Environmental Strategies
PROVIDING BENEFITS

Volume 7 of 7: Bayswater Power Station, Liddell Power Station, Lake Liddell and Tomago Development Site

Sampling, Analysis and Quality Plan

15092RP02 SAQP FINAL

Prepared for AGL Macquarie Pty Limited | 13 February 2018

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Document Information

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Signed Rod Harwood Project Director	

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Appendices

1 Introduction

1.1 Background

Environmental Strategies Pty Ltd (ES) was commissioned by AGL Macquarie (AGLM) to prepare a Sampling, Analysis and Quality Plan (SAQP) for an additional contamination study to be completed at four sites (Sites):

- The Bayswater Power Station (Bayswater PS);
- The Liddell Power Station (Liddell PS);
- Lake Liddell; and
- The Tomago Development site (Tomago).

The environmental conditions of the Bayswater PS, Liddell PS and Lake Liddell were recently investigated by Environmental Resources Management Australia (ERM) in 2013 as part of the process of the sale of the Sites. ERM's final reports were issued in January 2014. Details of the ERM reports are set out in various parts of this SAQP. No previous environmental investigation was reported for the Tomago site.

1.2 SAQP Objectives and Scope of Work

The overall objective of the project is to define, to the extent practicable, the nature and extent of contamination on the Sites and to make determinations whether the contamination was pre-existing on each of the Sites as at 2 September 2014, which is the date on which AGLM became the owner of the Sites.

The specific objectives of the proposed assessment are to:

- better define the nature and the lateral and vertical extent of the contamination identified to date at the areas of environmental concern (AECs) on each of the Sites;
- identify any additional contamination which may be present at the Sites; and
- provide an opinion as to whether the contamination identified at the Sites is 'Pre-Existing Contamination'.

For the purpose of this SAQP 'Pre-Existing Contamination' has been defined to mean:

(a) the presence of any contamination (as defined in the *Contaminated Land Management Act 1997 (NSW)*) in, on, under or emanating from or migrating onto or through the Sites (including any soil, groundwater or surface water on or under the Sites) or migrating from the Sites onto any land or water body contiguous with the Sites, to the extent to which it occurred on or before 2 September 2014; and

(b) any pollution (as defined in the *Protection of the Environment Operations Act 1997 (NSW)*) of, or emanating from, the Sites (including any soil, groundwater or surface water on or under the Sites) or harm to the environment resulting from an activity undertaken on the Sites prior to 2 September 2014.

The scope of work carried out in the preparation of this SAQP (which is detailed specifically in Section 11) included the following:

- ES have completed a review of reports and relevant documents, placed in the data room by AGLM at the time of tendering. The reports that have been reviewed included the following:
    - ERM (October 2013) Bayswater Power Station, Preliminary Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0213879RP01_DRAFT Rev02.

- ERM (October 2013) Liddell Power Station, Preliminary Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0213879RP02_DRAFT Rev02.
- ERM (January 2014) Bayswater Power Station, Stage 2 Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0224193RP01.
- ERM (January 2014) Liddell Power Station, Stage 2 Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0224198RP02.

- Assessment of data gaps and identification of uncertainties and issues that require further investigation to define, to the extent practicable, the nature and extent of contamination on the four Sites and to make determinations whether the contamination is 'Pre-Existing Contamination';
- Assessment of the contaminants of concern at the site, including a review of their physical and chemical properties; and
- Development of the sampling, analysis and quality plan presented in this document.

The SAQP has been developed specifically to identify the presence of Pre-Existing Contamination on the Sites. It has not been developed to identify the suitability of the Sites for any purpose.

1.3 Data Quality Objectives

Data quality objectives (DQOs) are statements that define the confidence required in conclusion drawn from data produced for a project, and which must be set to realistically define and measure the quality of the data needed to allow the objective of the investigation to be confidently achieved.

The DQO process follows a seven-step process that is designed to ensure that the type, quantity and quality of environmental data used in decision-making are appropriate for the intended application.

The seven steps followed in the DQO process are outlined as follows:

1. State the problem;
2. Identify the decision;
3. Identify the inputs to the decision;
4. Define the study boundaries;
5. Develop a decision rule;
6. Specify tolerable limits on decision errors; and
7. Optimise the design of the sampling and analytical program.

The procedures followed to define the project DQOs are set out in following sections of this SAQP.

According to NSW Department of Climate Change (DECC) (2006) *Guidelines for the NSW Site Auditor Scheme* (2nd edition), DQOs are qualitative and quantitative criteria that clarify the objectives of an investigation, define the amount and type of data to be collected, and specify the tolerable levels of decision-making errors. DQOs ensure that the data collected is of the appropriate quantity (sampling frequency) and quality to allow for sound decisions to be made about the nature and extent of subsurface impacts.

The DQOs derived for this SAQP have been developed in accordance with relevant guidelines made by, or approved by the NSW EPA.

1.4 Guidelines made by the NSW EPA

EPA (1995b) *Contaminated Sites: Sampling Design Guidelines*. NSW EPA, Sydney;

DEC (2006) *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme – 2nd Edition*. NSW DEC, Sydney; and

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

DECC (2008) Waste Classification Guidelines. NSW DECC, Sydney

DECC (2009) *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. NSW DECC, Sydney.

OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. NSW EPA, Sydney;

EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*, Sydney.

NSW EPA (2014) *Technical Note: Investigation of Service Station Sites*

1.5 Guidelines approved by the EPA

ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, Canberra-includes Sediment Quality Guidelines;

ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*. Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council, Canberra;

Department of Health and Ageing and EnHealth Council (2002) *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards*. Commonwealth of Australia, Canberra;

Lock, W. H., (1996) Composite Sampling, *National Environmental Health Forum Monographs, Soil Series No. 3*, National Environmental Health Forum, SA Health Commission, Adelaide;

NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure, Schedule A and Schedules B (1)-B (10).* National Environment Protection Council, Adelaide;

NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure, Schedule A and Schedules B (1)-B (9).* National Environment Protection Council, Adelaide;

NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy;* and

NSW OEH (2008) *Guidelines for Implementing the POEO (Underground Petroleum Storage Systems) Regulation 2008*. Dept. of Environment, Climate Change & Water – OEH NSW

NSW DECCW (2010) *UPSS Technical Note: Decommissioning, abandonment and removal of underground petroleum storage systems*.

NSW EPA (2014) *Technical Note: Investigation of Service Station Sites*

1.6 SAQP Structure

The sections within this SAQP contain the following information:

- Section 1 – Introduction:
  This section provides background to the project and the scope of works of the investigation and provides a brief overview of the DQOs employed during preparation of this document.
- Section 2 – Data Quality Objectives:
  This section presents, describes and addresses each of the seven steps of the DQO process used for each of the investigation components.

- Section 3 – Quality Assurance / Quality Control:
  This section details the QA/QC procedures used during the investigation works including data quality indicators (DQIs), field logging, QA/QC sampling and frequency and laboratory analysis specifications.
- Section 4 – Site Conditions:
  This section provides the site description, summary of site conditions and surrounding environment
- Section 5 – Summary of Previous Environmental Investigations:
  This section provides a brief summary of previous environmental investigations.
- Section 6 – Geological Setting:
  This section provides a description of the geological setting of the site, with an emphasis on the stratigraphy, lithology and structural features of the geological formations, based on findings in previous site investigations.
- Section 7 – Hydrogeological Setting:
  This section provides a current understanding of the local hydrogeological environment based on the findings of previous investigations.
- Section 8 – Contaminants of Potential Concern:
  This section presents an overview of the contaminants of potential concern (COPC) associated with site following a review of previous investigation findings and historical site use.
- Section 9 – Conceptual Site Model:
  This section presents a conceptual site model identifying areas of environmental concern (AEC) of the site that have potentially been impacted by site activities, site conditions and/or specific features that could present an environmental concern with regards to potential contamination.
- Section 10 – Data Gap Analysis:
  This section provides a discussion of the identified data gaps from previous investigations and details the additional information required to achieve the objectives of the proposed additional investigation works.
- Section 11 – Assessment Criteria:
  This section provides the investigation levels to be used to assess the field and analytical results, and includes summary tables for both soil and water investigation levels.
- Section 12 – Proposed Sampling Program:
  This section presents the proposed sampling programme designed to address the identified data gaps and meet the DQOs, including the Quality Assurance and Quality Control (QA/QC) requirements. It describes the proposed sampling strategy, specifying borehole and monitoring well locations, sampling methods and depths for the investigation works.
- Section 13 – Sampling Methodology:
  This section provides details on the soil sample collection techniques used during the assessment works, including sample preservation, storage, and handling procedures.
  This section provides details on the groundwater monitoring well installation and construction specifications for each of wells, including screen lengths, depths, gravel pack dimensions, seal locations, construction materials and development methods.
  This section details the proposed groundwater sample collection techniques including sample preservation, storage and handling procedures.
- Section 14– Analytical Programme
  This section provides details of the analytical suite for each of the sites broken down into AECs and matrices. The section also provides details of the laboratories to be used.
- Section 15– Unexpected Finds Protocol

This section provides details for dealing with unexpected finds during the course of the works.

- Section 16– Identification of Pre-existing Contamination

  This section provides definition of meaning of contamination within the context of the works and guidance on whether the contamination may have been pre-existing as of September 2014.

- Section 17– Limitations

  This section provides a statement of limitations relating to this document and proposed investigation

2 Data Quality Objectives

As summarised in Section 1.3 of this SAQP, the DQO process is a systematic planning tool based on the scientific method for establishing criteria for data quality and for developing data collection designs. The data quality objectives define the experimental process required to test a hypothesis. The DQO process was developed to ensure that efforts relating to data collection are cost effective, by eliminating unnecessary, duplicative or overly precise data whilst at the same time, ensuring the data collected is of sufficient quality and quantity to support defensible decision making.

It is recognised that the most efficient way to accomplish these goals is to establish criteria for defensible decision making before the data collection begins, and then develop a data collection design based on these criteria. By using the DQO process to plan the investigation effort, the relevant parties can improve the effectiveness, efficiency and defensibility of a decision in a resource and cost effective manner.

DQOs have been developed to detail the type of data that is needed to meet the overall objectives of this project. The DQOs presented in this document have been developed consistent with the following published guidance:

- National Environment Protection Council (1999) National Environmental Protection Measure 1999 as amended 2013 – Assessment of Site Contamination. Schedule B(2) Guideline on Site Characterisation (NEPC 2013);
- NSW DECC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- NSW DECC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition);
- NSW EPA (1995) Sampling Design Guidelines;
- NSW EPA (2000) Guidelines for Consultants Reporting on Contaminated Sites;
- Australian/New Zealand Standard, AN/NZS 4360:2004, *Risk Management – Principles and guidelines*; and
- Australian/New Zealand Standard, AN/NZS 5667.11:1998, Water Quality – Sampling - Guidance on sampling of groundwaters.

The DQO process is a seven-step method to optimise the design of the sampling and analysis plan to ensure that all objectives of the investigation are met. The seven steps are outlined as follows:

- **Step 1**: State the Problem – concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.
- **Step 2**: Identify the Decision – identify what questions the study will attempt to resolve, and what actions may result.
- **Step 3**: Identify the Inputs to the Decision – identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.
- **Step 4**: Define the Study Boundaries – specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.
- **Step 5**: Develop a Decision Rule – define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.
- **Step 6**: Specify Tolerable Limits on Decision Errors –define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.
- **Step 7**: Optimise the Design – evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
1. Give a concise description of the problem, 2. Identify the leader(s) & members of the planning team, 3. Develop a CSM of the environmental hazard to be investigated, 4. Determine resources (ie. budget, personnel, & planning & field works schedules), and constraints.	DQO Overlap. 1. Distribution List for the QA Project Plan revisions & final guidance, 2. Identify individuals or organisations participating in project and discuss their roles, responsibilities & organisation, 3. State the specific problem to be solved or decision to be made, 4. Identify the decision maker and the principal customer for the results, 5. Hypothesis test, 6. Expected measurements, 7. ARAR's or other appropriate standards, 8. Assessment tools (technical audits), 9. Work schedule & required reports, 10. Define the criteria for the use of non-measurement data such as data that originates from databases or literature. NB. Reference to ES documents acceptable.	***Background & Contamination Status Summary - Liddell Power Station (LPS).*** Liddell Power Station (LPS) was commissioned in 1971 as a conventional coal-fired power station featuring four generator units providing base load electricity for NSW located in the Hunter Valley region of NSW, formerly owned by Macquarie Generation until 2 September 2014, after which ownership of the asset belonged to AGL Macquarie. The LPS site is located approx. 1 km east of the New England Highway on the shore of Lake Liddell and surrounded by areas mainly used for coal mining purposes (Drayton, Liddell Colliery, Ravensworth Rehabilitation Area), with some grazing, bushland, viticulture and thoroughbred horse stud farms. The Bayswater Power Station (BPS) operational area is located approx. 3 km to the south-west of LPS. The closest residential areas to the Site include: Muswellbrook (approx. 10 km to north-west), Jerrys Plains Village (approx. 15 km to south-west), Singleton (approx. 25 km to south-east), and various rural residences not part of residential centres. The total area of the LPS site is approx. 1500 hectares. The operational area of LPS occupies 700 hectares and includes 22 known Areas of Environmental Concern (AEC's) principally arising from locations concerned with coal stockpiles & conveyors, electricity generation units (coal hoppers, bowl mills, feed systems, coal fired boilers, steam turbines, hydrogen cooled generators & transformers), air emission controls (fabric filters, chimney stacks), bulk fuel storage & transfer infrastructure, cooling water processes (intakes, pre-treatment facilities, cooling towers & returns), waste water holding ponds and treatment facilities, maintenance facilities and administration offices. *The listing of known AEC's (ERM, 2014) includes: Ammonia Plant (LA), Ash Dam (LB), Bulk Fuel Storage - light vehicle refuelling (LC), Bulk Fuel Storage - mobile refuelling facility (LD), Bulk Fuel Storage - fuel oil installation AST's A-F (LE), Bulk Fuel Storage - waste oil AST transformer road & former transformer oil AST's (LF), Bulk Fuel Storage - turbine oil AST (LG), Bulk Fuel Storage - waste oil AST's liquid alternative fuels & emergency generator AST (LH), Former & Current Coal Storage Areas (LI), Dangerous Goods & Flammable Liquids & Stores (LJ), Former Construction Workshop & Storage (LK), Hunter Valley Gas Turbines (LL), Machinery*	N/A

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		Graveyard (LM), Oil & Grit Trap (LN), Former & Current Maintenance Stores, Workshops, Foam Generator & Unofficial Lay-Down Areas (LO), Fill Material - site levelling & shoreline expansion (LP), Transformer Operations - transformer road (LQ), TransGrid switchyard (LR), Landfills - waste disposal & borrow pit (LS), Water Intake & Pump Station (LT), Water Treatment Plant (LU), and Buffer Land (LV). Two previous investigations have been completed at the LPS site, a Stage 1 Preliminary ESA (ERM, 2013) and a Stage 2 ESA (ERM, Jan. 2014) for Macquarie Generation to gather soil & groundwater data in order to develop a baseline assessment of environmental conditions at or near the time of the asset transaction. The key conclusions provided by the Stage 2 ESA (ERM, 2014) baseline assessment for the LPS environmental conditions (soils & groundwaters) included: asbestos being present beneath the ACM pipelines to the Liddell Ash Dam with potential risks associated with inhalation of petroleum hydrocarbon vapours near the light vehicle refuelling area, and potential migration of petroleum hydrocarbons from the bulk fuel storage areas towards Lake Liddell. No contamination issues were identified in the ERM (2014) report which would require material management or remediation based on the current and continued Commercial & Industrial landuse as a power station with the exception of the potential material issues associated with the identified asbestos impacts in soils surrounding the ACM pipelines to Liddell Ash Dam and water management issues related to Liddell Ash Dam that are subject of a Pollution Reduction Program required as part of the Environmental Protection Licence (EPL). Various metals were detected above the human health (drinking water) and/ or ecological screening values which were not attributed to background conditions in groundwater at a number of locations across the site. The ERM (2014) report concluded that the metal impacts were related to activities which were already regulated and monitored under the LPS site EPL which were generally located within the site boundary and up gradient of Lake Liddell (i.e. the discharge point also monitored and regulated under the LPS site EPL). ERM (2014) considered that the NSW EPA would most likely continue to manage this metals issue under the POEO Act via the EPL, and hence the issue would not require formal notification under the CLM Act, although this approach should be confirmed with NSW EPA to ensure strict adherence to the NSW	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		DECC (2009) guidelines. Environmental Strategies understands that the site has subsequently been reported to NSW EPA under s60 of the CLM Act. ERM (2014) recommended that a suitable Environmental Management Plan (EMP) be prepared and implemented to mitigate the risk of exposure to asbestos associated with areas in close proximity to the ACM pipelines to the Ash Dam and relating to the potential for asbestos to occur in soils across the LPS site as a whole. It was recommended by ERM (2014) that asbestos be delineated in accordance with ASC NEPM (2013) and should include more detailed inspections of these areas and the collection of soil samples for quantitative analysis. ERM (2014) recommended further assessment of groundwater impacts from petroleum hydrocarbons in bulk fuel storage areas was recommended to clarify the potential for contaminants to migrate to Lake Liddell, including consideration for fate and transport modelling and a detailed risk assessment. Additional characterisation at the light vehicle refuelling area (LC) was also recommended to assess the potential for vapour intrusion in relation to the Main Stores building which was proposed to include re-sampling of groundwater wells in the vicinity of this area, installation and sampling of soil vapour wells and/ or sub-slab vapour points, and collection of indoor air samples from within the Main Stores building. Confirmatory groundwater sampling was recommended at the water intake and pump station to confirm concentrations of benzene to clarify the duty to report contamination under Section 60 of the CLM Act 1997. Confirmatory groundwater sampling and ultra-trace laboratory analysis was also recommended at the former and current maintenance stores, workshops, foam generator and unofficial lay-down areas to assess whether vinyl chloride is present due to detection of PCE and other breakdown products. - ERM (Oct, 2013) Liddell Power Station, Preliminary ESA. Macquarie Generation-Project Symphony, Ref 0213879RP02-Draft Rev02. - ERM (Jan, 2014) Liddell Power Station, Stage 2 ESA. Macquarie Generation-Project Symphony, Ref 0224198RP02.	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		Background & Contamination Status Summary - Bayswater Power Station (BPS). Bayswater Power Station (BPS) was commissioned in 1986 as a conventional coal-fired power station featuring four generator units providing base load electricity for NSW located in the Hunter Valley region of NSW, formerly owned by Macquarie Generation until 2 September 2014, after which ownership of the asset changed to AGL Macquarie along with LPS. The BPS site is located on the New England Highway, approx. 15 km to the south-east of the township of Muswellbrook and approx. 28 km to the north-east of the township of Singleton in NSW. BPS is also surrounded by areas mainly used for coal mining purposes (Drayton, Liddell Colliery, Ravensworth Rehabilitation Area), with some grazing, bushland, viticulture and thoroughbred horse stud farms. The Liddell Power Station (LPS) operational area is located approx. 3 km to the north-east of BPS. BPS & LPS share some infrastructure such as coal & water supply. The total area of the LPS site is approx. 8300 hectares. The operational area of BPS occupies 300 hectares and includes 25 known Areas of Environmental Concerns (AECs). The listing of known AECs (ERM, 2014) includes: Brine Concentrator Holding Pond (BA), Brine Concentrator Decant Basin (BB), Fuel Oil Installation (BC), Vehicle Refuelling Depot (BD), Coal Storage Area (BE), Coal Unloaders, Rail Infrastructure & Coal Transfer Lines (BF), Contaminated Water Treatment Plant (BG), Cooling Water Treatment Plants (BH), Demineraliser Plant (BI), Former Contractor Staging Area (BJ), Former Large Items Assembly Area (BK), Generator Transformer Areas (BL), Landfill (BM), Lime Softening Plant (BN), Lime Softening Plant Sludge Lagoons (BO), Mobile Plant Workshop & Refuelling (BBP), Pikes Gully Ash Dam (BQ), Ravensworth Rehabilitation Area (BR), Low Pressure Pumping Station (BBS), High Pressure Pumping Station (BT), Main Store Dangerous Goods Storage Area (BU), Power Block (BV), Sediments in Surrounding Waterways & Lake Liddell (BW), Transgrid Switchyard (BX), and Buffer Lands (BY). Two previous investigations have been completed at the BPS site, a Preliminary ESA (ERM, 2013) and a Stage 2 ESA (ERM, Jan. 2014) for Macquarie Generation to gather soil & groundwater data in order to develop a baseline assessment of environmental conditions at or near the time of the asset transaction.	N/A

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		The key conclusions provided by the Stage 2 ESA (ERM, 2014) baseline assessment for the BPS environmental conditions (soils, groundwaters, sediments & surface waters) included: asbestos in soils at specific locations, asbestos identified beneath the pipelines linking the BPS with the Pikes Gully Ash Dam and in one location within the Coal Storage Area. Metals in groundwater, metals in surface water and metals & hydrocarbons in sediments (Lake Liddell). Various metals identified were at concentrations in excess of screening levels designed for the protection of freshwater environments across the Site. Potential health and environmental risks associated with these exceedences were interpreted by ERM (2014) as four broad groups based upon the location of the samples as follows: exceedences identified in groundwater discharging to the Pikes Gully Ash Dam were likely to be minor contributors to any overall potential health or environmental risks associated with the Ash Dam, given the volume and nature of the ash and water stored within the area. Exceedences identified in groundwater discharging to Plashett Reservoir, were not considered to represent a significant risk to human health or the environment on the basis that the reservoir was created as a part of the power station water management system. No public access to the Reservoir is allowed and waters discharging from the reservoir flow back into the BPS within a closed system design. Exceedences identified in groundwater discharging directly to off-site receptors (Bowmans Creek & Hunter River) were generally consistent with background concentrations and were not considered by ERM (2014) to represent a significant risk to human health or the environment in the context of the surrounding environment. The one exception was for arsenic, which was detected in groundwater beneath the Ravensworth Coal Unloader warranting further assessment to assess potential risks. Exceedences identified in groundwater discharging to Lake Liddell (sediment & surface waters) metals and PAH's in sediment and metals in surface water were identified at concentrations in excess of the adopted ESL's, warranting further assessment to assess potential risks. No contamination issues were identified by ERM (2014) which would require material management or remediation based on the current and continued use of the Site as a power station with the exception of the identified asbestos impacts in soils surrounding	

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Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		the asbestos pipelines and works associated with surface water, seepage and groundwater management works in the vicinity of the Pikes Gully Ash Dam. The duty to report contamination under the CLM Act (1997), ERM (2014) notes that in many instances, exceedences of the adopted groundwater, surface water and sediment screening levels have been identified which are related to activities which are currently regulated and monitored under the Site EPL (No. 779) and (in the case of Pikes Gully Ash Dam) a current PRP (PRP1). ERM (2014) considered that NSW EPA would most likely continue to manage these issues under the POEO Act (1997) via the Site EPL, and hence not require formal notification of potential contamination under the CLM Act, however this approach should be confirmed with NSW EPA to ensure strict adherence to the NSW DECC (2009) guidelines. Environmental Strategies understands that the site has subsequently been reported to NSW EPA under s60 of the CLM Act. On the basis of the outcomes of the ERM (2014) Stage 2 ESA, the following additional characterisation of the baseline conditions of the BPS Site was considered to be required: delineation of asbestos contamination identified in the vicinity of the pipelines linking the power station to Ash Dam and within the Coal Storage Area, additional confirmatory groundwater sampling within the Mobile Plant Workshop and Refuelling Area, Power Block and the Coal Unloaders to confirm the measured concentrations of metals, additional confirmatory groundwater sampling within the Fuel Oil Installation and Transformer Area to confirm the measured concentrations of benzene with specific reference to clarify the duty to report contamination under Section 60 of the CLM Act (1997), further monitoring of metals in groundwater within the Plashett Reservoir and its catchment, and further assessment of bioavailability of sediment contaminants and whether sediment and surface water impacts have the potential to pose a risk to ecological receptors (and potentially human receptors via consumption of fish) associated with metals and hydrocarbons within Lake Liddell. - ERM (Oct, 2013) Bayswater Power Station, Preliminary ESA. Macquarie Generation-Project Symphony, Ref 0213879RP01-Draft Rev02. - ERM (Jan, 2014) Bayswater Power Station, Stage 2 ESA. Macquarie Generation-Project Symphony, Ref 0224193RP01.	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		Background & Contamination Status Summary - Lake Liddell (LL). A preliminary program of environmental assessment of sediment and water quality was completed by ERM within the lake and in targeted outfall areas of Lake Liddell. Elevated concentrations of PAH's, metals and TRH were identified on sediments, particularly in the western part of the lake, near the LPS. This current project will provide sediment and water data on a systematic grid across Lake Liddell and will also include sampling of edible fish (including eels) for analysis of tissue impact.	N/A
		Background & Contamination Status Summary - Tomago Development Site (TDS). The Tomago Development Site (TDS) is a vacant Greenfield site adjoining Tomago aluminium smelter. No environmental assessment programs are known to have been undertaken on the TDS. Systematic sampling of soil from boreholes and groundwater from monitoring wells is proposed by this SAQP to ensure that no significant risk is posed to the health of any subsequent users of the site or to the environment. Particular attention will focus on determining whether contaminated groundwater is or has migrated onto the site from the smelter	N/A

