominant land use at the Site is agricultural activity comprising grazing on unimproved pasture. Other land uses include farm buildings, public roads and vegetated areas.

The relevant environmental planning instrument applicable to undertaking development of the proposed Project area is the Narrabri LEP 1992 and Gunnedah LEP 2012.

Southern portions of MLA 2 and MLA 3 lie within the Gunnedah Shire Council's authority and are zoned for Primary Production which allows for open cut mining (with consent) (Gunnedah LEP 2012).

The portions of MLA 1 and MLA 2 that lie within the Narrabri Shire Council's authority are zoned for General Rural.

Further detail on the zoning of the Project area (including the Site) is provided in Section 6 of the Main Report of the EIS.

Planning Certificates were obtained from the Narrabri Shire Council and Gunnedah Shire Council (**Appendix A**).

2.3 Regional Geology

The Gunnedah Basin forms the central part of the Permo-Triassic Sydney-Gunnedah-Bowen Basin system which extends along the eastern margin of Australia. The Project is located in the Gunnedah Basin, which contains claystone, sandstone and siltstone, including coal measures, of the Permian age. A north-south-trending ridge of Early Permian volcanic rocks, the Boggabri Ridge, splits the Gunnedah Basin into the Maules Creek sub-basin to the east, and the Mullaley sub-basin on the western side of the Boggabri Ridge (NSW Department of Primary Industries, 2009).

2.4 Site Geology

The average observed surface soils of the sampled areas consisted of silt and in MLA 2 the soils were typically underlain by clay to approximately 2 metres (m). From approximately 2 m conglomerate rock is dominant (see Borelogs in **Appendix B**).

2.5 Site Topography

The topography of the area in the vicinity of the Project comprises rolling hills in the central part of the proposed open cut and Western Emplacement (largely due to the landform associated with the previous mining activities), with flatter areas to the north. The elevation of the south-eastern part of the Project mining area decreases from approximately 330 m Australian Height Datum (AHD) near the boundary of the Vickery State Forest, to around 270 m AHD at the southern extent of the Eastern Emplacement. Red Hill is located at the very northern extent of the proposed open cut, rising to an elevation of approximately 310 m AHD.

The private haul road and Kamilaroi Highway overpass is located on flat terrain adjacent to the Namoi River.

2.6 Regional Hydrogeology

Mapping from the NSW Office of Water (2010) indicates that two groundwater systems are associated with the Project mining area:

- a porous rock groundwater system; and
- an alluvial groundwater system.

The Project is bordered to the north and south by alluvial sediments associated with the Namoi River floodplain and the groundwaters lie within the Namoi Valley (Keepit Dam to Gin's Leap) Groundwater Source, also known as the Upper Namoi Zone 4 water source.

A separate assessment of potential impacts of the Project on groundwater resources (including identification of groundwater users) has been conducted and is included in Appendix A of the EIS.

2.7 Surface Waters

The Project is situated within the Namoi River catchment. The Namoi River abuts the south-western extent of CL 316 (**Figure 2**) and generally flows in a westerly direction from its headwaters in the Great Dividing Range and ultimately into the Barwon River.

The headwaters of Driggle Draggle Creek and a number of other un-named ephemeral streams originate in the slopes of the Vickery State Forest. As they descend onto the flatter areas to the north and south of the Project they become less well defined drainage paths which become expansive, ponded, overland flow areas during and following heavy rainfall. These flows slowly move down gradient and merge with the Namoi River floodplain.

Water storage dams are scattered throughout the Project area and there is one within 25 m of MLA1-1 and MLA2-1. There is a defined watercourse in the south of MLA 3 running in an east/west direction.

2.8 Underground Utilities Search

An underground utility search, using the DBYD database, was undertaken for the Site. The DBYD search did not reveal any water supply lines located within the Project area. Essential Energy records indicated that there were underground earths or wires and poles within the Project area. The search indicated the presence of above ground Telstra cables. Results of the DBYD database search are included in **Appendix C**.

3 SITE HISTORY

3.1 Historical Aerial Photograph Review

Historical aerial photographs were obtained from NSW Department of Land and Property Information, copies of which are provided in **Appendix D**. Information obtained from the review of these photographs is provided in **Table 3-1.**

Table 3-1 Historical Aerial Review

Photograph Details	Observations	
	On-Site	Surrounding Land
Date: 1956	The sites are sparsely vegetated and are mostly cleared.	East: Vickery State Forest. South, North, West: Sparsely vegetated, cleared land.
Date: 1975	Conditions do not appear to have changed with sites still sparsely vegetated and mostly cleared.	East: No change. South, North, West: No change.
Date: 1991	No change.	East: No change. South, North: No change. West: Excavation and exposed areas, two dams.
Date: 2001	No change.	East: Vickery State Forest to the east. North: In the north-west excavations works have been undertaken on previously cleared land. South: No change. West: Excavation and exposed areas apparent in 1991 have been filled and/or revegetated.
Date: 2012	No change.	No change.

4 Stage 1 – Site Investigation

4.1 On-site Observations

Lloyd Consulting senior personnel undertook a site inspection and intrusive works for the Site from 16 to 18 January 2012. The potentially contaminated areas identified during the site inspection are listed below.

MLA1–1: The site was mostly cleared with remnants of a farmhouse present. There were no signs of a sheep dip present; however there were remnants of a holding yard. There was an abandoned well towards the rear of the site containing refuse. The refuse included some chemical containers. Samples were collected at depth adjacent to the well (**Photos 4-1 to 4-4**).

Photo 4-1 Abandoned well at MLA1-1

Photo 4-3 Fuel storage in shed

Photo 4-2 Shed at MLA1-1

Photo 4-4 Ground underneath shed

MLA2–1: The site was mostly cleared with a decommissioned sheep dip present as well as the ruins of a sheep shearing shed. A water storage dam was located to the north-east of the site. Samples were collected surrounding the dip to depth and surface samples collected within the floors of the shed (**Photos 4-5 to 4-10**).

Photo 4-5 Abandoned sheering shed at MLA2-1

Photo 4-8 Surface water dam adjacent to MLA2-1

Photo 4-6 Concrete slab for the sheep spray at MLA2-1

Photo 4-9 Disused spray structure adjacent to the dip at MLA2-1

Photo 4-7 Abandoned spray drip pad area at MLA2-1

Photo 4-10 Abandoned sheep drencher facing west at MLA2-1

MLA3–1: The site bordered Vickery State Forest, with areas that were densely populated by trees. The area to the south and south-west had been cleared. A general refuse dump area was identified in an area that was relatively thick with trees and was sloping towards the south (**Photo 4-11**). The refuse contained what appeared to be fuel storage containers (**Photo 4-12**). Samples were collected directly south of the refuse.

Photo 4-11 General refuse dump area at MLA3-1

Photo 4-12 Types of refuse in area

Private haul road and Kamilaroi Highway overpass: The presence of an Above Ground Storage Tank (AST) and large generator were identified on-site (**Photo 4-13** and **4-14** respectively), however access to the site was not available so a limited inspection was conducted from the road.

Photo 4-13 Above ground fuel storage tank

Photo 4-14 Generator

Areas that were also inspected but contained no infrastructure or presence of contaminating activities on-site included:

- Blue Vale Road realignment: The area was cleared with no structures present. No areas of concern were identified.
- Pipeline corridor east: The area was cleared with no structures present. No areas of concern were identified.
- Pipeline corridor west: The area was cleared with no structures present. No areas of concern were identified.

4.2 Potential Contamination

The site history review and site inspections identified four (4) potentially contaminated sites that required further investigation (**Section 4.1**). The possible sources of contamination and potential contaminants at each of these sites are identified in **Table 4-1**. **Figure 4** displays the Site locations at MLA1, MLA2 and MLA3 and **Figure 5** displays the area where the AST and generator are located within the allotment adjacent to the private haul road and Kamilaroi Highway overpass construction area.

Details of the further investigations conducted at each of these sites are provided in **Section 5**.

Table 4-1 Possible Sources of Contamination and Potential Contaminants

Area	Site Number	Potential Source of Contamination	Potential Contaminants
MLA 1	1	Abandoned well backfilled with refuse.	OC/OPs and metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc).
MLA 2	1	Sheep dip and shearing shed.	OC/OPs and metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc).
MLA 3	1	General refuse and fuel storage containers.	OC/OPs and metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc).
Haul Road and Kamilaroi Highway Overpass	1	AST and generator.	Metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury and zinc), TPH, BTEX and PAHs.

Notes:

