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Orica Australia Pty Ltd

**Post Remediation Annual
Groundwater Monitoring
Event - June 2024**

Arsenic Remediation
Program, Orica Kooragang
Island

wsp

September 2024

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Post Remediation Annual Groundwater Monitoring Event - June 2024 Arsenic Remediation Program, Orica Kooragang Island

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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1 Introduction

WSP Australia Pty Ltd (WSP) was commissioned by Orica Australia Pty Ltd (Orica) to undertake an annual (June 2024) groundwater monitoring event (GME) at Orica's facility at Greenleaf Road, Kooragang Island, New South Wales (NSW) (the 'site') (**Figure 1**) in line with an Arsenic Groundwater Monitoring Program (GMP) as defined in the Long Term Environment Management Plan (LTEMP) (WSP, 2023 Rev2). This report details the results of the June 2024 annual GME and is the fifth annual monitoring report prepared under the LTEMP post completion of the remediation.

1.1 Background

1.1.1 Arsenic Remediation Program

Orica has completed a remediation program at the former arsenic sludge disposal pit in the north western portion of the site, **Figure 1**.

The remediation was undertaken between February and September 2019. The remediation program involved the construction of a containment system comprising a soil/bentonite cut-off wall with an integrated capping system designed to hydraulically isolate the identified arsenic contamination in accordance with the Remediation Action Plan (RAP) (Golder, 2016a). The cut-off wall component of the integrated system is approximately 12 m in depth and covers an area of approximately 4,200 m². A full description of the remediation and validation program is provided in the Remediation Validation Report (Golder, 2019b).

A requirement of Section 15 of the RAP, Action 2 (d and e) of the Management Order (MO) (Order No. 20181401) and Condition B9 and B10 of the Development Consent was the preparation and implementation of a LTEMP for the operational phase of the remediation system. The LTEMP was to incorporate any long-term requirements for the post remediation monitoring, maintenance and restrictions on site activities permitted to be undertaken in the vicinity of the containment system. The LTEMP is to be periodically revised based on monitoring results. The current revision of the LTEMP is Revision 2 updated in May 2023 (WSP, 2023).

1.1.2 Groundwater Monitoring Plan

The key purpose of the monitoring requirements of the GMP, as defined in Section 8 of the LTEMP, is to demonstrate that the containment cell is performing as per the design and achieving the Remediation Objective of segregating the residual source of arsenic from the surrounding groundwater system by reducing the flux of groundwater through the hydraulically isolated arsenic contamination. Reducing the groundwater flux through the source area is intended to reduce the contaminant mass flux of arsenic migrating off site. By achieving this Remediation Objective, the MO requirement of preventing further offsite migration of arsenic in groundwater will be considered to have been met.

Section 4.3 of the LTEMP provides the rationale for the 'weight of evidence' approach for the assessment of the hydraulic effects for assessing the ongoing performance of the containment cell. It is noted in the GMP that the chemical monitoring of arsenic is being undertaken as a 'secondary line of evidence' to provide long-term understanding of the redistribution of the arsenic contamination over time.

Based on the first three years of monitoring undertaken as part of the LTEMP, the monitoring requirements were revised, with the change being the reduction of groundwater data logger down-loads from quarterly to six-monthly (bi-annual). The revised monitoring requirements were incorporated into the LTEMP - Revision 2 (WSP, 2023).

1.2 Objective

The objectives of the post remediation GMP are to assess:

- hydraulic performance of the containment cell in accordance with the requirements of the Remediation Validation Report (RVR) (Golder, 2019b), and
 - long-term changes in the groundwater flow regime and dissolved arsenic distribution in groundwater down-gradient of the containment cell.
-

1.3 Monitoring Well Network

1.3.1 Containment Cell Wells

The groundwater network associated with the containment cell is a series of nested well suites at strategic locations on either side of the completed cut-off wall, such that the internal and external ‘piezometric’ water levels can be compared, enabling the hydraulic performance of the containment system to be assessed.

The containment cell monitoring well (MWCC series) network is shown in **Figure 2a** and defined in **Table A**. It comprises three sets of paired monitoring wells (a total of six nested well suites) located around the cut-off wall alignment. The selection of locations is constrained by the site characteristics and design features of the cell.

Well locations for the containment cell monitoring well monitoring network are described below:

- Eastern boundary (MWCC01), up-gradient of the containment cell.
- Western boundary (MWCC02), near the north-western corner of the containment cell, down-gradient.
- Southern Boundary (MWCC03), cross-gradient of the containment cell.

At each well suite location, three separate piezometers have been installed, one each into target Units 1, 2 and 3. This is considered an appropriate level of assessment and reflects the considerations presented in the groundwater model prepared for the design of the cell, which advocated such an approach.

An additional well has also been installed in the unsaturated zone to allow assessment of barometric pressures within the containment cell and allow ‘normalisation’ of the internal water level data, as required.

Groundwater level data loggers were installed within the containment cell wells to continually collect groundwater elevation data, thereby allowing assessments to demonstrate the containment cell is performing as per design. A barometric pressure logger was also installed in the dry (‘shallow’) well in the unsaturated zone to allow assessment of barometric pressure compensating for the influence of localised atmospheric pressure variation.

1.3.2 Surrounding Groundwater Monitoring Network

There is a network of groundwater monitoring wells located in the vicinity of the containment cell, primarily down-gradient, to assess and monitoring the spatial and temporal responses in arsenic concentrations. These monitoring wells are shown on **Figure 2b** and defined in **Table A**.

2 Scope of services

The scope of works undertaken was in accordance with the requirements of the LTEMP (Rev2) (WSP, 2023), and as summarised below.

2.1 Hydraulic Monitoring

2.1.1 Manual Measurement of Groundwater Depths

Standing water levels in each monitoring well listed in **Table A** were manually measured using an electronic water level ‘dipper’ probe. These were measured in a single water level measuring event, with measurements referenced to the top of the well casing.

2.1.2 Data Transducer Download

Electronically recorded groundwater elevation data was downloaded from each data logger using the *Solinst* Optical Reader cable, utilizing the *Solinst Levellogger™* series software.

Manual measurements of groundwater levels were collected prior to the data-logger download event as described in Section 2.1.1. Manual measurements were used to validate those groundwater levels estimated from data of the water pressure transducers and data loggers.

Groundwater levels from the water-pressure transducers were estimated using:

- the elevation of the water-pressure transducer in each well
- the total pressure measured by the water-pressure transducers
- corresponding measurements of barometric pressure, and
- the assumption regarding the density of the groundwater (in this case assumed to be 1.0 gram per millilitre).

The nominated hydraulic monitoring locations and the sampling methodologies are presented in **Table A** and the Sampling, Analysis and Quality Plan (SAQP) (Appendix A).

2.2 Chemical Monitoring (Arsenic)

Groundwater monitoring to assess dissolved arsenic concentrations in groundwater was undertaken as a ‘secondary line of evidence’. This has been carried out to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

Representative groundwater samples, including quality assurance and quality control (QA/QC) sampling, were collected at nominated locations in **Table A**. It should be noted that sampling at four offsite monitoring locations could not be completed due to access restriction (refer to Section 6.2).

The nominated chemical monitoring locations and the sampling and analytical (including QA/QC) methodologies are presented in Appendix A. Field sheets are presented in Appendix B.

2.3 Reporting

Preparation of this annual report to include the following:

- Summary of the project background, objectives and scope of the monitoring, site environmental setting.
- Presentation and interpretation of the hydraulic monitoring data including:

- Preparation of hydrographs illustrating comparative hydraulic responses of each well pair to external influences and the effect of the containment cell.
- Preparation of Figures presenting groundwater elevations/potentiometric surface for average water levels within and surrounding the containment cell.
- Interpretation of the hydraulic responses in the 'weight of evidence' approach.
- Presentation and interpretation of chemical monitoring data including:
 - Tabulation of chemical data.
 - Data validation.
 - Comparison to historic monitoring data (noting that changes in arsenic concentrations is considered to be a long-term response to the construction of the containment cell).
- Recommendations, in accordance with the requirement of the LTEMP (if required).

3 Site location and identification

3.1 Location and Identification

The site's main entrance is at 75 Greenleaf Road, Kooragang Island, NSW. The site is described as Lot 2 and Lot 3 in Deposited Plan 234288, and has an area of approximately 22 hectares.

The site is located on the south eastern peninsula of Kooragang Island at the confluence of the North and South Arms of the Hunter River (**Figure 1**).

3.2 Site Setting

A detailed description of the site land use, surrounding areas, history of use and geology and hydrogeology is provided in the Conceptual Site Model (CSM) (Golder, 2013). A brief summary is provided below, however, if further detail is required the CSM should be referred to.

Kooragang Island was originally a series of smaller islands which formed part of the Hunter River Delta. The southern portion of Kooragang Island was subsequently reclaimed² in the late 1950s and early 1960s from the original landform, which comprised a series of tidal mud flats, using dredged sand from the Hunter River. Since reclamation, the southern portion of Kooragang Island, including the area occupied by the site, has been developed for heavy industrial use, including port facilities, chemical manufacturing and storage, waste recycling and hazardous waste treatment.

3.2.1 Current Land Use

The Orica site is used for the manufacturing of ammonia and nitric acid as intermediate products in the production of ammonium nitrate for use in the mining sector. The Orica site is classified as a major hazard facility (MHF) as the site produces the scheduled materials ammonia and ammonium nitrate at rates that exceed threshold quantities specified in Schedule 15 of the *Work Health and Safety Regulation 2011*.

3.2.2 Surrounding Land Use

The southern portion of Kooragang Island, including the Orica site, is zoned 'Special Activities' under the New South Wales State Environmental Planning Policy (Major Projects) Amendment (Three Ports) 2009 under the Environmental Planning and Assessment Act 1979. The objective of this zoning is to facilitate development to maximise use of the port facility, particularly special land uses that are not allowed for in other zones as well as ensuring separation from residential areas and other sensitive land uses.

The Orica facility is surrounded (**Figure 1**):

- **To the west:** by East Coast Cement facility, immediately to the west of the remediation area, then by Heron Road where port related facilities are used for bulk goods handling at two Port of Newcastle (PoN) berths (Kooragang Berths No.2 and No.3) located adjacent to the South Arm of the Hunter River.
- **To the north:** by vacant land owned by Independent Cement and Lime, and Air Liquide who leases a fenced property on IPL owned land immediately to the north of the Ammonia Plant for purification, storage and despatch of carbon dioxide. Further north is a combination of operating facilities and vacant land owned by Incitec Pivot Limited (IPL) which operates a fertiliser storage and distribution facility.
- **To the east:** by Greenleaf Road, and on the opposite side of Greenleaf Road the Park Fuels facility which includes a number of large fuel tanks and associated bunding or grass vacant land owned by the PoN and then the North Arm of the Hunter River.

- **To the south:** by warehousing operated by logistics company Linx for the storage and distribution of bulk goods, followed by Heron Road and the Walsh Point Reserve. The Walsh Point Reserve represents both the southern extent of Kooragang Island and the point at which the North and South Arms of the Hunter River converge.

3.3 Geological Profile

A detailed summary of the inferred site hydrostratigraphy is reported in Module D of Golder (2016b). The site is underlain by appreciable thicknesses of sedimentary materials overlying bedrock at approximately 35 to 40 m below ground surface. Detailed investigations have allowed the unconsolidated materials to be divided into hydrostratigraphic 'units' which exhibit common hydrogeological characteristics. These are, from shallow to deepest:

- Unit 1: fill and reclaimed sands;
- Unit 2: estuarine silt and clay;
- Unit 3: alluvial sand;
- Unit 4: coarse fluvial sand;
- deeper sands and clays; and
- Permian bedrock.

3.4 Contaminant History

A summary of arsenic contamination associated with the former sludge disposal pit is presented in the CSM (Golder, 2013). Provided below is a summary of arsenic contamination in the area to which the MO applies. In general, this contamination is located in an area of approximately 4,000 m² in the north-western portion of the Orica site, bounded to the north by the Incitec Pivot Limited site and to the west by the East Coast Cement Pty Ltd site (**Figure 1**).

3.4.1 Former Sludge Disposal Pit

The former sludge disposal pit (**Figure 1**) was used for the disposal of solids and liquid arsenic wastes from the Vetrocoke process used at the Ammonia Plant from late 1960s to 1994.

Although the primary source of contamination has been removed (ceased disposal), residual arsenic sorbed to soils beneath the former pit and in the surrounding subsurface represent an ongoing source of arsenic to groundwater.

3.4.2 Soil Contamination

Beneath the remediated extent of the former pit on site, residual arsenic soil concentrations average 170 mg/kg, 540 mg/kg and 130 mg/kg in Units 1, 2 and 3 respectively beneath the former pit. Maximum arsenic concentrations reported are of the order of 1,900 mg/kg, whilst the estimated mass of arsenic in soil on site is 8,200 kg (Appendix A of Orica, 2013).

Further investigations were completed as part of the remediation design in part to define the lateral and vertical extents of arsenic contamination (Golder, 2016b). The extent of identified arsenic contamination based on soil and groundwater data collected from the remediation investigation and previous investigation was defined as an area of approximately 55 m (north-south) by 75 m (east-west). The vertical extent of arsenic contamination is approximately 8 m below ground level (bgl).

3.4.3 Groundwater Contamination

Dissolved arsenic in groundwater is present below and down-gradient (west-northwest) of the former sludge disposal pit. Concentrations of arsenic in groundwater on site have ranged between 15 mg/L and 85 mg/L, with concentrations decreasing since the remediation of the former disposal pit in 2005.

The highest dissolved arsenic concentrations occur between 3 and 7 m bgl. At depths greater than approximately 8 m bgl, dissolved arsenic concentrations are much lower (typically <1 mg/L).

The predominant arsenic species in groundwater is As (III) (arsenite) with a minor portion as As(V) (arsenate), which is consistent with the original arsenic source (arsenic trioxide) and the groundwater geochemistry (mildly reducing). Both As(III) and As(V) are inferred to be present predominantly as oxyanions (including their hydrogen substituted forms) in groundwater (Golder, 2013).

A fate and transport review indicated that arsenic, either released from arsenic trioxide solution during operation of the sludge disposal pit or as a result of the subsequent leaching of arsenic from the contaminated soils below the pit, has entered into the vadose zone below the former pit and then the saturated zone (groundwater). Dissolved arsenic has then migrated with the groundwater flow. Arsenic has adsorbed to aquifer matrix materials along groundwater flow paths until the attenuation capacity of the aquifer is exceeded, with dissolved arsenic concentrations thereby migrating slower than the groundwater flow. Investigations have confirmed that the predominant process attenuating arsenic in the aquifer is adsorption onto naturally occurring iron minerals (particularly hydrous ferric (oxy) hydroxides (HFO)) (Golder, 2013).

4 Data quality objectives

The Data Quality Objectives (DQO) for the post-remediation GMP have been developed in accordance with the seven-step process described in the National Environmental Protection Measure, Schedule B2.

The Data Quality Indicators (DQIs) that are used to assess the reliability of field procedures and analytical results are described in Appendix A.

4.1 State the Problem

Remediation of the identified arsenic contamination was completed by the construction of a containment cell to prevent the further off-site (Orica) migration of arsenic in groundwater. The monitoring of groundwater elevations is required to confirm the containment cell is performing as per its design. Chemical (arsenic) monitoring is required as a secondary line of evidence to confirm further off-site migration is not occurring.

Monitoring of groundwater elevations and dissolved arsenic concentrations is purposely more intensive in the initial years to confirm the containment cell is performing as per the design. Once this has been confirmed monitoring requirements will be reduced to provide sufficient data to confirm ongoing performance of the containment cell.

4.2 Identify the decision / goal of the study

To assess the efficacy of the hydraulic segregation of the arsenic source, a ‘weight of evidence’ approach considering the consistency of the observed hydraulic effects of the containment system on groundwater elevations with those effects predicted by the groundwater modelling completed during the design.

Predicted potential hydraulic effects of the containment system as inferred from the numerical groundwater flow modelling included:

- A flattening of the groundwater table(s) inside the cell relative to external conditions.
- An increase in the external hydraulic gradient across the cell (in the direction of groundwater flow), and/or potential increase in gradients around the perimeter of the cell.
- The detection of responses to rainfall events that may be recorded in the external wells, but which would be expected to be less prevalent in the data collected from inside the wall.

Groundwater monitoring to assess arsenic concentrations in groundwater will be undertaken as a ‘secondary line of evidence’ to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

4.3 Identify the information inputs

Hydraulic monitoring includes the long-term assessment of groundwater levels in the three hydrostratigraphic units both inside and outside of the containment cell, to allow consideration of the effectiveness of the containment cell.

Chemical monitoring includes the assessment of dissolved arsenic concentrations down-gradient of the containment cell to provide data for the long-term trends and confidence that the containment cell has prevented the further off-site migration of dissolved arsenic in groundwater by confirmation of a stable or decreasing dissolved arsenic concentrations.

4.4 Define the boundaries of the study

Monitoring is to be undertaken both within and immediately outside the containment cell within the three sets of paired monitoring wells located around the containment cell. These wells target the three hydrostratigraphic units in which the cut-off wall has been constructed to contain the identified arsenic contamination.

Further to the wells located adjacent to the containment cell, groundwater monitoring wells located in the vicinity of the containment cell, predominantly down-gradient of the cell, will also be used in the ongoing performance assessment.

The monitoring network is defined in Section 1.3 and in Table A.

The duration of the monitoring program will continue to confirm the long-term performance of the containment cell.

4.5 Develop the analytical approach

Hydraulic monitoring of groundwater levels is to consider data collected using both manual gauging and down-hole water level loggers that log hydraulic data continuously. A barometric logger was also be used to compensate for the influence of localised atmospheric pressure variation within the containment cell. Data loggers were programmed to collect water level data at 2 hourly intervals.

Chemical monitoring includes the collection of representative groundwater samples and analysis for dissolved arsenic at a commercial environmental laboratory.

Quality assurance (QA) and quality control (QC) sampling and requirements are presented in Section 6.1.

Validation of the data will be undertaken as described in Section 6.2.

4.6 Specify performance or acceptance criteria

There are no specific performance or acceptance criteria for assessing the performance of the containment cell. As indicated in Section 4.1 a ‘weight-of-evidence’ approach will be applied to assessing the hydraulic data to verify that the design outcome of hydraulic segregation has been achieved. The key indicators of the hydraulic segregation are presented in Section 4.2.

4.7 Develop the plan for obtaining the data

The GMP (as defined in Section 8 of the LTEMP) and the SAQP (Appendix A) defined the plan for obtaining the necessary hydraulic and chemical data required to assess the ongoing performance of the containment cell. The GMP and SAQP will be reviewed and updated throughout the implementation of the LTEMP, as required and as a minimum 2 yearly in accordance with the requirements of the consent/MO.

5 Hydraulic Monitoring results

5.1 Quality Assurance / Quality Control (QA/QC)

5.1.1 Groundwater Data Logger Performance

Groundwater level data loggers recorded groundwater pressures (which were used to derive groundwater elevations) and temperature at two-hourly intervals throughout the monitoring period described in this report. These have collected data considered suitable for the assessment of groundwater elevations in each of those groundwater monitoring wells surrounding the containment cell, however the following issues were encountered with the those data loggers installed in the following wells.

- MWCC01-6OUT: this logger was re-installed in March 2024 after the previous logger ceased recording in July 2023.
- MWCC01-9OUT and MWCC02-3OUT: these loggers ceased recording data in January 2024, and data unable to be downloaded in the June 2024 monitoring event. These loggers were subsequently replaced during this monitoring event.
- MWCC02-6IN and MWCC03-6IN: these loggers were identified to be faulty in the July 2023 monitoring round and were replaced in October 2023.
- MWCC03-9IN recorded decreasing water pressures (i.e., levels) in March 2024. Data was not able to be downloaded from this logger in the field, however was later able to be recovered after the logger was returned to the manufacturer. This logger was repaired by the manufacturer and reinstalled in this well, and its performance will be monitored in future monitoring rounds.

5.1.2 Data Gaps

During the June 2024 post remediation GME, the following data gaps were noted:

- Unable to download data from those data loggers installed in MWCC01-9OUT and MWCC02-3OUT.
- Manual water levels were not able to be measured in offsite (Port of Newcastle) monitoring wells POMW60-3, POMW60-6, POMW60-9 and POMW60-12 due to access constraints associated with construction activities; a temporary shed blocked access.

The omission of manual groundwater levels or data logger outputs at these locations are not considered to influence the long-term interpretation of the performance of the containment cell as the combined knowledge of groundwater flow direction and gradient complemented with the available data provide sufficient understanding of the groundwater responses within the vicinity of the containment cell.

5.2 Hydrographs

Hydrographs for those nested well sets located on the eastern (MWCC01), western (MWCC02) and southern (MWCC03) side of the containment cell are presented in Appendix C. Two separate Hydrographs are presented for each nested well clusters:

- 1 One hydrograph showing groundwater elevations between June 2019 to June 2024 summarising that monitoring carried out since the construction of the containment cell; and
- 2 A second hydrograph summarising that groundwater elevation data for the current monitoring 'year' between July 2023 to June 2024.

Rainfall data shown on the hydrographs was obtained from the Bureau of Meteorology (BoM) weather station at Nobby's Head (Station No. 061055) located 3 km south-east of the site; this is the nearest BoM weather station to the site.

When reviewing the hydrographs it should be noted the application of the geomembrane of the containment cell cap was completed by 27 July 2019. As such it is likely groundwater level measurements from those wells within the containment cell following this date may reflect lower infiltration rates of rainfall recharge into the containment cell.

For the period 27 July 2023 to 28 June 2024, key observations from the hydrographs are summarised below.

- Groundwater elevations in Unit 1 and some Unit 2 outside the containment cell respond to rain events, whilst little or no response to the same events is observed in the corresponding wells inside the containment cell.
- Groundwater elevation responses to three heavy rainfall events either in aggregate and/or duration during the monitoring period (namely between 4 April to 6 April 2024 comprising 112 mm, 19 April to 21 April 2024 comprising 82 mm and 1 May to 8 May 2024 comprising 197 mm) were observed in those wells screened in Unit 1 outside of the containment cell.

During these events a coincidental – albeit subdued – increase in groundwater elevations was also observed in those wells installed in Unit 1 within the containment cell. These elevation changes were less than 0.4 m, whilst elevation changes in those wells outside of the containment cell ranged between 1.0 and 1.7 m.

- For the heavy rainfall events, in April and May as described in the above bullet point, groundwater elevations in groundwater monitoring wells installed within the cell were observed to:
 - increase slightly after groundwater elevation increases observed in respective counterpart wells installed on the outside of the cell, and
 - decline after the groundwater elevation declines observed in respective counterpart wells installed on the outside of the cell.

Given however groundwater pressures within the cell did not show coincidental increases to rainfall events of lesser magnitude or duration, it is considered those rises on groundwater elevations observed within the cell during these 'large' rainfall events are in response to localized pressure changes and loadings in the respective hydrostratigraphic units in response to increased groundwater levels outside of the cell (both locally and regionally). As such these changes in groundwater elevations are not thought to be indicative of the infiltration of rainfall through the cell capping.

- Changes in groundwater elevations due to tidal loadings on aquifer pressures are evident in all monitoring wells except MWCC01-3IN and -3OUT, MWCC01-6OUT MWCC02-3IN, -3OUT and MWCC03-3IN and -3OUT
- Groundwater elevations in the paired well sets for Unit 1 (and Unit 2 at MWCC01) both inside and outside the cell appear to respond independently and differently (pressure changes inside the cell described above) to rainfall following the completion of the cap liner. This suggests groundwater within the cell is hydraulically separated from that groundwater outside of the cell by the cut-off wall (i.e. different head present within the same hydrostratigraphic units inside and outside of the cell).
- Groundwater elevations in Unit 1 within the cell continue to decline slowly following the completion of the cap liner. This is consistent with previous observations.
- Groundwater elevations in those wells screened in Unit 1 are generally between about 0.5 m and 1 m higher than those in Unit 2. However, during the significant rainfall event in April and May 2024, groundwater elevations in Unit 1 were 2m higher than those in Unit 2.

5.3 Groundwater Level Contours and Hydraulic Gradients

Groundwater contours based on the 24 to 28 June 2024 monitoring event are summarised in **Table B1** and **B2** and presented in **Figures 3a, 3b** and **3c** for Unit 1, Unit 2 and Unit 3 hydrostratigraphic units, respectively. Field sheets are presented in Appendix B.

In summary groundwater elevations indicate the following.

Unit 1 – Comprising MWCC01 to MWCC03 -3IN and -3OUT.

- Groundwater elevations within the containment cell are lower than those observed on the outside of the cell.
- Within the containment cell, a relatively flat water table at about 1.20 m AHD had developed. A similar observation was made during the January 2024 monitoring event.
- Groundwater elevations in those wells installed outside the containment cell show the hydraulic gradient in this unit is from east to west; i.e., towards the South Arm of the Hunter River. This is consistent with the regional groundwater flow direction in this unit prior to construction of the containment cell.
- Groundwater mounding is evident to the east and south (i.e., up-gradient) of the containment cell as shown by groundwater levels in MWCC01-3OUT and MWCC03-3OUT. This mounding is consistent with that observed during previous monitoring events.

Unit 2 – Comprising MWCC01 to MWCC03 -6IN and -6OUT.

- Within the containment cell, a relatively flat hydraulic gradient has developed at an elevation of about 0.72 m AHD.
- Groundwater elevations within the containment cell appear to be approximately 0.6 m lower than the groundwater level up-gradient of the cell as evidenced in MWCC01-6OUT.
- Groundwater elevations in those wells across and down-gradient of the cell (i.e., MWCC02-6OUT and MWCC03-6OUT respectively) were about 0.1 m higher than those inside the cell. This is expected to be due to those significant rainfall events that occurred in April and May 2024.
- Outside the containment cell groundwater in this unit flows to the west (again towards the South Arm of the Hunter River), which is consistent with the groundwater flow direction prior to construction of the cell.
- Groundwater mounding appears to be occurring up-gradient and to the east of the containment cell as suggested by groundwater elevations in MWCC01-6OUT. As discussed above, slight tidal effects are beginning to be observed in Unit 2 and could potentially influence measured water levels in this unit.

Unit 3 – Comprising MWCC01 to MWCC03 -9IN to -9OUT.

- Within the containment cell, a relatively flat gradient has developed at 0.7 m AHD between groundwater monitoring wells MWCC02-9IN and MWCC03-9IN, with the groundwater elevation in MWCC01-9IN of 0.35 m AHD. The temporary development of slight hydraulic gradient, considered to represent the pre-construction groundwater flow directions, is suggestive of localized changes in groundwater pressures (associated with large rain events during April and May) rather than the down-ward movement of groundwater from Units 1 and 2 due to infiltration of water into the cell. It is anticipated that a flat gradient within cell will re-established once these pressures have re-equilibrate.
- Groundwater elevations in those wells within the containment cell are generally about 0.1 m higher than groundwater elevations in those wells outside of the cell, albeit with the exception of MWCC01 which is ~0.5 m higher.
- Outside the containment cell the hydraulic gradient is reasonably flat as inferred from groundwater elevations in MWCC01-9OUT (0.85 m AHD) and MWCC03-9OUT (0.66 m AHD), with a slight decline to the west. The groundwater elevation in MWCC02-9OUT, the down gradient monitoring well, was 0.59 m AHD.

5.4 Assessment of the Containment System – Hydraulic

As described in the RVR (Golder, 2019b), the validation of hydraulic containment within the containment cell is primarily based on groundwater elevation measurements in Units 1, 2 and 3 both inside and outside of the cell. Table 5.1 provides a framework to outline the hydraulic verification outcome matrix and allows effect to be tracked during the remainder of the hydraulic verification process. The assessment of hydraulic responses has considered data available since the completion of remediation in September 2019.

