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WSP

# REMEDIAL ACTION PLAN

## Bayswater No. 2 Infrastructure, Mt Arthur Coal Complex, Muswellbrook, NSW

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|---|---|---|---|
| 26/06/2013 | | Revised: | 14/05/2014 |
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# REMEDIAL ACTION PLAN

## Bayswater No. 2 Infrastructure, Mt Arthur Coal Complex, Muswellbrook, NSW

26/06/2013

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# APPENDICES

# List of Abbreviations

A list of common abbreviations used in this report is provided below:

| | |
|---|---|
| AHD | Australian Height Datum |
| BGL | Below Ground Level |
| BTEX | Benzene, Toluene, Ethyl benzene and Xylene |
| CHPP | Coal Handling and Processing Plant |
| CLM | Contaminated Land Management |
| CSM | Conceptual Site Model |
| DQO | Data Quality Objectives |
| EIL | Environment-based Investigation Level |
| EMP | Environmental Management Plan |
| ESA | Environmental Site Assessment |
| ETSF | Expanded Tailings Storage Facility |
| GAC | Groundwater Assessment Criteria |
| HHERA | Human Health and Environmental Risk Assessment |
| HIL | Health-based Soil Investigation Levels |
| LOR | Limit of Reporting |
| NSW EPA | NSW Environmental Protection Agency, now incorporated into the NSW Office of Environment and Heritage |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated biphenyls |
| PSH | Phase Separated Hydrocarbons |
| RAP | Remedial Action Plan |
| TOC | Total Organic Carbon |
| TPH | Total Petroleum Hydrocarbons |

# Executive Summary

WSP Environmental Pty Limited (WSP) was commissioned by BHP Billiton Mt Arthur Coal (Mt Arthur Coal) to develop a Remedial Action Plan (RAP) for the remediation of the Bayswater No. 2 Infrastructure area, Muswellbrook NSW (the site). Reference made throughout the report to “offsite” refers to those areas immediately outside the Bayswater No. 2 Infrastructure area but within the mine boundary, unless otherwise stated.

The overarching objective of the RAP is to meet the requirements of Schedule 3, Condition 35 of the Mt Arthur Coal Mine, Open Cut Consolidation Project Approval PA 09_0062. This condition requires the preparation and implementation of a Remedial Action Plan for the former Bayswater No. 2 infrastructure area.

The RAP has been prepared based on the finding of the Phase 2 Environmental Site Assessment (WSP, 2013A), which identified soil impact, namely TPH, arsenic and lead at varying concentrations above the adopted soil assessment criteria across the site. Groundwater impacted by TPH (and some heavy metals) was also identified in shallow isolated groundwater lenses at the site.

The preferred remedial strategy has been selected based on a review of available remediation options for soil and groundwater impact identified at the site. The remedial strategy is also supported by the findings of a human health and environmental risk assessment (HHERA), conducted for the site.

Based on the findings of the HHERA, review of available remediation options and provided that the Planned Development (Section 5.1) for the site is undertaken – being removal of existing infrastructure and placement of overburden/tailings material on the site – the preferred remedial action for management of identified soil and groundwater impact, is through the placement of overburden/tailing material to facilitate a capping layer on top of the impacted media. Therefore no further action for identified soil and groundwater impact at the site is deemed required.

# 1 Introduction

## 1.1 Background

WSP Environmental Pty Limited (WSP) was commissioned by BHP Billiton Mt Arthur Coal (Mt Arthur Coal) to develop a Remedial Action Plan (RAP) for the Bayswater No. 2 Infrastructure area, Muswellbrook NSW (the site). The site location is presented in Figure 1, **Appendix A**. Reference made throughout the report to "offsite" refers to those areas immediately outside the Bayswater No. 2 Infrastructure area but within the mine boundary, unless otherwise stated

The RAP has been prepared based on the findings of the Phase 2 Environmental Site Assessment (WSP, 2013A), which identified soil impact, namely TPH, arsenic and lead at varying concentrations above the adopted soil assessment criteria across the site. Groundwater impacted by TPH (and some heavy metals) was also identified in shallow isolated groundwater lenses at the site.

## 1.2 Objective of the RAP

The RAP is required to meet the the requirements of Schedule 3, Condition 35 of the Mt Arthur Coal Mine, Open Cut Consolidation Project Approval PA 09_0062 which states:

"*The proponent shall prepare and implement a Remedial Action Plan for the former Bayswater No. 2 infrastructure area to the satisfaction of the Director General. The Remedial Action Plan shall be prepared by a suitably qualified consultant, in accordance with the Contaminated Land Management Act 1997 and applicable Office of Environment and Heritage (OEH) guidelines, and be submitted to the Director-General for approval prior to undertaking any overburden placement in this area*."

In addition the RAP is to be implemented such that the site complies, where practicable, with relevant guidelines, including:

- NEPM HIL- F (1999) Soil Investigation Levels for Commercial/Industrial land use;
- NSW EPA (1994) Guidelines for Assessing Service Station Sites;
- NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme; and
- State Environmental Planning Policy No. 55 (1998) – Remediation of Land (SEPP 55).

## 1.3 RAP Structure

The RAP is structured as follows:

- Section 2 – Describes the site characteristics
- Section 3 – Describes the environmental setting of the site, including soils, geology, hydrogeology and sensitive environments in the vicinity of the site;
- Section 4 – Characterises the current contamination status of the site, outlining potential risks to human health and sensitive environmental receptors;
- Section 5 – Outlines the remediation goals and available remediation options for the site;
- Section 6 – RAP Conclusions and preferred remedial option;
- Section 7 – Report limitations; and
- Section 8 – References.

The RAP figures that accompany this report are included in **Appendix A**.

