NSW Department of Planning Industry and Environment

Hurlstone Agricultural High School Environmental Assessment

May 2021

Executive summary

Department of Planning, Industry and Environment (DPIE) proposes an upgrade of Hurlstone Agricultural High School's (HAHS) educational dairy and agricultural facilities (the proposal) at Roy Watts Road, Glenfield (the site). The site is located about 13 kilometres north of Campbelltown and is within the Campbelltown local government area (LGA) in Sydney's south west. The site is used for educational purposes and surrounded by residential and commercial properties.

A concept masterplan to meet future residential, educational and agricultural needs was prepared by Fitzpatrick + Partners (2020) The future agricultural activities planned for the site within the concept masterplan have the potential to impact on the existing local environment and land uses, including impacts on environmental values and existing and future sensitive receptors.

This Environmental Report has been prepared to provide an understanding of the potential land use conflicts that may occur between the existing and future planned educational farm facility, future planned residential development and school upgrades and identifies potential mitigation measures. Six key environmental aspects were investigated and assessed, and this Environmental Report provides a summary of the findings of these technical assessments.

The potential environmental issues and constraints for the proposal include:

- **Spray drift** – meteorological conditions are a primary constraint on spraying operations and the greatest opportunity for spraying is in the winter months during the morning and, to a lesser extent lesser extent, periods of the afternoon
- **Odour** – proposed future residential areas would reduce the distance between receptors and odour sources and may be impacted by odour related to effluent dispersal and composing as a result of the existing waste practices
- **Noise** – noise impacts from the proposed agricultural activities resulting from mechanical plant and pumps, farming equipment (tractors and front end loaders), and truck deliveries all have the potential to create a noise impact on existing and future surrounding noise sensitive receivers
- **Soil** – soil analysis carried out at the site recorded low pH acidic soils present. Routine soil sampling and across the site is necessary to ensure there is no negative impact from the intensification of the educational farm facility, and that the crop, meat and dairy produce are fit for human consumption
- **Surface water** – as parts of the site are located within areas prone to flooding, further stormwater quality monitoring at detailed design is required to better understand water quality risk and to manage the risk of increased stormwater pollutants entering receiving waterbodies
- **Groundwater** – it is anticipated that the proposal would have minimal impact to groundwater levels, however if groundwater drilled at depth was considered as a potential water source option for stock and domestic purposes in the future, consideration of the Water Sharing Plan rules would be required
- **Waste** – effluent from animal related activities associated with the future farm have the potential to cause short term impacts at future residential zoned areas if not properly managed

The findings of this Environmental report provide recommendations and key mitigation measures for each study as noted in Sections 5 to 12 that include design considerations recommended for the proposal.

The design considerations recommended to be incorporated into the proposal design are intended to reduce the potential environmental issues and constraints identified and are summarised in Table E-1 below.

Table E-1 Recommended design considerations

Technical assessment	Recommended design consideration
Spray drift	• Create a vegetation buffer interface zones between cropping areas and receptors • Crops that require extensive pesticide use, such as brassica crops, should be located in paddocks where receptors are least frequently downwind, and far away from receptors to the north-west • A site weather station should be installed at an appropriate location and used to inform good or poor conditions for odour and dust dispersion. • Controlled droplet applicators (CDA) are preferred typical nozzles (pressure over orifice), as they produce a spray with limited variability from target droplet size • Boom sprayers should be fitted with shields which act to improve deposition of product on target and reduce spray drift • A digital system can incorporate real-time weather data to inform daily planning of spraying activities and reduce the risk of spray drift impacts
Odour	• Vegetation screenings should be used around the boundary of the site to assist in dust and odour management • Composting should be located in a central farm location near the Memorial Forest • Effluent fertigation should where possible be undertaken via underground irrigation infrastructure • Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities
Noise	• Design the location of the mechanical plant and equipment (including pumps) in areas to maximise the distance to the nearest receivers. If this is not possible, the following design measures could be considered: – Locating plant within an enclosure or building – Using well designed noise barriers, which should be located as close to the mechanical plant as possible – Acoustic louvres on any plant enclosures • Locate animal sheds and enclosures (particularly the pig shed) in areas to maximise the distance to the nearest receivers and orientated so opening are facing the west or north-west direction, maximising the distance from

Technical assessment	Recommended design consideration
	the source to the receiver. If this is not possible, the following design measures could be considered: – Design the façade with high acoustic insulation levels, including upgraded glazing – Locate sensitive internal areas away from the most impacted facades • Establish an alternate entrance to access properties at the western end of Roy Watts Roads to minimise impacts on the receivers adjacent to HAHS during both construction and operation • An acoustic assessment should be undertaken during the design of the pumps to assist with location, plant selection, and any mitigation measures required to minimise impacts
Soils	• Investigate the use and application of an automatic weather station and other farm sensors across the farm as indicated in the spray drift assessment
Surface water	• If the location of the underpass at Basin 3 that connects the agricultural areas to the north of the proposed Cambridge Avenue extension is retailed, further flood modelling is required as this is within a flood zone
Waste	• The existing animal bedding and manure composting area composting area is in a suitable location and should be retained

The recommended design considerations identified as per Table E-1 will be examined in further detail during the next phase of the development including the environmental planning and approvals stage.

