Department of Defence
Surface Water Quality Monitoring RAAF Base Williamtown
August 2014 Quarterly Report
October 2014
### List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALS</td>
<td>Australia Laboratory Services</td>
</tr>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment and Conservation Council</td>
</tr>
<tr>
<td>ARMCANZ</td>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>cfu</td>
<td>Colony forming units</td>
</tr>
<tr>
<td>CN NSW</td>
<td>Central Northern New South Wales</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
</tr>
<tr>
<td>FC</td>
<td>Thermotolerant (Faecal) Coliforms</td>
</tr>
<tr>
<td>FOP</td>
<td>Field Operating Procedures</td>
</tr>
<tr>
<td>GC-FID</td>
<td>Gas Chromatograph - Flame Ionisation Detector</td>
</tr>
<tr>
<td>GHD</td>
<td>GHD Pty Ltd</td>
</tr>
<tr>
<td>L</td>
<td>Litre</td>
</tr>
<tr>
<td>mg/L</td>
<td>Milligrams per litre (generally equivalent to parts per million for water)</td>
</tr>
<tr>
<td>µg/L</td>
<td>Micrograms per litre (generally equivalent to parts per billion for water)</td>
</tr>
<tr>
<td>MHSPE</td>
<td>Ministry of Housing, Spatial Planning and Environment, The Netherlands</td>
</tr>
<tr>
<td>NATA</td>
<td>National Association of Testing Authorities of Australia</td>
</tr>
<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
</tr>
<tr>
<td>NH3</td>
<td>Ammonia</td>
</tr>
<tr>
<td>NO3</td>
<td>Nitrate</td>
</tr>
<tr>
<td>NOx</td>
<td>Nitrate + Nitrite</td>
</tr>
<tr>
<td>NRMMC</td>
<td>Natural Resource Management Ministerial Council</td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units</td>
</tr>
<tr>
<td>PFOS</td>
<td>Perfluorooctane sulphonate</td>
</tr>
<tr>
<td>PFOA</td>
<td>Perfluorooctanoic acid</td>
</tr>
<tr>
<td>PQL</td>
<td>Practical Quantitation Limit</td>
</tr>
<tr>
<td>PR</td>
<td>Percent Recovery</td>
</tr>
<tr>
<td>PSC</td>
<td>Port Stephens Council</td>
</tr>
<tr>
<td>QA</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control</td>
</tr>
<tr>
<td>RAAF WLM</td>
<td>RAAF Base Williamtown</td>
</tr>
<tr>
<td>Redox</td>
<td>Oxidation reduction potential</td>
</tr>
<tr>
<td>RPD</td>
<td>Relative Percent Difference</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>SSTV</td>
<td>Site specific trigger values</td>
</tr>
<tr>
<td>TKN</td>
<td>Total Kjeldahl Nitrogen</td>
</tr>
<tr>
<td>TN</td>
<td>Total Nitrogen</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>TP</td>
<td>Total Phosphorus</td>
</tr>
<tr>
<td>TRP</td>
<td>Total Reactive Phosphorus</td>
</tr>
<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbons</td>
</tr>
<tr>
<td>TRH</td>
<td>Total Recoverable Hydrocarbons</td>
</tr>
<tr>
<td>WQM</td>
<td>Water quality meter</td>
</tr>
</tbody>
</table>
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1. **Introduction**

1.1 **Overview**

GHD Pty Ltd (GHD) was commissioned by Transfield Services Australia Pty Ltd (Transfield), on behalf of the Department of Defence (Defence), to carry out quarterly surface water quality monitoring at RAAF Base Williamtown (RAAF WLM) as part of the Water Quality Monitoring works for the Central Northern NSW (CN NSW) Region. This report details the work carried out and highlights results from the August 2014 monitoring round, undertaken on 13 August 2014. Previously, surface water monitoring was undertaken on a monthly basis between May 2003 and June 2008. Since June 2008, the monitoring frequency has been altered from monthly to quarterly. Since November 2013, event based surface water monitoring has been undertaken as per the recommendations provided by GHD in the 2012 Annual Report (GHD, 2013).

1.2 **Objectives**

Surface water monitoring is undertaken to satisfy Condition of Consent No. 18 of the Environmental Impact Statement (EIS) for the introduction into service of the Hawk Lead-In Fighter. Additionally, Defence wishes to determine whether the quality of the surface water exiting RAAF WLM could impact receiving environments such as the aquatic ecosystems and oyster growing industry within the Port Stephens and Hunter River Estuaries in addition to the Tomago Sandbeds drinking water supply.

1.3 **Scope of works**

The following works were carried out as part of the August 2014 surface water monitoring round:

- Surface water sampling at locations MD1, DD1, F8 and F9 (shown in Figure 1 in Appendix A). During sampling, the first-flush (F-F) sampler at DD1 was noted to be partially full which prevented the collection of all sample bottles required for the full suite of analysis.

- Analysis of each surface water quality sample by a National Association of Testing Authorities of Australia (NATA) accredited laboratory, according to the analytical schedule outlined in Table B-1 in Appendix B.

- Preparation of this quarterly monitoring report including presentation and discussion of results, identification of potential impacts and provision of management actions/recommendations (where required).