# 2 Site Characteristics

## 2.1 Site Identification

The site layout is presented in Figure 2, **Appendix A.** Pertinent site details are summarised in Table 2.1 below:

***Table 2.1 Summary Site Details***

| | |
|---|---|
| Location | Mt Arthur Coal Mine - Thomas Mitchell Drive, Muswellbrook NSW |
| Site description | Bayswater No. 2 Infrastructure Area |
| Site Investigation Size | 15 Hectares[1] |
| Current use | Disused CHPP[2] and mining infrastructure area |
| Surrounding land use | Open cut coal mining and associated exploration activities |

1. Based on the findings of the preliminary site inspection, the size of the site was reduced from the original size stated in the proposal (approximately 20.5 hectares). This was the result of significant overburden identified in the north-west corner of the site (approximately 5.5 hectares).
2. CHPP – Coal Handling and Preparation Plant

## 2.2 Site History

The following site history information was sourced from the Phase 1 Site Contamination Assessment (Umwelt, 2007):

The original consent for coal mining at the Bayswater No. 2 area was granted to H R Poutney by the Joint Coal Board in 1954;

The Bayswater Colliery Company was formed in 1956 and worked the mine intermittently between 1956 and 1964;

Open cut mining operations commenced in 1966 and progressively expanded over the next thirty years. In 1994, approval was obtained to develop the Bayswater No. 3 mining area. Operations at Bayswater No.2 and No.3 were concurrent until 1998, when mining at Bayswater No. 2 ceased; and

Primary use of the Bayswater No. 2 mining infrastructure facilities ceased in 1998 following the construction at Mount Arthur North (MAN). The facilities are currently used for refuelling light vehicles (one above-ground storage tank only) and intermittent use of the site offices and workshops by contractors.

# 3 Previous Investigations

A summary of previous investigations undertaken for the site area is presented as follows:

## 3.1 Phase 1 Site Contamination Assessment – Bayswater No. 2 Pit top Facilities (Umwelt Environmental Consultants, June 2007)

Umwelt (2007) conducted a Phase 1 contamination assessment of the Bayswater No. 2 Infrastructure area, which included a desktop review of available pertinent site documentation, a site inspection and staff interviews. Umwelt identified that the following potential contamination sources were present at the site:

- Storage, handling and use of diesel fuel;
- Storage, handling and use of bulk oils and other mechanical fluids;
- Stores areas, electrical, drums or equipment stores;
- Sewage generated by pit top facilities; and
- PCBs contained within the electrical equipment such as transformers and capacitors.

Umwelt identified that the potentially high and medium contamination risk areas were generally associated with infrastructure in the central portion of the site. Umwelt also identified that environmental incidents (diesel fuel losses) associated with underground diesel supply pipelines from the diesel fuel tank farm to the grease workshop and the light vehicle bowser had historically occurred at the site. It is understood that the subsequent contamination in soil had been remediated however, no formal records were available to confirm this.

Given the site is to eventually be backfilled with overburden material from current mining operations, Umwelt concluded that further investigation (Phase 2 ESA) was required to determine the nature, extent and degree of contamination at the site, including any associated remediation liability.

## 3.2 Phase 2 Environmental Site Assessment (WSP, 2013A)

Works conducted by WSP included targeted and representative soil sampling from seventy-five (75) boreholes, five (5) of which were converted to groundwater monitoring wells (also used for soil vapour / hazardous ground gas assessment). Sampling locations targeted potential contamination sources identified in the previous Phase 1 ESA (described above) and for site coverage in accordance with EPA (1995) Sampling Design Guidelines.

WSP reported TPH contamination in shallow soils in the vicinity of the bulk lube facility, lube bay and drainage channel down-gradient of the grease workshop and to a lesser extent; the build pad. TPH (and some heavy metals) impact was also reported in shallow perched groundwater lenses identified at the site. WSP concluded that TPH impact at the site is likely to be associated with diesel/lube oil storage and historical activities associated with the workshops/stores. Based on the nature of the identified perched groundwater and review of available geological information for the site, WSP concluded that it is unlikely that groundwater impact has migrated off-site at concentrations that pose an unacceptable risk to human health and/or the environment

Arsenic impacted shallow soils were reported in the northern portion of the site (up-gradient of the workshops and stores) particularly within the CHPP. Based on the location of identified impact (up-gradient of identified potential contamination sources at the site), arsenic concentrations are likely associated with naturally occurring mineralisation within the natural soil material at the site.

Based on the contamination findings of the investigation and in accordance with the Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, WSP considers that subject to the findings of a risk assessment for identified TPH contamination (completed 2 July 2013 by WSP and summarised in Section 3.3 below) the site does not require notification to NSW EPA.

WSP also concluded that provided the site is covered with overburden material demonstrated to be suitable for the proposed future land use (overburden/tailings placement); identified soil contamination is unlikely to pose

an unacceptable risk to human health and/or the environment. This is illustrated in the human health and environmental risk assessment (HHERA) conducted for the site (**Appendix C**).

## 3.3 Human Health and Environmental Risk Assessment (WSP 2013B)

Based on recommendations contained within the Phase 2 ESA, Mt Arthur Coal engaged WSP to complete a Human Health and Environmental Risk Assessment (HHERA) for the site, which is presented in **Appendix C**. The overarching objective of the HHERA was to provide an assessment of risks to human health and the environment, associated with the identified TPH $C_{10}$-$C_{36}$ and heavy metal impact in groundwater and soil for the future land use scenarios based (commercial/industrial land use and open space) on site specific information. The HHERA pertains to the future site setting after finalisation of at least Stage 2 of the proposed development for the site. Available information indicates that the site will be covered with approximately 10 metres of tailings or embankment materials at the end of Stage 2, which is due for completion in 2015 (*Note*: following the finalisation of WSP, 2013B the likely completion date for Stage 2 has been revised to 2018). The risk assessment identified whether complete source-pathway-receptor linkages exist that pose potentially unacceptable risks to humans or the environment that require further (quantitative) risk assessment. The assessment was based on a Conceptual Site Model (CSM) developed for the site, including contaminant fate, transport and dilution modelling.