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Appendices

Acronyms and Abbreviations

Acronym /abbreviation	Full Name
AHD	Australian Height Datum
APVMA	Australian Pesticides and Veterinary Medicines Authority
BATEA	Best available technology economically achievable
BMP	Best Management Practice
BoM	Bureau of Meteorology
DoE	Department of Education
DPI	Department of Primary Industry
DPIE	Department of Planning, Industry and Environment
DSI	Detailed Site Investigation
EPA	Environment Protection Agency
FIDOL	— Frequency of the exposure — Intensity of the odour — Duration of the odour episodes — Offensiveness of the odour — Location of the source
GDE	Groundwater dependent ecosystem
GHD	GHD Pty Ltd
HAHS	Hurlstone Agricultural High School
LEP	Local environmental plan
LGA	Local government area
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NCA	Noise Catchment Area
PISC	Primary Industries Standing Committee
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PSI	Preliminary Site Investigation
QA	Quality assurance
QC	Quality control
RAP	Remediation Action Plan
RBL	Rating Background Levels
RDS	Residential Development Strategy
RMS	Roads & Maritime Services
RPD	Relative Percentage Difference
SAQP	Sampling and Analytical Quality Plan
SCARM	Standing Committee on Agriculture and Resource Management
SDS	Safety Data Sheet
SEE	Statement of Environmental Effects

1. Introduction

1.1 Background

GHD Pty Ltd (GHD) has been engaged by the Department of Planning, Industry and Environment (DPIE) to assess the potential environmental constraints and issues associated with the upgrading of Hurlstone Agricultural High School's (HAHS) educational dairy and agricultural facilities (the proposal).

The site currently encompasses an area of about 120 hectares and is located on Roy Watts Road, Glenfield about 13 kilometres north of Campbelltown and is within the Campbelltown local government area (LGA) in Sydney's south west.

A concept masterplan for the re-development of the facility has been prepared by Fitzpatrick + Partners (2020) (Appendix A), which includes an overall precinct plan of the site and is designed to meet future residential, educational and agricultural needs.

The future agricultural activities planned for the site have the potential to impact on the existing local environment and land uses, including impacts on environmental values and on future sensitive receptors within the proposed masterplan. Accordingly, GHD was engaged (October 2020) to undertake a range of technical environmental investigations and to prepare an Environmental Report, which summarises the key findings of the investigations and highlights the potential key environmental risks for further consideration for the development of the proposal.

1.2 Purpose

The purpose of this Environmental Report is to inform the DPIE to support their proposal for upgrading HAHS's educational dairy and agricultural facilities.

This Environmental Report provides an understanding of the potential land use conflicts that may occur between the existing and future educational farm facility, future residential and school components of the masterplan, and identifies potential mitigation measures in the following environmental areas:

- Air quality (spray drift)
- Odour generation
- Noise
- Soils
- Water quality (surface water and groundwater) and
- Waste management.

Technical assessments were undertaken in the above environmental areas, and a summary of each is been provided in this report. The complete technical assessments areas appendices, with the exception of the Waste assessment which is provided in full in within Section 11 of this report.

1.3 Methodology

A project inception meeting was held on 9 October 2020 between DPIE and GHD to discuss and confirm the scope for the technical studies and obtain background information and existing reports that have been prepared for the proposal.

A group site visit was undertaken with the specialist leads on 27 November 2020 which provided an understanding of the current land use, land capability and type/condition of existing infrastructure.

A review of existing information was undertaken to support the preparation of the technical studies. Each technical study followed the same general approach, with individual methodologies and background studies reviewed (refer to the technical studies in the appendices). A summary of each technical study was provided and forms part of this report, which generally follows the following structure:

- Section 1 – Introduction
- Section 2 – Site context
- Section 3 – The proposal
- Sections 5 to 11 – Summaries of the technical environmental investigations
- Section 12 – Mitigation measures
- Section 13– Conclusion and recommendation
- Section 14– References
- Appendix A – Concept masterplan
- Appendices B to H – Technical investigations.

1.4 Scope and limitations

This report: has been prepared by GHD for NSW Department of Planning Industry and Environment and may only be used and relied on by NSW Department of Planning Industry and Environment for the purpose agreed between GHD and the NSW Department of Planning Industry and Environment as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Department of Planning Industry and Environment arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Site context

This section provides a description of the site and surrounding area providing context to the project.

2.1 Site description

The HAHS site is located on Roy Watts Road, Glenfield about 13 kilometres north of Campbelltown and is within the Campbelltown local government area (LGA) in Sydney's south west.

The site is about 120 hectares in area and is bound by the Main Southern and South West railway lines to the east, residential properties to the north, Campbelltown Road and the Hume Highway (M31) to the west and vacant land to the south (refer to Figure 2-1).