Table 5.1: Verification Outcomes Matrix

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
Groundwater level changes in response to rainfall events that may be observed in external wells, but which would be expected to be less prevalent in magnitude and frequency within the cell.	Yes	The effect of rainfall infiltration on groundwater elevations is presented in the hydrographs; refer to Appendix C. Large rain events have occurred post construction of the containment cell. Groundwater elevations increase in response to rainfall in those wells screened in Unit 1 and located outside of the containment cell when compared to those wells located within the containment cell. Increasing groundwater elevations in response to rainfall can also be seen in some of those wells screened in Unit 2 outside of the containment cell. Given however this unit is an aquitard, the lack of any notable response in these wells is not considered to reflect either the design or performance of the containment cell. Groundwater elevation changes in response to heavy rainfall events are observed in those wells screened in Unit 1 outside of the containment cell; for these events a ‘muted’ increase of groundwater levels was also observed in the corresponding wells inside the containment cell. These responses within the cell during these rainfall events though are considered to reflect localized pressure changes and loadings in the respective hydrostratigraphic units as a result of increased groundwater elevations outside the cell (both locally and regionally), rather than being indicative of the infiltration of rainfall through the cell capping.
A flattening of the groundwater table(s) inside the cell relative to external conditions.	Yes	A flattening of the water table is evident in the Unit 1 and Unit 2 within the containment cell, whereas hydraulic gradients – with groundwater flowing to the west / north-west and ultimately discharging to discharging to the Southern Arm of the Hunter River – is still evident in all units outside of the containment cell; this is also evident during those above average high-intensity and/or long-duration rainfall events in the Newcastle area (refer to Figures 3a and 3b). In Unit 3, flattening of the groundwater table inside the containment cell appears to be occurring (Figure 3c), however, is not as pronounced as that inferred in Units 1 and 2. This is likely a combination of the fact that the Unit 3 wells (screened 8 to 10 m bgl) are closer to the base of the wall (12 m bgl) and possible tidal influences which can be observed in the hydrographs for Unit 3 wells. Data also shows possible tidal influence in those wells screened in Unit 2.

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
A higher external hydraulic gradient across the cell (in the direction of groundwater flow) and/or potential increase in gradients around the perimeter of the cell.	Yes	An external hydraulic gradient with flow to the west is evident – and continues to be evident – in each hydrostratigraphic unit, including during and after those above average high-intensity and/or long-duration rainfall events between April and May 2024. This is consistent with the groundwater flow directions observed prior to the construction of the containment cell. Furthermore, in Units 1 and 2 there appears to be some mounding occurring on the eastern (up-gradient) side of the containment cell (i.e., in groundwater monitoring wells MWCC01-3OUT and -6OUT).
Water levels (groundwater elevations) in Units 1 and 2 will be lower inside the cell by an order of 1 to 2 m, while groundwater elevations in Unit 3 will be slightly higher on the inside.	Yes	There appears to be a lowering of groundwater elevations in Units 1 and 2 within the containment cell (relative to groundwater elevations outside of the cell). However, it should be noted that groundwater elevations outside the cell, particularly in Unit 1, are notably influenced by rainfall events. As such, those rain events discussed in Section 5.2 need to be considered when assessing the difference in groundwater elevations inside and outside of the cell. There continues to be a gradual lowering of groundwater elevations over the monitoring period (July 2023 – June 2024) within the containment cell in Unit 1 between rain events, with groundwater elevations declining from approximately 1.0 m AHD to 0.8 m AHD. Groundwater elevations in Unit 2 up-gradient and inside of the cell are about 0.6 m lower than groundwater elevations outside of the cell. Conversely, groundwater elevations on the down-gradient side of the cell are 0.1 m higher within the cell. This is expected to reflect the mounding of groundwater on the up-gradient side of the cell, particularly during and immediately following ‘large’ rain events. For Unit 3, groundwater levels on the up-gradient side of the cell are lower inside the cell (0.5m lower), whereas, at the down-gradient side groundwater levels are slightly (0.2 m) higher within the cell.

6 Arsenic monitoring

6.1 Quality Assurance / Quality Control (QA/QC)

During the GME (between 24 to 28 June 2024), those QA/QC procedures detailed in Appendix A and summarised below were implemented.

- Equipment used to perform testing or data recording (i.e. the water quality meter, electronic water level probe) was calibrated to manufacturer's specifications by the supplier prior to use. Calibration recorded for June 2024 are presented in Appendix B.
- Groundwater samples were collected in accordance with the SAQP (See Appendix A).
Groundwater purging records summarising data collected during groundwater sampling, including groundwater elevation prior to purging and measurements of field physio-chemical parameters (such as pH, electrical conductivity and dissolved oxygen content) are included in Appendix B.
- The field QC samples listed in Table 6.1 were collected during this groundwater sampling event.

Table 6.1: Field QC Samples during the June 2024 monitoring event

Primary Sample	Duplicate Sample	Triplicate Sample	Field Blank
MWCC02-9IN	D01_20240625	T01_20240625	--
GW03-I	D02_20240625	T02_20240625	--
BP5-6	D01_20240628	T01_20240628	--
--	--	--	FB01

In addition to the field QC samples, the laboratory prepared and analysed the following QC samples with each laboratory batch:

- laboratory duplicates
- laboratory blanks
- matrix spikes, and
- laboratory control samples.

6.2 Data Gaps

During the post remediation GME, June 2024, four monitoring locations (POMW60-3, POMW60-6, POMW63-9 and POMW60-12) on Port of Newcastle land were unable to be accessed and sampled due to construction activities onsite with a temporary shed blocking access. As the purpose of the monitoring of arsenic concentrations is to assess long-term trends in arsenic concentrations this is not considered to be a significant data gap.

6.3 Data Validation

Validation of the reported analytical data was undertaken to ensure that data of known quality are reported and to assess whether the data can be relied upon to fulfil the overall monitoring objectives.

The data validation guidelines adopted were based on the following data validation guidance documents published by the United States Environmental Protection Agency (USEPA) and the National Environment Protection Council (NEPC):

- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (EPA 540-R-10-011, dated January 2010).
- National Environmental Protection (Assessment of Site Contamination) Measure 1999 (April 2013).

Based on the data validation summary report presented in Appendix D, it is considered that the analytical data is suitable for environmental interpretive use.

Laboratory analytical reports are also included in Appendix D.

6.4 Groundwater Field Parameters

Groundwater field parameters collected during the June 2024 monitoring event is presented in **Table B2**, the data indicates the following.

- pH values at the monitoring locations ranged from approximately 6.5 to 8.6, indicating slightly acidic to alkaline groundwater conditions over the monitoring round.

Wells inside the cut-off wall reported slightly higher pH levels, between 6.9 and 8.6 with an average of 7.8 (based on the hydrogen ion concentration), than that in the surrounding groundwater network.

In stating the above, groundwater pH may have been influenced by the materials used in the construction of the cut-off wall. The design specification allowed the bentonite slurry to have a pH of 7 to 11, with daily records completed throughout the construction phase measuring pH's of about 9 on almost all occasions (LTEMP 2019, REV0).

- Groundwater was generally reducing with low measurements of oxidation/reduction (redox) potential, ranging from -6 to 320 millivolts (mV).

Dissolved oxygen values were also similarly low, less than 1 milligram per litre (mg/L) in most wells.

- The electrical conductivity on site to Heron Road was fresh to moderately brackish (ranging from 670 to 3,200 microSiemens per centimetre, $\mu\text{S}/\text{cm}$) and was increasingly saline with depth and proximity to the South Arm of the Hunter River (up to 9670 $\mu\text{S}/\text{cm}$ in well GWW03D). The vertical and horizontal differences in electrical conductivity close to the river are influenced predominantly by saline intrusion from the Hunter River (URS, 2014).

Groundwater chemistry from the June 2024 monitoring event is consistent with that (i) of previous monitoring rounds, and (ii) presented in the CSM (Golder, 2013), albeit with the exception of higher groundwater pH observed in those wells adjacent to the cut-off wall. These, however, have decreased during monitoring events post construction.

6.5 Arsenic Groundwater Analytical Data

The analytical results are screened against Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) trigger values for the protection of 95% species in marine water in slightly to moderately disturbed ecosystems. The Australian and New Zealand Guidelines only includes low-reliability trigger values (known as indicative interim work levels – IIWLs) for As (III) and As (V) in marine waters (0.0023 mg/L and 0.0045 mg/L, respectively) and do not provide a specific guideline value for arsenic (dissolved) in marine waters. Given that previous geochemical assessment undertaken at the site has indicated that arsenic in groundwater is present predominantly in the

As (III) state (a more toxic state than As (V)) and the trigger value for As (III) is lower than that for As (V), the low-reliability working level trigger value for As (III) in marine waters has been adopted for screening purpose as a conservative measure.

The arsenic groundwater analytical results from June 2024, including comparison with the As (III) trigger level (ANZG 2018), are presented in **Table B2**.

Review of the fifth round of monitoring post remediation indicated the following:

- Monitoring wells located (i) on the inside of the Eastern Wall (MWCC01) up-hydraulic gradient of the former disposal pit, and (ii) on the inside of the Southern Wall (MWCC03) across-hydraulic gradient of the containment cell were those with low concentration of dissolved arsenic, typically less than 0.4 mg/L. These concentrations are consistent with those expected in areas up-gradient of the former disposal pit source areas.
- Monitoring locations on the inside of the Western Wall (MWCC02) down-hydraulic gradient of the former disposal pit reported dissolved arsenic concentrations consistent with former concentrations detected down-gradient of the former source area, with a maximum concentration of 68.1 mg/L. This is consistent with previous monitoring events since the completion of the remediation.

6.5.1 *Historical Arsenic Concentrations*

The following sections present discussions regarding trends observed in dissolved arsenic concentrations. Arsenic groundwater analytical results are presented in **Table B2** and historical analytical results are present in **Table C**.

6.5.2 *Temporal Trends in Arsenic Concentrations*

The objective of that monitoring discussed in this report is to assess long-term trends of dissolved arsenic in groundwater post remediation. Given, however, this is only the fifth monitoring round post remediation and to date there is only limited monitoring data post remediation for those wells located adjacent to the containment cell (i.e., at IPL and the Port of Newcastle lands), discussion of temporal trends are considered preliminary only.

Temporal trends of dissolved arsenic concentrations have been presented in Table 6.2 (with trend analysis calculation sheets are presented in Appendix E); these provide a 'baseline' to assess the development of long-term arsenic trends as part of the monitoring program. The following should be noted when considering the trend in arsenic concentration at the monitoring wells located down-gradient of the containment cell:

- The trends in arsenic concentrations may be influenced by past disposal practices and remediation works. Disposal practices may have resulted in pulses of arsenic moving within the aquifer whereas previously completed remediation may result in declining concentrations. Previous remediation includes:
 - cessation of disposal of arsenic (primary source) to the former pit in 1994;
 - removal of secondary source of contamination, with the remediation of contaminated soil beneath the former pit to the depth of the groundwater table in 2005; and
 - geochemical fixation remediation trial in 2010/2011 which involved the introduction of iron compounds to assist with attenuation of arsenic.
- The installation of the cut-off wall is likely to have disturbed the aquifer and associated groundwater quality in the vicinity of the wall resulting in short-term mobilisation of arsenic.
- The distance of the well from the containment cell given the groundwater velocity (range between <1 m/year up to 100 m/year), it may take several years to decades before the effects of the containment cell are seen at wells located near Heron Road.
- The monitoring of dissolved arsenic concentrations to provide a 'secondary line of evidence' of the long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

Table 6.2: Trend Analysis

Well ID	Trend in Arsenic Concentrations	Distance from Containment Cell	Comments
MWCC01-3IN	Stable	0 m	- Wells located within the containment cell. - Dissolved arsenic trends assessed using concentrations from the five previous monitoring rounds. - Preliminary trend analysis for dissolved arsenic concentrations completed for locations within the containment cell.
MWCC01-6IN	Decreasing	0 m	
MWCC01-9IN	Stable	0 m	
MWCC02-3IN	Stable	0 m	
MWCC02-6IN	Stable	0 m	
MWCC02-9IN	Stable	0 m	
MWCC03-3IN	No Trend	0 m	
MWCC06-3IN	Stable	0 m	
MWCC03-9IN	No Trend	0 m	
MW54	Decreasing	<10 m	Monitoring well located adjacent to the containment cell, with initial concentrations of dissolved arsenic thought to have been influenced by (i) the construction of containment cell, and (ii) other previous remediation works.
BP7-3	Prob. Decreasing	50 m	Subject to season variability due to groundwater level response to rain events.
BP7-6	Decreasing	50 m	- Located within 50 m of the containment cell. - Dissolved arsenic concentrations may have been influenced by (i) the construction of containment cell, and (ii) other previous remediation works.
BP7-9	Decreasing	50 m	Monitoring resumed at this location. Decreasing trend observed, similar to that in the shallow wells at this location.
BP5-3	Stable	120 m	- Historical fluctuations at these wells likely to be influenced by (i) the construction of containment cell, and (ii) other previous remediation works. - Dissolved arsenic concentrations during this monitoring event though unlikely to be influenced by containment cell construction at present
BP5-6	Increasing	120 m	
BP5-9	Increasing	120 m	

Well ID	Trend in Arsenic Concentrations	Distance from Containment Cell	Comments
MW21A	Decreasing	140 m	Located within 130/140 m of cell. Long-term decreasing trend likely to be reflective of previous remediation works.
MW50	Decreasing	130 m	
GWW02S	Stable	120 m	Less long-term monitoring data at these locations (2014). Located within 120 m of cell and unlikely to be influenced by the containment cell construction at present. Likely to be influenced by previous disposal practices as well as previous remediation.
GWW02I	Decreasing	120 m	
GWW02D	Increasing	120 m	
GWW03S	Stable	120 m	
GWW03I	Increasing	120 m	
GWW03D	Prob. Increasing	120 m	
POMW7	Decreasing	200 m	- Located within 200-250 m of cell and unlikely to be influenced by the containment cell construction at present. Likely to be influenced by previous disposal practices as well as previous remediation. Arsenic concentrations are lower at these locations west of Heron Road. - Note access to POMW60 series of wells has been limited in 2023 and 2024 due to temporary shed located on the location.
POMW60-3	No Trend	200 m	
POMW60-6	Decreasing	200 m	
POMW60-9	No Trend	200 m	
POMW60-12	No Trend	200 m	
POMW62-6	Decreasing	250 m	
POMW63-3	Decreasing	220 m	
POMW63-6	No Trend	220 m	
POMW63-9	No Trend	220 m	
POMW63-12	Prob. Increasing	220 m	

6.5.3 Spatial Trends

The spatial distribution of dissolved arsenic concentrations from the June 2024 monitoring event is presented on Figures 4A to 4C for Units 1 to Unit 3 respectively. Consideration of the spatial distribution as well as the historical data indicated the following.

- Dissolved arsenic concentrations reported in Unit 2 (i.e. intermediate monitoring wells) were generally higher than those of Units 1 and 3 (i.e. shallow and deep wells), which is consistent with:
 - (i) a shallow source of dissolved arsenic within Unit 1, and

- (ii) downward hydraulic and diffusion gradients, both of which influence dissolved arsenic concentrations migration towards the Hunter River.
- Dissolved arsenic concentrations in up- and cross-gradient wells (i.e., MWCC01 and MWCC03) of the former disposal pit were lower than those adjacent to the down-gradient wall (MWCC02), which is consistent with the location of the source area (disposal pit) and groundwater flow conditions.
- Monitoring wells located east of Heron Road, downgradient from the former disposal pit towards the South Arm of the Hunter River, reported the highest concentrations of dissolved arsenic. This is consistent with previous investigations and monitoring.
- Dissolved arsenic concentrations decrease moving from Heron Road towards the Hunter River.
- Dissolved arsenic concentrations from the June 2024 monitoring indicate plume has remained stable, with no notable change in concentration or location suspected.

These above conclusions are consistent with those from previous monitoring events completed as part of the former GMP.

6.6 Assessment of the Containment System – Arsenic Distribution

Groundwater monitoring, in accordance with the LTEMP, is undertaken to assess dissolved arsenic concentrations in groundwater as a ‘secondary line of evidence’ to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable. Table 6.3 provides a framework to assess the distribution and trends in dissolved arsenic concentration.

Table 6.3: Arsenic Distribution Assessment

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
Changes in dissolved arsenic concentrations within the containment cell	Yes – stable trend in arsenic concentration	Mann-Kendall analysis has been used to assess dissolved arsenic trends within the containment cell, using the results from the five previous monitoring rounds (2020-2024). A stable or no trend was observed for wells targeting the three hydrostatic units, which is consistent with expectations for arsenic concentrations within the cell.
Spatial distribution of arsenic concentration outside of the containment cell	Yes – spatial distribution consistent	Spatial distribution of dissolved arsenic concentrations in areas down-gradient of the containment cell and within Units 1, 2 and 3 remain consistent with the distribution prior to the remediation. This suggests the construction of the containment cell has not resulted in significant changes in the migration of dissolved arsenic in groundwater either laterally or vertically (including between) hydrogeological units.

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
Trends in arsenic concentration down-gradient of the containment cell	Yes – decreasing trend apparent in monitoring locations within 50 m of the containment cell	This is the fifth monitoring round post remediation and as such statistical analysis of trends is considered preliminary, particularly for assessing the effect of the construction of the containment cell at locations at distances further away from the cell. Preliminary trends in dissolved arsenic concentrations suggest a decreasing or stable trend at monitoring locations downgradient of the containment cell in the predicted post-construction zone of influence of the cell/remediation. Based on estimated groundwater flow rates (~10 m per annum, noting variability between hydrostatic units) and the 5 years that have elapsed since completion of construction, the groundwater chemistry data suggests this zone of influence is in the order of 50 m (i.e., where groundwater unaffected by the contained contamination has now displaced arsenic-contaminated groundwater). Locations further down-gradient of the containment system (outside this zone of cell/remediation influence) exhibit more variable trends (both increasing and decreasing concentrations of dissolved arsenic) reflecting the flow of contaminated groundwater generated prior to construction of the cell through these locations.

7 Conceptual site model

The pre-remediation Conceptual Site Model (CSM) has been presented in previous reports including the Remediation Action Plan (Golder, 2016a) and holistically for the Orica site in the Conceptual Site Model report (Golder, 2013).

Provided below is a summary of the key elements of the CSM that relate to the arsenic contamination post-remediation.

Contaminants of Concern:	Arsenic
Sources:	Former Sludge Disposal Pit (on-site) - removed.
Mechanism of contamination:	Prior to remediation, disposal to ground with sorption to soil and subsequent leaching into the vadose and saturated zones.
Affected environmental media:	Soil and groundwater.
Remediation:	Removal of contaminated soils in the vadose zone – 2005. Construction of containment cell to 12 m below ground level and capping – 2019.
Exposure Pathways:	Within the Cap and Containment area – nil. Remediation (Containment Cell) has: — prevented further off-site migration of contaminated groundwater — management of the cap prevents direct contact exposure and rain infiltration Off the Orica site – management controls as defined within the Off-site EMP. Exposure pathways associated with the existing off-site groundwater contamination include: — Direct contact — Inhalation of dust — Ingestion of soil and groundwater — Inhalation of aerosols from groundwater spray
Human and Ecological Receptors:	Within the Cap and Containment area – nil Off the Orica site (existing off-site groundwater contamination) — Workers undertaking intrusive works — Workers exposed to extracted groundwater.
Data Gaps:	— Groundwater samples could not be collected from four monitoring wells during the June 2024 monitoring event (Section 6.2). — Two groundwater level data-logger malfunctioned during this monitoring event. Data from previous monitoring events for these locations exist and arsenic concentrations are not anticipated to have changed significantly. As such these data gaps are not considered significant as assessment of down-gradient arsenic trends is a long-term program.
Management and Monitoring:	Ongoing management and monitoring of the containment cell to be undertaken in accordance with the LTEMP – Revision 2.

8 Conclusion

The following key conclusions can be drawn from the results of the hydraulic and arsenic groundwater monitoring program.

8.1 Hydraulic Monitoring

Based on the available data, evidence of hydraulic head and redistribution as a result of construction of the containment cell is emerging. The following effects have been identified.

- Difference in response to rain events inside and outside of the containment cell; changes in groundwater elevations are greatest outside of the containment cell and smallest within the cell.
- Whilst increases of groundwater elevations have been observed within the cell following high-intensity and/or long-duration rainfall events, this is considered to be in response to localized pressure changes and loadings due to the increased groundwater levels outside the cell (both locally and regionally), and not indicative of infiltration of rainfall through the cell capping.
- A flattening of the hydraulic gradient (i.e., groundwater table) inside the containment cell when compared with historical gradients within the cell and hydraulic gradients outside of the cell.
- Possible mounding of groundwater levels on the up-hydraulic gradient side of the containment cell.

It is noted that significant mounding was noted in July 2022 when significantly above average rainfall was experienced at the site.

- Differences in groundwater elevations in the monitoring wells either side of the wall with lowering of groundwater levels in Unit 1 and possible Unit 2, and an apparent increase in groundwater levels in Unit 3 compared to outside the cell. However, fluctuations of water levels outside the cell in Unit 1 due to rain events are likely to influence these relative levels.
-

8.2 Arsenic Monitoring

- The annual groundwater monitoring event completed in June 2024 met the requirements of the Arsenic GMP as defined in the LTEMP – Revision 2 (WSP, 2023). However, monitoring locations POMW60-3, POMW60-6, POMW60-9 and POMW60-12 located on adjacent Port of Newcastle land could not be accessed or sampled due to ongoing construction activities on these lands at this time. As the purpose of the monitoring of arsenic concentrations is to assess long-term trends in arsenic concentrations, this however, is not considered to be a significant data gap.
- Preliminary trends in dissolved arsenic concentrations at monitoring locations within the containment cell exhibited a stable trend or no trend.
- Preliminary trends in dissolved arsenic concentrations indicate decreasing or stable trends at those monitoring locations down-gradient of the containment cell and in the predicted post-construction zone of influence of the cell/remediation. Based on an estimated groundwater flow rate (~10 m per annum) and the 5 years that have elapsed since completion of remediation, the groundwater chemistry data suggests this zone of influence is in the order of 50 m (i.e., where groundwater unaffected by the contained contamination has now displaced contaminated groundwater). Locations further down-gradient of the containment system (outside this zone of cell/remediation influence) exhibit more variable trends (both increasing and decreasing) reflecting the migration of arsenic-impacted groundwater, generated prior to construction of the cell, through these locations.
- Concentrations of dissolved arsenic from the June 2024 monitoring event suggest there have been no significant changes in the spatial distribution of dissolved arsenic concentrations in groundwater.

- The monitoring of dissolved arsenic concentrations will continue as defined within the LTEMP (WSP, 2023) as a secondary line of evidence to confirm that further migration of dissolved arsenic in groundwater has been prevented to the extent practicable by the containment cell.
-

8.3 Recommendations for Revision of Monitoring Program

Monitoring is to continue in accordance with Section 8 of the LTEMP (WSP, 2023). It is recommended that this monitoring program continue to be implemented for a further year (2025), which will bring the post remediation monitoring program to 6 years, where, if trends in hydraulic and chemical performance support such a change a further reduction in the monitoring program can be implemented.

9 Limitations

Your attention is drawn to the document titled - “Limitations Statement”, which is included in Appendix F of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Limitations Statement document does not alter the obligations WSP has under the contract between it and its client.

10 References

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- USEPA, 2010. Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (EPA 540-R-10-011). January 2010.
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Tables





Table A: Long-Term Environmental management Plan - Groundwater Monitoring Program (Revision 1_2020), Arsenic MO
Orica Kooragang Island

Area of Site	Well ID	Hydraulic Monitoring			Chemical Monitoring		Rationale / Comments
		SWL	Data-logger	Barometric logger	G/W Parameter (field)	Dissolved Arsenic	Rationale / Comments
Containment Cell Wells	MWCC01-3IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-6IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-9IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-3OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-6OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-9OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC02-3IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-6IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-9IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-3OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-6OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-9OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC03-3IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-6IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-9IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-3OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-6OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-9OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
On-site	MWCC03-Baro			Q			Southern - Inside Cell - Unsaturated
	MW48A-4	Q			A	A	upgradient of the former sludge pit.
	MW48A-6	Q					upgradient of the former sludge pit.
Off-site (Inictec Pivot)	MW21A	Q			A	A	Downgradient of the former sludge pit.
	MW50	Q			A	A	Downgradient of the former sludge pit.
	MW54	Q			A	A	Downgradient of the former sludge pit.
	BP5-3	Q			A	A	Downgradient of the former sludge pit.
	BP5-6	Q			A	A	Downgradient of the former sludge pit.
	BP5-9	Q			A	A	Downgradient of the former sludge pit.
	BP7-3	Q			A	A	Downgradient of the former sludge pit.
	BP7-6	Q			A	A	Downgradient of the former sludge pit.
	BP7-9A	Q			A	A	Downgradient of the former sludge pit.
	GWW01S	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW01I	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW01D	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW02S	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
Off-site (East Coast Cement)	GWW02I	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW02D	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW03S	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
Off-site (Newcastle Port Corporation)	GWW03I	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW03D	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	POMW7	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-3	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-9	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-12	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW62-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-3	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-9	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-12	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.