1.4 **Surface water sample location details**

The discharge points at DD1 and MD1 drain the majority of stormwater flows from RAAF WLM. A summary of each catchment is presented in Table 1-1 below.
### Table 1-1 MD1 and DD1 catchment details

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Facilities within catchment</th>
<th>Receiving waters</th>
</tr>
</thead>
</table>
| MD1       | Former Fuel Farm 1 (Facility E01)  
            | Engine Repair (Facility 134)  
            | Battery Workshop (Facility 26)  
            | Former Caltex Service Station (Facility 549)  
            | Fuel Farm 3 (Facility 384)  
            | Fuel Farm 3A (Facility 509)  
            | North-East Landfill (Facility E06)  | Stormwater flows to Tilligerry Creek via Moors Drain. |
| DD1       | Former Fuel Farm 2 (Facility E03)  
            | Fire Training Pad (Facility 465)  
            | Fire Training Pit (Facility 479)  
            | Most of the Stage 1 redevelopment area | Stormwater is detained within Lake Cochran before flowing off site to Fullerton Cove. |

Sampling locations F8 and F9 are part of the Port Stephens Council (PSC) water quality monitoring program and are situated on Tilligerry Creek, upstream of the confluence between Moors Drain and Tilligerry Creek. Catchment areas are shown in Figure 2 in Appendix A.
2. **Summary of recommendations**

There are no new recommendations based on the August 2014 monitoring round data. Event based sampling should be continued at sampling locations MD1 and DD1 in order to identify potential impacts and to identify any increasing trends.
3. **Methodology**

Stormwater samplers were installed at MD1 and DD1 based on the recommendations provided in the 2012 Annual Report (GHD, 2013) and in accordance with the manufacturer’s installation procedures. The stormwater samplers are designed to collect the initial flush of surface water during rainfall events (defined as F-F samples). As such, surface water monitoring was conducted to coincide with a rainfall event which was defined as 5-10 millimetres (mm) of rainfall in the previous 24 hours. The August 2014 surface water monitoring round represented the fourth round in which event based monitoring has been undertaken.

Surface water sampling was undertaken at locations MD1, DD1, F8 and F9 with reference to Australian and New Zealand Environment and Conservation Council/ Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ 2000b) Guidelines for Water Quality Monitoring and Reporting. This involved:

- **Collection of samples at MD1 and DD1 as follows:**
  - F-F samples were collected via the transfer of water stored in the stormwater samplers into appropriately preserved containers. The sampling from the stormwater samplers were prioritised based on the primary water quality issues at RAAF WLM. The priority sampling was required to ensure relevant water quality issues were assessed and addressed as volumes were limited as a result of the stormwater samplers 1 litre (L) capacity. Surface water samples collected from the stormwater samplers were assigned with the suffix “FF” to the location name i.e. the F-F sample for monitoring location MD1 was identified as MD1FF.
  - Follow-up (F-U) samples were collected by immersion (using a sampling pole) of clean unpreserved sample containers to a depth of 0.3 metres (m) if possible. The mouth of the containers faced upstream during filling. Collected water was then poured into appropriately preserved sample containers.

- **The measurement of surface water field parameters (pH, electrical conductivity (EC), dissolved oxygen (DO), oxidation reduction potential (redox) and temperature) was not undertaken due to the unavailability of a calibrated multi-parameter water quality meter (WQM). Instead, laboratory pH and EC values were determined for both samples collected during F-U sampling (MD1 and DD1) and both locations within Tilligerry Creek (F8 and F9). It is noted that laboratory measured pH and EC is likely to differ slightly from field collected measurements due to chemical reactions which take place within the sample during transportation to the analytical laboratory however, the differences would generally be minimal.**

- **Surface water samples for dissolved heavy metal analysis were filtered in the field using a 0.45 micrometre (µm) filter in combination with a Millipore © filter cup and dedicated disposable syringe. The non-dedicated filter cup was decontaminated between sampling locations with a solution of Decon Neutracon © and tap water to prevent cross contamination.**

- **Following collection, surface water samples were placed in an ice-filled cooler and transferred to Australian Laboratory Services (ALS) for analysis under signed Chain of Custody (COC) documentation. ALS is NATA accredited for the analyses requested.**

- **Surface water samples were analysed according to the schedule outlined in Table B-1 in Appendix B, including the annual suite of parameters.**

- **Surface water monitoring at F8 and F9 involved the collection of surface water samples as per the F-U methodology described above.**
Silica gel clean-up for Total Petroleum Hydrocarbon (TPH) and Total Recoverable Hydrocarbons (TRH) analysis was undertaken by the laboratory to ensure that any detections of TPH/TRH only included petroleum hydrocarbons. The silica gel clean-up method removes polar compounds in the sample extract, allowing only non-polar petroleum based compounds to be analysed by the Gas Chromatograph - Flame Ionisation Detector (GC-FID).
## 4. Assessment criteria for surface water quality

### 4.1 Nominated assessment criteria

Surface water quality data was assessed, in most cases, against Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (2013) *Groundwater Investigation Levels* (NEPC, 1999) which references the Australian and New Zealand Guidelines for Fresh Water and Marine Water Quality (ANZECC/ARMCANZ 2000) default trigger values for

- Toxicants for the protection of aquatic ecosystems at the 99% level of protection (for heavy metals).
- Physical and chemical stressors for slightly disturbed ecosystems (for total nitrogen (TN), oxidised nitrogen (NO₃), total phosphorus (TP), total reactive phosphorus (TRP), turbidity and total suspended solids (TSS)).
- Protection of human consumers of aquatic food (for faecal coliforms (FC)).

The adopted trigger values have been summarised in Table 4-1.

The 99% level of protection has been selected due to the sensitive nature and relatively high ecological value of the receiving estuarine systems. Both freshwater and marine water trigger values have been identified in Table 4-1.

Freshwater trigger values are lower in most cases and have generally been adopted to assess the surface water quality data. Marine water trigger values have been adopted in place of the freshwater trigger values where they are lower (e.g. copper). Note that the adopted trigger values are consistently lower than the ANZECC/ARMCANZ (2000) toxicant guidelines for the protection of saltwater aquaculture species.

Where no ANZECC/ARMCANZ (2000) trigger values are available or suitable, other guidelines have been referenced such as the Dutch Intervention Level for Mineral Oil in Groundwater (MHSPE, 1994) for the assessment of TPH. For some analytes, assessment criteria are not available.