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Step 1. State the Problem Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem (NSW DEC, 2006)			
		Based on the existing Conceptual Site Model and Stage 2 ESA conclusions (ERM, 2014) and data gaps identified in the Environmental Strategies Proposal document P15166 - May 2015 (Appendix K), the following specific problems (objectives) for new Works include: 1. Better define the nature and lateral & vertical extent of the contamination identified to date by the previous environmental consultant (ERM) at the areas of environmental concern (AEC's) on each of the four Sites (ie. Bayswater Power Station - BPS, Liddell Power Station - LPS, Lake Liddell, and the Tomago Development Site), a) Pollution under the NSW EPA POEO Act 1997 and contamination under the CLM Act 1997 for open space and/ or commercial & industrial landuse (operational areas); b) Site suitability under NEPM 1999 (Amendment 2013) and other relevant guidelines, including Lake Liddell (NHMRC 2008 recreational waters), c) Groundwaters according to ANZECC/ ARMCANZ (2000) Trigger Values for fresh water (95% P & 99% P bioaccumulation mercury & selenium), and d) Sediments assessed according to Low & High ISQG and HSQA 2005. e) Fish (including eels) will be assessed currently to reported as to whether they contain heavy metals, PAH's, TRH, VOC's or BTEX above the Practical Quantitation Limits and whether the flesh of the aquatic species poses a risk of harm to consumers. 2. Identify any further contamination which may be present at each of the four Sites, and	N/A

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
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		3. Provide an opinion on whether potential contamination identified at the Site can be classified as pre-existing contamination prior to 2 September 2014. Include evidence and indicators (nature and extent) of any contamination suspected as meeting the definition of pre-existing contamination as provided by AGLM below. 'Pre-Existing Contamination', has been defined by AGLM to mean: a) The presence of any contamination in, on, under or emanating from or migrating onto or through the sites (including any soil, groundwater, or surface water on or under the Sites) or migrating from the Sites onto any land or water body contiguous with the Sites, to the extent to which it occurred on or before 2nd September 2014; and b) Any pollution of, or emanating from, the Sites (including any soil, groundwater or surface water on or under the Sites) or harm to the environment resulting from an activity undertaken on the Sites prior to the 2 September 2014. ***Note 1***. it shall be important to consider assessing groundwater wells to determine if there are significant differences in concentrations of chemicals of concern between the ERM (2014) data set and a new post 2 September 2014 data set, to be able to identify potential impact signature differences such as: differentiation between old and new NAPL's, odour descriptions, colour descriptions, and whether potential NAPL is surface or depth defined, etc). All qualitative records shall need to be recorded in field logs. Research of recent spill history is also an important factor to derive this opinion. In addition, if relevant, selected samples will be tested for aging and characterisation to assist with providing an opinion of the age of the contamination. This additional testing is currently outside the scope of the original contract.	
		Project Resources Budget - Confidential (withheld), but considered by Environmental Strategies to be appropriate for the tasks involved in delivering the scope of work set out in this SAQP.	N/A

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		Variations to budget to be decided by AGLM's technical advisor, based on documentation provided by and recommendations made by Environmental Strategies. Personnel The following personnel are assigned to the investigation program: • Project director: Rod Harwood, who is a site auditor accredited by NSW EPA under the CLM Act, but is not acting in this capacity. The PD has over 25 years experience in the investigation and assessment of contamination of soil, groundwater, surface waters and sediments: • Project manager: Craig Wellings. The PM has over 25 years experience in the investigation and assessment of contamination of soil, groundwater, surface waters and sediments: • Field personnel - Two teams, with contingency backup team, refer to the ES proposal document P15155 - May 2015 (Appendices D & F). • A specialist sub-contractor, has been engaged to collect fish (including eels and yabbies) from Lake Liddell: Dr Peter Hancock, who is a specialist in freshwater ecological studies) will collect the above samples and by netting or fishing methods which will not disturb the health of the population and will provide samples of the critical tissue for analysis of the contaminants of concern which will be PAH's, TRH,BTEX, heavy metals and OCP and OPP pesticides. The study only includes quantification of the chemicals of concern and will compare the concentrations to NOEC, LD50 and other relevant parameters. It will not specifically comment on risk. • Data management: David Burns is an analytical chemist who was a Principal of Labmark, and has worked with the ES team for over 2 decades, ensuring the superiority and integrity of our data. David will work full-time on this project, primarily from the office, ensuring that real time field data is	

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integrated to both laboratory and reporting templates. David will review and take the lead in managing field and laboratory quality control for the project. David specialises in technical support of Contaminated Site Auditors in the area of data quality (i.e. DQO/ DQI-PARCCS assessments of field & laboratory data).

- GIS manager: Derek Mascarenhas will lead GIS and conceptual site modelling efforts for the projects. Derek is a digital specialist with professional experience in engineering. For over 20 years Derek has provided visual communication services including graphic design, technical illustration and 3D visualisation / animation, specifically for development applications, environmental approvals and stakeholder engagement.

Schedule (RFT prescribed) - 1st June 2015 with Draft report submitted within 4 months.

Refer to (Appendix B: Gantt Chart for the work schedule).

Project Constraints & Risks

Project risk mitigation measures will be employed These include:

- A well-documented chain of command from Project Director down to field and office staff.
- A field back up team both for ES personnel and subcontractors;
- Detailed project schedule / Gantt chart;
- A robust field programme with inbuilt Chain of Custody and field templates to ensure ready interchange of data from the field to the office;
- Data management making data transfer immediate to a full time office-based data manager;
- A project Risk Analysis; and

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		• Project Management Tools which will ensure major milestones are completed to satisfaction of the AGL Macquarie's expectations. Within the project Risk Analysis ES have outlined 10 risk factors and how these will be mitigated within the project. The risk factors are: • Contractual, Health and Safety, • Commercial, • Field Work Programming, • Project Delivery, • Contractor Management, • Data Quality Management, • Community /Stakeholder Engagement, • Unexpected Finds, • Environmental Management/Site Security. Delay in receiving GIS maps from ERM via AGLM, (as of COB 2 June 2015). Delay in receiving Stage 2 ESA Appendices (B-K) from ERM via AGLM which specifically includes important sample, (as of COB 2 June 2015). If the ES investigation produces results which are significantly different from those indicated in the ERM reports, the following data presented in the ERM reports will need to be assessed: borelogs, field records, result tables, original NATA accredited laboratory reports, COC's, SRN's, completeness of sampling according to SAQP, sampling nomenclature protocol, water stabilisation criteria, and the refined CSM. ***Note 2.*** The provision of an environmental report defining the nature and lateral & vertical extent of the Sites contamination status is considered to be an Estimation	

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		Problem and shall be assessed according to the NEPM 2013 Guidelines, ANZECC/ AMCANZ 2000 (ISQG), and HSQA 2005. ***Regulatory Authorities & Local Government Area*** NSW EPA Muswellbrook local government area (LGA) Lake Liddell Recreational Area Reserve Trust (appointed by NSW Government to manage Crown Lands)	

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Step 2. Identify the Decision (Identify the goal of the study) Identify what questions the study will attempt to resolve, and what actions may result (NSW DEC, 2006)			
. Identify the principle study questions (s), 2. Consider alternative outcomes or actions that can occur upon answering the questions (s), 3. For decision problems develop decision statement(s), organise multiple decisions, 4. For estimation problems, state what needs to be estimated and key assumptions.	DQO Overlap. 1. State the specific problem to be solved or decision to be made, 2. Identify the decision maker and the principal customer for the results, 3. Hypothesis test, 4. Expected measurements, 5. ARAR's or other appropriate standards, 6. Assessment tools (technical audits), 7. Work schedule & required reports, NB. Reference to ES documents acceptable.	***Key Decisions to be Made*** 1. Do any of the AGLM Sites represent a risk and/ or liability resulting from potential contamination existing prior to 2 September 2014 (the asset ownership transfer date), including offsite and mobile risk and liabilities from soils, groundwaters, sediments, lake water and edible aquatic fishes/ species? 2. Do any of the AGLM Sites represent a risk of potential contamination impact or migrating onto or offsite and impact human or ecological receptors? What are the likely magnitude and risk posed by of any potential impacts? 3. If contamination is evident, can it be effectively addressed by natural attenuation processes (sustainably, and within a reasonable timeframe), or will active remediation of source areas and/or of contaminated environmental media be required? 4. Does the impact at the Sites represent unacceptable risk to human health or to the environment, based on the current and continued use of the site? 5. Is impact likely to warrant notification and/ or regulation under the: • NSW CLM Act; and/or • NSW POEO Act? 6. Is material remediation likely to be required? 7. The alternative outcomes or actions include, but not limited to: a) may relocate locations of boreholes and/ or groundwater monitoring wells, and b) the site may potentially have been contaminated post-2 September 2014.	To be confirmed, where applicable

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		8. The investigations listed in the SAQP are intended to address a number of issues at the site, assess the nature and extent of contamination at the site, and determine if contamination at the site presents any unacceptable risks to either onsite occupants under a mixed use scenario or to the surrounding environment. From a review of the potential for contamination, the following decisions require to be resolved: o Are COPC present at concentrations above local background levels in soil and/or groundwater? o Are COPC present at concentrations above health- and/or environmentally-based guidelines values in soil and/or groundwater? o Is the 95% upper confidence limit (UCL) of the arithmetic average concentration for each of the COPC in in soil in each of the AECs less than the guideline level? o Is groundwater containing concentrations of COPC exceeding health- and/or environmentally-based guidelines values migrating from the site of has potential to migrate from the site so as to cause an unacceptable risk to human health and/or to the environment? o Are leachable concentrations of any of the COPC indicative of potential remobilisation of contamination in surface water, sediment transport, or mobilisation of contaminants through the vadose zone and into the water table? o Are the COPC present at concentrations likely to adversely affect human health or any environmentally significant ecosystems? o Can contamination identified during the investigation be managed or remediated in order to render the site suitable for the current site use? Are groundwater monitoring wells constructed appropriately to determine hydrogeological regime across the site?	

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		o Are all areas of environmental concern targeted for investigation? o Are the drilling methods appropriate to gain an understanding of the site geological and hydrogeological regime? Are there sufficient data to facilitate the development of a Tier 2 Human Health Risk Assessment, if a risk assessment is required subsequent to the completion of the ESAs? Following completion of the investigation works detailed in the SAQP, a Tier 2 human health risk assessment may need to be completed to determine the potential risk to site occupants. Should the Tier 2 human health risk assessment indicate that an unacceptable risk to human health is apparent, remediation and/or management options (presented as contingency options) will be required to ensure that the site is suitable for the proposed land use. In addition to accommodate the NEPM 2013 process, further work on soil vapours may be required to quantify exposure pathways but this is not a requirement of the existing scope of work.	

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Step 3. Identify the Inputs to the Decision (Identify information inputs Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement (NSW DEC, 2006)			
1. Identify types & sources of information needed to resolve decisions or produce estimates, 2. Identify the basis of information that will guide or support choices to be made in later steps of the DQO Process, 3. Select appropriate sampling & analysis methods for generating the information.	DQO Overlap. 1. Hypothesis test, 2. Expected measurements, 3. ARAR's or other appropriate stds, 4. Assessment tools (technical audits), 5. Work schedule & required reports, 6. Itemise information & records in the data package, including report format & requirements for storage, etc, 7. Identify analytical methods & equipment for the study, including method performance requirements, 8. Describe quality control procedures that associated with each sampling & measurement technique. List required checks & corrective action procedures, 9. Discuss how inspection, acceptance testing & QC samples to ensure their intended use as specified by the design, 10. Identify tools, gauges & instruments, and other sampling or measurement devices that need calibration. Describe how the calibration should be done,	***The following inputs to the decision process are required:*** 1. Previous Preliminary & Stage 2 ESA ERM reports. Existing ERM data shall be assessed for DQI compliance as per the current project scope. 2. Comments & recommendations provided by the AGLM Technical Advisor; 3. Information relating to local geology, including: near-surface geology and anthropogenic materials; hydrogeology – particularly vertical characterisation and aquifer properties; obvious signs of contamination and location; site history; PID screening; and field observations (visual, olfactory, foreign materials) indicating aesthetic issues. *4.* New intrusive investigations (drilling, test pitting, groundwater monitoring wells, sediment collection). New sampling also includes collection and chemical analysis of edible aquatic species from Lake Liddell. *5.* Collection of NATA accredited analytical data from soil, groundwater, sediment and edible aquatic marine species samples for chemical analysis (as specified by AGLM) of heavy metals arsenic, boron, cadmium, total chromium, copper, lead, mercury, nickel, selenium, zinc), petroleum hydrocarbons (TRHs), benzene, toluene, ethylbenzene, xylenes (BTEX), volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs),salinity, nitrate, nitrite, ammonia, phosphorus, and fluoride. If bonded asbestos identified report type of asbestos identified in bonded matrix; if asbestos fibres in soil are identified report mineral types and types of fibres as % fibres in sample. (Note: that sampling and testing for asbestos, soil pH and fire fighting foams have not been specified but considered important COPC by Environmental Strategies in this DQO Step. In addition, VOC's in the returnable schedule include BTEX, VHC's, VAC's, and various other analytical compounds from USEPA method 8260). *6.* Assess whether the laboratory sample containers/preservation chemistries and reporting limits (i.e. PQL's, LOR's) are appropriate for the project,	Email received from the AGLM Technical Advisor (2 June 2015) to Mr. Rod Harwood (ES Project Director), stated that the 'SAQP should address the obvious contaminants but also address: salinity (site wide, pH (soil & GW site wide), fire fighting chemicals (specific locations) and VOC's (specific locations). The original AGLM RFT had not included any requirement for the planning, sampling, testing, assessment of potential site specific fire fighting chemicals. This will be achieved by recoding these parameters as field descriptors for groundwater as this is a standard part of the field protocol but will need to be processed as a variation for soil. VOC's and AFFF compounds will need to be processed as variations and further details will be conveyed to the project team before any intrusive works are completed.

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	11. Outline the data management scheme including the path & storage of the data & the data record-keeping system. Identify data handling equipment & procedures used to process, compile & analyse the data, 12. Describe the process for verifying & validating the data, including the COC for data throughout the project lifetime. NB. Reference to ES documents acceptable	*7.* Groundwater monitoring results including physio-chemical parameters, presence/absence of phase separated liquid, groundwater elevation data and any impacts to results by the presence of suspended solids in groundwater samples; *8.* Review of the contaminants of concern on sampling methodologies, sample locations and sample depths; *9.* Proposed investigation strategy and the accompanying analytical schedule; *10.* Results of quality control samples collected during the investigation, so that it can be ascertained whether the data set generated is defensible and usable for the purposes of the investigation; quality control samples collected during this investigation will include inter-laboratory duplicates, intra-laboratory duplicates, equipment rinsate samples, trip blanks and trip spikes; *11.* The proposed use and development layout of the site; *12.* The adopted soil, groundwater, sediment and edible aquatic species assessment criteria for the site (NEPM 2013 Guidelines, ANZECC/ AMCANZ 2000 (Low & High ISQG), and HSQA 2005), and *13.* Site history including previous & recent hazardous material spills within the operational areas. Site personnel will be requested to provide details of any significant spills, leakages, breakages, etc that have occurred pose-2 September 2014.	

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		Other information inputs include, but not limited to: 1. Laboratory testing results to be reported as ESDAT EDD files, 2. Sampling techniques, analytical methodology, field and laboratory QC samples, performance requirements to be specified in detailed SAQP (DQO Step 7). 3. Electronic COC records obtained from field works, BOM records, professional competency records of key field sampling personnel, physical observations (incl. visual, olfactory) and PID screening results during site activities, 4. Site specific Environmental Protection Licences (EPLs), 5. Site specific Pollution Reduction Programs (PRPs), 6. Site maps identifying areas of environmental concern, historical sampling locations (existing GW wells, soil bores, surface samples), new sampling locations, site workspaces prepared by Chelace, underground services, ArcGIS software and Site files provided by AGL as shape files and Site imagery as geotiff: orthorectified geo-referenced imagery for each site and surrounds; project boundary; cadastral dataset including Lot/DP and land ownership; roads; rail; water courses; 0.5m 3D contours for site and surrounds; soils; and general arrangement plan of each site showing key features.	To be confirmed, where applicable

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Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
1. Define the target population of interest (such as landuse & receptors) & its relevant spatial boundaries, 2. Define what constitutes a sampling unit, 3. Specify temporal boundaries and other practical constraints associated with sample/ data collection, 4. Specify the smallest unit on which decisions or estimates will be made.	DQO Overlap. 1. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 2. Scope of the project (domain or geographical locale). NB. Reference to ES documents acceptable.	***Liddell Power Station (LPS)*** ***Spatial Boundary***: The total area of the LPS site is approx. 1500 hectares. The operational area of LPS occupies 700 hectares and includes 22 identified AEC's. The approx. coordinates of LPS are 309693 m East and 6416597 m South. A site location plan is provided by ERM Stage 2 ESA (Jan, 2014) Ref 0224198RP02 as Figure 1 of Annex A.The baseline assessment within the operational area includes soils and groundwaters as follows: - The maximum depth of soil sampling shall be 3.0 m BGL or until clean natural material/ bedrock is encountered. Sampling may be required from deeper locations if indicators of contamination are identified by visual, olfactory of PID means, then the Environmental Strategies Field Supervisor may discuss the options to advance the bore hole depth with AGLM technical advisor on a case by case basis. - The maximum depth of groundwater monitoring wells shall be 6.0 m BGL, except if groundwater at deeper depths is contaminated and where the deeper groundwater may migrate from the LPS or may give rise to a risk of harm on the LPS. Where there is potential for Site locations to be unlikely to find saturated conditions (eg. significantly elevated areas), then the Environmental Strategies Field Supervisor may discuss the options to either abandon the location or drill deeper with the AGLM technical advisor on a case by case basis. The potential to impact groundwater at deeper than 6m will often only be determined after additional soil quality data is assessed and may need to be recommended after soil boring information is analysed. ***Practical Constraints*** (Sampling): high voltage electricity services (above and below ground). AGLM must provide authorisation to specific operational areas for safe field works. Shallow bedrock known to exist on site from the past ERM Stage 2 ESA field works. Condition & location of existing GW monitoring wells. Some dry groundwater monitoring wells (winter), but recent significant rainfall in May could result in elevated groundwater levels. Abandonment of monitoring wells due to encountering mine spoil. Dense grasses and overgrown areas where these exist. ***Landuse***: commercial & industrial.	To be confirmed, where applicable.

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		Sensitive Receptors: indoor & outdoor human health receptors (industrial on-site and off-site users), intrusive maintenance workers (on-site and off-site), residential receptors and potential groundwater users in the vicinity of the site, recreational users of Lake Liddell including persons who consume aquatic species collected from Lake Liddell, and ecological receptors including freshwater ecological receptors in the local creeks and Lake Liddell. ***Temporal Limits***: The temporal boundaries for the LPS assessment are limited to the dates of fieldworks identified in the ES proposed schedule (Proposal document P15155 - May 2015, Appendix B) due to the timetable specified by AGLM, during winter daylight hours. Seasonal fluctuations in the groundwater table may be considered by reviewing groundwater parameters from previous reports and/ or imposing a monitoring program for 12 months post assessment works, dependant upon the on-site and off-site groundwater concentration findings. ***The Sampling Unit*** for LPS on which estimates shall be made shall include: Soil: 85 x soil bores where 80 shall be converted into GW monitoring wells, 49 x test pits, plus field QC samples (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity (sample specific analyte selection to be specified in detailed SAQP to follow). GW: sampling 67 x existing and 80 x newly installed GW monitoring wells, plus field QC samples (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). SW: collection of 54 x surface water samples, plus field QC samples (ie. field duplicates, field triplicates, field blanks). Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). Sediments: collection of 65 sediment samples, plus field QC samples (ie. field duplicates, field triplicates, field blanks). Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow).	

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		Background Samples: 8 x soil bores where all 8 shall be converted into GW monitoring wells, 6 x test pits, plus field QC samples, GW: sampling 15 x existing and 8 newly installed GW monitoring wells, plus field QC samples (field duplicates, field triplicates, field blanks). Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). Refer to the analytical programme in Section 14 of the SAQP.	
1. Define the target population of interest (such as landuse & receptors) & its relevant spatial boundaries, 2. Define what constitutes a sampling unit, 3. Specify temporal boundaries and other practical constraints associated with sample/ data collection, 4. Specify the smallest unit on which decisions or estimates will be made.	DQO Overlap. 1. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 2. Scope of the project (domain or geographical locale). NB. Reference to ES documents acceptable	***Bayswater Power Station (BPS)*** ***Spatial Boundary***: The total area of the BPS site is approx. 8300 hectares, including the Ravensworth Rehabilitation Area, Lake Liddell and surrounds and buffer lands not currently in active use. The operational area of BPS and Pikes Gully Ash Dam occupies 300 hectares and includes 25 known AEC's. The approx. coordinates of BPS are 307144 m East and 6413998 m South. A site location plan is provided by ERM Stage 2 ESA (Jan, 2014) Ref 0224193RP01 as Figure 1 of Annex A, Figures 2, 3 and 4.1 to 4.11. The baseline assessment within the operational area includes soils and groundwaters as follows: - The maximum depth of soil sampling shall be 3.0m m BGL or until clean natural material/ bedrock is encountered. Sampling may be required from deeper locations if indicators of contamination are identified by visual, olfactory of PID means, then the Environmental Strategies Field Supervisor may discuss the options to advance the bore hole depth with AGLM technical advisor on a case by case basis. The maximum depth of groundwater monitoring wells shall be 6.0 m BGL, except if groundwater at deeper depths is contaminated and where the deeper groundwater may migrate from the LPS or may give rise to a risk of harm on the LPS. Where there is potential for Site locations to be unlikely to find saturated conditions (eg. significantly elevated areas), then the Environmental Strategies Field Supervisor may discuss the options to either abandon the location or drill deeper with the AGLM technical advisor on a case by case basis. ***Practical Constraints (Sampling)****:* high voltage electricity services (above and below ground). AGLM must provide authorisation to specific operational areas for safe field works. Condition & location of existing GW monitoring	To be confirmed, where applicable

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Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
		wells. Some dry groundwater monitoring wells (winter), but recent significant rainfall in May could result in elevated groundwater levels. Abandonment of monitoring wells due to encountering mine spoil. Dense grasses and overgrown areas where these exist. ***Landuse: commercial & industrial.*** ***Sensitive Receptors****:* indoor & outdoor human health receptors (industrial on-site and off-site users), intrusive maintenance workers (on-site and off-site), residential receptors and potential groundwater users in the vicinity of the site, recreational users of Lake Liddell including persons who consume aquatic species collected from Lake Liddell, aquifers beneath BPS site and nearby potable water wells, and ecological receptors including freshwater ecological receptors in Lake Liddell and the Hunter River, and the local gullies & creeks noted from previous investigations as being defined as intermittent drainage lines which feed into these larger receptors of which most form part of the site Water Management System and have not been considered further herein. ***Temporal Limits****:* The temporal boundaries for the BPS assessment are limited to the dates of fieldworks identified in the ES proposed schedule due to the timetable specified by AGLM, during winter daylight hours. Seasonal fluctuations in the groundwater table may be considered by reviewing groundwater parameters from previous reports and/ or imposing a monitoring program for 12 months post assessment works, dependant upon the on-site and off-site groundwater concentration findings. ***The Sampling Unit*** *for BPS on which estimates shall be made shall include:* *Soil: 121 x soil bores where all 121 shall be converted into GW monitoring wells, 51 x test pits, plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity (sample specific analyte selection to be specified in detailed SAQP to follow)., *GW: sampling 87 x existing and 121 newly installed GW monitoring wells, plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow).	