WSP concluded that the site is considered suitable for commercial/industrial use, based on the results of this HHERA that identified no complete source-pathway-receptor linkages with significant risk. This conclusion was subject to the following assumptions and limitations:

- Relevant components of the planned development included in Section 2.5 (**Appendix C**) will be realised;
- Stage 2 of the ETSF filling with tailings has been completed (thickness of tailings on the site will be 10 metres); and
- The assessment was limited to risks to human health and the environment associated with environmental contamination identified in the Phase 2 ESA (WSP, 2013A).

In addition WSP concluded that the site is suitable for use as recreational open space, based on the results of this HHERA that identified no complete source-pathway-receptor linkages with significant risk. This conclusion is subject to the following assumptions and limitations:

- Relevant components of the planned development included in Section 2.5 (**Appendix C**) will be realised;
- Stage 4 of the ETSF filling with tailings has been completed as well as reinstatement with overburden; and
- The assessment was limited to risks to human health and the environment associated with environmental contamination identified in the Phase 2 ESA (WSP 2013A).

The findings of the HHERA were used to support the remedial strategy developed for this RAP.

# 4 Site Characterisation

Information provided in this Section is sourced from the HHERA (**Appendix C**) and based on findings from the Phase 2 ESA, Phase 1 ESA by Umwelt (2007) and details of the proposed development design of a tailings facility expansion (ATCW, 2011).

## 4.1 Current Site Environmental Setting

Field investigations of the Phase 2 ESA included drilling 75 boreholes to maximum depths of approximately 6.5m bgl, with three (3) selected boreholes (MW01 – MW03) progressed to a maximum depth of 10m bgl to facilitate installation of groundwater wells. An additional two (2) groundwater wells (MW04 and MW05) were installed where perched groundwater was identified across the site. For borehole and groundwater well locations refer to Figure 3, Appendix B of the HHERA presented in **Appendix C**.

Identified subsurface conditions are characterised by highly heterogeneous fill materials overlying natural residual clays and bedrock. Thickness of fill on the site generally increased from between 0 and 3 metres in the north (CHPP area) to between 2 and 5 metres in the centre (workshops, lubricant facility) and to between 4 metres and below investigation depth in the south (vacant office, car park). Fill materials in the central site area typically consisted of clays and gravelly clays, but were locally characterised by sand, gravel, crushed rock and coal inclusions (likely to be residue from mining operations). Fill materials in the southern portion of the site were characterised by sand and gravel.

Natural geology at the site comprises residual clays underlain by bedrock comprising sandstone, shale and coal seams.

Topography of the site slopes from north to south. Site elevation is approximately AHD+250m at the northern site boundary and drops with a moderate slope to AHD+240m at the central workshop area where ground level is generally horizontal. The site exhibits a further gentle slope to the south, towards an elevation of AHD+235m at the southern site boundary. Site drainage is expected to follow the site topography in a south to south-west direction to the West Cut Void Tailings Storage Facility (WCV TSF). The WCV TSF has a current tailings level of approximately AHD+210m, 30 metres below the site surface level. The majority of the site is unsealed with local hardstand areas and built-up areas. Site drainage is facilitated by several open drains (refer to Figure 2) and a containment dam that collects surface runoff, groundwater recharge and potentially groundwater drainage.

Groundwater conditions on the site during the field investigations are characterised by the presence of local perched groundwater horizons in and on top of (low-permeability) clayey fill materials at varying depths (3.7m and 3.0m bgl in wells MW04 and MW05, respectively). In most areas of the site, where fill comprised more permeable materials (gravelly clay, gravel/sand), no groundwater was identified. This includes the three (3) groundwater well locations (MW01 – MW03), which were reported drying during sampling. These wells were constructed to depths of 9 or 10 metres, with screens intersecting fill and natural bedrock. Groundwater flow rates in fill materials are anticipated not to exceed several millimetres per day in the clayey fill and centimetres per day in the sandy fill.

Lateral migration of groundwater via the identified perched groundwater horizons is not considered to facilitate significant migration because the horizons are generally not connected and are associated with low permeability strata (clays). Vertical downward seepage from shallow groundwater to deep groundwater systems is likely to be insignificant considering low vertical permeability of the bedrock (including shales, sandstone and coal seams).

For the purposes of the RAP (and particularly for the HHERA) it is conservatively assumed that under wet meteorological conditions groundwater levels can rise and create a continuous groundwater body in fill materials with discharge occurring towards the open drainage canals on the site (eventually discharging to the WCV TSF) and via lateral groundwater flow towards the WCV TSF. It is noted that a scenario with higher groundwater levels is realistic, given that no significant rainfall events were recorded (Muswellbrook BOM station) in a period of 1.5 months prior to the field investigations.

A groundwater bore search with the NSW Office of Water indicated that the closest registered bores are more than 3 kilometres distance from the site. Groundwater level was reported to be approximately 40 metres below ground level.

Total organic carbon (TOC) content of the fill material was investigated as part of the Phase 2 ESA. The TOC concentration in soil is an important factor in determining migration rates of a variety of contaminants in groundwater. High TOC fractions will slow down migration (retardation) due to sorption processes. From a viewpoint of contaminant transport the TOC fractions at the site are relatively high and will result in considerable retardation. Reported TOC fractions ranged from 0.7 to 6.6 %, averaged 4.2 %, and are associated with coal fines identified in the fill (refer to selected borelogs sourced from the Phase 2 ESA and included in the HHERA (**Appendix C**)).