The characteristics of the land varies owing to its many land uses. The site comprises several schools including the HAHS to the east, and Glenfield Park School, Ajuga School and Campbell House School consolidated to the west. The balance of the site comprises open paddocks used for agriculture (irrigated and non-irrigated) and towards the centre of the site are farming structures, including a dairy and other intensive animal buildings used by the HAHS. Several dams and clusters of vegetation are scattered throughout with patches of trees surrounding the schools.

Access to the site is from Roy Watts Road, which is accessible via Railway Road to the east. Roy Watts Road spans the site from east to west, providing access to the schools. Several internal roads are also established on site, including North Lane which runs parallel to Roy Watts Road in addition to several smaller access roads around each of the schools.

Infrastructure on the site comprises distribution powerlines throughout as well as transmission lines which run east west along the northern boundary of the site.

The site is zoned SP2 Infrastructure under the Campbelltown Local Environmental Plan (LEP).

The land is currently owned by the Department of Education (DoE).

2.2 Surrounding area

The site is located in an urban area surrounded by residential and commercial enterprises despite being used for education and agricultural purposes.

The surrounding area is shown on Figure 2-2. The site and immediate surrounding land use zoning is shown on Figure 2-2.

Legend

- Site Boundary
- Local Government Area
- Train station
- Railway
- Road
- Watercourse

Paper Size ISO A4

0 0.2 0.4 0.6 0.8 1

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

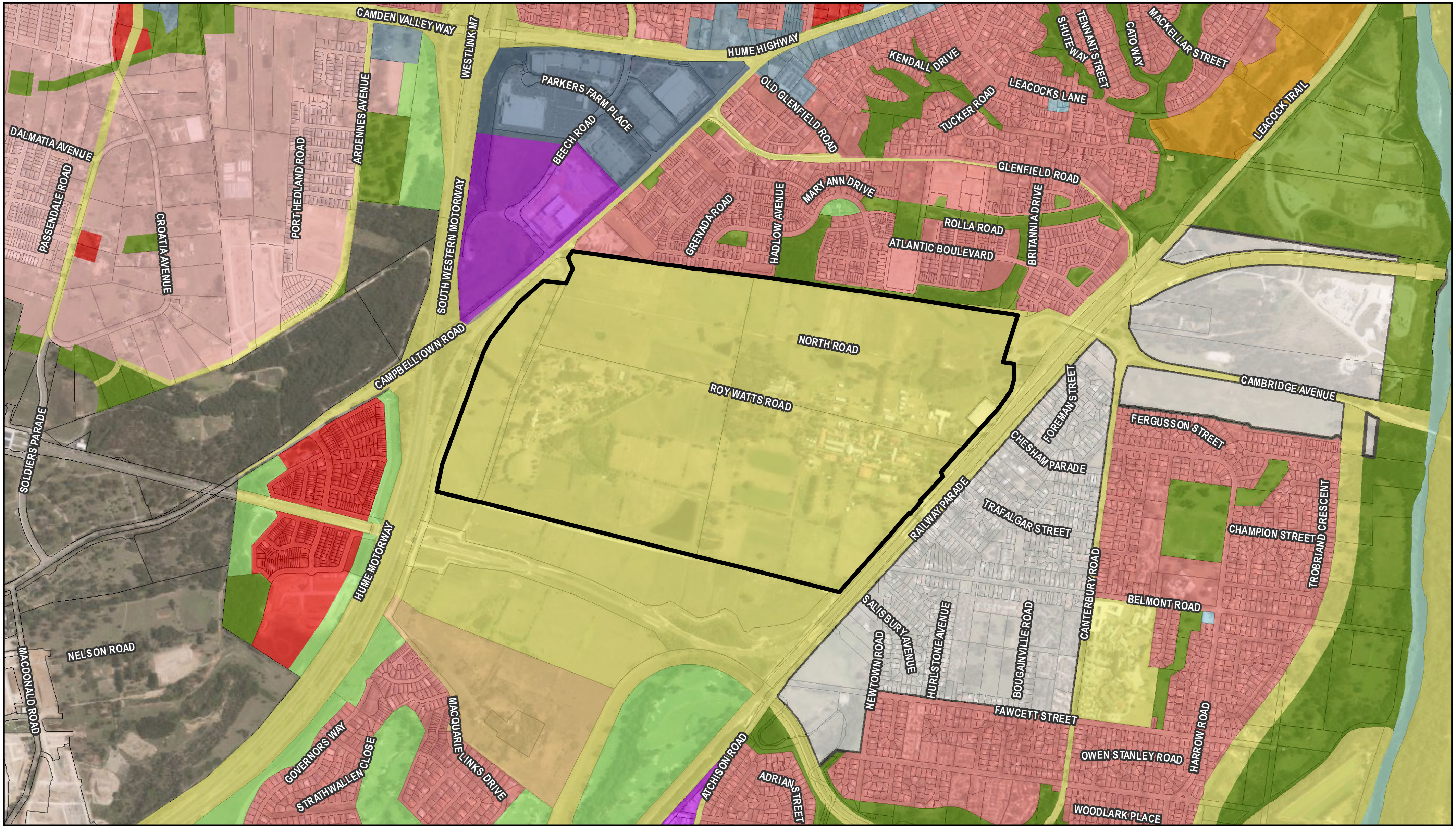
Project No. 12537824
Revision No. -
Date 25/02/2021