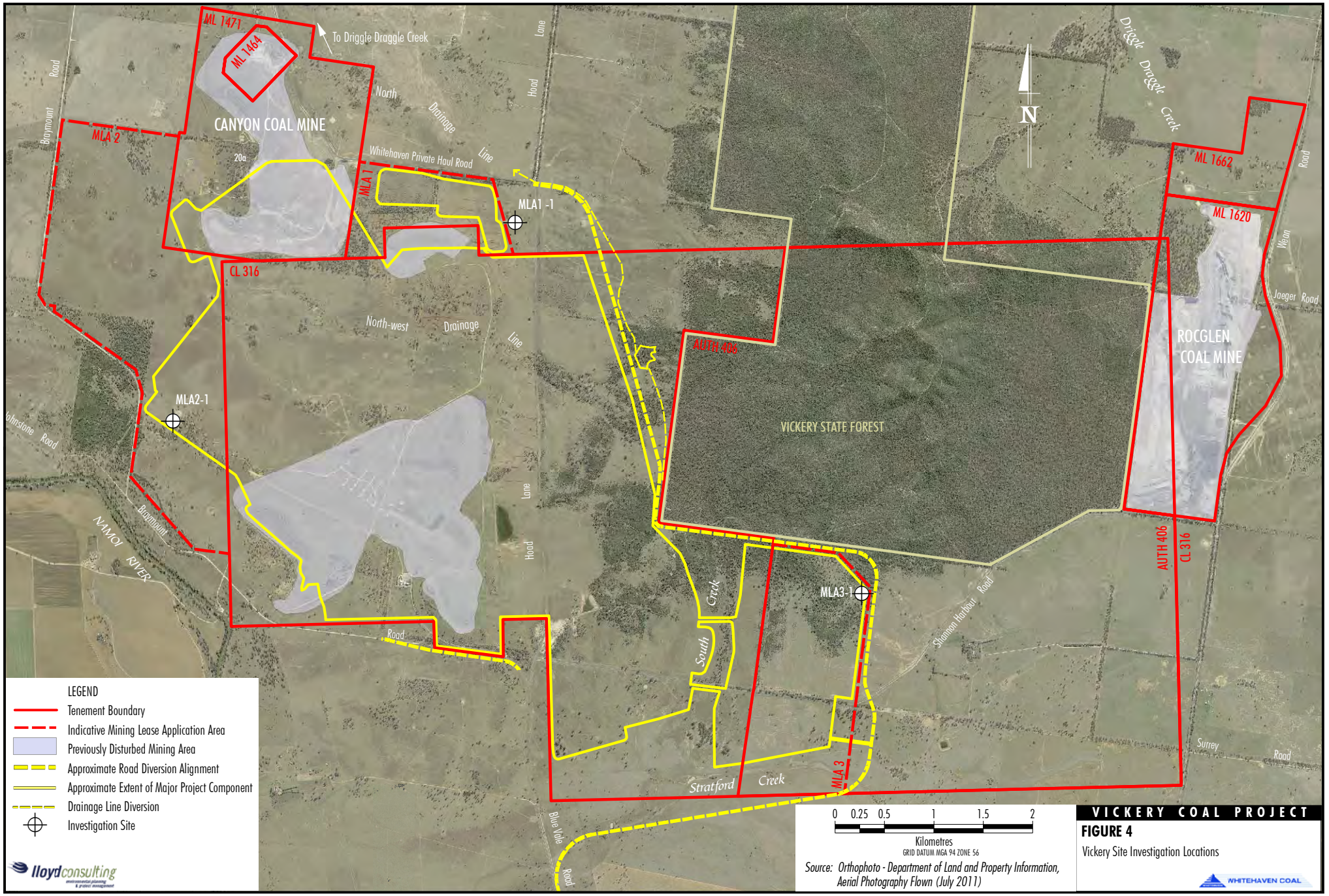
OC/OPs Organochlorine Pesticides and Organophosphorous Pesticides.

TPH Total Petroleum Hydrocarbon.

BTEX Benzene, Toluene, Ethylbenzene, Xylene.

PAH Polycyclic Aromatic Hydrocarbons.

No intrusive investigations were undertaken as part of the Stage 1 – Preliminary Investigations within the private haul road and Kamilaroi Highway overpass area.



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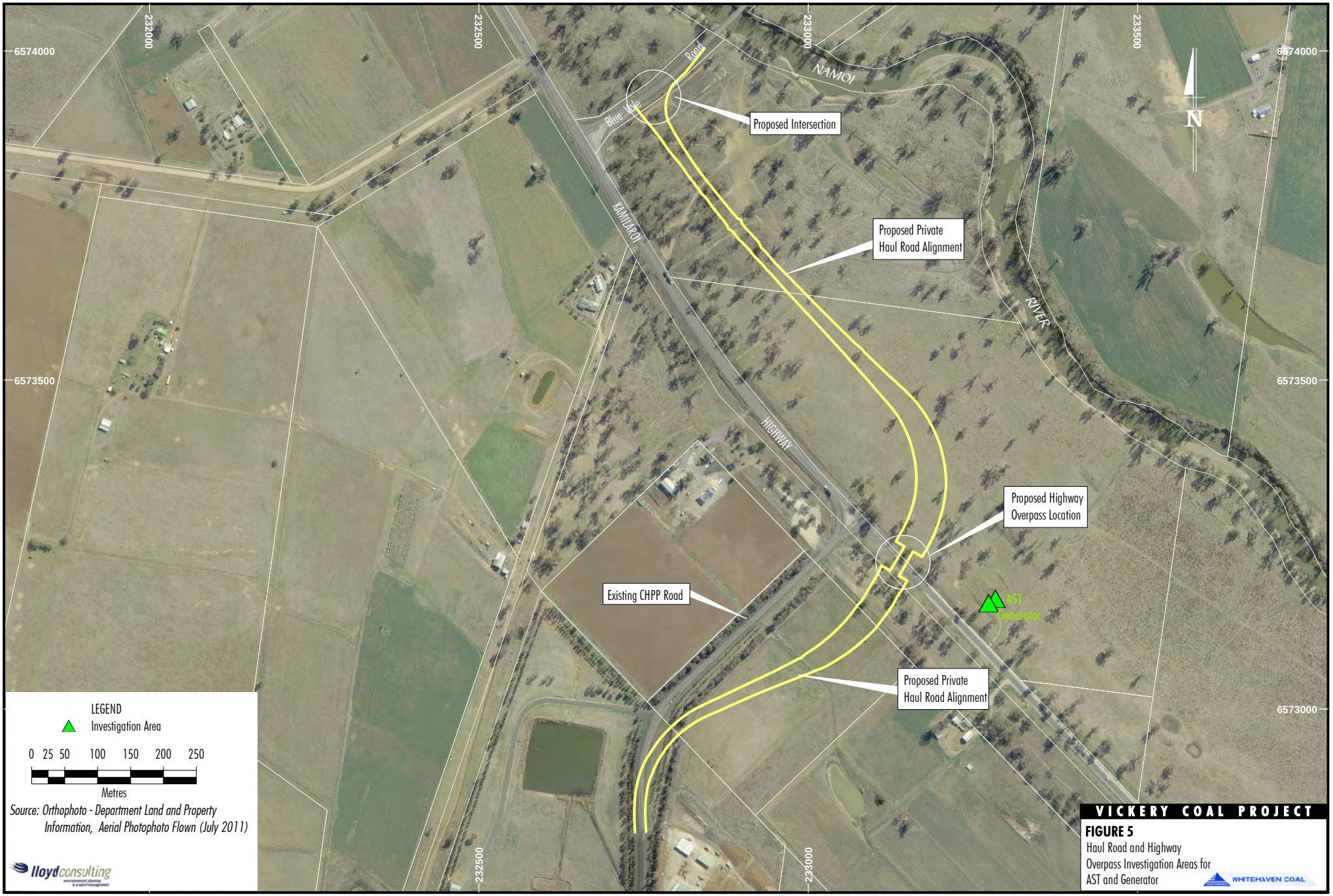

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4.3 Nomenclature

Sample identification was structured the following way:

- Site location – Site number – Sample location – Sample depth / stockpile e.g. MLA1 – 1 – 5 – 0.2 (Site location MLA 1, Site number 1, Sample location 5 at 0.2 m depth); and
- MLA2 – 1 – SP1 (Site MLA2-1, Stockpile 1). Stockpile samples were not given a sample location number.

5 STAGE 1 SOIL INVESTIGATIONS

5.1 Soil Investigation Program

5.1.1 Sampling Program

The site history identified three areas of concern within the Project area that required soil sampling to be undertaken, MLA1-1, MLA2-1 and MLA3-1. The Stage 1 Preliminary Investigation soil sampling program was undertaken on 16, 17 and 18 January 2012.

Soil samples were collected from MLA1-2, MLA2-1 and MLA3-1 as follows:

- MLA1-1 had four (4) samples collected to a depth of 1.5 m. One (1) sample was submitted for laboratory analysis.
- MLA2-1 had 37 samples (including two (2) duplicate samples) collected to a depth of 1.5 m. 29 samples were submitted for laboratory analysis.
- MLA3-1 had four (4) samples collected from one area at each location to a depth of 1.5 m. Two (2) samples were submitted for laboratory analysis.

5.1.2 Sampling Procedures

Soil sampling was undertaken in accordance with the principles described in Australian Standard (AS) 4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* and AS 4482.2-1999 *Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances.*

All soil samples were collected using an excavator or stainless steel trowel.

Samples were selected from each soil investigation area for laboratory analysis such that they target the maximum impact indicated by known historical land-uses (i.e. surface soils); and attempted to achieve the inferred lateral extent of impact. Samples were collected on a judgemental basis.

Samples were collected directly from the excavator bucket by hand or with a stainless still trowel using disposable nitrile gloves. New nitrile gloves were used for each sample collected to avoid cross contamination. No decontamination was required for samples collected by trowel, as a new stainless steel trowel was used for collection of each sample. All samples were stored and kept in an ice packed esky and transported to a National Association of Testing Authorities (NATA) Accredited laboratory for analysis. Blind (duplicate) samples were collected and analysed at a rate of one per twenty samples collected. Soil profiles were logged during sampling.

Upon the completion of the investigation all potentially contaminated areas were backfilled and the Site was returned to its previous condition.

Sample collection included two blind samples, collected and analysed for QA/QC purposes. Determination of the analytes selected for laboratory analysis was dependant on the potential for contamination within the area (judgemental).

5.1.3 Assessment Criteria

The proposed use for MLA1-1, MLA2-1 and MLA3-1 is for mining and mining-related activities. The investigation areas did not form part of the open cut or emplacement areas. The nature of the activities within MLA1-1, MLA2-1 and MLA3-1 may involve the excavation and placement of waste rock material (overburden and interburden). Further, there may be topsoil removal in these areas and possible associated activities such as construction of access roads, drainage etc. The location of the area for topsoil storage or use once removed from the site is unknown. Considering the proposed site use and the limited knowledge on the end use of soils, the primary site investigation criteria is the Environmental Investigation Levels as outlined in NEPM's (1999b) *Schedule B (7a) Guideline on Health-Based Investigation Levels*.

The Health-based Investigation Level A (HIL-A) exposure setting is included for reference for human health. HIL-A criteria are the NEPM guideline levels for residential settings with access for the land user to the soil surface. The HIL-A criteria has been conservatively chosen as the site assessment criteria in consideration of the type of activities that would be conducted within the Site. The Ecological Investigation Level (EIL) exposure setting is included for reference for ecological health.