Notes:
M: Monthly
B: Bi-annual
A: Annual
SWL: Standing Water Level (manual measurement with dipper)
S: Shallow
I: Intermediate
D: Deep
G/W Parameters: Field measurement of pH, EC, Redox potential, DO and temperature



Table B1 and B2. Monitoring Well Gauging, GW Quality, TD As (mg/l) Data
Post Remediation Annual Groundwater Monitoring Event - June 2024
Orica Kooragang Island

Location				Well Gauging						Water Parameters							Analysis	
Area	Well Location	Sampling Date	Type	Depth of Well	Top of Casing (TOC)	Screened Depth From	Screened Depth To	Standing Water Level	Standing Water Level	pH	Dissolved Oxygen	Electrical Conductivity	Redox	Eh	Temperature	Description	Sample Type	^ Dissolved Arsenic
				m bTOC	m AHD	m bgl	m bgl	m bTOC	m AHD	pH units	ppm	µs/cm	mV	mV	deg c			mg/L
Containment Cell Wells	MWCC01-3IN	25/6/2024	S	5	5.329	2.5	4.5	4.11	1.219	7.02	1.35	1088	-5.7	199.3	18.8	Clear, no odour	PS	0.338
	MWCC01-6IN	25/6/2024	I	8	5.356	5.5	7	4.62	0.736	7.78	0.05	1547	-152.1	52.9	18.4	Clear, no odour	PS	0.03
	MWCC01-9IN	25/6/2024	D	11	5.358	8	10	5.01	0.348	7.86	1.59	1587	-166.1	38.9	20.2	Clear, no odour	PS	0.188
	MWCC01-3OUT	25/6/2024	S	5	4.469	2.5	4.5	1.565	2.904	-	-	-	-	-	-	-		
	MWCC01-6OUT	25/6/2024	I	8	4.47	5.5	7	2.62	1.85	-	-	-	-	-	-	-		
	MWCC01-9OUT	25/6/2024	D	11	4.468	8	10	3.615	0.853	-	-	-	-	-	-	-		
	MWCC02-3IN	25/6/2024	S	5	4.906	2.5	4.5	3.64	1.266	6.91	0.41	831	13.7	218.7	18.4	Clear, no odour	PS	0.43
	MWCC02-6IN	25/6/2024	I	8	4.864	5.5	7	4.2	0.664	7.85	0.17	1571	18	223	18.7	Clear, no odour	PS	68.1
	MWCC02-9IN	25/6/2024	D	11	4.859	8	10	4.14	0.719	8.24	0.15	1496	-7.6	197.4	18.8	Clear, no odour	PS	29
	D01_20240625	25/6/2024	D	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	29.9
	T01_20240625	25/6/2024	D	-	-	-	-	-	-	-	-	-	-	-	-	-	TS	42
	MWCC02-3OUT	25/6/2024	S	5	4.072	2.5	4.5	1.54	2.532	-	-	-	-	-	-	-		
	MWCC02-6OUT	25/6/2024	I	8	4.07	5.5	7	3.35	0.72	-	-	-	-	-	-	-		
	MWCC02-9OUT	25/6/2024	D	11	4.07	8	10	3.48	0.59	-	-	-	-	-	-	-		
	MWCC03-3IN	25/6/2024	S	4.5	5.424	2.5	4.5	4.12	1.304	7.55	0.07	1375	-83.7	121.3	18.2	Clear, no odour	PS	0.008
	MWCC03-6IN	25/6/2024	I	8	5.461	5.5	7	4.74	0.721	7.97	0.15	1181	-15.2	189.8	18.6	Clear, no odour	PS	0.001
	MWCC03-9IN	25/6/2024	D	11	5.461	8	10	4.74	0.721	8.62	0	2298	-211.3	-6.3	18.6	Clear, no odour	PS	<0.001
	MWCC03-3OUT	25/6/2024	S	5	4.447	2.5	4.5	1.88	2.567	-	-	-	-	-	-	-		
	MWCC03-6OUT	25/6/2024	I	8	4.455	5.5	7	3.73	0.725	-	-	-	-	-	-	-		
	MWCC03-9OUT	25/6/2024	D	11	4.508	8	10	3.85	0.658	-	-	-	-	-	-	-		
	MWCC03-Baro	25/6/2024		1.5	5.222	0.3	1.5											
On-site	MW48A-4	25/6/2024	S	3.93	3.13	1.5	4	-	-	-	-	-	-	-	-		PS	0.003
Off-site (Initect Pivot)	MW21A	28/06/2024	I	6.03	3.49	2.5	5.5	1.795	1.70	7.27	0.03	1704	-25.9	179.1	18.4	Clear. No odour	PS	7.77
	MW50	28/06/2024	I	6.28	3.64	4.5	6.0	3.37	0.27	7.75	0.10	2877.00	-53.90	151.10	18.80	Clear. No odour	PS	45.30
	MW54	28/6/2024	I	6.34	3.95	5.0	6.0	1.89	2.06	7.51	0.13	1047.00	17.40	222.40	19.20	Clear. No odour	PS	2.52
	BP5-3	28/6/2024	S	3.50	3.38	2.0	3.0	1.40	1.98	6.89	0.18	2526.00	80.10	285.10	18.60	Clear. No odour	PS	2.93
	BP5-6	28/6/2024	I	6.35	3.32	5.0	6.0	3.06	0.26	7.20	0.28	2564.00	41.30	246.30	19.50	Clear. No odour	PS	28.70
	D01_20240628	28/6/2024	I	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	29.00
	T01_20240628	28/6/2024	I	-	-	-	-	-	-	-	-	-	-	-	-	-	TS	42.00
	BP5-9	28/6/2024	D	9.48	3.28	8.0	9.0	3.34	-0.06	7.52	0.29	3075.00	19.10	224.10	19.90	Clear. No odour	PS	14.70
	BP7-3	28/6/2024	S	3.01	2.95	1.0	3.0	0.58	2.37	6.72	3.10	2831.00	59.30	264.30	16.80	Clear. No odour	PS	0.31
	BP7-6	28/6/2024	I	6.48	3.45	5.0	6.0	2.43	1.02	7.05	0.20	1980.00	27.10	232.10	19.30	Clear. No odour	PS	8.34
	BP7-9A	28/6/2024	D	7.79	3.02	7.5	9.0	2.38	0.64	7.35	0.22	669.00	-9.30	195.70	19.70	Well Damaged	PS	2.23
	GWW01S	28/6/2024	S	2.38	3.38	1.5	3.0	1.52	1.86							Gauged only		
	GWW01I	28/6/2024	I	7.63	3.35	5.5	7.0	3.13	0.22							Gauged only		
	GWW01D	28/6/2024	D	9.52	3.36	7.5	9.0	3.27	0.09							Gauged only		
	GWW02S	28/06/2024	S	3.53	3.45	1.5	3.0	1.49	1.96	7.26	1.11	761.00	-25.30	179.70	17.20	Clear. No odour	PS	0.98
	GWW02I	28/06/2024	I	7.56	3.42	5.5	7.0	3.24	0.18	7.34	0.04	3212.00	-30.40	174.60	20.10	Clear. No odour	PS	37.80
	GWW02D	28/06/2024	D	8.82	3.42	7.0	8.5	3.31	0.11	7.57	0.05	2825.00	-43.40	161.60	20.20	Clear. No odour	PS	51.20
Off-site (East Coast Cement)	GWW03S	25/6/2024	S	3.81	3.43	2.0	3.5	1.43	2.00	7.41	0.84	841	-31.6	173.40	19.4	Clear, no odour	PS	0.063
	GWW03I	25/6/2024	I	7.95	3.56	6.0	7.5	2.91	0.65	7.39	0.19	1690	-101.5	103.50	21.2	Clear, no odour	PS	33.1
	D02_20240625	25/6/2024	I	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	32.4
	T02_20240625	25/6/2024	I	-	-	-	-	-	-	-	-	-	-	-	-	-	TS	48
	GWW03D	25/6/2024	D	10.89	3.55	8.8	10.3	3.10	0.45	7.97	0.1	9663	-200.9	4.1	21.4	Clear, no odour	PS	0.047
Off-site (Port of Newcastle)	POMW7	27/06/2024	S	2.88	2.44	1.5	5.0	1.09	1.35	6.93	0.15	1291	69.4	274.4	20	Clear, no odour	PS	2.29
	POMW60-3	-	S	2.960	2.42	1.5	3.0	-	-	-	-	-	-	-	-	Could not access	PS	
	POMW60-6	-	I	5.56	2.45	4.5	6.0	-	-	-	-	-	-	-	-	Could not access	PS	
	POMW60-9	-	D	8.89	2.41	7.5	9.0	-	-	-	-	-	-	-	-	Could not access	PS	
	POMW60-12	-	D	11.90	2.43	10.5	12.0	-	-	-	-	-	-	-	-	Could not access	PS	
	POMW62-6	27/06/2024	I	5.64	2.05	4.5	6.0	2.21	-0.16	6.89	0.21	1008	69.6	274.6	21.1	Clear, no odour	PS	3.01
	POMW63-3	27/06/2024	S	2.810	2.55	1.5	3.0	1.50	1.05	6.54	0.4	805	100.2	305.2	20.3	Sediment, no odour	PS	0.084
	POMW63-6	27/06/2024	I	4.41	2.55	4.5	6.0	0.75	1.80	6.85	0.63	884	113.6	318.6	22	Sediment, no odour	PS	0.004
	POMW63-9	27/06/2024	D	8.74	2.53	7.5	9.0	2.04	0.50	7.73	0.08	7554	-115.2	89.8	22	Clear, no odour	PS	0.053
	POMW63-12	27/06/2024	D	10.44	2.54	10.5	12.0	1.75	0.79	8.43	0.09	710	-93.8	111.2	21.5	Clear, no odour	PS	0.005

Notes:

S: shallow monitoring well
I: intermediate monitoring well
D: deep monitoring well
m AHD: metres above Australian Height Datum
m bTOC: metres below top of casing
mbgl: metres below ground level
- data not available.

PS: Primary Sample
FD: Field Duplicate
FT: Field Triplicate
QC: Qaulity Control
mg/l: milligram per litre
NA: Not Accessible

µs/cm: microseims per centimetre
mV: milli-Volts
ppm: parts per million
Eh: Redox Potential (converted to Eh by Eh = Er + 205 mV)
LOR: limit of reporting

^ Concentration exceeds the low-reliability working level trigger value for Arsenic (III) for marine water specified in ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

LOR is 0.001
Trigger Value is 0.0023^



Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	MWCC01-3IN	MWCC01-6IN	MWCC01-9IN	MWCC01-3OUT	MWCC01-6OUT	MWCC01-9OUT	MWCC02-3IN	MWCC02-6IN	MWCC02-9IN	MWCC02-3OUT	MWCC02-6OUT	MWCC02-9OUT	MWCC03-3IN	MWCC03-6IN
	MWCC Wells Installed for the Remediation System													
	On-Site Wells													
Apr-97														
Mar-98														
Sep-98														
Feb-99														
Feb-00														
Jun-00														
May-01														
Jul-01														
Sep-01														
Oct-01														
Jun-02														
Apr-04														
Oct-04														
Jan-05														
Mar-05														
Jul-05														
Jul-05 (plume)*														
Jan-06														
Mar-06														
Jul-06														
Feb-07														
Aug-07														
Jan-08														
Jul-08														
Jan-09														
Jul-09														
Feb-10														
Jul-10														
Jan-11														
Jul-11														
Dec-11														
Jun-12														
Dec-12														
Jun-13														
Feb-14														
Jul-14														
Jan-15														
Jul-15														
Jan-16														
Jun-16														
Jan-17														
Jul-17														
Jan-18														
Jul-18														
Jan-19														
Jul-19														
Mar-20	0.695	0.077	0.26	0.002	0.008	0.002	0.774	87.5	35.8	4.08	26	22.1	0.003	0.002
Oct-21	0.272	0.259	0.5	NS	NS	NS	1.55	84	31.1	NS	NS	NS	0.001	0.001
Jul-22	0.465	0.049	0.43	NS	NS	NS	3.04	84.7	33.3	NS	NS	NS	0.002	0.002
Jul-23	0.324	0.044	0.296	NS	NS	NS	1.86	89.8	36.8	NS	NS	NS	0.003	0.003
Jun-24	0.338	0.03	0.188	NS	NS	NS	0.43	68.1	29	NS	NS	NS	0.008	0.001

Notes:

(1) All arsenic data in mg/L

(2) Data from May-01, Jul-01, Sep-01 and Oct-01 was analysed by Incitec laboratory.

(3) Triplicate result was used for MW27A and POMW60-9 (July-2010)

(4) Duplicate result was used for MW50 (July-2010)

(5) Triplicate result was used for MW45 (July-2011)

(5) Triplicate result was used for POMW60-3 (July-2011)

(6) Triplicate result was used for BP5-6 (June 2012)

(7) Duplicate result was used for MW54 (Dec 2012)

(8) There was no access to POMW58 or POMW59 wells during the December 2012 event. Therefore, the wells were sampled on 25 January 2013.

(9) Duplicate result was used for MW48 (June 2013)

(10) Triplicate result was used for POMW61-12 (June 2013)

(11) Highest concentrations between primary sample, field duplicate and field triplicate were used for monitoring rounds completed after July 2014.

DRY - Insufficient volume of water available to sample

NS - Not Sampled

NA - Not Accessible

(Plume)* - Data collected as part of plume hydrogeochemical characterisation (not Bi-annual monitoring round)

Data prior to July 14 were collected and reported by others.

^: MW48 was destroyed and replaced in December 2014. ID for the replacement well is MW48A_4.0

^^: MW27, MW27A and MW45, as well as all other wells associated with the IGF trial were decommissioned in August 2016 in preparation for the cap and containment remediation system.



Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	MWCC03-9IN	MWCC03-3OUT	MWCC03-6OUT	MWCC03-9OUT	^MW48 / MW48A_4.0	MW21A	MW50	MW54	BP5-3	BP5-6	BP5-9	BP7-3
					-		-	-	-	-	-	-
	Off-Site Wells (IPL and Vue)											
Apr-97					-		-	-	-	-	-	-
Mar-98					-		-	-	-	-	-	-
Sep-98					-		-	-	-	-	-	-
Feb-99					-		-	-	-	-	-	-
Feb-00					-		-	-	-	-	-	-
Jun-00					-		-	-	-	-	-	-
May-01					-		-	-	-	-	-	-
Jul-01					-		-	-	-	-	-	-
Sep-01					-		-	-	-	-	-	-
Oct-01					-		-	-	-	-	-	-
Jun-02					-		-	-	7.0	26.7	0.6	-
Apr-04					-		-	-	11.2	44.4	2.7	-
Oct-04					-		-	-	11.7	55.3	1.6	-
Jan-05					0.03	92.1	-	-	11.3	45.3	3.1	-
Mar-05					-	-	23.9	63.5	-	-	-	51.9
Jul-05					0.006	79.2	-	-	3.6	29.6	24.8	-
Jul-05 (plume)*					-	71.7	125	83.6	4.7	24.0	18.3	2.1
Jan-06					-	-	-	-	-	-	-	-
Mar-06					-	-	-	-	-	-	-	-
Jul-06					0.001	125	140	38.1	8.9	41.5	1.6	23.5
Feb-07					0.02	131	125	39.6	10.9	38.7	2.5	97.6
Aug-07					0.006	87.3	111	56.8	12.7	31.3	3.3	1.1
Jan-08					0.005	73.2	149	58.8	9.8	41.1	2.9	35.6
Jul-08					0.003	59.7	158	63.8	10.8	34.7	4.3	1.7
Jan-09					0.003	81.1	133	41.5	10.9	37.3	2.3	71.3
Jul-09					0.002	57.8	99.5	53.0	5.5	37.7	3.4	1.1
Feb-10					0.004	NS	132	41.6	10.1	49.0	1.9	81.6
Jul-10					0.02	58.6	118	42.1	7.8	39.0	3.4	0.7
Jan-11					0.008	63.6	107	38.7	10.8	48.7	2.4	2.4
Jul-11					0.02	59.7	109	38.5	14.9	60.0	11.0	0.8
Dec-11					0.02	43.3	87.2	26.6	13.6	37.6	6.6	0.5
Jun-12					0.001	33.8	108	23.7	12.4	44.8	4.3	0.8
Dec-12					0.002	38.0	100	17.1	11.0	46.0	2.6	46.2
Jun-13					0.002	45.8	70.6	18.3	9.4	39.4	6.6	2.0
Feb-14					0.002	44.4	108	15.6	13.0	67.3	5.9	83.2
Jul-14					0.016	24.8	86	10.5	10.4	60.6	6.5	1.2
Jan-15					0.01	36.1	82.8	8.9	14.5	75.1	6.6	59.0
Jul-15					-	32.7	78.4	11.2	-	-	-	1.44
Jan-16					0.016	42.8	77.4	8.3	10.8	72.8	17.4	1.0
Jun-16					-	17.9	47.8	8.53	-	-	-	3.3
Jan-17					0.019	41.8	77	7.38	14.8	65.6	1.8	34.2
Jul-17					-	30.2	74.3	6.18	-	-	-	1.9
Jan-18					0.016	32.8	73.9	4.6	16.3	63.4	4.9	27.6
Jul-18					-	25.4	74.6	5.43	-	-	-	2.19
Jan-19					0.012	23.8	84.4	4.92	13.9	78.0	6.2	13.8
Jul-19					-	20.4	84.2	4.96	-	-	-	1.66
Implementation of Cap Remediation System, Post Remediation Below												
Mar-20	0.003	0.002	<0.001	<0.001	0.010	NA	NA	NA	NA	NA	NA	NA
Oct-21	0.001	NS	NS	NS	0.003	11.1	70.3	2.62	8.86	49.1	14.3	0.685
Jul-22	<0.001	NS	NS	NS	0.002	14.8	65.2	2.75	2.23	54.5	19.6	0.344
Jul-23	0.003	NS	NS	NS	NS	11.6	61.8	2.95	4	43.5	14.5	2.89
Jun-24	<0.001	NS	NS	NS	0.003	7.8	45.3	2.52	2.93	28.7	14.7	0.31



Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	BP7-6	BP7-9A	GWW01S	GWW01I	GWW01D	GWW02S	GWW02I	GWW02D	GWW03S	GWW03I	GWW03D	POMW7	POMW60-3
	-	-			-	-	-	-	-	-	-	DMMW7	-
			Transect Well (Along Heron Road)						East Coast Cement			Off-Site Wells (PoN)	
Apr-97	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-98	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-98	-	-	-	-	-	-	-	-	-	-	-	6.6	-
Feb-99	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-00	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-00	-	-	-	-	-	-	-	-	-	-	-	-	-
May-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-02	-	-	-	-	-	-	-	-	-	-	-	26.6	-
Apr-04	-	-	-	-	-	-	-	-	-	-	-	21.5	-
Oct-04	-	-	-	-	-	-	-	-	-	-	-	22.8	-
Jan-05	-	-	-	-	-	-	-	-	-	-	-	20.4	-
Mar-05	33.4	-	-	-	-	-	-	-	-	-	-	-	-
Jul-05	-	-	-	-	-	-	-	-	-	-	-	15.4	-
Jul-05 (plume)*	31.7	-	-	-	-	-	-	-	-	-	-	22.0	-
Jan-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-06	-	-	-	-	-	-	-	-	-	-	-	-	4.6
Jul-06	126.0	-	-	-	-	-	-	-	-	-	-	22.6	3.1
Feb-07	119.0	8.7	-	-	-	-	-	-	-	-	-	15.8	3.7
Aug-07	116.0	28.9	-	-	-	-	-	-	-	-	-	19.9	0.9
Jan-08	128.0	37.1	-	-	-	-	-	-	-	-	-	18.6	0.9
Jul-08	113.0	36.1	-	-	-	-	-	-	-	-	-	17.7	0.9
Jan-09	105.0	37.6	-	-	-	-	-	-	-	-	-	22.7	4.8
Jul-09	61.8	32.7	-	-	-	-	-	-	-	-	-	29.5	1.4
Feb-10	99.0	37.8	-	-	-	-	-	-	-	-	-	3.6	4.1
Jul-10	62.0	42.7	-	-	-	-	-	-	-	-	-	4.4	0.6
Jan-11	75.7	-	-	-	-	-	-	-	-	-	-	-	1.8
Jul-11	79.6	-	-	-	-	-	-	-	-	-	-	8.6	0.9
Dec-11	48.3	-	-	-	-	-	-	-	-	-	-	8.0	0.3
Jun-12	67.7	-	-	-	-	-	-	-	-	-	-	12.1	2.4
Dec-12	48.2	-	-	-	-	-	-	-	-	-	-	11.2	4.3
Jun-13	39.0	-	-	-	-	-	-	-	-	-	-	11.4	1.3
Feb-14	115.0	21.00	10.8	9.2	0.004	2.8	81.9	6.9	0.4	7.5	0.01	14.1	3.2
Jul-14	91.3	10.90	9.7	10.0	0.05	2.0	63.2	9.0	0.4	6.5	0.1	9.3	0.7
Jan-15	83.7	16.70	8.3	8.3	0.01	1.1	60.4	10.8	0.6	6.4	0.004	5.8	2.3
Jul-15	70.2	10.20	-	-	-	-	-	-	-	-	-	5.9	-
Jan-16	87.0	4.70	4	0.01	6.1	1.1	74.6	29.4	0.1	6.6	0.1	5.2	0.4
Jun-16	37.6	10.20	-	-	-	-	-	-	-	-	-	8.7	-
Jan-17	47.9	13.00	2.6	0.02	3.4	2.8	85.5	13.2	1.8	12.0	0.008	8.9	2.8
Jul-17	39.9	10.50	-	-	-	-	-	-	-	-	-	NA	-
Jan-18	28.1	6.87	1.3	0.03	2.1	4.8	85.0	20.5	0.8	12.2	0.010	8.46	1.9
Jul-18	22.9	6.22	-	-	-	-	-	-	-	-	-	9.35	-
Jan-19	21.9	8.30	1.1	1.96	0.006	3.6	89.3	98.6	1.34	21.2	0.110	8.69	9.71
Jul-19	24.2	7.54	-	-	-	-	-	-	-	-	-	9.34	-
Mar-20	NA	NA	NA	NA	NA	NA	NA	NA	0.2	14.9	0.430	8.5	0.6
Oct-21	9.9	NA	NS	NS	NS	1.4	53.0	73.0	0.3	47.2	0.101	3.3	1.6
Jul-22	8.78	NA	NS	NS	NS	0.7	49.3	66.6	0.6	54.4	0.148	2.8	0.9
Jul-23	7.93	NA	NS	NS	NS	2.8	44.6	63.9	1.1	44.3	0.012	2.1	NS
Jun-24	8.34	2.23	NS	NS	NS	0.98	37.8	51.2	0.06	33.1	0.047	2.29	NS

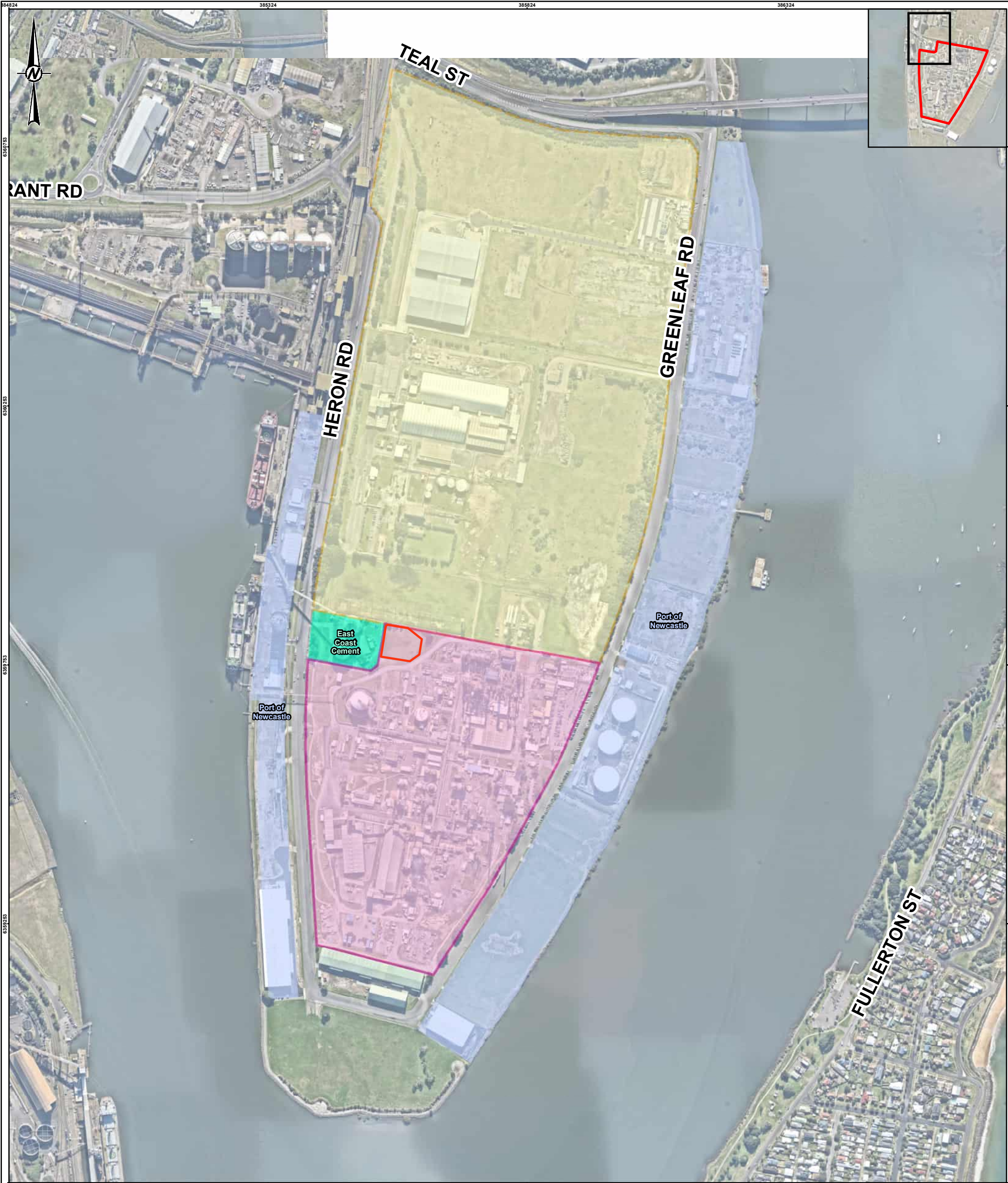


Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	POMW60-6	POMW60-9	POMW60-12	POMW62-6	POMW63-3	POMW63-6	POMW63-9	POMW63-12
	-	-	-	-	-	-	-	-
	Off-Site Wells (PoN)							
Apr-97	-	-	-	-	-	-	-	-
Mar-98	-	-	-	-	-	-	-	-
Sep-98	-	-	-	-	-	-	-	-
Feb-99	-	-	-	-	-	-	-	-
Feb-00	-	-	-	-	-	-	-	-
Jun-00	-	-	-	-	-	-	-	-
May-01	-	-	-	-	-	-	-	-
Jul-01	-	-	-	-	-	-	-	-
Sep-01	-	-	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-	-	-
Jun-02	-	-	-	-	-	-	-	-
Apr-04	-	-	-	-	-	-	-	-
Oct-04	-	-	-	-	-	-	-	-
Jan-05	-	-	-	-	-	-	-	-
Mar-05	-	-	-	-	-	-	-	-
Jul-05	-	-	-	-	-	-	-	-
Jul-05 (plume)*	-	-	-	-	-	-	-	-
Jan-06	-	-	-	-	-	-	-	-
Mar-06	0.02	0.005	0.001	2.6	20.7	13.9	0.1	0.02
Jul-06	2.1	<0.001	<0.001	8.1	13.6	14.5	0.3	<0.001
Feb-07	3.9	<0.001	<0.001	20.6	18.5	21.4	0.4	<0.001
Aug-07	4.8	0.002	0.003	20.2	4.3	18.0	0.3	0.05
Jan-08	5.8	<0.001	0.001	23.3	2.0	6.7	0.5	<0.001
Jul-08	5.3	0.001	0.002	19.7	2.0	16.0	0.2	0.001
Jan-09	4.8	<0.001	<0.001	23.6	10.1	13.7	0.2	<0.001
Jul-09	4.9	<0.001	0.001	17.8	1.6	8.9	0.2	0.002
Feb-10	5.1	<0.001	0.01	21.1	17.4	10.6	0.2	<0.02
Jul-10	5.7	0.003	0.006	10.8	5.0	6.4	0.1	0.005
Jan-11	-	-	0.009	11.8	-	-	-	-
Jul-11	5.5	<0.001	0.002	10.9	0.3	0.1	0.04	<0.001
Dec-11	3.8	0.005	0.001	7.8	0.5	0.1	0.02	0.006
Jun-12	6.5	0.018	0.4	7.1	NA	NA	NA	0.007
Dec-12	6.4	0.001	<0.001	9.0	4.5	NA	0.2	0.001
Jun-13	4.2	0.003	<0.010	8.1	0.4	NS	0.01	< 0.001
Feb-14	8.2	<0.001	<0.01	10.3	11.8	NS	0.006	<0.001
Jul-14	5.4	<0.01	<0.01	9.7	7.5	0.5	0.005	0.001
Jan-15	6.7	<0.001	<0.01	9.4	11.8	2.9	0.002	0.01
Jul-15	-	-	-	4.9	-	-	-	-
Jan-16	6.6	0.001	0.004	5.1	0.1	0.01	0.04	0.002
Jun-16	-	-	-	3.8	-	-	-	-
Jan-17	4.3	0.008	0.01	5.3	14.8	5.62	0.13	0.001
Jul-17	-	-	-	3.2	-	-	-	-
Jan-18	4.3	0.012	0.01	3.3	12.0	0.02	0.004	<0.001
Jul-18	-	-	-	1.61	-	-	-	-
Jan-19	5.91	<0.001	0.004	2.44	1.92	7.00	0.111	0.004
Jul-19	-	-	-	1.46	-	-	-	-
Mar-20	5.0	<0.001	<0.001	3.0	8.9	0.00	0.09	0.001
Oct-21	4.2	0.507	0.108	2.3	2.3	NA	NA	0.094
Jul-22	0.2	0.016	<0.010	2.0	0.0	NA	NA	0.037
Jul-23	NS	NS	NS	2.4	0.152	0.01	0.09	0.012
Jun-24	NS	NS	NS	3.01	0.084	0.004	0.053	0.005

Figures





- LEGEND
- Orica Kooragang Island Facility
 - Incitec Pivot Property Boundary
 - Port of Newcastle
 - East Coast Cement
 - Arsenic Remediation Area



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT
ORICA KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

TITLE
SITE LOCATION

	CONSULTANT	YYYY-MM-DD	14/08/2024
	DESIGNED	-	
	PREPARED	FS	
	REVIEWED	AH	
	APPROVED	AH	

PROJECT NO. 19135645	CONTROL 002-R	REV. A	FIGURE F001
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- LEGEND
- Monitoring Well
 - Cut-off Wall Alignment
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