### Table 4-1 Nominated assessment criteria for surface water quality at RAAF WLM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Protection of Aquatic Ecosystems - Freshwater(^{(a)}) µg/L(^{(a)})</th>
<th>Protection of Aquatic Ecosystems - Marine Water(^{(b)}) µg/L(^{(a)})</th>
<th>Nominated Assessment Criteria µg/L(^{(b)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic (as As V) (As)</td>
<td>0.8</td>
<td>-</td>
<td>0.8(^{(k)})</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.06</td>
<td>0.7</td>
<td>0.06(^{(k)})</td>
</tr>
<tr>
<td>Chromium (Cr) (III)</td>
<td>-</td>
<td>7.7</td>
<td>7.7</td>
</tr>
<tr>
<td>Chromium (Cr) (VI)</td>
<td>0.01</td>
<td>0.14</td>
<td>0.01(^{(k)})</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>1</td>
<td>0.3</td>
<td>0.3(^{(k)})</td>
</tr>
<tr>
<td>Parameter</td>
<td>Protection of Aquatic Ecosystems - Freshwater (a) (µg/L)</td>
<td>Protection of Aquatic Ecosystems - Marine Water (x) (µg/L)</td>
<td>Nominated Assessment Criteria (µg/L)</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------------------------------------------</td>
<td>------------------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>1</td>
<td>2.2</td>
<td>1</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>0.06</td>
<td>0.1</td>
<td>0.06 (k)</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>2.4</td>
<td>7</td>
<td>2.4 (k)</td>
</tr>
<tr>
<td><strong>Non Metallic Inorganics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate as N (NO₃)</td>
<td>3.8 (o)</td>
<td>-</td>
<td>3.8 (k, p)</td>
</tr>
<tr>
<td>Oxidised nitrogen (NO₂)</td>
<td>40 (c)</td>
<td>15 (e)</td>
<td>15</td>
</tr>
<tr>
<td>Total Nitrogen (TN)</td>
<td>350 (d)</td>
<td>300 (e)</td>
<td>300</td>
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<tr>
<td>Ammonia (NH₃) as N</td>
<td>320</td>
<td>500</td>
<td>320</td>
</tr>
<tr>
<td>Total Phosphorus (TP)</td>
<td>25 (g)</td>
<td>30 (e)</td>
<td>25</td>
</tr>
<tr>
<td>Total Reactive Phosphorus (TRP)</td>
<td>20 (c, m)</td>
<td>5 (e, m)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Petroleum Hydrocarbons</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPH C₁₀-C₃₆</td>
<td>7 (f) / 600 (g)</td>
<td>-</td>
<td>600 (f)</td>
</tr>
<tr>
<td><strong>Phenols</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenol</td>
<td>85</td>
<td>270</td>
<td>85</td>
</tr>
<tr>
<td>2-Chlorophenol</td>
<td>340 / 300 (e)</td>
<td>340 (c)</td>
<td>340</td>
</tr>
<tr>
<td>2.4-Dichlorophenol</td>
<td>120</td>
<td>120 (c)</td>
<td>120</td>
</tr>
<tr>
<td>2.4.5-Trichlorophenol</td>
<td>0.5 (i)</td>
<td>4 (i)</td>
<td>0.5</td>
</tr>
<tr>
<td>2.4.6-Trichlorophenol</td>
<td>3</td>
<td>3 (i)</td>
<td>3</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>3.6</td>
<td>11</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>6 (c)</td>
<td>6 (c)</td>
<td>6</td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>6,000 (d, q)</td>
<td>6,000 (d, q)</td>
<td>6,000</td>
</tr>
<tr>
<td>Faecal Coliforms (FC)</td>
<td>0 (n)</td>
<td>14 (l)</td>
<td>14 (l)</td>
</tr>
<tr>
<td>Perfluorooctane Sulfonate (PFOS)</td>
<td>0.3 (a)</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Perfluorooctanoic Acid (PFOA)</td>
<td>0.3 (a)</td>
<td>-</td>
<td>0.3</td>
</tr>
</tbody>
</table>

- a. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000a), 99% Protection Level for freshwater and marine water.
- b. All units in µg/L unless indicated.
- c. ANZECC/ARMCANZ (2000a) trigger value for physical/chemical stressors for NSW lowland rivers, slightly disturbed ecosystems – Tables 3.3.2 and 3.3.3.
- d. ANZECC/ARMCANZ (2000a) trigger value for physical/chemical stressors for NSW coastal rivers, slightly disturbed ecosystems – Tables 3.3.2 and 3.3.3.
- e. ANZECC/ARMCANZ (2000a) trigger value for physical/chemical stressors for NSW estuaries, slightly disturbed ecosystems – Tables 3.3.2 and 3.3.3.
Site specific trigger values (SSTV) were derived as part of the 2012 Annual Report (GHD, 2013) on the basis of the ANZECC/ARMCANZ (2000a) procedure. The recommended process is to calculate a series of different percentiles for different parameters based on reference site data as follows:

- For physicochemical parameters: 20th and/or 80th percentile
- For nutrients: 80th percentile

SSTV were derived using water quality data from monitoring undertaken between December 2004 and December 2012 at three locations (F8, F9 and B5) within the Tilligerry Catchment by PSC. PSC sampling locations F8 and F9 are situated within Tilligerry Creek, upstream of the point where Moors Drain discharges into Tilligerry Creek. They are therefore not considered to be directly affected by Defence’s activities at RAAF WLM and adequately characterise background conditions across the Tilligerry Creek Catchment.

Over five years of monitoring data collected weekly and/or fortnightly was available for pH, turbidity, EC, FC, TN and TP. SSTV for these parameters are outlined in Table 4-2. Current SSTV were not updated as part of the 2013 Annual Report (GHD, 2014b) as it was considered unlikely that the minimal amount of data obtained during 2013 (only three monitoring rounds) would substantially alter the current SSTV. Furthermore, SSTV for TSS, metals and some nutrients were not calculated due to insufficient data at reference sites F8 and F9 at this time. SSTV will be updated and calculated (where required) during subsequent annual reporting once sufficient data becomes available.