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Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
		SW: collection of 32 x surface water samples, plus field QC samples (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). *Sediments: collection of 68 sediment samples, plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). *Background Samples: 4 x soil bores where all 4 shall be converted into GW monitoring wells, 6 x test pits, plus field QC samples, GW: sampling 23 x existing and 4 newly installed GW monitoring wells, plus field QC samples,* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, PCB's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). Refer to the analytical programme in Section 14 of the SAQP.	
1. Define the target population of interest (such as landuse & receptors) & its relevant spatial boundaries, 2. Define what constitutes a sampling unit, 3. Specify temporal boundaries and other practical constraints associated with sample/ data collection, 4. Specify the smallest unit on which decisions or estimates will be made.	DQO Overlap. 1. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 2. Scope of the project (domain or geographical locale). NB. Reference to ES documents acceptable.	***Liddell Lake (LL)*** ***Spatial Boundary***: The total surface area of LL is approx.1100 hectares and is up to 32m deep (Lake Liddell Hydrodynamic Modelling, Worley Parsons, 2009). The previous ERM (2014) report identified 23 known Areas of Environmental Concerns (AEC's). Lake Liddell is situated approx. 1.5km to the north-east of the BPS Block and is adjacent to LPS to the east, north and south where the approx. coordinates of LPS are 309693 m East and 6416597 m South. A site location plan is provided by ERM Stage 2 ESA (Jan, 2014) Ref 0224193RP01 as Figure 1 of Annex A. *The baseline assessment of Lake Liddell includes sediments, surface and deeper waters and edible aquatic species as follows:* - *Sediments by surface collection methods (manual piston corer for depths <20m, small gravity piston corer for depths > 20m).*	To be confirmed, where applicable.

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
		- *The depth of discrete surface water samples at target depths from 0.2m above the lake bottom.* - Angling (Australian Bass), Fyke Netting (Carp, Yabbies) and Seine Nets/ Baited Traps (Yabbies) and eels. ***Practical Constraints (Sampling)****: Sampling during significant rain events could bias sampling. Recreational users, weather and lake conditions not being optimal for sampling over water. Contaminated sediments may be disturbed and/ or mobilised during sampling activities, though management measures shall be undertaken to control any disturbances.* ***Landuse****: commercial & industrial, recreational.* ***Sensitive Receptors****: indoor & outdoor human health receptors (industrial on-site and off-site users), intrusive maintenance workers (on-site and off-site), residential receptors and potential groundwater users in the vicinity of the site, recreational users of Lake Liddell, aquifers beneath BPS site and nearby potable water wells, and ecological receptors including freshwater ecological receptors in Lake Liddell and the Hunter River, and the local gullies & creeks noted from previous investigations as being defined as intermittent drainage lines which feed into these larger receptors of which most form part of the site Water Management System and have not been considered further herein.* ***Temporal Limits****: The temporal boundaries for the LL assessment are limited to the dates of fieldworks identified in the ES proposed schedule (Proposal document P15155 - May 2015, Appendix B) due to the timetable specified by AGLM, during winter daylight hours. Water from Lake Liddell is periodically discharged to manage salinity and water levels, noting that the discharge point is located at the dam wall and discharges flow via Bayswater Creek to the Hunter River approx. 13km downstream.* ***The Sampling Unit*** *for LL on which estimates shall be made shall include:* *Sediments: collection of lake sediment samples from 25 locations, plus field QC samples.* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's (sample specific analyte selection to be specified in detailed SAQP to follow). *The depth intervals for sample collection to be advised by the sub-contracting.*	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
		SW: sampling 25 x water column samples, plus field QC samples, (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, Salinity, Nutrients (sample specific analyte selection to be specified in detailed SAQP to follow). *The depth intervals for sample collection to be advised by the sub-contracting expert.* *Edible aquatic species: collected from 4 locations (target is to collect 3 samples of 100g from each species), plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, (sample specific analyte selection to be specified in detailed SAQP to follow). *Background Samples: N/A.* Refer to the analytical programme in Section 8 of the SAQP.	
1. Define the target population of interest (such as landuse & receptors) & its relevant spatial boundaries, 2. Define what constitutes a sampling unit, 3. Specify temporal boundaries and other practical constraints associated with sample/ data collection, 4. Specify the smallest unit on which decisions or estimates will be made.	DQO Overlap. 1. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 2. Scope of the project (domain or geographical locale). NB. Reference to ES documents acceptable.	***Tomago Development Site (TDS)*** ***Spatial Boundary***: TDS is a greenfield non-operational site with a total area of (to be advised by AGLM in hectares). There have been no Areas of Environmental Concern (AEC) identified in communicating with AGLM. The approx. coordinates of TDS are (to be advised by AGLM). A site location plan is to be provided by to AGLM *The baseline assessment within the operational area includes soils and groundwaters as follows:* - *The maximum depth of soil sampling shall be 3.0m m BGL or until clean natural material/ bedrock is encountered.* - *The maximum depth of groundwater monitoring wells shall be 6.0 m BGL.* ***Practical Constraints (Sampling)****: Dense grasses and overgrown areas where these exist. Slashing of grasses may be required for access purposes, but trees will be retained wherever possible. Approval by AGLM is required when any significant trees are to be removed for access purposes We have currently not allowed for grass slashing..* ***Landuse****: commercial & industrial.*	To be confirmed, where applicable.

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 4. Define the Boundaries of the Study Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected (NSW DEC, 2006)			
		***Sensitive Receptors**: potential groundwater users in the vicinity of the site, aquifers beneath TDS site and potential potable water wells, and ecological receptors including brackish water ecological receptors in the Hunter River and adjacent wetlands (mangroves).* ***Temporal Limits**: The temporal boundaries for the TDS assessment are limited to the dates of fieldworks identified in the ES proposed schedule (proposal document P15155 - May 2015, Appendix B) due to the timetable specified by AGLM, during winter daylight hours. Seasonal fluctuations in the groundwater table may be considered by reviewing groundwater parameters from previous reports and/ or imposing a monitoring program for 12 months post assessment works depending upon the on-site and off-site groundwater concentration findings.* ***The Sampling Unit** for TDS on which estimates shall be made shall include:* *Soil: 10 x soil bores where all 10 shall be converted into GW monitoring wells, 10 x test pits, plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, Salinity, Fluoride, SVOC's (sample specific analyte selection to be specified in detailed SAQP to follow). *Note: Fluoride in the scope of works does not mean total fluoride by the soil fusion method.* *GW: sampling 10 newly installed GW monitoring wells, plus field QC samples* (ie. field duplicates, field triplicates, field blanks), Analytes include: Metals, Metalloids, TRH, BTEX, PAH's, VOC's, Salinity, Fluoride, SVOC's (sample specific analyte selection to be specified in detailed SAQP to follow). *SW: N/A.* *Sediments: N/A.* *Background Samples: N/A* Refer to the analytical programme in Section 14 of the SAQP.	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 5. Develop a Decision Rule (Develop the Analytical Approach) Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions. (NSW DEC, 2006)			
1. Specify appropriate population parameters (ie. landuse & receptors) for making decisions or estimates, 2. For decision problems, choose a workable Action Level and generate an "If...then...else" decision rule which involves it, 3. For estimation problems, specify the estimator and the estimation procedure.	DQO Overlap 1. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 2. Scope of the project (domain or geographical locale), 3. Outline the experimental design, including sampling design & rationale, sampling frequencies, matrices and measurement parameter of interest. NB. Reference to ES documents acceptable.	***Estimation Problems*** The decision rules for this pre-existing contamination assessment are as follows: 1. If concentrations of COPC are identified that are greater than the adopted assessment criteria in Site soils, groundwater, sediments, surface water, or sediments further assessment and/ or management option shall be assessed in order to ensure the Sites are or can be made suitable for the continued land uses stipulated by AGLM and to ensure no significant risk is posed to the environment, 2. If concentrations of COPC are identified that exceed the adopted assessment criteria in groundwater, the potential for off-site migration or for migration to a sensitive receptor will be considered and further works may need to be undertaken, 3. If aesthetic issues are identified this shall require consideration in assessing the management options required for the relevant areas of the Sites to be suitable for open space / recreational use. In general, aesthetic issues will not be assessed in operational parts of LPS or BPS. 4. It should be noted that the above decision rules are considered to be preliminary and depending on the conditions identified at the Sites during the field works, the decision rules may be revised. ***Assessment Criteria*** Soils: NEPM 1999 (Amendment 2013) schedule B1 HIL-D (commercial & industrial), HIL-C (public open space), HIL-C (applied to non-operational areas considered to present a more sensitive land use category) as per ERM reports, ecological investigation/ screening levels (EIL's/ ESL's) as applicable. It is noted that laboratory analysis of pH & CEC is required to establish site specific EIL's/ ESL's, and an assessment of background conditions. Health Screening Levels for vapour intrusion and direct soil contact HSL-D (commercial & industrial) and HSL for vapour intrusion and direct soil contact intrusive maintenance worker (shallow trench).	To be confirmed, where applicable

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 5. Develop a Decision Rule (Develop the Analytical Approach) Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions. (NSW DEC, 2006)			
		Groundwater & Surface Waters: NEPM1999 (Amendment 2013) schedule B1 Guideline on Investigation Levels for Soil & Groundwater which reference the following guidance: ANZECC/ ARMCANZ (2000) Trigger Values Fresh Water & level of protection 95% species and level of protection 99% species (bioaccumulation mercury & selenium); NHMRC & NRMMC (2011) Australian Drinking Water Quality Management Strategy; CRC Care Technical Report No.10 Health Screening Levels for Petroleum Hydrocarbons in Soil & Groundwater (2011); Health Screening Levels for vapour intrusion HSL-D (commercial & industrial) and HSL for vapour intrusion intrusive maintenance worker (shallow trench) shall continue to be adopted as per previous ERM assessments. NHMRC (2008) Guidelines for Managing Risks in Recreational Waters (note these shall be applied with reference to NHMRC and NRMMC 2011 referenced above). In the absence of an Australian endorsed assessment criteria for PFOS, a health screening value of 0.3ug/l for PFOS in groundwater has been adopted as proposed by UK Health Protection Agency UKHPA (2009) and the Minnesota Department of Health MDH (2011).. Sediments: ANZECC/ ARMCANZ (2000) Fresh and Marine Water Quality - Interim Sediment Quality Guidelines (ISQG's), or equivalent Commonwealth of Australia (2009) National Assessment Guidelines for Dredging, and The Handbook for Sediment Quality Assessment (Simpson et al. (2005). Edible Aquatic Species: NSW Health (2001) Metal and other contaminants by reference to Contamination of Major NSW Fish Species Available for Human Consumption, Australian and New Zealand Food Standards Code - standard 1.4.1 Contaminants and Natural Toxicants and Standard 1.4.2 maximum Residue limits. ES will include all contaminants of concern listed in the Tender documentation and will need to discuss other potential contaminants od concern which have been subsequently raised in this DQO assessment including VOC's AFF, asbestos, and pH.	

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 6. Specify Acceptable Limits on Decision Errors (Specify Performance or Acceptance Criteria) Define the decision maker's tolerable decision error rates based on a consideration of consideration of the consequences of making an incorrect decision (NSW DEC, 2006)			
1. For decision problems, specify the decision rule as a statistical hypothesis test, examine consequences of making incorrect decisions from the test, and place acceptable limits on the likelihood of making decision errors, 2. For estimation problems, specify acceptable limits on estimation uncertainty.	DQO Overlap. 1. Hypothesis test, 2. Expected measurements, 3. ARAR's or other appropriate stds, 4. Assessment tools (technical audits), 5. Work schedule & required reports, 6. Decision(s), population parameter of interest, action level, summary statistics & acceptable limits on decision errors, 7. Scope of the project (domain or geographical locale), NB. Reference to ES documents acceptable.	The acceptable limits on decision errors to be applied and the manner of addressing possible decision errors have been developed based on Data Quality Indicators (DQI's) of precision, accuracy, representativeness, comparability, completeness, and sensitivity (known as PARCCS) and which shall be defined in detail (application, frequency, acceptance criteria, and assessment) as part of the detailed SAQP in Step 7 of the DQO planning process (ie. the next step). The potential for significant decision errors are to be minimised by: 1. Completing a robust DQI program for field and laboratory QA/QC with assessment of data and information whereby there shall be a probability that 95% of data shall satisfy DQI's, and therefore a limit on the decision error shall be 5% that a conclusion maybe incorrect, 2. Assessing whether sampling and analytical density for the purposes of the assessment has been applied, 3. That representative sampling methodologies have been applied by appropriately trained and experienced field personnel in appropriate environmental weather conditions and 4. Ensuring that the criteria set for the assessment works are appropriate for the proposed use of the Sites and, where relevant for protection of the environment and for protection of users of Lake Liddell, incusing people who consume aquatic species collected from Lake Liddell.	To be confirmed, where applicable.

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 7. Optimise the Design for Obtaining Data (Develop the detailed plan for obtaining data) Evaluate information from the previous steps and generate data collection designs. Choose the most resource-effective design that meets all DQOs. (NSW DEC, 2006)			
1. Complete all information & outputs generated in Steps 1-6, 2. Use this information to identify alternative sampling & analysis designs that are appropriate for your intended use, 3. Select & document a design that will yield data that will best achieve your performance or acceptance criteria.	DQO Overlap. 1. Itemise information & records in the data package, including report format & requirements for storage, etc, 2. Outline the experimental design, including sampling design & rationale, sampling frequencies, matrices and measurement parameter of interest, 3, Sample collection method & approach, 4. Identify analytical methods & equipment for the study, including method performance requirements, 5. Define the criteria for the use of non-measurement data such as data that originates from databases or literature, 6. Outline the data management scheme including the path & storage of the data & the data record-keeping system. Identify data handling equipment & procedures used to process, compile & analyse the data, 7. Describe the assessment activities needed for this project, 8. State the criteria used to accept or reject the data based on quality,	*The SAQP has been designed to ensure that the problems identified in the Step 1 of the DQO planning process can be solved within the time, budget, available resources and constraints of the project. The investigation program shall ensure minimise sample or measurement errors.* *The purpose of this step is to identify a resource effective field investigation sampling design that generates data that are expected to satisfy the DQI parameters and give confidence to the chosen decision(s). The outputs of this final DQO step is the sampling design that shall guide development of the field sampling and analysis plan. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.* *Separate Site specific detailed SAQP's shall be prepared for all four Sites (including DQI criteria to assess field & laboratory data quality: PARCCS). The separate SAQP documents shall specifically include, but not be limited to the following content:* 1. Methodology for identifying pre-existing contamination, 2. Sampling locations determined by ES employing professional judgement and where resampling of groundwater from monitoring wells installed by ERM has occurred, as shown on relevant drawings that will be endorsed by the AGLM Technical Advisor prior to commencement of the sampling program. 3. Identify the field sampling teams including backup team on standby, 4. Procedures for the field teams to maintain excellent records (borelogs, monitoring wells, qualitative sample observations for recording evidence to be used to derive the opinion on whether pre-existing contamination exists at any of the Sites), 5. Document the chain of command/ communication process from Project Director through to field & office personnel and client (noting that communication is very important as it may trigger the need to report contamination), 6. Detailed project schedule to coordinate field activities and resources,	To be confirmed, where applicable.

DQO Steps USEPA QA/G – (Feb 2006)	QA Project Plan USEPA QA/R5 (March 20012)[Modified]	Environmental Strategies DQO Planning	Deviations (Completed Post Assessment)
Step 7. Optimise the Design for Obtaining Data (Develop the detailed plan for obtaining data) Evaluate information from the previous steps and generate data collection designs. Choose the most resource-effective design that meets all DQOs. (NSW DEC, 2006)			
	9. Describe how results will be evaluated to determine if performance criteria have been satisfied. NB. Reference to ES documents acceptable.	7. Weekly progress reports to provide locations of the following week's sampling plan to allow for future site access on an ongoing basis for the duration of the site works schedule, 8. Describe the use of field tablets for use in capturing real-time field record entry and integrated with GPS tracking & COC forms, 9. Provision for pre-entered sample ID's on COC's & field templates to eliminate field errors and ensure ready interchange of data from field to office environments, 10. Provision of purpose built field vehicles equipped with refrigerators, calibration standards and fragile field equipment, for immediate retrieval to ensure efficiency of sampling & quality, 11. Provision for GPS embedded into site photographs for each sample location, and 12. Real-time review/ spot audits of COC, SRN, lab reports as they generated, sampling practices (as per Project QA Plan).	

Glossary: ARAR = Applicable or Relevant & Appropriate Requirements.

Additional Project QA Plan Requirements to be defined

A. Project management
1. Title & Approval Sheet,
2. Table of Contents: document control format,
3. Special training certification: identify special training that personnel shall require.

Data Generation & Acquisition

1. Sample Handling & Custody: describe the provisions for sample labelling, shipment, COC forms, procedures for transferring & maintaining custody of samples,
2. Inspection/ Acceptance of Supplies & Consumables: define how & by whom the sampling supplies & other consumables shall be accepted for use in the project.

Assessment & Oversight

1. Reports to Management: identify the frequency, content and distribution of reports issued to keep management informed.

Data Validation & Usability

1. Nil: no additional requirements that have no already been addressed by the DQO Process.

3 Quality Assurance and Quality Control

3.1 Data Quality Indicators

To assess the achievement of the project DQO, data quality indicators (DQIs), precision, accuracy, representativeness, comparability and completeness, are employed. The DQIs are defined as follows:

- **Precision** is a measure of the agreement between duplicate or replicate samples.
- **Accuracy** is a measure of the agreement between an experimental determination and the true values of the parameter being measured.
- **Representativeness** is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical constituent in the sample of each environmental medium.
- **Comparability** is a qualitative assessment made to express the confidence with which one data set may be compared with another.
- **Completeness** is a quantitative measure defined as the percentage of total measurements made that are judged to be valid compared to the total number of measurements that were proposed to be made.
- **Sensitivity** refers to the capability of a method or instrument to detect a given analyte at a given concentration and reliably quantify the analyte at that concentration.

DQIs are used to assess the achievement of both field and laboratory procedures, in accordance with the requirements of NSW DECC (2006) and NEPC (2013).

The field QA/QC program set out in this SAQP requires fieldwork to be conducted in accordance with the requirements of NEPC (2013), Australian Standard AS4482.1-2005 to measure the precision of the field and laboratory analyses and to determine the accuracy of the analytical results. All samples will be analysed by NATA accredited laboratories. Field QA will include compliance with appropriate standard operating procedures.

The laboratory QA/QC program set out in this SAQP requires chemical analyses to be conducted by laboratories in accordance with the registration of analytical methods provided by the National Association of Testing Authorities Australia (NATA).

Field QC samples will be collected and analysed by commercial laboratories at the following frequencies:

Precision

- Field duplicates ≥ 5%
- Inter-laboratory duplicates ≥ 5%
- Laboratory duplicates ≥ 10%

Accuracy

- Surrogate spikes All organics by GC
- Matrix spikes ≥ 1/media type
- Laboratory control samples ≥ 1/lab batch

Representativeness

- Rinsate samples ≥ 1/field batch
- Trip blanks ≥ 1/field batch (volatiles)
- Trip spikes ≥ 1/field batch (volatiles)
- Laboratory blanks ≥ 1/lab batch

The QA/QC program will also include an assessment of comparability and completeness. No additional samples will be collected for these quality attributes, rather their assessment will focus on consideration of relevant field and laboratory factors, in accordance with the requirements of NSW DECC (2006) and NEPC (2013).

Evaluation of the field DQIs compared to the DQOs will be completed as follows:

Precision A quantitative measure of the variability (or reproducibility) of data		
Field Considerations	**Laboratory Considerations**	**Comments**
SOPs appropriate and complied with	Analysis of: • laboratory and Interlaboratory duplicates • field duplicates • laboratory-prepared volatile trip spikes	Measured by the coefficient of variance or standard deviation of the mean or by RPDs Field duplicates measure field and laboratory precision Laboratory duplicates measure analytical precision

Accuracy (bias) A quantitative measure of the closeness of reported data to the true value		
Field Considerations	**Laboratory Considerations**	**Comments**
SOPs appropriate and complied with	Analysis of: • trip blanks • rinsate blanks • reagent blanks • method blanks • matrix spikes • matrix spike duplicates • surrogate spikes • reference materials • laboratory control samples • laboratory-prepared spikes	Bias introduced: • by chemicals during handling or transport • from contaminated equipment • from contaminated reagents • during laboratory analysis • during laboratory preparation and analysis (may be high or low) • precision of preparation and analytical method

Representativeness The confidence (expressed qualitatively) that data are representative of each media present on the site		
Field Considerations	**Laboratory Considerations**	**Comments**
Appropriate media sampled according to SAQP All media identified in SAQP sampled	All samples analysed according to SAQP Rinsate samples indicate that decontamination procedures adequate. The frequency of laboratory blanks acceptable and the results were within specified ranges.	Samples must be collected to reflect the characteristics of each media Sample analysis must reflect properties of field samples Homogeneity of the samples Appropriate collection, handling, storage and preservation Detection of laboratory artefacts, e.g. contamination blanks

Completeness A measure of the amount of useable data (expressed as %) from a data collection activity		
Field Considerations	**Laboratory Considerations**	**Comments**
All locations sampled All samples collected (from grid and at depth) SOPs appropriate and complied with Experienced sampler Documentation correct	All samples analysed according to SAQP All analytes analysed according to SAQP Appropriate methods and PQLs Sample documentation complete Sample holding times complied with	The required percentage completeness should be specified in the SAQP. All required data must be obtained for critical samples and chemicals of concern. Incompleteness is influenced by: • field performance problems (access problems, difficulties on site, damage, …) • laboratory performance problems (matrix interference, invalid holding times, …) • matrix problems

Comparability The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event		
Field Considerations	**Laboratory Considerations**	**Comments**
Same SOPs used on each occasion	Sample analytical methods used (including clean-up)	Same approach to sampling (SOPs, holding times…)

Comparability The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event		
Field Considerations	**Laboratory Considerations**	**Comments**
Experienced sampler Climatic conditions (temperature, rainfall, wind, …) Same types of samples collected (filtered, size fractions, ...)	Sample PQLs (justify/ quantify if different) Same laboratories (justify/ quantify if different) Same units (justify/quantify if different).	Quantify influence from climatic or physical conditions Samples collected, preserved, handled in same manner (filtered, same containers)

Sensitivity Capability of a method or instrument to detect a given analyte at a given concentration		
Field Considerations	**Laboratory Considerations**	**Comments**
SOPs appropriate and complied with and correct sample preservation employed	NATA accreditation of the laboratory for the analyses requested. Adoption of the appropriate analytical methodology. Appropriate detection levels requested to meet the requirements of the assessment criteria	Laboratory to confirm NATA accreditation. Laboratory to state methodologies used for analyses on report certificates. Laboratory limits of reporting (LOR), the effective detection limits of the methodologies employed to be stated on the report certificates and checked as being lower than the respective acceptance criteria for the analyte/s.

The acceptable limits for soil and groundwater are as follows:

- %RPD for laboratory duplicates for Total Recoverable Hydrocarbons (TRH) and Benzene, Toluene, Ethylbenzene and Xylene (BTEX) analysis is less than 60%.
- Recovery of matrix spikes and surrogate spikes is as per the laboratory's Quality Assurance targets accepted under their National Association of Testing Authorities (NATA) accreditation.
- Trip Spike recoveries are acceptable when between 70-130% recovery. Between 60%-70% requires discussion on the potential error and acceptability of data. If trip spike recovery results are <60%, further discussions on data acceptability is required.

