Water Quality Assessment
Army Aviation Centre Oakey

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Abbreviations

AACO	Army Aviation Centre Oakey
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
CSIC	Corporate Services and Infrastructure Centre
C_6-C_{36}	Hydrocarbon chainlength fraction
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CoC	Chain of Custody
DO	Dissolved Oxygen
EC	Electrical Conductivity
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
IER	Initial Environmental Review
IP	Interface Probe
IT	*IT* Environmental (Australia) Pty Ltd
LAS	Linear Alkybenzene Sulfonates
MBAS	Methylene Blue Active Substances
µg/L	micrograms per litre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
MW	Monitoring Well
NATA	National Association of Testing Authorities
SVOC	Semi-volatile Organic Compound
TD	Total Depth
TDS	Total Dissolved Solid
TOC	Top of Casing
TPH	Total Petroleum Hydrocarbon
UST	Underground Storage Tank
VOC	Volatile Organic Compound

Executive Summary

The Department of Defence (Defence) Corporate Services and Infrastructure Centre (CSIC) – South Queensland commissioned IT Environmental (Australia) Pty Ltd (*IT*) to undertake the Phase 2 component of the Environmental Management Plan (EMP) for the Army Aviation Centre Oakey (AACO). As per the recommended additional works from the Initial Environmental Review (IER) (2002) (J207965A-R01) this report covers the assessment of water quality.

The objective of this assessment is to evaluate the impacts to water resources (including both surface and groundwater) from Defence activities at AACO.

The IER identified a lack of information regarding the quality of groundwater and surface water for AACO. The following scope of work was designed to both collect information on the quality of water resources at AACO and to provide groundwater monitoring wells for future sampling:

- Groundwater monitoring wells were installed at locations that targeted former landfill areas, areas containing underground storage tanks (USTs) and other areas potentially impacted from site operations.
- Due to site operations, Defence personnel requested that groundwater monitoring wells not be installed within the area of the toxic waste treatment facility or the former paint shop waste pond which are both potential sources of groundwater contamination.
- Groundwater samples were collected from the monitoring wells seven days after installation, as per Environmental Protection Agency (EPA) and best-practice protocols.
- Surface water samples were collected at locations where sufficient surface water was available and where potential impacts would be captured.
- Quality control samples were collected at a rate of approximately 10% as per EPA and best-practice protocols.
- Water quality samples were analysed at a National Association of Testing Authorities (NATA) certified laboratory for various analytes including:
  - total petroleum hydrocarbons (TPH);
  - benzene, toluene, ethylbenzene and xylenes (BTEX);
  - arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and mercury (Hg); and
  - semi-volatile organic compounds (SVOCs).
- This document was prepared detailing the findings of the assessment.

Groundwater monitoring wells were sampled on 8 May 2002. Laboratory analyses identified the following results above the nominated investigation thresholds:

- copper in OMW-01, OMW-03 and OMW-04;
- zinc in OMW-01 and OMW-03; and
- TPH in 0MW-02.

In monitoring well OMW-05, approximately 18.5 cm of separate phase hydrocarbons (SPH) was measured floating on top of the groundwater. Product analysis of the SPH reported that it is a light fraction (C_6 to C_9) of hydrocarbon fuel.

Monitoring well OMW-06 did not contain sufficient water to obtain a sample.

Gauging of the groundwater monitoring wells found that groundwater was between 7.8m and 13.7m below ground surface. Based on the groundwater height information collected the aquifer intersected by the installed groundwater monitoring wells is not likely to be a laterally extensive aquifer and is more likely to be a series of saturated lenses.

Surface water was sampled on 8 and 22 May 2002. Laboratory analyses identified the following results above the nominated investigation levels:

- copper;
- zinc;
- TPH; and
- methylene blue active substances (MBAS) or surfactants, reported as linear alkybenzene sulfonates (LAS).

Based on the results of this assessment, *IT* concludes the following.

SPHs are present on the groundwater in the area of Tanker Parking Bay A, which includes the liquid waste UST, intercept, manual valve and pipe work suggesting that system is leaking and requires maintenance/replacement. Laboratory analysis indicated the SPH product is a light fraction fuel of C_6-C_9 hydrocarbon chainlengths.

Dissolved phase hydrocarbons are present within the groundwater surrounding the vehicle refuelling underground tanks suggesting that a leakage in the tanks and/or pipe work has or is occurring. The hydrocarbon chainlengths present are predominantly C6-C28, which is consistent with a combination of diesel and petrol.

Copper and zinc concentrations were identified within all groundwater samples analysed for metals. As the copper and zinc concentrations were found both up and down gradient of the main AACO operations area, it is likely the identified concentrations are natural background concentrations.