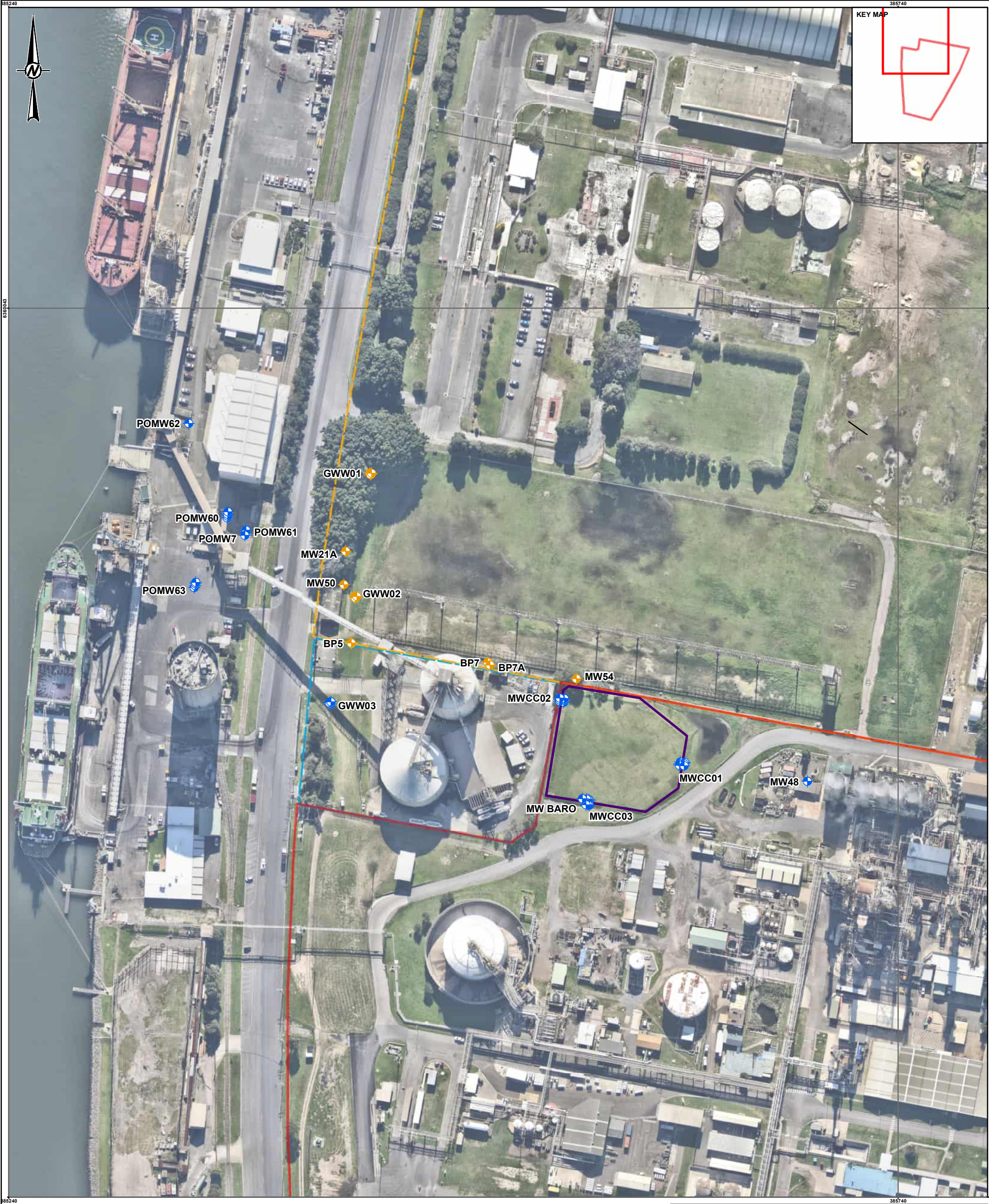
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GRONUDWATER MONITORING
EVENT - JULY 2022

TITLE
CONTAINMENT CELL WELL LOCATION PLAN

CONSULTANT	YYYY-MM-DD	2024-08-14
	DESIGNED	
	PREPARED	FS
	REVIEWED	AH
	APPROVED	GB

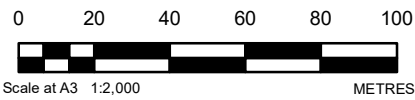
PROJECT NO. 19135645	CONTROL 002	REV. A	FIGURE 2A
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- LEGEND**
- Monitoring Well
 - Monitoring Well (Incitec Pivot)
 - Cut-off Wall Alignment
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary

NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD



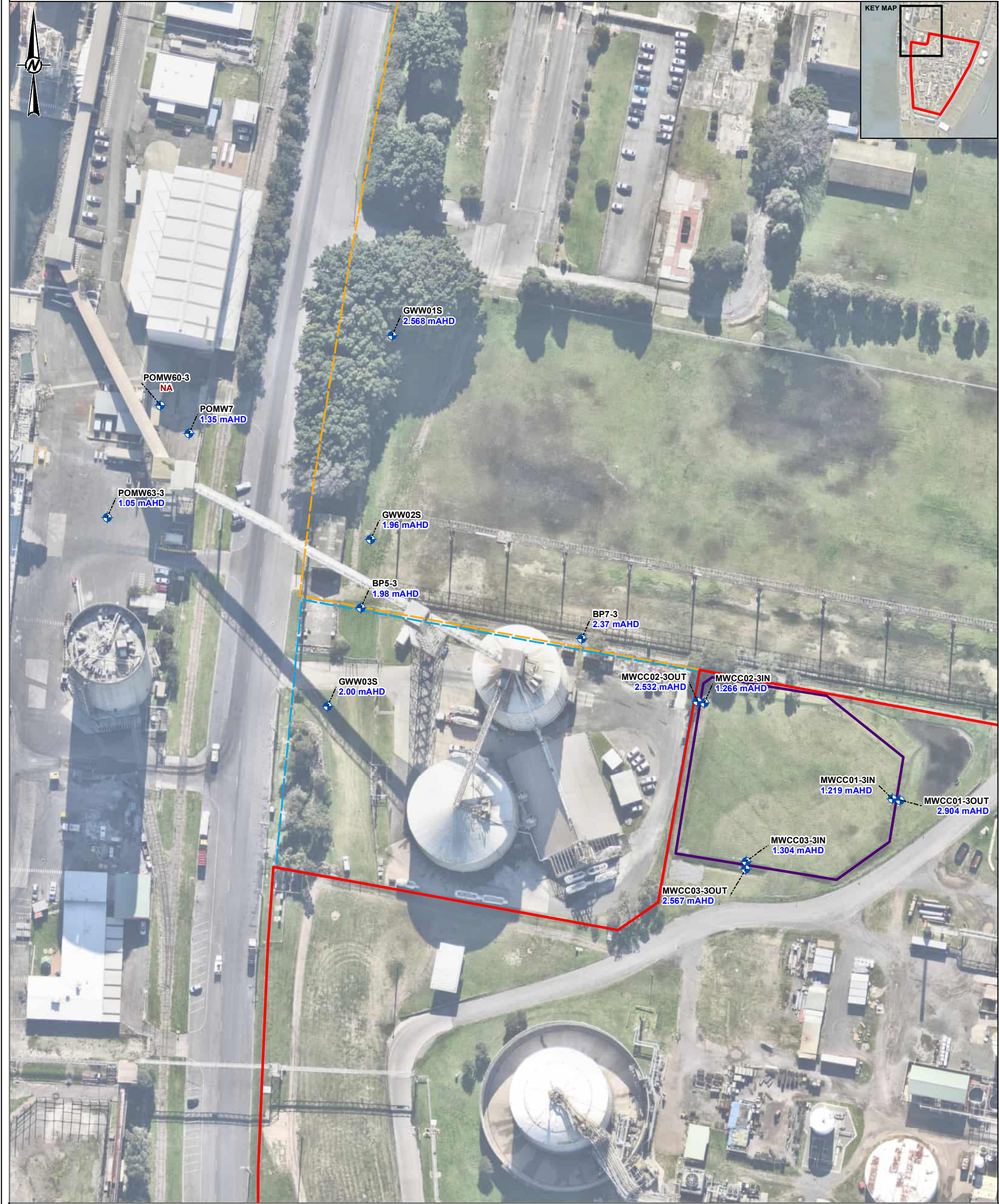
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE

TITLE
MONITORING WELL NETWORK

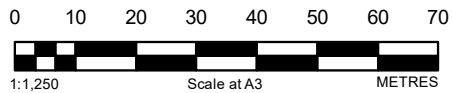
CONSULTANT	YYYY-MM-DD	2024-08-14
DESIGNED		
PREPARED	FS	
REVIEWED	AH	
APPROVED	GB	

PROJECT NO. 19135645	CONTROL 002	REV. A	FIGURE 2B
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- LEGEND**
- Cut-off Wall Alignment
 - ▭ Orica Property Boundary
 - ▭ Incitec Pivot Property Boundary
 - ▭ East Coast Cement Property Boundary

mAHD Standing Water Level (mAHD)
NA - Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

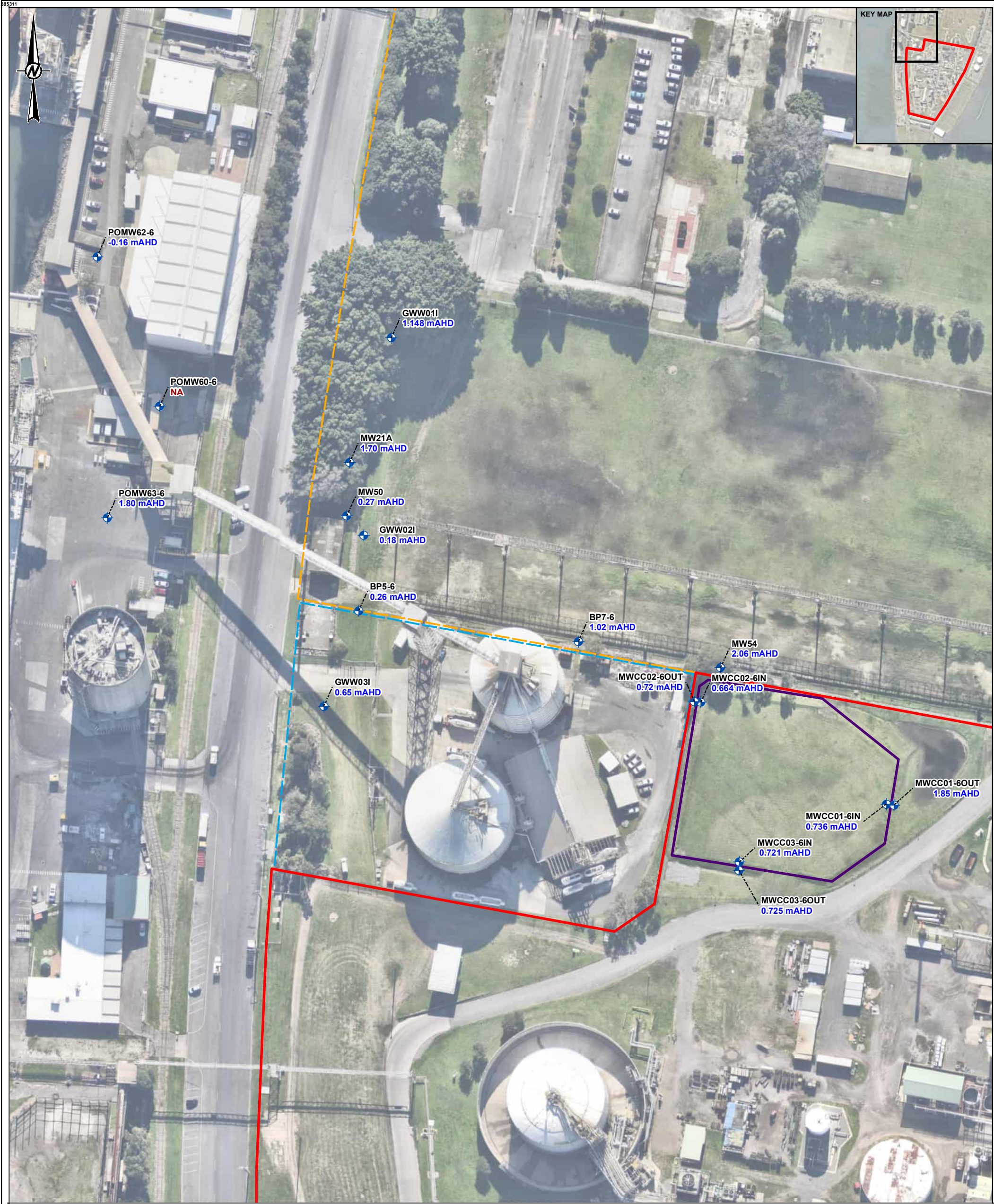
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

TITLE
UNIT 1 STANDING WATER LEVELS

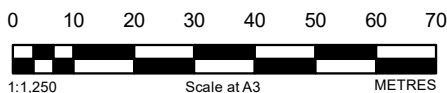
CONSULTANT	YYYY-MM-DD	2024-08-23
	DESIGNED	
	PREPARED	FS
	REVIEWED	AH
	APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	3A



LEGEND

- Monitoring Well
- Cut-off Wall Alignment
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary
- mAHd** Standing Water Level (mAHd)
- NA -** Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

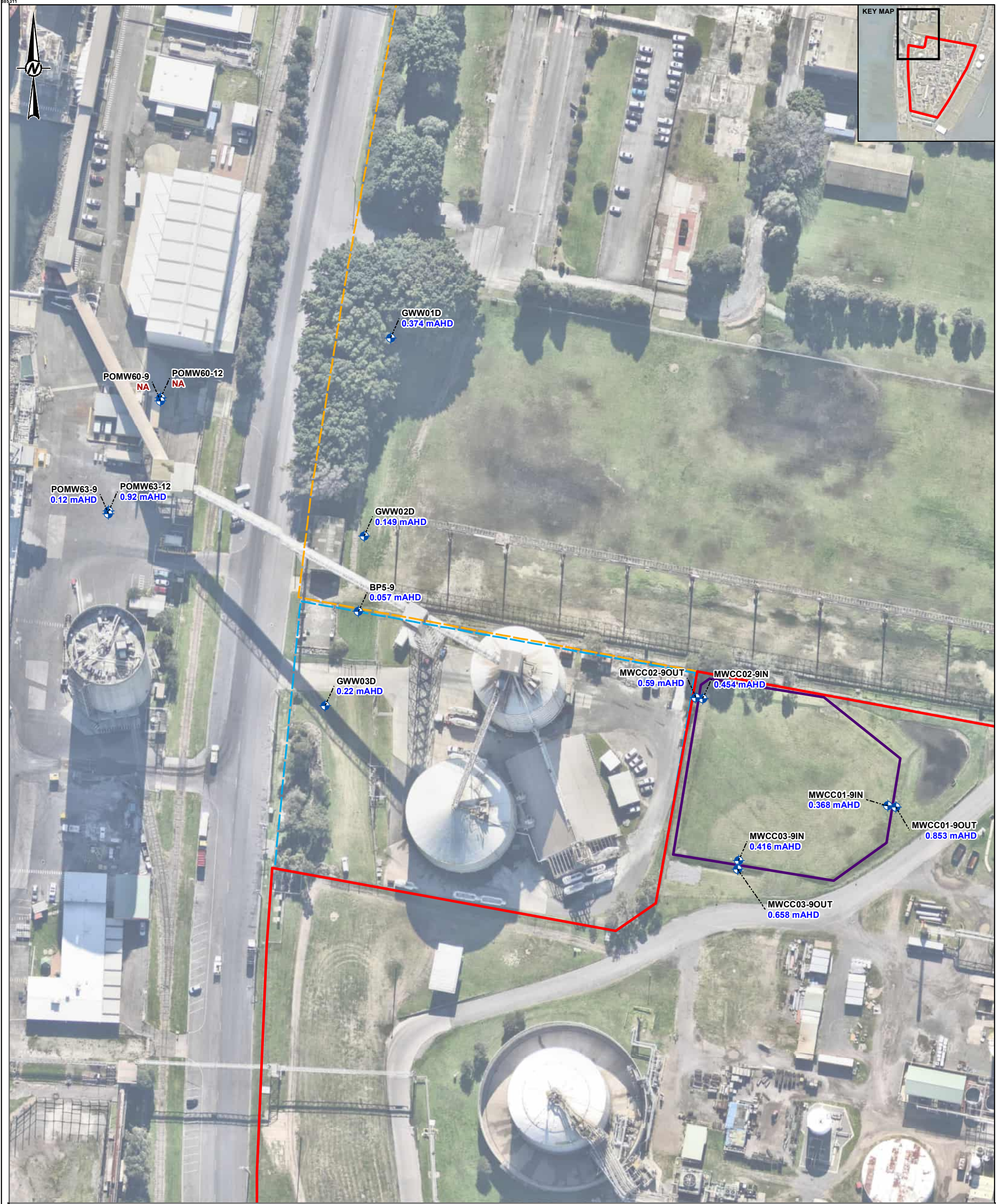
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

TITLE
UNIT 2 STANDING WATER LEVELS

CONSULTANT	YYYY-MM-DD	2024-08-23
	DESIGNED	
	PREPARED	FS
	REVIEWED	AH
	APPROVED	AH

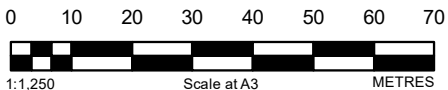
PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	3B



LEGEND

- Monitoring Well
- Cut-off Wall Alignment
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary

mAHd Standing Water Level (mAHd)
NA - Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

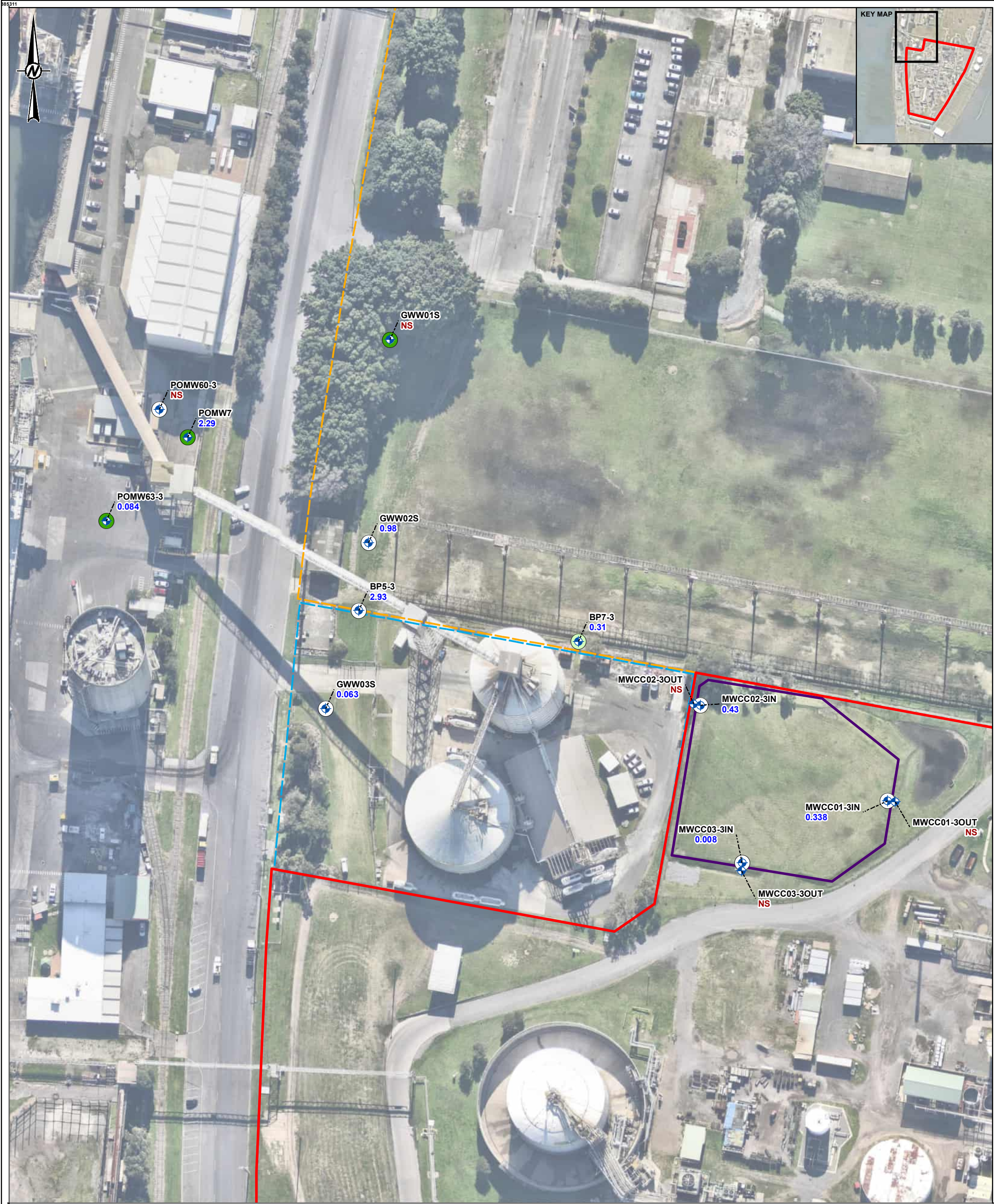
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

TITLE
UNIT 3 STANDING WATER LEVELS

CONSULTANT	YYYY-MM-DD	2024-08-23
DESIGNED		
PREPARED	FS	
REVIEWED	AH	
APPROVED	AH	

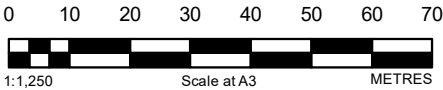
PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	3C



- LEGEND**
- Monitoring Well
 - Cut-off Wall Alignment
 - Island_Outline
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS** Not Sampled



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

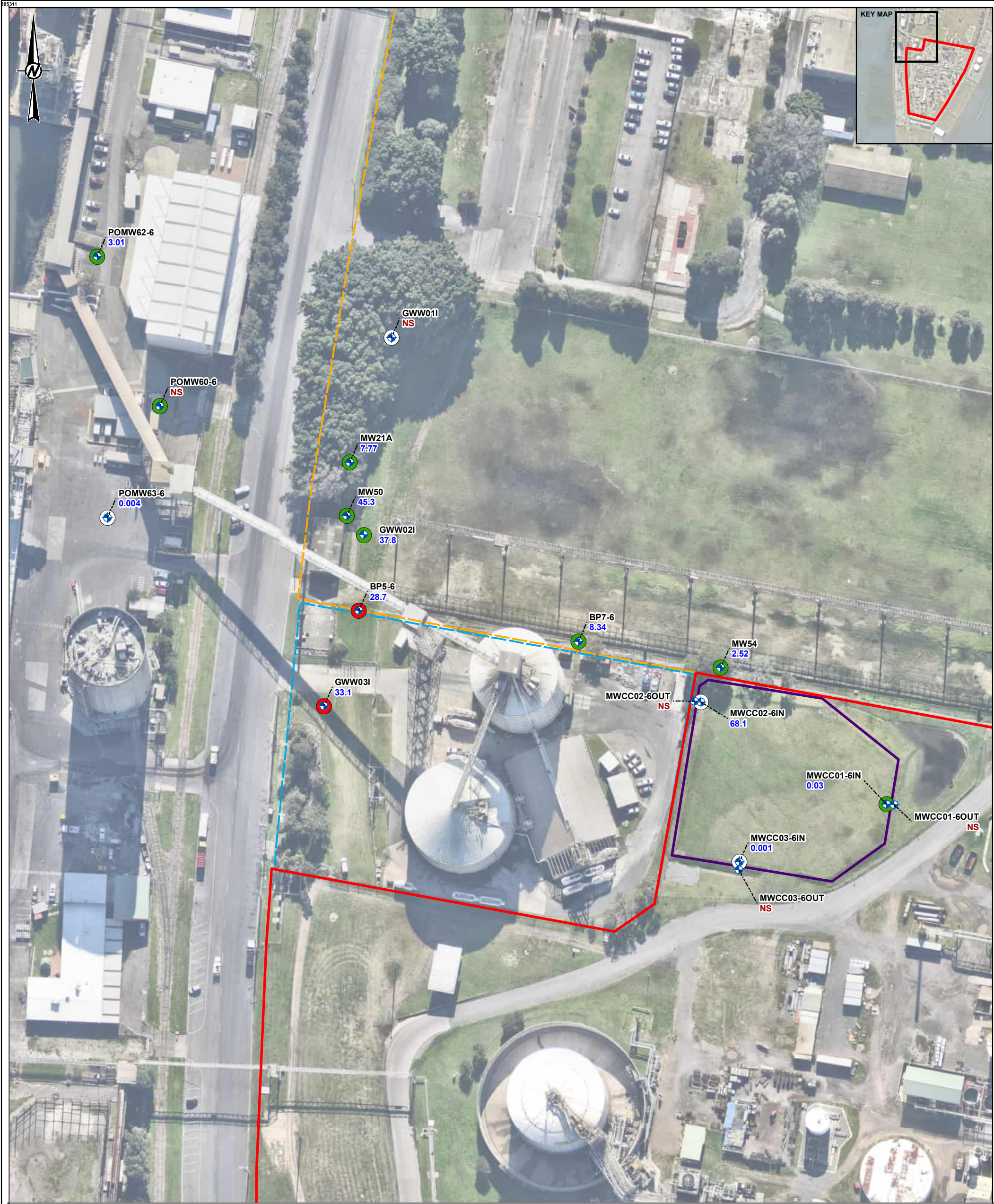
TITLE
UNIT 1 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT
YYYY-MM-DD 2024-08-23



DESIGNED	
PREPARED	FS
REVIEWED	AH
APPROVED	AH

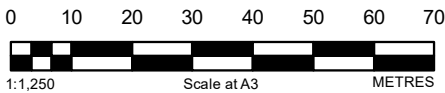
PROJECT NO. 19135645	CONTROL 002-R	REV. A	FIGURE 4A
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- LEGEND**
- Monitoring Well
 - Cut-off Wall Alignment
 - Island_Outline
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS Not Sampled



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

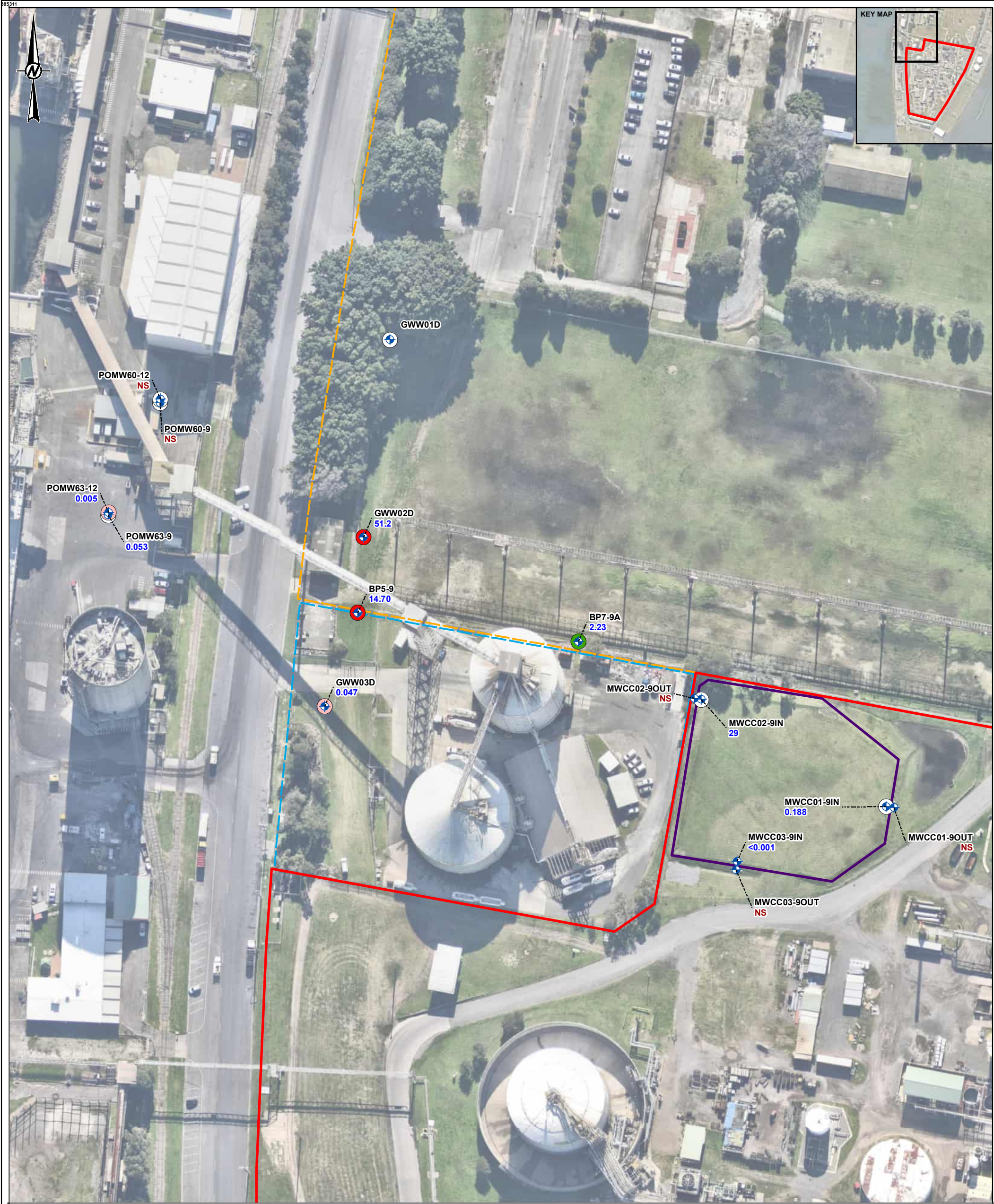
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

TITLE
UNIT 2 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT	YYYY-MM-DD	2024-08-23
DESIGNED		
PREPARED	FS	
REVIEWED	AH	
APPROVED	AH	

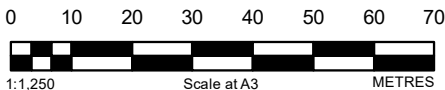
PROJECT NO. 19135645	CONTROL 002-R	REV. A	FIGURE 4B
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- LEGEND**
- Monitoring Well
 - Cut-off Wall Alignment
 - Island_Outline
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS Not Sampled



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JUNE 2024

TITLE
UNIT 3 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT
YYYY-MM-DD 2024-08-23



DESIGNED	
PREPARED	FS
REVIEWED	AH
APPROVED	AH

PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	4C

Appendix A

Sampling Analysis and Quality Plan



Document Revision

The following table outlines the revisions made to the SAQP.