Precision is measured using either standard deviation (SD) or per cent Relative Percent Difference (%RPD). For the purpose of the SAQP RPD has been adopted. Replicate data for field duplicates of organics is expected to be as follows:

- RPD criteria of 50% or less, for concentrations > or = 10 times EQL;
- RPD criteria of 75% or less, for concentrations between 5 and 10 times the EQL; and
- RPD criteria of 100% or less, for concentrations < 5 times EQL.

Replicate data for field duplicates for inorganics, including metals is expected to be as follows:

- RPD criteria of 30% or less, for concentrations > or = 10 times EQL;
- RPD criteria of 75% or less, for concentrations between 5 and 10 times the EQL; and
- RPD criteria of 100% or less, for concentrations < 5 times EQL.

Where acceptable limits for field duplicates were not met, a discussion on the implications to the data will be provided.

4 Site Conditions

4.1 Site Description

The identification details for the Sites are provided in Table 4-1 and Table 4-2, below, which are sourced from the ERM reports (Oct 2013a, Oct 2013b). Lake Liddell was been included in the ERM report for Bayswater Power Station.

4.1.1 Bayswater Power Station

Table 4-1: Site Identification Details – Bayswater Power Station (includes Lake Liddell)

Site Characteristic	Detail		
Street Address	New England Highway, Muswellbrook		
Lot / DP	Lot 1 DP 113655 Lot 1 DP 234545 Lot 1 DP 252530 Lot 1 DP 369326 Lot 1 DP 574168 Lot 1 DP 616024 Lot 1 DP 616025 Lot 1 DP 658099 Lot 1 DP 738417 Lot 1 DP 774679 Lot 1 DP 774706 Lot 1 DP 986496 Lot 1 DP 1135603 Lot 1 DP 1142103 Lot 1 DP 1155775 Lot 1 DP 1158697 Lot 1 DP 1158700 Lot 1 DP 1175303 Lot 2 DP 113655 Lot 2 DP 247943 Lot 2 DP 327372 Lot 2 DP 574168 Lot 2 DP 628645 Lot 2 DP 774679 Lot 2 DP 774706 Lot 2 DP 986496 Lot 2 DP 1095515	Lot 2 DP 1167986 Lot 2 DP 1175303 Lot 3 DP 113655 Lot 3 DP 247943 Lot 3 DP 774681 Lot 3 DP 774706 Lot 3 DP 1171724 Lot 4 DP 113655 Lot 4 DP 247943 Lot 4 DP 774706 Lot 4 DP 1175271 Lot 5 DP 966589 Lot 5 DP 1175271 Lot 6 DP 247943 Lot 6 DP 966589 Lot 9 DP 247943 Lot 10 DP 700554 Lot 11 DP 247943 Lot 13 DP 247945 Lot 15 DP 247945 Lot 15 DP 848095 Lot 17 DP 752468 Lot 18 DP 752468 Lot 19 DP 752486 Lot 23 DP 225426 Lot 25 DP 225426	Lot 30 DP 752468 Lot 31 DP 752468 Lot 62 DP 752468 Lot 73 DP 752468 Lot 74 DP 752468 Lot 75 DP 752468 Lot 76 DP 752468 Lot 86 DP 752468 Lot 88 DP 752468 Lot 89 DP 752468 Lot 91 DP 752468 Lot 103 DP 752468 Lot 105 DP 752468 Lot 107 DP 547864 Lot 110 DP 625973 Lot 112 DP 1059007 Lot 120 DP 1174907 Lot 125 DP 752468 Lot 150 DP 752468 Lot 151 DP 752468 Lot 322 DP 625513 Lot 331 DP 752486 Lot 910 DP 1123501 Lot 1000 DP 1132937 Lot 2012 DP 1151790
Local Government Authority	Singleton, and Muswellbrook Shire Council		
Land Zoning	SP2 Infrastructure Zone (Muswellbrook LEP 2009) RU1 Rural Primary Production (Muswellbrook LEP 2009) Zone 1(a) Rural (Singleton LEP 1996) RU1 Primary Production (Draft Singleton LEP 2012)		
Site Area	8,300 ha		

Site Characteristic	Detail
Geographical Coordinates	307 144 m E 6 413 998 m S.
Proprietor	AGL Macquarie

4.1.2 Liddell power Station

Table 4-2: Site Identification Details – Liddell Power Station

Site Characteristic	Detail		
Street Address	New England Highway, Muswellbrook		
Lot / DP	Lot 1 DP135548 Lot 1 DP1to bTe 99669 Lot 1 DP214241 Lot 1 DP236869 Lot 1 DP238862 Lot 1 DP247944 Lot 1 DP434523 Lot 1 DP556370 Lot 1 DP574166 Lot 1 DP645240 Lot 1 DP790994 Lot 1 DP1095515 Lot 1 DP1104230 Lot 1 DP1106490 Lot 1 DP1126279 Lot 1 DP1135603 Lot 2 DP247944 Lot 2 DP556370 Lot 2 DP752486 Lot 2 DP774681 Lot 2 DP929149 Lot 2 DP966589 Lot 2 DP1022827 Lot 2 DP1095515 Lot 2 DP1135606 Lot 3 DP247944 Lot 3 DP252529 Lot 3 DP556370 Lot 3 DP752486 Lot 3 DP1105210 Lot 4 DP201211 Lot 4 DP238862 Lot 4 DP247944 Lot 4 DP252529 Lot 4 DP774680	Lot 6 DP238862 Lot 6 DP252529 Lot 6 DP258548 Lot 6 DP1140127 Lot 6 DP1175270 Lot 8 DP247944 Lot 8 DP250890 Lot 10 DP 250890 Lot 10 DP1105152 Lot 11 DP247944 Lot 11 DP250890 Lot 11 DP1105152 Lot 11 DP1151798 Lot 12 DP1151798 Lot 16 DP241179 Lot 17 DP241179 Lot 17 DP247944 Lot 18 DP241179 Lot 19 DP247944 Lot 18 DP752486 Lot 19 DP241179 Lot 19 DP247944 Lot 19 DP752468 Lot 20 DP241179 Lot 21 DP241179 Lot 22 DP241179 Lot 23 DP241179 Lot 23 DP752486 Lot 24 DP241179 Lot 24 DP752486 Lot 25 DP241179 Lot 25 DP752486 Lot 26 DP241179 Lot 27 DP241179 Lot 28 DP241179 Lot 28 DP752486	Lot 31 DP241179 Lot 31 DP255215 Lot 32 DP255215 Lot 33 DP241179 Lot 33 DP255215 Lot 34 DP241179 Lot 34 DP752486 Lot 35 DP255215 Lot 36 DP241179 Lot 36 DP255215 Lot 37 DP255215 Lot 38 DP241179 Lot 38 DP255215 Lot 39 DP241179 Lot 39 DP255215 Lot 40 DP241179 Lot 40 DP255215 Lot 41 DP241179 Lot 42 DP241179 Lot 43 DP241179 Lot 44 DP241179 Lot 45 DP241179 Lot 46 DP241179 Lot 74 DP752468 Lot 102 DP1053098 Lot 116 DP752486 Lot 125 DP752470 Lot 144 DP752486 Lot 145 DP752486 Lot 157 DP752486 Lot 160 DP752486 Lot 162 DP752486 Lot 163 DP752486 Lot 181 DP812852 Lot 313 DP752486 Lot 320 DP752486

Site Characteristic	Detail		
	Lot 5 DP247944 Lot 5 DP252529 Lot 5 DP1140127	Lot 29 DP241179 Lot 30 DP241179	Lot 322 DP861090 Lot 601 DP1019325
Local Government Authority	Muswellbrook Shire Council		
Land Zoning	SP2 Infrastructure Zone (Muswellbrook LEP 2009) RU1 Rural Primary Production (Muswellbrook LEP 2009)		
Site Area	1500 ha		
Geographical Coordinates	309693 m E 6146597 m S		
Proprietor	AGL Macquarie		

4.1.3 Tomago site

According to the RFT provided by AGLM, the Tomago development site is vacant land adjacent to the Tomago Aluminium Smelter, with a frontage to the Pacific highway at Tomago. No previous reports relating to the environmental condition of the Tomago site are available.

As part of the ES Scope of Works, a Phase 1 for the site at Tomago will be completed to identify areas of areas of environmental concern, chemicals of potential concern potential environmental media that may be impacted. These criteria will provide guidance for the SAQP for Phase Detailed Site Investigation.

4.2 Site Conditions

4.2.1 Land Use - Bayswater Power Station

- The site has been used as a large conventional coal-fired power station since 1986. Prior to that time, the site was used for grazing purposes.
- Bayswater Power Station comprises four coal-fired units.
- The site is composed of the following key features:
    - Bayswater Power Station and associated infrastructure;
    - Pikes Gully Ash Dam and other dams;
    - Ravensworth Rehabilitation Area;
    - Coal conveyors, unloaders and storage areas;
    - Landfills;
    - Buffer lands surrounding infrastructure that are for the most part undeveloped and are either vacant or are used for stock grazing; and
    - A 330 kV and 500 kV switching station.

4.2.2 Topography - Bayswater Power Station

The general fall of land on the Bayswater PS is towards the Hunter River in the south, and the regional topography of the area is characterized by undulating hills that give rise to high variability in slope directions across the Site.

The Bayswater PS operational area was identified to gently fall to the north with the main power block at an elevation of approximately 200 m above sea level, dropping to an elevation of approximately 170 m above sea level at the northern edge of the coal storage facility. Pikes Gully Ash Dam is at an elevation of approximately 170 m above sea level, with the down-

gradient Pikes Gully valley falling towards the east. The Ravensworth Rehabilitation Site lies at an elevation of 120 m above sea level, with the local topography highly disturbed by former mining operations.

4.2.3 Surrounding Land Uses – Bayswater Power Station

The surrounding land uses as reported within the ERM (Oct 2013a) ESA were as follows:

- Surrounding areas used mainly for mining purposes with some grazing, bushland, viticulture and thoroughbred horse stud farms in the region.
- Industrial uses in the area include Liddell Power Stations (approx. 4 km north-east of Bayswater PS) and coal mines surrounding Bayswater PS and at Ravensworth Rehabilitation Site.
- The closest residential centres are:
    - Muswellbrook, located 11 km north-west of Bayswater PS; and
    - Jerrys Plains Village, located 11 km to the south of Bayswater PS.

Singleton, located 25 km to south-east of Bayswater PS, and 12 km south-east from Ravensworth Rehabilitation Site, the point of operations closest to Singleton.

4.2.4 Land-Use Liddell Power Station

- The site has been used as a large conventional coal-fired power station since 1971.
- The site comprises four generating units.
- The site is composed of the following key features:
- Liddell Power Station's main power block, which includes electricity generating units, auxiliary fuel storage, water treatment plan and associated infrastructure, workshops and stores;
- Liddell Ash Dam with associated pipelines for ash slurry and return water;
- Coal storage area and conveyors;
- Landfills;
- 33 kV Switching Station;
- Hunter Valley Gas Turbines; and
- Buffer lands surrounding the infrastructure.

4.2.5 Topography – Liddell Power Station

The general fall of land in the area is towards the Hunter River in the south, and the regional topography of the area is characterized by undulating hills that give rise to high variability in slope direction across the Site.

The operational area of the site falls gently to the east. The main power block is cut into the side of a hill, the section of which exposes natural bedrock. The 33 kV Switching Station at the higher end of the slope lies at an elevation of approximately 176 m above sea level. It falls to the main power block at an elevation of approximately 145 m above sea level and reaches approximately 133 m above sea level at Lake Liddell. Evidence suggests that the site level at the boundary with Lake Liddell has been raised over time through in-filling.

4.2.6 Surrounding Land Uses – Liddell Power Station

The surrounding land uses as reported within the ERM (Oct 2013b) ESA were as follows:

- Surrounding areas used mainly for mining purposes with some grazing, bushland, viticulture and thoroughbred horse stud farms in the region.
- Industrial uses in the area include Bayswater Power Stations (approx. 4km south-west of Bayswater PS) and existing and former coal mines.
- The closest residential centres are:
    - Muswellbrook, located 11 km north-west of Bayswater PS; and

- Jerrys Plains Village, located 11 km to the south of Bayswater PS.

Singleton, located 25 km to south-east of Bayswater PS, and 12 km south-east from Ravensworth Rehabilitation Site.

4.2.7 Land-Use Lake Liddell

- Lake Liddell is a man-made lake created to provide a source of process / cooling water for the Liddell conventional coal-fired power station.
- Cooling water intake and discharge points, the dam wall and a recreation area at the northern shore of the lake;
- Near the power station access is restricted by line of buoys,
- The remainder of the lake is accessed by the public and is used for recreational purposes, with a dedicated recreational area situated on the northern shoreline,
- The public are known to collect and consume fish, eels and yabbies that inhabit the lake and to have access to sediments in the shallower parts of the lake and to waters except where access is restricted.

4.2.8 Land-Use Tomago

The Tomago site is not currently used for any purpose and is in effect a greenfield site. It is understood that the site is intended for future commercial/industrial development.

4.2.9 Surrounding Land Use Tomago

Surrounding land uses for the Tomago site include:

- South East - South, Tomago Aluminium smelter and surrounding land;
- South, commercial industrial precinct, Old Punt Road, further industrial land including Forgacs Shipyard and the Hunter River;
- North North West, the Pacific Highway (Raymond Terrace – Hexham), grazing land and the Hunter River;
- North, wooded land owned and or controlled by Tomago Aluminium, Hunter Water Corporation and the Crown.

5 Summary of Previous Environmental Investigations

The site history, site conditions and previous investigations have been sourced from historical investigations conducted by ERM on the site as follows:

- ERM (October 2013a) Bayswater Power Station, Preliminary Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0213879RP01_DRAFT Rev02.
- ERM (October 2013b) Liddell Power Station, Preliminary Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0213879RP02_DRAFT Rev02.
- ERM (January 2014a) Bayswater Power Station, Stage 2 Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0224193RP01.
- ERM (January 2014b) Liddell Power Station, Stage 2 Environmental Site Assessment. Macquarie Generation – Project Symphony. Ref 0224198RP02.

A summary of key findings from these reports is set out in **Section 2**, Step 1 of the DQO.

6 Geological Setting

6.1 Bayswater PS

As reported by ERM (Oct 2013), a range of regional geological conditions make-up the entire site, which is summarised below:

- **Bayswater Power Station** – The Site is located on the northern section of the Sydney Geological Basin and the 1:100,000 Hunter Coalfield geological map (Department of Mineral Resources – 1993) indicates the Bayswater Power Station is underlain by Permian age conglomerate, sandstone, siltstone and claystone of the marine-derived Maitland Group. Coal measures of Permian age underlie the site.
- **Pikes Gully Ash Dam –** The majority of the Pikes Gully Ash Dam is located on the Mulbring Siltstone of the Maitland Group. The Eastern most extent is located on the sandstone, siltstone and minor coal bands of the Saltwater Creek Formation of the Wittingham Coal Measures, Singleton Supergroup.
- **The Ravensworth Rehabilitation Site –** This site is underlain by the Jerrys Plain Subgroup, Archfield Sandstone and the Foybrook Formation within the Wittingham Coal Measures, which consist of sandstones, shales, mudstone, minor conglomerate and coal seams. This area occurs in a synclinal structure known as the Bayswater Syncline, and isolated basalt dykes or sills may occur within the stratigraphy of the general area.

  The surface geology of this site has been disturbed by mining operations. Much of the opencast mine workings at the Ravensworth Rehabilitation Site have been backfilled with mine spoil, made-up of fragments of mudstone, siltstone and medium to fine grained lithic sandstone mixed together, as well as coal from uneconomic seams. This coal is subject to spontaneous combustion, which has been identified at the site. Where mining has been completed in the area, approximately 60 to 80 metres of disturbed overburden or mine spoil overlies the Archerfield Sandstone which forms the base of opencast mine workings. There are also areas that have been backfilled with fly ash and coal preparation plant rejects.

Local soils and bedrock encountered during the drilling program on the Bayswater PS, as reported by ERM (Jan 2014a), are detailed in Table 6-1 below.

Table 6-1: Summary of Subsurface Conditions identified at the Bayswater PS.

Profile	Description
Hardstanding	Concrete generally in good condition.
Fill	Reworked silty clay, clay and/or gravel, brown or brown with orange or grey mottling, dry to moist, no-plastic, no odours or staining.
Silty Clay	Orange-brown with grey mottling and light brown with grey mottling, moist, shale or siltstone gravel inclusions (completely weathered).
Bedrock	Siltstone, shale or sandstone bedrock, brown becoming grey with depth, generally dry, fine grained.

6.2 Liddell PS

As reported by ERM (Oct 2013), the regional and local geological conditions are summarised below:

- The Muswellbrook 1:25,000 Geological Sheet 9033-II-N (NSW Department of Mineral Resources) indicated the Liddell Power Station and the areas adjacent to Lake Liddell to

the north to be underlain by Permian Age, Maitland Group, Mulbring siltstone consisting of dark-grey shale and siltstone.

- The Jerry Plains Geological Series Sheet 9033-11-S (edition 1) 1987 indicates the geology around the area adjacent to the south of Lake Liddell to consist of Permian Age, Singleton Super Group, Whittingham Coal Measures, Saltwater Creek formation comprising sandstone and siltstone with thin lenticular coaly bands and marine siltstone intercalated towards base.
- ERM (Oct 2013) reviewed Borelog Data from DLA Environmental (2011) which indicated the local geology beneath the northern stack area consisted of brown topsoil loam up to 0.25 m, underlain by light brown gravelly sands up to 2.2m, and then fractured rock; sandstone, limestone up to 4.2 m; fractured rock and sandstone limestone was encountered at 5.5m.
- The soil in the area is categorised as 'sodosol' (Atlas of Australian Soils 1:2,000,000 Map). Characteristics of these soils are high sodium contents, abrupt increases in clay content at depth, prone to crusting, unstable soil structure prone to erosion, with seasonally perched water tables.

Local soils and bedrock encountered during the drilling program on the site, as reported by ERM (Jan 2014b), have been detailed in Table 6-2 below.

Table 6-2: Summary of Subsurface Conditions identified at the Liddell PS.

Profile	Description
Hardstanding	Concrete or bitumen generally in good condition.
Fill	Reworked silty clay, clay and/or gravel, brown or brown with orange or grey mottling, dry to moist, non-plastic
Silty Clay	Orange-brown with grey mottling and light brown with grey mottling, moist, shale or siltstone gravel inclusions (weathered).
Bedrock	Siltstone, shale or sandstone bedrock, brown grading to grey with depth, generally dry, fine grained.

6.3 Tomago Site

Regional geological conditions under the Tomago site are summarised below:

- **Tomago** – The Site is located on the northern section of the 1:100,000 Newcastle geological map (Department of Mines – 1975) which indicates the Tomago site is underlain by Permian age shale, mudstone, sandstone, coal, tuff and clay of the Tomago Coal measures.

7 Hydrogeological Setting

7.1 Bayswater PS

As reported by ERM (Jan 2014a), the sedimentary rocks of the region are categorised as follows:

- Low permeability conglomerate, sandstone, siltstone and mudstone that comprise the majority of the Permian sediments.
- Low to moderately permeable coal seams, typically ranging in thickness from 2.5 m to 10 m, which are the prime water-bearing strata within the Permian sequence.
- Medium to highly permeable Quaternary alluvial sediments associated with the Bayswater Creek, Foy Creek and the Hunter River.

Regional groundwater flow is expected to be towards the Hunter River located to the south. Locally, variations in groundwater flow directions are probable and groundwater flow is expected to follow topography, i.e. northerly flow from Bayswater Power Station towards Lake Liddell, easterly flow at the Pikes Gully Ash Dam, Westerly flow at the landfill, westerly to north westerly at the brine concentrator decant basin, southerly flow at lime softening sludge lagoons. At the Ravensworth Rehabilitation Area, groundwater flow is towards the Hunter River.

During ERM's Stage 2 Investigation, groundwater was encountered at depths ranging from 0.35 m bgl to 43.126m Below Top of Casing (TOC). At the time of writing this report, Annexures B and E of the ERM Stage 2 report, which relate to the groundwater at the site, were not available to ES and have not been reviewed.

There is currently no recorded beneficial use of groundwater since the target geological formations are generally of low permeability and of poor salinity, being derived from marine or lacustrine deposits which contain remnant salinity. The exceptions are the fractured coal horizons which are more permeable than the other geological formations. There are numerous monitoring bores constructed in site and in surrounding properties.

7.2 Liddell PS

As reported by ERM (Jan 2014b) the sedimentary deposits of the region are categorised as follows:

- Low permeability conglomerate, sandstone, siltstone and mudstone that comprise the majority of the Permian sediments.
- Low to moderately permeable coal seams, typically ranging in thickness from 2.5 m to 10 m, which are the prime water bearing strata within the Permian sequence.
- Medium to highly permeable Quaternary alluvial sediments are associated with the Bayswater Creek, Foy Creek and the Hunter River.

Regional groundwater flow is expected to be towards the Hunter River located to the south. Locally, variations in groundwater flow directions are probable and groundwater flow is expected to follow topography, i.e. easterly to north-easterly groundwater flow from Liddell Power Station towards Lake Liddell.

During ERM's Stage 2 Investigation, groundwater was encountered at depths ranging from 0.54m bgl to 14.58. At the time of writing this report, Annexures B and E of the ERM Stage 2 report, which relate to the groundwater at the site, were not available to ES and have not been reviewed.

8 Contaminants of Potential Concern

Based on previous environmental investigation data and known historical site operations, the potential contaminants of potential concern (COPCs) set out below were identified.

8.1 Bayswater PS

- Heavy metals and metalloids (arsenic, boron, cadmium, chromium (Total), copper, lead, mercury (Total), nickel, selenium and zinc;
- Total Recoverable Hydrocarbons (TRH);
- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Volatile Organic Compounds (VOCs);
- Polychlorinated Biphenyls (PCBs);
- Aqueous Film Forming Foam (AFFF);
    - As Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)
- Salinity;
- pH;
- Nutrients (specifically nitrate, nitrite, ammonia and phosphorus); and
- Asbestos.

8.2 Liddell PS

- Heavy metals and metalloids (As, B, Cd, Cr (Total), Cu, Pb, Hg (Total), Ni, Se, Zn);
- TRH;
- BTEX;
- PAHs;
- VOCs;
- PCBs;
- AFFF;
    - As PFAS
- Salinity;
- pH;
- Nutrients (specifically nitrate, nitrite, ammonia and phosphorus); and
- Asbestos.

8.3 Lake Liddell

- Heavy metals and metalloids (As, B, Cd, Cr (Total), Cu, Pb, Hg (Total), Ni, Se, Zn);
- TRH;
- BTEX;
- PAHs;
- VOCs;
- Salinity;
- pH; and
- Nutrients (specifically nitrate, nitrite, ammonia and phosphorus).

8.4 Tomago

- Heavy metals and metalloids (As, Cd, Cr (Total), Cu, Pb, Hg (Total), Ni, Zn);
- TRH;
- BTEX;
- PAHs;
- VOCs;
- Semivolatile Organic Compounds (SVOCs);
- Fluoride;
- Salinity; and

- pH.

8.5 Chemicals of potential concern to be analysed

The COPC that will be analysed for soil, groundwater, surface water and sediments on the Bayswater and Liddell PS, in water and sediments from Lake Liddell and in soil and groundwater on the Tomago Site are detailed in Section 14.

9 Conceptual Site Model

Based on the available background information, site history and site inspection, the following conceptual site model has been developed. The areas of environmental concern (AEC) are sections of the site that have potentially been impacted by site activities, site conditions and/or specific features that could present an environmental concern with regards to potential contamination. The AEC are presented in Table 9-1 below.

