Water Cycle Management Plan

90 Gindurra Road, Somersby – Stage 2

80518002

Prepared for

Kariong Sand and Soil Supplies

11 January 2019

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Document Information

Prepared for	Kariong Sand and Soil Supplies
Project Name	90 Gindurra Road, Somersby – Stage 2
File Reference	20180109 80518002 WCMP for 90 Gindurra Road Somersby - V6.docx
Job Reference	80518002
Date	11 January 2019
Version Number	6

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Effective Date 11/01/2019

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Date Approved 11/01/2019

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
3	5/7/18	Final Issue for DA Submission	Matthew Oliver	Sara Belgrove
4	6/11/18	Revised Issue for DA Submission following DPE Comments	Jason Stewart	Sara Belgrove
5	14/12/18	Revised issue for DA following client comments	Jason Stewart	Sara Belgrove
6	11/01/19	Revised Issue for DA	Jason Stewart	Sara Belgrove

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1 Background Information

Cardno (NSW/ACT) Pty Ltd has been engaged by Kariong Sand and Soil Supplies (KSSS) to prepare a Water Cycle Management Plan for the proposed industrial development at 90 Gindurra Road, Somersby. This Water Cycle Management Plan has been prepared in accordance with the requirements of Chapter 6.7 – Water Cycle Management of Gosford City Council's Development Control Plan 2013 (DCP 2013).

Stage 1 of the proposed works have been approved by Central Coast Council under DA 52541/2017 and include a two storey office building attached to a large plant storage shed with driveway access and carpark.

This report is concerned with Stage 2 of the proposed works, which involves the construction of a resource recovery facility in line with best practice. It is proposed that the KSSS site be developed to receive, process and store up to 200,000 tonnes per annum of soil, sand and building materials.

Stage 2 of the development will require:

- Clearing of selected vegetation from the front half of the site as determined by the Fauna and Flora and Vegetation Management Plan;
- Civil and drainage works to ensure the site directs stormwater into a catchment dam;
- Re-development of the existing stormwater catchment dam;
- Installation of a hardstand across the operational areas of the site;
- Allocation of areas for vehicle parking and manoeuvring;
- Installation of a weighbridge;
- Installation of storage bunkers for receiving incoming material for processing and bunkers for storing processed products ready for sale;
- Installation of sorting equipment into the Secondary Processing Warehouse;
- Installation of crushing and shredding machinery;
- Construction of a noise barrier along the Eastern boundary of the site; and
- Construction of two noise barriers within the operational areas of the site.

2 Site Context

Stage 2 of the proposed development consists of hardstand areas for processing material, storage bays for processed material and on-site gravel roads.

The total site area is 100,810m² (10.81ha).

The lot is currently occupied in the northern portion by Kariong Sand and Soil Supplies, a landscaping supply business. Site features consist of supply storage areas, two existing buildings and unpaved driveway areas. The southern part of the site consists of heavy vegetation.

The lot to the west of the site is vacant, and the site shares a boundary to the east with three rural residential lots. Gindurra Road is to the north and Kangoo Road is to the south. The site falls to the south and south-west at approximately 4% grade.

Aerial photography of the site is presented in Figure 2-1.

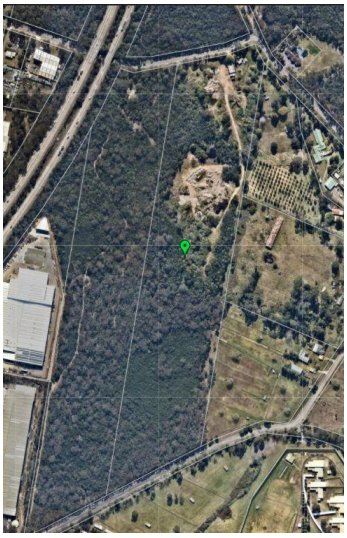

Figure 2-1 Aerial photography (www.nearmap.com.au)

3 Proposed Development

Stage 2 of the proposed works involves the following elements:

- Clearing of selected vegetation from the front half of the site as determined by the Fauna and Flora and Vegetation Management Plan;
- Civil and drainage works to ensure the site directs stormwater into a catchment dam;
- Re-development of the existing stormwater catchment dam;
- Installation of a hardstand across the operational areas of the site;
- Allocation of areas for vehicle parking and manoeuvring;
- Installation of a weighbridge;
- Installation of storage bunkers for receiving incoming material for processing and bunkers for storing processed products ready for sale;
- Installation of sorting equipment into the Secondary Processing Warehouse;
- Installation of crushing and shredding machinery;
- Construction of a noise barrier along the Eastern boundary of the site; and
- Construction of two noise barriers within the operational areas of the site.

The proposed development area is approximately 5.6 ha.

4 Water Cycle Management Objectives

The objectives of this Water Cycle Management Plan align with the purpose of Gosford City Council's Chapter 6.7 (Water Cycle Management) from DCP 2013. These include to:

1) Maintain and restore natural water balance whilst reducing the cost of providing and maintaining water infrastructure in a sustainable and efficient manner.
2) Reduce risk to life and damage to property by restricting and controlling building and other development so that it minimises risks to residents and those involved in rescue operations during floods.
3) Reduce nuisance and high level flooding and the cost of providing and maintaining flood mitigation infrastructure whilst improving water quality in streams and groundwater.
4) Reduce potable water demand by using stormwater as a resource.
5) Protect and enhance natural water systems (creeks, rivers, wetlands, estuaries, lagoons and groundwater systems).
6) Protect and enhance the water quality, by improving the quality of stormwater runoff from the urban catchments.

7) Integrate stormwater management systems into the landscape in a manner that provides multiple benefits, including water quality protection, stormwater retention and detention, public open space and recreational and visual amenity.

5 Constraints and Opportunities

5.1 Constraints

Site constraints include the following:

- The proposed works comprise of processing areas, storage bays, waste receiving areas and operational areas. Sediment will be of primary concern in regards to the operational areas of the site.
- Waste received on site has the potential to impact existing groundwater if runoff is not controlled.
- The difference in elevation between the east and west property boundaries is too great to grade out. The site will require retaining walls to accommodate the level differences and to provide flatter working platforms.
- Natural grade of the land drains surface water westward onto the neighbouring property. Regrading of the site will be required to keep stormwater drainage within the subject property.

5.2 Opportunities

The area to the south of the proposed development area will be untouched, so the opportunity exists for discharge from the developed area to be directed to this vegetated area to allow flows to return to natural conditions, and to allow the existing site vegetation to provide water quality treatment. Additional opportunities include:

- By re-grading the site to discharge to the south-west corner and filling the existing pond located in the centre of the site, this could potentially activate additional land and create a more efficient utilisation of the land form.
- A new detention / treatment pond system will be required by CCC. This system can be designed to minimise potential stormwater discharge off site and maximise captured water reuse.
- Re-use of stormwater can be utilised for dust suppression during operations and can be used in processing areas, thus reducing the potable water usage of the proposed development.
- The detention system can be designed to contain runoff under design rainfall events and meet detention and water quality targets under CCC DCP.
- Reclaimed crushed concrete from site stockpiles (or off site) can be utilised with a bentonite impregnated geotextile membrane layer to prevent movement of leachate and contaminants into groundwater.
- A below ground OSD tank could be considered as it could potentially save on usable land.