Site context

FIGURE 2-1

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z011_SiteLocation.mxd
Print date: 25 Feb 2021 - 16:42

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© OpenStreetMap (and) contributors, CC-BY-SA



Legend

Site Boundary
Cadstre

Land Zoning

- B1, Neighbourhood Centre
- B5, Business Development
- B6, Enterprise Corridor
- DM, Deferred Matter
- E1, National Parks and Nature Reserves
- E3, Environmental Management
- IN2, Light Industrial
- IN3, Heavy Industrial
- R1, General Residential
- R2, Low Density Residential
- R3, Medium Density Residential
- R5, Large Lot Residential
- RE1, Public Recreation
- RE2, Private Recreation
- SP2, Infrastructure
- W1, Natural Waterways

Paper Size ISO A4

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Hurlstone Agricultural School
Environmental Assessment

Project No. 12537824
Revision No. -
Date 3/03/2021

Land use zoning

FIGURE 2-2

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z010_CurrentLandZoning.mxd
Print date: 03 Mar 2021 - 12:32

Data source: Ccadastre and roads - DPIE 2021, Land use zoning - DPI 2016, Aerial© Department of Customer Service 2020. Created by: eibbertson

3. The proposal

This section provides an overview of the proposal, lists the existing studies reviewed and contains a summary of applicable legislation and guidelines.

3.1 Description of the proposal

The HAHS Farm Facilities Redevelopment (concept masterplan) (Fitzpatrick+Partners, 2020) sets out the vision for the overall site and is shown in Appendix A.

The concept masterplan includes a precinct concept plan that shows the proposed redevelopment of the site. A key feature of the precinct concept plan is the retention of the existing education and agricultural uses in the centre of the site and creation of a Farm Hub.

A description of the precinct concept plan and Farm Hub is provided below.

3.1.1 Precinct concept plan

The overall precinct concept plan includes:

- Retention of the existing schools (HAHS, Glenfield Park School, Ajuga School and Campbell House School)
- Upgrade of the HAHS's educational dairy and agricultural facilities including creation of a Farm Hub to the west of the school
- Proposed new primary school north of Roy Watts Road, opposite the existing HAHS
- Removal of North Road and extension of Cambridge Avenue road from the east through to the western boundary of the site
- Consolidation of the agricultural land into two areas connected by a new underpass. The two areas are in the centre of the site and along the northern boundary north of the proposed Cambridge Avenue extension
- A drainage corridor in the north eastern corner of the site
- A memorial forest located in the centre of the site that is north and south of Roy Watts Road and an open space area at the centre of the the southern boundary
- Proposed rezoning for residential that is along the eastern, western and southern boundaries of the site.

A key feature of the precinct plan is the creation of the Farm Hub to be used by HAHS. Further details on the Farm Hub are provided in Section 3.1.2.

3.1.2 Farm Hub

The proposed Farm Hub is an upgrade to the school's agricultural facilities to enhance students accessibility to state of the art agricultural facilities and optimise the students' learning experiences.

The location of the proposed Farm Hub is between the proposed memorial forest and the existing HAHS within the designated agricultural area. The Farm Hub would include the following facilities:

- Dairy shed
- Milking parlour
- Dairy processing facility

- Viewing gallery
- Co-located learning space
- New calf, beef and pig sheds, and relocation and reconstruction of the sheep shed, chicken pends, and aquaculture facility
- Horticulture
- Commodity shed and storage facilities
- New equipment
- Irrigation systems.

4. Summary of technical assessments

4.1 Technical assessments

GHD undertook technical assessments in the environmental areas listed in Section 1.2, to understand the potential land use conflicts that may occur between the existing and future sensitive receptors as a result of the proposed concept masterplan.

This Environmental Report provides a summary of the technical assessments as outlined in the sections listed below:

- Section 5 – Spray drift
- Section 6 – Odour
- Section 7 – Noise
- Section 8 – Soils
- Section 9 – Surface water
- Section 10 – Groundwater
- Section 11 – Waste management.

4.2 Existing studies

This Environmental Report refers to and relies upon relevant information provided in a number of existing reports and assessments. Where gaps were identified in these studies, additional sampling and/or analysis was undertaken. The following reports and assessments are referenced throughout this report:

- Concept Masterplan – Hurlstone Agricultural High School Farm Facilities Redevelopment (Fitzpatrick + Partners, 2020) (Appendix A)
- Statement of Environmental Effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School (Scibus, 2020)
- Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott MacDonald, 2018)
- Preliminary Site Investigation (PSI) (Senversa, 2017)
- Detailed Site Investigation (DSI) – Targeted Phase 2 Site Investigation (Senversa, 2019)
- Biodiversity Constraints Assessment Hurlstone Development Project (Ecological Australia, 2016)
- Tree Survey Hurlstone Development Project (Ecological Australia, 2016).