Table 9-1: Areas of Environmental Concern (AEC) for Bayswater PS

Area of Concern	*Location*	*Suspected Issue*	*Result*
BA **Brine Concentrator Holding Pond**	700 m South of E section BPS	Receives waste water from cooling water treatment plants and Pikes Gully Ash Dam	High levels salinity, metals and biocides Overflows into Pikes Gulley Ash Dam? 3 Wells installed around pond No field indicators of impact noted Wells from 5.8 – 10 mbgl Media likely to be impacted: Surface water and sediment
BB **Brine Concentrator Decant Basin**	1.4 km south west main BPS	Receives highly saline waste water from brine concentration process	High levels of salinity, metals Interception curtain installed creating second pond Discharge to Plashett Reservoir via creek and GW 5 wells installed from 3-10 mbgl No field indicators of impact noted Salt crystals noted in one soil bore Media likely to be impacted: Surface water and sediment
BC **Fuel Oil Installation**	Southeast corner BPS	Large diesel ASTs and pipework 4 (in use 3)	Potential for HC impact GW>20m Well installed to 30m No HC impact noted Several soil bores indicated no sig HC impact Some metals Media likely to be impacted: soil and groundwater
BD **Vehicle Refuelling Depot**	North east of BPS adjacent to main store	Unleaded UST 21 kL Diesel UST 37 kL and bowsers of infrastructure with additional UST decommissioned in 2007, in situ.	Diesel UST failed pressure test 2009 Decommissioned EST filled with fly ash 4 UPSS wells 2010 No HC impact detected Sulfur odour noted Some metals elevated in GW Media likely to be impacted: soil and groundwater

Area of Concern	*Location*	*Suspected Issue*	*Result*
BE **Coal Storage Area**	35 ha in area on north side of BPS	Stormwater runoff and leachate from stockpile coal	Stormwater captured in retention ponds in northern portion of area No field observations of visual impacts or of odours Friable asbestos detected in soil at one location Metals in GW elevated Media likely to be impacted: Surface water, sediment, groundwater and soil
BF **Coal Unloader** **Rail Infrastructures** **Coal Transfer Lines**	Antiene Coal Unloader (Rail Coal Unloader – RCU) ---------- Ravensworth RCU ---------- Coal Transfer Lines (conveyers)	Current and historic bulk fuel storage and locomotive refuelling and maintenance ---------- Only occasionally used Locomotive maintenance Diesel releases from locomotive recorded ---------- Potential for oil leaks around gear boxes and other lubricated sections	No observations of impact noted in area BF Metals elevated as per other areas of site GW fresh to saline Antiene RCU GW to take Lake Liddell via Maidswater Creek Ravenswoth RCU GW to Hunter River via Bowmans Creek Coal transfer lines GW to Plashett Reservoir via Saltwater Creek Media likely to be impacted: Surface water, sediment, groundwater and soil
BG **Contaminated Water Treatment Plant**	North east section of operational area Consists of Sed basin with oil skimmer and secondary oil/water separator , into storage pond then into Tinkers Creek via weir	Oils, fuels, chemicals, coal and ash Oily residue on sides of Sed basin and light layer of LNAPL on water surface	No field impacts noted in soil or GW Metals elevated Sulfur odour noted in one GW well Media likely to be impacted: Surface water, sediment
BH **Cooling Water Treatment Plants**	Adjacent to cooling towers on east and west sides of plant	ASTs containing : - Anhydrous ammonia - Sulphuric acid - Sodium Hydroxide - Chlorine and Ferric Chloride	Previous leaks from ASTs recorded Metals elevated in soil and GW Discharge into Lake Liddell Media likely to be impacted: groundwater and soil
BI **Demineraliser Plant**	North east corner BPS 40 m W/NW of vehicle refuelling depot	ASTs: - Sulphuric Acid - Sodium Hydroxide - Ferric Chloride - Damage to bunds and corroded pipework	No impacts noted visual or odours Metals elevated in soil and GW Discharge into Lake Liddell via various surface water bodies Media likely to be impacted: groundwater and soil

Area of Concern	Location	Suspected Issue	Result
BJ **Former Contractor Staging Area**	30 ha 250 m South/South West of Freshwater Dam	Largely unused since BPS commissioned Two retention ponds southern portion of area Potential for fuels , solvents, cleaning agents , fill and asbestos	GW>15m Limited investigation No impact noted visual or odour Zn elevated in soil Media likely to be impacted: soil
BK **Large item assembly area**	8Ha Northwest of coal storage area and adjacent to Tinkers Creek	Largely unused since BPS commissioned Unsealed levelled using cut/fill Sed basin on NE of area Fuels and heavy metals from welding	GW generally > 10 m No impacts noted GW brackish, no metals analysis Soil all below SC Media likely to be impacted: Surface water, sediment
BL **Transformer Area**	Immediately west of main power block Split into two sections with admin buildings between	PCB removal program in 1990s Low level of PCBs may remain Previous leaks and failures reported especially 2A Generator transformer failure and fire in 1986	No impacts noted in field Some yellow crystals observed in soil from one bore Metals in GW Slightly elevated benzene in one location Media likely to be impacted: groundwater and soil
BM **Landfill**	1.3km south of BPS	Undefined footprint Unlined Received both operational and construction waste Potential for various hazardous wastes	No impact noted in field Metals elevated in soil and GW Minor detection of dichloromethane in GW Waste observed: Soil, steel, plastic, foam, timber, gravel, concrete Asbestos? Media likely to be impacted: groundwater and soil
BN **Lime Softening Plant (LSP)**	1.2km south of BPS	Gypsum and lime storage Acid Storage Ferric chloride storage Mechanical plant room Clarifiers x 2	No field impact noted , except HC odours in one location at 7.5mbgl HC above LOR but below SC in some soils PAH also detected above LOR in GW
BO **LSP Sludge Lagoons**	5 Lagoons over 10 ha south of BPS	Sludge contains calcium oxides, magnesium, hydroxide, other precipitates from water treatment from LPS	High EC No field impacts noted in soil or GW Metals , toluene and light chain TRH detected but <SC Media likely to be impacted: Surface water, sediment

Area of Concern	Location	Suspected Issue	Result
BP **Mobile Plant** **Workshop Refuelling**	Directly south of coal storage area	Fuels, lubricants and waste oils 9 kl waste oil sump	Significant surface staining noted on concrete No field impacts noted in soil of GW TRH impact in soil> ESL Metals >SC in GW Media likely to be impacted: groundwater and soil
BQ **Pike Gulley Ash Dam**	200m East/South East Of BPS 150 ha	Acids Fly Ash and bottom ash Asbestos Waste Oil / Fuels Boiler cleaning residues Fly ash filter bags Water treatment residues Metals	Potential ACM observed No other field impacts noted except sulphur odour in GW at one location Asbestos detected in large number of locations near pipelines Elevated metals in GW PRP in effect Media likely to be impacted: Surface water, sediment, groundwater and soil
BR **Ravensworth** **Rehabilitation Area**	8km East/ southeast of BPS Former Ravensworth No2 and portion of Ravensworth South Mines	Fly ash Mine spoils Salinity Heavy Metals Spon Com Difficult subsoil conditions due to mine spoil	Spon com noted No other field impacts observed in soil or GW Soil below SC BTEX and TRH detected – likely associated with coal and spon com PAH detected in GW likely from coal/ spam com Some metals elevated in GW Media likely to be impacted: groundwater and soil
BS **Low Pressure** **Pumping Station**	9.6km Southwest of BPS operations	Low concentrations of PCBs via pipework from operational areas	No field observations of impact noted No GW assessed No exceedances in soil Media likely to be impacted: groundwater and soil
BT **High Pressure Pumping Station**	8.6km Southwest of BPS operations	Receives water from low pressure pumping stations Hydrocarbon staining in pump house	No field observations of impact noted except for pump house Strong organic odour in GW Low levels of phenols detected in GW Elevated metals in GW Media likely to be impacted: groundwater and soil
BU **Main Store** **Dangerous Good Storage**	East edge of BPS	Various chemicals Acetone, turpentine, kerosene, sodium , hydroxide, hypochlorite, formaldehyde, ammonia Sump pumped out by contractor	No field observations of impact noted other than sulphur odours in GW Elevated metals in GW Media likely to be impacted: groundwater and soil

Area of Concern	*Location*	*Suspected Issue*	*Result*
BV **Power Block**	Main building BPS	Lubricating oils Chemical in w/shops Drains	No field observations of impact noted except dark stain in soil at location Investigation only around the perimeter due to operations Elevated metals in GW Media likely to be impacted: groundwater and soil
BW **Lake Liddell and surrounding Waters**		- Biocides and anti-scale - High temperature - Oils - Salts, metals, lime - O/W effluent - Overflow from ash dam - Stormwater	No field observations of impact noted in SW or Sed Elevated metals and PAHs in sed especially east of Liddell PS. TRH also No exceedances in SW Media likely to be impacted: Surface water, sediment
BX **Transgrid Switchyard**	South of LPS	PCBs Not owned by MacGen or subsequently by AGL MAC Outside of proposed Investigation area	No field impacts noted in soil of GW Metals > SC in GW Media likely to be impacted: groundwater and soil
BY **Buffer Lands**	Extant boundary areas of site	No significant known contamination issues No infrastructure	No field impacts noted in soil or GW Elevated metals in GW Media likely to be impacted: groundwater and soil

Table 9-2: Areas of Environmental Concern (AEC) for Liddell PS

Area	Location	Suspected Issue	Result
LA **Ammonia Plant**	100 m Southwest of main power block	Ammonia – historical leak of asbestos in building and soil	No field impact noted in soil or groundwater Elevated metals in GW Media likely to be impacted: groundwater and soil
LB **Ash Dam**	4 km West of main power block	1 Mm3 ash (fly and bottom) / annum Sand filter backwash treated sewage water Metals, Hydrocarbon Used filter bags Asbestos (old piping)	Asbestos in soil near disposal pipeline bench – numerous locations Metals in GW >SC PRP in effect 2014 Media likely to be impacted: Surface water, sediment, groundwater and soil
LC	Not noted in report or shown on plan	Unleaded and diesel USTs and infrastructure	HC odours noted during previous GW sampling

Area	Location	Suspected Issue	Result
Bulk Fuel Storage - Light Vehicle Refuelling Area		Diesel UST failed integrity testing 2013 Area is largely unsealed	No soil sampling by ERM Wells installed previously No LNAPL observed BTEXN, TRH C6-C10 , Metals all >SC Media likely to be impacted: groundwater and soil
LD Bulk Fuel Storage – Mobile Refuelling Area	Southwest of main power block and immediately west of coal storage facility	Former 100kl UST removed – infrastructure remains Existing self-contained AST – historic spill with soil impact removed (visual) GW not investigated Potential for leaking joints on dispensing lines Waist oil UST (east side of shed) Lubricant bay workshop heavy staining around drainage system	No field impact noted in soil (outside of staining previously noted) or GW TRH C10-C16, C16-34 >SC in soil Metals in GW > SC Media likely to be impacted: groundwater and soil
LE Bulk Fuel Storage -Bulk Oil Installation ASTs	Southeast of power block	4 active and 2 disused ASTs – historic leaks from pipework	Staining in several locations and HC odour in soil HC odour noted in GW wells NO LNAPL noted Soil – TRH C10-C16, C16-34 >SC GW – Benzene , Naphthalene metals > SC Media likely to be impacted: groundwater and soil
LF Bulk Fuel Storage - Waste Oil AST (Transformer Road) And Former Transformer Oil ASTs	Location not given in report	AST fed by collector systems from turbines Historic loss to ground in 2012 from overfilling AST and bund	No field impacts noted in soil GW not sampled TRH C16-34 in soil > SC Media likely to be impacted: groundwater and soil
LG Bulk Fuel Storage – Turbine Oil AST	North of main power block	Pipework in AST bunds showing signs of leaking	No field impacts noted in soil H2S odour noted in GW wells Metals > SL in GW Media likely to be impacted: groundwater and soil

Area	Location	Suspected Issue	Result
LH **Bulk Fuel Storage – Waste Oil ASTs (Liquid Alternative Fuels) and Emergency Generator AST**	Southeast position of main power block	3 x 55kl ASTs – staining noted in in-bund sumps	No field impacts noted in soil or GW Metals in GW > SC Media likely to be impacted: groundwater and soil
LI **Current Former Coal Storage Area**	Adjacent Lake Liddell	Oil Leaks from conveyor system Cord fines	No field impacts noted in soil, H2S odour in one location in GW Metals in GW > SC Media likely to be impacted: groundwater and soil
LJ **Dangerous Goods, Flammable Liquid Stores**	Northern boundary – main power block	Various chemicals – ethanol , acetone , methyl ethyl ketone, xylene, petrol in locked shed - Hypochlorite - Hydranzine Hydrate - Acrylic Acid - Ammonia - Tetrachloroethene - Chlorophenols - Potassium bromate Potential for PCBs in stored transformers	Hydrocarbon odour noted in soil at two locations H2S odour noted in one GW well TRH in soil > SC in one location Potential ACM detected in one location Metals >SC in GW
LK **Former Construction Workshop Storage**	Northwest of power block and west of water intake and pump station	Unknown	No field impact noted in soil GW not sampled from the AEC Media likely to be impacted: groundwater and soil
LL **Hunter Valley Gas Turbines**	Not stated	Numerous hydrocarbon releases	Staining sheen in drains HC odour in soil at one location HC odour in MW at two locations TRH > SC in soil at two locations BaP > SC in soil at two locations Benzene > SC in GW at two locations Metals in GW > SC Media likely to be impacted: groundwater and soil
LM **Machinery Graveyard**	South of exit road to gatehouse North of coal reclaimer bays	Unpaved Oils, Chemicals and Asbestos	No field impact noted in soil or GW Metals in GW >SC Media likely to be impacted: groundwater and soil
LN **Oil and Grit Trap**	On shoreline Lake Liddell	Receives runoff from operational areas	No field impact noted in soil of GW Metals in GW > SC

Area	Location	Suspected Issue	Result
			Media likely to be impacted: groundwater and soil
LO **Former Current Maintenance Stores Workshop Foam Generators and Unofficial Laydown Areas**	Various around site	Fuels , oils , solvents , fire – fighting foam	HC odour and soil staining in one location HC odour in GW at five locations Asbestos in one sample Benzene and Naphthalene > SC in one location Chlorinated hydrocarbon > SC in two locations Metals in GW >SC Media likely to be impacted: groundwater and soil
LP **Fill Material Site levelling and Shoreline Expansion**	East of LPS	Coal fines, ash , oil and grit sediment , other station waste	No field impacts noted in soil of GW BaP in soil at one location > SC Metals in GW >SC
LQ **Transformer Operations / Transformer Road**	Immediately west of Power Block	Transformer oils (up to 68kl per transformer)	No field impacts noted in soil or GW TRH in soil > SC at one location Metals in GW >SC Media likely to be impacted: groundwater and soil
LR **Transgrid Switchyard**	West of LPS	Transformer Oil (PCBs)	No field impacts noted in soil or GW Metals in GW>SC Media likely to be impacted: groundwater and soil
LS **Landfills**	South of main power block	Various wastes and asbestos	No field impacts noted in soil or GW Cu and ZN in soil > SC at one location Metals in GW>SC Media likely to be impacted: groundwater and soil
LT **Water Intake and Pump Stations**	Adjacent Lake Liddell	Oil discharges chlorine	Potential ACM in soil at one location No field impacts noted in soil or GW

Area	Location	Suspected Issue	Result
			Benzene > SC in GW at one location Metals in GW>SC Media likely to be impacted: groundwater and soil
LU **Water Treatment Plant**	Southwest Corner of Main Power Block	Ferric Chloride ASTs x 2 Some staining of drains	No field impacts noted in soil or GW Metals in GW>SC Media likely to be impacted: Surface water, sediment, groundwater and soil
LV **Buffer Land**	Extant Boundary Areas	Unknown	No field impacts noted in soil or GW Metals in GW>SC Media likely to be impacted: groundwater and soil

No conceptual site model has been developed for Lake Liddell and Tomago.

9.1.1 Sensitive Receptors

ERM (2013a, 2013b) noted the following sensitive receptors for both Bayswater PS and Liddell PS sites:

- Indoor and outdoor human health receptors in the form of industrial on- and off-site users;
- Intrusive maintenance workers both on- and off-site;
- Residential receptors and potential groundwater users in the vicinity of the site;
- Recreational users of Lake Liddell, including consumers of fish, eels and yabbies;
- Ecological receptors in aquifers beneath the site and nearby potable wells; and
- Ecological receptors, including freshwater ecological receptors in the local creeks, Lake Liddell, the Plashett Dam and the Hunter River.

9.1.2 Exposure Pathways

ERM (2013a, 2013b) noted the following potential exposure pathways human end ecological receptors for both Bayswater PS and Liddell PS sites:

- Transport via the site drainage system into surface waters;
- Leakage via the site drainage system into groundwater;
- Seepages of split chemicals/fuels direct to ground;
- Leaching of metals from soil into groundwater;
- Dermal contact with contaminated soils;
- Ingestion of contaminated soils/sediments;
- Inhalation of vapours related to impacted soils/groundwater (e.g. in presence of high concentrations of volatile contaminants or Non Aqueous Phase Liquids (NAPL);
- Seepage from the Ash Dam, and overflow/skimmer ponds into local creeks;
- Inhalation of asbestos fibres; and
- Groundwater flow into surface water bodies.

10 Data Gap Analysis

ES has completed a summary review of ERM's Stage 1 and draft Stage 2 reports for Bayswater and Liddell, which was included in the Tender Submission. The ES review has informed this SAQP, the scope of which is in general agreement with the scope of work set out in the AGLM RFT, subject to the following:

- ES has tendered on the scope of works outlined in the RFT. ES understands that AGLM has undertaken a review of the Scope of Works contained with the ES tender submission, and on the basis of engaging ES, approves ES to proceed on the basis of the tendered scope. Should Data Gaps be identified by ES during the course of the investigation, they will be documented, AGLM will be advised of them, and a review will be undertaken for any further works required. Any Data Gaps identified, will be documented in the weekly progress reports to AGL Macquarie.

11 Assessment Criteria

11.1 Soil

The selected soil investigation criteria for the Pre-existing Contamination investigation will be:

- NEPC (2013) *Health Investigation Levels (Soil HIL-D)* commercial/industrial land-use and *(Soil HIL-C)* public open space.
- NEPC (2013) Health Screening Levels (HSL-D) commercial/industrial and (HSL-C) public open space for soil.
- NEPC (2013) Management Limits for TPH fractions F1-F4 in soil;
- NEPC (2013) Ecological Screening Levels (*ESLs)* commercial/industrial land-use and, urban residential and open space. ESLs will not be applied to soils within operational parts of the Bayswater and Liddell PS sites.

11.2 Groundwater

The groundwater investigation criteria for the contamination study will be from:

- NEPC (2013) Groundwater Investigation Levels (GILs) Fresh Waters, based on;

  - ANZECC /ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh Water.

11.3 Sediment

The sediment investigation criteria will be from:

- Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) Interim Sediment Quality Guideline Trigger Values.

11.4 Surface Water

The surface water analytical results will be assessed against criteria from the following guidelines:

- Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) Australian New Zealand Australian and New Zealand Guidelines for Fresh and Marine Water Quality 95% Level of Protection Trigger Values for Fresh Water (Reference Table 3.4.1, ANZECC 2000 Trigger values for toxicants at alternative levels of protection which are applicable to slightly–moderately disturbed systems.)
- Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) Guidelines for primary contact recreational water quality and aesthetics.

11.5 Aquatic Fauna

Aquatic fauna will be collected and results from chemical analysis will be compared to criteria from:

- Australian and New Zealand Food Standards Code – Standard 1.4.1 – Contaminants and Natural Toxicants and Standard 1.4. – Maximum Residue Limits.

11.6 Aesthetics

In addition to reporting laboratory results against soil and groundwater assessment criteria, aesthetic considerations will be reported on borehole logs. Aesthetics relates to the generation of odours from the soil, discolouration of the soil as a result of contamination and the presence of anthropogenic materials, such as building and demolition wastes.

11.7 PFAS

PFAS results in soil, surface and groundwater will be assessed against:

- Western Australian Department of Environment Regulation - Interim Guideline on the Assessment of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): Contaminated Sites Guidelines; February 2016.
- Department of Defence (May 2015) Defence Contamination Directive #8 Interim Screening Criteria – Groundwater – Human Health – Drinking Water Quality Guideline

11.8 Rationale for and Appropriateness of the Selection of Criteria

11.8.1 Soil

The soil criteria adopted are based on the latest regulatory guidelines and current understanding of the assumed continued use of the site for commercial/industrial purposes with buffer lands used as recreational or open space, with potential sensitive ecological receptors. The soil criteria adopted are considered appropriate given the varied settings and use of the sites.

11.8.2 Groundwater

The groundwater criteria adopted are based on the latest regulatory guidelines and current understanding of the assumed continued use of the site for commercial/industrial purposes. Groundwater will also be assessed for potential for human consumption and for recreational activities. The groundwater criteria adopted are considered appropriate given the settings and use of the sites.

11.8.3 Sediment

The sediment criteria adopted are based on the latest regulatory guidelines. Sediments have unique physio-chemical properties and need to be assessed separately to soils. The sediment criteria adopted are considered appropriate given the number of potential sediment sinks, pond, creeks and the like, and the settings and use of the sites.

11.8.4 Surface Water

The surface criteria adopted is based on the latest regulatory guidelines. Surface waters which are commonly the receiving bodies for contamination are assessed on criteria based on the level of protection for aquatic species, rather than health considerations. The surface water criteria used are considered appropriate given the all of the surface water bodies being assessed are potential or actual receptors.

The waters of Lake Liddell are used for swimming and boating and the criteria for primary and secondary contact set out in ANZECC (2000) are appropriate.

11.8.5 PFAS

PFAS is an emerging contaminant with guidance changing rapidly with a growing understanding of the issue world-wide. Within the Australian setting there are currently no established national guidelines however since the commencement of the APECS for BPS and LPS the Western Australian Department of Environment Regulation has issued the Interim Guideline on the Assessment of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): Contaminated Sites Guidelines; February 2016. This Interim Guideline is widely recognised by regulators, including the NSW EPA as the most developed guidance currently available in Australia with regards to the site assessment of PFAS impacts in soil, surface and groundwater.

12 Proposed Sampling Programme

12.1 Overview

This section of the SAQP sets out the strategy for the sampling and analysis programme for the proposed investigation, including the guideline methods to be followed, the analytical schedule and the laboratories that will conduct the analyses. The programme has been developed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended in 2013 (NEPC, 2013), the NSW EPA Sampling Design Guidelines (NSW EPA, 1995) and the Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011).

12.2 Proposed Scope Under Initial Works Contract

Following review of the ERM reports, ES has developed a programme of sampling. The numbers of samples proposed within the ES sampling programme for each of the matrices within the respective AECs matches that from the Principal's Test Schedules appended to the AGLM RFT. It is noted that this programme of testing is more comprehensive than that provided on the Principal's Cost Schedules, provided within the same document. The sampling programme will be carried out in accordance with technical procedures outlined in this section. To the extent practicable, all fieldwork will be performed in accordance with the Australian Standard, Guide to the Sampling and Investigation of Potentially Contaminated Soil (AS4482.1/1997).