Where criteria were not available in the above guidelines, the following assessment criteria were used:

- *Regional Screening Levels – Residential* (United Stated Environmental Protection Agency (USEPA) Region 9, 2011 (USEPA, 2011)); and
- *Guidelines for Assessing Service Station Sites* (NSW Office of Environment and Heritage [OEH], 2011).

Table 5-1 displays the adopted site assessment criteria for the Site.

Table 5-1 Soil Site Assessment Criteria

Parameter	Site Assessment Criteria			
	NEPM		USEPA	OEH[3]
	HIL-A[1]	EILs	Residential[2]	
Petroleum Hydrocarbons				
C_6-C_9	-	-	-	65
C_{10}-C_{36}	-	-	-	1000
BTEX				
Benzene	-	-	-	1
Toluene	-	-	-	130
PAH	-		-	-
Total PAH	20	-	-	-
Benzo(a)Pyrene	1	-	-	-
OCs				
Aldrin + Dieldrin	10	-	-	-
Chlordane	50	-	-	-
Heptachlor	10	-	-	-
DDT + DDD + DDE	200	-	-	-
OPs				
Dichlorvos	-	-	1.7	-
Demeton-S-methyl	-	-	2.4	-
Dimethoate	-	-	12	-
Diazinon	-	-	43	-
Chlorpyrifos-methyl	-	-	610	-
Malathion	-	-	1200	-
Chloropyrifos	-	-	61	-
Parathion	-	-	370	-
Pirimphos-methyl	-	-	610	-
Fenamiphos	-	-	15	-
Ethion	-	-	310	-
Metals				
Arsenic	100	20	-	-
Cadmium	20	3	-	-
Chromium (III)	12%	400	-	-
Chromium (VI)	100	1	-	-
Copper	1000	100	-	-
Lead	300	600	-	-
Nickel	600	60	-	-
Zinc	7000	200	-	-

[1] NEPM (1999b) HIL-A.

[2] USEPA (2011).

[3] OEH (2011).

Note: All parameters are in milligrams per kilogram (mg/kg).

5.2 Analysis Results

Laboratory analysis identified 19 exceedances of the site assessment criteria at MLA2-1. There were no exceedances of the site assessment criteria at MLA3-1, with one exceedance of the EIL criteria for zinc at MLA1-1.

A summary of the soil samples submitted for analysis, the minimum and maximum concentrations reported and the samples that exceeded the adopted site assessment criteria are provided in **Table 5-2.**

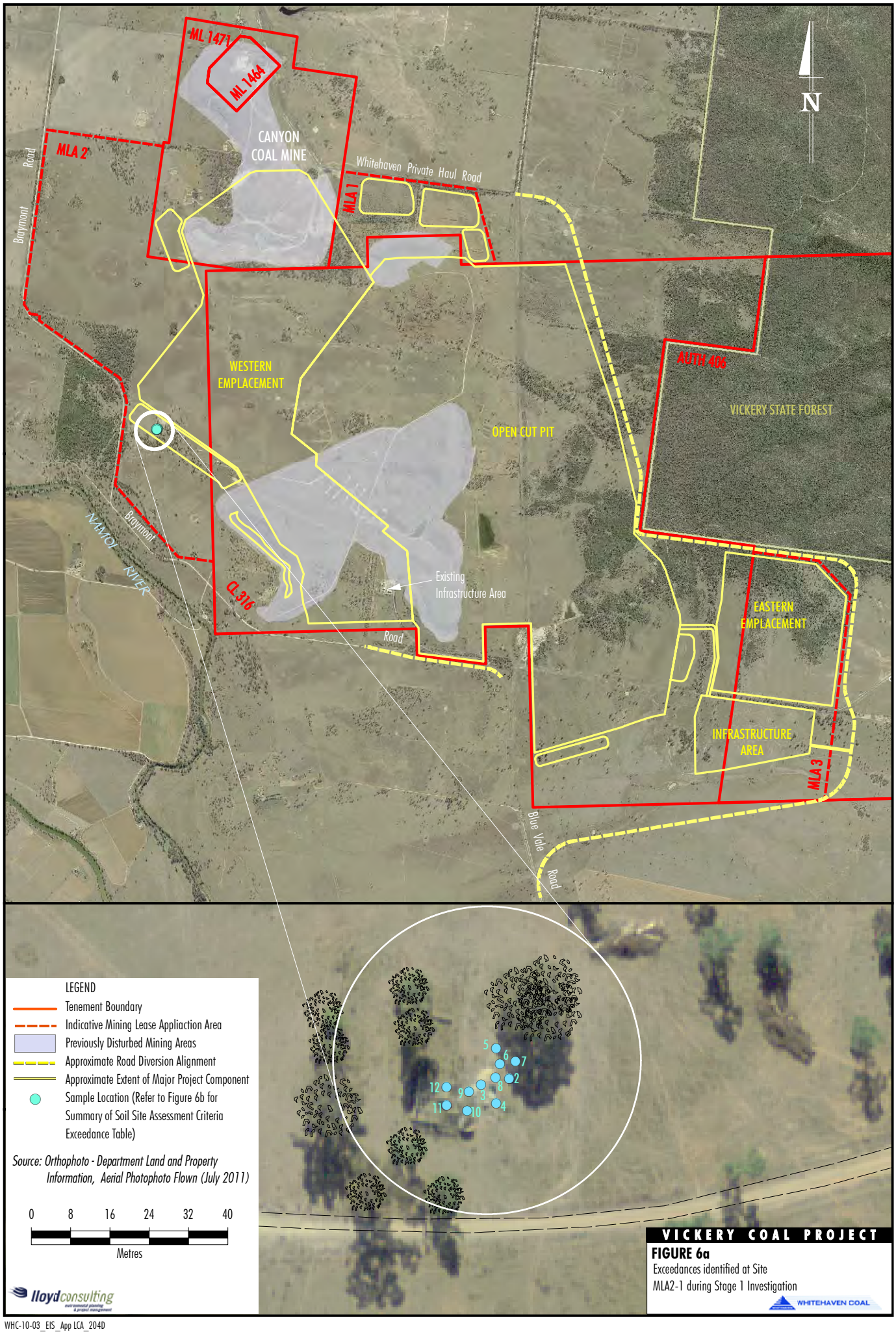
Table 5-2 Summary of Soil Analysis Results

Number of Samples Submitted	Analyte	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Number of Samples Exceeding Site Assessment Criteria[1]
25	Arsenic	<5	2860	15
25	Cadmium	<1	<1	0
25	Chromium*	6	112	0
25	Copper	6	72	0
25	Lead	8	113	0
25	Nickel	7	23	0
25	Zinc	11	342	4
21	OPs	<0.02	<0.05	0
21	OCs (DDD+DDE+DDT)	<0.03	5.66	0
21	OCs (Dieldrin)	<0.05	0.46	0
5	TPH C_6-C_9	<10	<10	0
5	TPH C_{10}-C_{36}	<50	<50	0

[1] Refer to **Table 5-1** for site assessment criteria.
* assuming Chromium on site is Cr(III).

The majority of the exceedances were identified in the surface layer of soils surrounding the sheep dip and within the shed at MLA2-1. There were five exceedances of the site assessment criteria at depth (0.5 m to 1.5 m) located in the sheep dip area.

Figure 6a shows the locations of the samples that exceeded the site assessment criteria at MLA2-1, and **Figure 6b** identifies the exceedences. Laboratory analysis results are provided in full in **Appendix E**, with Laboratory Certificates provided in **Appendix F**.



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Analyte	Site Assessment Criteria (mg/kg)	Location & Site	Sample Location (as shown on Figure 6a)	Sample Depth	Sample ID	Conc. (mg/kg)
Arsenic	20[1] 100[2]	MLA2-1	2	0.2	MLA2-1-2-0.2	93
			3	0.2	MLA2-1-3-0.2	2860
			3	0.5	MLA2-1-3-0.5	146
			3	1.0	MLA2-1-3-1.0	148
			4	0.2	MLA2-1-4-0.2	548
			4	0.5	MLA2-1-4-0.5	194
			4	1.0	MLA2-1-4-1.0	65
			4	1.5	MLA2-1-4-1.5	387
			4	2.0	MLA2-1-4-2.0	53
			5	0.2	MLA2-1-5-0.2	53
			5	1.0	MLA2-1-5-1.0	26
			6	0.2	MLA2-1-6-0.2	218
			6	0.2	MLA2-1-6-0.2D	204
			7	0.2	MLA2-1-7-0.2	89
			8	0.2	MLA2-1-8-0.2	89
			9	0.2	MLA2-1-9-0.2	30
			10	0.2	MLA2-1-10-0.2	82
			11	0.2	MLA2-1-11-0.2	35
			12	0.2	MLA2-1-12-0.2	35
Zinc	200[1] 7000[2]	MLA2-1	8	0.2	MLA2-1-8-0.2	204
			11	0.2	MLA2-1-11-0.2	258
			12	0.2	MLA2-1-12-0.2	202
		MLA1-1	1	0.2	MLA1-2-1-0.2	342

[1] NEPM (1999b) EIL

[2] NEPM (1999b) HIL-A

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FIGURE 6b
Summary of Stage 1
Soil Site Assessment Criteria
Exceedances

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5.3 Discussion of Results

5.3.1 MLA1-1

Laboratory analysis of soil samples collected from MLA1-1 identified one marginal exceedance of the EIL criteria for zinc within the surface soils. No other laboratory exceedances were identified within samples collected from this site. Following the site history review, site inspection and intrusive investigations, it was considered that no further investigations were required at this site.

5.3.2 MLA2-1

Laboratory analysis of soil samples collected from MLA2-1 (sheep dip and surrounding infrastructure) identified 19 exceedances of arsenic concentrations above NEPM (1996b) HIL-A and / or EIL guidelines. Arsenic concentrations ranged from 35 mg/kg to 2860 mg/kg. Further, there were three (3) NEPM (1996b) EIL exceedances for zinc. Ten (10) samples identified OCs present, but none of these samples displayed levels above the site assessment criteria. Based on results from the Stage 1 Preliminary Investigation, a Stage 2 Detailed Investigation was required for this site.