## 4.2 Site Activities

The site comprised facilities to support open cut mining in the Bayswater No. 2 Area. Figure 2, Appendix A presents the infrastructure currently identified on site. Facilities and activities included:

- Coal handling and preparation;
- Electrical infrastructure;
- Storage, handling and use of diesel fuel, bulk oils and other mechanical fluids;
- Storage areas and equipment stores;
- Multiple workshops, build pad; and
- Office, bathhouse and mine deployment area.

A previous investigation (Umwelt, 2007) identified that environmental incidents (diesel fuel losses) associated with underground diesel supply pipelines from the diesel fuel tank farm to the grease workshop and the light vehicle bowser had historically occurred at the site. It is understood that the subsequent contamination in soil had been remediated; however no formal records were available to confirm this.

It is anticipated that operations on the site commenced between 1956 and 1966. Primary use of the Bayswater No. 2 mining infrastructure facilities ceased in 1998. The facilities are currently used for refuelling light vehicles (one above-ground storage tank only) and intermittent use of the site offices and workshops by contractors.

From the site activities, the following contaminants of potential concern (COPCs) were identified in the Phase 2 ESA:

- For most portions of the site TPH ($C_6$ - $C_{36}$), volatile organic compounds, polycyclic aromatic hydrocarbons, phenol, heavy metals (M8)
- Locally: PCBs, surfactants (MBAS) and faecal coliforms.

## 4.3 Summary of Phase 2 ESA Results

The scope of the RAP is to address results from the Phase 2 ESA that exceed relevant site criteria that are protective of human health and the environment.

Appendix B of the HHERA (**Appendix C**) presents Phase 2 ESA analytical results compared against the following relevant guidelines, which are deemed protective of both human health and the environment:

**Soil:**

- Health-based Investigation Levels HIL E – Parks, recreational open space and playing fields – Guidelines for the NSW Site Auditor Scheme (NSW DEC, 2006). It is noted that trigger levels for HIL E are more

conservative than, and thus protective than, 'commercial/industrial' land use (HIL F in NEPM 1999) which was adopted in the Phase 2 ESA.; and

- NSW EPA (1994) Contaminated Sites: Service Station Guidelines for petroleum hydrocarbons in soil and groundwater.

**Groundwater:**

- 95% Protection Levels from ANZECC (2000) Australian and New Zealand Guidelines for Freshwater Quality, the National Environment Protection (Assessment of Site Contamination) Measure (1999) Schedule B(1) Groundwater Investigation Levels, Aquatic Ecosystems, Freshwaters;
- NSW EPA (1994) Contaminated Sites: Service Station Guidelines for petroleum hydrocarbons in soil and groundwater (screening levels only); and
- Ministry of Housing (Netherlands), Spatial Planning and the Environment (2000) Environment Quality Objectives in the Netherlands for petroleum hydrocarbons in groundwater (screening levels for TPH $C_{10}$ – $C_{36}$ only).

The results from the Phase 2 ESA are summarised as follows (amended to account for use of HIL E investigation levels):

### 4.3.1 Soil

- With the exception of TPH $C_{10}$ - $C_{36}$, arsenic, lead and total PAH, all soil samples reported concentrations for contaminants of concern below either the laboratory limit of reporting and / or the adopted assessment criteria.
- TPH $C_{10}$ - $C_{36}$ contamination was identified in soil samples from twenty (20) locations across the site. The maximum reported concentration was 45,900 mg/kg. The majority of TPH $C_{10}$ - $C_{36}$ impact was identified in shallow soil material (<1.5 m bgl), with the exception of BH30 (3.8 m bgl) and B71 (2.7m and 4.0 m bgl). The most significant impact was identified in the vicinity and down-gradient of the lube bay, bulk lube facility and in the drainage depression down-gradient of the grease workshop. Where additional depth analysis was undertaken (based on field observations) impact was vertically delineated to a maximum depth of approximately 5.5 m bgl with the majority being identified between 0.5 – 1.2 m bgl.
- Shallow TPH $C_{10}$ - $C_{36}$ "hotspots" were also identified across the build pad, in the CHPP and in the vicinity of former store area; however reported concentrations of TPH $C_{10}$ - $C_{36}$ from these areas were an order of magnitude lower than reported TPH impact described above.
- The majority of TPH impact in soil was within the $C_{10}$ - $C_{36}$ fraction, which in the context of the investigation is indicative of diesel and lubricating oils;
- Arsenic was reported above the adopted soil assessment criteria in soil samples from thirty-one (31) locations across the site. The maximum reported concentration was 1980 mg/kg. The majority of arsenic impact was identified in the northern portion (up-gradient of the workshops and stores) particularly within the CHPP. Most significant arsenic impact was reported to a depth of 1.5m bgl between 0.1 – 0.4 m bgl. Arsenic concentrations are likely associated with naturally occurring arsenic within the fill/overburden/coal residues material.
- Lead was reported above the adopted soil assessment criteria in soil samples from seventeen (17) locations across the site. Maximum concentration was 1750 mg/kg (HIL E investigation level is 600 mg/kg). The majority of lead impact was identified in the central infrastructure area with workshops, car park areas and roads north of the workshops, as well as in the car park near the office and in a dispersed pattern in the CHPP area. Soil samples in exceedance of adopted criteria were reported to a depth of 1.5 m bgl, with

samples containing the most significant lead impact reported between 0.1 – 0.2 m bgl. Lead concentrations are most likely to be associated with naturally occurring lead within the fill/overburden/coal residue material.