Based on the above, GHD considered that the existing SSTV for MD1 and DD1 were appropriate and their use should be continued at this time to assist with the interpretation of results for each monitoring round, in conjunction with baseline data and nominated assessment criteria.
Table 4-2 SSTV for RAAF WLM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>80th percentile F8</th>
<th>80th percentile F9</th>
<th>Current SSTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH units</td>
<td>7.1 - 7.5&lt;sup&gt;1&lt;/sup&gt;</td>
<td>7.1 - 7.8&lt;sup&gt;1&lt;/sup&gt;</td>
<td>7.1 - 7.8&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>57.2</td>
<td>34.2</td>
<td>57.2</td>
</tr>
<tr>
<td>EC</td>
<td>µS/m</td>
<td>29,100</td>
<td>2200</td>
<td>29,100</td>
</tr>
<tr>
<td>FC</td>
<td>cfu/100ml</td>
<td>688</td>
<td>844</td>
<td>844</td>
</tr>
<tr>
<td>TN</td>
<td>mg/L</td>
<td>1.7</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>TP</td>
<td>mg/L</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Notes:
<sup>1</sup> Range shown is for the 20<sup>th</sup> percentile and 80<sup>th</sup> percentile, calculated for pH only as per ANZECC/ARMCANZ (2000a).

4.3 Assessment procedure

Surface water quality results for August 2014 are provided in Tables B-2 and B-3 in Appendix B. Data has been compared to the nominated assessment criteria (presented in Table 4-1), SSTV (presented in Table 4-2) and baseline concentrations for MD1 and DD1.

Exceedances above nominated assessment criteria have been highlighted according to the key below (assessment criteria referred to as ‘guidelines’ in key). Changes in surface water quality over time have not specifically been assessed as part of this report.

**Key: Exceedances categories highlighted as follows**

- **Green**: within 1.1 times guideline concentrations
- **Yellow**: greater than 1.1 and up to 2.5 times guideline concentrations
- **Orange**: greater than 2.5 and up to 10 times guideline concentrations
- **Red**: greater than 10 times guideline concentrations
- **Gray**: below guideline concentrations

Data for surface water locations MD1 and DD1 have also been compared to baseline concentrations. A baseline concentration has been calculated for each analyte for both MD1 and DD1 (where sufficient data exists) by taking the 80th percentile concentration of monthly results reported at these locations between May 2003 and November 2004. This period has been assumed to represent pre-redevelopment concentrations for RAAF WLM. The methodology for calculating baseline concentrations conforms to the ANZECC/ARMCANZ (2000a) procedure for establishing SSTVs. Baseline concentrations are given in Tables B-2 to B-3 in Appendix B. Corresponding baseline concentrations over the same period are not available for locations F8 or F9.

Where the majority of results between May 2003 and November 2004 were reported as less than the laboratory Practical Quantitation Limit (PQL), the PQL was adopted as the baseline concentration. Analytes which were not monitored between May 2003 and November 2004 do not have baseline concentrations. The baseline concentrations for MD1 and DD1 were reviewed as part of the 2013 Annual Report (GHD, 2014b). GHD considered that the existing baseline concentrations were appropriate and their use should be continued at this time to assist with the interpretation of results for each monitoring round, in conjunction with SSTV and nominated assessment criteria.
5. Field and analytical results

5.1 Rainfall

Rainfall data obtained from the Bureau of Meteorology (BoM) weather station located at RAAF WLM (Station No. 061078) indicated that a combined total of 33.4 millimetres (mm) of rain fell over the period from 12th to 17th August 2014. It is noted that only a combined total was provided for this period and as such, it is not clear how much rain fell during the 24 hours prior to sampling on 12th August 2014 or during sampling undertaken on 13th August 2014. A total of 0.2 mm of rain fell during the week prior to the 12th August 2014 (5th to 11th August 2014).

Due to the limitations of the BoM rainfall data noted above, supplementary rainfall data was obtained from the Weatherzone Williamtown rainfall report for August 2014 (Weatherzone, 2014). The Weatherzone Williamtown rainfall report indicated that 0.2 mm of rain fell during the 24 hours prior to sampling on 12th August 2014 and 5.2 mm of rain fell on the day of sampling (13th August 2014). A total of 0.2 mm of rain fell during the week prior to the 12th August 2014 (5th to 11th August 2014).

5.2 Field observations

The F-U sample collected from sampling location MD1 was described as being clear and colourless, with organic matter and trace bacteria sheen. The F-U sample collected from DD1 was described as being clear and colourless while the samples collected from F8 and F9 were described as being brown and turbid. No obvious odours were noted at any of the surface water sampling locations.

5.3 Analytical results

5.3.1 Overview

The following discussion is based on data obtained from the August 2014 surface water monitoring round and is therefore relevant only for this point in time and subject to review in the next monitoring round. Trends in water quality data are assessed annually.

In the case where no additional actions or recommendations are provided, this is not meant to imply that there are no contamination issues with respect to surface water exiting RAAF WLM. Rather, it implies that the current actions should continue or previous recommendations should still be investigated.

Surface water exceedances for each location have been reported in separate summary tables in Sections 5.3.2, 5.3.4 and 5.3.5. The summary of exceedances has been limited to those analytes that exceed the nominated assessment criteria or SSTV (where applicable). The subsequent discussion of these exceedances has been limited to those analytes that are greater than baseline concentrations (where applicable) and have concentrations outside historical ranges.

The following tables should be read with consideration of the following notes:

- For analytes with ISSTVs, the exceedance category (i.e. > 2.5 x – 10 x, > 10 x) by which the greatest exceedance of the ISSTV corresponds has been listed (see column 2). Where there are no ISSTVs, the exceedance category by which the greatest exceedance of the assessment criteria corresponds has been listed.
- Results of analytes with concentrations marginally above the nominated assessment criteria, SSTV, baseline concentrations or laboratory PQLs that may be influenced by
laboratory analysis precision error have not been reported in the exceedance tables or discussed. ¹.

- N/A – indicates that baseline concentrations are not available for particular analytes at identified monitoring locations. Where baselines are not available, exceedances have been compared to historical ranges only.
- Where analyte concentrations are greater than baseline concentrations, comments have been provided with respect to historical concentrations.
- Where higher concentrations are reported for a quality control (QC) sample within a duplicate sample pair, the concentration reported for the QC sample has been used in the assessment of the results.
- Refer to list of abbreviations for analyte abbreviations in the following tables.