5.3.3 MLA3-1

There were no exceedances of the site assessment criteria at MLA3-1. Following the site history review, site inspection and intrusive investigations, it was considered that no further investigations were required at this site.

6 STAGE 2 DETAILED INVESTIGATION

Based on the information provided in the Stage 1 Preliminary Investigation a Stage 2 Detailed Investigation for MLA2-1 was considered necessary in accordance with Section 3.4.1 of the *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land* (DUAP/EPA, 1998). The investigation was undertaken between 20 and 24 February 2012 and included soil and water sampling.

The objectives of the Stage 2 Detailed Investigation were to delineate laterally and vertically the extent of contamination identified during the Stage 1 Preliminary Investigation (**Sections 4** and **5**), and to develop a RMP for the Site.

6.1 Site Investigations

The following was identified during the Stage 1 Preliminary Investigation:

- **Site MLA2-1:** Laboratory analysis of soil samples collected from MLA2-1 identified 19 exceedances of arsenic concentrations above NEPM (1996b) HIL-A and/or EIL guidelines. Further, there were three (3) NEPM (1996b) EIL exceedances for zinc. Further intrusive investigations were identified as being required.
- **Private haul road and Kamilaroi Highway overpass area:** A site inspection identified the presence of an AST and large generator approximately 100 m to the south-east of the private haul road and Kamilaroi Highway overpass construction area.

6.2 Stage 2 Detailed Investigation Site Inspection

As part of the Stage 2 Detailed Investigation a site inspection of the private haul road and Kamilaroi Highway overpass construction area was undertaken on 24 February 2012. From the site history review and site inspection for the private haul road and Kamilaroi Highway overpass construction area there were no potentially contaminating activities identified within the construction area. The adjacent allotment contained an AST (**Photo 6-1**), a large generator and two storage drums (possibly used for fuel or pesticides) placed on wood (**Photos 6-2** and **6-3**). There was also a disused shed and an abandoned vehicle present (**Photos 6-4** and **6-5**). The type of fuel stored within the AST and drums were not able to be identified and the AST was not placed within a bund, however soils surrounding the AST and generator did not appear to show any signs of staining. The AST and generator were constructed on what appeared to be a filled area. The type of fill appeared to be alluvial material sourced from the nearby creek (**Photo 6-6**).

Photo 6-1 AST on fill material

Photo 6-2 Storage containers placed on wood

Photo 6-3 Generator

Photo 6-4 Disused storage shed

Photo 6-5 Abandoned vehicle adjacent to fill and creek

Photo 6-6 Adjacent creek

The private haul road and Kamilaroi Highway overpass would be located approximately 100 m away from the AST and generator.

Following the site history review and a site inspection of the private haul road and Kamilaroi Highway overpass construction area, no further works are recommended for this area.

6.3 Soil Fieldworks Program

6.3.1 Sampling Program

The Stage 2 Detailed Investigation of MLA2-1 was undertaken between 20 and 24 February 2012.

During the Stage 2 investigation 160 soil samples were collected as well as 10 blind (duplicate) samples and six (6) split (triplicate) samples for QA/QC purposes. Of these, 70 primary samples, 10 blind and six (6) split samples underwent laboratory analysis.

Stage 2 sampling of the MLA2-1 area was conducted using a 10 x 10 m grid system. The sampling grid extended beyond the identified areas of contamination in order to delineate the extent of the contamination both laterally and vertically.

6.3.2 Sampling Procedures

The sampling procedures outlined in **Section 5.1.2** were used for the Stage 2 Detailed Investigation. However, in addition to blind samples (duplicates) being collected for QA/QC purposes, split samples (triplicates) were collected for submission to a secondary laboratory for inter-laboratory quality control (i.e. to assess the difference between laboratory methodology) (see **Appendix G** for RPD results).

The drill rig used water to remove the hollow flights from the auger. A sample of the drill rig water was collected to identify any potential cross contamination for QA/QC purposes.

6.3.3 Assessment Criteria

The assessment criteria outlined in **Section 5.1.3** were used for the Stage 2 Detailed Investigation.

6.4 Soil Analysis Results

Laboratory analysis identified numerous exceedances of the site assessment criteria. **Table 6-1** summarises the minimum and maximum soils results and the number of samples exceeding the site assessment criteria. **Figure 8** provides a conceptual site model that displays indicatively the contamination identified at MLA2-1.

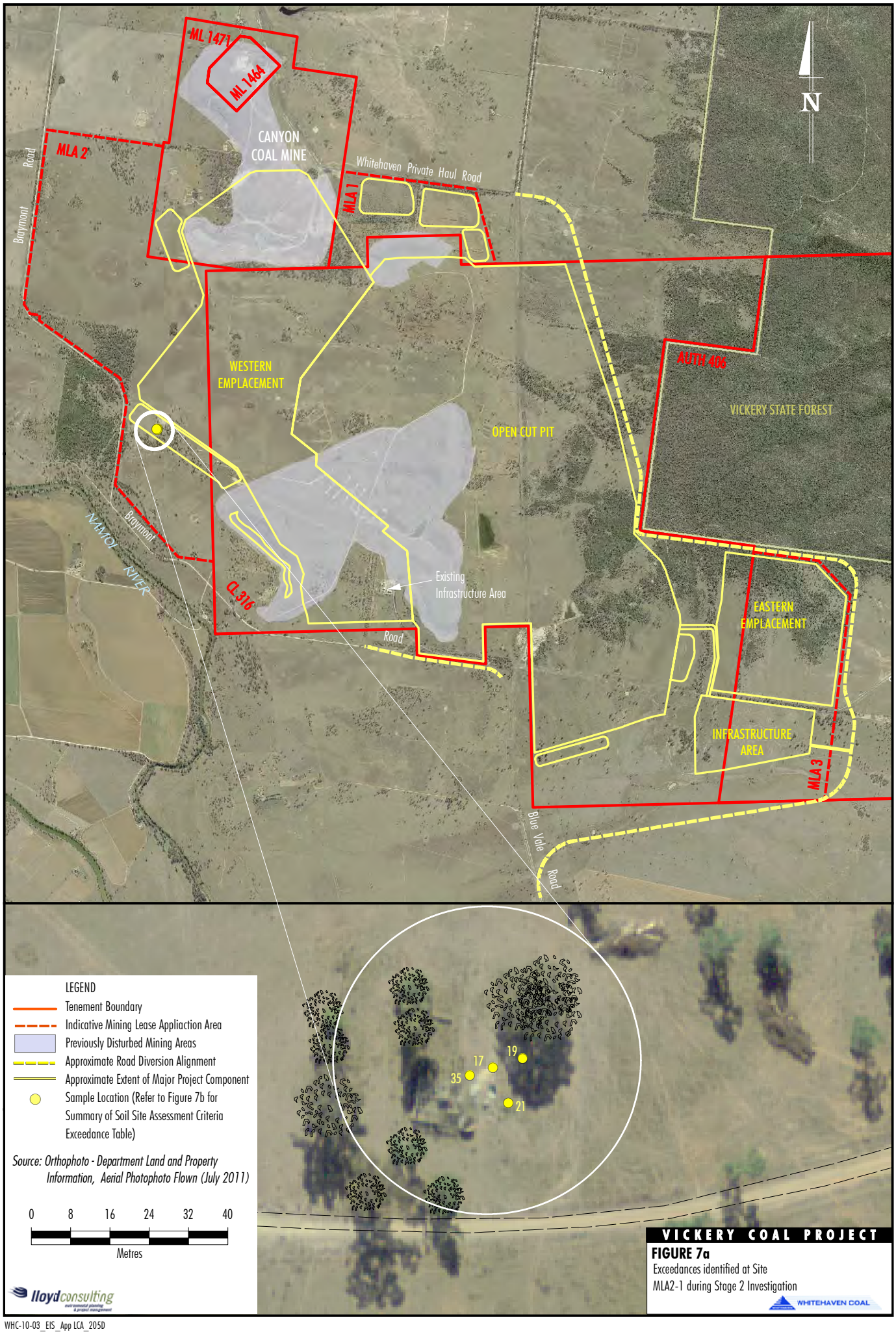
Laboratory analysis results are provided in full in **Appendix E**, with Laboratory Certificates provided in **Appendix F**.

Table 6-1 Summary of Stage 2 Soil Analysis Results

Number of Samples Submitted	Analyte	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Samples Exceeding Site Assessment Criteria[1]
80	Arsenic	<5	126	9
80	Cadmium	<1	<1	None
80	Chromium	6	54	None
80	Copper	<5	23	None
80	Lead	<5	15	None
80	Nickel	3	35	None
80	Zinc	<5	106	None
11	OPs	<0.05	<0.2	None
11	OCs (DDD+DDE+DDT)	<0.3	<0.3	None
11	Ops (Dieldrin)	<0.05	0.27	None
6	TPH C_6-C_9	<10	<10	None
6	TPH C_{10}-C_{36}	<50	<50	None

[1] Refer to **Table 5-1** for site assessment criteria.

The Stage 2 Detailed Investigation identified exceedances of the site assessment criteria over a range from surface samples (0.2 m) to a depth of 1.0 m. Areas that were previously sampled during the Stage 1 Preliminary Investigation were not re-sampled during the Stage 2 Detailed Investigation. **Figure 7a** shows the locations of the samples that exceeded the site assessment criteria at MLA2-1, and **Figure 7b** identifies the exceedances.