Date	Revision	Nature of Revision	Editor
May 2019	Rev0	Original SAQP, prepared 2 months prior to completion of construction of the containment cell	Golder Associates
May 2020	Rev1	SAQP Revision 1, prepared post completion of remediation and first 6 months of monitoring	Golder Associates
January 2023	Rev2	SAQP Revision 2, prepared completion of 3 years post remediation monitoring	WSP

D.1 SAMPLING, ANALYSIS AND QUALITY PLAN

This is Revision 2 of the Sampling, Analysis and Quality Plan (SAQP) for the Post Remediation Groundwater Monitoring Plan (GMP) for the Containment Cell at Orica's Kooragang Island Site. This SAQP should be read in conjunction with the Long-Term Environmental Management Plan (LTEMP) prepared for the Containment Cell.

D.1.1 Background

The LTEMP provides details on:

- Site Location and Identification, including current use of the site.
- A summary of the remediation works completed at the site including the construction of the Containment Cell.
- A summary of the Surrounding Land use is presented within the Remediation Validation Report (Golder, 2019b).

The LTEMP (in Section 8) provides the GMP including the objectives and scope of works. Section 4.3 of the LTEMP provides the rationale for the 'weight of evidence' approach for the assessment of the hydraulic effects for assessing the ongoing performance of the containment cell. It is also noted in the GMP that the chemical monitoring of arsenic is being undertaken as a 'secondary line of evidence' to provide long-term understanding of the redistribution of the arsenic contamination over time. As such, there is no applicable criteria for arsenic concentrations in groundwater.

D.1.2 Conceptual Site Model

The pre-remediation Conceptual Site Model (CSM) has been presented in previous reports including the Remediation Action Plan (Golder, 2016a) and holistically for the Orica site in the Conceptual Site Model report (Golder, 2013).

Provided below is a summary of the key elements of the CSM that relate to the arsenic contamination post-remediation, which has been continually reviewed as part of each annual monitoring round.

Contaminants of Concern:	Arsenic
Sources:	Former Sludge Disposal Pit (on-site) – removed
Mechanism of contamination	Prior to remediation, disposal to ground with sorption to soil and subsequent leaching into the vadose and saturated zones
Remediation:	Removal of contaminated soils in the vadose zone – 2005 Construction of containment cell to 12 m below ground level and capping – 2019
Exposure Pathways:	Within the Cap and Containment area – nil Remediation (Containment Cell) has: — prevented further off-site migration of contaminated groundwater — management of the cap prevents direct contact exposure and rain infiltration Off the Orica site – management controls as defined within the Off-site EMP Exposure pathways associated with the existing off-site groundwater contamination include: — Direct contact — Inhalation of dust — Ingestion of soil and groundwater — Inhalation of aerosols from groundwater spray
Human and Ecological Receptors:	Within the Cap and Containment area – nil Off the Orica site (existing off-site groundwater contamination) — Workers undertaking intrusive works — Workers exposed to extracted groundwater
Data Gaps:	None identified, however, occasional wells were not available for sampling during the monitoring program, or data logger errors. Repair to wells and data loggers are regularly undertaken. Associated data gaps are considered minor due to long-term monitoring data set, extensive monitoring network confirms no significant changes, wells / data loggers are regularly repaired so data gaps for limited monitoring rounds.
Management and Monitoring:	Ongoing management and monitoring of the containment cell to be undertaken in accordance with the LTEMP.

D.2 DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQO) for the post-remediation Groundwater Monitoring Program have been developed in accordance with the seven-step process described in the National Environmental Protection Measure, Schedule B2, Appendix B.

D.2.1 State the Problem

Remediation of the identified arsenic contamination has been completed by the construction of a containment cell to prevent the further off-site (Orica) migration of arsenic in groundwater. Hydraulic monitoring is required to confirm the containment cell in performing as per the design. Chemical (arsenic) monitoring is required as a secondary line of evidence to confirm further off-site migration is not occurring.

It is expected that the monitoring program will be more intensive in the initial years to confirm the containment cell is performing as per the design. Once this has been achieved the monitoring requirements will be reduced to a program that provides sufficient

data to confirm the ongoing performance of the containment cell. Revision 2 of the LTEMP and this SAQP is part of this revision process.

D.2.2 Identify the decision / goal of the study

To assess the efficacy of the hydraulic segregation of the arsenic source, a ‘weight of evidence’ approach considering the holistic assessment of observed hydraulic effects in consideration of the anticipated effects predicted by the groundwater modelling completed during the design.

Identified potential hydraulic effects included:

- The detection of responses to rainfall events that may be recorded in the external wells, but which would be expected to be less prevalent in the data collected from inside the wall.
- A flattening of the groundwater table(s) inside the cell relative to external conditions.
- An increase in the external hydraulic gradient across the cell (in the direction of groundwater flow), and/or potential increase in gradients around the perimeter of the cell.
- Groundwater monitoring to assess arsenic concentrations in groundwater will be undertaken as a ‘secondary line of evidence’ to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

D.2.3 Identify the information inputs

Hydraulic monitoring to include the long-term assessment of groundwater levels in the three hydrostratigraphic units both inside and outside of the containment cell, to allow consideration of the effectiveness of the containment cell.

Chemical monitoring to include the assessment of dissolved arsenic concentrations down-gradient of the containment cell to provide data for the long-term trends and confidence that the containment cell has prevented the further off-site migration by confirmation of a stable or decreasing trend.

D.2.4 Define the boundaries of the study

Monitoring is to be undertaken both within and immediately outside the containment cell within the three sets of paired monitoring wells located around the containment cell. These wells target the three hydrostratigraphic units in which the cut-off wall has been constructed to contain the identified arsenic contamination. Further to the well located adjacent to the containment cell, groundwater monitoring wells located within the vicinity of the containment cell, predominantly down-gradient, will also be used in the ongoing performance assessment. The monitoring network is defined in Table A.

The duration of the monitoring program will need to be ongoing to confirm the long-term performance of the containment cell.

D.2.5 Develop the analytical approach

Hydraulic monitoring to assess groundwater levels is to use both manual gauging and down-hole water level loggers that log hydraulic data continuously using. A barometric logger will also be used to compensate for the influence of localised atmospheric pressure variation within the containment cell. Data loggers are programmed to collect water level data at 2 hourly intervals.

Chemical monitoring includes the collection of representative groundwater samples and analysis for dissolved arsenic at a commercial laboratory. Quality assurance and quality control sampling and requirements are presented in Section C.8. The performance criteria for the Chemical monitoring are presented in the Data Quality Indicators in Section C.7.1. Validation of the data will be undertaken as described in Section C.9.

D.2.6 Specify performance or acceptance criteria

There are no specific performance or acceptance criteria for assessing the performance of the containment cell. As indicated in Section C2.1 a weight-of-evidence approach will be applied in assessing the hydraulic data to verify that the containment cell has achieved the design outcomes of preventing the further off-site migration of arsenic in groundwater by the hydraulic segregation caused by the containment cell. The key indicators of the hydraulic segregation are presented in Section C2.2.

D.2.7 Develop the plan for obtaining the data

The Groundwater Monitoring Program (as defined in Section 8 of the LTEMP) and this SAQP defined the plan for obtaining the necessary hydraulic and chemical data required to assess the ongoing performance of the containment cell. The GMP and SAQP will be reviewed and updated throughout the implementation of the LTEMP, as required.

This is Revision 2 of the LTEMP and GMP (dated 2023).

D.3 GROUNDWATER MONITORING NETWORK

The groundwater network associated with the containment cell consists of a series of nested wells at strategic locations on either side of the completed cut-off wall, to allow internal and external ‘piezometric’ water levels to be compared. This monitoring system allows collection of groundwater data to demonstrate that the containment cell is performing as per the design

The groundwater monitoring network will be used to confirm the ongoing performance of the containment cell.

D.3.1 Containment Cell Well Installation

Construction and installation of the monitoring network was completed in May of 2019 by Golder and subcontractor Star Drilling Pty Ltd. Borehole advancement was carried out with a “Sonic LX 600” truck mounted drill rig. The monitoring well network is shown in **Figure 3** of the LTEMP. It comprises three groups of nested monitoring wells (each group containing a total of six wells), located around the cut-off wall alignment. Each group included three pairs of piezometers installed to target the 3 separate and distinct groundwater units (Units 1, 2 and 3). Each pair included a well inside and outside of the cut-off wall. The locations selected were as follows:

- Western boundary, near the north-western corner of the containment cell, down-gradient.
- Southern Boundary, cross-gradient.
- Eastern boundary, up-gradient.

The construction details of these monitoring wells are shown in Table 1 below. An additional well was installed in the unsaturated zone on the southern boundary to allow assessment of barometric pressure within the containment cell and allow ‘normalisation’ of the internal water level data.

Wells were constructed using 50 mm, Class 18 unplasticised Poly Vinyl Chloride (uPVC) threaded screens and casings. Well caps and plugs were fitted to the top and bottom of the well, respectively. Screened sections as shown in Table 1, were backfilled with gravel and sealed with bentonite (above top of screen) of at least 0.5 metre (m) thickness. The remaining volume of the well annulus was backfilled using cement bentonite grout. Wells were finished with monuments. Borelogs / well construction logs are presented in the Remediation Validation Report (Golder, 2019). It is noted that depths shown on borelogs were relative to the original surface levels prior to construction of the cap. At the completion of the well installation the wells were finished with stick-ups to allow for the completion of the capping system which was higher than original surface levels. Well stick-ups were protected using barricades. Upon completion of the capping system the wells were finished with monuments and survey of the final top of casing.

Table 1: Containment Cell Well construction details.

Well Name	Total Depth of borehole* (mbgl)	Screen Interval Depth* (m bgl)	Target Unit	Survey Height** (m AHD)
MWCC01-3IN	5	2.5-4.5	1	5.329
MWCC01-3OUT	5	2.5-4.5	1	4.469
MWCC01-6IN	8	5.5-7.0	2	5.356
MWCC01-6OUT	8	5.5-7.0	2	4.470
MWCC01-9IN	11	8.0-10.0	3	5.358

Well Name	Total Depth of borehole* (mbgl)	Screen Interval Depth* (m bgl)	Target Unit	Survey Height** (m AHD)
MWCC01-9OUT	11	8.0-10.0	3	4.468
MWCC02-3IN	5	2.5-4.5	1	4.906
MWCC02-3OUT	5	2.5-4.5	1	4.072
MWCC02-6IN	8	5.5-7.0	2	4.864
MWCC02-6OUT	8	5.5-7.0	2	4.070
MWCC02-9IN	11	8.0-10.0	3	4.859
MWCC02-9OUT	11	8.0-10.0	3	4.070
MWCC03-3IN	4.5	2.5-4.5	1	5.424
MWCC03-3OUT	5	2.5-4.5	1	4.447
MWCC03-6IN	8	5.5-7.0	2	5.461
MWCC03-6OUT	8	5.5-7.0	2	4.455
MWCC03-9IN	11	8.0-10.0	3	5.461
MWCC03-9OUT	11	8.0-10.0	3	4.508
MWCC03-Baro	1.5	0.3-1.5	Unsaturated Zone	5.222

* depth is relative to the original ground surface level. Wells have been extended above original ground level to allow for cap construction.

** Survey height is post construction of capping system (final height)

D.3.2 Well Development

Post construction, wells across the groundwater monitoring network were developed to remove silt, clay, or other fine material introduced during drilling and for alignment of the gravel pack surrounding the well screens. Well development was carried out using Waterra tubing, in conjunction with a Powerpack (small petrol-powered engine) and manual surge blocking to agitate and remove water and fines from the well. The groundwater well development records are included in Remediation Validation Report (Golder, 2019). It is noted that sediment and some bentonite slurry were found in the majority of the wells. This is likely to be associated with the bentonite/clay that was used to construct the containment wall. At the completion of the well development small-scale falling head tests were completed (October 2019 - using the 30 minute data logging) which confirmed that the wells are functional and are in good hydraulic connection with the aquifer.

At the completion of well development, the wells were suitable for use of the monitoring program. It is noted that given the proximity of the wells to the cut off wall, that periodic redevelopment of the wells may be required to remove fines.

D.3.3 Surrounding Groundwater Monitoring Network

There is an existing network of groundwater monitoring wells located in the vicinity of the containment cell, primarily down-gradient, to assess and monitor the nature and extent of arsenic contamination. These monitoring wells are shown on **Figure 3** and **Figure 4**.

D.4 HYDRAULIC MONITORING

D.4.1 Groundwater Level Measurement

Standing water levels in each monitoring well are to be measured using an electronic water level probe. If practicable, all standing water levels should be measured in a single water level measuring event to allow interpretation of groundwater flow direction and

gradient. Water levels are to be measured to a marked point (or the highest point) on the top of the well uPVC casing to enable repeatability of measurements. Water levels should be re-measured prior to purging.

D.4.2 Data Transducer Deployment

Data loggers are installed in each well to record the depth of groundwater in each well over time. Solinst Levellogger Edge M5 & M10 data loggers were installed at a depth of 0.5 m above the base of each well. These loggers were attached to the top cap of each well via stainless steel wire and set to record the water depth every 2 hours. A barometric logger (Solinst Levellogger Barologger) was also installed in MWCC03-Baro to measure barometric pressure at 2 hourly intervals.

D.4.3 Data Transducer Download

Logger data is downloaded manually via the *Solinst* Optical Reader cable, utilizing the *Solinst Levellogger™* series software available from the *Solinst* website (www.solinst.com/downloads).

Manual measurements of groundwater levels are collected prior to data-logger download events as described in Section C.4.1. The manual measurements are used to check the validity of groundwater levels estimated from data of the water pressure transducers and data loggers.

Groundwater levels from the water-pressure transducers were estimated using:

1. the elevation of the water-pressure transducer in each well
2. the total pressure measured by the water-pressure transducers
3. corresponding measurements of barometric pressure, and
4. the assumption regarding the density of the groundwater (in this case assumed to be 1.0 gram per millilitre).

D.5 GROUNDWATER SAMPLING METHOD – ARSENIC

Based on the historical groundwater monitoring experience at the site, a low-flow groundwater sampling method is proposed. The preferred method uses a surface mounted peristaltic pump with dedicated Low-Density Polyethylene (LDPE) tubing and silicon tubing. The end of the LDPE tubing will correspond with the screened section of the well. Submersible sampling bladder pumps may also be used as an alternative, as long as bladders are replaced and equipment is decontaminated between each location.

Groundwater monitoring wells should be purged prior to collection of groundwater samples. The following data will be collected during the purging process:

- A physical description of the sample will be recorded on the field data sheets including:
 - Colour;
 - Turbidity;
 - Odour; and
 - Films/sheens.
- Groundwater parameters will be tested in the field at the time samples are collected using a calibrated meter/probe, for the following field parameters:
 - pH;
 - Electrical conductivity (EC);
 - Temperature;
 - Dissolved oxygen (DO); and
 - Redox potential.

Groundwater parameters are to be measured ex-situ using a flow through cell. Purging is to continue until representative groundwater has entered the well. This will be determined by obtaining stable water parameters (primarily pH, EC and redox). Water parameters are considered to be stable when successive parameter measurements are +/- 10 %.

Groundwater is to be sampled directly from the LDPE tubing, field filtered (0.45 µm), and transferred into the laboratory provided and pre-preserved bottles appropriate for the analyses.

Once filled, sample containers will be immediately tightly capped and placed in a secure chilled esky. Samples must be held and transported under Chain of Custody (CoC) protocols.

D.6 GENERAL FIELD PROCEDURES

D.6.1 Sample Labelling

The sample labels will include the sample identification number, place of collection, date of collection and initials of the sampling personnel. Each sample will be labelled with a unique sample identification number that is consistent with the site's EQIS database and that will facilitate tracking and cross-referencing of sample information. Quality Assurance / Quality Control (QA/QC) samples will also be numbered with a unique sample number.

D.6.2 Field Logs

A summary of activities performed at the site will be recorded in a field logbook. Entries for each day will commence on a new page, which will be dated. Corrections will be made by drawing a single line through the error, initialling this action and writing the correction.

The following types of information will be recorded for each groundwater sample collected:

- Unique sample identification number;
- Date and time of sample collection;
- Initials of the sampling personnel;
- Designation as to the means of collection;
- Analyses to be performed on sample; and
- Any other relevant comments (odour, colour, sheen, filtering, preservation, etc).

D.6.3 Equipment Decontamination

All non-dedicated sampling and measurement equipment is to be decontaminated before and after each use and then rinsed with deionised or distilled water following decontamination (where appropriate).

Dedicated or single use disposable equipment such as LDPE tubing and nitrile gloves will not be decontaminated and will be disposed of appropriately following use.

D.6.4 Sample Storage and Transportation

Groundwater samples are to be kept secure and cool in eskies during the field program. Eskies are to contain ice during the field program and subsequent transportation to the laboratory. Storage of the samples is to be under the custody of the field personnel during the field program.

If samples are not sent to the laboratory on the day of collection, the method of storage such as in refrigerator or in esky on ice (with ice regularly changed to maintain cool temperature) must be noted in the field log books and on the CoC form.

Samples are to be transported to the laboratories, in cooled eskies, under CoC documentation (below).

D.6.5 Chain of Custody Documentation

A CoC record must be utilised by field personnel to document possession of all samples collected for laboratory analysis. The CoC record is to include, but is not limited to, the following information:

- Project name and number;
- Name(s) of sampler(s);
- Sample type, identification number and location;
- Date of collection;
- Number, type and size of containers;
- Required analyses;
- Preservatives;
- Signatures documenting change of sample custody; and
- Turnaround time required for analytical results.

The esky containing the samples should be sealed with tape and secured with a custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorised personnel.

During sampling events partially filled and unfilled coolers are to be kept under the custody of the sample custodian. The sample custodian is to be a designated member of the sampling team.

The original CoC record must accompany the samples to the analytical laboratory, with a copy returned to the field engineer/scientist within 24 hours of sample receipt. The original, or a copy of the original, CoC record is to be placed in the appropriate project file. Samples are to be delivered to the laboratory promptly.

D.6.6 Equipment Calibration

Equipment used to perform testing or data recording (i.e. the water quality meter) will be calibrated to manufacturer's specifications by the supplier prior to use. The calibration records will be retained by the field engineer/scientist. Calibration checks and adjustments will be performed as required (i.e. generally on at least a daily basis for water quality meter) during field operations. The identification of the specific device or equipment calibrated, date, reference standard, results or adjustments made and the signature of the person performing the calibration will be documented on field data sheets or in the field log book.

D.7 ANALYTICAL PLAN - ARSENIC

The primary laboratory selected for the chemical analysis of groundwater samples is Australian Laboratory Services (ALS). The laboratory selected as the check laboratory for the inter-laboratory duplicate (i.e. triplicate) samples is Envirolab Services Pty Ltd (ELS). Both laboratories are accredited by National Association of Testing Authorities (NATA) for the required analyses.

The analytical plan for groundwater samples is detailed in **Table A** (attached), with analytical methods, limits of reporting and holding time for the analyte outlined in Table 2 below.

Table 2: Arsenic Analytical Methods

Analyte	LOR (mg/L)	Recommended Holding Time	Analytical Method	Container Type	Preservation
Arsenic (Dissolved)	0.001	Six months	USEPA 6020 ICP/MS	60ml plastic	Nitric acid to pH<2, chill

LOR – Limit of Reporting

mg/L – milligram per litre

ml - millilitre

LOR may vary depending the presence and concentration of other constituents

D.7.1 Data Quality Indicators

Data Quality Indicators (DQIs) are used to assess the reliability of field procedures and analytical results. They are described as follows:

- **Precision:** A quantitative measure of the variability (or reproducibility) of data;
- **Accuracy:** A quantitative measure of the closeness of reported data to the “true” value;
- **Representativeness:** The confidence (expressed qualitatively) that data are representative of each media present on site;
- **Completeness:** A measure of the amount of useable data from a data collection activity; and
- **Comparability:** The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.

The quantitative and qualitative measures/criteria employed to enable application of these parameters are described in the following sections. Descriptions of the various QA/QC samples are provided in **Section A.5**.

Precision

Suitable criteria and/or performance indicators for assessment of precision include:

- Performance of intra-laboratory duplicate sample sets through calculation of relative percentage differences (RPD);
- Performance of blind field duplicate sample sets, through calculation of RPD; and
- The RPDs will be assessed as acceptable if less than 30%. RPDs that exceed this range may be considered acceptable where:
- Results are less than 10 times the limits of reporting (LOR); or
- Results are less than 20 times the LOR and the RPD is less than 50%.

Accuracy

The closeness of the reported data to the “true” value is assessed through review of performance of:

- Performance of blind field triplicates (or inter-laboratory duplicate) sample sets, through calculation of RPD;
- Field blanks to assess bias introduced by chemicals during handling or transport or from laboratory supplied water, containers or preservatives (water only);
- Rinsate blanks to assess bias introduced from contaminated field equipment (if using non-dedicated equipment only); and
- Method blanks (MB), Matrix spikes (MS) and Laboratory control samples (LCS) which are analysed to assess for bias introduced from contaminated reagents (MB), and bias in percent recovery from expected values (MS and LCS), during laboratory analysis or preparation.

Representativeness

To ensure the data produced by the laboratory is representative of conditions encountered in the field, the following steps are taken by the laboratory and subsequently reviewed:

- Laboratory method blank samples will be run in parallel with field samples to confirm there are no unacceptable instances of laboratory artefacts;
- Review of RPD values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities; and
- The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods).

Completeness

In validating the degree of completeness of the analytical data sets acquired during the program the following is considered:

- Whether standard operating procedures (SOPs) for sampling protocols have been adhered to;
- Copies of all CoC documentation are reviewed and presented; and
- Whether appropriate laboratory methods and LORs were used and sample holding times were complied with.

It can therefore be considered whether the proportion of “useable data” generated in the data collection activities is sufficient for the purposes of the validation.

Comparability

Given the reported data set is likely to be comprised of several data sets from separate sampling episodes, issues of comparability between data sets are reduced through adherence to the same SOPs on each data gathering activity, the use of the same sample preparation and analytical methods as well as documenting the seepage sample locations and returning to the same nominated location (or documenting any changes in location due to the dynamic environment from which the seepage samples will be collected).

D.8 GENERAL QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Standard QA/QC procedures will be adopted during the assessment process including those for sample collection, management and handling. Specific requirements will include the use of laboratory prepared containers, use of dedicated sampling equipment where possible, decontamination of non-dedicated sampling equipment between locations, collection of an appropriate number of quality control samples, preservation of samples in ice chests and transport to laboratories under CoC documentation within holding times. Calibration of all field measurement equipment will be carried out by the supplier and the calibration certificates retained by the field engineer/scientist.

D.8.1 Field Quality Control Samples

The following field quality control (QC) samples will be collected and analysed as part of this monitoring program:

- Intra-laboratory field duplicates (blind replicates): The intra-laboratory field duplicates and corresponding primary samples will be collected from the same location, preserved, stored, transported, prepared and analysed in an identical manner by the primary laboratory, however, the duplicate sample will be blind coded. Intra-laboratory field duplicates provide an indication of the precision or reproducibility of the field sampling techniques and analytical results. Intra-laboratory field duplicates will be collected at a frequency of at least 1 in 10 (10%). Intra-laboratory field duplicate results will be assessed by calculating the RPDs;
- Inter-laboratory field duplicates (field triplicate/split sample): Individual samples will be split in the field and placed in two separate containers. One sample will be sent to the primary laboratory and the duplicate sent to an independent check

laboratory. To provide an indication of the precision or reproducibility of the analytical results. These will be analysed at a frequency of at least 1 in 20 (5%). Inter-laboratory field duplicate results will also be assessed by calculating the RPDs; and

- Field blanks: are used to provide an assessment of potential gain of constituents during sample collection, transport and storage, and/or cross contamination from storage of sampling methodology. These will be analysed at a rate of one field blank per monitoring round and assessed by comparison with percent recoveries and detection limits respectively.

D.8.2 Laboratory QA/QC

Laboratory QA/QC for the water monitoring program includes accreditation of laboratories providing analytical services, and their internal QA/QC procedures and documentation. Laboratory QA/QC will be assessed based on results of internal duplicates, blanks, controls, spikes and surrogates. The internal duplicates results will be reviewed and discussed. The results of the internal blank samples will be evaluated to demonstrate minimal interference.

The following internal laboratory QC samples will be reviewed as part of this monitoring program:

- Internal Laboratory Duplicates: are prepared by the laboratory by dividing a field sample into two or more aliquots, which are analysed separately to provide an indication of the effect of sample matrix variability on precision. These are assessed through the calculation of RPDs;
- Method Blanks: are contaminant free samples analysed by the laboratory to assess the level of contamination that exists in the laboratory analytical system. Results are evaluated by comparison to reporting limits;
- Laboratory Control Samples (LCS): are samples spiked with known concentrations of specific analytes to assess the laboratory performance on sample preparation and the analysis procedure. Results are assessed in terms of accuracy by calculating a percent recovery between the observed and spiked concentrations; and
- Matrix Spikes: are field samples spiked with known concentrations of specific analytes to assess the effects of the sample matrix on the accuracy and precision of analyses. Like laboratory control samples, matrix spike sample accuracy is evaluated in terms of a percent recovery between the observed and expected spiked compound concentrations.

D.9 DATA VALIDATION

The objective of the data validation process is to ensure that the data reported can be used to achieve the project objectives.

Accuracy and precision measurements from the appropriate QC check samples will be compared with the analytical DQIs to assess the quality of the analytical data. Should data be found to fall outside acceptable limits of precision and accuracy, appropriate corrective actions will be investigated.

The data will also be evaluated to assess the reproducibility, comparability and completeness of the data. Upon review of the DQIs an assessment as to whether the data can be relied upon for the purposes of the monitoring will be made.

Appendix B

Field Records and Calibration Certificates



Table A: Long-Term Environmental Management Plan - Arsenic - Groundwater Monitoring Plan (2023-2025)
 REVISION 2 of LTEMP (2023)
 Orica Kooragang Island

Area of Site	Well ID	Hydraulic Monitoring			Chemical Monitoring		Rationale / Comments
		SWL	Data-logger	Barometric logger	G/W Parameter (field)	Dissolved Arsenic	
Containment Cell Wells	MWCC01-3IN	B	B		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-6IN	B	B		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-9IN	B	B		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-3OUT	B	B			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-6OUT	B	B			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-9OUT	B	B			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC02-3IN	B	B		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-6IN	B	B		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-9IN	B	B		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-3OUT	B	B			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-6OUT	B	B			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-9OUT	B	B			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC03-3IN	B	B		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-6IN	B	B		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-9IN	B	B		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
On-site	MWCC03-3OUT	B	B			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-6OUT	B	B			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
Off-site (Initiec Pivot)	MWCC03-9OUT	B	B	B		(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-Baro						Southern - Inside Cell - Unsaturated upgradient of the former sludge pit.
Off-site (Initiec Pivot)	MW48A-4	B			A	A	upgradient of the former sludge pit.
	MW48A-6	B					Downgradient of the former sludge pit.
	MW21A	B			A	A	Downgradient of the former sludge pit.
	MW50	B			A	A	Downgradient of the former sludge pit.
	MW54	B			A	A	Downgradient of the former sludge pit.
	BP5-3	B			A	A	Downgradient of the former sludge pit.
	BP5-6	B			A	A	Downgradient of the former sludge pit.
	BP5-9	B			A	A	Downgradient of the former sludge pit.
	BP7-3	B			A	A	Downgradient of the former sludge pit.
	BP7-6	B			A	A	Downgradient of the former sludge pit.
	BP7-9A	B			A	A	Downgradient of the former sludge pit.
	GW001S	B			A	A	Downgradient of the former sludge pit.
	GW001I	B					Downgradient of the former sludge pit (well installed in June 2013).
	GW001D	B					Downgradient of the former sludge pit (well installed in June 2013).
	GW002S	B			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GW002I	B			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GW002D	B			A	A	Downgradient of the former sludge pit (well installed in June 2013).