5. Spray drift

A spray drift assessment was undertaken by GHD (2021) to assess the potential human health impacts of agricultural spraying activities at future sensitive receivers within the proposed development. The spray drift assessment is provided in Appendix B and this section provides a summary of the findings.

5.1 Background

The existing farm operation includes spray irrigation and the application of herbicides and pesticides via boom sprays across all crop areas.

Agricultural spray drift is a potential source of nuisance (mist and odour) and importantly a health risk when associated with the application of chemicals including herbicides, pesticides, fungicides.

The proposed upgrade of agricultural facilities will see major changes to irrigation and chemical application procedures through the use of sub-surface irrigation. Existing measures currently employed for the protection and health of surrounding land uses during spraying include a set-back distance and consideration of meteorological conditions.

The spray drift assessment provides an overview of the risk associated with chemical spraying within the paddocks identified within the proposed precinct plan and considers existing and future sensitive receptors.

5.1.1 Study area

The existing farm operation incudes spray irrigation and application of herbicides, pesticides via boom and spot spraying across all crop areas.

The proposed spraying of herbicides and pesticides is expected to be carried out within the agricultural area on all paddocks allocated for agriculture shown within the concept precinct plan with the exception of the Farm Hub area.

The agricultural areas (paddocks potentially allocated for cropping) are located directly adjacent to existing residential locations (to the north) and to proposed residential and other sensitive locations to the west, south, and south-east. Existing residential properties to the north are a combination of one and two-storey houses. Proposed development will allow for residential properties from two storeys up to 6 storeys, directly adjacent to cropping paddocks.

Of note, there will be vegetative buffers between potential spraying activities and high-density residential locations.

5.1.2 Relevant policy or background studies

Standard control measures apply to the application of chemical products to crops. It is expected that a minimum standard of spray drift control would be implemented, as per the guidance outlined in the following policies:

- Spray Drift Management Principles, Strategies and Supporting Information Primary Industries Standing Committee (PISC) (SCARM Report 82, CSIRO, 2002)
- Spray drift management (APVMA, 2020)
- Reducing herbicide spray drift (NSW DPI, 2015).

5.2 Key findings

5.2.1 Proposed spray application methods

The design of the chemical product application system for the proposal has not yet been finalised. The existing farm operation includes application of chemical herbicides and pesticides by spray boom with nozzles producing large droplet size. At this stage it is assumed boom irrigation is likely to be the primary method of chemical application and would be undertaken by trained operators.

5.2.2 Potential impacts associated with spray drift

The movement of chemical spray droplets (and particulates within spray) have the potential to impact human health when the spray droplets drift off-target. The human health risk associated with spray drift is highly variable between each farm and from day-to-day, on the following critical parameters:

- Risk of inhalation and dermal ingestion associated with each product
- Rate of spraying (litres/hectare) and extent of spraying (hectare/hour)
- Equipment specifications, boom length, boom height, nozzle type (droplet size)
- Distance to nearest residences
- Meteorological conditions on each day.

Based on the variability of each of the above parameters, and the complexity of interaction between each parameter, quantitative impact assessment is not considered a practical or reliable method for understand potential risk posed due to chemical spray. Furthermore, prescribed buffer distances, which are typically used for protection of human health and amenity for many sources of emission to air, are not readily available for chemical spray drift applications.

Understanding of the risk to human health associated with chemical spray drift can be indicated through the assessment and subsequent registration of each chemical by regulators, including the Australian Pesticides and Veterinary Medicines Authority (APVMA). The APVMA is the government statutory authority concerning pesticide use and pesticides cannot be sold and used in Australia unless they are both safe and registered.

When pesticides are used and applied according to industry leading practice (ie the APVMA), the use is considered to be within safe exposure levels including, dermal (skin absorption), inhalation or any residuals that may occur offsite from aerial spraying.

All products proposed to be utilised at the farm (complete list is provided in Appendix A) are registered by the APVMA and are considered safe for application where robust spray drift measures are in place.

The inclusion of a downwind buffer is recommended as a mitigation measure, however limited guidance is provided on this distance other than other than keeping a boom's width from the downwind edge of the field (NSW DPI, 2015). The APVMA provides a buffer calculation tool which can be utilised to develop a site specific buffer distance however, this requires details of proposed application rate and extent which are not currently available.

5.2.3 Meteorological influence

Meteorological conditions have significant influence on the potential for spray drift impacts and as such, act as a primary constraint on spraying operations.

Assessing the local meteorological conditions such as wind (speed and pattern), temperature and humidity, allows for an understanding of the frequency of occurrence of periods where spraying would not be permitted anywhere at the farm. This data can be utilised to inform farm planning as well design of chemical spraying systems.