The locations of AEC are shown on Figures (*pending).*

12.2.1 Bayswater PS

Table 12-1 Proposed Sampling Programme – Bayswater PS

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
BA Brine Concentrator Holding Pond	700 m South of E section BPS	2	2	0	2	2
BB Brine Concentrator Decant Basin	1.4 km south west main BPS	2	2	0	2	2
BC Fuel Oil Installation	Southeast corner BPS	0	0	0	0	0
BD Vehicle Refuelling Depot	North east of BPS adjacent to main store	3	3	0	0	0

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
BE Coal Storage Area	35 ha in area on north side of BPS	6	6	0	3	6
BF Coal Unloader Rail Infrastructures Coal Transfer Lines	Antiene Coal Unloader (Rail Coal Unloader – RCU) ---------- Ravensworth RCU ---------- Coal Transfer Lines (conveyers)	1	1	0	0	0
BG Contaminated Water Treatment Plant	North east section of operational area Consists of Sed basin with oil skimmer and secondary oil/water separator , into storage pond then into Tinkers Creek via weir	10	10	0	2	2
BH Cooling Water Treatment Plants	Adjacent to cooling towers on east and west sides of plant	12	12	0	0	0
BI Demineraliser Plant	North east corner BPS 40 m W/NW of vehicle refuelling depot	3	3	0	0	0
BJ Former Contractor Staging Area	30 ha 250m South/South West of Freshwater Dam	0	0	0	0	0
BK Large item assembly area	8 ha Northwest of coal storage area and adjacent to Tinkers Creek	7	7	10	1	7
BL Transformer Area	Immediately west of main power block Split into two sections with admin buildings between	3	3	0	0	0
BM Landfill	1.3 km south of BPS	0	0	0	0	0
BN Lime Softening Plant (LSP)	1.2 km south of BPS	0	0	0	0	0

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
BO LSP Sludge Lagoons	5 Lagoons over 10 ha south of BPS	0	0	0	0	0
BP Mobile Plant Workshop Refuelling	Directly south of coal storage area	9	9	6	2	2
BQ Pike Gulley Ash Dam	200 m East/South East of BPS 150 ha	12	12	3	6	6
BR Ravensworth Rehabilitation Area	8 km East/ southeast of BPS Former Ravensworth No2 and portion of Ravensworth South Mines	5	5	0	0	0
BS Low Pressure Pumping Station	9.6 km Southwest of BPS operations	0	0	0	0	0
BT High Pressure Pumping Station	8.6 km Southwest of BPS operations	0	0	0	0	0
BU Main Store Dangerous Good Storage	East edge of BPS	0	0	0	0	0
BV Power Block	Main building BPS	6	6	0	2	0
BW Lake Liddell and surrounding Waters		0	0	0	0	0
BX Transgrid Switchyard	South of LPS	0	0	0	0	0
BY Buffer Lands	Extant boundary areas of site	40	40	34	13	64

The proposed locations of the samples for the Bayswater PS are shown on Figures (*pending).*

12.2.2 Liddell PS

Table 12-2: Proposed Sampling Programme – Liddell PS

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
LA Ammonia Plant	100 m Southwest of main power block	2	2	0	0	0
LB Ash Dam	4 km West of main power block	2	2	1	4	4
LC Bulk Fuel Storage - Light Vehicle Refuelling Area	Not noted in report or shown on plan	2	2	0	0	0
LD Bulk Fuel Storage – Mobile Refuelling Area	Southwest of main power block and immediately west of coal storage facility	2	2	0	0	0
LE Bulk Fuel Storage -Bulk Oil Installation ASTs	Southeast of power block	4	4	0	0	0
LF Bulk Fuel Storage - Waste Oil AST (Transformer Road) And Former Transformer Oil ASTs	Location not given in report	0	0	0	0	0
LG Bulk Fuel Storage – Turbine Oil AST	North of main power block	0	0	0	0	0
LH Bulk Fuel Storage – Waste Oil ASTs (Liquid Alternative Fuels) and Emergency Generator AST	Southeast position of main power block	0	0	0	0	0
LI	Adjacent Lake Liddell	17	17	8	13	16

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
Current Former Coal Storage Area						
LJ Dangerous Goods, Flammable Liquid Stores	Northern boundary – main power block	4	4	0	1	1
LK Former Construction Workshop Storage	Northwest of power block and west of water intake and pump station	3	3	0	0	0
LL Hunter Valley Gas Turbines	Not stated	7	4	0	2	2
LM Machinery Graveyard	South of exit road to gatehouse North of coal reclaimer bays	0	0	0	0	0
LN Oil and Grit Trap	On shoreline Lake Liddell	3	2	0	2	2
LO Former Current Maintenance Stores Workshop Foam Generators and Unofficial Laydown Areas	Various around site	3	2	0	0	0
LP Fill Material Site levelling and Shoreline Expansion	East of LPS	4	4	0	3	7
LQ Transformer Operations / Transformer Road	Immediately west of Power Block	3	3	0	2	2
LR Transgrid Switchyard	West of LPS	0	0	0	0	0
LS Landfills	South of main power block	3	3	0	0	0
LT Water Intake and Pump Stations	Adjacent Lake Liddell	0	0	0	0	0
LU	Southwest Corner of Main Power Block	0	0	0	0	0

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
Water Treatment Plant						
LV Buffer Land	Extant Boundary Areas	34	34	46	27	31

The proposed locations of the samples for the Liddell PS are shown on Figures (*pending).*

12.2.3 Lake Liddell

Table 12-3: Proposed Sampling Programme – Lake Liddell

Area of Concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
Lake Liddell	Entire Lake extent	0	0	0	55 (1m below surface and 0.05-0.2m above sediment surface)	55 (0-0.1m,0.15-0.25m, 0.4-0.5m at each location)

In addition to surface water and sediment samples there is a requirement to collect representative samples of edible aquatic animals (fish, eels and yabbies) from four locations within Lake Liddell. At each of the locations, three representative sample types will be collected. A total of fourteen (14) edible aquatic species samples, Including QC sample, will be collected from Lake Liddell.

The proposed locations of the samples for Lake Liddell are shown on Figures (*pending).*

12.2.4 Tomago

Table 12-4: Proposed Sampling Programme – Tomago

Area of concern	Location	Soil Bores	Groundwater Wells	Test Pits	Surface Water Sample Locations	Sediment Sample Locations
Tomago	Across extent of site	10	10	10	0	0

The locations of the samples for the Tomago site are shown on Figures provided in Volume 6 of the APECS.

12.3 Scope Changes Under 2nd Deed of Variation

Additional analysis required of:

- AFFF in soil and groundwater (at targeted AECs); and
- TOC in sediments (including Lake Liddell); and

- additional data handling and reporting as required for this additional analysis.

Water monitoring bores will not be drilled in any locations where ES considers (based on its expertise and review of technical information provided to date) that groundwater will only be intercepted at a depth of greater than 6m below ground level (bgl) (each referred to a Deep Groundwater Location); rather

- a soil bore only will be drilled at each Deep Groundwater Location.

Notwithstanding the above, ES will drill water monitoring bores in the Deep Groundwater Locations provided that:

- no water monitoring bores are to be drilled in any Deep Groundwater Location where ES considers (based on its expertise and review of technical information provided to date) that groundwater will be intercepted at a depth of greater than 15m; and
- ES is able to justify why it is appropriate to install a water monitoring bore at these depths in consideration of the following;
    - nature of activity carried out at each areas of environmental concern;
    - toxicity of chemicals of potential concern identified by ERM in groundwater;
    - concentrations of contaminants in groundwater or soils identified by ERM;
    - depth of groundwater;
    - whether groundwater was likely to discharge to ecologically significant area/s; and
    - whether the contamination was likely to be required to be remediated by the EPA,
    - (collectively, referred to as the **Permitted Deep Groundwater Locations**).

Due to concerns associated with the potential to encounter underground services, no test pits will be dug for any soil samples taken after 17 October 2015.

From 17 October 2015 all soil sampling will be done via soil bores.

12.4 Scope Changes Under 3rd Deed of Variation

12.4.1 BPS

12.4.1.1 AEC 52: Diesel Tanks

Sampling three existing ES wells (B_52_ESMW01, B_52_ESMW02, B_52_ESMW03)

Install two (2) new wells to the west of AEC 52 (as AEC 52 is on a hill, less coverage to the west at this stage towards AEC 54: CW Holding Pond).

- Sampling soils in new wells + GW post development.
    - Analysis for PFAS only

12.4.1.2 AEC 54: CW Holding Pond (West of potential source are AEC 52)

- Sampling of surface water (2 samples) and Sediment (2 samples) for PFAS
    - Analysis for PFAS only

12.4.1.3 AEC 51: Diesel Tank Overflow Pond

- Sampling two existing ES wells (B_51_ESMW01 and BC_MW05)
    - Analysis for PFAS only
- SD sampling from over flow pond (1 sample of each)
    - Analysis for PFAS only
- Sampling of soils in two (2) locations along water flow path towards AEC 18 (BPS Ash Dam).
    - Analysis for PFAS only

12.4.1.4 AEC 50: Sewage Ponds

Strong possibility of impact given its location down gradient of source area.

- Sampling of SD (there are 6 inter-connecting ponds - ES previously took 2x SD and 2x SW samples).
    - Analysis for PFAS only
        - No GW wells recommended here.

12.4.1.5 AEC 18: BPS Ash Dam

AEC 51 ultimately discharges into here.

- Sampling SD (2x SD samples).
    - Analysis for PFAS only

12.4.1.6 AEC 17: BPS Transformers

PFAS identified here previously - extent unknown (ERM identified it, ES installed new wells but did not sample for PFAS).

- Sampling two (2) existing ES wells.
    - Analysis for PFAS only

12.4.2 LPS

12.4.2.1 LPS Tank Farm and Surrounds

AEC 96: LPS Fuel Tanks, AEC 95: Interceptor Pits, AEC 94: Chemical Drain Outfall, AEC 93: Old Fuel Tanks E&F

- GW sampling of the following 19 existing wells:
    - (LE_MW01, LE_MW02, LE_MW03, LE_MW04, LE_MW05 LE_MW06, LE_MW07, LE_MW08, L_96_ESMW01, L_96_ESMW02, L_96_ESMW03b, L_96_ESMW04, L_96_ESMW05, L_96_ESMW06, LH_MW03, L_94_ESMW01, L_93_ESMW01, L_93_ESMW02, L_93_ESMW03).
        - Analysis for PFAS and VOCs.
- Shallow soil sampling of 14 locations in unpaved areas within AECs 93-96.
    - Analysis for PFAS only.

12.4.2.2 AEC 106 LPS Transformers

Where the foam generators are (need to get definite confirmation of the location of the generators).

- GW sampling of the following seven (7) existing wells:
    - (LQ_MW01, LQ_MW03, LQ_MW05, LQ_MW06, LQ_MW07, L_106_ESMW01, L_106_ESMW02).
        - Analysis for PFAS and VOCs.

12.4.2.3 Resampling of Groundwater Wells – PFAS Repeatability Analysis, AAA vs SGS

Testing, for comparison purposes of the repeatability achievable between analytical laboratories AAA and SGS for PFAS analysis, six (6) of the existing PFCs groundwater locations as follows:

- two (2) wells that previously reported no detectable PFCs (BAW_11_ESMW03, LAW_95_ESMW04);
- two (2) wells that previously reported low concentrations of PFCs (LO_MW_06, LO_MW_10); and
- two (2) wells that previously reported the highest concentrations of PFCs (LAW_95_ESMW02, LAW_95_ESMW02).

12.4.3 General Clarifications to the Proposed Scope

12.4.3.1 SAQP

AGLM have indicated that they are satisfied that the updated SAQP associated with the proposed scope be a brief document and will not require duplication of any items. ES have correspondingly reduce the proposed costing for this item within the schedule.

12.4.3.2 Quality Control

AGLM has noted that the number of duplicate and triplicate quality control (QC) samples proposed by ES to be collected and analysed is generally adequate for overall compliance with good industry practice, but because only a small number of soil and groundwater samples will be collected each day, there is the requirement to ensure each batch of soil, groundwater and surface water samples dispatched to the laboratory is accompanied by duplicate and triplicate samples. In addition, rinsate and trip blank samples are required to be collected each day of sampling and sent to the laboratory for analysis with each batch of field samples.

This requirement means that additional QC samples to the number originally proposed will be required.

Based on the above comment ES have amended the schedule of the proposal to reflect the expected number of additional QC samples to be collected based on a minimum frequency of daily collection of a full suite of QC samples being:

- Duplicates & Triplicates;
- Rinsate and trip blanks; and
- Trip spikes.

12.4.3.3 Soil Vapour Investigations

ES confirms that for the vapour investigation of AECs 5 and 102 the minimum recommended scope would be the same, as it is determined by the setting and use of the respective AECs, not the location.

12.4.3.4 Suspended Solids

Suspended solids in be addressed as per the requirements of the SAQP. This includes a suite of measures to be employed at each groundwater sampling location as follows:

- Use of low-flow sampling techniques for purging and sampling of groundwater wells, with the inlet positioned within the first metre of the screened section of the well, minimising potential for disturbance of settled sediments;

- Silica gel cleanup of samples for hydrocarbon analyses to remove naturally occurring polar hydrocarbons associated with organic matter in sediments;

Field filtering of groundwater samples for metals analyses through a 45 µm filter.

13 Sampling Methodology

Sampling and fieldworks are to be completed in compliance with the requirements of this section of the SAQP, unless:

- there is a justified reason for change and that change is documented at the time; and/or
- there is a need for compliance with any alterations to the works as detailed within such Deeds of Variation which may be executed during completion of the works, as detailed in Section 12.

13.1 Sampling Methodology Service Location

The locations of new bores and test pits will be will be determined using professional judgement by a senior ES scientist/engineer during a Site Walkover inspection and in consideration of the results reported by ERM. The locations will be marked on the surface of the ground using paint to indicate the bore or test pit number and either a wooden stake drive into the ground in non-operational areas or a suitable marker (e.g. a coloured paint) in operational areas, as required by the relevant site safety officer.

Prior to commencing intrusive investigations, diagrams of underground services from the dial before you dig (DBYD) database and AGLM records will be reviewed.

A certified underground service locator will be contracted to perform electromagnetic scanning and Ground Penetrating Radar (GPR) survey for the purpose of clearing drilling and test pit locations of infrastructure and subsurface structures.

Where any doubt relating to the possible presence of underground services occurs, a hand auger will be used to a depth of 1 m bgl.

In operational parts of Bayswater and Liddell PS, the locations of bores and groundwater monitoring wells will be required to be cleared with AGLM operational staff.

13.2 Completion of Boreholes & Test Pits

Boreholes will be drilled using truck-mounted drill rigs using split tube samplers in order to collect undisturbed samples.

Test pits will be excavated using long-reach backhoes. The test pits will determine whether wastes have been dumped or buried in areas that appear as disturbed ground on aerial photographs.

Each bore hole and test pit will be extended to a maximum depth of 3 m below surface level or at least 0.5 m into natural material or to refusal (whichever is shallower). If the presence of waste materials is confirmed during test pitting, ES will continue to excavate (with AGLM's instruction) until the vertical extent of the waste materials is determined (or to the maximum extent of the backhoe reach).

Three (3) or more soil samples will be collected from each borehole and test pit with two (2) selected samples submitted for immediate chemical analysis. The remaining samples were held for potential additional analysis. Sampling intervals were typically:

- One in the fill;
- One in the natural material;

- On the basis of field observations, evidence of staining or olfactory indicators; and
- At any changes in the strata targeting fill and natural material.

All soil samples collected for chemical analysis will be screened in the field for Volatile Organic Compounds (VOCs) using a Photo Ionisation Detector (PID). The PID will be calibrated at the start and end of each day of use.

The locations of bores and test pits will be surveyed using a system relative to Australia Map Grid (AMG).

13.3 Reinstatement

All monitoring wells, installed within operational parts of the site where hardstand pavements are present, will be finished off with a flush-mounted cast iron road box using concrete or asphaltic cement products (to match existing) constructed to prevent surface water from entering wells. Wells installed within garden areas and non-operation areas of the site will be finished with the top of the well sticking up at least 300mm above the level of the garden. ES recommend the use of steel monuments to ensure protection of well stick-ups from site operations. All monitoring wells will be secured with a lockable well cap.

The monitoring well identification number will be engraved in the top of the road box or painted on the well pipe and also engraved on an aluminium tag attached to each well cap.

Any grass or other plant that is excavated during test pitting will be replaced at the surface of the reinstated test pit.

13.4 Storage of Waste

Surplus materials generated during installation of soil bores and test pits (i.e soil cuttings) will be replaced into the bores or test pits in reverse order of excavation and compacted by several traverses of the drill rig/excavator, if no contamination was identified by visual, olfactory or PID screening and if groundwater was not encountered. Any grass or other plant that is excavated will be placed at the surface of the reinstated bore or test pit where possible.

Groundwater generated during development and purging of wells will be stored in 200 L steel drums as provided by ES.

Surplus materials generated during installation of soil bores or groundwater monitoring wells that cannot be replaced into bores or test pits, will be stored in appropriately labelled 200 L capped steel drums (label will be marked in letters not less than 25 mm high in water-proof paint).

Drums will be stored on either the Bayswater or Liddell PS in locations directed by AGL Macquarie. All sample locations will be made free of waste generated during sampling works. Permission from AGLM will be first sought prior to disposing of waste in any of the existing storage/disposal containers on each site.

13.5 Nomenclature for Test Locations and Sample Identification

Test locations are required to be identified as follows:

- Soil bores, test pits, groundwater monitoring wells, surface water and lake water collection points are required to be located using a unit relative to the Australian Map Grid (AMG); and

- The collars of groundwater monitoring wells are required to be referred to elevations relative to Australian Height Datum (AHD).

Samples are required to be identified as originating from the Sites, as follows:

- Samples collected from the Bayswater PS, commence with “BPS”;
- Samples collected from the Liddell PS, commence with “LPS”; and
- Samples collected from the Lake Liddell, commence with “LL”.

Samples collected from AECs are required to identify the AEC. For example, a sample collected from AEC 4 on the Bayswater PS would be labelled “BSW4”.

Samples collected from a “Background Areas”, in locations where no AEC has been identified, are required to identify the location as “BK”. For example, a sample collected from location BK22 on the Bayswater PS would be labelled “BPS-BK22”.

The type of sample is required to be identified as being collected from a:

- Soil bore as “SB”;
- Test pit as “TP”;
- Surface soil grab sample “SG”;
- Groundwater monitoring well as “GW”;
- Water grab sample as “W”; and
- Sediment sample as “SD”

On the Bayswater and Liddell PS, the depth samples are collected from is required to be stated in metres below surface to the nearest 0.1 m.

For water grab samples, the depth samples are collected from is required to be stated in metres below surface to the nearest 0.1 m.

For sediment samples, the depth samples are collected from is required to be stated in metres below surface of the sediments to the nearest 0.1 m.

Sample locations are required to be identified commencing at 201 on the Bayswater PS, 301 on the Liddell PS and 401 from Lake Liddell.

For example:

- A soil sample from the Liddell PS at AEC 29 from test pit 301 at a depth of 2.1 m is labelled as “LPS-AEC29-TP301-2.1”;
- A groundwater sample from the Liddell PS at AEC 29 from groundwater monitoring well at location 302 from a depth of 4.5 m is labelled as “LPS-AEC29-GW302-4.5;
- A soil the sample from Bayswater PS at location BK21 from a test pit 310 at a depth of 1.1 m is labelled as “BPS-BK21-TP210-1.1”; and

A sediment sample collected from sediment within Lake Liddell at location 401 from a depth of 0.2 m beneath the surface of the sediments is labelled as “LL-SD401-0.2”.

13.6 Soil Logging and Sampling

Soil sampling will be conducted during borehole construction and the soil type/s will be described according to the Unified Soil Classification System (USCS) and a detailed log will be completed at each location describing at relevant depth intervals:

- Fill materials, including the presence or absence of indicators of contamination, such as presence of chemical odours, unusual staining, anthropogenic materials, including asbestos-containing materials;
- Natural soils according to the USCS classification; and
- Presence or absence of moisture.

In addition, the log will record at each test location, the presence or absence of indicators of contamination at the surface, such as:

- salt deposits;
- dead or stressed vegetation;
- staining; or
- anthropogenic materials.

During the works, fill and natural soil samples will be collected from dedicated HDPE push tube sleeves (minimising the potential for cross-contamination and sample disturbance) using disposable nitrile gloves. In some cases it may be necessary to sample from the solid-flight auger bit where sample recovery from the push tube is not optimum. This will only be completed with strict supervision ensuring that a sample is obtained only from the bottom of the cutting bit and not allowing cross-contamination of the sample and minimising the loss of VOCs.

Soil sampling will also be conducted during test pitting works. Soil samples from the test pits will be collected from the centre of the excavator bucket by hand using disposable nitrile gloves, avoiding soil which had come into contact with the excavator bucket (minimising the opportunity cross-contamination and minimising the loss of VOCs). Excess soil will be shaken from the excavator bucket between sampling locations. Soil that is difficult to remove from the bucket will be dry brushed using a stainless steel or stiff nylon brush. Soil samples will be collected by hand using disposable nitrile gloves.

The soil samples will then be subdivided with one part being put into snap -lock plastic bags for screening with the PID and the other being placed into a laboratory prepared 250 ml glass jar with Teflon lined lids with the details of the sample, including the sample name, the job number, the date of sample and the sample depth.

For additional sample integrity, the disposable nitrile gloves will be replaced between each sampling location.

Each soil sample will be described in general accordance with the Unified Soil Classification System (USCS) and details of any discolouration, staining, odours or other indicators of contamination and the presence of anthropogenic materials, especially asbestos-containing materials, will also be noted.

Samples that exhibit visual or olfactory evidence of contamination will be submitted for laboratory analysis. If no PID or sensory indication of contamination is noted, one sample of fill material and representative natural samples will be submitted for analysis. Depth samples, typically comprising changes in soil type, will be retained for future analysis, if required.

- As soon as practicable after collection, samples will be labelled and placed on ice in an insulated container that is to be stored in a secure location and chain-of-custody documentation will be completed.

13.7 Groundwater Sampling

13.7.1 Locations of new groundwater monitoring wells

The locations of new groundwater monitoring wells will be will be determined using professional judgement by a senior ES scientist/engineer during a Site Walkover inspection and in consideration of the results reported by ERM. The locations will be marked on the surface of the ground using paint to indicate the bore or test pit number and either a wooden or plastic stake drive into the ground in non-operational areas or a suitable marker (e.g. a coloured witch's hat) in operational areas, as required by the relevant site safety officer.

13.7.2 Construction and Materials

All soil bores will be extended to a maximum depth of 6 m below surface level and converted into groundwater monitoring wells.

The groundwater monitoring well screens will comprise 50 mm ID, Class 18, threaded, flush jointed uPVC with machine slots of 0.5 mm width. Casing for the wells will comprise 50 mm ID, Class 18, threaded, flush jointed uPVC. Screen and casing will be joined using Viton™ O-rings which are chemically resistant to petroleum hydrocarbons and chlorinated solvents.

Screened sections of monitoring wells will be constructed above and below the groundwater level to enable any light non-aqueous phase liquids (LNAPL), if present, to enter the monitoring well.

If confined conditions are encountered (the static water level is above the depth of water entry) consideration will be given to inserting shorter screens as the behaviour of LNAPL in confined groundwater is different from unconfined groundwater, and can lead to different design considerations. We anticipate that within the fill horizon, unconfined conditions will result, but within the Permian consolidated sequence, confined conditions may result.

The void will be gravel packed with 1-2mm of washed graded gravel to approximately 0.5m above the top of the screen interval. This will be followed by a cement/bentonite seal installed above the gravel pack to just below the ground surface. Refer to Section 3.9 for the reinstatement of the ground surface at each investigation location.

Groundwater monitoring wells, top of casing, will be surveyed using a differential GPS relative to Australia Map Grid (AMG) and elevations will be relative to Australian Height Datum (AHD).

13.7.3 Well Development and Groundwater Sampling

Methods and standards set out in guidance documents will be adopted for the groundwater development and sampling. The guidance documents are as follows:

- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination;
- VIC EPA (2006) Publication 668, Hydrogeological Assessment (Groundwater Quality) Guidelines; and
- VIC EPA (2000) Publication 669, Groundwater Sampling Guidelines.

Development of the newly-installed monitoring wells will be conducted using a combination of stainless steel bailer and a 12 v submersible pump. The stainless steel bailer and pump will be cleaned with a Decon 90 wash mixture and rinsed with potable water between each monitoring well. Each well will be developed until the majority of sediment is removed to

ensure a good connection between the screened borehole interval and the surrounding aquifer. Well development will occur within 48 hours of monitoring well installation.

Sampling from wells will take place a minimum of 5 days following development.

Prior to sampling, and following removal of the well cap, the headspace of each well (including the existing ERM monitoring wells) will immediately be screened with a PID to determine the likely presence, or otherwise, of volatile compounds. The PID will be calibrated at the start and end of each day of use. Following well headspace screening, all wells will be gauged with an interface water level meter to determine depth to water below top of casing and the presence, or otherwise, of LNAPL or dense non aqueous phase liquids (DNAPL). If the interphase meter detects either LNAPL or DNAPL, the thickness will be recorded and the presence confirmed with a dedicated Teflon lined clear bailer.