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Analyte	Site Assessment Criteria (mg/kg)	Location & Site	Sample Location (as shown on Figure 7a)	Sample Depth	Sample ID	Concentration (mg/kg)
Arsenic	20[1] 100[2]	MLA2-1	Stockpile	-	MLA2-1-SP2	78
			Stockpile	-	MLA2-1-SP3	126
			17	0.2	MLA2-1-17-0.2	101
			17	0.5	MLA2-1-17-0.5	37
			19	0.5	MLA2-1-19-0.5	24
			21	0.2	MLA2-1-21-0.2	86
			21	0.5	MLA2-1-21-0.5	44
			21	1.0	MLA2-1-21-1.0	48
			35	0.2	MLA2-1-35-0.2	57

[1] NEPM (1999b) EIL

[2] NEPM (1999b) HIL-A

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FIGURE 7b
Summary of Stage 2
Soil Site Assessment Criteria
Exceedances

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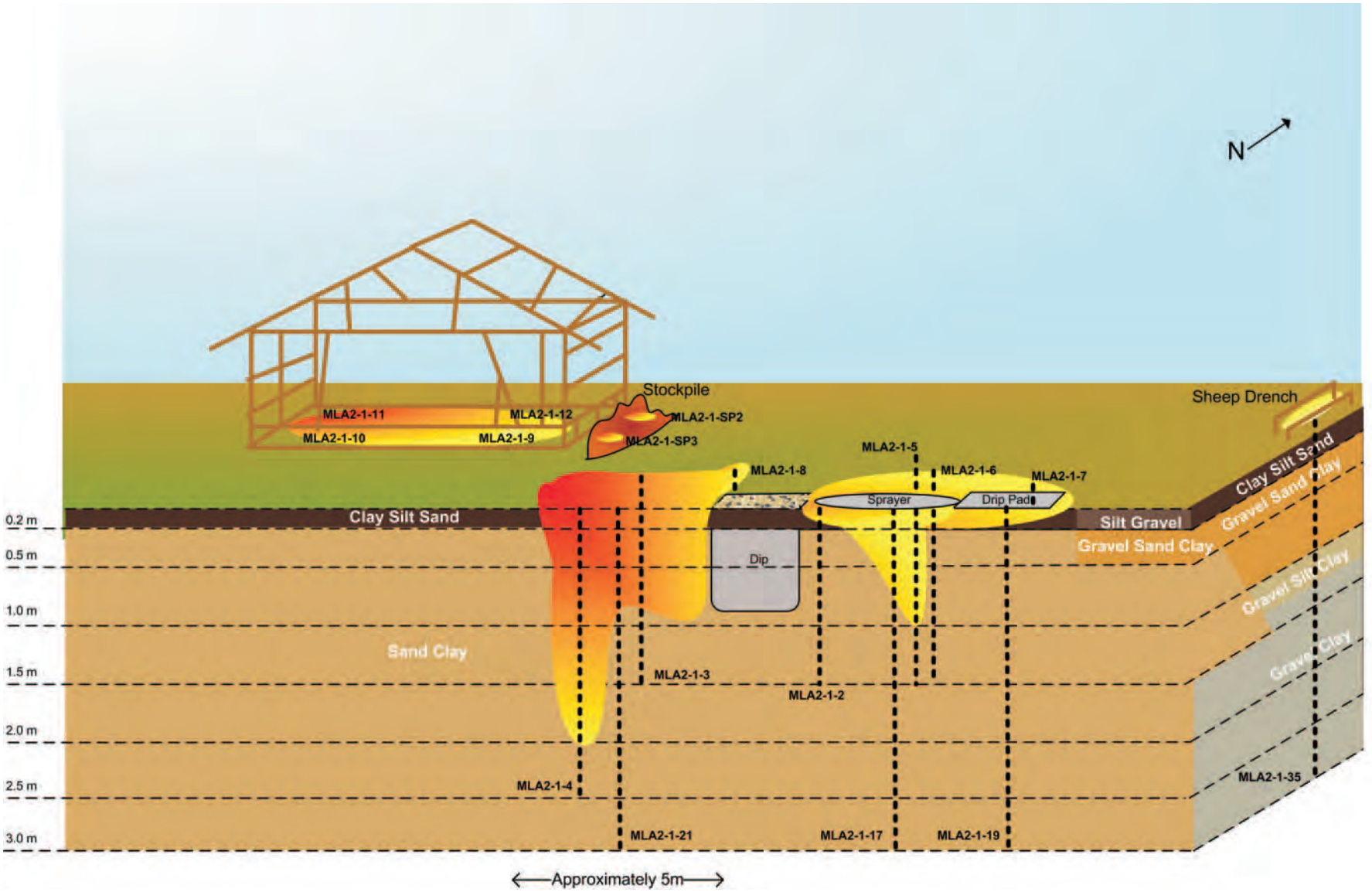

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FIGURE 8

Stage 2 Conceptual Diagram

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6.5 Leachate Analysis and Results

Following the laboratory analysis of the soils for the Stage 1 and Stage 2 investigations, four (4) of the soil samples were sent to ALS to undergo a Toxicity Characteristic Leaching Procedure (TCLP) and Deionised Water (DI) leach testing for arsenic. The testing was conducted to determine the leachability of the arsenic identified in the soils on-site under two different conditions. TCLP testing is conducted under acidic conditions (pH <5), with DI leach testing conducted under pH neutral (pH 7) conditions.

The results from the leach analysis (**Table 6-2**) indicate that the arsenic present in the soils analysed, is leachable under both acidic and neutral conditions.

Table 6-2 Leachate Test Results

	MLA2-1-3-0.2	MLA2-1-4-0.2	MLA2-1-SP3	MLA2-1-17-0.2
Arsenic (TCLP)	3.1	1	0.4	0.4
Arsenic (DI)	6.63	3.46	1.01	1.12

Note: all results are in milligrams per litre (mg/L).

6.5.1 Classification of Soils for Landfill

In accordance with the NSW Department of Environment and Climate Change (DECC) 2008, *Waste Classification Guidelines, Part 1: Classifying Waste,* soils on site would be classified in accordance with **Table 6-3**. Leachate testing (DI) indicated arsenic above 5 mg/L, therefore, the Restricted Solid Waste guidelines would apply. Following discussions with Tamworth Landfill, a soil disposal permit would be required to remove the waste from site and allow for disposal to landfill.

Table 6-3 TCLP and Specific Contaminant Concentration (SCC) Values for Classifying Waste by Chemical Assessment

Maximum Values for leachable concentration and SCC when used together				
	General Solid Waste		Restricted Solid Waste	
Contaminant	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	5.0	500	20	2000

6.6 Discussion of Stage 2 Soil Results

There were nine (9) exceedances of arsenic concentrations at MLA2-1 above NEPM (1996b) EIL guidelines, with two (2) samples exceeding NEPM (1996b) HIL-A guidelines for arsenic. No exceedances of any other metals were recorded during the Stage 2 Detailed Investigation.

One sample identified dieldrin; however this sample did not display levels above the site assessment criteria.

There were no OPs or total petroleum hydrocarbon (TPH) fractions above the Laboratory's limit of reporting identified during the Stage 2 Detailed Investigation.

Sampling within the area as part of the Stage 2 Detailed Investigation delineated the arsenic contamination laterally and vertically, with the contamination being observed to be present within the surface material in most areas.

6.7 Surface Water Fieldworks Program

6.7.1 Sampling Program

Stage 1 Preliminary Investigation sampling program was undertaken on the 16, 17 and 18 January 2012. No surface water samples were collected however a storage dam was identified adjacent to the abandoned sheep dip site.

During the Stage 2 Detailed Investigation a surface water sample was collected from the storage dam identified during the Stage 1 Preliminary Investigation. One (1) primary sample and one (1) blind sample was collected and analysed for total metals and OC/OPs. Field measurements of Dissolved Oxygen (DO), Electrical Conductivity (EC), Total Suspended Solids (TSS), and pH were also taken using a water quality meter.

A water sample was collected from under the sheep dip. The dip had been backfilled with building rubble and gravel and it is likely that rain had penetrated the materials and a small amount of water had accumulated on the bottom of the dip. The sample was analysed for total metals and OC/OPs.

Samples were immediately placed on ice, sealed in an esky and sent to a NATA accredited laboratory for analysis.

6.7.2 Sampling Procedures

Samples were collected in accordance with AS/NZS 5667:4-1998: *Water quality – Sampling Part 4: Guidance on sampling from lakes, natural and man-made.* All samples were collected from the surface by placing a sample collection bottle upside down into the water body and rotating the bottle at approximately 0.2 m below the surface to collect the water sample.

Surface water samples (primary and blind) were collected on 20 February 2012 from the storage dam adjacent to the sheep dip site. The surface water samples were submitted to a NATA accredited laboratory and analysed for total metals and OC/OPs. Field parameters were recorded using an Aquameter water quality meter. The calibration certificate for the Aquameter is included in **Appendix F**.

The water sample collected from under the sheep dip was taken using a pair of clean disposable gloves and a laboratory prepared bottle. The dip water sample was submitted to a NATA accredited laboratory and analysed for total metals and OC/OPs.

All sampling equipment was disposable so no decontamination procedures were necessary.

6.7.3 Assessment Criteria

The adopted site assessment criteria for surface waters is the Australian and New Zealand *Guidelines for Fresh and Marine Water Quality Ecosystems Fresh Water (90% protection level)* (Australian and New Zealand Environment and Conservation Council [ANZECC] and Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ]) (2000) and is summarised in **Table 6-4**. These guidelines provide trigger values for protection of species in fresh waters.

Table 6-4 Surface Water Site Assessment Criteria

Analytes	ANZECC Freshwater 90% Protection[1]
Metals	
Arsenic (V)	0.042
Cadmium	0.0004
Chromium (VI)	0.006
Copper	0.0018
Lead	0.0056
Nickel	0.013
Zinc	0.015

Table 6-4 Surface Water Site Assessment Criteria (Cont.)

Analytes	ANZECC Freshwater 90% Protection[1]
OCs	
Aldrin	
Chlordane	0.00014
DDE	
DDT	0.00002
Dicofol	
Dieldrin	
Endosulfan	0.0006
Endosulfan alpha	
Endosulfan beta	
Endrin	0.00005
Heptachlor	0.00025
Heptachlor epoxide	
Lindane	0.0004
Methoxychlor	
Mirex	
Toxaphene	0.0003
OPs	
Azinphos methyl/Guntion	0.00005
Bromophos-ethyl	
Chlorpyrifos	0.00011
Demeton	
Demeton-S-methyl	
Diazinon	0.0002
Dimethoate	0.0002
Fenitrothion	0.0003
Malathion	0.0002
Parathion	0.00001
Profenofos	
Temephos	

[1]ANZECC and ARMCANZ (2000) *Ecosystems Fresh Water (90% protection level)*

6.7.4 Sample Identification

Water sample identification was based on the location from where it was collected.