The information collected on groundwater heights indicates the water intersected within the wells installed is not likely to be a laterally extensive aquifer and is more likely to be a series of saturated lenses. Therefore groundwater height information from the monitoring wells is not suitable for determining the direction and speed of groundwater flow.

Surface water within the open drainage line discharging off site to the south and into Oakey Creek contained copper, zinc, TPH and surfactants above the nominated investigation levels. Due to the lack of rain at the time of sampling, the surface water samples consisted solely of discharge waste water from site activities. The contaminants identified were consistent with what would be expected from wash down operations utilising groundwater from the site. Triple intercepts generally utilised at wash down bays at AACO are not capable of removing the identified contaminants from waste water.

IT recommends the following:

- during redevelopment of AACO, groundwater monitoring wells should be installed surrounding new USTs, intercepts and other potentially contaminating activities;
- monitor groundwater at least annually to assess the trends of contaminants over time and to monitor the identified impacts/attenuation;
- collect surface water samples where/when possible to identify contaminants being discharged to assist in rectification of the sites hazardous materials handling and liquid waste disposal practices;
- repair or replace the liquid waste UST, valve and intercept associated with Tanker Parking Bay A to eliminate the source of contaminants; and
- continued monitoring of the thickness of SPH and dissolved phase concentrations at OMW05 to assess the rate of natural attenuation and to determine any required remedial works such as product recovery.

1 Introduction

The Department of Defence (Defence) Corporate Services and Infrastructure Centre (CSIC) – South Queensland commissioned *IT* Environmental (Australia) Pty Ltd (*IT*) to undertake the Phase 2 component of the Environmental Management Plan (EMP) for the Army Aviation Centre Oakey (AACO). As per the recommended additional works from the Initial Environmental Review (IER) 2002 (J207965A-R01) this report addresses water quality aspects.

1.1 Objective

The objective of this assessment is to evaluate the impacts to water resources (surface and ground) from Defence activities at AACO.

1.2 Scope of Work

The IER identified a lack of information regarding the quality of groundwater and surface water for AACO. The following scope of work was designed to both collect information on the quality of water resources at AACO and to provide groundwater monitoring wells for future sampling.

- Groundwater monitoring wells were installed at locations that targeted former landfill areas, areas containing underground storage tanks (USTs) and other areas potentially impacted from site operations.
- Groundwater samples were collected from the monitoring wells seven days after installation, as per Environmental Protection Agency (EPA) and best-practice protocols.
- Surface water samples were collected at locations where sufficient surface water was available and where potential impacts would be captured.
- Quality control samples were collected at a rate of approximately 10% as per EPA and best-practice protocols.
- Water quality samples were analysed at a National Association of Testing Authorities (NATA) certified laboratory for various analytes including:
  - total petroleum hydrocarbons (TPH);
  - benzene, toluene, ethylbenzene and xylenes (BTEX);
  - arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and mercury (Hg); and
  - semi-volatile organic compounds (SVOCs).
- This document was prepared detailing the findings of the assessment.

2 Groundwater Monitoring Well Installation

Groundwater monitoring wells were installed at the site in accordance with industry best practice and EPA accepted protocols. Groundwater monitoring well installation and sampling is described as follows.

- Prior to installation, each of the selected locations was checked against available plans for the presence of underground services.
- Drilling augers were decontaminated prior to use and between locations.
- Boreholes were drilled with a mechanical drill rig equipped with 150mm diameter solid stem augers to a maximum depth of 14 metres, two metres below the water table or refusal on materials unable to be penetrated by the drill rig whichever occurred first.
- Groundwater monitoring wells consisted of a string of class 18 PVC casing with the portion below and to one metre above the groundwater table machine slotted (0.5mm). From the base to at least 0.5 metres above the slotted casing, screened and washed silica sand was used to fill the annulus surrounding the casing. A bentonite plug was used above the silica sand to seal the well from surface water infiltration. The remaining annulus was filled with cement grout to the surface. The head of the well was protected via either a metal cover at grade or standing well monument and sealed with a locking gripper cap.
- All groundwater monitoring wells were surveyed relative to the Australian Height Datum (AHD) to enable evaluation of groundwater flow directions.
- After installation, groundwater monitoring wells were developed by purging them of three to five well volumes of water.
- Monitoring wells were sampled seven days after installation as per best practice protocol to allow the groundwater conditions to re-equilibrate after disturbance from drilling and well installation.

The locations of the groundwater monitoring wells are illustrated on Figure 1. Copies of the soil logs and groundwater monitoring well construction details are contained in Appendix A.