6 Best Planning Practices

Options for the configuration of the water cycle management treatment devices have been reviewed with the development team, including the project planner and client.

The nominated treatment measures have been agreed and coordinated with the project team and meet the objectives outlined in Council's DCP 2013.

7 Water Conservation

7.1 Water Conservation Target

In accordance with DCP 2013, Section 6.7.7.1.1 the target for potable water reduction is 40%.

The proposed development intends to reduce potable water usage by storing stormwater runoff in the storage pond for re-use over the site in dust suppression. In this manner, potable water will not be used for this purpose.

7.2 Water Retention Target

The minimum Stormwater Retention Volume (SRV) as required by DCP 2013, Section 6.7.7.2.4 is calculated from the following formula.

$SRV = 0.01A(0.02F)^2$ where: SRV = stormwater retention volume (m^3)

A = total site area (m^2)

F = fraction impervious (%)

Developed site imperviousness is estimated at 17% based upon 17,000 m^2 of development over the 100,810 m^2 site.

Thus the required stormwater retention volume is:

Stormwater Retention Volume (SRV) = 114.7 m^3

We have provided a permanent storage volume within the proposed pond of 250 m^3, which more than doubles the required site storage volume.

7.3 Site Water Balance

7.3.1 Re-Use Demand

Water stored in the proposed pond will be re-used on the following elements:

- Dust suppression on all roads and operational surfaces across the site will be performed, using a truck water cart, with water applied at a rate of 2.2L/m^2/hr[1]. This equates to a water usage of 171,527 kL/yr over a wetting area of approximately 3.284 ha.
- Application of water sprays via sprinklers or misting to material stockpiles is recommended in the Air Quality Impact Assessment to prevent wind erosion, with assumed application rate of 2.2L/m^2/hr. This equates to a water usage of 41,380 kL/yr over a wetting area of approximately 0.792 ha.
- All waste materials will require a 1% increase in moisture content to achieve a minimum of 1.5% moisture content for good dust control during processing. This is equivalent to 200,000 tonnes processing/yr x 1/100 = 2,000 tonnes water required /yr = 2,000 kL/yr.

Water stored in the 10kL rainwater tank that collects runoff from the roof of the site shed will be re-used via misting dust suppression for processing inside the shed, using internal sprinklers, with water applied at a rate of 2.1kL/day.

7.3.2 Water Balance Model

A MUSIC model (Version 6.3) was prepared to assess the site water balance.

[1] From the Bureau of Meteorology's Peats Ridge weather station, long term historical records suggest the number of wet weather days (>1mm rainfall) per year is 100.4 (average between 1981 and 2015). This means number % of dry weather days is 72.4%. Operational hours per week is ~ 11 hrs/day (weekdays) x 5 days per week + 8hrs on Sat = 63 hrs/week or 3,276 hrs/year. Number of dry operational hours/yr at 72.4%= 2,374 hrs /yr. Annual water consumption (kL) can be calculated by 2,374 hrs/year x 2.2 L /m^2/hr x area (site operational area and roads in m^2)/1000.

Meteorological stations near the subject site were reviewed in reference to distance from the site, completeness of data record, dates of data record and type of data record.

Historical pluviograph data was taken from Meteorology Station Number 061351 at Waratah Road, Peats Ridge. The station is approximately 7km from the development site with the rainfall record approximately 99% complete.

Over 25 years of historical rainfall data was analysed in 6 minute time steps from 3 October 1981 to 30 June 2007. The average annual rainfall over this period was 1,122mm.

Daily evapotranspiration data from Sydney was analysed over the same 25 year time period noted above.

Results of the water balance for the proposed pond and 10kL rainwater tank are presented in Tables 7-1 and 7-2, respectively.

Table 1-1 Pond Water Balance

Component	Rate
Stormwater Flow - In	25.33 ML/yr
Stormwater Flow - Out	15.80 ML/yr
Evapotranspiration - Out	0.15 ML/yr
Infiltration - Out	0 ML/yr
Re-use - Out	9.41 ML/yr
Re-use Demand Met	4.38 %

Table 1-2 Rainwater Tank Water Balance

Component	Rate
Stormwater Flow - In	2.93 ML/yr
Stormwater Flow - Out	1.42 ML/yr
Evapotranspiration - Out	0 ML/yr
Infiltration - Out	0 ML/yr
Re-use - Out	0.43 ML/yr
Re-use Demand Met	56.3 %

It is noted that the pond will be lined with a HDPE liner (Nilex 40 mil or equivalent) to prevent infiltration of stored stormwater in order to minimise the loss of captured stormwater.

7.3.3 Overflows from the Proposed Pond

The proposed pond is located at the lowest point of the regraded site. Overflows from the rainwater tank or waste receival tank will be piped or flow as surface flow to the pond.

The water balance results indicate that the pond overflows 901 times in the period from 3/10/1981 to 30/06/2007, based on the rainfall simulation within MUSIC. This averages to approximately 35 overflows per year.

Overflows occur over the spillway from the pond and are directed via a level spreader to the existing vegetation located in the southern portion of the site. Runoff would flow at grade through the vegetation over a distance of approximately 280 metres to Kangoo Road, where the road drainage system would collect it.

8 Stormwater Management

8.1 Site Discharge Index (SID)

The Site Discharge Index (SID) as described in Section 6.7.7.3.3 of DCP 2013 is calculated from the following equation:

$$SID = \frac{\text{Area of Site Directly Connected to Street } (m^2)}{\text{Total Site Area } (m^2)}$$

The proposed development does not connect any part of the site to the street, due to natural topography.

The development's SID is therefore:

Site Discharge Index (SID) = 0.0

DCP 2013, Section 6.7.7.3.4 requires the SID to be less than 0.1. The development's SID is therefore in compliance with this requirement.

8.2 Potential Site Contaminants

The site is identified as a proposed sand, soil and building materials recycling facility. It is understood that the site will store waste such as mixed building waste, asphalt, timber, metals and excavated natural material (ENM). The breakdown of wastes to be processed at the site are summarised below in Table 8-1:

Table 8-1 Expected Volumes of Waste to Be Processed On Site (EIS, Jackson Environment & Planning (2019))

Waste material	2019	2025
Excavated Natural Material (soil)	12,000	80,000
Virgin Excavated Natural Material (VENM) (soil)	3,000	20,000
Asphalt	3,000	20,000
Metal	600	4,000
Timber, stumps and rootballs (clean, non-treated and non-painted separated timber and woody tree material)	3,000	20,000
Concrete / tiles / masonry	6,900	46,000
Mixed building waste	1,500	10,000
TOTAL	30,000	200,000

With reference to the above table, the primary contaminant expected in stormwater runoff from the site is sediment based. Concrete dust from processing the recycled concrete, and sediment runoff from soils to be stored on site are expected to be the primary pollutants that require management in relation to stormwater collection and management.

8.3 Stormwater Quality Target

DCP 2013, Section 6.7.7.3.3 requires, as a minimum, the following reductions in total pollutant load, compared to untreated runoff from impervious areas of the developed site.