- MLA2-1-SW1: surface water sample collected from the storage dam.
- MLA2-GW1: groundwater sample collected from under the former sheep dip.

6.8 Surface and Dip Water Results

Laboratory results indicate exceedances of the site assessment criteria in all water samples analysed. Laboratory analysis results are provided in full in **Appendix E**, with Laboratory Certificates provided in **Appendix F**.

6.8.1 *In-situ* Water Monitoring

The results from the surface water *in-situ* sampling are displayed in **Table 6-5**. *In-situ* sampling of the groundwater within the sheep dip was not conducted.

Table 6-5 *In-situ* Surface Water Monitoring Results

Sample	pH	EC @ 25°C (µS/cm)	Total Dissolved Solids (ppm)	DO (mg/L)	Temperature (°C)	Observations
MLA2-1-SW1	6.91	306	198	108.8	35.6	Water clear, hot and sunny

µS/cm microSiemens per centimetre
ppm parts per million
°C degrees Celsius

6.8.2 Laboratory Analysis

A summary of the water samples submitted for analysis and the analytical results for total metals are provided in **Table 6-6**.

The surface water samples (primary and duplicate samples) (MLA2-1-SW1 and MLA2-1-SW1D) exceeded the site assessment criteria for total copper and total zinc.

The laboratory analysis of the groundwater sample collected from beneath the sheep dip (MLA2-1-GW1) displayed exceedances for all total metals analysed.

There were no OC/OPs identified above the laboratory's limit of reporting in the samples analysed.

Laboratory analysis results are provided in full in **Appendix E**, with Laboratory Certificates provided in **Appendix F**.

Table 6-6 Summary of Stage 2 Water Analysis Results

Sample ID	Arsenic	Cadmium	Chromium	Copper	Nickel	Lead	Zinc
MLA2-1-SW1	0.003	<0.0001	<0.001	0.003	0.003	0.002	0.064
MLA2-1-SW1D	0.003	<0.0001	<0.001	0.002	0.003	0.002	0.05
MLA2-GW1	9.90	0.0108	0.159	1.04	0.2	0.763	7.78

Note: All results are reported in mg/L.
Shaded cells represent samples exceeding ANZECC Freshwater 90% protection.

6.9 Discussion of Water Results

Results from the Stage 2 Detailed Investigation for the surface water storage dam indicated that total concentrations of metals and OC/OPs were below the site assessment criteria except for copper and zinc. The laboratory analysis showed that the surface water sample marginally exceeded the site assessment criteria for total copper and total zinc. The water from the storage dam is suitable for use as a dust suppressant.

A water sample was collected from under the sheep dip. The dip had been backfilled with building rubble and gravel and it is likely that rain had penetrated the materials and a small amount of water had accumulated on the bottom of the dip. The sample was analysed for total metals and OC/OPs. The sample displayed exceedances for all total metals analysed.

There were no OC/OPs identified above the laboratory's limit of reporting in the samples analysed.

7 RISK ASSESSMENT

The proposed use for MLA2-1 is for mining and mining-related activities. The nature of the activities within MLA1-1, MLA2-1 and MLA3-1 may involve the excavation and placement of waste rock material (overburden and interburden). Further, there may be topsoil removal in these areas and possible associated activities such as access roads, drainage etc. The location of the area for soil storage or use once removed from site is unknown.

Based on Stage 1 and Stage 2 investigations a risk assessment for human health and the environment has been undertaken.

The objectives of the risk assessment were to:

- assess the potential for risk to human health based on observed contaminants in soil; and
- assess the potential risk to the environment for the end use of contaminated soils.

In order to assess the risk associated with contamination at MLA2-1 the data was compared with NEPM HIL-A and EIL criteria based on MLA2-1 end use and potential human exposure. The source, receptor and exposure routes have been considered for the risk assessment.

7.1 Source

Historical information and a site inspection identified a former sheep dip at MLA2-1. Arsenic contamination in soils associated with the sheep dip, was identified through laboratory analysis.

7.2 Receptors

The topsoil at MLA2-1 is to be excavated by mine workers. The end use of excavated topsoil is unknown, however the most likely environmental receptors for the area is local streams, creeks and rivers.

7.3 Exposure Route

The human health exposure routes considered are dust, dermal and inhalation during excavation activities. The environmental exposure route is through surface soil runoff and dust.

7.4 Risk Management

Considering the proposed site use and the limited knowledge on the end use of soils, the results from the Stage 1 and Stage 2 investigations indicate that there may be some potential risk to on-site workers during soil removal and to the environment if soils are inappropriately stored. On this basis a RMP was developed (**Section 9**).

8 QUALITY ASSURANCE AND QUALITY CONTROL

8.1 Data Quality Objectives

The data quality objectives of the investigation were to obtain sufficient data to allow a high quality environmental assessment to be made of:

- The likelihood of impacted soil quality at the Site;
- The risks posed to the environment;
- The adequacy and completeness of all information available to be used in making decisions on remediation; and
- The requirements for any further investigative works.

The evaluation criteria adopted by the investigation are summarised below in **Table 8-1.**

Table 8-1 Evaluation Criteria

Protocol	Description
Documentation completeness	Completion of field calibration records, chain of custody documentation, laboratory test certificates from NATA accredited laboratories.
Data completeness	Targeted sampling in accordance with DUAP/EPA's (1998) *Managing Land Contamination, Planning Guidelines SEPP 55 Remediation of Land* for potential contaminants of concern at all areas of environmental concern.
Data comparability	Use of appropriate techniques for the sampling, storage and transportation of samples. Use of NATA certified laboratory using NEPM procedures.
Data representation	Good sampling coverage of main areas of environmental concern at the site, and selection of representative samples.
Precision and accuracy for sampling and analysis	Use properly trained and qualified field personnel. Blind field duplicates to be collected at a minimum rate of 1 in 20. RPD's to be less than 30% for inorganic and 50% for organic analyses. Achieve laboratory QC criteria.

8.2 Field Quality Assurance and Quality Control

The QA and QC protocols used during the fieldwork for the assessment are shown in **Table 8-2.**

Table 8-2 QA/QC Protocols

Protocol	Description
Sampling team	Site personnel will comprise of professionally qualified environmental scientists and engineers trained in conducting site contamination investigations.
QA/QC system	All fieldwork will be conducted in accordance with an approved Lloyd Consulting Field Work Plan.
Chain of Custody forms	All samples will be logged and transferred under appropriately completed Chain of Custody Forms.
Preservation	All samples will be sent to and received at the laboratory in appropriately preserved containers, with preservation including packing samples with ice packs in eskies.
Blind and Split Field Duplicates	Blind field duplicates and split field triplicates will be prepared in accordance with procedures given in Section 8 of AS 4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*. The frequency of duplicate testing will be at least 20% for all soil samples. Blind duplicates are split field samples, which are both sent to the laboratory for individual analyses. RPD's to be less than 30% for inorganic and 50% for organic analyses. These samples are analysed to assess the field methods. Split samples are a triplicate or duplicate sample of the primary field sample, which are then sent to a secondary laboratory for analyses to determine any differences between laboratories. RPD's to be less than 30% for inorganic and 50% for organic analyses.

8.3 Laboratory Quality Assurance and Quality Control

Soil and water samples collected from the Site were sent to the ALS Laboratory in Sydney which is NATA accredited for the specified analysis. The data validation process and overall QA/QC procedures used to assess the effectiveness of the overall analytical process and to assess the use of data is outlined in **Table 8-3**.

Table 8-3 Laboratory QA/QC

Protocol	Description
Holding Times	Holding times are the maximum permissible elapsed time in days from the collection of the sample to its extraction and/or analysis.
Reagent Blanks	The reagent blank sample is a laboratory prepared sample containing the reagents used to prepare the sample for final analysis. The purpose of this procedure is to identify contamination in the reagent materials and assess potential bias in the sample analysis due to contaminated reagents. The QC criteria are no detectable contamination in the reagents.
Laboratory Duplicates	Laboratory duplicates are field samples that are split in the laboratory and subsequently analysed a number of times in the same batch. These subsamples are selected by the laboratory to assess the accuracy and precision of the analytical method. ALS Laboratories undertakes QA/QC procedures such as calibration standards, laboratory control samples, surrogates, reference materials, sample duplicates and matrix spikes. The QC criteria are 50% RPD.
Matrix Spikes/Matrix Spike Duplicates (MS/MSD)	MS/MSDs are field samples to which a predetermined stock solution of known concentration has been added. The samples are then analysed for recovery of the known addition. Recoveries should be within the stated laboratory control limits of 70 to 130% and duplicates should have RPDs of less than 50%.

8.3.1 Laboratory and Field Duplicates

Precision is a measure of the ability to reproduce results, and is assessed on the basis of agreement between a set of replicate results obtained from duplicate analyses. The precision of a set of duplicates can be measured as RPD, and is calculated from the following equation:

$$RPD = \left[\frac{X1 - X2}{\left(\frac{X1 + X2}{2} \right)} \right] \times 100$$

8.4 Data Quality Objective Completion

A summary of the Data Quality Objectives are provided in **Table 8-4**.

Table 8-4 Data Quality Objectives Completion

Data Quality Objectives	Description	Achieved
Documentation Completeness	ALS QA/QC procedures such as calibration standards, laboratory control samples, surrogates, reference materials, sample duplicates and matrix spikes are included in **Appendix F**. All necessary documentation has been provided by the laboratory following analysis including Chain of Custody forms, Certificate of Analysis, and QC Report(s) and included within **Appendix F**.	✓
Data Completeness	Targeted sampling was undertaken within those areas of concern at the site in accordance with the relevant DUAP/EPA's (1998) *Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land* for potential contaminants of concern.	✓
Data Comparability	All sampling was undertaken in accordance with the DUAP/EPA's (1998) *Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land*. Samples were stored in an Esky packed with ice, transported to the laboratory and extracted/analysed within the necessary holding times. ALS is a NATA certified laboratory using NEPM procedures (Schedule B(3)).	✓
Data Representativeness	Appropriate sampling coverage at the site undertaken. Representative samples were also collected.	✓
Precision and accuracy for sampling and analysis	Properly trained and qualified field personnel were used to undertake the Land Contamination Assessment. Blind field duplicates and split field triplicates were collected at a minimum rate of 1 per 20 samples. RPD's to be less than 30% for inorganic and 50% for organic analyses. (RPD Calculations table is available in **Appendix G**). Achieve laboratory QC criteria.	✓

8.5 Discussion of Data Quality Objective Completion

8.5.1 Cross Contamination

As part of the QA/QC a water sample (MLA2-1-DR1) was collected from the drill rig water supply unit. Water is used with the drill rig under high pressure to remove the hollow flights from the auger. The purpose of this sample was to identify any potential cross contamination from the water to the soils. There was no arsenic present in the sample, therefore, it is unlikely that cross contamination occurred.