Prior to collection of samples, all monitoring wells will be purged using low-flow techniques using either a peristaltic pump or micropurge pump and controller. Monitoring wells will be purged at a flow rate of the order of 0.1 - 0.5 L/min to minimise the suspended solids within the purge water. However, this is dependent on site-specific hydrogeology. A purge rate that minimises drawdown (<0.1m) within the well will be adopted and continued until the groundwater parameters (dissolved oxygen, pH, temperature, electrical conductivity and redox) have stabilised to within approximately 10% over three consecutive readings (pH +/- 0.1, temperature +/-10%, electrical conductivity +/-3%, dissolved oxygen +/-10%, and redox +/-10%). Physical indicators such as the presence (and percentage) of suspended solids, colour, the presence/absence and nature of odours and the presence/absence of slicks or sheens on purge water will be recorded on all field sheets.

Dedicated Teflon lined LDPE tubing will used at each monitoring well, and remain in each monitoring well following sampling. The interface probe will be thoroughly decontaminated between gauging events with a phosphate free detergent (Decon 90) and rinsed with potable water.

Low-flow sampling equipment will be used to fill the appropriately preserved laboratory prepared sample containers with groundwater extracted from each well.

For additional sample integrity, the disposable nitrile gloves will be replaced between each sampling location.

The locations of new groundwater monitoring wells will be determined using professional judgement by a senior ES scientist/engineer during a Site Walkover inspection and in consideration of the results reported by ERM.

13.8 Sediment Sampling (In areas other than Lake Liddell)

Sediment samples from locations other than Lake Liddell will be collected using sludge sampling equipment that is designed to retain samples from non-cohesive materials, including underwater sediment in shallow lakes, streams, and various types of impoundments with a capability of capturing an undisturbed sample. The samplers can be used to take undisturbed samples up to 0.3m thick in single use sealable plastic liners, suitable for geotechnical and/or chemical analysis.

Excess or unsuitable sediment will be collected and stored as waste in 200 L steel drums as for waste materials from soil bores and test pits – it must not be disposed into the water body.

All samples will be submitted to NATA accredited laboratories under chain of custody protocols.

13.9 Surface Water Sampling (in areas other than Lake Liddell)

There are many acceptable methods of collecting water samples. However, ES will be collecting surface water samples via an extension pole with a Teflon cup (i.e dip sampler). The water will be collected at a consistent depth of approximately 300mm below the water surface at each location. The surface water collected via the dip sampler will be carefully transferred to appropriately preserved laboratory prepared sample containers. All sample containers will be completely filled to eliminate headspace and minimise the loss of volatile compounds. The samples for metals will be submitted as both filtered through a 45 µm cellulose filter and non-filtered for analysis.

The surface water parameters (dissolved oxygen, pH, temperature, electrical conductivity, redox and turbidity) will be recorded during sample collection.

The dip sampler cup will be thoroughly decontaminated between sampling location with a phosphate-free detergent (Decon 90) and rinsed with potable water.

For additional sample integrity, the disposable nitrile gloves will be replaced between each sampling location.

As soon as practicable after collection, samples will be labelled and placed on ice in an insulated container that is to be stored in a secure location and chain-of-custody documentation will be completed.

13.10 Specific Requirements for Lake Liddell

13.10.1 Sediment

Sediment sampling methods will be in general accordance with relevant Australian Standards and guidance documents including ANZECC/AMCANZ (2000), National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009) and the Handbook for Sediment Quality Assessment (Simpson et al., 2005).

Sediment samples will be collected using several surface (not diver-assisted) collection techniques.

A manually-driven piston corer will be used in water depths less than 20 m and a small gravity/piston corer in waters greater than 20 m.

To operate the piston corer a core barrel will be manually pushed into the sediment with the piston remaining at bed level to create a partial vacuum and draw sediment into the barrel. The core barrel is then lifted onto the vessel (an aluminum self-bailing purpose-built boat) and separated from the coring device.

The gravity/piston corer is an effective device that uses its own mass to penetrate into the sediment and collect a sample. The use of a piston and refined sampling techniques means that samples are collected and retained without loss of easily re suspended surficial layers of sediment.

Both techniques have been used to collect hundreds of cores at numerous locations around Australia.

More than one sample may need to be collected to provide representative samples at each sampling location. These samples would be composited as necessary. Sediment cores will be logged, photographed and subsampled as per requirements in the brief.

Excess or unsuitable sediment will be collected and stored as waste in 200 L steel drums as for waste materials from soil bores and test pits – it must not be disposed into Lake Liddell. .

13.10.2 Surface Water

Lake Liddell water samples will be collected using Wildco Beta Water Bottle Sampler deployed from the vessel. This method allows for the collection of discrete samples from target depths. The horizontal sampler will be lowered on a line to within 0.2 m above the sea bed and activated by a trigger weight that slides down the retrieval line.

Collection of re suspended sediment will be mitigated by waiting for sediment to settle before triggering the sampler and closing the tube and/or instructing the laboratory to allow particles to settle prior to subsampling from the supplied bottles.

13.10.3 Aquatic Species

NSW Fisheries will be notified of our intention to sample the aquatic species, as required by our Scientific Collection Permit.

Aquatic fauna will be collected from four sites at Lake Liddell using a range of survey techniques, including fyke netting and angling. Fyke netting is an effective method for collecting all three species targeted by the sampling program, but is expected to be most successful for Carp. Australian Bass occur at lower densities than carp in Lake Liddell, and will be targeted with the additional survey technique of angling. Yabbies will be collected using fyke nets, seine nets, and baited traps. Eels are known to exist in Lake Liddell and will also be collected.

Physico-chemical variables (dissolved oxygen concentration, pH, electrical conductivity, and temperature) will be measured at each of the survey sites, and the location of sampling determined using GPS.

If capture rates are high enough, three samples from each species will be collected from separate fish. This equates to a total catch of 9 Australian Bass, 9 Eels and 9 Common Carp. Nine x 100 g samples of Yabby will also be collected.

Samples will be chilled or frozen prior to freighting by courier to the NATA accredited laboratory for analysis.

Fish will be humanely euthanized and prepared on site for dispatch following the methods specified in *Metal contamination of major NSW fish species available for human consumption* (NSW Health 2001). Fillets weighing a minimum of 100 g will be couriered in either a chilled or frozen state. Crustaceans will be kept whole and sent chilled or frozen to the laboratory. An estimate will be made so that the total of each crustacean sample sent exceeds 100 g of cleaned mass. Fish carcasses will be disposed of responsibly on-site so that they do not attract scavengers.

The Food Standard Code requires analysis to be done on the edible portion of the fish, which is why fillets will be used in the analyses. However, the liver and gullet can be the main areas of contaminant accumulation in fish, but it is not proposed to analyse these organs during this investigation.

Results from chemical analyses will be compared to the *Australian and New Zealand Food Standards Code-Standard 1.4.1- Contaminants and Natural Toxicants and Standard 1.4.2- Maximum Residue Limits*.

13.11 Preservation of Custody and Samples

All sample containers will be completely filled to eliminate headspace and minimise the loss of volatile compounds. The groundwater samples for metals analysis will be filtered in the field using a 0.45micron millipore filter unit prior to bottling.

Appropriately preserved laboratory prepared sample containers will be used for all soil, sediment and water analysis.

Sample preservation will be undertaken in accordance with NEPM (2013) with samples immediately placed and stored in an ice filled Esky to keep them below 4°C, prior to being couriered to the laboratory with the signed chain of custody form filled out with the required analysis.

13.12 PFAS

All works associated with the 3rd Deed of Variation to the APECS works, and which involves the collection of samples for the analysis of PFAS will be required to meet the requirements of the sampling methodologies set out in this SAQP, unless those sampling methodologies are in conflict with the requirements of the WA DER Interim PFAS Guidelines 2016; Appendix 1. PFAS – specific Sample Collection Methods, Equipment and Equipment Decontamination Methods. In the instance of any such conflict, the WA DER guidance shall take precedence over any ES methodologies, SOPs or other regulatory guidance.

14 Analytical Programme

14.1 Laboratories

ES will use laboratories that are registered by the National Association of Testing Authorities Australia (NATA) for each of the analysis. ES have scoped the chemical analysis of soil, water, sediment and biota as per the 'Request For Tender' Schedules. The chemical analysis for the works at each site are presented in Table 14-1.

Table 14-1: Proposed Chemical Analysis Programme

Site	Media	Location	Sample Type and Number	No. of Primary Samples	Analysis
Bayswater Power Station	Soil	AEC	121 soil bores	242	Heavy metals and metalloids (As, Bo, Cd, Cr (total), Cu, Pb, Hg (total), Ni, Se and Zn); Total recoverable hydrocarbons (TRH); Benzene, toluene, ethyl benzene and xylenes (BTEX); Polycyclic aromatic hydrocarbons (PAHs); Volatile organic compounds (VOCs) – ¼ total samples; Polychlorinated biphenyls (PCBs) – ¼ total samples; and Salinity.
			51 test pits	102	
		Background Areas	4 soil bores	8	
			6 test pits	12	
	Groundwater	AEC	87 existing	87	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; PCBs - ¼ total samples; AFFF – xx total samples Salinity; and Nutrients (specifically nitrate, nitrite, ammonia and phosphorous)
			121 newly installed	121	
		Background Areas	23 existing	23	
			10 newly installed	10	
	Sediment	AEC	68	68	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; Salinity; and Nutrients
		Background Areas	0	0	

Site	Media	Location	Sample Type and Number	No. of Primary Samples	Analysis
	Surface water	AEC	32	32	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; Salinity; and Nutrients
		Background Areas	0	0	
Liddell Power Station	Soil	AEC	85 soil bores	170	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; PCBs - ¼ total samples; and Salinity.
			49 test pits	98	
		Background Areas	8 soil bores	16	
			6 test pits	12	
	Groundwater	AEC	67 existing	67	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; AFFF – xx total samples Salinity; and Nutrients
			80 newly installed	80	
		Background Areas	15 existing	15	
			8 newly installed	8	
	Sediment	AEC	65	65	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; Salinity; and Nutrients
		Background Areas	0	0	
	Surface water	AEC	54	54	Heavy metals and metalloids; TRH; BTEX;
		Background Areas	0	0	

Site	Media	Location	Sample Type and Number	No. of Primary Samples	Analysis
					PAHs; VOCs - ¼ total samples; Salinity; and Nutrients
Lake Liddell	Sediment	AEC	25 locations	50	Heavy metals and metalloids; TRH; BTEX; PAHs; and VOCs
	Surface water	AEC	25 locations	50	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs; Salinity; and Nutrients
	Edible aquatic species	AEC	4 locations	12	Heavy metals and metalloids; TRH; BTEX; PAHs; and VOCs;
Tomago	Soil	AEC	10 soil bores	20	Heavy metals and metalloids; TRH; BTEX; PAHs; VOCs - ¼ total samples; Salinity - ¼ total samples; Fluoride; and Semi volatile organic compounds (SVOCs) - ¼ total samples
			10 test pits	20	
	Groundwater	AEC	10 newly installed	10	Heavy metals and metalloids; TRH; BTEX;

Site	Media	Location	Sample Type and Number	No. of Primary Samples	Analysis
					PAHs – 2 locations only; VOCs – 3 locations only; Salinity; Fluoride; and SVOCs – 3 locations only

The analytical programme does not include asbestos analysis in soil. As per AGLM instruction, soil at all locations will be visually screened in the field for the presence of asbestos or potential asbestos containing material.

15 Unexpected Finds Protocol

15.1 Unexpected Finds Protocol

Environmental investigations completed to date have identified a number of contaminated areas, but these were judged by ERM to be not significant contamination. However, works elsewhere on-site may uncover materials requiring additional assessment or management. It is imperative that the potential for such material to impact site workers and the remainder of the site is minimised during the works program and that such material is isolated for assessment and characterisation. Following this remediation may be required. If unexpected findings or environmental issues are encountered during site works, the following protocol is to be followed:

- cease disturbance of the affected site and evacuate the immediate area;
- contact ES field leader;
- ES are to conduct an assessment of the location and extent of the suspected contaminated soil/unexpected find;
- if ES identify that the contamination is significant and may pose an unacceptable risk of harm to human health or to the environment, the ES field leader is to contact the AGLM representative as soon as practicable;
- all areas are to be isolated and secured against unintended access;
- temporary encapsulation (sealing) of the suspect area to ensure no airborne spread of contamination occurs may be appropriate. This may include friable asbestos or if high wind is spreading dust from the suspect area, this may involve clean soil or plastic sheeting. Ensure workers wear appropriate PPE whilst encapsulating the suspect area;
- dust should be prevented by wetting the soil and drainage controls should be arranged where there is a potential for runoff to occur (runoff should be minimised);
- warning signs should be placed in the vicinity of the suspected material;
- an unexpected findings incident report must be completed by ES;
- visual assessment, sample collection and laboratory analysis if required, will be undertaken by ES with reference to the relevant guidelines;
- if necessary, ES will advise on further environmental controls that may require establishment to minimise the potential for migration of contaminants from the impacted area;
- once laboratory results are available, evaluation of analytical data and site observations are to be undertaken with respect to site specific health investigation levels, phytotoxicity criteria and waste classification criteria. An unexpected findings incident report with final classification of soils, including whether the soils are suitable for the proposed land use or need to be remediated and the proposed remedial method and estimated volumes (or further characterisation works that are considered to be required) will be forwarded for comment by AGLM; and
- area is to be reopened for earthworks following clearance of site (based on laboratory results) or management by AGLM.

16 Identification of Pre-Existing Contamination

16.1 Requirement for additional investigation

This SAQP has provided the quality assurance and quality control procedures and the methodology for identifying 'Pre-Existing Contamination' on the parts of the Sites identified to pose the highest risks, which are the AECs. However, it is recognised that there may be the requirement to undertake investigation additional to that set out in this SAQP to fully identify all 'Pre-Existing Contamination'.

16.2 Identification of 'contamination'

The definition of 'Pre-Existing Contamination' refers to 'contamination' as defined in the *Contaminated Land Management Act 1997 (NSW)* (CLM Act).

The CLM Act relevantly defines contamination to mean 'the presence in, on or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment.'

Without limiting this definition, this SAQP proposes that the presence of contamination at the Sites will be confirmed when any of the following conditions are identified:

This SAQP proposes that the presence of contamination at the Sites will be confirmed when any of the following conditions are identified:

- **Soil contamination** – when concentrations of one or more chemicals of concern exceed the HIL D level or open space criteria;
- **Groundwater and surface water contamination**, except for water in Lake Liddell- when concentrations of one or more chemicals of potential concern exceed the 95% levels of protection as defined in the ANZECC 2000 Marine and Freshwater Quality Guidelines;
- **Sediment contamination** (Lake Liddell) or in water bodies discharging into Lake Liddell - when concentrations of chemicals of potential concern exceed the ISQG –low level for protection of aquatic species;
- **Sediment contamination in Lake Liddell:**
  - in areas frequented by recreational users – when concentrations of chemicals of potential concern exceed ISQG low levels;
- **Water contamination in Lake Liddell** – when concentrations of one or more chemicals of potential concern exceed relevant criteria for primary and secondary contact by human users as well as the Australian Water Quality Drinking Criteria (ADWG);
- **Edible Aquatic Species-** when concentrations of chemicals of potential concern in flesh of edible aquatic species exceed the Australian New Zealand Food Standards Code 1.4.1 Contaminants and Natural Toxicants and Standard 1.4.2 Maximum Residue Limits.

These levels are generally the equivalent of Tier One Guidelines as defined in the NEPM 1999 (as amended 2013). Tier Two Guidelines may need to be derived at a later stage but are outside the scope of this project.

16.3 Identification of Pollution

The definition of 'Pre-Existing Contamination' refers to 'pollution' as defined in the *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act).

'Pollution' is relevantly defined in the POEO Act to include 'water pollution' and 'land pollution'.

The POEO Act defines 'water pollution' very broadly:

> *(a) placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed, or*
>
> *(b) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any refuse, litter, debris or other matter, whether solid or liquid or gaseous, so that the change in the condition of the waters or the refuse, litter, debris or other matter, either alone or together with any other refuse, litter, debris or matter present in the waters makes, or is likely to make, the waters unclean, noxious, poisonous or impure, detrimental to the health, safety, welfare or property of persons, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters or unsuitable for use in irrigation, or obstructs or interferes with, or is likely to obstruct or interfere with persons in the exercise or enjoyment of any right in relation to the waters, or*
>
> *(c) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, that is of a prescribed nature, description or class or that does not comply with any standard prescribed in respect of that matter,*
>
> *and, without affecting the generality of the foregoing, includes:*
>
> *(d) placing any matter (whether solid, liquid or gaseous) in a position where:*
>
> *(i) it falls, descends, is washed, is blown or percolates, or*
>
> *(ii) it is likely to fall, descend, be washed, be blown or percolate,*
>
> *into any waters, onto the dry bed of any waters, or into any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted, or*
>
> *(e) placing any such matter on the dry bed of any waters, or in any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted,*
>
> *if the matter would, had it been placed in any waters, have polluted or have been likely to pollute those waters.*

The POEO Act defines 'land pollution' to mean:

> *placing in or on, or otherwise introducing into or onto, the land (whether through an act or omission) any matter, whether solid, liquid or gaseous:*
>
> *(a) that causes or is likely to cause degradation of the land, resulting in actual or potential harm to the health or safety of human beings, animals or other terrestrial life or ecosystems, or actual or potential loss or property damage, that is not trivial, or*

(b) that is of a prescribed nature, description or class or that does not comply with any standard prescribed in respect of that matter,

but does not include placing in or on, or otherwise introducing into or onto, land any substance excluded from this definition by the regulations.

For the purpose of paragraph (b) of this definition, the regulations prescribe the following matters:

(a) hazardous waste,

(b) restricted solid waste,

(c) more than 10 tonnes of asbestos waste,

(d) more than 5 tonnes of waste tyres or more than 500 waste tyres.

Without limiting these definitions, this SAQP proposes that the presence of pollution at the Sites will be confirmed in:

Water (including groundwater): where is any level of concentration of a Potential Contaminant of Concern in water (including any groundwater) which may be above a background contamination for soil, groundwater, surface water, sediment or edible fish. The background level will need to be established for the project based on sampling of those areas likely to have no impact, or by other analysis of published data if it is not possible to establish a reliable background by collecting site data; and

Soil: where there is any level of concentration of a Potential Contaminant of Concern in soils which exceeds the HIL D level or open space criteria.

16.4 Identification of Pre-Existing Contamination

The following criteria are to be employed to identify whether contamination identified in the program of field and laboratory works was present at 2 September 2014:

- Contamination is present in areas in which contamination or impact by chemical substances was identified in the ERM reports, except if it is identified that ERM wells were not located optimally, or samples were collected improperly, or samples were not analyses for the chemicals of potential concern;
- Contamination is associated with one or more sources that were present at 2 September 2014;
- Contamination is identified in areas where no leaks, spills, dumping etc. have taken place since 2 September 2014; and/or
- The chemical signature of the contamination indicates that contamination to be “aged” so that it was present prior to 2 September 2014.

17 Report Limitations

Limitations and Important Information about this Report

This report has been prepared in accordance with the scope of services described in the previous sections of this report. The report has been prepared for the sole use of:

- AGL Macquarie Pty Limited (the client) and its related bodies corporate (as defined in the Corporations Act 2001 (Cth) (collectively, the AGL Parties); and
- any person who purchases the land to which this report relates from the AGL Parties,

(Relevant Parties) and has been prepared in accordance with a scope of work agreed by the client.

The report or document does not purport to provide legal advice and any conclusions or recommendations made should not be relied upon as a substitute for such advice.

The report does not constitute a recommendation by Environmental Strategies Pty Ltd (ES) for the client, the Relevant Parties or any other party to engage in any commercial or financial transaction and any decision by the client, the Relevant Parties or other party to engage in such activities is strictly a matter for them.

The report relies upon data, surveys, measurements and results taken at or under the site at particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Relevant Parties. Furthermore, the report has been prepared solely for use by the Relevant Parties and ES accepts no responsibility for its use by other parties. Subject to the express terms of any agreement between the client and ES, the client agrees that ES' report or associated correspondence:

- will not be used or reproduced in full or in part for promotional purposes; and
- cannot be used or relied upon by any person other than the Relevant Parties.

Any other individual, party, group or company seeking to rely this report cannot do so and should seek their own independent advice.

Subject to the express terms of any agreement between the client and ES, no warranties, express or implied, are made. Subject to the scope of work undertaken, ES' assessment is limited strictly to identifying typical environmental conditions associated with the subject property based on the scope of work and testing undertaken and does not include and evaluation of the structural conditions of any buildings on the subject property or any other issues that relate to the operation of the site and operational compliance of the site with state or federal laws, guidelines, standards or other industry recommendations or best practice. Scope of work undertaken for assessments are agreed in advance with the client and may not necessarily comply with state or federal laws or industry guidelines for the type of assessment conducted.

Additionally, unless otherwise stated ES did not conduct soil, air, wastewater or other matrix analyses including asbestos or perform contaminated sampling of any kind. Nor did ES investigate any waste material from the property that may have been disposed off the site, or undertake and assessment or review of related site waste management practices.

The results of this assessment are based upon (if undertaken as part of the scope work) a site inspection conducted by ES personnel and/or information from interviews with people who have knowledge of site conditions and/or information provided by regulatory agencies. All conclusions and recommendations regarding the property are the professional opinions of the

ES personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made, subject to the express terms of any agreement between the client and ES, ES assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of ES, or developments resulting from situations outside the scope of this project/assessment.

ES is not engaged in environmental auditing and/or reporting of any kind for the purpose of advertising sales promoting, or endorsement of any client's interests, including raising investment capital, recommending investment decisions, or other publicity purposes.

Information relating to soil, groundwater, waste, air or other matrix conditions in this document is considered to be accurate at the date of issue. Surface, subsurface and atmospheric conditions can vary across a particular site or region, which cannot be wholly defined by investigation. As a result, it is unlikely that the results and estimations presented in this report will represent the extremes of conditions within the site that may exist. Subsurface conditions including contaminant concentrations can change in a limited period of time and typically have a high level of spatial heterogeneity.

From a technical perspective, there is a high degree of uncertainty associated with the assessment of subsurface, aquatic and atmospheric environments. They are prone to be heterogeneous, complex environments, in which small subsurface features or changes in geologic conditions or other environmental anomalies can have substantial impact on water, air and chemical movement.

Major uncertainties can also occur with source characterisation, assessment of chemical fate and transport in the environment, assessment of exposure risks and health effects, and remedial action performance. These factors make uncertainty an inherent feature of potentially impacted sites. Technical uncertainties are characteristically several orders of magnitude greater at impacted sites than for other kinds of projects.

In relation the conduct of Asbestos inspections or the preparation of hazardous materials reports ES has conducted inspections and the identification of hazardous material within the constraints presented by the property. Whist efforts are made to access areas not normally accessed during normal use of the site to identify the presence of asbestos or other hazardous material, unless explicitly tested no guarantee can be provided that such material is or is not present.

ES' professional opinions are based upon its professional judgment, experience, and training. These opinions are also based upon data derived from the limited testing and analysis described in this report or reports reviewed. It is possible that additional testing and analysis might produce different results and/or different opinions or other opinions. ES has limited its investigation(s) to the scope agreed upon with its client. ES believes that its opinions are reasonably supported by the testing and analysis that has been undertaken (if any), and that those opinions have been developed according to the professional standard of care for the environmental consulting profession in this area at this time. Other opinions and interpretations may be possible. That standard of care may change and new methods and practices of exploration, testing and analysis may develop in the future, which might produce different results.

18 References

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Western Australian Department of Environment Regulation (DER 2016) - *Interim Guideline on the Assessment of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): Contaminated Sites Guidelines*.