Meteorological observations are available from the DPIE Air Quality Monitoring Station at Liverpool, less than 4 kilometres north-northeast of the site. Data from this station are downloaded and analysed for five years, from 2016 through 2020. From this data, available hours for spraying were calculated.

Conditions appropriate for spraying

To allow for spraying to be carried out on site, the following criteria will guide the site operator when to construct spraying, in addition to using the standard control measures as outlined in section 5.1.2:

- Be within farm operational hours (this is assumed from 6 am to 6 pm)
- Be during wind speed between 2 km/h and 10 km/h (0.56 m/s – 2.8 m/s)
- Not be during highly stable or highly unstable meteorological conditions (A, B or F, G class Pasquil-Gifford stability class classifications)
- Not be during temperatures greater than 30 Celsius
- Not be during relative humidity less than 40%.

Ultimately spraying will be conducted at the discretion of the trained operator based on training, experience and site conditions at the time.

The most significant constraints are wind speed and stability class. Constraints associated with temperature and humidity are low, as it is expected that highest temperature days will most commonly coincide with unstable conditions and high wind speeds.

Approximate time of year available for spraying

Seasonally, the greatest opportunity for spraying occurs during the winter months, where spraying could occur for up to 20 per cent of the time (June). Summer months have meteorological conditions which are less conducive to spraying, and spraying would be appropriate less often between November through March.

The greatest opportunity for spraying generally occurs during the morning, and to a lesser extent in the afternoon. This pattern is consistent with a higher frequency of high wind speeds and very unstable conditions occurring during the middle of the day where solar radiation is greatest.

5.2.4 Key issues for masterplan

An assessment of site-representative weather conditions has found that that opportunities for spraying during low-risk periods would be limited based on meteorological conditions (wind speed, stability class etc) and would mean that spraying would also be influenced by season and time of day.

Any opportunities where meteorological conditions are appropriate for spraying will need to be taken as identified by the certified and trained operator, and consequently the requirement to maintain an expansive (conservative) downwind buffer may be reduced.

In summary, for the proposal to reduce the impact on sensitive receptors due to the use of agricultural sprays the trained operator should be aware of the following:

- Spraying operations during the winter months would have the least constraints. It is expected that where spraying is planned for the mid-morning, then meteorological conditions which permit spraying would be probable
- Application of sprays during the summer months will pose the most difficulty for farm operators
- Spraying should be avoided during the middle of the day.

5.3 Recommendations and key mitigation measures

The spray drift assessment has taken into consideration the proposed spray drift occurring as a result of the use of agricultural sprays associated with the proposal.

In order to further reduce risk of any spray drift impact without significant cost to operations (crop health), the following recommendations are proposed:

- **Create vegetation interface zones between cropping areas and receptors**. A vegetation buffer is expected to increase the minimum possible distance between spraying activities and human receptors, filter spray drift in addition to improving visual amenity
- **Allow for sufficient buffering of high spray demand crops**. Crops that require extensive pesticide use, such as brassica crops, should be located in paddocks where receptors are least frequently downwind, and far away from identified sensitive receptors to the north-west
- **Utilising a high standard of spray equipment.** In some instances, a smaller downwind buffer distance would be required to sensitive receptors if spraying using best practice equipment
- **Effective understanding of meteorological conditions**. It is recommended that an automatic weather station is established on site. Relevant sensors could include but not limited to temperature, precipitation, humidity, atmospheric pressure, wind direction, wind speed sensor, solar radiation and soil moisture and temperature.
- **Creation of a digital paddock management system**. A digital system can incorporate real-time weather data to inform daily planning of spraying activities and reduce the risk of spray drift impacts.

In addition to the above recommendations, specific mitigation measures have been identified as part of the spray drift assessment and are provided in Section 12.

6. Odour

An odour impact assessment was undertaken by GHD (2021) to determine the potential odour impacts from the proposed agricultural activities within the development area. The odour impact assessment is provided in Appendix C and this section provides a summary of the findings. Dust impacts were also considered in the odour impact assessment.

6.1 Background

Odour from existing and future farm activities have the potential to impact on the amenity of existing residents and future occupants of the land identified the concept precinct plan. Rezoning of the land surrounding the farm to residential use would mean that there is a smaller buffer between potentially odorous activities and residential areas may be impacted.

Odour impact is a subjective experience and has been found to depend on several factors. The most important factors associated with odour impact are known as the 'FIDOL' factors. These include:

- **F**requency of the exposure
- **I**ntensity of the odour
- **D**uration of the odour episodes
- **O**ffensiveness of the odour
- **L**ocation of the source.