### 5.3.2 General

General comments that apply to both MD1 and DD1 are as follows:

- The pH values reported at MD1 and DD1 during F-U sampling were less than the SSTV range however, were consistent with the historical ranges of values.
- Analyte concentrations at MD1 and DD1 generally decreased or remained consistent between F-F and F-U sampling. The exceptions to this included PFOS and PFOA concentrations at DD1 which increased between F-F and F-U sampling. These increases were however, within an order of magnitude and therefore considered to be minimal.

General comments that apply to all sampling locations are as follows:

- Total Kjeldahl Nitrogen (TKN) at all locations, including during both F-F and F-U sampling at MD1 and DD1, was largely present in organic form which is consistent with previous monitoring rounds.
- Phosphorus at all locations, including during both F-F and F-U sampling at MD1 and DD1, was largely present in particulate or bound form which is generally not bioavailable. It is noted however, that the bioavailability of phosphorus can change with changes in water quality conditions. The proportion of suspended phosphorus was consistent with previous monitoring rounds.

### 5.3.3 Location MD1

Analyte concentrations at MD1 were reported below laboratory PQLs, nominated assessment criteria and SSTV (where applicable) with the exception of the following outlined in Table 5-1 and Table 5-2.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Exceedance of assessment criteria or SSTV (where applicable)</th>
<th>Sample greater than baseline criteria?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>Zinc</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>NO₃</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>NOₓ</td>
<td>&gt;10 times</td>
<td>Yes</td>
<td>Greater than historical range.</td>
</tr>
</tbody>
</table>

¹ A laboratory precision error of 3 times the laboratory PQL has been used for this report.
Table 5-2 Exceedances at MD1 – F-U

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Exceedance of assessment criteria or SSTV (where applicable)</th>
<th>Sample greater than baseline criteria?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>&gt;2.5 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>Zinc</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>NO₃</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>NO₂</td>
<td>&gt;2.5 times</td>
<td>No</td>
<td>-</td>
</tr>
</tbody>
</table>

Analyte concentrations that exceeded nominated assessment criteria and SSTV (where applicable) for surface water location MD1 during both F-F and F-U sampling were within historical ranges with exception of the following:

- The zinc concentration during F-F sampling which was greater than the historical range. In the previous monitoring report (GHD, 2014d) it was noted that zinc concentrations at MD1 (F-F) had remained less than the substantially elevated concentration reported in November 2013 (GHD, 2014a). For this monitoring round however, the zinc concentration during F-F sampling increased to be greater than the historical range of concentrations for event and non-event based sampling suggesting that there is the potential for zinc contamination issues associated with the initial flush of surface water at MD1 following a rainfall event. This cannot be confirmed at this time however, due to the limited number of F-F samples to date. As such, zinc concentrations at MD1 (F-F) should continue to be reviewed during subsequent monitoring rounds to determine if they remain greater than the historical ranges for event and non-event based sampling.

- Nitrate (NO₃) and NO₂ concentrations during F-F sampling which were greater than the historical range of concentrations. In the previous monitoring report (GHD, 2014d) it was noted that the NO₂ concentration at MD1 (F-F) decreased from the substantially elevated concentrations reported in November 2013 (GHD, 2014a) and February 2014 (GHD, 2014c) to be consistent with the historical range of concentrations reported for non-event based sampling. For this monitoring round, NO₃ and NO₂ concentrations during F-F sampling increased to be greater than the historical range of concentrations for both event based and non-event based sampling. Based on the continued elevated NO₃ and NO₂ concentrations at MD1 (F-F) above the baseline concentration (for NO₂ only), there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at MD1 following a rainfall event. However, this cannot be confirmed at this time due to the limited number of F-F samples to date. As such, NO₃ and NO₂ concentrations at MD1 (F-F) should continue to be reviewed during subsequent monitoring rounds to determine if they remain greater than the historical ranges for event and non-event based sampling.

Additional important points to note for this monitoring round include the following:

- The lead concentration during F-F sampling decreased from the elevated concentration previously reported during June 2014 (GHD, 2014d) to be below the laboratory POL. Based on this decrease, it is considered that the elevated concentration reported during June 2014 (GHD, 2014d) was an isolated incidence and therefore not considered to represent an issue at this time. With this in mind however, the lead concentration at MD1 F-F should continue to be reviewed during the subsequent monitoring round to confirm that the concentration remains below the concentration reported during June 2014 (GHD, 2014d).
5.3.4 Location DD1

Analyte concentrations at DD1 were reported below laboratory PQLs, nominated assessment criteria and SSTV (where applicable) with the exception of the following outlined in Table 5-3 and Table 5-4.

**Table 5-3 Exceedances at DD1 – F-F**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Exceedance of assessment criteria or SSTV (where applicable)</th>
<th>Sample greater than baseline criteria?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>TSS</td>
<td>&gt;2.5 times</td>
<td>Yes</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>Zinc</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>NO₃</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>NOₓ</td>
<td>&gt;10 times</td>
<td>Yes</td>
<td>Greater than historical range.</td>
</tr>
</tbody>
</table>

**Table 5-4 Exceedances at DD1 – F-U**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Exceedance of assessment criteria or SSTV (where applicable)</th>
<th>Sample greater than baseline criteria?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOS</td>
<td>&gt;10 times</td>
<td>N/A</td>
<td>Within historical range.</td>
</tr>
</tbody>
</table>

Analyte concentrations that exceeded nominated assessment criteria and SSTV (where applicable) for surface water location DD1 during both F-F and F-U sampling were within historical ranges with exception of NO₃ and NOₓ concentrations during F-F sampling which were greater than the historical concentrations for event based sampling. It is noted that only February 2014 (GHD, 2014c) data is available at this time for F-F sampling and as such, the historical dataset is limited. Given that the NO₃ and NOₓ concentrations reported during this monitoring round were greater than the historical ranges for non-event based sampling and greater than the baseline concentration (for NOₓ only), there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at DD1 following a rainfall event. However, this cannot be confirmed at this time due to limited data for F-F sampling. Based on this, NO₃ and NOₓ concentrations should continue to be reviewed during subsequent monitoring rounds to determine if concentrations continue to remain greater than the historical ranges for event and non-event based sampling.