8.5.2 Laboratory Documentation

8.5.2.1 Laboratory Certificate ES1201146

All soil samples were received and analysed within laboratory holding times.

There were two laboratory control spike exceedances for metals (copper and lead). As the soil sample results did not exceed the site assessment criteria it is not anticipated that these results will affect the outcomes of this report.

There were four OC exceedances for matrix spike recoveries, with the recovery being less than the lower data quality objective in two instances, and not determined due to sample matrix interference in the other two instances. This may indicate an underestimate in results reported. However, as the OC results were well below site assessment criteria it is unlikely that the exceedance will affect the outcome of the report.

There were no other laboratory outliers to report.

8.5.2.2 Laboratory Certificate ES1202047

All soil samples were received and analysed within laboratory holding times.

There were no laboratory outliers to report.

8.5.2.3 Laboratory Certificate ES1203989

All water samples were received and analysed within laboratory holding times.

There were no laboratory control spike exceedances reported.

There were three matrix spike recovery exceedances (for arsenic, chromium, nickel) within water samples, with recovery being greater than the upper control limit in all three instances indicating that there may be an overestimate in the results from the laboratory analysis for the water samples. As the results for the surface water samples did not exceed the ANZECC guidelines it is not anticipated that these results will affect the outcomes of this report.

8.5.2.4 Laboratory Certificate ES1204112

All samples were received and analysed within laboratory holding times.

There was one laboratory control spike exceedance for metals (lead). As there were no exceedances of the site assessment criteria for lead within these samples analysed, it is not anticipated that these results will affect the outcomes of this report.

There were two matrix spike recovery exceedances, one for TPH and one for TRH, with the recovery not determined and the background level greater than or equal to four (4) times the spike level for both. This may indicate an underestimate of TPH reported however as there were no TPH results above the laboratory's limit of reporting it is not anticipated that these results will affect the outcomes of this report.

8.5.2.5 Laboratory Certificate ES1204230

All samples were received and analysed within laboratory holding times.

There were two laboratory control spike recovery exceedances for metals (chromium and nickel). The recovery marginally exceeded the upper recommended limit suggesting that the reported concentration of this analyte in the samples may be overestimated. Therefore, chromium and nickel results in the groundwater sample may be slightly overestimated. The chromium and nickel results for MLA2-GW1 exceed the ANZECC 90% protection levels by three (3) and one (1) order of magnitude respectively, therefore a minor overestimate is unlikely to affect the outcomes of the results.

There were no matrix spike recovery exceedances to report.

There no other laboratory outliers to report.

8.5.2.6 Laboratory Certificate ES1204352

All samples were received and analysed within laboratory holding times.

There was one laboratory control spike recovery exceedance for metals (chromium). As the results for chromium do not exceed the site assessment criteria it is not anticipated that this result will affect the outcome of this report.

There was one regular soil sample surrogate exceedance for toluene however all TPH results were below the limit of reporting and therefore it is not anticipated that this result will affect the outcome of this report.

There were no other laboratory outliers to report.

8.5.2.7 Laboratory Certificate 69625 (Envirolab)

All samples were received and analysed within laboratory holding times.

There were no laboratory outliers to report.

8.5.3 Soil RPDs

For the Stage 1 investigation there were three (3) exceedances of the RPD calculations for the soils analysed. The RPD result for arsenic was 33% at MLA2-1-1-1.5, which is marginally above site assessment criteria and the result for lead and Dibromo DDE at MLA2-1-6-0.2 being 46% and 47% respectively. Due to the levels of arsenic and lead identified in the samples being below NEPM EIL and HILs the results are considered unlikely to affect the outcomes of this report.

8.5.3.1 Blind Samples

For the Stage 2 investigation there were 10 RPD exceedances of the blind (duplicate) samples for the soils analysed. **Table 8-5** summarises these exceedances. RPD calculations exceedances may be attributed to the heterogeneity of the soil samples collected. Further, the levels of all analytes, except chromium, were lower than NEPM HILs and EILs. Chromium levels all exceeded the EIL. However chromium in the soil is naturally high in this region therefore the RPD results indicate that the laboratory analysis data was suitable for the purposes of site assessment works.

The RPD results indicated that the laboratory analysis data was suitable for the purposes of site assessment works.

Table 8-5 Summary of Stage 2 Soil Blind RPD Exceedances

Analyte	RPD	Location
Arsenic	50%	MLA2-1-40-0.2
Chromium	51%	MLA2-1-18-0.5
	75%	MLA2-1-22-0.5
	41%	MLA2-1-32-0.5
	46%	MLA2-1-38-0.1
	49%	MLA2-1-40-0.2
Lead	35%	MLA2-1-22-0.5
	40%	MLA2-1-32-0.5
Nickel	55%	MLA2-1-22-0.5
Zinc	33%	MLA2-1-40-0.2

8.5.3.2 Split Samples

Split (triplicate) samples were also submitted to Envirolab for inter laboratory QA/QC analysis as part of the Stage 2 investigation. There were ten (10) split sample RPD exceedances. **Table 8-6** summarises triplicate exceedances. RPD calculation exceedances may be attributed to the heterogeneity of the soil sample collected. Additionally all of the results associated with the RPD calculations were below NEPM EIL and HILs.

The RPD results indicated that the laboratory analysis data was suitable for the purposes of site assessment works.

Table 8-6 Summary of Stage 2 Soil RPD Triplicate Exceedances

Analyte	RPD	Location
Arsenic	46%	MLA-2-1-32-0.5
	57%	MLA2-1-35-0.5
	40%	MLA2-1-40-0.2
Lead	48%	MLA2-1-32-0.5
	35%	MLA2-1-28-0.5
	44%	MLA2-1-25-1.0
Zinc	45%	MLA2-1-35.0.5
	45%	MLA2-1-38-1.0
	42%	MLA2-1-40-0.2
	40%	MLA-2-1-28.0.5

8.5.4 Water RPDs

For the Stage 2 investigation there was one exceedance of the RPD calculation for copper (40%) at MLA2-1-SW1. The exceedance of the RPD may be due to the sample being unfiltered and the copper being bound to the soils present within the water sample. The exceedance is marginal and the result is considered suitable for reporting purposes.

All RPD results can be viewed in **Appendix G.**

8.6 Data Suitability

Following an analysis of the field and laboratory QA/QC the results contained within this report are suitable for reporting purposes.

9 REMEDIATION MANAGEMENT PLAN

9.1 Objectives

There are three objectives of the RMP:

1) To provide a remediation strategy for the Site that ensures remediation works are conducted in a manner that protects human health and the environment.
2) To ensure that, once remediated, the Site is suitable for its intended end use (i.e. that is the Project).
3) To ensure ongoing protection of human health and the environment post remediation.

The objectives of the RMP would be achieved by removing soils contaminated by arsenic for reuse where appropriate, or for removal for landfilling at a licensed landfill facility.

9.2 Identified Areas of Contamination

Results from the Stage 1 and 2 investigations at MLA2-1 identified 28 exceedances of arsenic concentrations above NEPM (1996b) EIL guidelines, with 10 samples exceeding NEPM (1996b) HIL-A guidelines.

9.3 Environmental Guidelines

Relevant environmental guidelines to the RMP include:

- Guidelines issued under Schedule B of the NEPM (1999); and
- AS 4482.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*.

9.4 Site Contamination Remediation Strategies

9.4.1 MLA2-1

The Site would require removal of solid waste for recycling/landfill disposal (shed structures and concrete) as well as excavation and landfill disposal of arsenic contaminated soils at levels above EILs. The HIL-A exposure setting is included for reference for human health. HIL-A criteria are the NEPM guideline levels for residential settings with access for the land user to the soil surface. **Table 9-1** summarises the remediation required for the site.

Table 9-1 Remediation Strategy

Site Area	Contaminant Source and Type	*In situ* Volume (m^3)	Remediation Method	Control Measures
MLA 2 Site 1 (Former Sheep Dip)	Arsenic	~ 1,000	Excavate according to Remediation Management Plan. Validate underlying soils.	General control measures (dust suppression, Site Safety Plan, Sediment Control Plan, etc.). Soils removed to be placed immediately into trucks prior to transport to an appropriately licensed landfill (no stockpiling at the Project).
MLA1-1 and MLA3-1	Refuse	~ 200	Excavate refuse and supervise for signs of soil contamination.	Supervision by suitably qualified person for removal of refuse to ensure any unexpected contamination would be controlled and if further excavations to depth are required.

m^3 cubic metres

9.4.2 MLA1-1 and MLA3-1

The Sites would require removal of solid waste for recycling/landfill disposal. Removal work is to be overseen by a suitably qualified person. In the event that possible contamination within soils is identified, then soils are to be excavated and stockpiled on plastic sheeting. Samples are to be collected at the rate of 1 in 50 m^3 and sent to a NATA accredited laboratory to undergo analysis for metals (arsenic, zinc, copper, cadmium, mercury, cadmium, chromium, and nickel), TPH, BTEX and PAHs.

9.5 Remediation Criteria

The Site Acceptance Criteria adopted for validation of the soils at the Site is listed in **Table 9-2**. The Site Acceptance Criteria have been selected considering the HIL-A and EILs (NEPM, 1999b).