Table 8-2 Minimum Pollutant Reduction Targets

Pollutant	Minimum Reduction
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%
Gross Pollutants	80%

In order to meet the water quality requirements associated with the discharge of stormwater from the site, the following measures will be employed:

- A 25 kL collection and storage tank has been provided to the waste receival and storage area. This area is bunded and any runoff from this area is collected within the storage tank and disposed off site. In this manner, the potential for contaminants from mixed waste sources to enter the stormwater system for the site is reduced through management and containment.

- A 10kL rainwater tank will be used to capture runoff from the shed roof of Stage 1. Stored rainwater will be used for dust suppression within the enclosed workshop;
- A grassed swale will be used to pre-treat runoff from the working areas of the site. This is a critical component in the capture of sediment from the working areas of the site.
- Sediment inlet ponds will be used at the entry to the proposed pond storage to capture sediment from site runoff;
- A storage pond will be used to capture runoff from the site. The pond will consist of a permanent pool for re-use purposes, and an on-site detention component to ensure site discharge meets Council's requirements.
- A Jellyfish filter from Stormwater 360 (or approved equivalent) will be installed on the outlet pipe from the pond to ensure that any discharges from the pond are appropriately filtered prior to discharge to the vegetated area to the south of the site.

The proposed stormwater system layout is shown in Figure 8-1 below, as it has been modelled in MUSIC. Treatment efficiencies based on the model are included in Table 8-3 and demonstrate that the required efficiencies have been achieved.

Figure 8-1 MUSIC Model Layout

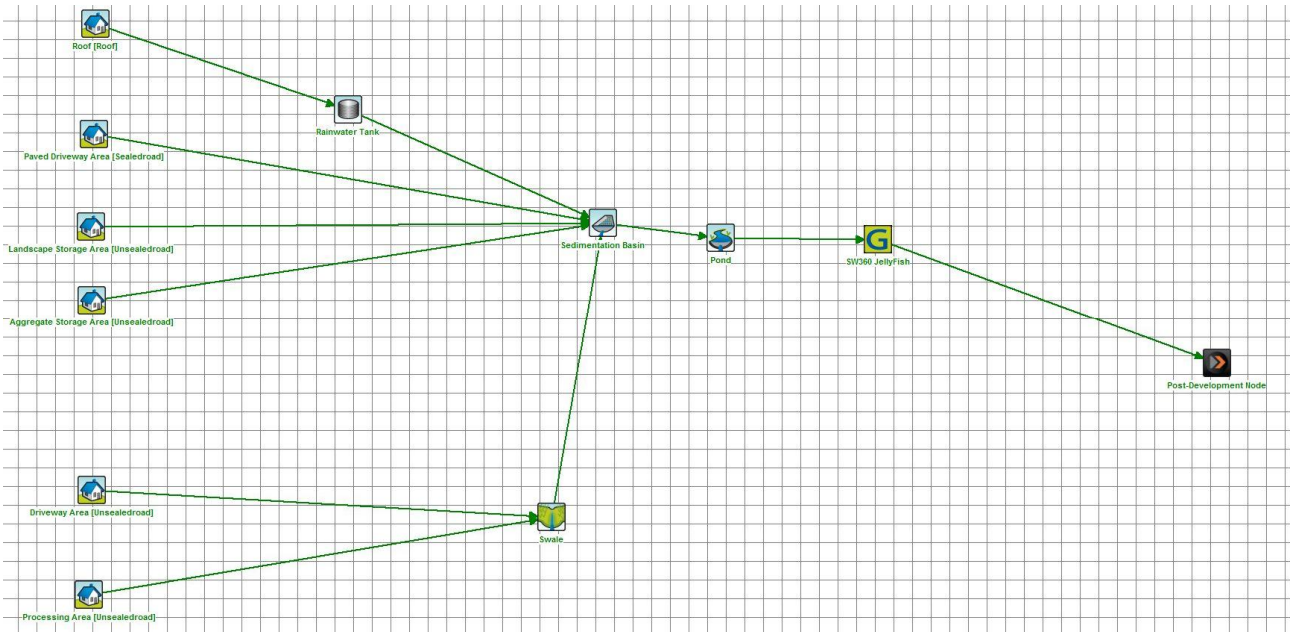

Table 8-3 System Treatment Efficiencies from MUSIC

Pollutant	Achieved Reduction
Total Suspended Solids (TSS)	87.6%
Total Phosphorus (TP)	75.6%
Total Nitrogen (TN)	53.7%
Gross Pollutants	100%

8.4 Existing Water Quality on Site

In addition to review of potential site contaminants, sampling of existing surface water was undertaken and screened for a suite of analytes. The surface water assessment was conducted on the 8th November 2018 and comprised the sampling of a dam water located on site (Figure 1 – Appendix B). The screened suite of analytes include:

> BTEX;

> TPH;

> CRC Care TPH Fractions;

> PAH;
> Metals;
> Anions and Cations;
> Nutrients;
> Physical Parameters;
> Organochlorine Pesticides;
> Organophosphorus Pesticides; and
> Pesticides.

8.4.1 Sampling and Analysis Methodology

The surface water sampling methodology was as follows:

1. Surface water samples were collected using a clean sampler and placed in laboratory prepared jars specific to each analyte with the sample details added to the label on the jar.
2. A multi parameter reader was used to monitor water quality parameters: Electrical conductivity (EC); pH; redox potential, Dissolved Oxygen (DO) and temperature.
3. Sample jars were preserved in a chilled esky containing ice blocks immediately after sampling and during shipment to the laboratories. A trip spike was included in the esky. The laboratory chain of custody documentation was completed and accompanied the sampling during shipment.

8.4.2 Analytical Testing

The results of analytical testing of the samples collected are contained in Appendix B with the laboratory reports contained in Appendix C.

8.4.3 Discussion of Results

A standard suite was undertaken with all results being under reporting limits. For a more detailed analysis, a trace analysis may be required for pH's and pesticides to achieve results within ANZECC Guidelines[2].

Upon additional monitoring events, the results of analytical testing will be compared to the previous monitoring rounds and assessed against the adopted environmental criteria. A trend analysis will then be undertaken to determine whether the concentrations are stable, decreasing or increasing.

Based on the above, the suite of analytes should be considered for long term monitoring of surface water and groundwater. The installation of groundwater monitoring wells up-gradient and down-gradient of site boundaries is recommended.

8.5 Protection of Existing Groundwater and Downstream Water Quality

If left uncaptured, runoff from the waste receival area, and from the proposed storage areas of the site has the potential to impact on natural watercourses and groundwater.

In order to prevent this from occurring, the following measures have been put in place:

- The waste material storage area has been bunded to prevent runoff from this area mixing with stormwater runoff from the remainder of the site. Runoff will be captured in a 25 kL tank within the site and will be disposed of in accordance with the Environmental Protection License for the site. The bunded area is also on a concrete surface which prevents movement of runoff to groundwater.
- In order to prevent potential infiltration of leachate from unsealed sections of the hardstand, a bentonite impregnated geotextile liner will be used (Bentofix® GCL or equivalent). Bentofix® Geosynthetic Clay Liner (GCL) is a factory produced wide width rolls of bentonite

[2] *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) Table 3.4.1: Trigger Values for Freshwater Ecosystems (95 percent level of species protection). The ANZG (2018) guidelines were reviewed as part of the assessment and no changes to the adopted assessment criteria (ANZECC 2000) were noted.