- PAH marginally exceeded the assessment criteria in one (1) soil sample. Given that the 95% Upper Concentration Limit (UCL value) is below the guideline value, PAH concentrations in soil are considered to be indicative of acceptable risks and do not require further assessment.

### 4.3.2 Groundwater (sampling results from two (2) monitoring wells MW04 and MW05)

- TPH $C_{10}$ – $C_{36}$ impact was reported in MW04 located adjacent to the bulk lube facility and in MW05 down-gradient of the westerly store (between the diesel AST farm and the lube bay in the approximately location of the disused underground pipeline). Saturated and impacted soils between the workshops and within the drainage channel, down-gradient of the grease workshop are indicative of isolated contaminated perched groundwater at the site;
- No PSH were identified during the investigation;
- The majority of TPH impact in groundwater was within the $C_{15}$ – $C_{28}$, fraction, which in the context of the investigation is indicative of diesel contamination likely associated with the historical leak in the underground diesel line, reported in the Phase 1 ESA (Umwelt 2007);
- Reported concentrations of arsenic (0.024 mg/L) and zinc (0.026 mg/L) in groundwater sample MW5 exceeded the GAC of 0.013 mg/L and 0.008 mg/L respectively.
- Reported concentrations of copper (0.003 mg/L), nickel (0.018 mg/L) and zinc (0.075 mg/L) in groundwater sample MW4 exceeded the GAC of 0.0014 mg/L, 0.011mg/L and 0.008 mg/L respectively; and
- It is noted that lead concentrations in samples from both wells were below the laboratory limit of reporting (LOR).

# 5 Selection of Remediation Strategy

The preferred remediation approach has been selected based on a review of available remediation options for soil and groundwater impact described in Sections 5.2 and 5.3 below. The remediation strategy is supported by the findings of HHERA conducted for the site (WSP, 2013B). The Planned Development for the site and surrounding land use and sensitive environments, which informed the findings of the HHERA are summarised in Sections 5.1 and 5.2 below.

## 5.1 Planned Development

Based on information provided by Mt Arthur Coal, WSP understand the future development of the site and site surroundings to include the following components:

- The general area will developed for the Expanded Tailings Storage Facility (ETSF). The footprint of the ETSF (including embankments) fully comprises the site;
- Prior to redevelopment of the site, existing infrastructure will be removed from the site, including storage tanks and fuel pipelines. Concrete slabs will remain on site;
- The land use of the site will be as a tailings dam, until the site is covered with tailings and reinstated with overburden. The area of the site will only be incidentally accessed by humans for works related to mining operations such as maintenance, as well as uncontrolled access by wildlife;
- The ETSF will be filled with tailings in four stages. At the end of stage 2 the tailings level will be at approximately 249 mAHD, refer to Figure 4 and 5 in Attachment A. Given that the portion of the site that is not under the embankment is at or below 240 mAHD, the site will be covered with approximately 10 metres of tailings or embankment materials at the end of stage 2. Based on recent advice from Mt Arthur Coal it is roughly estimated that the end of stage 2 will be reached in 2018 (estimated on the basis of tailings production, tailings density and available tailings storage volume in stage 1 and stage 2 respectively);
- The catchment area of the ETSF will be 334 ha (area within the embankment crest);
- The ETSF can be considered an end point for water flows. Fill points will be located such that decanting ponds are encouraged to expand from where water can be reused as process water for mining operations. Water that is lost from the ETSF via seepage will migrate through relatively permeable deposits of mining spoil to Drayton Water Storage Pond from where it is also understood to be recovered for process water. For events of extreme rainfall an emergency spillway will be constructed, flowing to the Drayton Water Storage Pond;
- At the end of the final construction stage (stage 4), the tailings level will be 280 mAHD and will represent approximately 40 metres above the current site level. Based on recent advice from Mt Arthur Coal it is approximately estimated to take until 2035 to reach the end of stage 4; and
- After the ETSF has reached capacity (RL280m AHD) (post stage 4), the area is planned to be re-contoured by the direct placement of overburden. The proposed land use will be ‘open space’ with, for example, occasional grazing.

It is noted that the proposed stage completion dates are subject to variance as production continues. WSP understand that relevant stakeholders (including the Department of Planning and Infrastructure) will be updated on the proposed development in 2017.

## 5.2 Surrounding Land Uses and Sensitive Environments

The site is located completely within the Mt Arthur Coal mine complex, as shown in Figure 1 of the HHERA (**Appendix C)**. The minimum distance from the site to the Mt Arthur Coal lease boundary is 400 metres.

Tailings dams associated with mining activities are also located in the vicinity of the site. The closest of which is the WCV TSF at approximately 150 m south-west from the site.

The planned construction of the ETSF will comprise the footprint of the site as well as surrounding areas. The crest of the ETSF will border the boundary of the Mt Arthur Coal lease and development boundary. At the portion of the boundary where the ETSF borders the boundary, Drayton Coal Mine is located on the other side of the boundary; refer to Figure 1 of the HHERA (**Appendix C)**.

## 5.3 Remediation Objectives

The main objectives of the remediation program are to:

- Comply with the most recent Planning Approval for Mt Arthur Coal (PA 09_0062) (Section 1.2) subject to the approval of the Director General; and
- Remove potential risks to human health and/or the environment posed by identified concentrations of TPH and heavy metals in soil and groundwater at the site.

## 5.4 Soil Remediation Options

A suitability evaluation of feasible soil remediation options is outlined below and summarised in **Table 5**. The selection of the preferred remediation strategy assumes compliance with relevant components of the Planned Development for the site (Section 4.3.3)

### 5.4.1 Risk Assessment

WSP completed a risk assessment to determine the potential human health and environment impacts associated with soil contamination identified in the Phase 2 ESA. The results of the risk assessment, which were used to inform the selection of the most appropriate remediation strategy for the site, are presented in **Appendix C**. The risk assessment was based on the understanding that the site will be covered with a minimum thickness of 10m (over a period of 4 years) of material demonstrated to be suitable for the proposed future land use (overburden/tailings placement).