The locations selected for installation of groundwater monitoring wells were biased towards areas with the potential for contamination from current and past site activities. The groundwater monitoring wells installed and the site activity targeted are as follows:

Groundwater Monitoring Well Number	Site Activity Targeted	Depth
OMW01	Former landfill.	14 m
OMW02	USTs adjacent to Facility C26.	14 m
OMW03	In ground toxic waste storage tank located adjacent to Facility C23.	14 m
OMW04	In ground waste oil collection UST in museum compound.	14 m
OMW05	Tanker parking bay A and associated intercept and UST.	14 m
OMW06	Former fuel farm.	14 m

Prior to undertaking the drilling program and groundwater monitoring well installation program, the nominated locations were sent to CSIC and relevant site staff. Defence advised that due to potential disturbance of site activities and access difficulties, groundwater monitoring wells were unable to be installed adjacent to the toxic waste treatment plant (Facility C11) and in the area of the former paint shop waste pond.

Details on the sampling methodology used for the groundwater monitoring wells are contained in the Water Quality Sampling Manual (J207965B-R08).

3 Nominated Investigation Levels

Nominated investigation levels for AACO that have been used for this assessment are the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, trigger values for fresh water – 90% species protection. The ANZECC/ARMCANZ (2000) recommend the following species protection levels:

- 99% species protection, for ecosystems of high conservation value;
- 95% species protection, for ecosystems with slight to moderate disturbance; and
- 80-90% species protection, for highly disturbed ecosystems depending on management goals and for intermediate targets for water quality improvement.

The 90% species protection level was selected based on the industrial nature of site operations, high levels of disturbance and extensive agricultural use of surrounding land.

These nominated investigation levels have been used for both surface water and groundwater, as there are no applicable guidelines for groundwater within Australia. As the ANZECC (2000) guidelines do not include any values for hydrocarbons within water, the Dutch (1994) Intervention Values have been used.

The nominated investigation levels for each of the parameters analysed are contained with the laboratory analytical results in Tables 1 and 2.

Details on sample collection including sample filtration are included within the AACO Water Quality Sampling Manual (our Ref J207965B-R08).

4 Groundwater

4.1 Groundwater Monitoring Well Results

Groundwater monitoring wells were sampled on 8 May 2002. Water quality results are summarised in Tables 1 and 2 and the gauging and in-situ (field) measurements for groundwater are summarised in Table 3. Laboratory Analytical Results are contained in Appendix B. Figure 1 illustrates the groundwater height contours extrapolated from gauging and survey data. The laboratory analyses identified the following results above the nominated investigation thresholds:

- copper in OMW-01, OMW-03 and OMW-04;
- zinc in OMW-01 and OMW-03; and
- TPH in 0MW-02.

In monitoring well OMW-05, approximately 18.5 cm of separate phase hydrocarbons (SPH) was measured floating on top of the groundwater. Therefore groundwater samples were not collected at this location. Product analysis of the SPH reported that it is a light fraction (C_6 to C_9) of hydrocarbon fuel.

Monitoring well OMW-06 did not contain sufficient water to obtain a sample.

Gauging of the groundwater monitoring wells found that groundwater was between 7.8m and 13.7m below ground surface. Based on the groundwater height information collected the aquifer intersected by the installed groundwater monitoring wells is not likely to be a laterally extensive aquifer and is more likely to be a series of saturated lenses. In-situ monitoring indicated slightly acidic groundwater conditions with pH results ranging between 5.6 and 6.5.

4.2 Discussion of Results

The laboratory analyses for each location were selected based on the likely impacts from the adjacent site activities. For example, groundwater samples from monitoring wells adjacent to petroleum underground storage tanks were analysed for TPH, BTEX and lead.

All samples analysed for metals recorded copper and zinc concentrations above the nominated investigation levels. Therefore it is possible the concentrations of copper and zinc noted are natural background levels and have not resulted from site activities. On-going monitoring of the sites groundwater monitoring wells will provided information on trends and confirm the presence of background concentrations.

Dissolved phase hydrocarbons were detected in OMW-02 at concentrations above the nominated investigation levels. OMW-02 is located adjacent to the underground storage tanks (USTs) and bowsers on the northern side of Facility C26. This suggests that a leakage in the USTs or associated pipe work has or is occurring. As only one monitoring well was installed in the proximity of the USTs the TPH impact is not fully delineated, although other monitoring wells in surrounding areas confirms that contamination has not migrated off site.

The SPH identified in monitoring well 0MW-05 was short chain length hydrocarbons (C_6 to C_9) i.e., light fraction fuel. As the SPH is likely to be sourced from the liquid waste disposal UST or associated triple intercept which contain a mixture of products, a match with a known single product could not be obtained. The extent of the hydrocarbon contamination identified in OMW-05 has not been delineated, although due to the size of the site and local geology the plume is expected to be contained within the boundaries of AACO.