"sandwiched" between layers of geotextile. GCL's are an engineered replacement for traditional clay lining of proposed containment structures. The permeability of Bentofix® GCL is less than $2.5x10^{-11}$ m/s when installed in accordance with the manufacturer's recommendations.

- In addition to the use of the geotextile liner the site surface grading has been formed to direct surface water to swales that will transport the surface water to the water storage basin. This is a critical component in the capture of sediment from the working areas of the site.
- Sediment inlet ponds will be used at the entry to the proposed pond storage to capture sediment from site runoff. Regular maintenance of the sediment inlet pond areas to remove stored sediment will ensure that sediments are not disturbed in major storm events and discharged from the site.
- A storage pond will be used to capture runoff from the site. The pond will consist of a permanent pool for re-use purposes, and an on-site detention component to ensure site discharge meets Council's requirements. The proposed water storage basin will be lined with an impermeable liner (HDPE – Nilex 40 mil or approved equivalent) to prevent leaching of potential contaminants collected on site to the underlying groundwater system.
- A Jellyfish filter from Stormwater 360 (or approved equivalent) will be installed on the outlet pipe from the pond to ensure that any discharges from the pond are appropriately filtered prior to discharge to the vegetated area to the south of the site.

8.6 DRAINS On-Site Detention Model

Section 6.7.7.4.4 of DCP 2013 requires on-site detention to ensure that post developed flows from a development site do not exceed pre-development flows for all storm events up to and including the 1% AEP storm events.

A DRAINS computer model (Version 2016.10) was developed to demonstrate compliance with DCP 2013.

8.6.1 Base Information

The DRAINS computer model was prepared in accordance with the requirements of Central Coast Council's – Civil Works Specification – Volume 1 Design, Dec 2017. Rainfall data was adopted based on Bureau of Meteorology IFD data.

Initial rainfall losses were set to 1mm of paved/impervious areas and 10mm for grassed/pervious areas in accordance with Australian Rainfall and Runoff, Table 6.2.

8.6.2 Existing Catchment

Only the developed portion of the site draining to the on-site detention system was modelled. This represents 56,000 m^2 of the total developed portion of the site, being 60,500 m^2. The remaining 4,500 m^2 is made up of the Stage 1 Building (with its own OSD system), the EEC area and the bunded waste receival area that is collected separately.

Modelling of the existing site (56,000 m^2) was undertaken as a single catchment with 0% imperviousness as required by Council's DCP 2013 (i.e. the existing site is to be modelled in a state of nature). Times of concentration are estimated from the Kinematic wave equation for the 100 year ARI at 15 minutes.

8.6.3 On-Site Detention

The on-site detention storage is proposed as part of the storage pond in the south-western corner of the site as shown on Cardno's Concept Stormwater Management Plan (80518002-CI-115) included in Appendix A.

The storage volume is 685 cu.m at 1.14 m storage depth.

8.6.4 Results

The top water level for the storage is at 1.14 m depth. The outlet is a 675 mm pipe at the base of the storage, with a 10m wide overflow weir at 1.00 m depth.

Results of peak outflows from the DRAINS model are summarised in Table 8-3.

Table 8-4 Summary of DRAINS Peak Outflows

Storm Event	Predeveloped Flows	Developed Flows (no OSD)	Developed Flows (with OSD)
5 year ARI (20% AEP)	752 L/s	850 L/s	643 L/s
100 year ARI (1% AEP)	1780 L/s	1850 L/s	1770 L/s

8.7 Local Overland Drainage

There are no external catchments that drain into the site within the proposed development area as the eastern site boundary is located along the ridge line of the topography.

8.8 Flooding Targets

The development site is not subject to flooding and therefore Section 6.7.7.6 of DCP 2013 is not applicable.

8.9 Drainage Black Spots on the Peninsula

The development site is located in Somersby and therefore Section 6.7.8 of DCP 2013 is not applicable.

8.10 Setbacks to Creeks, Rivers and Lagoons

The development site is not impacted by creeks, rivers or lagoons and therefore Section 6.7.9 of DCP 2013 is not applicable.

8.11 Building Adjacent to a Drainage Easement/Stormwater Pipe

The development site is not impacted by existing drainage easements or stormwater pipes and therefore Section 6.7.10 of DCP 2013 is not applicable.

8.12 Access to Rural Properties Affected by Flooding

The development site is not affected by flooding and therefore Section 6.7.11 of DCP 2013 is not applicable.

9 Integration with Urban Design

The water cycle management measures outlined in this report have been developed in conjunction with the project team including architects and landscape architects.

Pits and pit grates will be positioned sympathetically with other design elements.

Maintenance operations for the nominated water cycle management measures will not be impeded by proposed landscaping or other site improvement works.

10 Maintenance

It is expected that all operation and maintenance works will be undertaken at regular intervals and following significant rainfall events.

Regular inspection and maintenance of the stormwater management measures employed on the site will ensure that the system is able to perform as required during a storm event. Maintenance should be undertaken by the owner in accordance with the details below.

10.1 Inspections

Inspections should be carried out once per month and after significant storm events.

The sediment and OSD pond system should be inspected to assess the sediment capture volume, and the condition of the storage itself. Sediment should be removed when storage has reached 60% of capacity.

The condition of the spillways and level spreader should also be inspected for scour.

Inlet pits should be cleaned of gross pollutants and sediment.

The Jellyfish filter should be cleaned in accordance with the manufacturer's instructions.

Immediate rectification should be undertaken if any measures are found not to be in order.

10.2 Maintenance

General maintenance and servicing of mechanical and electrical equipment should be carried out by appropriately qualified professionals at least once a year. Where applicable, maintenance works should include desilting/cleaning of the collection tank for the water receival area, removing sediment from the sedimentation ponds, cleaning of pits to remove trash and maintenance of the Jellyfish filter.

Maintenance of the grassed swale includes regular mowing to improve vegetation capture, and removal of accumulated sediment where the swale capacity has been impacted by sediment deposition.

11 References

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000).

Australian and New Zealand Guidelines for Fresh and Marine Water Quality, published by Australian and New Zealand Government (ANZG), August 2018.

Bureau of Meteorology Website - http://www.bom.gov.au/climate/averages/tables/cw_061087.shtml.

Civil Works Specification – Volume 1, Design, Central Coast Council,Dec 2017.

Environmental Impact Statement: Kariong Sand and Soil Supplies - Sand, Soil and Building Materials Recycling Facility - SSD8660, Jackson Environment & Planning (2019).

Gosford Development Control Plan (DCP) 2013, Gosford City Council, February 2014.