### 5.4.2 No Active Management Actions

- No active remedial action is taken using this approach. The advantages of this option are that no remedial costs are incurred.
- This is not an acceptable remediation approach as an exposure pathway to human health and potential mobilisation of contaminants by surface flow still exists.

### 5.4.3 Capping and Containment

- This approach reduces potential exposure to hydrocarbon and heavy metal impacted shallow soils through a cap e.g. covering with overburden/tailings material.

- The results of a human health / ecological risk assessment, which was based on a “cap” of suitable overburden/tailing material with a minimum thickness of 10m, has confirmed this remediation strategy as appropriate.
- The advantages of this option are the comparatively low cost and that soils are not required to be removed/disposed offsite.
- WSP considers that the objectives of the capping and containment remediation strategy are met under the Planned Development for the site. Therefore no additional soil remediation is required.

### 5.4.4 Source Removal, Soil Excavation and Onsite Treatment

- This process would involve the excavation, removal and off-site disposal of impacted soil identified at the site. Validation sampling would need to be carried out to demonstrate that the contaminated areas had been successfully remediated.
- The advantage of this remediation option includes no on-going liability and unrestricted land use following remediation and validation.
- The disadvantages of this option include the cost of transport and offsite disposal of soils.

### 5.4.5 Source Removal, Soil Excavation and Onsite Treatment by Bioremediation

- This process would involve the excavation, removal and of impacted soil identified at the site. Treatment of impacted soils would be conducted using land-farming and enhanced bioremediation techniques. Validation sampling would need to be carried out to demonstrate that the contaminated areas had been successfully remediated.
- Based on the EPA 1994 *Hierarchy of Remediation Methods,* this technique is a preferred methodology to offsite disposal. No obvious constraints exist for a land farm option at the Mt Arthur Coal Mine Complex.
- The disadvantage of this option is that it is not suitable for treatment of soils impacted with heavy metals. Metals would need to be addressed by offsite disposal or stabilisation.
- WSP deems this approach unacceptable due to the costs involved and minimal benefits achieved in comparison to the method identified in 5.4.4.

## 5.5 Groundwater Remediation Options

A suitability evaluation of feasible groundwater remediation options is outlined below and summarised in **Table 5**.

### 5.5.1 Risk Assessment

WSP completed a risk assessment to determine potential risks of identified groundwater contamination on nearby sensitive environmental receptors. The risk assessment included the assessment of dilution/attenuation factors and the development of a Conceptual Site Model (CSM) based on the findings of the Phase 2 ESA. The results of the risk assessment, which were used to inform the selection of the most appropriate remediation strategy for the site, are presented in **Appendix C**. Based on the identified nature of sub-surface conditions and expected depth to regional groundwater (>10m bgl), WSP considered that an assessment on the impact to the regional groundwater system was not required. It is noted that at the time the risk assessment was prepared (2013), the proposed completion date for Stage 2 works was 2015.

### 5.5.2 No Active Management Actions

- No active remedial action is taken using this approach. The advantages of this option are that no remedial costs are incurred.
- Based on the findings of the Phase 2 ESA, and confirmed through the HHERA, perched groundwater is not expected to migrate offsite at concentrations that pose an unacceptable risk to human health and or the environment.
- Based on the results of the risk assessment, there is little likelihood of mobilisation of the contaminants for any significant distance.

### 5.5.3 Monitored Natural Attenuation

- Monitored natural attenuation (MNA) is the monitoring of naturally occurring physical, chemical and biological processes to demonstrate via multiple lines of evidence that one or a combination of these processes reduce the mass, concentration or toxicity of identified hydrocarbon impact in groundwater; to an acceptable level within an acceptable timeframe.
- The advantages of MNA are that it has very low energy and natural resource requirements, compared with mechanical methods of removal (pumping etc.)
- The disadvantages of MNA are that it is expensive in terms of data assessment and requirement for a long term monitoring program. Installation of additional monitoring wells, following the proposed future development of the site would be required.

### 5.5.4 Capping and Containment

- This approach precludes direct exposure of human receptors at ground level to impacted groundwater at depth.
- Capping also increases the lateral distance of groundwater migration pathways to groundwater discharge locations. The infiltration of water contained within tailings material planned for use as capping material, therefore has the potential to dilute impacted groundwater at discharge and receptor exposure locations.
- WSP considers that the objectives of the capping and containment remediation strategy are met under the Planned Development for the site. Therefore no additional groundwater remediation is required.

***Table 5 Evaluation of Remediation Options***

| Remedial Option | Benefits | Limitations | Acceptability | Time Effectiveness | Cost | On-going Liability |
|---|---|---|---|---|---|---|
| **Impacted Soil** | | | | | | |
| Risk Assessment | Used to inform the selection of the most appropriate remediation strategy for the site. | N/A | Meets EPA requirements for soil remediation. | Completed (June 2013) | Low | N/A |
| No active management actions | Nil cost | Subject to undertaking relevant components of the Planned Development for the site. | Exposure pathway to human health and potential mobilisation of contaminants by surface flow currently still exists | No time required | Nil | Yes |
| Capping and containment | Eliminates requirement for offsite disposal.<br>Objectives are met under the Planned Development for the site (ATCW, 2011) | Subject to undertaking relevant components of the Planned Development of the site. | Acceptable approach based on the findings of the HHERA | Up to 4 years – depending on construction program for the Expanded Tailings Storage Facility. | Nil – Costs are incurred under the Planned Development for the site | Yes |
| Excavation and removal of onsite soils for offsite disposal | No on-going liability and unrestricted land use following remediation and validation | Requires waste classification of excavated material prior to disposal and validation sampling works post remediation. | Meets EPA requirements for soil remediation. | Up to 1 month | Medium | No |
| Excavation and bioremediation of onsite soils using land-farming techniques | No on-going liability and unrestricted land use following remediation and validation<br>The site comprises a suitable land-farming area and is remote from residential areas | Not suitable for treatment of soils impacted with heavy metals. | Not an acceptable form of remediation for soils impacted with heavy metals | 3-6 months | Low - Medium | No |