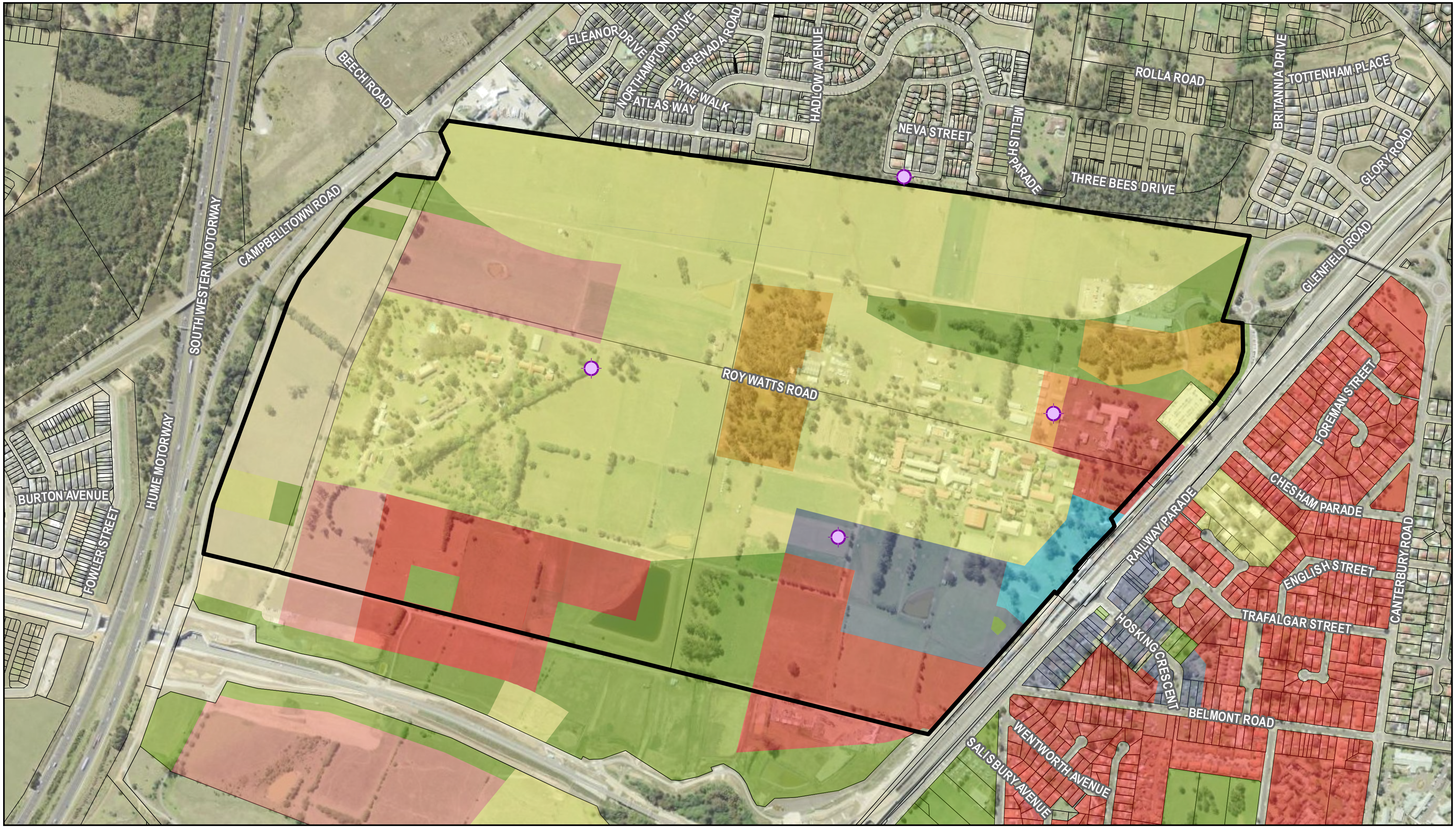
6.1.1 Study area

The odour assessment assesses the entire HAHS site for odour generating sources. Odour sources are generated from the agriculture activities throughout the site and concentrated at the location of the Farm Hub and via the disposal of effluent by way of a slurry wagon.

The proposed rezoning will result in reduced distances from key odour generating sources to residential receptors as well as a much larger population size who might be exposed to any odours. The nearest future sensitive receptors to the Farm Hub have been identified below in Table 6-1 and locations used to estimate distances are shown in Figure 6-1. Note these are estimates only based on provided indicative masterplan.

Table 6-1 Approximate distance to Farm Hub receptors

Future receptor	Approximate distance
Proposed primary school	Directly adjacent
HAHS	Directly adjacent
Proposed rezoning to east	300 m (from milk processing and pigs)
Proposed rezoning to south	240 m (from piggery)
Existing residential to north	330 m (from effluent system)
Ajuga school site	450 m (from cattle barn)



Legend

- Assessed receptor location
- Site Boundary
- Cadstre

Proposed Land Rezoning (DPIE)

- B3, Commercial Core
- B4, Mixed Use
- E2, Environmental Conservation
- E4, Environmental Living
- R2, Low Density Residential
- R3, Medium Density Residential
- R4, High Density Residential
- R5, Large Lot Residential
- RE1, Public Recreation
- SP2, Infrastructure