90 Gindurra Road, Somersby – Stage 2

APPENDIX A

CONCEPT STORMWATER MANAGEMENT PLAN

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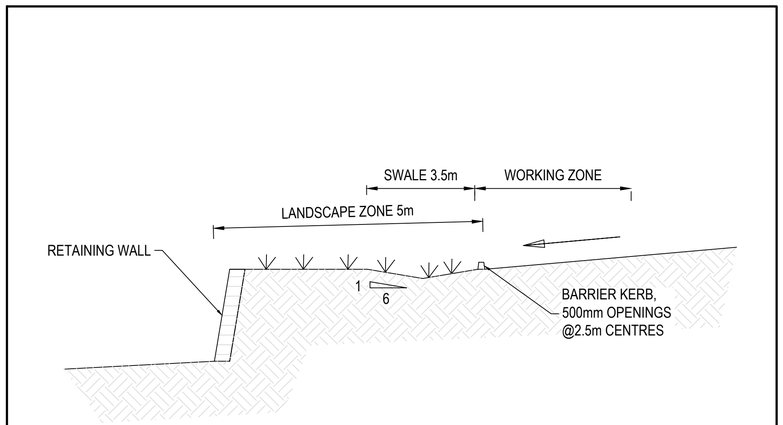
LEGEND

- NOISE WALL
- LANDSCAPE ZONE (5m)
- MELALEUCA BICONVEXA PROTECTION AREA - APZ
- PAVEMENT AREA (CONCRETE)
- APPROVED BUILDING - STAGE 1
- SEALED SURFACE (ASPHALT)
- RECYCLED CRUSHED CONCRETE ROADBASE WITH GEOTEXTILE MEMBRANE
- CONCRETE KERB AND GUTTER
- PROPOSED RETAINING WALL



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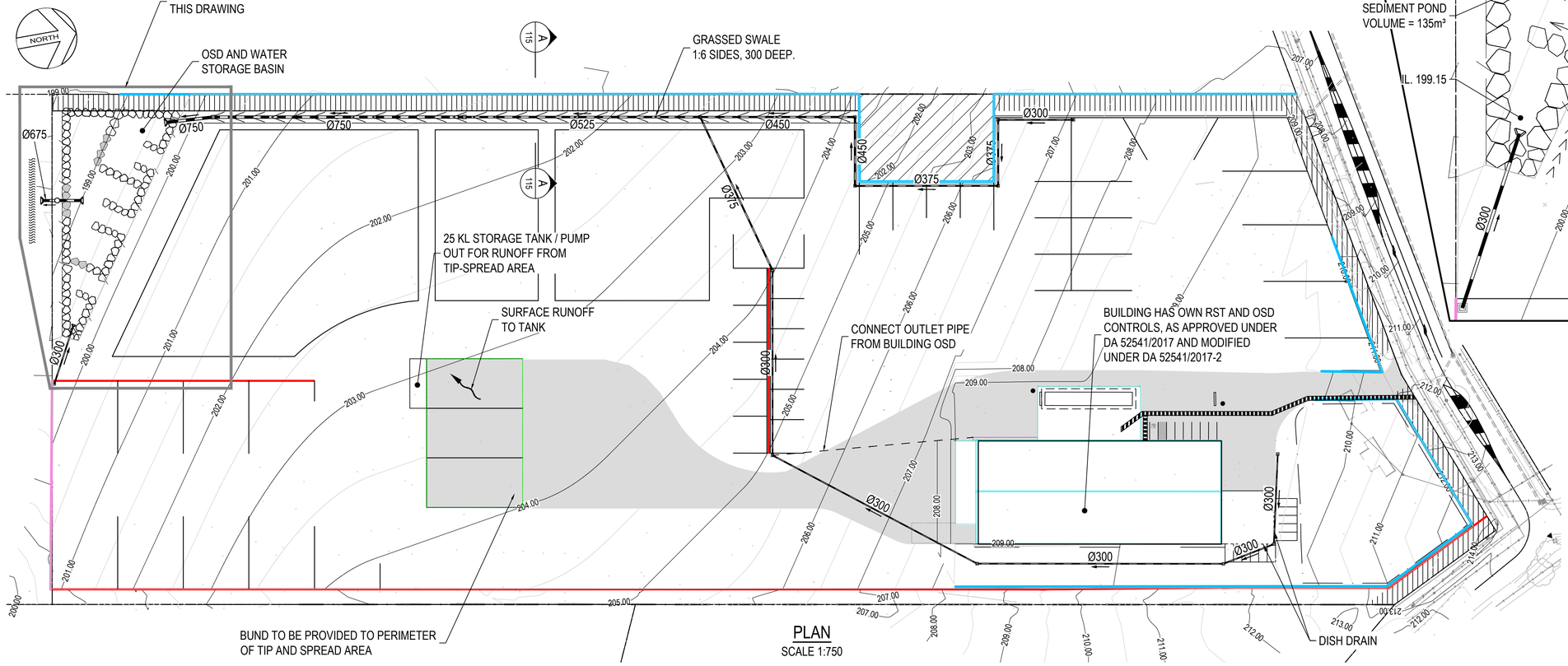

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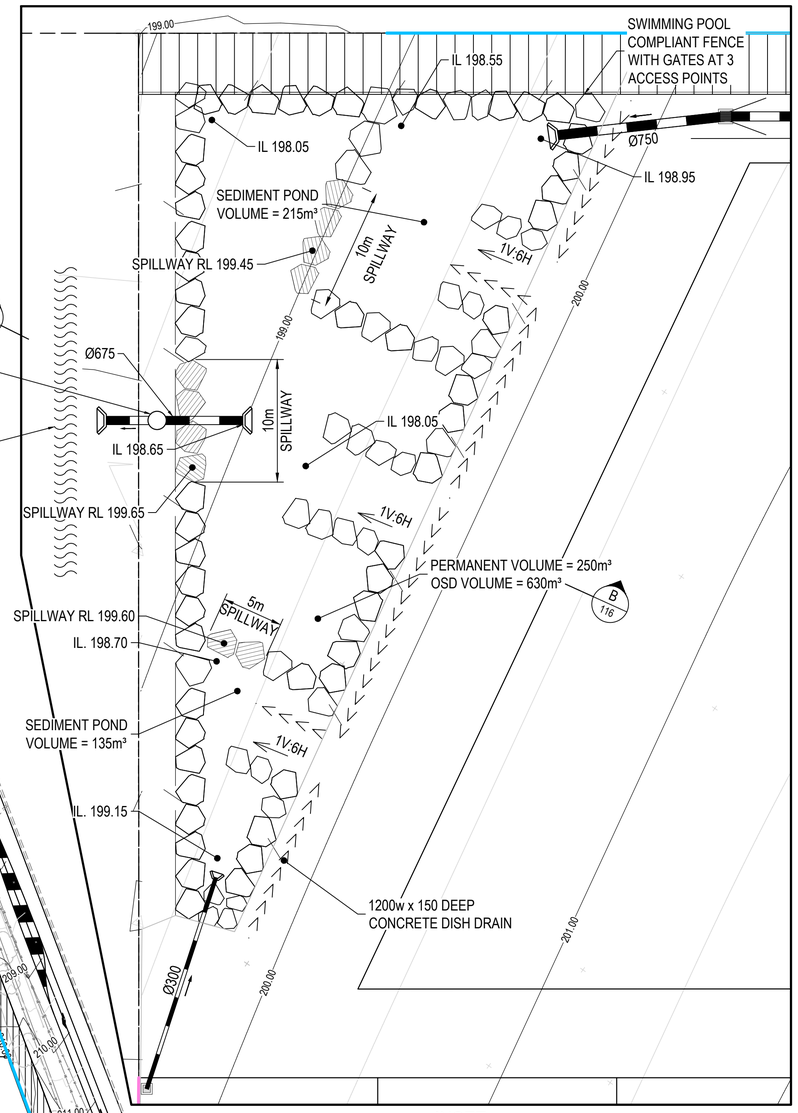