| Remedial Option | Benefits | Limitations | Acceptability | Time Effectiveness | Cost | On-going Liability |
|---|---|---|---|---|---|---|
| **Impacted Groundwater** | | | | | | |
| Risk Assessment | Used to inform the selection of the most appropriate remediation strategy for the site. | N/A | Meets EPA requirements for groundwater remediation. | Completed (June 2013) | Low | N/A |
| No active management actions | Nil cost | N/A | Acceptable approach based on the findings of the HHERA | No time required | Nil cost outlay | Yes |
| Monitored Natural Attenuation (MNA) | Low energy and natural resource requirements, compared with mechanical methods of removal (pumping etc.) | Slow process<br><br>Long-term monitoring program required. | Acceptable approach based on the findings of the HHERA.<br><br>Not suitable following the proposed future development of the site (no access to monitoring wells). | On-going | Medium | Yes |
| Capping and Containment | Objectives are met under the Planned Development for the site (ATCW, 2011) | Subject to undertaking relevant components of the Planned Development of the site. | Acceptable approach based on the findings of the HHERA | Up to 4 years – depending on construction program for the Expanded Tailings Storage Facility. | Nil – Costs are incurred under the Planned Development for the site | Yes |

# 6 Conclusions

The strategy presented in this RAP is considered to be the most effective method to:

- Meet requirements of Schedule 3, Condition 35 of the Mt Arthur Coal Mine, Open Cut Consolidation Project Approval PA 09_0062; and
- Minimise potential risks to human health and/or the environment posed by identified concentrations of TPH and heavy metals in soil and groundwater at the site.

WSP completed a HHERA for identified soil and groundwater impact at the site, to support development of a remedial strategy based on a review of available remediation options for the site. The key findings of the HHERA are as follows:

- The site is considered suitable for commercial/industrial use, based on the results of the HHERA that identified no complete source-pathway-receptor linkages with significant risk. This conclusion was subject to the following assumptions and limitations:
  - Relevant components of the Planned Development (Section 5.1) will be realised;
  - Stage 2 of the ETSF filling with tailings has been completed (thickness of tailings on the site will be 10 metres); and
  - The assessment was limited to risks to human health and the environment associated with environmental contamination identified in the Phase 2 ESA (WSP, 2013A).
- In addition WSP concluded that the site is suitable for use as recreational open space, based on the results of the HHERA that identified no complete source-pathway-receptor linkages with significant risk. This conclusion is subject to the following assumptions and limitations:
  - Relevant components of the planned development included in Section 2.5 (Appendix C) will be realised;
  - Stage 4 of the ETSF filling with tailings has been completed as well as reinstatement with overburden; and
  - The assessment was limited to risks to human health and the environment associated with environmental contamination identified in the Phase 2 ESA (WSP 2013A).

Based on the findings of the HHERA, review of available remediation options and provided that the Planned Development (Section 5.1) for the site is undertaken – being removal of existing infrastructure and placement of overburden/tailings material on the site – the preferred remedial action for management of identified soil and groundwater impact, is through the placement of overburden/tailing material to facilitate a capping layer on top of the impacted media. Therefore no further action for identified soil and groundwater impact at the site is deemed required.

# 7 Limitations

WSP prepared this RAP in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession.

This report relates only to the objectives stated and does not relate to any other work undertaken for the Client. It is a report based on the concentrations of contaminants observed in soil and groundwater (WSP, 2013A) and findings of the HHERA (WSP, 2013B). These conditions may change with time and space. The absence of any identified hazardous or toxic materials on the subject property should not be interpreted as a guarantee that such materials do not exist on the site.

All conclusions regarding the property area are the professional opinions of WSP, subject to the qualifications in the report. While normal assessments of data reliability have been made, WSP assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of WSP, or developments resulting from situations outside the scope of this project.

The client acknowledges that this report is for the exclusive use of the client.

# 8 References

NSW Environment Protection Authority (1994) Guidelines for Assessing Service Station Sites.

NSW Environment Protection Authority (1995) Sampling Design Guidelines.

National Environment Protection Council (1999) National Environment Protection Measure (NEPM) 1999 Assessment of Site Contamination, Schedule B (1) and B (2).

NEPM (1999) National Environmental Protection (Assessment of Soil Contamination) Measure, NEPC Guidelines.

National Environment Protection (Assessment of Site Contamination) Measure (1999) Schedule B(6) (NEPM, 1999) Guideline on Risk Based Assessment of Groundwater Contamination.

NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination.

NSW Department of Environment and Conservation (2009) Waste Classification Guidelines Part 1: Classifying Waste.

NSW Department of Environment and Conservation (2006) Guidelines for the Site Auditor Scheme, Second Edition.

State Environmental Planning Policy No. 55 (1998) – Remediation of Land.