MWCC02 - 9IN [D01-20240625
T01-20240625]

GW003 - I [D02-20240625
T02-20240625]

BP5-6 [D01-20240628
T01-20240628]

Monitoring Summary

Project Number: PS135343

Date: 25-6-24

Name: A. Lyne

No.	Location ID	Date	Time	Water Level	Water Level	Gasing Height	Depth	Interface Probe (IP)/Dip Meter (DM)?	Comments
				m bgl	m bnc	m			
1	03-31N	25/6/24	0830	1	4.18		6.45	IP / DM	Model #4 2001
2	03-61N	"	"		4.73			IP / DM	M5-DNSB
3	03-91N	"	"		5.79		11.9	IP / DM	M5
4	03-90UT	"	"		3.85		10.65	IP / DM	M5-DNSB
5	03-60UT	"	"		3.73		7.97	IP / DM	M5
6	03-30UT	"	"		1.88			IP / DM	M5
7	01-31N	"	"		4.125		6.02	IP / DM	M5
8	01-61N	"	"		4.59		8.26	IP / DM	M4
9	01-91N	"	"		4.75		10.36	IP / DM	M4
10	01-30UT	"	"		1.565		5.34	IP / DM	M4
11	01-60UT	"	"		2.62		7.14	IP / DM	M5
12	01-90UT	"	"		3.615		10.70	IP / DM	M4 *
13	02-31N	"	"		3.64		5.82	IP / DM	M4
14	02-61N	"	"		4.14		8.77	IP / DM	M5 DNSB
15	02-91N	"	"		4.155		11.30	IP / DM	M4
16	02-90UT	"	"		3.48		10.70	IP / DM	M5
17	02-60UT	"	"		3.35		8.06	IP / DM	M4
18	02-30UT	"	"		1.54		5.10	IP / DM	M4 *
19	GLW01-S	28-6-24	11:01		3.27		9.52	IP / DM	
20	GLW01-I	"	"		3.13		7.63	IP / DM	
21	GLW01-D	"	"		1.52		2.38	IP / DM	
22								IP / DM	
23								IP / DM	
24								IP / DM	
25								IP / DM	
26								IP / DM	

*From bottom of well cap.

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	MWSO				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	9.370				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	6.280		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1000		3.455	7.79	17.8	2799	-55.0	5.06	clear, N.O.O
1005		3.560	7.74	17.0	2804	-53.5	0.26	" " Flow not yet started
1010		3.570	7.75	18.9	2867	-53.7	0.14	" "
1015		3.555	7.75	18.8	2877	-53.9	0.10	" "
sample collected @ 1015								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	LWW02-D				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	3.310				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	9.820		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0940		3.320	7.57	20.0	2816	-43.4	0.53	clean, N.O.O
0945		3.320	7.56	20.1	2810	-43.3	0.08	" "
0950		3.315	7.57	20.2	2825	-43.4	0.05	" "
sample taken @ 0950								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				

Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS 135343		Well ID:	GWW02-I				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	3.240				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	7.555		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0915		3.295	7.43	19.4	2993	-34.7	1.29	clean, N.O.O
0920		3.310	7.37	19.8	3100	-32.3	0.12	" "
0925		3.320	7.34	20.0	3193	-30.5	0.04	" "
0930		3.320	7.34	20.1	3212	-30.4	0.04	" "
Sample taken @ 0930								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:			Calibration date:					
Did field parameters stabilise? Yes / No / NA			Was the well dry purged Yes / No					
Sampling details:			Analysis required:					
Method/pump type:			TRH			Phenols		
Tubing material:			TRH silica gel			Metals (see COC for list)		
Sampling equipment:			BTEXN			MNA		
Hydrocarbon sheen observed?: Yes / No			VOC			Nutrients		
Primarily Sample ID:			PAH			Other		
Were samples filtered? Yes / No			QC samples collected? Yes / No					
Preservations:			If yes - QC Sample IDs:					
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:			Project manager:					

Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	GWW02-5				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.490				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	3.530		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0850		1.500	7.59	15.9	743	-41.9	2.78	clear, N.O.O
0855		1.495	7.36	16.9	702	-31.1	1.33	" "
0900		1.475	7.30	17.1	743	-27.4	1.13	" "
0905		1.500	7.26	17.2	761	-25.3	1.11	" "
sample taken @ 0905								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	MW21A				
Client:			Sampling date:	28/06/24				
Site location:			Sampler:	NM				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.795				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	6.030		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1040		1.735	7.26	18.2	1600	-25.2	0.92	clear, NOO
1045		1.900	7.25	18.5	1741	-25.0	0.04	" "
1050		1.905	7.26	18.5	1711	-25.8	0.03	" "
1055		1.910	7.27	18.4	1704	-25.9	0.03	" "
sample taken @ 1055								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

PS135343

Job number:	POMW63-12		Well ID:	POMW63-12				
Client:			Sampling date:	27/6				
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.750				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	10.44		Actual purge volume (L):					
Well condition:	good, high sediment build up in gatic		Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:			(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)					
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1340		1.840	8.17	20.3	692	-103.4	1.78	clear, N.O.O
1343		2.045	8.50	21.3	708	-66.7	0.38	" "
1346		2.250	8.45	21.4	711	-49.1	0.12	" "
1350		2.455	8.43	21.5	710	-93.8	0.09	" "
sample taken @ 1350								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	POMW63-9				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	2.035				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	8.740		Actual purge volume (L):					
Well condition:	good		Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1400		2.140	7.74	21.9	6203	-38.3	1.91	clear, turbid-floc
1405		2.185	7.76	21.9	6322	-60.4	0.24	" slightly turbid
1410		2.200	7.71	22.0	7336	-106.9	0.08	clear, "
1415		2.200	7.73	22.0	7554	-115.2	0.08	" "
Sample taken @ 1415								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	POMW7				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.090				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	2.880		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1240		1.175	7.1	19.9	1046	86.9	0.41	clear, N.O.O
1245		1.170	6.89	19.9	1098	87.5	0.23	" "
1250		1.190	6.91	19.9	1235	78.4	0.17	" "
1255		1.180	6.93	20.0	1291	69.4	0.15	" "
sample taken @ 1300								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	MWCC02-600 IN					
Client:	Orica – Kooragang Island	Sampling date:	25-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 4.20							
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):							
LNAPL thickness (mm):	Initial Pump Speed (Purging):							
Method/pump type:	Initial Pump Speed (Sampling):							
Start time (2400 hr):	Pump depth (from base of well):							
Well depth from TOC (m):	Actual purge volume (L):							
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?							
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10:47	0.5	4.31	7.89	18.4	1541	23.1	0.40	
10:50	1.0	4.32	7.85	18.6	1570	21.2	0.23	
10:53	1.5	4.33	7.85	18.7	1571	18.0	0.17	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed? Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343		Well ID:	MWCC02-8131N				
Client:	Orica – Kooragang Island		Sampling date:	25-6-24				
Site location:			Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	3.64				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):			Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11:05	0.5	3.65	7.14	17.9	1184	0.5	0.57	-
11:08	1.0	3.65	6.90	18.3	845	10.1	0.41	-
11:11	1.5	3.66	6.91	18.4	831	13.7	0.41	-
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged:			Yes / No	
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?	Yes / No			VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered?	Yes / No			QC samples collected?			Yes / No	
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	GWW003-S					
Client:	Orica – Kooragang Island	Sampling date:	25-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	1.43					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
16:32	0.5	1.44	7.48	19.2	854	-40.4	2.25	—
16:35	1.0	1.44	7.41	19.4	839	-35.0	0.92	—
16:38	1.5	1.44	7.41	19.4	841	-31.6	0.84	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA		Was the well dry purged: Yes / No						
Sampling details:		Analysis required:						
Method/pump type:	TRH	Phenols						
Tubing material:	TRH silica gel	Metals (Dissolved Arsenic)						
Sampling equipment:	BTEXN	MNA						
Hydrocarbon sheen observed? Yes / No	VOC	Nutrients						
Primarily Sample ID:	PAH	Other						
Were samples filtered? Yes / No	QC samples collected? Yes / No							
Preservations:	If yes – QC Sample IDs:							
Other comments and observations:								
Field scientist:	Project manager: Jack Flanagan							



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	GW003-D					
Client:	Orica – Kooragang Island	Sampling date:	25-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	3.10					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
13:03	0.5	3.12	7.97	21.3	9986	-187.8	0.10	* 7.96 pH
13:06	1.0	3.12	7.97	21.4	9734	-198.6	0.12	—
13:09	1.5	3.12	7.97	21.4	9663	-200.9	0.10	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA		Was the well dry purged: Yes / No						
Sampling details:		Analysis required:						
Method/pump type:	TRH	Phenols						
Tubing material:	TRH silica gel	Metals (Dissolved Arsenic)						
Sampling equipment:	BTEXN	MNA						
Hydrocarbon sheen observed? Yes / No	VOC	Nutrients						
Primarily Sample ID:	PAH	Other						
Were samples filtered? Yes / No	QC samples collected? Yes / No							
Preservations:	If yes – QC Sample IDs:							
Other comments and observations:								
Field scientist:	Project manager: Jack Flanagan							



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135 343	Well ID:	BP5-9					
Client:	Orica – Kooragang Island	Sampling date:	28.6.24					
Site location:		Sampler:	A. Lynne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	3.34					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0929	0.5	3.36	7.55	19.0	3001	67.5	0.92	—
0932	1.0	3.38	7.45	19.8	2857	40.7	0.87	—
0935	1.5	3.38	7.49	19.9	3007	24.6	0.30	—
0938	2.0	3.38	7.52	19.9	3075	19.1	0.29	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals, (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed? Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	BP7-3					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	0.58					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10:26	0.5	0.59	6.75	17.0	2773	52.4	2.65	— 0.59 mBTOC
10:29	1.0	0.59	6.76	17.0	2825	54.2	2.82	—
10:32	1.5	0.59	6.72	16.8	2831	59.3	3.1	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed? Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	BP7-9A					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	2.38					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):	7.79	Actual purge volume (L):						
Well condition:	Damaged.	Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0955	0.5	2.59	7.44	19.3	692	27.0	0.54	—
0958	1.0	2.68	7.46	19.4	693	3.5	0.35	—
1001	1.5	2.69	7.38	19.5	692	-7.6	0.28	—
1004	2.0	2.70	7.35	19.7	669	-9.3	0.22	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?	Yes / No			VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered?	Yes / No			QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	BP7-6					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 2.43							
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):							
LNAPL thickness (mm):	Initial Pump Speed (Purging):							
Method/pump type:	Initial Pump Speed (Sampling):							
Start time (2400 hr):	Pump depth (from base of well):							
Well depth from TOC (m):	Actual purge volume (L):							
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?							
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1011	0.5	2.46	7.00	19.2	1958	52.2	0.35	—
1014	1.0	2.49	7.04	19.3	1972	34.9	0.22	—
1017	1.5	2.50	7.05	19.3	1980	27.1	0.20	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH			Phenols	
Tubing material:				TRH silica gel			Metals (Dissolved Arsenic)	
Sampling equipment:				BTEXN			MNA	
Hydrocarbon sheen observed? Yes / No				VOC			Nutrients	
Primarily Sample ID:				PAH			Other	
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343	Well ID:	BPS-3					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	1.395					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):	3.50	Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
8:57	0.5	1.43	6.91	17.7	2499	89.0	0.47	—
9:00	1.0	1.43	6.89	18.5	2524	81.8	0.19	—
9:03	1.5	1.43	6.89	18.6	2526	80.1	0.18	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:					Calibration date:			
Did field parameters stabilise? Yes / No / NA					Was the well dry purged: Yes / No			
Sampling details:					Analysis required:			
Method/pump type:					TRH	Phenols		
Tubing material:					TRH silica gel	Metals (Dissolved Arsenic)		
Sampling equipment:					BTEXN	MNA		
Hydrocarbon sheen observed? Yes / No					VOC	Nutrients		
Primarily Sample ID:					PAH	Other		
Were samples filtered? Yes / No					QC samples collected? Yes / No			
Preservations:					If yes – QC Sample IDs:			
Other comments and observations:								
Field scientist:					Project manager: Jack Flanagan			



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS ~~19~~ 135343	Well ID:	MW54					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	1.1089					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):	6.34	Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10486	0.5	1.92	7.62	18.4	1108	74.7	0.62	—
1049	1.0	1.93	7.54	19.2	1062	44.7	0.18	—
1052	1.5	1.92	7.51	19.2	1051	18.1	0.13	—
1055	2.0	1.92	7.51	19.2	1047	17.4	0.13	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA		Was the well dry purged: Yes / No						
Sampling details:		Analysis required:						
Method/pump type:		TRH	Phenols					
Tubing material:		TRH silica gel	Metals (Dissolved Arsenic)					
Sampling equipment:		BTEXN	MNA					
Hydrocarbon sheen observed? Yes / No		VOC	Nutrients					
Primarily Sample ID:		PAH	Other					
Were samples filtered? Yes / No		QC samples collected? Yes / ~~No~~						
Preservations:		If yes – QC Sample IDs:						
Other comments and observations:								
Field scientist:		Project manager: Jack Flanagan						

Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	POMW63 - 3				
Client:			Sampling date:					
Site location:			Sampler:					
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.50				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	13.30		Pump depth (from base of well):					
Well depth from TOC (m):	2.81		Actual purge volume (L):					
Well condition:	Good, sediment around		Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	10L		(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)					
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
13.35		1.59	6.87	20.5	686	122.0	0.47	Clear, no odours.
13.40		1.59	6.48	20.6	674	114.6	0.38	" "
13.45		1.63	6.49	20.3	789	107.5	0.33	" "
13.50		1.65	6.54	20.3	805	100.2	0.40	" "
Sample taken @ 13.50								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes - QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	POMW63 - 6					
Client:	Orica KI	Sampling date:	27-6-24					
Site location:	PON	Sampler:	JF					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	0.75					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):	1.55	Pump depth (from base of well):						
Well depth from TOC (m):	4.41	Actual purge volume (L):						
Well condition:	Good, Sediment around	Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:	TOC.	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)						
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
2.00		0.78	7.43	21.5	905	116.8	0.46	Some turbidity / black flow.
2.05		1.22	7.17	21.9	875	114.1	0.48	" "
2.10		1.28	6.89	21.9	876	117.7	0.58	" "
2.15		1.31	6.85	22.0	884	113.6	0.63	" "
Sample taken @ 2.15								
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:					Calibration date:			
Did field parameters stabilise? Yes / No / NA					Was the well dry purged Yes / No			
Sampling details:					Analysis required:			
Method/pump type:					TRH		Phenols	
Tubing material:					TRH silica gel		Metals (see COC for list)	
Sampling equipment:					BTEXN		MNA	
Hydrocarbon sheen observed?: Yes / No					VOC		Nutrients	
Primarily Sample ID:					PAH		Other	
Were samples filtered? Yes / No					QC samples collected? Yes / No			
Preservations:					If yes – QC Sample IDs:			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:					Project manager:			



Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	MW0001-9 FN					
Client:	Orica – Kooragang Island	Sampling date:	25.6.24					
Site location:		Sampler:	JTC					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	4.75					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):	10.20	Pump depth (from base of well):						
Well depth from TOC (m):	10.37	Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10.25		4.78	7.70	18.2	1587	-140.1	0.37	Clear, no odours
10.30		4.80	7.74	18.7	1626	-168.2	0.10	" "
10.35		4.81	7.85	18.8	1662	-198.9	0.0	" "
10.40		4.81	7.87	19.0	1673	-196.7	0.0	" "
Sample taken @ 10.40.								
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH			Phenols	
Tubing material:				TRH silica gel			Metals (Dissolved Arsenic)	
Sampling equipment:				BTEXN			MNA	
Hydrocarbon sheen observed? Yes / No				VOC			Nutrients	
Primarily Sample ID:				PAH			Other	
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faulk	Date: 8/12/14
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Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 135343	Well ID:	BPS-6					
Client:	Orica – Kooragang Island	Sampling date:	28-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	3.06					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):	—	Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
0914	0.5	3.10	7.24	18.7	2490	82.2	0.85	—
0917	1.0	3.12	7.22	19.7	2506	57.8	0.35	—
0920	1.5	3.12	7.20	19.7	2547	47.4	0.30	—
0923	2.0	3.12	7.26	19.5	2564	41.3	0.28	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA				Was the well dry purged: Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (Dissolved Arsenic)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed? Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs: DO1-20240628 TO1-20240628				
Other comments and observations:								
Field scientist:				Project manager: Jack Flanagan				



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS 135343	Well ID:	MWCC02-91N					
Client:	Orica – Kooragang Island	Sampling date:	25-4-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	4.14					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10:35	0.5	4.24	8.15	18.3	1475	23.4	0.27	—
10:39	1.0	4.30	8.24	18.7	1495	-5.5	0.14	—
10:42	1.5	4.31	8.24	18.8	1496	-7.6	0.15	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA		Was the well dry purged: Yes / No						
Sampling details:		Analysis required:						
Method/pump type:		TRH		Phenols				
Tubing material:		TRH silica gel		Metals (Dissolved Arsenic)				
Sampling equipment:		BTEXN		MNA				
Hydrocarbon sheen observed? Yes / No		VOC		Nutrients				
Primarily Sample ID:		PAH		Other				
Were samples filtered? Yes / No		QC samples collected? Yes / No						
Preservations:		If yes – QC Sample IDs:		DOI-20240625				
Other comments and observations:				to 1-20240625				
Field scientist:		Project manager: Jack Flanagan						



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS 1353AB	Well ID:	GW03-I					
Client:	Orica – Kooragang Island	Sampling date:	25-6-24					
Site location:		Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m):	2.91					
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m):		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N	If yes, volume (L)?					
Bore volume:								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12:46	0.5	2.91	7.39	21.0	1670	-92.7	0.46	—
12:49	1.0	2.93	7.39	21.0	1686	-98.5	0.24	—
12:52	1.5	2.93	7.39	21.2	1690	-101.5	0.19	—
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:		Calibration date:						
Did field parameters stabilise? Yes / No / NA		Was the well dry purged: Yes / No						
Sampling details:		Analysis required:						
Method/pump type:		TRH	Phenols					
Tubing material:		TRH silica gel	Metals (Dissolved Arsenic)					
Sampling equipment:		BTEXN	MNA					
Hydrocarbon sheen observed? Yes / No		VOC	Nutrients					
Primarily Sample ID:		PAH	Other					
Were samples filtered? Yes / No		QC samples collected? Yes / No	Yes / No					
Preservations:		If yes – QC Sample IDs:	D02-20240625 T02-20240625					
Other comments and observations:								
Field scientist:		Project manager: Jack Flanagan						

Multi Parameter Water Meter

Instrument
Serial No. YSI Quatro Pro Plus
11C100763



Air-Met Scientific Pty Ltd
1300 137 067

19/06/2024

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00 (pH)		pH 7.00		419529	6.97
2. pH 4.00 (pH)		pH 4.00		414104	4.00
3. ORP (mV)		253.42		420151/420152	253.6
4. EC (mS)		2760		424499	2759
5. D.O		0.0%		407802	-0.1%
6. Temp (°C)		13.8		MultiTherm	13.6

Calibrated by:

Samuel Tanner

Calibration date:

19/06/2024

Next calibration due:

19/07/2024

Multi Parameter Water Meter

Instrument **YSI Quatro Pro Plus**
Serial No. **09K101342**



Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Diffusion mode Aspirated mode

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00		7.00		419529	7.02
2. pH 4.00		4.00		414104	4.00
3. ORP (mV)		253.2		A420151/B420152	253.3
4. EC (uS/cm)		2760		424499	2760
5. D.O (%)		0.0%		407802	0.0%
6. Temp (°C)		14.0		MultiTherm	13.8

Calibrated by:

Samuel Tanner

Calibration date:

19/06/2024

Next calibration due:

19/07/2024



Item	Test	Pass	Comments
Battery	Compartment	✓	
	Capacity	✓	
Probe	Cleaned/Decon.	✓	
	Operation	✓	
Connectors	Condition	✓	
		✓	
Tape Check	Cleaned	✓	
	Checked for cuts	✓	
Instrument Test	At surface level	✓	Issue with handle as back of device to tightened reel - Does not tighten.

Certificate of Calibration

This is to certify that the above instrument has been cleaned and tested.

Alex Buist

Next calibration due: 14/07/2024



Air-Met Scientific Pty Ltd
1300 137 067

Certificate of Calibration

Tested by:

Test date:

14/06/2024

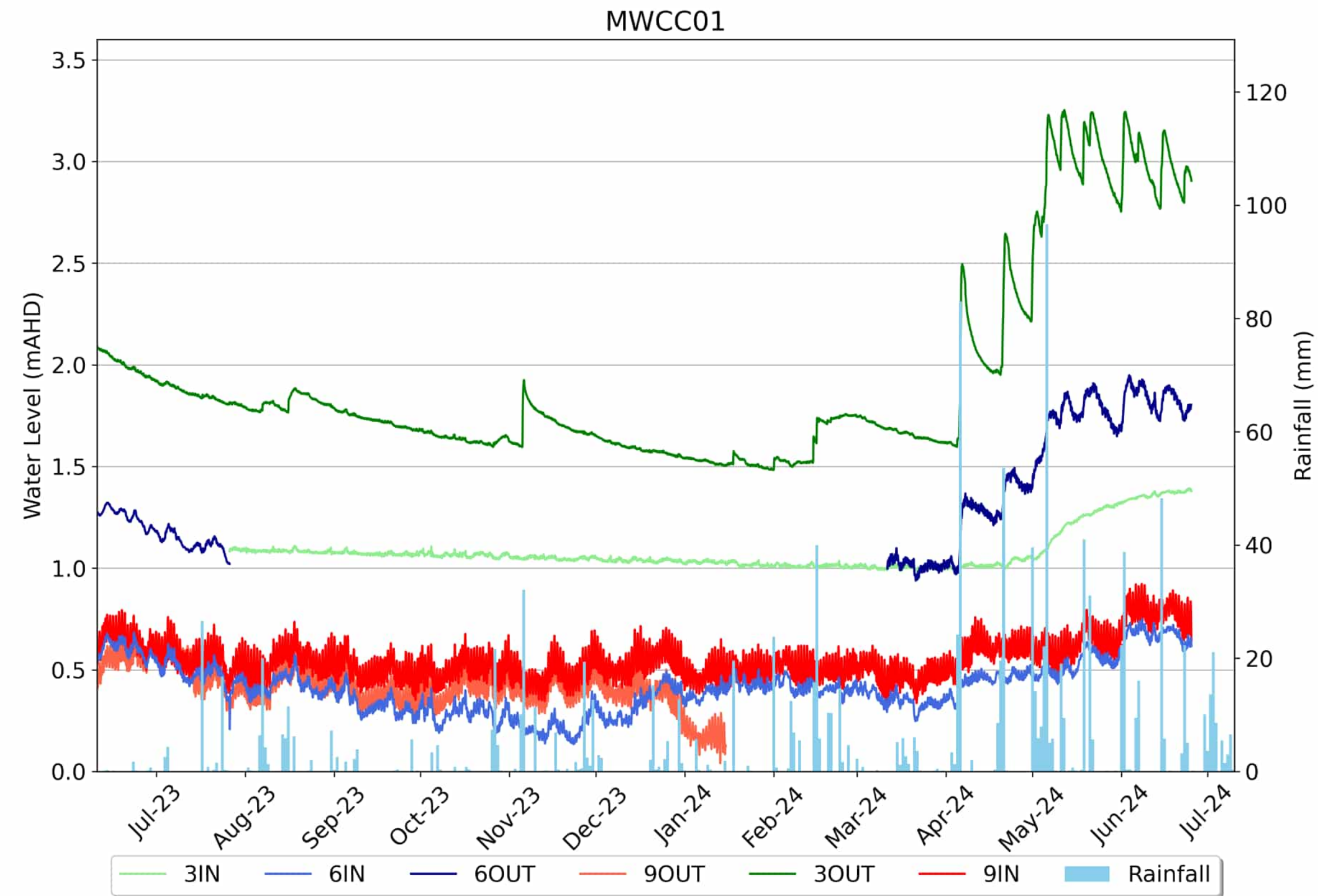
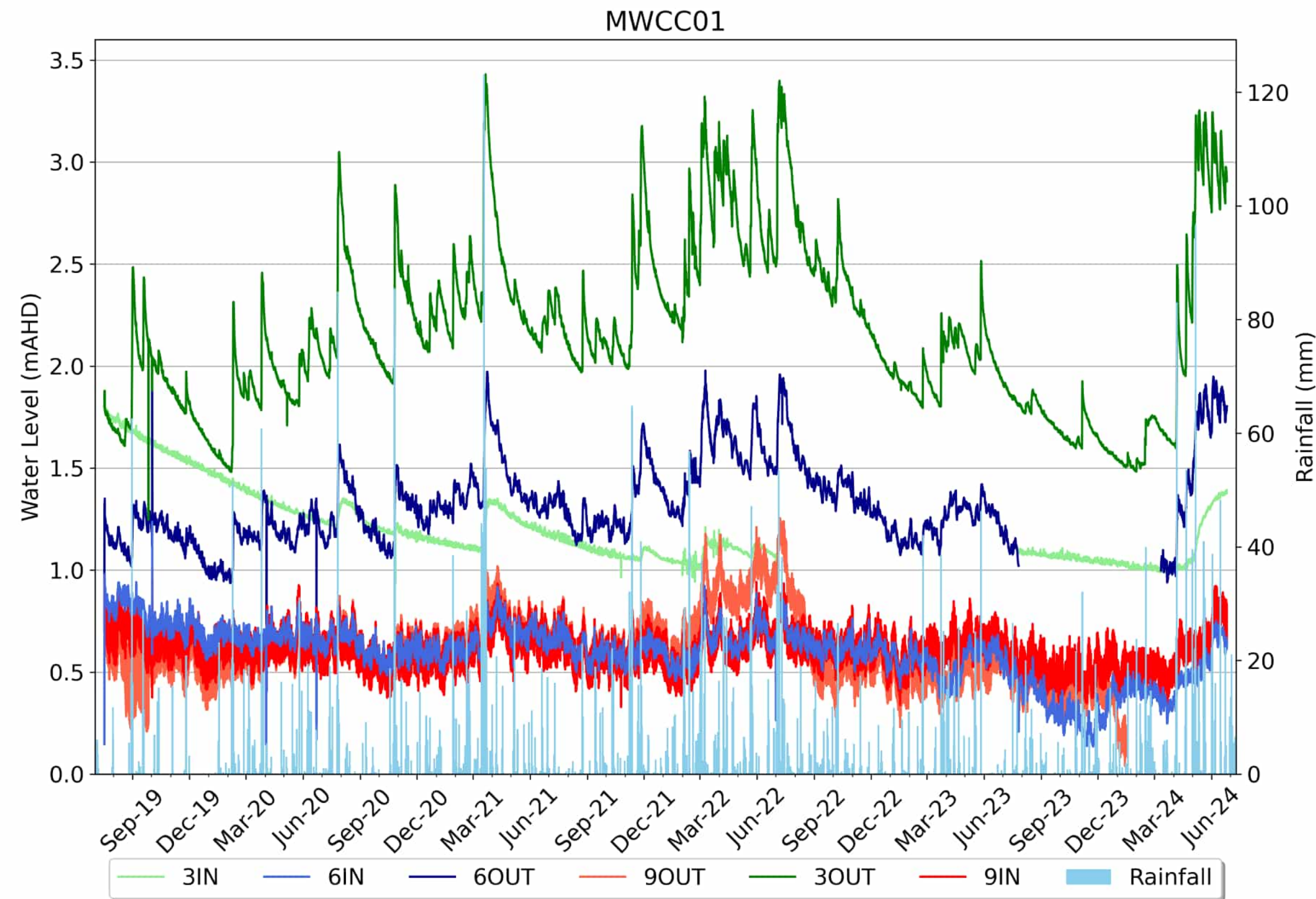
Next Test due:

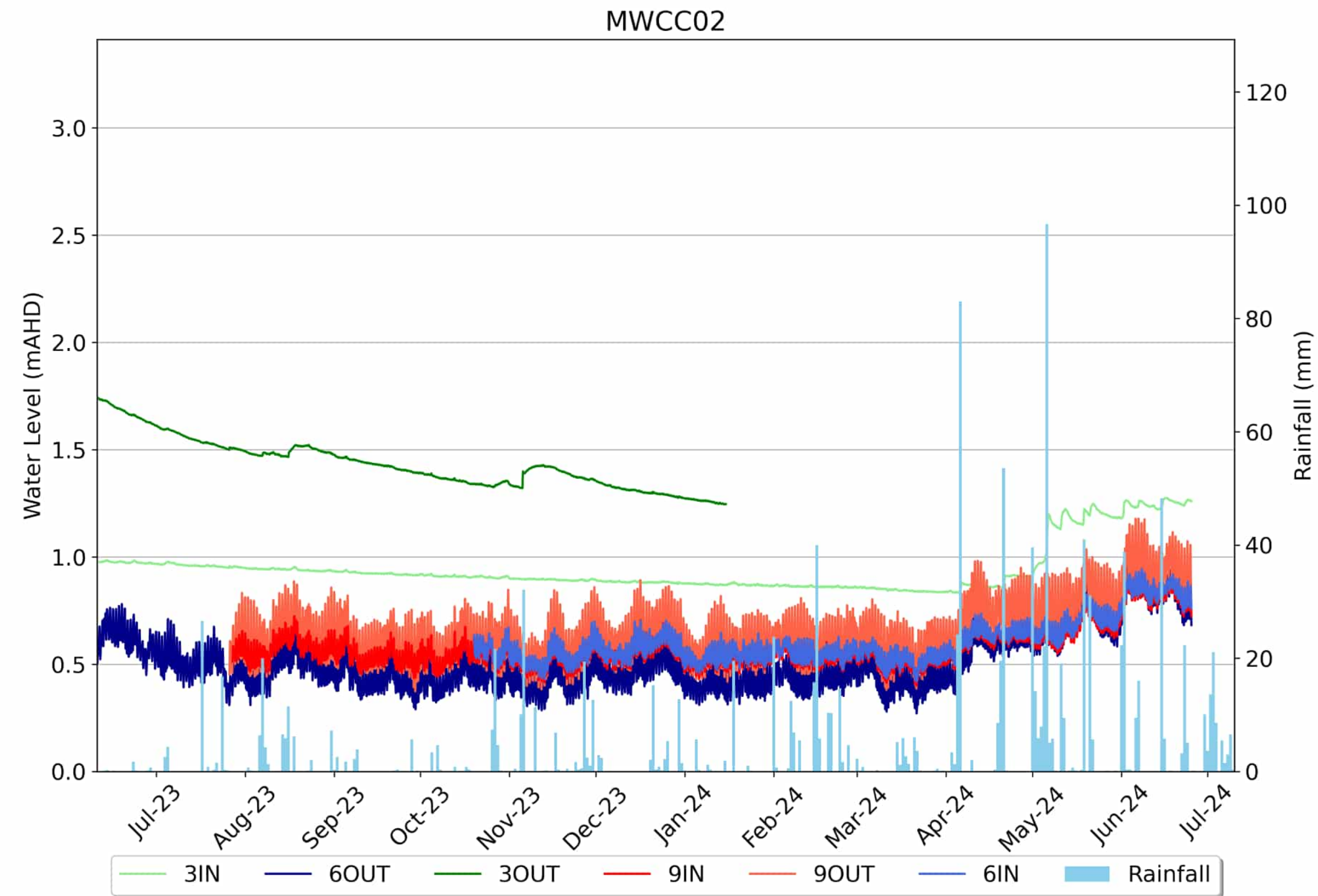
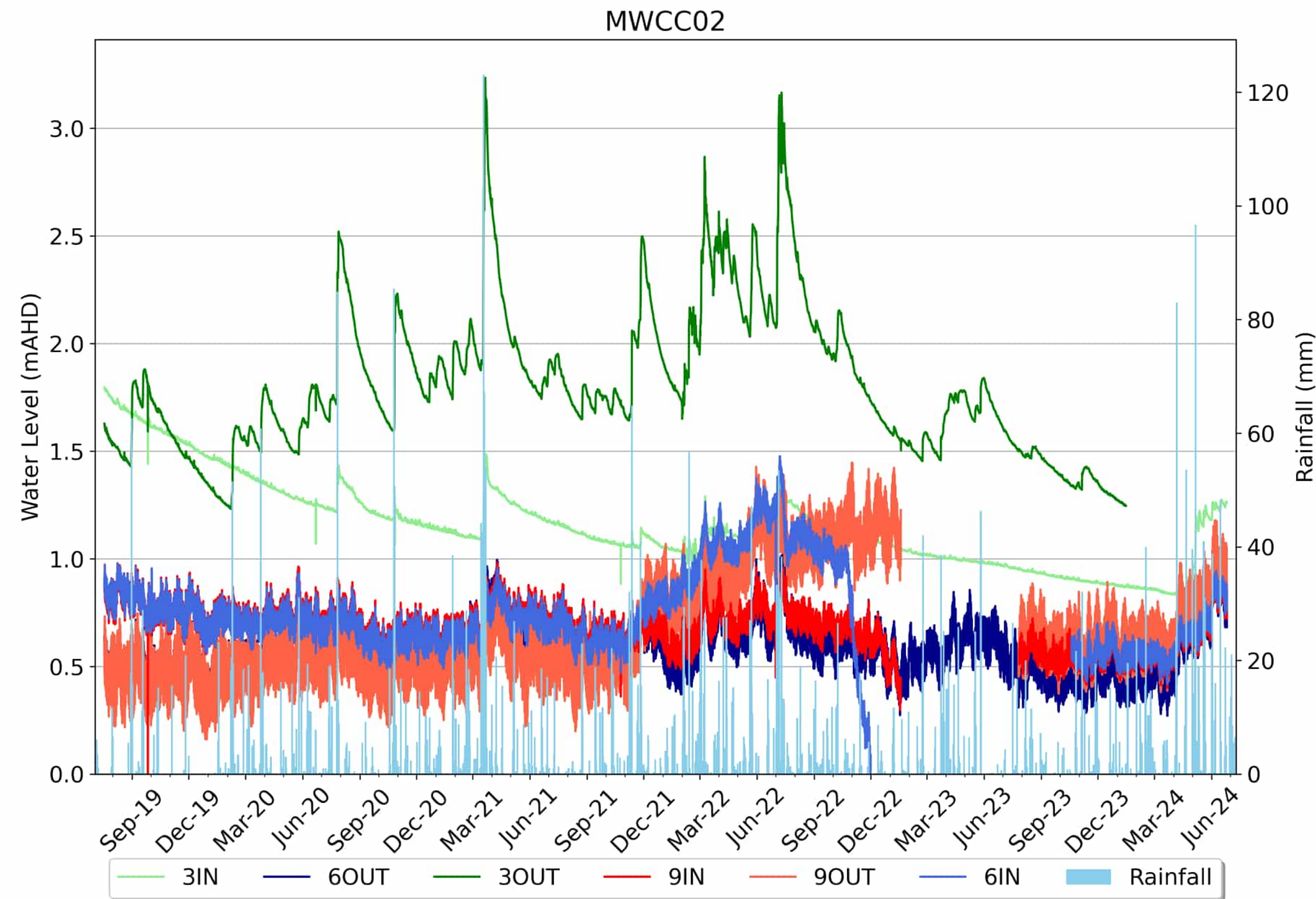
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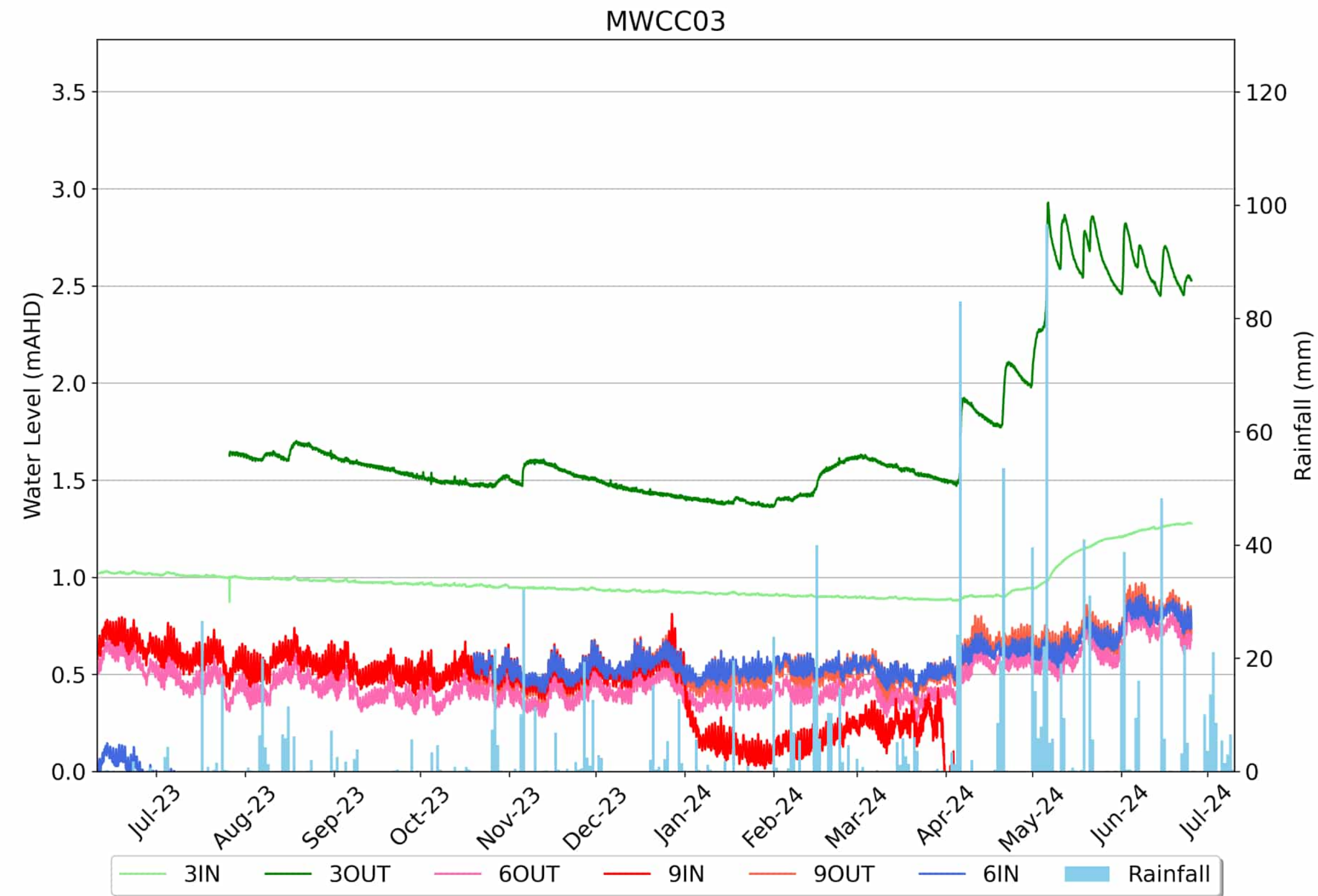
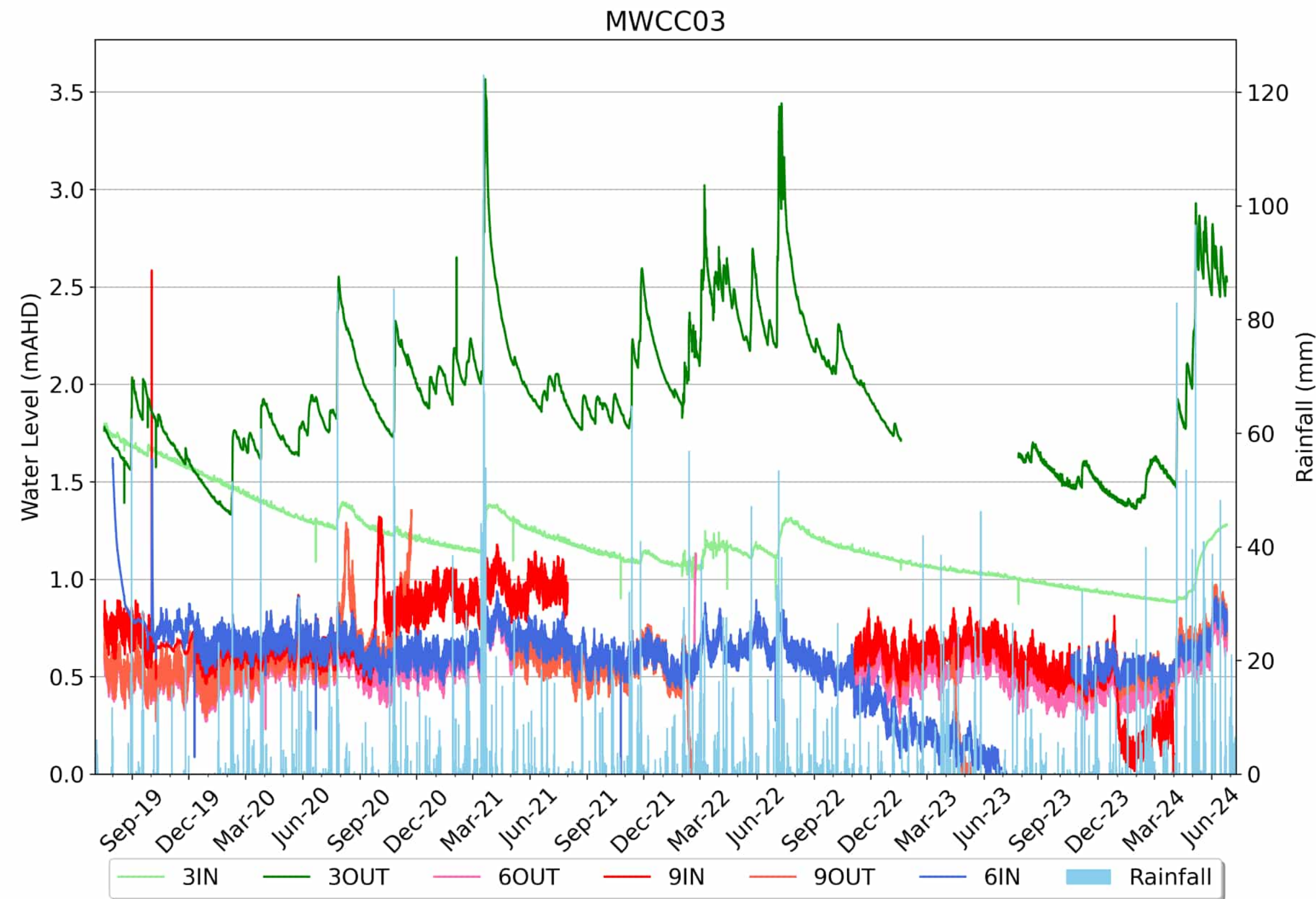
Appendix C

Hydraulic Verification









Appendix D

Data Validation and Laboratory Results





DATA VALIDATION SUMMARY SHEET (NSW)

Project Name:		Orica KI LTEMP GW Monitoring		Project Number:		PS135343			
Primary Laboratory:		ALS Newcastle		Work Order Number:		ES2421640			
Secondary Laboratory:		Eurofins		Work Order Number:		1114361			
Date Sampled:		24 - 28 June 2024		Sample Medium:		Water			
Sample Information									
Number of Primary Samples:		31		Number of Triplicate Samples:		3			
Number of Duplicate Samples:		3		Number of Other QAQC Samples:		1			
Documentation and Sample Handling Information									
		Y/N		Comments					
COC completed properly?		Y		Signed by field staff and laboratory personnel.					
All requested analysis completed?		Y		All requested analyses on the COC performed by ALS & Eurofins.					
Samples received intact and chilled?		Y		ALS: 2.4°C, ice present. Samples received in good order. Note, sample delivered directly to laboratory from the site (<30 minutes) Eurofins: 6.4°C.					
Samples analysed within appropriate holding times?		Y		All samples were analysed within appropriate holding times (ALS & Eurofins).					
Sample volumes sufficient for QC analysis?		Y		Sufficient sample volume was provided for all laboratory tests (ALS & Eurofins).					
Are there non-NATA accredited methods used?		N		ALS & Eurofins are NATA accredited for all methods used in this batch.					
Chromatograms supplied as appropriate?		NA		N/A.					
Laboratory reports signed by authorised personnel?		Y		All reports signed.					
QAQC Sample Information (Method Blank - MB, Rinsate Blank - RB, Field Blank - FB, Trip Blank - TB)									
Type		Sample ID		Comments					
MB		Method Blank		All results were below the LOR (ALS).					
FB		FB01		All results were below the LOR (ALS).					
Trip Spike Information									
Analyte		Control Spike Concentrations		Trip Spike Concentration		% Recovery		Comments	
Sample ID: NA									
Laboratory Control Spike (LCS) Analyses									
Analyte Group			Comments						
All			All LCS recoveries are within the laboratory based DQOs (ALS).						
Matrix Spike (MS) Analyses									
Analyte Group			Comments						
Arsenic			ALS: MS recoveries for arsenic are not determined (ES2421640-018). Refer to overall comments.						
-			All other MS recoveries are within the laboratory based DQOs (ALS & Eurofins).						
Laboratory Duplicates (LD) Analyses									
Analyte Group			Sample ID		Comments				
-			-		All LD RPDs are within the laboratory based DQOs (ALS & Eurofins).				
Field Duplicates (FD) Analyses									
Analyte Group		Primary ID		Duplicate ID		Comments			
-		MWCC02-9IN		D01_20240625		All FD RPDs are within DQOs.			
		GWW03-I		D02_20240625					
		BP5-6		D01_20240628					
Field Triplicates (FT) Analyses									
Analyte Group		Primary ID		Triplicate ID		Comments			
-		MWCC02-9IN		T01_20240625		All FT RPDs are within DQOs.			
		GWW03-I		T02_20240625					
		BP5-6		T01_20240628					
Surrogate Compound Monitoring Analyses									
Analyte Group		Analyte(s)		Comments					
-		-		N/A					
Overall Comments									
ALS: MS recovery for Arsenic are not determined. As stated by ALS, "MS recoveries are not determined, background level greater than or equal to 4x spike level.									
This batch has been validated and is considered suitable for environmental interpretive use.									
Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.									
*When concentrations are less than the LOR for both primary and duplicate/triplicate results, no RPDs are calculated									
Performed By:		Jack Flanagan			Checked By:		Andrew Holloway		
Date:		12/08/2024			Date:		17/08/2024		

Sample ID	MWCC02-9IN	D01_20240625	T01_20240625
Sample Type	Primary	Field Duplicate	Field Triplicate
Date Sampled	25/6/2024	25/6/2024	25/6/2024

Legend
 ND = Not Detected (RPDs not calculated if both primary and duplicate results are below LOR)
 - = Not analysed/calculated
Indicates RPD result does not meet the acceptable criteria
 Acceptable RPDs: Analysis result < 10 times LOR: any RPD
 Analysis result ≥ 10 times LOR and < 20 times LOR: RPD ≤ 50%
 Analysis result ≥ 20 times LOR: RPD ≤ 30%

Project : Orica KI LTEMP GW Monitoring
Project Number: PS135343
Duplicate Analysis RPDs
Batch/es: ES2421640 / 1114361

Sample ID	GWW03-I	D02_20240625	T02_20240625
Sample Type	Primary	Field Duplicate	Field Triplicate
Date Sampled	25/6/2024	25/6/2024	25/6/2024

[illegible]

Legend

ND = Not Detected (RPDs not calculated if both primary and duplicate results are below LOR)

- = Not analysed/calculated

Indicates RPD result does not meet the acceptable criteria

Acceptable RPDs:

Analysis result < 10 times LOR: any RPD

Analysis result ≥ 10 times LOR and < 20 times LOR: RPD $\leq 50\%$

Analysis result ≥ 20 times LOR: RPD $\leq 30\%$

Sample ID	BP5-6	D01_20240628	T01_20240628
Sample Type	Primary	Field Duplicate	Field Triplicate
Date Sampled	28/6/2024	28/6/2024	28/6/2024

Legend
 ND = Not Detected (RPDs not calculated if both primary and duplicate results are below LOR)
 - = Not analysed/calculated
Indicates RPD result does not meet the acceptable criteria

Acceptable RPDs:	
	Analysis result < 10 times LOR: any RPD
	Analysis result ≥ 10 times LOR and < 20 times LOR: RPD $\leq 50\%$
	Analysis result ≥ 20 times LOR: RPD $\leq 30\%$



CERTIFICATE OF ANALYSIS

Work Order : **ES2421640**
Client : **WSP Australia Pty Ltd**
Contact : JACK FLANAGAN
Address : PO BOX 1162
NEWCASTLE NSW, AUSTRALIA 2300
Telephone : ----
Project : PS135343 West Arsenic Groundwater Monitoring
Order number : PS135343
C-O-C number : ----
Sampler : AL, JF, NM
Site : Orica K.I
Quote number : EN/000
No. of samples received : 35
No. of samples analysed : 35

Page : 1 of 9
Laboratory : Environmental Division Sydney
Contact : Sepan Mahamad
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61 2 8784 8555
Date Samples Received : 02-Jul-2024 10:06
Date Analysis Commenced : 05-Jul-2024
Issue Date : 09-Jul-2024 13:05



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories

Position

Accreditation Category

Ankit Joshi

Senior Chemist - Inorganics

Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MWCC01_3IN	MWCC01_6IN	MWCC01_9IN	MWCC02_3IN	MWCC02_6IN
Sampling date / time					25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-001	ES2421640-002	ES2421640-003	ES2421640-004	ES2421640-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.338	0.030	0.188	0.430	68.1



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MWCC02_9IN	MWCC03_3IN	MWCC03_6IN	MWCC03_9IN	MW48
Sampling date / time					25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-006	ES2421640-007	ES2421640-008	ES2421640-009	ES2421640-010
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		29.0	0.008	0.001	<0.001	0.003



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW21A	MW50	MW54	BP5-3	BP5-6
Sampling date / time					28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-011	ES2421640-012	ES2421640-013	ES2421640-014	ES2421640-015
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		7.77	45.3	2.52	2.93	28.7



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BP5-9	BP7-3	BP7-6	BP7-9A	GWW02S
Sampling date / time					28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-016	ES2421640-017	ES2421640-018	ES2421640-019	ES2421640-020
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		14.7	0.305	8.34	2.23	0.980



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	GWW02 I	GWW02D	GWW03 S	GWW03I	GWW03 D
Sampling date / time					28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00	28-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-021	ES2421640-022	ES2421640-023	ES2421640-024	ES2421640-025
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		37.8	51.2	0.063	33.1	0.047



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	POMW7	POMW62-6	POMW63-3	POMW63-6	POMW63-9
Sampling date / time					27-Jun-2024 00:00	27-Jun-2024 00:00	27-Jun-2024 00:00	27-Jun-2024 00:00	27-Jun-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-026	ES2421640-027	ES2421640-028	ES2421640-029	ES2421640-030
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		2.29	3.01	0.084	0.004	0.053



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	POMW63-12	D01_20240625	D02_20240625	D01_20240628	FB01
Sampling date / time					27-Jun-2024 00:00	25-Jun-2024 00:00	25-Jun-2024 00:00	28-Jun-2024 00:00	01-Jul-2024 00:00
Compound	CAS Number	LOR	Unit		ES2421640-031	ES2421640-032	ES2421640-033	ES2421640-034	ES2421640-035
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.005	29.9	32.4	29.0	<0.001



QUALITY CONTROL REPORT

Work Order : **ES2421640**

Page : 1 of 3

Client : **WSP Australia Pty Ltd**

Laboratory : Environmental Division Sydney

Contact : **JACK FLANAGAN**

Contact : Sepan Mahamad

Address : PO BOX 1162
NEWCASTLE NSW, AUSTRALIA 2300

Address : 277-289 Woodpark Road Smithfield NSW Australia 2164

Telephone : ----

Telephone : +61 2 8784 8555

Project : PS135343 West Arsenic Groundwater Monitoring

Date Samples Received : 02-Jul-2024

Order number : PS135343

Date Analysis Commenced : 05-Jul-2024

C-O-C number : ----

Issue Date : 09-Jul-2024

Sampler : AL, JF, NM

Site : Orica K.I

Quote number : EN/000

No. of samples received : 35

No. of samples analysed : 35



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories

Position

Accreditation Category

Ankit Joshi

Senior Chemist - Inorganics

Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5904017)									
EN2406095-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
ES2421640-007	MWCC03_3IN	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.008	0.008	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5904018)									
ES2421640-017	BP7-3	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.305	0.307	0.7	0% - 20%
ES2421640-027	POMW62-6	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	3.01	3.04	1.2	0% - 20%



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EG020F: Dissolved Metals by ICP-MS (QCLot: 5904017)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.7	85.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5904018)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	107	85.0	114

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5904017)							
EN2406095-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	97.4	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5904018)							
ES2421640-018	BP7-6	EG020A-F: Arsenic	7440-38-2	1 mg/L	# Not Determined	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2421640	Page	: 1 of 4
Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: JACK FLANAGAN	Telephone	: +61 2 8784 8555
Project	: PS135343 West Arsenic Groundwater Monitoring	Date Samples Received	: 02-Jul-2024
Site	: Orica K.I	Issue Date	: 09-Jul-2024
Sampler	: AL, JF, NM	No. of samples received	: 35
Order number	: PS135343	No. of samples analysed	: 35

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, where applicable to the methodology, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG020F: Dissolved Metals by ICP-MS	ES2421640--018	BP7-6	Arsenic	7440-38-2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) FB01	01-Jul-2024	----	----	----	05-Jul-2024	28-Dec-2024	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) MWCC01_3IN, MWCC01_9IN, MWCC02_6IN, MWCC03_3IN, MWCC03_9IN, D01_20240625, MWCC01_6IN, MWCC02_3IN, MWCC02_9IN, MWCC03_6IN, MW48, D02_20240625	25-Jun-2024	----	----	----	05-Jul-2024	22-Dec-2024	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) POMW7, POMW63-3, POMW63-9, POMW62-6, POMW63-6, POMW63-12	27-Jun-2024	----	----	----	05-Jul-2024	24-Dec-2024	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) MW21A, MW54, BP5-6, BP7-3, BP7-9A, GWW02 I, GWW03 S, GWW03 D, MW50, BP5-3, BP5-9, BP7-6, GWW02S, GWW02D, GWW03I, D01_20240628	28-Jun-2024	----	----	----	05-Jul-2024	25-Dec-2024	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	35	11.43	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	5.71	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	5.71	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	5.71	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

WSP Australia P/L NSW
Level 27, Ernst & Young Centre
Sydney
NSW 2001



NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition
Arrangement for the mutual recognition of the
equivalence of testing, medical testing, calibration,
inspection, proficiency testing scheme providers and
reference materials producers reports and certificates.