Due to site operations, Defence personnel requested that groundwater monitoring wells not be installed within the area of the toxic waste treatment facility or the former paint shop waste pond which are both potential sources of groundwater contamination.

5 Surface Water

Limited surface water was available for sampling at the time of fieldwork due to a lack of rainfall. However, waste water discharges from the site provided opportunities to collect samples within the open stormwater drain adjacent to Facility A15 (SW01) and at the down gradient site boundary (SW02).

5.1 Surface Water Sample Results

Surface water was sampled on 8 and 22 May 2002. Water quality results are summarised in Tables 1 and 2. Laboratory Analytical Results are contained in Appendix B. The laboratory analyses identified the following results above the nominated investigation thresholds:

- copper;
- zinc;
- TPH; and
- methylene blue active substances (MBAS) or surfactants, reported as linear alkybenzene sulfonates (LAS).

5.2 Discussion of Surface Water Results

No background data, trends or receiving water quality information is available for surface water at AACO. As there was no rain prior to sampling, the water contained at both sample locations is the result of site waste water discharges from site operations. Drainage lines up-gradient of AACO did not contain water at the time of sampling. Surface water sample locations are illustrated on Figure 2.

The copper and zinc concentrations within the surface water samples are comparable to that found within the groundwater. As groundwater is used on site for vehicle wash down operations, which are generally connected to stormwater drains through triple intercepts, the source of copper and zinc might be from groundwater usage.

The dissolved phase TPH identified within the surface water were chainlength hydrocarbons C_{10} to C_{36} at SW01 (pipe discharge to open drain) and C_{10} to C_{28} at SW02 at the down-gradient site boundary. These chainlengths are consistent with diesel, oils and greases.

Surfactants are likely to be sourced from vehicle and aircraft wash down water being discharged, either untreated or through triple intercepts, into the open drainage line.

Due to the lack of rainfall at the time of sampling, the water contained at the surface water sample locations is assumed to be discharges from AACO site activities. During fieldwork the predominant discharges to stormwater were from wash down operations, which were generally directed through triple intercepts prior to discharge to stormwater. The type of contaminants detected within the surface water being discharged from the AACO operations is consistent with what would be expected from vehicle wash down operations. Dissolved phase hydrocarbons, surfactants and metal contaminants can not be removed from waste water by triple intercepts.

6 Conclusion

Based on the results of this assessment, *IT* concludes the following.

SPHs are present on the groundwater in the area of Tanker Parking Bay A, which includes the liquid waste UST, intercept, manual valve and pipe work suggesting that system is leaking and requires maintenance/replacement. Laboratory analysis indicated the SPH product is a light fraction fuel of C_6-C_9 hydrocarbon chainlengths.

Dissolved phase hydrocarbons are present within the groundwater surrounding the vehicle refuelling underground tanks suggesting that a leakage in the tanks and/or pipe work has or is occurring. The hydrocarbon chainlengths present are predominantly C_6-C_{28}, which is consistent with a combination of diesel and petrol.

Copper and zinc concentrations were identified within all groundwater samples analysed for metals. As the copper and zinc concentrations were found both up and down gradient of the main AACO operations area, it is likely the identified concentrations are natural background concentrations.

The information collected on groundwater heights indicates the water intersected within the wells installed is not likely to be a laterally extensive aquifer and is more likely to be a series of saturated lenses. Therefore groundwater height information from the monitoring wells is not suitable for determining the direction and speed of groundwater flow.

Surface water within the open drainage line discharging off site to the south and into Oakey Creek contained copper, zinc, TPH and surfactants above the nominated investigation levels. Due to the lack of rain at the time of sampling, the surface water samples consisted solely of discharge waste water from site activities. The contaminants identified were consistent with what would be expected from wash down operations utilising groundwater from the site. Triple intercepts generally utilised at wash down bays at AACO are not capable of removing the identified contaminants from waste water.

IT recommends the following:

- during redevelopment of AACO, groundwater monitoring wells should be installed surrounding new USTs, intercepts and other potentially contaminating activities;
- monitor groundwater at least annually to assess the trends of contaminants over time and to monitor the identified impacts/attenuation;
- collect surface water samples where/when possible to identify contaminants being discharged to assist in rectification of the sites hazardous materials handling and liquid waste disposal practices;
- repair or replace the liquid waste UST, valve and intercept associated with Tanker Parking Bay A to eliminate the source of contaminants; and
- continued monitoring of the thickness of SPH and dissolved phase concentrations at OMW05 to assess the rate of natural attenuation and to determine any required remedial works such as product recovery.

7 References

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

Department of Environment and Heritage (1995) Water Quality Sampling Manual

Netherlands (1994) Environmental Quality Objectives in the Netherlands. Ministry of Housing, Spatial Planning and the Environment, Netherlands Government. ISBN 90-6092-783-4.

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