WSP Environmental (2013A): Phase 2 Environmental Site Assessment, MAC Bayswater No. 2 Infrastructure Area, Muswellbrook

WSP Environmental (2013B): Human Health and Environmental Site Assessment, MAC Bayswater No. 2 Infrastructure Area, Muswellbrook

# APPENDIX A: FIGURES


36374.03 WSP CVG, 11 July 2013

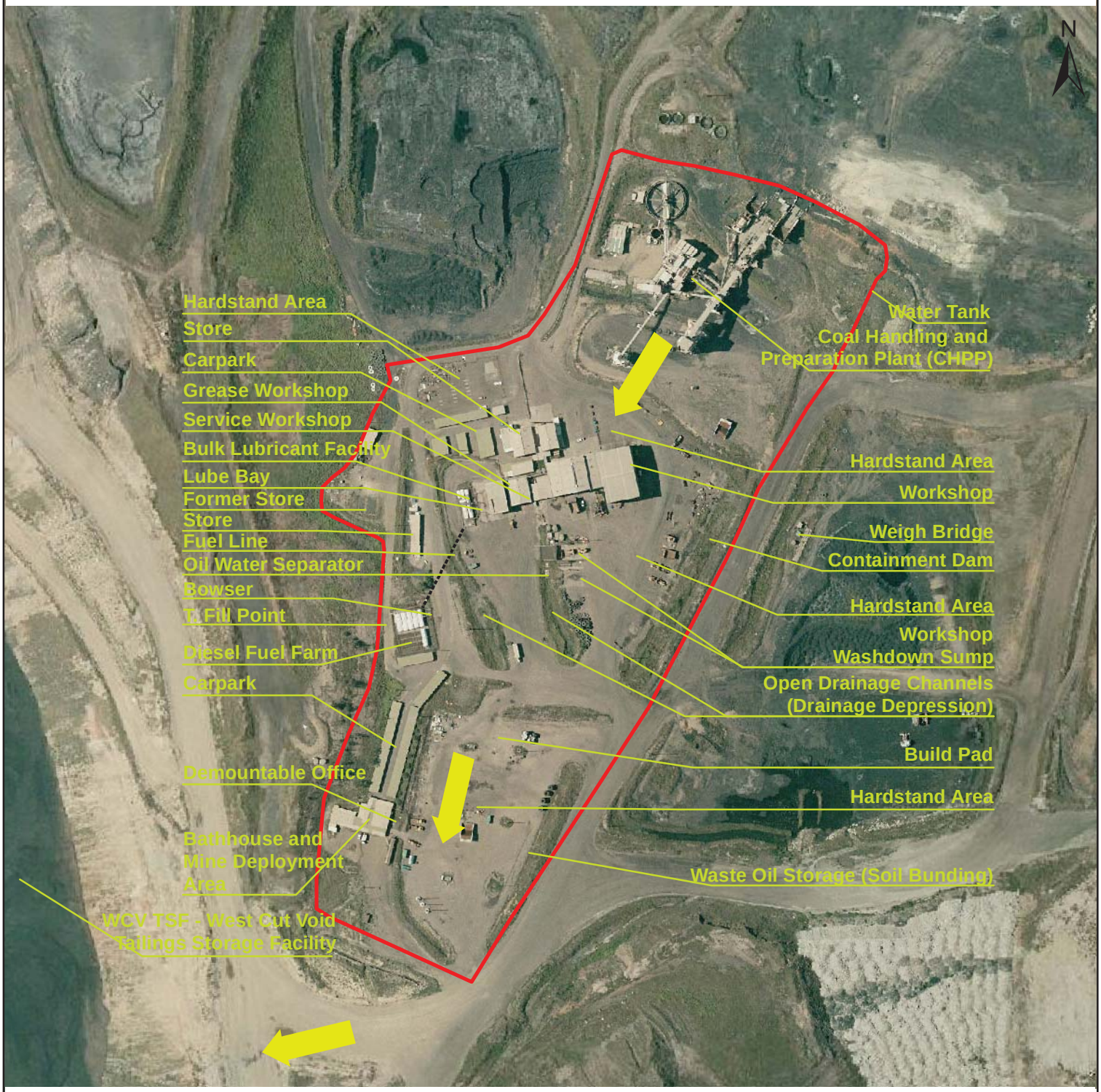
Legend

Site Boundary

## Site Location

Remedial Action Plan
Mount Arthur Coal Mine, Bayswater No. 2 Infrastructure Area
Figure 1

UNITED BY OUR DIFFERENCE WSP




Background Aerial Photograph: SixViewer LPI NSW Government

36374.03 WSP, CvG, 11 July 2013

Meters

0 20 40 80 120 160

Legend

Site Boundary

General topographic gradient

## Site Layout

Remedial Action Plan
Mount Arthur Coal Mine, Bayswater No. 2 Infrastructure Area, NSW

Figure 2

UNITED BY OUR DIFFERENCE WSP

NSW GOVERNMENT | Planning & Environment

Contact: Ben Harrison
Phone: (02) 6575 3402
Fax: (02) 6575 3415
Email: benjmain.harrison@planning.nsw.gov.au
Our Ref: MP 09_0062

Xavier Wagner
General Manager Operations
Mt Arthur Coal
PMB 8
MUSWELLBROOK NSW 2333

Dear Xavier

**Mt Arthur Coal Mine – MP 09_0062 - Approval of Remedial Action Plan**

Thank you for forwarding the Remedial Action Plan required under Condition 35, Schedule 3 of PA 09_0062 for the Department's consideration.

The Department has reviewed the plan and accordingly, I wish to advise you that the Secretary has approved the plan.

Could you please ensure that the finalised Remedial Action Plan is forwarded to the Department at your earliest convenience and that the plan is uploaded onto the company's website as soon as possible.

Should you have any enquiries on this matter please contact Ben Harrison on (02) 6575 3402.

Yours sincerely

Scott Brooks
**Team Leader Compliance**
As nominee of the Secretary
19 - 5 - 14