Attention: **Jack Flanagan**

Report **1114361-W**
Project name **WEST ARSENIC GROUDWATER MONITORING**
Project ID **PS135343**
Received Date **Jul 03, 2024**

Client Sample ID			T01-20240625	T02-20240625	T01-20240628
Sample Matrix			Water	Water	Water
Eurofins Sample No.			S24-JI0009905	S24-JI0009906	S24-JI0009907
Date Sampled			Jun 25, 2024	Jun 25, 2024	Jun 28, 2024
Test/Reference	LOR	Unit			
Heavy Metals					
Arsenic (filtered)	0.001	mg/L	42	48	42

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description

Heavy Metals (filtered)

Testing Site

Sydney

Extracted

Jul 05, 2024

Holding Time

180 Days

- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS



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Company Name: WSP Australia P/L NSW
Address: Level 27, Ernst & Young Centre
Sydney
NSW 2001

Project Name: WEST ARSENIC GROUDWATER MONITORING
Project ID: PS135343

Order No.:
Report #: 1114361
Phone: 02 9272 5586
Fax: 02 9272 5101

Received: Jul 3, 2024 11:00 AM
Due: Jul 10, 2024
Priority: 5 Day
Contact Name: Jack Flanagan

Eurofins Analytical Services Manager : Bonnie Pu

Sample Detail						Arsenic (filtered)
Sydney Laboratory - NATA # 1261 Site # 18217						X
External Laboratory						
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID	
1	T01-20240625	Jun 25, 2024		Water	S24-JI0009905	X
2	T02-20240625	Jun 25, 2024		Water	S24-JI0009906	X
3	T01-20240628	Jun 28, 2024		Water	S24-JI0009907	X
Test Counts						3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follow guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013. They are included in this QC report where applicable. Additional QC data may be available on request.
2. Unless otherwise stated, all soil/sediment/solid results are reported on a dry weight basis.
3. Unless otherwise stated, all biota/food results are reported on a wet weight basis on the edible portion.
4. For CEC results where the sample's origin is unknown or environmentally contaminated, the results should be used advisedly.
5. Actual LORs are matrix dependent. Quoted LORs may be raised where sample extracts are diluted due to interferences.
6. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds where annotated.
7. SVOC analysis on waters is performed on homogenised, unfiltered samples unless noted otherwise.
8. Samples were analysed on an 'as received' basis.
9. Information identified in this report with **blue** colour indicates data provided by customers that may have an impact on the results.
10. This report replaces any interim results previously issued.

Holding Times

Please refer to the 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours before sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and despite any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the sampling date; therefore, compliance with these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether, the holding time is seven days; however, for all other VOCs, such as BTEX or C6-10 TRH, the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	mg/L: milligrams per litre	ppm: parts per million
µg/L: micrograms per litre	ppb: parts per billion	%: Percentage
org/100 mL: Organisms per 100 millilitres	NTU: Nephelometric Turbidity Units	MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony Forming Unit	Colour: Pt-Co Units (CU)	

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where moisture has been determined on a solid sample, the result is expressed on a dry weight basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples, these are performed on laboratory-certified clean sands and in the case of water samples, these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC represents the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a similar compound to the analyte target is reported as percentage recovery. See below for acceptance criteria.
TBTO	Tributyltin oxide (<i>bis</i> -tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment; however, free tributyltin was measured, and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 6.0
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should only be used as a guide and may be different when site-specific Sampling Analysis and Quality Plan (SAQP) have been implemented.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is ≤30%; however, the following acceptance guidelines are equally applicable:

Results <10 times the LOR:	No Limit
Results between 10-20 times the LOR:	RPD must lie between 0-50%
Results >20 times the LOR:	RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range, not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%, VOC recoveries 50 – 150%

PFAS field samples containing surrogate recoveries above the QC limit designated in QSM 6.0, where no positive PFAS results have been reported or reviewed, and no data was affected.

QC Data General Comments

1. Where a result is reported as less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown are not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery, the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results, a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data; thus, it is possible to have two sets of data.

Quality Control Results

Test				Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank										
Heavy Metals										
Arsenic (filtered)				mg/L	< 0.001			0.001	Pass	
LCS - % Recovery										
Heavy Metals										
Arsenic (filtered)				%	84			80-120	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1				Acceptance Limits	Pass Limits	Qualifying Code
Duplicate										
Heavy Metals										
Arsenic (filtered)	N24-JI0008050	NCP	mg/L	0.003	0.004	6.2		30%	Pass	

Comments
Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Adam Bateup
Mickael Ros

Analytical Services Manager
Senior Analyst-Metal



Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please [click here](#).

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Sample Receipt Advice

Company name: WSP Australia P/L NSW
Contact name: Jack Flanagan
Project name: WEST ARSENIC GROUDWATER MONITORING
Project ID: PS135343
Turnaround time: 5 Day
Date/Time received: Jul 3, 2024 11:00 AM
Eurofins reference: 1114361

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✓ Sample Temperature of chilled sample on the batch as recorded by Eurofins Sample Receipt : 6.4 degrees Celsius.
- ✓ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✓ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✗ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Bonnie Pu on phone : or by email: BonniePu@eurofins.com

Results will be delivered electronically via email to Jack Flanagan - Jack.Flanagan@wsp.com.

Note: A copy of these results will also be delivered to the general WSP Australia P/L NSW email address.

Appendix E

Trend Analysis

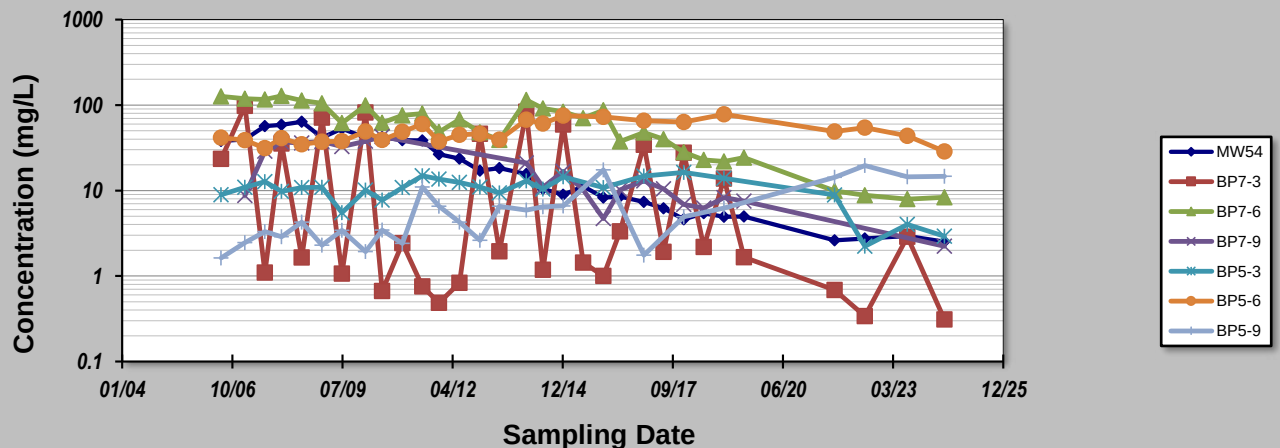


Evaluation Date: 9-Aug-24
 Facility Name: Orica Kooragang Island
 Conducted By: Jack Flanagan

Job ID: PS135343
 Constituent: Arsenic
 Concentration Units: mg/L

Sampling Point ID: MW54 BP7-3 BP7-6 BP7-9 BP5-3 BP5-6 BP5-9

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Jul-06	38.1	23.5	126.0	-	8.9	41.5	1.6
2	Feb-07	39.6	97.6	119.0	8.7	10.9	38.7	2.5
3	Aug-07	56.8	1.1	116.0	28.9	12.7	31.3	3.3
4	Jan-08	58.8	35.6	128.0	37.1	9.8	41.1	2.9
5	Jul-08	63.8	1.7	113.0	36.1	10.8	34.7	4.3
6	Jan-09	41.5	71.3	105.0	37.6	10.9	37.3	2.3
7	Jul-09	53.0	1.1	61.8	32.7	5.5	37.7	3.4
8	Feb-10	41.6	81.6	99.0	37.8	10.1	49.0	1.9
9	Jul-10	42.1	0.7	62.0	42.7	7.8	39.0	3.4
10	Jan-11	38.7	2.4	75.7	-	10.8	48.7	2.4
11	Jul-11	38.5	0.8	79.6	-	14.9	60.0	11.0
12	Dec-11	26.6	0.5	48.3	-	13.6	37.6	6.6
13	Jun-12	23.7	0.8	67.7	-	12.4	44.8	4.3
14	Dec-12	17.1	46.2	48.2	-	11.0	46.0	2.6
15	Jun-13	18.3	2.0	39.0	-	9.4	39.4	6.6
16	Feb-14	15.6	83.2	115.0	21.00	13.0	67.3	5.9
17	Jul-14	10.5	1.2	91.3	10.90	10.4	60.6	6.5
18	Jan-15	8.9	59.0	83.7	16.70	14.5	75.1	6.6
19	Jul-15	11.2	1.44	70.2	10.20	-	-	-
20	Jan-16	8.3	1.0	87.0	4.70	10.8	72.8	17.4
21	Jun-16	8.53	3.3	37.6	10.20	-	-	-
22	Jan-17	7.38	34.2	47.9	13.00	14.8	65.6	1.8
23	Jul-17	6.18	1.9	39.9	10.50	-	-	-
24	Jan-18	4.6	27.6	28.1	6.87	16.3	63.4	4.9
25	Jul-18	5.43	2.19	22.9	6.22	-	-	-
26	Jan-19	4.92	13.8	21.9	8.30	13.9	78.0	6.2
27	Jul-19	4.96	1.66	24.2	7.54	-	-	-
28	Mar-20	-	-	-	-	-	-	-
29	Oct-21	2.62	0.685	9.9	-	8.86	49.1	14.3
30	Jul-22	2.75	0.34	8.78	-	2.23	54.5	19.6
31	Jul-23	2.95	2.89	7.93	-	4	43.5	14.5
32	Jun-24	2.52	0.31	8.34	2.23	2.93	28.7	14.7
33								
34								
35								
Coefficient of Variation:		0.86	1.52	0.60	0.73	0.35	0.29	0.80
Mann-Kendall Statistic (S):		-395	-85	-339	-113	-1	121	175
Confidence Factor:		>99.9%	92.3%	>99.9%	>99.9%	50.0%	99.6%	>99.9%
Concentration Trend:		Decreasing	Prob. Decreasing	Decreasing	Decreasing	Stable	Increasing	Increasing



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.

3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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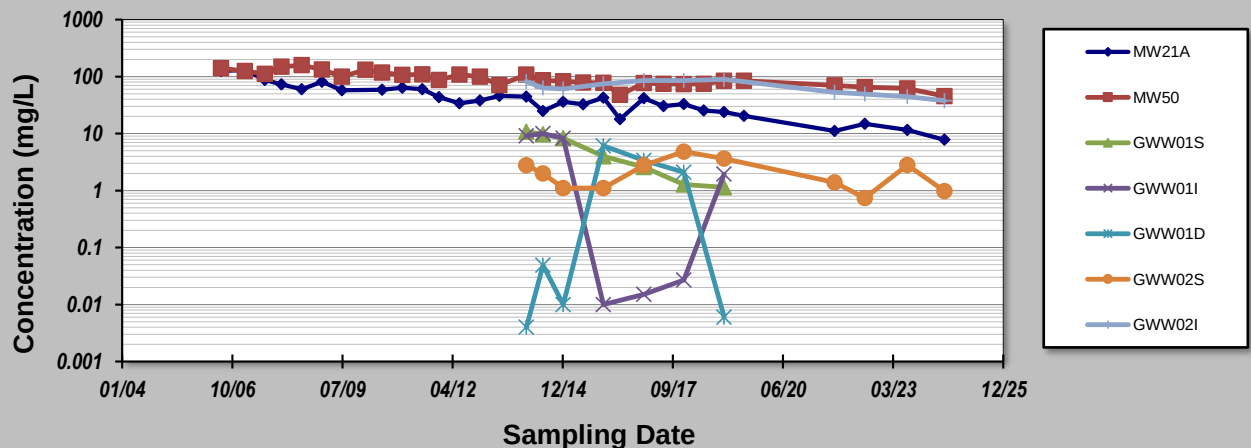
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Evaluation Date: 9-Aug-24
 Facility Name: Orica Kooragang Island
 Conducted By: Jack Flanagan

Job ID: PS135343
 Constituent: Arsenic
 Concentration Units: mg/L

Sampling Point ID: MW21A MW50 GWW01S GWW01I GWW01D GWW02S GWW02I

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Jul-06	125	140					
2	Feb-07	131	125					
3	Aug-07	87.3	111					
4	Jan-08	73.2	149					
5	Jul-08	59.7	158					
6	Jan-09	81.1	133					
7	Jul-09	57.8	99.5					
8	Feb-10	NS	132					
9	Jul-10	58.6	118					
10	Jan-11	63.6	107					
11	Jul-11	59.7	109					
12	Dec-11	43.3	87.2					
13	Jun-12	33.8	108					
14	Dec-12	38.0	100					
15	Jun-13	45.8	70.6					
16	Feb-14	44.4	108	10.8	9.2	0.004	2.8	81.9
17	Jul-14	24.8	86	9.7	10.0	0.05	2.0	63.2
18	Jan-15	36.1	82.8	8.3	8.3	0.01	1.1	60.4
19	Jul-15	32.7	78.4	-	-	-	-	-
20	Jan-16	42.8	77.4	4	0.01	6.1	1.1	74.6
21	Jun-16	17.9	47.8	-	-	-	-	-
22	Jan-17	41.8	77	2.6	0.02	3.4	2.8	85.5
23	Jul-17	30.2	74.3	-	-	-	-	-
24	Jan-18	32.8	73.9	1.3	0.03	2.1	4.8	85.0
25	Jul-18	25.4	74.6	-	-	-	-	-
26	Jan-19	23.8	84.4	1.1	1.96	0.006	3.6	89.3
27	Jul-19	20.4	84.2	-	-	-	-	-
28	Mar-20	-	-	-	-	-	-	-
29	Oct-21	11.1	70.3	-	-	-	1.4	53.0
30	Jul-22	14.8	65.2	-	-	-	0.74	49.3
31	Jul-23	11.6	61.8	-	-	-	2.8	44.6
32	Jun-24	7.77	45.3	-	-	-	0.98	37.8
33								
34								
35								
Coefficient of Variation:		0.66	0.30	0.76	1.12	1.42	0.59	0.28
Mann-Kendall Statistic (S):		-350	-340	-21	-7	3	-7	-23
Confidence Factor:		>99.9%	>99.9%	100.0%	80.9%	61.4%	67.6%	95.7%
Concentration Trend:		Decreasing	Decreasing	Decreasing	No Trend	No Trend	Stable	Decreasing



- Notes:
- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.

3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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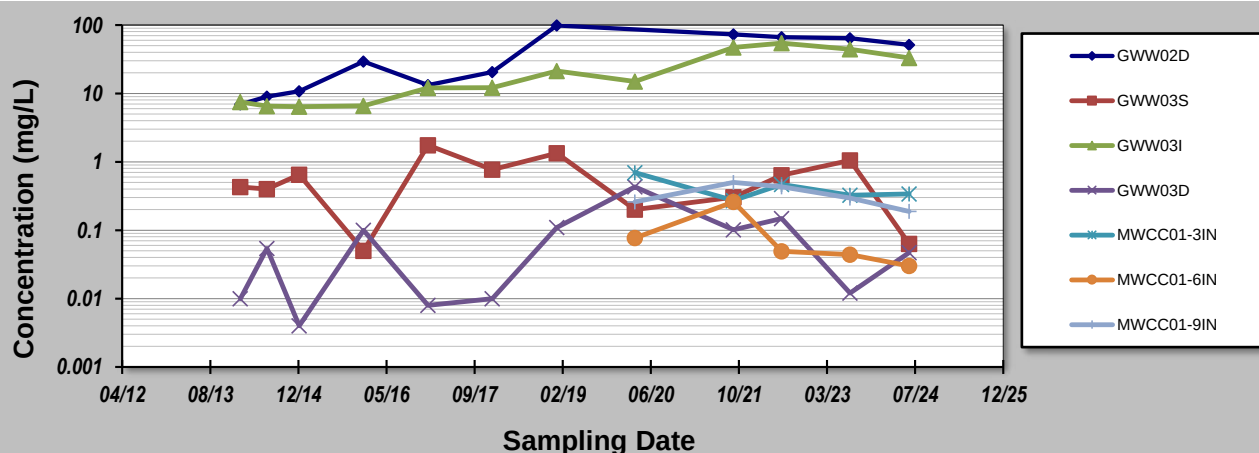
for Constituent Trend Analysis

Evaluation Date: **9-Aug-24**
 Facility Name: **Orica Kooragang Island**
 Conducted By: **Jack Flanagan**

Job ID: **PS135343**
 Constituent: **Arsenic**
 Concentration Units: **mg/L**

Sampling Point ID: **GW02D** **GW03S** **GW03I** **GW03D** **MWCC01-3IN** **MWCC01-6IN** **MWCC01-9IN**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14	6.9	0.4	7.5	0.01			
2	Jul-14	9.0	0.4	6.5	0.1			
3	Jan-15	10.8	0.6	6.4	0.004			
4	Jul-15	-	-	-	-			
5	Jan-16	29.4	0.1	6.6	0.1			
6	Jun-16	-	-	-	-			
7	Jan-17	13.2	1.8	12.0	0.008			
8	Jul-17	-	-	-	-			
9	Jan-18	20.5	0.8	12.2	0.010			
10	Jul-18	-	-	-	-			
11	Jan-19	98.6	1.34	21.2	0.110			
12	Jul-19	-	-	-	-			
13	Mar-20	-	0.2	14.9	0.430	0.695	0.077	0.26
14	Oct-21	73.0	0.3	47.2	0.101	0.272	0.259	0.5
15	Jul-22	66.6	0.636	54.4	0.148	0.465	0.049	0.43
16	Jul-23	63.9	1.05	44.3	0.012	0.324	0.044	0.296
17	Jun-24	51.2	0.063	33.1	0.047	0.338	0.03	0.188
18								
19								
20								
Coefficient of Variation:		0.79	0.82	0.80	1.38	0.41	1.04	0.38
Mann-Kendall Statistic (S):		31	-2	46	21	-2	-8	-4
Confidence Factor:		99.2%	52.7%	100.0%	91.3%	59.2%	95.8%	75.8%
Concentration Trend:		Increasing	Stable	Increasing	Prob. Increasing	Stable	Decreasing	Stable



Notes:

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- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, Ground Water, 41(3):355-367, 2003.

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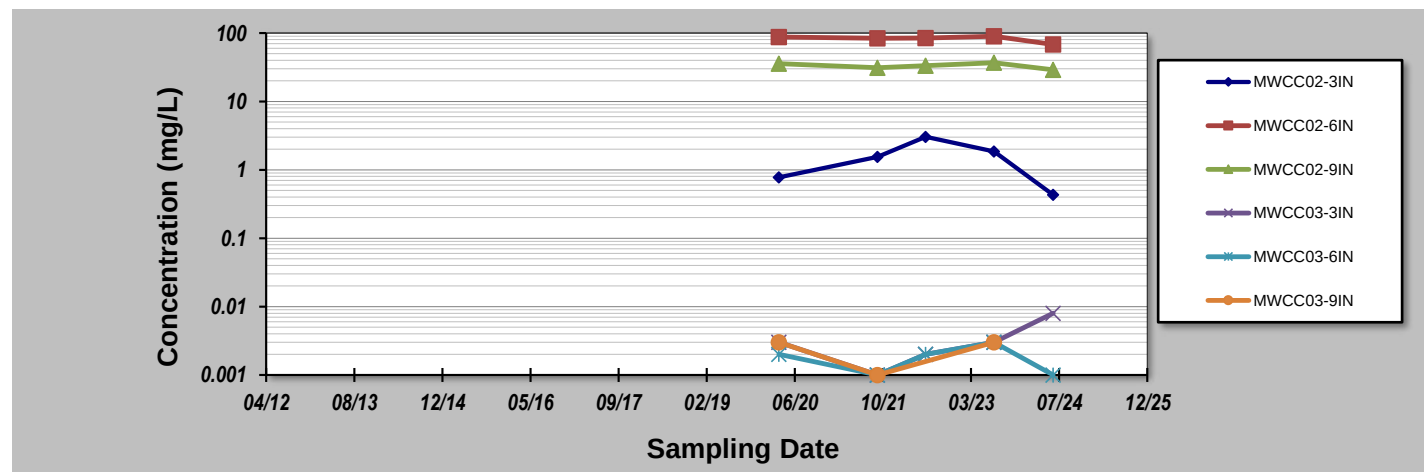
for Constituent Trend Analysis

Evaluation Date: **9-Aug-24**
 Facility Name: **Orica Kooragang Island**
 Conducted By: **Jack Flanagan**

Job ID: **PS135343**
 Constituent: **Arsenic**
 Concentration Units: **mg/L**

Sampling Point ID: **MWCC02-3IN MWCC02-6IN MWCC02-9IN MWCC03-3IN MWCC03-6IN MWCC03-9IN**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)					
1	Feb-14						
2	Jul-14						
3	Jan-15						
4	Jul-15						
5	Jan-16						
6	Jun-16						
7	Jan-17						
8	Jul-17						
9	Jan-18						
10	Jul-18						
11	Jan-19						
12	Jul-19						
13	Mar-20	0.774	87.5	35.8	0.003	0.002	0.003
14	Oct-21	1.55	84	31.1	0.001	0.001	0.001
15	Jul-22	3.04	84.7	33.3	0.002	0.002	<0.001
16	Jul-23	1.86	89.8	36.8	0.003	0.003	0.003
17	Jun-24	0.43	68.1	29	0.008	0.001	<0.001
18							
19							
20							
Coefficient of Variation:		0.67	0.10	0.10	0.79	0.46	0.49
Mann-Kendall Statistic (S):		0	-2	-2	5	0	0
Confidence Factor:		40.8%	59.2%	59.2%	82.1%	40.8%	
Concentration Trend:		Stable	Stable	Stable	No Trend	Stable	



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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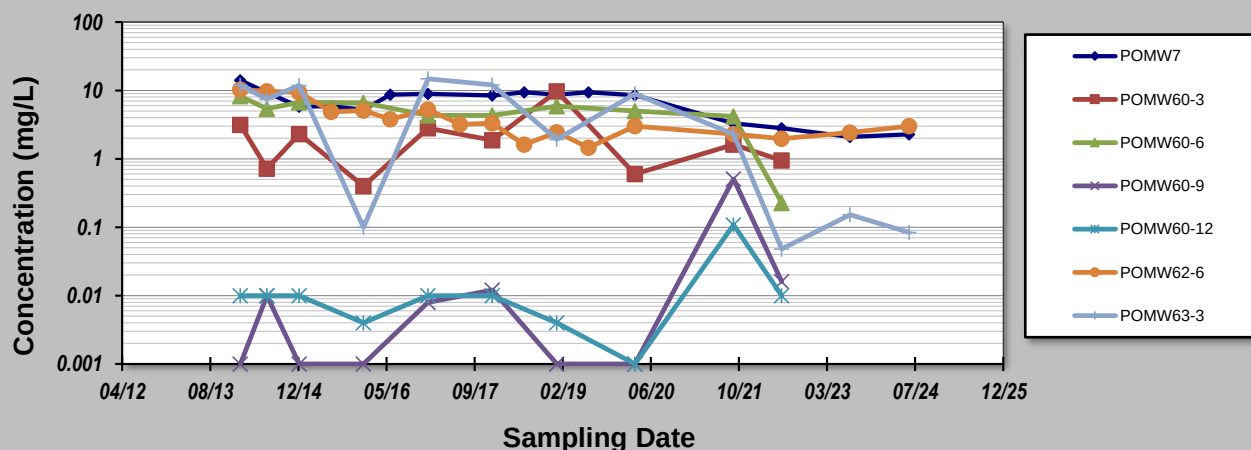
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Evaluation Date: **9-Aug-24**
 Facility Name: **Orica Kooragang Island**
 Conducted By: **Jack Flanagan**

Job ID: **PS135343**
 Constituent: **Arsenic**
 Concentration Units: **mg/L**

Sampling Point ID: **POMW7** **POMW60-3** **POMW60-6** **POMW60-9** **POMW60-12** **POMW62-6** **POMW63-3**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14	14.1	3.2	8.2	0.00	0.01	10.3	11.8
2	Jul-14	9.3	0.7	5.4	0.0	0.01	9.73	7.47
3	Jan-15	5.8	2.3	6.7	0.001	0.01	9.4	11.8
4	Jul-15	5.9					4.88	
5	Jan-16	5.2	0.4	6.6	0.0	0.004	5.1	0.1
6	Jun-16	8.7					3.8	
7	Jan-17	8.9	2.8	4.3	0.008	0.01	5.25	14.8
8	Jul-17						3.19	
9	Jan-18	8.5	1.9	4.3	0.012	0.01	3.29	12
10	Jul-18	9.4					1.61	
11	Jan-19	8.7	9.71	5.9	0.001	0.004	2.44	1.92
12	Jul-19	9.3					1.46	
13	Mar-20	8.5	0.6	5.0	0.001	0.001	3.0	8.9
14	Oct-21	3.3	1.6	4.2	0.507	0.108	2.3	2.3
15	Jul-22	2.8	0.9	0.2	0.016	0.01	2.0	0.0
16	Jul-23	2.1					2.4	0.2
17	Jun-24	2.29	-	-	-	-	3.01	0.084
18								
19								
20								
Coefficient of Variation:		0.47	1.13	0.42	2.84	1.80	0.66	0.96
Mann-Kendall Statistic (S):		-50	-7	-31	15	-3	-88	-29
Confidence Factor:		98.7%	70.0%	99.8%	89.2%	56.9%	>99.9%	97.4%
Concentration Trend:		Decreasing	No Trend	Decreasing	No Trend	No Trend	Decreasing	Decreasing



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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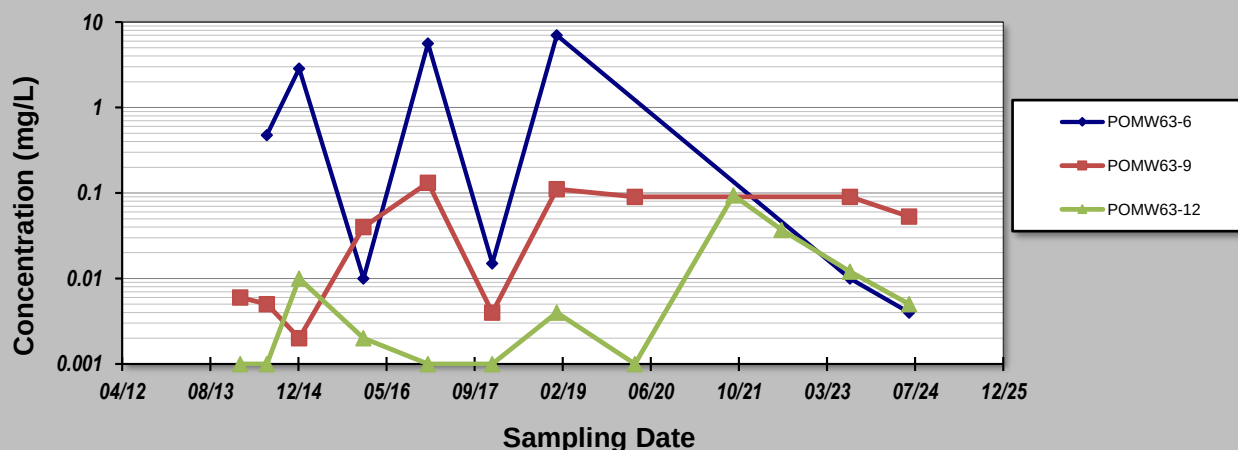
for Constituent Trend Analysis

Evaluation Date: **9-Aug-24**
 Facility Name: **Orica Kooragang Island**
 Conducted By: **Jack Flanagan**

Job ID: **PS135343**
 Constituent: **Arsenic**
 Concentration Units: **mg/L**

Sampling Point ID: **POMW63-6** **POMW63-9** **POMW63-12**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)					
1	Feb-14		0.006	0.001			
2	Jul-14	0.5	0.005	0.001			
3	Jan-15	2.9	0.002	0.010			
4	Jul-15						
5	Jan-16	0.0	0.040	0.002			
6	Jun-16						
7	Jan-17	5.6	0.132	0.001			
8	Jul-17						
9	Jan-18	0.0	0.004	0.001			
10	Jul-18						
11	Jan-19	7.0	0.11	0.004			
12	Jul-19						
13	Mar-20	0	0.09	0.001			
14	Oct-21			0.094			
15	Jul-22			0.037			
16	Jul-23	0.01	0.09	0.012			
17	Jun-24	0.004	0.053	0.005			
18							
19							
20							
Coefficient of Variation:		1.55	0.93	1.93			
Mann-Kendall Statistic (S):		-11	12	24			
Confidence Factor:		84.6%	83.2%	94.2%			
Concentration Trend:		No Trend	No Trend	Prob. Increasing			



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
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Appendix F

Limitations





Limitation Statement

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