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Rev.	Date	Description	Des.	Verif.	Appd.
6	10/01/19	JELLYFISH FILTER ADDED	SJB	SJB	SJB
5	06/12/18	ISSUED FOR DEVELOPMENT APPLICATION	SJB	SJB	SJB
4	28/11/18	ISSUED FOR DEVELOPMENT APPLICATION	SJB	SJB	SJB
3	06/07/18	ISSUED FOR DEVELOPMENT APPLICATION	SJB	SJB	SJB
2	02/07/18	ISSUED FOR CLIENT REVIEW	SJB	SJB	SJB
1	21/06/18	ISSUED FOR CLIENT REVIEW	SJB	SJB	SJB

0 5 10 15 20 25m
SCALE 1:250 @A1

0 15 30 45 60 75m
SCALE 1:750 @A1

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Drawn	LDB	Date 21/06/18
Checked	SJB	Date 21/06/18
Designed	SJB	Date 21/06/18
Verified	SJB	Date 21/06/18
Approved		Date

Client: KARIONG SAND AND SOIL SUPPLIES
Project: SAND, SOIL & BUILDING MATERIALS RECYCLING FACILITY. 90 GINDURRA ROAD SOMERSBY
Title: CONCEPT STORMWATER MANAGEMENT PLAN
Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	Register	Scale	Size
AHD	-	AS SHOWN	A1

Drawing Number: 80518002-CI-115
Revision: 6

90 Gindurra Road, Somersby – Stage 2

APPENDIX B

FIELD ANALYSIS

NOTES:

Image underlay adapted from Nearmaps aerial imagery.

LEGEND:

Dam — Approximate Dam Water Sample location.

DAM

NOT TO SCALE

NORTH

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Drawn	DP	Date 28/11/2018
Checked		Date
Designed		Date
Verified		Date
Approved		

Client: Kariong Sand and Soil Supplies

Project: Sand, Soil & Building Materials Recycling Facility
90 Gindurra Road,
Somersby

Title: Dam Water Sample Location Plan
Surface Water Baseline Assessment

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
80518002	N.T.S.	A3

Figure Number: Site Plan Figure 1

Revision: A

DATE PLOTTED: 28 November 2018 4:31 PM BY - DANIEL PAGE

XREF's:
CAD File: \\cardnolapac_collab\Projects\80518\FY18\002_90 GINDURRA RD SOMERSBY\Drawings\Dam Site Plan\Dam Geo Site Plan.dwg

SURFACE WATER SAMPLING FIELD SHEET

Ref. Number:	80518002	**Date:**	Thursday, 08/11/2018
Project:	Kariong SSS	**Surface Water Location:**	Dam
Location:	90 Gindurra Road, Somersby	**Sampler(s):**	DM

Field Observations

Surface water body flow:	Nil	Volume of water in water body:	Small to Moderate water body
Ponded / pooled water:	YES (DAM)	Able to sample location:	Yes

Well Purging

Sampling method:	Swing Sampler	Field Parameter Measurement Device:	Multimeter

Time	TEMP (°C)	EC (µS/cm)	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Comments (Appearance, odour, etc)
9:40	17.0	929	7.39	2.19	99.7	7.41	Slight murky / cloudy

Miscellaneous Field Comments

Samples Filtered:	Yes
Weather Condition:	Sunny
Other:	Rainfall the previous day, presence of vegetation in the water body, concrete and timber materials on access track

90 Gindurra Road, Somersby – Stage 2

APPENDIX C

LABORATORY RESULTS

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Surface Water Baseline Laboratory Results Sumamry

90 Gindurra Rd, Somersby, NSW

				Physical Paramters	BTEX					TPH				CRC Care TPH Fractions						PAH																	Metals									
				Electrical Conductivity 1:5 soil:water	Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	C6 - C9	C10 - C14	C15 - C28	C29-C36	C6-C10	C10-C16	C16-C34	C34-C40	F1: C6-C10 less BTEX	F2: >C10-C16 less Naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (WHO)	Benzo(b+j) & Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Pyrene	Arsenic	Cadmium	Calcium (Filtered)	Chromium (III+VI)	Copper	Lead	Magnesium (Filtered)	Manganese	Mercury	Nickel
				µS/cm	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL				1	1	1	1	2	1	10	50	100	100	10	50	100	100	10	50	1	1	1	1	1	5	2	1	1	1	1	1	1	1	1	1	0.001	0.0001	0.5	0.001	0.001	0.001	0.5	0.005	0.00005	0.001
ANZECC 2000 Fresh Water (95%)					950				350													0.4											16				0.0002			0.0014	0.0034		1.9	0.0006	0.011
ANZG (2018) Freshwater 95% toxicant DGVs					950				350																								16				0.0002			0.0014	0.0034		1.9	0.0006	0.011
Sample ID	**Location**	**Sampled_Date_Time**																																											
DAM	DAM	8/11/2018		880	<1	<1	<1	<2	<1	<10	<50	<100	<100	<10	<50	<100	<100	<10	<50	<1	<1	<1	<1	<1	<5	<2	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	0.003	<0.0001	130	<0.001	0.001	<0.001	11	0.04	<0.00005	0.001
DUP	DAM	8/11/2018		880	<1	<1	<1	<2	<1	<10	<50	<100	<100	<10	<50	<100	<100	<10	<50	<1	<1	<1	<1	<1	<5	<2	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	0.003	<0.0001	120	<0.001	0.001	<0.001	11	0.04	<0.00005	<0.001
Statistical Summary																																												
Maximum Concentration				880	<1	<1	<1	<2	<1	<10	<50	<100	<100	<10	<50	<100	<100	<10	<50	<1	<1	<1	<1	<1	<5	<2	<1	<1	<1	<1	<1	<1	<1	0	<1	<1	0.003	<0.0001	130	<0.001	0.001	<0.001	11	0.04	<0.00005	0.001
Maximum Detect				880	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.003	ND	130	ND	0.001	ND	11	0.04	ND	0.001
Average Concentration																																													
Median Concentration				880	0.5	0.5	0.5	1	0.5	5	25	50	50	5	25	50	50	5	25	0.5	0.5	0.5	0.5	0.5	2.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.003	0.00005	125	0.0005	0.001	0.0005	11	0.04	0.000025	0.00075
Standard Deviation																																												
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Surface Water Baseline Laboratory Results Sumamry