Additional important points to note for this monitoring round include the following:

- The following concentrations at DD1 during F-F sampling decreased from the previously elevated concentrations:
  
  - The zinc concentration decreased from the previous monitoring round (GHD, 2014c) however, was greater than the concentration reported during November 2013 (GHD, 2014a). Given that zinc concentrations at DD1 during F-F sampling continue to be reported at greater than ten times the assessment criteria and greater than the historical range for non-event based sampling, there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at DD1 following a rainfall event. However, this cannot be confirmed at this time due to limited data for F-F sampling. Based on this, the zinc concentration should continue to be reviewed during subsequent monitoring rounds to determine if concentrations continue to remain greater than the historical ranges for event and non-event based sampling.
- TSS decreased from the elevated concentration reported during February 2014 (GHD, 2014c) however, continued to remain greater than the DD1 baseline concentration. Given that the historical dataset for non-event based sampling at DD1 indicates that TSS concentrations have remained below the SSTV since September 2010, it is considered that there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at DD1 following a rainfall event. However, this cannot be confirmed at this time due to limited data for F-F sampling. Based on this, the TSS concentration should continue to be reviewed during subsequent monitoring rounds to determine if it continues to remain greater than the historical ranges for event and non-event based sampling.

- The ammonia concentration decreased from the elevated concentration reported during February 2014 (GHD, 2014c) to be consistent with the historical range of concentrations reported for non-event based sampling. Based on this decrease, it is considered that the elevated concentration reported during February 2014 (GHD, 2014c) was an isolated incidence and therefore not considered to represent an issue at this time. With this in mind however, the ammonia concentration at DD1 F-F should continue to be reviewed during the subsequent monitoring round to confirm that the concentration remains below the concentration reported during February 2014 (GHD, 2014c).

- The TN concentration decreased from the elevated concentration reported during February 2014 (GHD, 2014c). Although the concentration reported during this monitoring round remained greater than the DD1 baseline concentration, it was reported below the SSTV. Based on this decrease, it is considered that the elevated concentration above the SSTV reported during February 2014 (GHD, 2014c) was an isolated incidence and as such, does not represent an issue at this time. With this in mind however, the TN concentration at DD1 F-F should continue to be reviewed during the subsequent monitoring round to confirm that the concentration remains below the SSTV.

### 5.3.5 Locations F8 and F9

Analyte concentrations at F8 and F9 were reported below laboratory PQLs, nominated assessment criteria and SSTV (where applicable) with the exception of the following outlined in Table 5-5.

#### Table 5-5 Exceedances at F8 and F9

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Exceedance of assessment criteria or SSTV</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>F8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS</td>
<td>&gt;2.5 times</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&gt;10 times</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>NH₃</td>
<td>&gt; 1.1 times</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>NO₃</td>
<td>&gt;10 times</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>NOₓ</td>
<td>&gt;10 times</td>
<td>Greater than historical range.</td>
</tr>
<tr>
<td>F9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO₃</td>
<td>&gt;10 times</td>
<td>Within historical range.</td>
</tr>
<tr>
<td>NOₓ</td>
<td>&gt; 2.5 times</td>
<td>Within historical range.</td>
</tr>
</tbody>
</table>

Analyte concentrations that exceeded assessment criteria and SSTV (where applicable) were within historical ranges with the exception of turbidity, NO₃ and NOₓ at F8. The cause of the
elevated NO\textsubscript{3} and NO\textsubscript{x} concentrations is unknown, however, it is considered possible that they are partially associated with elevated turbidity and TSS concentrations.

The results reported for F8 and F9 were generally greater than results reported for locations MD1 and DD1 (both F-F and F-U sampling) with the exception of NO\textsubscript{3}, NO\textsubscript{x} and zinc concentrations.

As noted in the previous monitoring report, the elevated concentrations reported at F8 and F9 during February 2014 (GHD, 2014c) have been reviewed:

- The ammonia concentration at F8 increased from the previous monitoring round (GHD, 2014d) however, was less than the substantially elevated concentration reported during February 2014 (GHD, 2014c).

- Cadmium, lead and zinc concentrations at F9 continued to remain below the elevated concentrations reported during February 2014 (GHD, 2014c). Cadmium and lead concentrations reported during this monitoring round were less than the laboratory PQL which is consistent with the previous monitoring round (GHD, 2014d).
6. **Conclusions and recommendations**

6.1 **Conclusions**

GHD has undertaken quarterly water quality monitoring as part of the surface water monitoring program for RAAF WLM. Reported results have been compared to the nominated assessment criteria, SSTV (where applicable) and baseline concentrations. All works undertaken as part of this monitoring were completed in accordance with the scope and limitations outlined in Section 1.3 and 1.4 of this report.

The following analytes at sampling locations MD1 and DD1 were identified as the highest concentrations reported to date based on the August 2014 monitoring round data:

- Zinc, NO₃ and NOₓ concentrations at MD1 (F-F).
- NO₃ and NOₓ concentrations at DD1 (F-F).

The results reported for F8 and F9 were generally greater than results reported for locations MD1 and DD1 (both F-F and F-U sampling) with the exception of NO₃, NOₓ and zinc concentrations. Based on this, it is considered that there are no significant issues associated with surface water exiting RAAF WLM at this time. While elevated NO₃, NOₓ and zinc concentrations may indicate there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water, this cannot be confirmed at this time due to the limited number of F-F samples to date. As such, NO₃ and NOₓ concentrations at MD1 and DD1 (F-F) and the zinc concentration at MD1 (F-F) should be reviewed during subsequent monitoring rounds to determine if they remain greater than the historical ranges.

Based on a review of elevated concentrations reported in previous monitoring reports (GHD, 2014c and GHD, 2014d), the following conclusions are made:

- The elevated lead concentration previously reported at MD1 (F-F) during June 2014 (GHD, 2014d) is considered to be an isolated incidence and therefore does not represent an issue at this time.

- Given that zinc concentrations at DD1 during F-F sampling continue to be reported at greater than ten times the assessment criteria and greater than the historical range for non-event based sampling, there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at DD1 following a rainfall event. The zinc concentration should be reviewed during subsequent monitoring rounds to determine if concentrations continue to remain greater than the historical ranges for event and non-event based sampling.