NEPM EIL criteria for arsenic are being applied to soils being removed from the site to allow for management of the soils. The HIL-A exposure setting is included for reference for human health. HIL-A criteria are the NEPM guideline levels for residential settings with access for the land user to the soil surface.

Table 9-2 Site Acceptance Criteria

Parameter	Site Acceptance Criteria		
	NEPM		
	HIL-A	EILs	OEH
Petroleum Hydrocarbons			
C_6-C_9	-	-	65
C_{10}-C_{36}	-	-	1000
BTEX			
Benzene	-	-	1
Toluene	-	-	130
PAH	-		-
Total PAH	20	-	-
Benzo(a)Pyrene	1	-	-
Metals			
Arsenic	100	20	-
Cadmium	20	3	-
Chromium (III)	12%	400	-
Chromium (VI)	100	1	-
Copper	1000	100	-
Lead	300	600	-
Nickel	600	60	-
Zinc	7000	200	-
Mercury	15	1	-

Note: parameters are displayed in mg/kg.

9.6 Remediation Program

All disposal and remediation operations must be supervised by a suitably qualified and experienced person.

A summary of responsibilities on-site for the suitably qualified person are:

- Implementation and maintenance of the RMP, including on-site monitoring of remediation activities, auditing contractor compliance with the RMP and associated documentation;
- Supervision including marking out of areas identified as requiring remediation in the RMP;
- Maintenance of a Materials Tracking Register, including audits of the Civil Contractor's soil tracking system; and
- Inspection and validation sampling of excavated surfaces and characterisation sampling of stockpiles (if required).

A Remedial Action Plan will be developed in accordance with the OEH's *Guidelines for Consultants Reporting on Contaminated Sites* (1997) prior to the works being undertaken

9.6.1 General Environmental Controls

Throughout the remediation of the Site control measures would be maintained. Specific control measures to be in place are to include:

- Environmental induction for all Site staff; and
- An implementation strategy would be required to control emissions to air (including dust); water quality; noise; pests; erosion and sediment controls; emergency planning and response; and occupational health and safety.

9.6.2 Offsite Disposal of Contaminated Soils

Remediation of the Site would require movement of soil off-site for disposal at landfill. All soils at MLA2-1 requiring disposal are to be placed immediately into trucks and not stockpiled at the Site. Soils from around the AST and generator adjacent to the private haul road and Kamilaroi Highway overpass area are to be stockpiled on plastic sheet and securely covered, whilst awaiting analytical results prior to landfill disposal (if excavation of these soils is necessary). It is anticipated that the soils would be disposed of at an appropriately licensed landfill, specifically Tamworth Landfill, in accordance with the landfill acceptance criteria described in **Table 9-3** as referred to in the *Waste Classification Guidelines, Part 1: Classifying Waste* (DECC, 2008), and would require a soil disposal permit. A Material Tracking Register will be maintained to track all soil material removed from the Site.

Table 9-3 TCLP and SCC Values for Classifying Waste by Chemical Assessment

	Maximum Values for TCLP and SCC when used together			
	General Solid Waste		Restricted Solid Waste	
Contaminant	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	5.0	500	20	2,000
Cadmium	1.0	100	4	400
Lead	5.0	1,500	20	6,000
Nickel	2.0	1,050	8	4,200
Mercury	0.2	50	0.8	200
TPH C_6-C_9	N/A	650	N/A	2,600
TPH C_{10}-C_{36}	N/A	10,000	N/A	40,000
PAHs	N/A	200	N/A	800
Benzo(a)Pyrene	0.04	10	0.16	23
Benzene	0.5	18	2	72
Ethylbenzene	30	1,080	120	4,320
Toluene	14.4	518	57.6	2073
Xylenes (total)	50	1,800	200	7,200

9.6.3 Unexpected Contamination

In the event that unexpected contamination is uncovered during remediation, work in that area would cease immediately and the area would be made safe. The unexpected contamination would be assessed by a suitably qualified person and remediation strategies put in place to manage this contamination if necessary after approval by the appropriate authority.

9.6.4 Validation Sampling

Validation sampling for soil at the Site (when necessary) will be as per **Table 9-1**. Assessment data will assist in the validation of the soils at the Site.

9.6.5 Quality Assurance / Quality Control

A field QA/QC program would be conducted in accordance with the NEPM guidelines to measure the precision of the field/laboratory analyses and to determine the accuracy of the primary laboratory's analyses.

Blind (duplicate) and split (triplicate) soil samples would be collected and analysed by the primary laboratory at a minimum rate of one per 20 primary samples.

All analysis would be conducted by a NATA accredited laboratory.

9.7 Health and Safety

All works would be conducted in accordance with a Whitehaven Health and Safety System. All contractors would be inducted and made aware of the system and any other requirements prior to commencement of any activities on-site.

9.8 Reporting Requirements

Within 60 days of the completion of all remediation and validation works, a report detailing works for the Site would be prepared.

The report would include but not be limited to the documentation of the remediation works and validation program activities and an evaluation of the results against the remediation criteria and would include the results of any further excavation and/or validation.

The report would also include the results of the QA/QC program, Chain of Custody documentation and Sample Receipt Advices for all samples collected and copies of documentation validating the appropriate handling, disposal and treatment of any contaminated soil, materials and water.

10 DISCUSSION AND CONCLUSIONS

The objectives of the Stage 1 Preliminary Investigation were to identify any past or present potentially contaminating activities, to provide a preliminary assessment of any contamination and provide a basis for a more detailed investigation (i.e. Stage 2 Detailed Investigation).

The objectives of the Stage 2 Detailed Investigation were to define the nature, extent and degree of contamination; to assess potential risk posed by contaminants to health and the environment; and to obtain sufficient information to develop a RMP.

The site history review and site inspections identified four (4) potentially contaminated sites that required further investigation, lying within MLA1, MLA2 and MLA3 and the private haul road and Kamilaroi Highway overpass area, as follows:

- MLA1-1 – Abandoned well now backfilled with refuse;
- MLA2-1 – Sheep dip and shearing shed (disused) with water storage dam;
- MLA3-1 – General refuse and fuel storage containers; and
- private haul road and Kamilaroi Highway overpass area – AST and generator.

Intrusive investigations were undertaken to assess the levels of contamination at MLA1-1, MLA2-1 and MLA3-1 on the 16, 17 and 18 January 2012. A historical review and site inspection was undertaken within the private haul road and Kamilaroi Highway overpass area.

Laboratory analysis of soil samples collected from MLA1-1 identified one marginal exceedance of the EIL criteria for zinc within the surface soils. No other laboratory exceedances were identified within samples collected from this site. Following the site history review, site inspection and intrusive investigations, no further investigations were required at this site.

There were no exceedances of the site assessment criteria at MLA3-1. Following the site history review, site inspection and intrusive investigations, no further investigations were required at this site.

Laboratory analysis of soil samples collected from MLA2-1 (sheep dip and surrounding infrastructure) identified 19 exceedances of arsenic concentrations above NEPM (1996b) HIL-A and / or EIL guidelines. Arsenic concentrations ranged from 35 mg/kg to 2860 mg/kg. Further, there were three NEPM (1996b) EIL exceedances for zinc. Ten (10) samples identified OCs present. None of these samples displayed levels above the site assessment criteria. Based on results from the Stage 1 Preliminary Investigation, a Stage 2 Detailed Investigation was required for this site.

The Stage 2 Detailed Investigation for MLA2-1 was undertaken on the 20 – 24 February 2012. The Stage 2 Detailed Investigation included soil and water sampling and a site inspection of the private haul road and Kamilaroi Highway overpass area.

During the Stage 2 investigation, 160 soil samples were collected, as well as 10 blind (duplicate) samples and six (6) split (triplicate) samples for QA/QC purposes. Of these, 70 primary samples, 10 blind and six (6) split samples underwent laboratory analysis.

During the Stage 2 Detailed Investigation a surface water sample was collected from the water storage dam and was analysed for total metals and OC/OPs. Field measurements of DO, EC, TSS, and pH were taken using a water quality meter. The laboratory analysis showed that the water sample marginally exceeded the site assessment criteria for total copper and total zinc. The water from the storage dam is suitable for use as a dust suppressant.

A water sample was collected from under the sheep dip. The dip had been backfilled with building rubble and gravel and it is likely that rain had penetrated the materials and a small amount of water had accumulated on the bottom of the dip. The sample was analysed for total metals and OC/OPs. The sample displayed exceedances for all total metals analysed.

There were no OC/OPs identified above the laboratory's limit of reporting in the water samples analysed.

An analysis of the suitability of the data contained in the report was undertaken. Field and laboratory data underwent rigorous data QA and QC assessments. Following the analysis of the field and laboratory QA/QC the results contained within this report are considered suitable for reporting purposes.

Results from the Stage 1 and 2 investigations at MLA2-1 identified 28 exceedances of arsenic concentrations above NEPM (1996b) EIL guidelines, with 10 samples exceeding NEPM (1996b) HIL-A guidelines. 11 samples identified OCs present, however these sample did not display levels above the site assessment criteria. Sampling within the area as part of the Stage 2 Detailed Investigation delineated the arsenic contamination laterally and vertically.

The proposed use for MLA2-1 is for mining and mining-related activities. The nature of the activities within MLA1-1, MLA2-1 and MLA3-1 may involve the excavation and placement of waste rock material (overburden and interburden). Further, there may be topsoil removal in these areas and possible associated activities such as access roads, drainage etc. The location of the area for soil storage or use once removed from site is unknown.

Considering the proposed site use, the results indicate that there may be some potential risk to on-site workers during soil disturbance and to the environment if soils are inappropriately stored.

Following the site history review and a site inspection of the private haul road and Kamilaroi Highway overpass construction area, and consideration of the distance from the proposed construction works to the AST and generator identified during the site inspection, no further works are recommended for this area.

On the basis of the results of the Stage 1 Preliminary Investigation and Stage 2 Detailed Investigation a RMP was developed. Following the implementation of the proposed management measures (**Section 9**), it is considered that the Site is suitable for the land use change as proposed by the Project.

11 REFERENCES

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

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