90 Gindurra Rd, Somersby, NSW

				Anions and Cations									Nutrients			Physical Paramters			Organochlorine Pesticides																				Organophosphorou					
				Zinc	Potassium (Filtered)	Sodium (Filtered)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Alkalinity (total) as CaCO3	Chloride	Ionic Balance	Sulfate	Alkalinity (Carbonate)	Nitrate (as N)	Nitrite (as N)	Phosphorus	pH (Lab)	TDS	Turbidity	4,4-DDE	a-BHC	Aldrin	b-BHC	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Azinophos methyl	Bromophos-ethyl	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	pH_Units	mg/L	NTU	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL				0.001	0.5	0.5	5	5	5	1		1	5	0.005	0.005	0.05		5	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ANZECC 2000 Fresh Water (95%)				0.008										7.2													0.01					0.02		0.2	0.09				0.02		0.01		0.01	
ANZG (2018) Freshwater 95% toxicant DGVs				0.008																							0.01					0.02		0.2	0.09				0.02		0.01		0.01	
Sample ID	**Location**	**Sampled_Date_Time**																																										
DAM	DAM	8/11/2018		0.004	15	47	380	<5	380	31	-2	86	<5	<0.005	<0.005	0.06	7.7	560	3.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DUP	DAM	8/11/2018		0.003	14	45	370	<5	370	31	-5	87	<5	<0.005	<0.005	<0.05	7.7	640	3.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Statistical Summary																																											
Maximum Concentration				0.004	15	47	380	<5	380	31	0	87	<5	<0.005	<0.005	0.06	7.7	640	3.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Maximum Detect				0.004	15	47	380	ND	380	31	ND	87	ND	ND	ND	0.06	7.7	640	3.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																																												
Median Concentration				0.0035	14.5	46	375	2.5	375	31	-3.5	86.5	2.5	0.0025	0.0025	0.0425	7.7	600	3.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standard Deviation																																											
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	2	0	0	0	2	0	2	0	2	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Surface Water Baseline Laboratory Results Sumamry

	s Pesticides					Pesticides
	Dimethoate	Ethion	Fenitrothion	Malathion	Ronnel	Parathion
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.2	0.2	0.2	0.2	0.2	0.2
ANZECC 2000 Fresh Water (95%)	0.15		0.2	0.05		0.004
ANZG (2018) Freshwater 95% toxicant DGVs	0.15		0.2	0.05		0.004

Sample ID	Location	Sampled_Date_Time						
DAM	DAM	8/11/2018	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
DUP	DAM	8/11/2018	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Statistical Summary						
Maximum Concentration	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Maximum Detect	ND	ND	ND	ND	ND	ND
Average Concentration						
Median Concentration	0.1	0.1	0.1	0.1	0.1	0.1
Standard Deviation						
Number of Guideline Exceedances	2	0	0	2	0	2
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0

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CERTIFICATE OF ANALYSIS 205198

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	Daniel McCallum
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**80518002**
Number of Samples	4 Water
Date samples received	09/11/2018
Date completed instructions received	09/11/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	16/11/2018
Date of Issue	15/11/2018

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Results Approved By
Jaimie Loa-Kum-Cheung, Senior Chemist
Jeremy Faircloth, Organics Supervisor
Long Pham, Team Leader, Metals
Priya Samarawickrama, Senior Chemist
Steven Luong, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water					
Our Reference	UNITS	205198-1	205198-2	205198-3	205198-4
Your Reference		DAM	DUP	TS 1/11	TB 1/11
Date Sampled		08/11/2018	08/11/2018	01/11/2018	01/11/2018
Type of sample		Water	Water	Water	Water
Date extracted	-	09/11/2018	09/11/2018	09/11/2018	09/11/2018
Date analysed	-	12/11/2018	12/11/2018	12/11/2018	12/11/2018
TRH C_6 - C_9	µg/L	<10	<10	[NA]	<10
TRH C_6 - C_{10}	µg/L	<10	<10	[NA]	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10	[NA]	[NA]
Benzene	µg/L	<1	<1	119%	<1
Toluene	µg/L	<1	<1	113%	<1
Ethylbenzene	µg/L	<1	<1	115%	<1
m+p-xylene	µg/L	<2	<2	115%	<2
o-xylene	µg/L	<1	<1	117%	<1
Naphthalene	µg/L	<1	<1	[NA]	[NA]
Surrogate Dibromofluoromethane	%	103	101	100	99
Surrogate toluene-d8	%	96	95	100	92
Surrogate 4-BFB	%	103	99	103	101

svTRH (C10-C40) in Water			
Our Reference	UNITS	205198-1	205198-2
Your Reference		DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date extracted	-	13/11/2018	13/11/2018
Date analysed	-	13/11/2018	14/11/2018
TRH C_{10} - C_{14}	µg/L	<50	<50
TRH C_{15} - C_{28}	µg/L	<100	<100
TRH C_{29} - C_{36}	µg/L	<100	<100
TRH >C_{10} - C_{16}	µg/L	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50
TRH >C_{16} - C_{34}	µg/L	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100
Surrogate o-Terphenyl	%	78	77

PAHs in Water			
Our Reference	UNITS	205198-1	205198-2
Your Reference		DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date extracted	-	13/11/2018	13/11/2018
Date analysed	-	14/11/2018	14/11/2018
Naphthalene	µg/L	<1	<1
Acenaphthylene	µg/L	<1	<1
Acenaphthene	µg/L	<1	<1
Fluorene	µg/L	<1	<1
Phenanthrene	µg/L	<1	<1
Anthracene	µg/L	<1	<1
Fluoranthene	µg/L	<1	<1
Pyrene	µg/L	<1	<1
Benzo(a)anthracene	µg/L	<1	<1
Chrysene	µg/L	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2
Benzo(a)pyrene	µg/L	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	79	76

OCP in water			
Our Reference	UNITS	205198-1	205198-2
Your Reference		DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date extracted	-	13/11/2018	13/11/2018
Date analysed	-	13/11/2018	13/11/2018
HCB	µg/L	<0.2	<0.2
alpha-BHC	µg/L	<0.2	<0.2
gamma-BHC	µg/L	<0.2	<0.2
beta-BHC	µg/L	<0.2	<0.2
Heptachlor	µg/L	<0.2	<0.2
delta-BHC	µg/L	<0.2	<0.2
Aldrin	µg/L	<0.2	<0.2
Heptachlor Epoxide	µg/L	<0.2	<0.2
gamma-Chlordane	µg/L	<0.2	<0.2
alpha-Chlordane	µg/L	<0.2	<0.2
Endosulfan I	µg/L	<0.2	<0.2
pp-DDE	µg/L	<0.2	<0.2
Dieldrin	µg/L	<0.2	<0.2
Endrin	µg/L	<0.2	<0.2
pp-DDD	µg/L	<0.2	<0.2
Endosulfan II	µg/L	<0.2	<0.2
pp-DDT	µg/L	<0.2	<0.2
Endrin Aldehyde	µg/L	<0.2	<0.2
Endosulfan Sulphate	µg/L	<0.2	<0.2
Methoxychlor	µg/L	<0.2	<0.2
Surrogate TCMX	%	78	81

OP Pesticides in water			
Our Reference	UNITS	205198-1	205198-2
Your Reference		DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date extracted	-	13/11/2018	13/11/2018
Date analysed	-	13/11/2018	13/11/2018
Azinphos-methyl (Guthion)	µg/L	<0.2	<0.2
Bromophos ethyl	µg/L	<0.2	<0.2
Chlorpyriphos	µg/L	<0.2	<0.2
Chlorpyriphos-methyl	µg/L	<0.2	<0.2
Diazinon	µg/L	<0.2	<0.2
Dichlorovos	µg/L	<0.2	<0.2
Dimethoate	µg/L	<0.2	<0.2
Ethion	µg/L	<0.2	<0.2
Fenitrothion	µg/L	<0.2	<0.2
Malathion	µg/L	<0.2	<0.2
Parathion	µg/L	<0.2	<0.2
Ronnel	µg/L	<0.2	<0.2
Surrogate TCMX	%	78	81