- Based on the elevated TSS concentration reported during F-F sampling in February 2014 (GHD, 2014c), it is considered that there is a potential that activities within the catchment are impacting on water quality during the initial flush of surface water at DD1 following a rainfall event. The TSS concentration should continue to be reviewed during subsequent monitoring rounds to determine if it continues to remain greater than the historical ranges for event and non-event based sampling.

- The elevated ammonia and TN concentrations previously reported at DD1 (F-F) during February 2014 (GHD, 2014c) are considered to be isolated incidences and therefore do not represent an issue at this time.
• The ammonia concentration at F8 increased from the previous monitoring round (GHD, 2014d) however, was less than the substantially elevated concentration reported during February 2014 (GHD, 2014c).

• Cadmium, lead and zinc concentrations at F9 continued to remain below the elevated concentrations reported during February 2014 (GHD, 2014c).

6.2 Recommendations

There are no new recommendations based on the August 2014 monitoring round data. Event based sampling should be continued at sampling locations MD1 and DD1 in order to identify potential impacts and to identify any increasing trends.
7. Limitations

This August 2014 Quarterly Monitoring Report ("Report"):

- Has been prepared by GHD Pty Ltd ("GHD") for the Department of Defence.
- May only be used and relied on by the Department of Defence.
- Must not be copied to, used by, or relied on by any person other than the Department of Defence without the prior written consent of GHD and subject always to the next paragraph.
- May only be used for the purpose as stated in Section 1 of the Report (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than the Department of Defence arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- Were limited to those specifically detailed in Section 1.3 of this Report.
- Were undertaken in accordance with current profession practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this Report.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking the services mentioned above and preparing the Report ("Assumptions"), as specified throughout this Report.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation of this Report and are relevant until such times as the site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

No investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site.

The opinions, conclusions and any recommendations in this Report are based on information obtained from, and testing undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the site at other than these locations. Site conditions at other parts of the site may be different from the site conditions found at the specific sampling points.

GHD has considered and/or tested for only those chemicals specifically referred to in this Report and makes no statement or representation as to the existence (or otherwise) of any other chemicals.
Site conditions (including any the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD expressly disclaims responsibility:

- Arising from, or in connection with, any change to the site conditions.
- To update this Report if the site conditions change.

These Disclaimers should be read in conjunction with the entire Report and no excerpts are taken to be representative of the findings of this Report.
References

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


MDH (2007) Health Based Values for Perfluorocane Sulfonate (PFOS), Minnesota Department of Health Memo from Helen Goeden, MDH Risk Assessment Unit, 26 February 2007

Ministry of Housing, Spatial Planning and Environment (MHSPE) (1994). Environmental Quality Objectives in the Netherlands - A review of environmental quality objectives and their policy framework in the Netherlands

NEPC (2013). National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 1999 as amended by the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)


Appendices
Appendix A – Figures
### Table B-1 Analytical schedule for surface water quality monitoring at RAAF WLM

<table>
<thead>
<tr>
<th>Location</th>
<th>Analytes&lt;sup&gt;(a)&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| MD1, DD1 | • TRH by silica gel clean-up  
           • Turbidity and SS  
           • BOD  
           • PFOS/PFOA  
           • Total Phenols (Annually)  
           • TN, TKN, NH₃, NO₃, NO₂ and NOₓ  
           • TP and TRP  
           • FC  
           • Dissolved Heavy Metals (As, Cd, Cu, Cr, Hg, Pb, Zn) |
| F8, F9  | • Turbidity and SS  
          • BOD  
          • TN, TKN, NH₃, NO₃, NO₂ and NOₓ  
          • TP and TRP  
          • Dissolved Heavy Metals (As, Cd, Cu, Cr, Hg, Pb, Zn) |
Table B-2 - Surface Water Quality Data for RAAF WLM, August 2014

<table>
<thead>
<tr>
<th>Field</th>
<th>Total Petroleum Hydrocarbons - NEPM 1999</th>
<th>Total Recoverable Hydrocarbons - NEPM 2013</th>
<th>Perfluorinated Compounds</th>
<th>Inorganics</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>pH</td>
<td>Electrical Conductivity</td>
<td>Dissolved Oxygen</td>
<td>Redox Potential</td>
<td>Sample Comments</td>
</tr>
<tr>
<td>°C</td>
<td>pH units</td>
<td>µS/cm</td>
<td>mg/L</td>
<td>mV</td>
<td>-</td>
</tr>
<tr>
<td>PQL</td>
<td>0.1</td>
<td>0.01</td>
<td>1</td>
<td>0.01</td>
<td>1</td>
</tr>
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<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominated Assessment Criteria x 2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominated Assessment Criteria x 5</td>
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<td></td>
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<td>Nominated Assessment Criteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSTV</td>
<td>7.1-7.8</td>
<td>29,100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**First Flush Sampling**

**MD1 Baseline**
- 13/08/2014
- <20 <50 <777 154 <1000
- <20 <50 <777 154 <1000
- 3.8 3.8 0.3 0.3 1.2 3 20 5 20 5 20

**MD1 FF**
- 13/08/2014
- 6.42 116
- Clear, colourless, organic matter, trace bacteria sheen
- <20 <50 <777 154 <1000
- 19.2 12.2 104

**DD1 Baseline**
- 13/08/2014
- 5.4 8
- 6.52 108
- Clear, colourless
- <20 <50 <777 154 <1000
- 19.2 12.2 104

**DD1 FF**
- 13/08/2014
- 6.52 108
- Clear, colourless
- <20 <50 <777 154 <1000
- 19.2 12.2 104

**Follow Up Sampling**

**MD1 Baseline**
- 13/08/2014
- 6.42 116
- Clear, colourless, organic matter, trace bacteria sheen
- <20 <50 <777 154 <1000
- 19.2 12.2 104

**DD1 Baseline**
- 13/08/2014
- 6.52 108
- Clear, colourless
- <20 <50 <777 154 <1000
- 19.2 12.2 104

**Tilligerry Creek**

**PS**
- 13/08/2014
- 7.58 2850
- Brown, turbid
- <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2

**PF**
- 13/08/2014
- 7.48 1160
- Brown, turbid
- <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2 <2

NC = RPD not calculated as both concentrations within the duplicate pair were less than the PQL.
Where the concentration in one sample of the duplicate pair was reported less than the PQL, a value equal to the PQL has been used for the calculation of the RPD.