APPENDIX A – Proposed Sample Locations

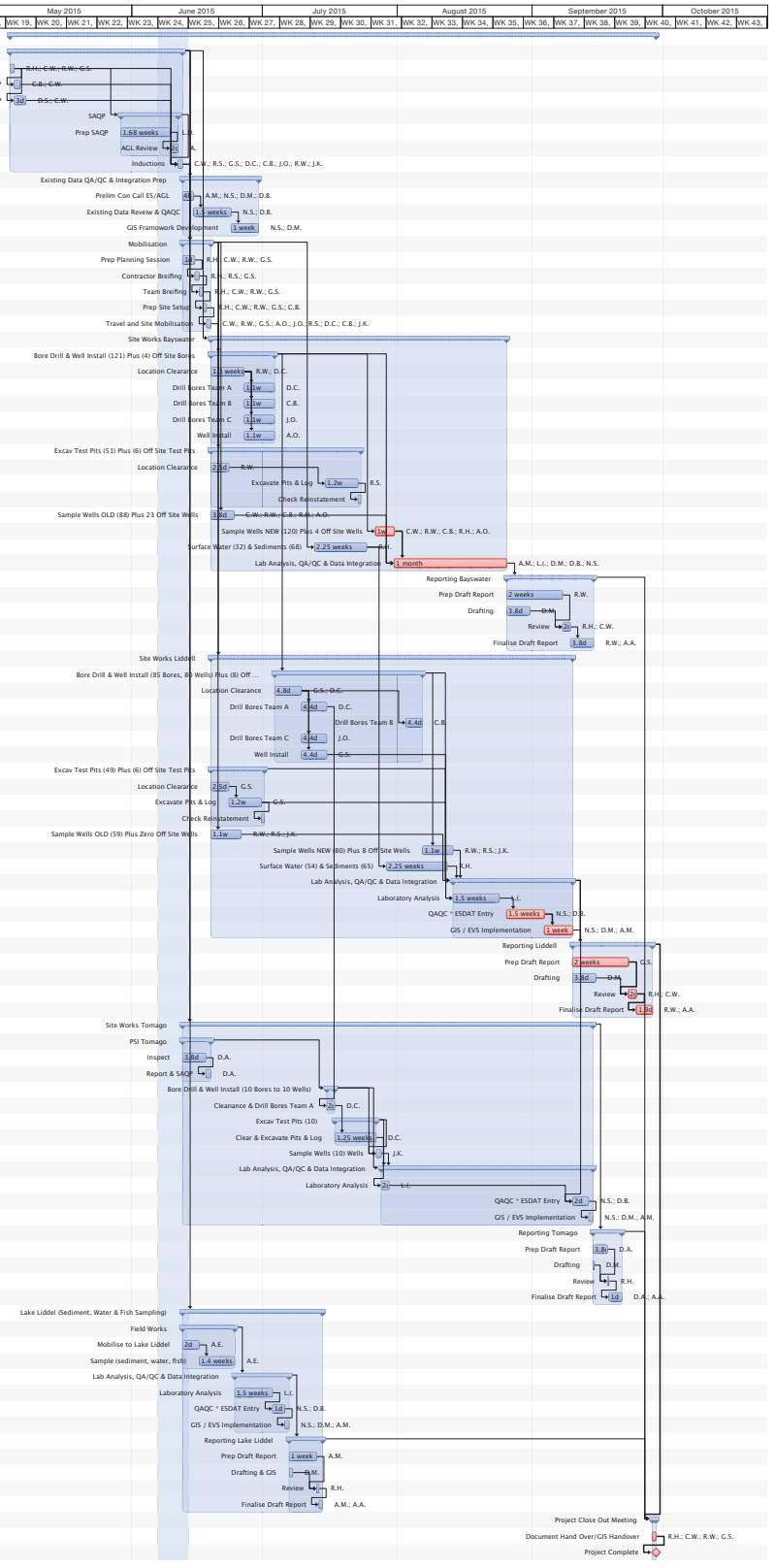
Area	Area of Environmental Concern	ERM Reference (AEC)	Geology	Description	ERM Borelog Lithology	Concrete	Water Strike (ERM) approximate	Final Water Level (ERM) approximate
Bayswater	1	BV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, sandy clay, clay, clayey gravel overlying shale, sandstone. Fill to 6.5m MW08		6.18	4.26
Bayswater	2	BV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, sandy clay, clay, clayey gravel overlying shale, sandstone. Fill to 6.5m MW08		6.18	4.26
Bayswater	3	BH	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, sandy clay, silty clay overlying sandstone, shale. Fill to 4.5m at MW01		5.96	3.54
Bayswater	4	BH	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, sandy clay, silty clay overlying sandstone, shale. Fill to 4.5m at MW01		5.96	3.54
Bayswater	5	BD	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	6	BI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, overlying sandstone and clay. Fill to 4m at MW02	0-0.2	8.83	7.515
Bayswater	7	BG	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, silty clay , sandy clay overlying shale, siltstone		3.36	1.8
Bayswater	8	BG	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, silty clay , sandy clay overlying shale, siltstone		3.36	1.8
Bayswater	9	BG	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, silty clay , sandy clay overlying shale, siltstone		3.36	1.8
Bayswater	10	BG	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, silty clay , sandy clay overlying shale, siltstone		3.36	1.8
Bayswater	11	BG	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly clay, silty clay , sandy clay overlying shale, siltstone		3.36	1.8
Bayswater	12	BP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	13	BP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	14	BP	Branxton Formation/Mulbring Siltstone	Conglomerate, sandstone, siltstone/Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	14	BP	Branxton Formation/Mulbring Siltstone	Conglomerate, sandstone, siltstone/Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	15	BH	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay, silty clay overlying sandstone, shale. Fill to 4.5m at MW01		5.96	3.54
Bayswater	16	BH	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay, silty clay overlying sandstone, shale. Fill to 4.5m at MW01		5.96	3.54
Bayswater	17	BL	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, gravelly clay overlying siltstone, shale and sandstone	0-0.2	3.42	2.61
Bayswater	17	BL	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, gravelly clay overlying siltstone, shale and sandstone	0-0.2	3.42	2.61
Bayswater	18	BQ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	19	BQ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	20	BQ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	21	BQ	Saltwater Creek Formation	Sandstone, siltstone, minor coal bands	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	22	BQ	Saltwater Creek Formation	Sandstone, siltstone, minor coal bands	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	23	BQ	Saltwater Creek Formation	Sandstone, siltstone, minor coal bands	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	24	BQ	Saltwater Creek Formation	Sandstone, siltstone, minor coal bands	Fill, clay, sandy clay overlying sandstone, siltstone, shale		4.98	4.14
Bayswater	25	BE	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly Clay, Clay overlying silstone and shale. Fill to 5m in MW07		5.975	2.96
Bayswater	26	BE	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly Clay, Clay overlying silstone and shale. Fill to 5m in MW07		5.975	2.96
Bayswater	27	BE	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly Clay, Clay overlying silstone and shale. Fill to 5m in MW07		5.975	2.96
Bayswater	28	BK	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay overlying shale and sandstone		-	-
Bayswater	29	BK	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay overlying shale and sandstone		-	-
Bayswater	31	BK	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay overlying shale and sandstone		-	-
Bayswater	32	BK	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay overlying shale and sandstone		-	-
Bayswater	33	BK	Branxton Formation	Conglomerate, sandstone, siltstone.	Gravelly clay, sandy clay overlying shale and sandstone		-	-
Bayswater	34	BB	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Sandy Clay, silty clay and gravelly clay overlying siltstone and sandstone		6.05	3.9
Bayswater	35		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	36	BA		Siltstone, claystone, minor fine-grained sandstone/Conglomerate, sandstone, siltstone.	Clay, sandy clay and silty clay overlying shale and siltstone		7 and 3.5	4.35 and 0.39
Bayswater	37		Branxton Formation	Conglomerate, sandstone, siltstone.				
Bayswater	38		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	39	BY	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, sandy clay overlying shale		8	5.8
Bayswater	40		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	42		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	43	BE	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Gravelly Clay, Clay overlying silstone and shale. Fill to 5m in MW07		5.975	2.96
Bayswater	44	BP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	45	BP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, gravelly clay, clay and sandy clay overlying shale	0-0.2	4.26	1.5
Bayswater	46		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	47		Branxton Formation	Conglomerate, sandstone, siltstone.				
Bayswater	48		Branxton Formation	Conglomerate, sandstone, siltstone.				
Bayswater	49		Branxton Formation	Conglomerate, sandstone, siltstone.				
Bayswater	50		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	51		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	52		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	53		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	54	BY	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, sandy clay overlying shale		8	5.8
Bayswater	55		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	56		Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Bayswater	57	BR	Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.	Fill overlying siltstone, coal, sandstone. Fill to 17m MW06		17 and 50	20.814 and 29.02
Bayswater	58	BF	Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.	Clayey sand, clay, sandstone, siltstone, shale, conglomerate. Fill to 4m at MW05		10.83	12.73

Bayswater	59	BR	Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.	Fill overlying siltstone, coal, sandstone. Fill to 17m MW06		17 and 50	20.814 and 29.02
Bayswater	60	BR	Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.	Fill overlying siltstone, coal, sandstone. Fill to 17m MW06		17 and 50	20.814 and 29.02
Bayswater	61		Vane Subgroup, Archerfield Sandstone	Coal seams, siltstone, lithic sandstone, shale, conglomerate. Well sorted quartz lithic sandstone (Archerfield Sandstone)				
Bayswater	62		Vane Subgroup, Archerfield Sandstone	Coal seams, siltstone, lithic sandstone, shale, conglomerate. Well sorted quartz lithic sandstone (Archerfield Sandstone)				
Liddell	63		Saltwater Creek Formation	Sandstone, siltstone, minor coal bands				
Liddell	64		Vane Subgroup, Archerfield Sandstone	Coal seams, siltstone, lithic sandstone, shale, conglomerate. Well sorted quartz lithic sandstone (Archerfield Sandstone)				
Miscellaneous (BSW & LDL)	66		Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.				
Miscellaneous (BSW & LDL)	67		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	68		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	69		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	70		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	71		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	72		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	73		Branxton Formation	Conglomerate, sandstone, siltstone.				
Miscellaneous (BSW & LDL)	74		Branxton Formation	Conglomerate, sandstone, siltstone.				
Liddell	76	LL	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, Clay, sandy clay overlying shale		12.45	5.3
Liddell	77	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	78	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	79	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	80	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	81	LL	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, Clay, sandy clay overlying shale		12.45	5.3
Liddell	82	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Miscellaneous (BSW & LDL)	83		alluvium 38485	Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted				
Miscellaneous (BSW & LDL)	84		Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.				
Miscellaneous (BSW & LDL)	85		Wittingham Coal Measures	Coal seams, claystone, siltstone, sandstone, conglomerate.				
Liddell	86	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	87	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	88	LA	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay overlying siltstone		8.5	5.2
Liddell	89	LU	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay overlying sandstone		11	1.543
Liddell	90	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	91	LO	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clayey gravel, silty clay, sandy clay overlying siltstone		5.9	3.34
Liddell	92	LJ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, silty clay overlying siltstone	0-0.2	5	2.194
Liddell	93	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	94	LP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay, gravelly sand, gravel overlying weathered siltstone		5.9	2.4
Liddell	95	LP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay, gravelly sand, gravel overlying weathered siltstone		5.9	2.4
Liddell	95	LP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay, gravelly sand, gravel overlying weathered siltstone		5.9	2.4
Liddell	96	LE	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay, sandy gravel, gravelly clay, siltstone		3.54	2.9
Liddell	97	LN	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, gravelly clay overlying shale		6.2	2.11
Liddell	98	LN	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, gravelly clay overlying shale		6.2	2.11
Liddell	99	LN	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, gravelly clay overlying shale		6.2	2.11
Liddell	100	LO	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clayey gravel, silty clay, sandy clay overlying siltstone		5.9	3.34
Liddell	101	LC	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.				
Liddell	102	LK	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Sand, fill, clay overlying siltstone		-	-
Liddell	103	LJ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, silty clay overlying siltstone	0-0.2	5	2.194
Liddell	104	LJ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, silty clay overlying siltstone	0-0.2	5	2.194
Liddell	105	LQ	Unknown	unknown	Clayey sand, gravelly sand overlying siltstone, sandstone	0-0.2	-	4.29
Liddell	106	LQ	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clayey sand, gravelly sand overlying siltstone, sandstone	0-0.2	-	4.29
Liddell	107	LB	Branxton Formation	Conglomerate, sandstone, siltstone.	Fill, gravelly clay, clay, sandy clay overlying sandstone, conglomerate, siltstone		4.88	4.74
Liddell	108	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	109	LB	Branxton Formation	Conglomerate, sandstone, siltstone.	Fill, gravelly clay, clay, sandy clay overlying sandstone, conglomerate, siltstone		4.88	4.74
Liddell	110	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	111	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	112	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	113	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	114	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	115	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9

Liddell	116	LU	Branxton Formation	Conglomerate, sandstone, siltstone.	Clay overlying sandstone		11	1.685
Liddell	117	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	118		Saltwater Creek Formation	Sandstone, siltstone, minor coal bands				
Liddell	119		Saltwater Creek Formation	Sandstone, siltstone, minor coal bands				
Liddell	120		Saltwater Creek Formation	Sandstone, siltstone, minor coal bands				
Liddell	121	LS	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, gravelly clay, coal, fill overlying siltstone			2.26
Liddell	122	LP	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, clay, sandy clay, gravelly sand, gravel overlying weathered siltstone		5.9	2.4
Liddell	123	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	124	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	125	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	126	LS	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, gravelly clay, coal, fill overlying siltstone			2.26
Liddell	127	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	128	LV	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	129	LP	Unknown	unknown	Fill, clay, sandy clay, gravelly sand, gravel overlying weathered siltstone		5.9	2.4
Liddell	130	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	131	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	132	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	133	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	134	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	135	LD	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Fill, sandy clay, clay, shale, gravelly clay		7.15	3.224
Liddell	136	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	137	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	138	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	139	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	140	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	141	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	142	LI	Mulbring Siltstone	Siltstone, claystone, minor fine-grained sandstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	143	LI	Branxton Formation	Conglomerate, sandstone, siltstone.	Clay, coal, gravelly clay overlying shale		6.55	3.42
Liddell	144	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	145	LV	Branxton Formation	Conglomerate, sandstone, siltstone.	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Liddell	146	LV	mafic volcanics 42177	Basaltic flows, sills and dykes; teschenite	Silty sand, clay, coal, gravelly clay overlying shale and sandstone		6.2	3.9
Bayswater	Background Areas (bayswater)							
Liddell	Background Areas (Liddell)							

APPENDIX B – Proposed Project Schedule

#	Info	Title	Assigned Resources	Given Planned Work	Expected Start
0		**AGL MACQUARIE POWER STATION ASSESSMENTS**	**Dean Stafford; Rod…**		**4 May 2015 8:00 am**
1		**Preliminaries**	**Rod Harwood; Crai…**		**4 May 2015 8:00 am**
2		Kick Off Meeting	Rod Harwood; Craig…	9 hours	4 May 2015 8:00 am
7		EMP	Colin Biggs; Craig…	12 hours	5 May 2015 8:00 am
10		HASP	Dean Stafford; Crai…	24 hours	5 May 2015 8:00 am
13		SAQP	**AGL; Lee Dougless**	48 hours	**29 May 2015 12:3…**
14		Prep SAQP	Lee Dougless		29 May 2015 12:30…
16		AGL Review	AGL	2 days	9 Jun 2015 4:30 pm
18		Inductions	Craig Wellings; Rya…	9 hours	11 Jun 2015 2:30 pm
27		**Existing Data QA/QC & Integration Prep**	**Alex Mikov; Derek…**		**12 Jun 2015 2:30 pm**
28		Prelim Con Call ES/AGL	Alex Mikov; Natash…	4 hours	12 Jun 2015 2:30 pm
33		Existing Data Reveiw & QAQC	Natash Strohfeldt;…	60 hours	15 Jun 2015 9:30 am
36		GIS Framowork Development	Natash Strohfeldt;…	80 hours	23 Jun 2015 3:30 pm
39		**Mobilisation**	**Rod Harwood; Coli…**		**12 Jun 2015 2:30 pm**
40		Prep Planning Session	Rod Harwood; Craig…	8 hours	12 Jun 2015 2:30 pm
45		Contractor Breifing	Rod Harwood; Ryan…	8 hours	15 Jun 2015 1:30 pm
49		Team Breifing	Rod Harwood; Craig…	8 hours	16 Jun 2015 12:30 pm
54		Prep Site Setup	Rod Harwood; Craig…	8 hours	17 Jun 2015 11:30 am
60		Travel and Site Mobilisation	Craig Wellings; Rya…	8 hours	18 Jun 2015 10:30 am
70		**Site Works Bayswater**	**David Burns; Ray…**		**19 Jun 2015 9:30 am**
71		**Bore Drill & Well Install (121) Plus (4) Off Site Bores**	**Jack O'Shaunessy;…**		**19 Jun 2015 9:30 am**
72		Location Clearance	Ryan Wells; Doug C…		19 Jun 2015 9:30 am
75		Drill Bores Team A	Doug Craven		26 Jun 2015 4:30 pm
77		Drill Bores Team B	Colin Biggs		26 Jun 2015 4:30 pm
79		Drill Bores Team C	Jack O'Shaunessy		26 Jun 2015 4:30 pm
81		Well Install	Aisling Ogrady		26 Jun 2015 4:30 pm
83		**Excav Test Pits (51) Plus (6) Off Site Test Pits**	**Ryan Wells; Ryan S…**		**19 Jun 2015 9:30 am**
84		Location Clearance	Ryan Wells	20 hours	19 Jun 2015 9:30 am
86		Excavate Pits & Log	Ryan Stewart	50 hours	15 Jul 2015 12:30 pm
88		Check Reinstatement		6 hours	23 Jul 2015 8:30 am
89		Sample Wells OLD (88) Plus 23 Off Site Wells	Craig Wellings; Rya…	50 hours	19 Jun 2015 9:30 am
95		Sample Wells NEW (120) Plus 4 Off Site Wells	Craig Wellings; Rya…	50 hours	27 Jul 2015 8:00 am
101		Surface Water (32) & Sediments (68)	Ray Harwood	90 hours	13 Jul 2015 8:00 am
103		**Lab Analysis, QA/QC & Data Integration**	**Alex Mikov; Lab (T…**		**31 Jul 2015 12:00 pm**
113		**Reporting Bayswater**	**Rod Harwood; Der…**		**26 Aug 2015 10:0…**
114		Prep Draft Report	Ryan Wells	80 hours	26 Aug 2015 10:00…
116		Drafting	Derek Maschernas	30 hours	26 Aug 2015 10:00…
118		Review	Rod Harwood; Craig…	16 hours	8 Sep 2015 9:00 am
121		Finalise Draft Report	Ryan Wells; Admin…	30 hours	9 Sep 2015 4:00 pm
124		**Site Works Liddell**	**David Burns; Ray…**		**19 Jun 2015 9:30 am**
125		**Bore Drill & Well Install (85 Bores, 80 Wells) Plus (8)…**	**Greg Sheehan; Do…**		**3 Jul 2015 3:30 pm**
126		Location Clearance	Greg Sheehan; Dou…		3 Jul 2015 3:30 pm
129		Drill Bores Team A	Doug Craven		10 Jul 2015 8:30 am
131		Drill Bores Team B	Colin Biggs		3 Aug 2015 8:00 am
133		Drill Bores Team C	Jack O'Shaunessy		10 Jul 2015 8:30 am
135		Well Install	Greg Sheehan		10 Jul 2015 8:30 am
137		**Excav Test Pits (49) Plus (6) Off Site Test Pits**	**Greg Sheehan**		**19 Jun 2015 9:30 am**
138		Location Clearance	Greg Sheehan	20 hours	19 Jun 2015 9:30 am
140		Excavate Pits & Log	Greg Sheehan	50 hours	23 Jun 2015 11:30 am
142		Check Reinstatement		6 hours	30 Jun 2015 4:30 pm
143		Sample Wells OLD (59) Plus Zero Off Site Wells	Ryan Wells; Ryan St…	45 hours	19 Jun 2015 9:30 am
147		Sample Wells NEW (80) Plus 8 Off Site Wells	Ryan Wells; Ryan St…	45 hours	6 Aug 2015 4:00 pm
151		Surface Water (54) & Sediments (65)	Ray Harwood	90 hours	29 Jul 2015 12:30 pm
153		**Lab Analysis, QA/QC & Data Integration**	**Alex Mikov; Lab (T…**		**13 Aug 2015 4:00 pm**
154		Laboratory Analysis	Lab (TBA)	1.5 weeks	13 Aug 2015 4:00 pm
156		QAQC * ESDAT Entry	Natash Strohfeldt;…	1.5 weeks	26 Aug 2015 10:00…
159		GIS / EVS Implementation	Natash Strohfeldt;…	1 week	3 Sep 2015 4:00 pm
163		**Reporting Liddell**	**Rod Harwood; Gre…**		**10 Sep 2015 11:00…**
164		Prep Draft Report	Greg Sheehan	80 hours	10 Sep 2015 11:00 am
166		Drafting	Derek Maschernas	30 hours	10 Sep 2015 11:00 am
168		Review	Rod Harwood; Craig…	16 hours	23 Sep 2015 10:00 am
171		Finalise Draft Report	Ryan Wells; Admin…	15 hours	25 Sep 2015 8:00 am
174		**Site Works Tomago**	**David Adams; Davi…**		**12 Jun 2015 2:30 pm**
175		**PSI Tomago**	**David Adams**		**12 Jun 2015 2:30 pm**
176		Inspect	David Adams	30 hours	12 Jun 2015 2:30 pm
178		Report & SAQP	David Adams	10 hours	18 Jun 2015 8:30 am
180		**Bore Drill & Well Install (10 Bores to 10 Wells)**	**Doug Craven**		**15 Jul 2015 4:30 pm**
181		Cleanance & Drill Bores Team A	Doug Craven	16 hours	15 Jul 2015 4:30 pm
183		**Excav Test Pits (10)**	**Doug Craven**		**17 Jul 2015 2:30 pm**
184		Clear & Excavate Pits & Log	Doug Craven	50 hours	17 Jul 2015 2:30 pm
186		Sample Wells (10) Wells	Jacob King	10 hours	27 Jul 2015 10:30 am
188		**Lab Analysis, QA/QC & Data Integration**	**Alex Mikov; Lab (T…**		**28 Jul 2015 11:30 am**
189		Laboratory Analysis	Lab (TBA)	2 days	28 Jul 2015 11:30 am
191		QAQC * ESDAT Entry	Natash Strohfeldt;…	2 days	10 Sep 2015 11:00 am
194		GIS / EVS Implementation	Natash Strohfeldt;…	1 day	14 Sep 2015 9:00 am
198		**Reporting Tomago**	**Rod Harwood; Dav…**		**15 Sep 2015 8:00 am**
199		Prep Draft Report	David Adams	30 hours	15 Sep 2015 8:00 am
201		Drafting	Derek Maschernas	4 hours	15 Sep 2015 8:00 am
203		Review	Rod Harwood	4 hours	18 Sep 2015 11:00 am
205		Finalise Draft Report	David Adams; Admi…	8 hours	18 Sep 2015 3:00 pm
208		**Lake Liddel (Sediment, Water & Fish Sampling)**	**Admin Assist; Rod…**		**12 Jun 2015 2:30 pm**
209		**Field Works**	**Aquatic Ecologist**		**12 Jun 2015 2:30 pm**
210		Mobilise to Lake Liddel	Aquatic Ecologist	2 days	12 Jun 2015 2:30 pm
212		Sample (sediment, water, fish)	Aquatic Ecologist	7 days	16 Jun 2015 12:30 pm
214		**Lab Analysis, QA/QC & Data Integration**	**Alex Mikov; Derek…**		**24 Jun 2015 2:30 pm**
215		Laboratory Analysis	Lab (TBA)	1.5 weeks	24 Jun 2015 2:30 pm
217		QAQC * ESDAT Entry	Natash Strohfeldt;…	3 days	3 Jul 2015 11:30 am
220		GIS / EVS Implementation	Natash Strohfeldt;…	3 days	6 Jul 2015 10:30 am
224		**Reporting Lake Liddel**	**Alex Mikov; Rod H…**		**7 Jul 2015 9:30 am**
225		Prep Draft Report	Alex Mikov	40 hours	7 Jul 2015 9:30 am
227		Drafting & GIS	Derek Maschernas	4 hours	7 Jul 2015 9:30 am
229		Review	Rod Harwood	4 hours	13 Jul 2015 1:30 pm
231		Finalise Draft Report	Alex Mikov; Admin…	8 hours	14 Jul 2015 8:30 am
234		**Project Close Out Meeting**	**Rod Harwood; Gre…**		**28 Sep 2015 2:00 pm**
235		Document Hand Over/GIS Handover	Rod Harwood; Craig…	8 hours	28 Sep 2015 2:00 pm
240		Project Complete			29 Sep 2015 1:00 pm



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