HM in water - total			
Our Reference		205198-1	205198-2
Your Reference	UNITS	DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date prepared	-	12/11/2018	12/11/2018
Date analysed	-	12/11/2018	12/11/2018
Arsenic-Total	µg/L	3	3
Cadmium-Total	µg/L	<0.1	<0.1
Chromium-Total	µg/L	<1	<1
Copper-Total	µg/L	1	1
Lead-Total	µg/L	<1	<1
Nickel-Total	µg/L	1	<1
Zinc-Total	µg/L	4	3
Mercury-Total	µg/L	<0.05	<0.05
Manganese-Total	µg/L	40	40

Miscellaneous Inorganics			
Our Reference	UNITS	205198-1	205198-2
Your Reference		DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date prepared	-	12/11/2018	12/11/2018
Date analysed	-	12/11/2018	12/11/2018
pH	pH Units	7.7	7.7
Electrical Conductivity	µS/cm	880	880
Total Dissolved Solids (grav)	mg/L	560	640
Turbidity	NTU	3.4	3.8
Nitrate as N in water	mg/L	<0.005	<0.005
Nitrite as N in water	mg/L	<0.005	<0.005
Ammonia as N in water	mg/L	<0.005	0.008

Ion Balance			
Our Reference		205198-1	205198-2
Your Reference	UNITS	DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date prepared	-	09/11/2018	09/11/2018
Date analysed	-	09/11/2018	09/11/2018
Calcium - Dissolved	mg/L	130	120
Potassium - Dissolved	mg/L	15	14
Sodium - Dissolved	mg/L	47	45
Magnesium - Dissolved	mg/L	11	11
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	380	370
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	380	370
Sulphate, SO4	mg/L	86	87
Chloride, Cl	mg/L	31	31
Ionic Balance	%	-2.0	-5.0

Metals in Waters - Total			
Our Reference		205198-1	205198-2
Your Reference	UNITS	DAM	DUP
Date Sampled		08/11/2018	08/11/2018
Type of sample		Water	Water
Date prepared	-	12/11/2018	12/11/2018
Date analysed	-	12/11/2018	12/11/2018
Phosphorus - Total	mg/L	0.06	<0.05

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-10°C.
Inorg-022	Turbidity - measured nephelometrically using a turbidimeter, in accordance with APHA latest edition, 2130-B.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 10% ie total anions = total cations +/-10%.
Inorg-055	Nitrate - determined colourimetrically. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	[NT]
Date extracted	-			09/11/2018	[NT]	[NT]	[NT]	[NT]	09/11/2018	[NT]
Date analysed	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
TRH C_6 - C_9	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	88	[NT]
TRH C_6 - C_{10}	µg/L	10	Org-016	<10	[NT]	[NT]	[NT]	[NT]	88	[NT]
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	87	[NT]
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	86	[NT]
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	89	[NT]
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	[NT]	[NT]	89	[NT]
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	[NT]	[NT]	89	[NT]
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-016	98	[NT]	[NT]	[NT]	[NT]	100	[NT]
Surrogate toluene-d8	%		Org-016	93	[NT]	[NT]	[NT]	[NT]	99	[NT]
Surrogate 4-BFB	%		Org-016	103	[NT]	[NT]	[NT]	[NT]	103	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	[NT]
Date extracted	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
Date analysed	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	97	[NT]
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	86	[NT]
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	108	[NT]
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	[NT]	[NT]	97	[NT]
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	86	[NT]
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	[NT]	[NT]	108	[NT]
Surrogate o-Terphenyl	%		Org-003	87	[NT]	[NT]	[NT]	[NT]	93	[NT]

QUALITY CONTROL: PAHs in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	[NT]
Date extracted	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
Date analysed	-			14/11/2018	[NT]	[NT]	[NT]	[NT]	14/11/2018	[NT]
Naphthalene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	80	[NT]
Acenaphthylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	93	[NT]
Fluorene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Phenanthrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	99	[NT]
Fluoranthene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	89	[NT]
Pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Chrysene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(b,j+k)fluoranthene	µg/L	2	Org-012	<2	[NT]	[NT]	[NT]	[NT]	97	[NT]
Benzo(a)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	87	[NT]	[NT]	[NT]	[NT]	88	[NT]

QUALITY CONTROL: OCP in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
Date analysed	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
HCB	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	70	[NT]
gamma-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	77	[NT]
Heptachlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	72	[NT]
delta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	72	[NT]
Heptachlor Epoxide	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	74	[NT]
gamma-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	80	[NT]
Dieldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	76	[NT]
Endrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	80	[NT]
pp-DDD	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	77	[NT]
Endosulfan II	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endrin Aldehyde	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	78	[NT]
Methoxychlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-005	107	[NT]	[NT]	[NT]	[NT]	84	[NT]

QUALITY CONTROL: OP Pesticides in water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
Date analysed	-			13/11/2018	[NT]	[NT]	[NT]	[NT]	13/11/2018	[NT]
Azinphos-methyl (Guthion)	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bromophos ethyl	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chlorpyriphos	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	88	[NT]
Chlorpyriphos-methyl	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Diazinon	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dichlorovos	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	99	[NT]
Dimethoate	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Ethion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	107	[NT]
Fenitrothion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	105	[NT]
Malathion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	87	[NT]
Parathion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	106	[NT]
Ronnel	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NT]	[NT]	94	[NT]
Surrogate TCMX	%		Org-008	107	[NT]	[NT]	[NT]	[NT]	97	[NT]

QUALITY CONTROL: HM in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
Date analysed	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
Arsenic-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Cadmium-Total	µg/L	0.1	Metals-022	<0.1	[NT]	[NT]	[NT]	[NT]	105	[NT]
Chromium-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Copper-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Lead-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Nickel-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Zinc-Total	µg/L	1	Metals-022	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]
Mercury-Total	µg/L	0.05	Metals-021	<0.05	[NT]	[NT]	[NT]	[NT]	94	[NT]
Manganese-Total	µg/L	5	Metals-022	<5	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
Date analysed	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	103	[NT]
Total Dissolved Solids (grav)	mg/L	5	Inorg-018	<5	[NT]	[NT]	[NT]	[NT]	98	[NT]
Turbidity	NTU	0.1	Inorg-022	<0.1	[NT]	[NT]	[NT]	[NT]	108	[NT]
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	[NT]	[NT]	[NT]	[NT]	99	[NT]
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	[NT]	[NT]	[NT]	[NT]	111	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	[NT]	[NT]	[NT]	[NT]	99	[NT]

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date prepared	-			09/11/2018	[NT]	[NT]	[NT]	[NT]	09/11/2018	[NT]
Date analysed	-			09/11/2018	[NT]	[NT]	[NT]	[NT]	09/11/2018	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	110	[NT]
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	116	[NT]
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	117	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	105	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	[NT]	[NT]	[NT]	[NT]	102	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	110	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	102	[NT]

QUALITY CONTROL: Metals in Waters - Total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
Date analysed	-			12/11/2018	[NT]	[NT]	[NT]	[NT]	12/11/2018	[NT]
Phosphorus - Total	mg/L	0.05	Metals-020	<0.05	[NT]	[NT]	[NT]	[NT]	103	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

About Cardno

Cardno is an ASX200 professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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