Where concentrations have been reported below the laboratory PQL, they have not been considered as exceedances.
### Table B-3 - Surface Water Quality Data for RAAF WLM, August 2014

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Sampled Date</th>
<th>Metals</th>
<th>Nutrients</th>
<th>Phenols</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD1 FF</td>
<td>13/08/2014</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
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<tr>
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**Metals**
- Arsenic
- Cadmium
- Chromium (III+VI)
- Copper
- Lead
- Mercury
- Zinc
- Ammonia as N
- Nitrate (as N)
- Nitrite (as N)
- Nitrogen (Total Oxidised)
- Nitrogen (Total)
- Kjeldahl Nitrogen Total
- Phosphorus
- Reactive Phosphorus as P
- 2,4,5-trichlorophenol
- 2,4,6-trichlorophenol
- 2,4-dichlorophenol
- 2,4-dimethylphenol
- 2,6-dichlorophenol
- 2-chlorophenol
- 2-methylphenol
- 2-nitrophenol
- 3-&4-methylphenol
- 4-chloro-3-methylphenol
- Pentachlorophenol
- Phenol

**Nutrients**
- PO4
- Reactive Phosphorus as P
- 2,4,5-trichlorophenol
- 2,4,6-trichlorophenol
- 2,4-dichlorophenol
- 2,4-dimethylphenol
- 2,6-dichlorophenol
- 2-chlorophenol
- 2-methylphenol
- 2-nitrophenol
- 3-&4-methylphenol
- 4-chloro-3-methylphenol
- Pentachlorophenol
- Phenol

**Phenols**
- PO4
- Reactive Phosphorus as P
- 2,4,5-trichlorophenol
- 2,4,6-trichlorophenol
- 2,4-dichlorophenol
- 2,4-dimethylphenol
- 2,6-dichlorophenol
- 2-chlorophenol
- 2-methylphenol
- 2-nitrophenol
- 3-&4-methylphenol
- 4-chloro-3-methylphenol
- Pentachlorophenol
- Phenol

**Notes:**
- NC = RPD not calculated as both concentrations within the duplicate pair were less than the PQL.
- Where the concentration in one sample of the duplicate pair was reported less than the PQL, a value equal to the PQL has been used for the calculation of the RPD.
- It is noted that the nominated assessment criteria is less than the laboratory PQL. Where concentrations have been reported below the laboratory PQL, they have not been considered as exceedances.
Appendix C – Quality assurance and quality control

Overview

Quality Assurance (QA) and QC practices were applied to data gathering and sample handling procedures. These were designed to provide control over both field and laboratory operations. Additionally, the analytical laboratory completed its own internal QA procedure (as required by NATA registration) during the analysis of samples.

Field QA/QC

Fieldwork was conducted in general accordance with GHD’s Standard Field Operating Procedures (FOP). The standard FOP is implemented so that environmental samples are collected by a set of uniform and systematic methods as required by the QA system. Chain-of-Custody (COC) documentation was prepared for sample transfer from RAAF WLM to the laboratory. QC checks were conducted both in the field and the laboratory.

Field QC sampling for this monitoring round comprised the collection of one blind duplicate (intra-laboratory) sample at location MD1 (F-U). The duplicate sample was a separate grab sample and was analysed for the same parameters as the primary sample. Assessment of field QC was undertaken by calculating the Relative Percent Difference (RPD) of the duplicate sample pair. An RPD value of 30% was nominated for assessment of QC results. A result exceeding this value does not necessarily mean the data is invalid, but rather the impact on the data may need to be assessed.

Field QC duplicate results are given in Tables B-2 and B-3 in Appendix B. RPD results that were not within the acceptable range are outlined in the table below.

Table C-1 Summary table of exceeding RPDs

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<th>Sample location</th>
<th>QC sample</th>
<th>Analyte</th>
<th>RPD (%)</th>
<th>Comment</th>
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<tr>
<td>MD1 (F-U)</td>
<td>Q01</td>
<td>Turbidity</td>
<td>67</td>
<td>Attributed to low analyte concentrations in both the primary and duplicate samples where minor differences in both samples can result in an elevated RPD. Given that the concentrations in both samples of the duplicate sample pair were less than the SSTV, the elevated RPD is not considered to impact the assessment of the results.</td>
</tr>
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Based on the comments provided in Table C-1, the RPD results indicate that the field and laboratory methods are appropriate for this monitoring round and the data obtained is considered to reasonably represent site conditions at the time of sampling.

Laboratory QC procedures

Laboratory QC procedures typically included analysis of the following:

- **Laboratory Duplicate Samples**: The analytical laboratory collects duplicate sub-samples from one sample submitted for analytical testing at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on analytical batch and the analytical precision (repeatability) of the test result.

- **Spiked Samples**: An authentic field sample is spiked by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques.
• **Certified Reference Standards**: A reference standard of known (certified) concentration is analysed along with a batch of samples. The Certified Reference Standard provides an indication of the analytical accuracy of the test method.

• **Surrogate Standard/Spikes**: These are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are spiked into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. They provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.

• **Laboratory Blank**: Usually an organic or aqueous solution that is as free as possible of analyte of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

**Laboratory QC assessment procedure**

Assessment of laboratory QC was undertaken internally by the testing laboratory. Duplicates were assessed by calculating the RPD. Percent Recovery (PR) is used to assess spiked samples and surrogate standards. Acceptable values for RPD and PR can vary depending on the type of analyte tested, concentrations of analytes, and sample matrix.

Laboratory QC results were independently assessed and reviewed by GHD in addition to holding time compliance and frequency of QC samples. The QC results reported by the laboratory were within acceptable limits with no outliers reported.

Based on this, GHD considers that the QC performed by the laboratory is acceptable for the analysis requested.
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Document Status

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