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Hurlstone Agricultural School
Environmental Assessment

Approximate locations of assessed future receptors

Project No. 12537824
Revision No. -
Date 24/02/2021

FIGURE 6-1

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Print date: 24 Feb 2021 - 09:41

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

6.1.2 Relevant policy

Standard control measures apply to activities that emit odour. It is expected that a minimum standard of odours controls would be implemented, as per the guidance outlined in the following policies:

- Technical framework: assessment and management of odour from stationary sources in NSW (NSW Department of Environment and Conservation, 2006)
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Sydney: State of NSW and Environment Protection Authority (Environment Protection Authority, 2016)
- Odour Review of Layer Farms and Development of S-factor Formula (Australian Eggs Limited, 2018)
- Australian Pork Limited National Environmental Guidelines for Indoor Piggeries (2018).

6.1.3 Odour criteria

The *Technical framework: assessment and management of odour from stationary sources in NSW* (NSW Department of Environment and Conservation, 2006a) (the Technical Framework) offers guidance for industry consent authorities, environmental regulators and odour specialists on assessing and managing activities that emit odour.

The impact assessment criteria for odour are applied at the nearest existing or likely future off-site sensitive receptor.

Based on the site and proposed residential zoning surrounding the school, an appropriate impact assessment criteria when assessing potential impacts would be the most stringent criteria of 2 odour units. This would apply at all surrounding residential areas.

6.2 Key findings

6.2.1 Summary of existing baseline conditions

The general activities within the existing and proposed farm which are identified to having the potential to lead to odour impacts are:

- Odour from farm animal animals located in the Farm Hub including:
  - Dairy cattle, loafing shed (three-sided shed) and milking shed (about 80 cows)
  - 20 dry cows in open paddocks
  - 60 young cow stock
  - Beef handling yards
  - Piggery (12 sows and 120 assumed piglets)
  - Chicken sheds (about 120 chickens)
  - Sheep (no details on the numbers of sheep proposed is provided, it is expected sheep numbers will be low and therefore are not considered further in this study)
- Collection and management of liquid and solid waste from piggery and dairy.
- Effluent disposal
- Agricultural chemical (herbicides, pesticides) application
- Carcass disposal
- General farm waste.

During the site visit the farm manager advised there had been no odour complaints or issues recorded. The odour impacts related to effluent dispersal are short term but can be experienced downwind. This includes at the Ajuga School where effluent is sprayed within the adjacent paddocks.

Odour from the existing piggery was strong within the immediate surrounding but became less noticeable about 30 m away from the shed. No cows were present in the milking parlour during the site inspection, and odour from the area was not considered to be strong or offensive in nature.

Odour from the carcass disposal site was found to be very strong and offensive in nature within the immediate area. The site is located about 100 m from the nearest receptor, the Ajuga School. The site is located on an elevated, vegetated area which mitigates odour from impacting at any existing receptors.

6.2.2 Key issues for masterplan

The key issues for odour generating activities for the proposal are:

- Proposed re-zoning and new buildings will reduce distance between receptors and odour sources
- Additional residential buildings and facilities will increase the overall population numbers directly adjacent to the site, increasing number of receptors who may be potentially impacted by odours
- New farm HAHS educational dairy and agricultural facilities within the Farm Hub will need to be well managed to ensure there are no odour impacts on sensitive areas
- The composing process generally takes up to 12 weeks. Quantities of material to be composted is expected to be low and odour impacts are unlikely to be a source of significant odour. However, prevailing winds from the west would likely mean odour impacts are more significant to the east. Consideration of the composting location will need to be undertaken to increase the buffer distance to future zoned receptors in the east
- Animal deaths have the potential to be a source of offensive odour. There are no proposed changes to carcass management, nor have there been any odour complaints or issues thus far. It is not expected that the odour from this activity would change given the quantity of animals are not expected to increase. Full burial methods may be required in the future if odour complaints or issues increase.

6.2.3 Recommended separation distances

The recommended separation distances between proposed activities in the farm hub and nearby sensitive receptors have been calculated to determine the risk of odour impacts. The assessment was based on the proposed animal numbers and how they will be managed. A summary of calculated separation distances is:

- 16 metres for chickens
- 238 metres for pigs
- 415 metres for dairy and cattle

This distance for the dairy and cattle is more than the distance to the nearest future receptor which is 240 metres to the south of the proposed Farm Hub.

This number is considered a worse-case estimate for the dairy, as cattle will not be permanently in a feed-lot situation. It is useful to demonstrate that odour impacts may be an issue without high level design and management during operation of the facility

6.3 Recommendations and mitigation measures

The odour assessment has taken into consideration the impacts of odour occurring as a result existing and proposed agricultural activities.

In order to further reduce risk of odour impact, the following principles are recommended:

- Prepare and implement an odour management plan to ensure regular cleaning and mitigation measures are followed
- An annual audit should be undertaken in order to ensure management plan and controls in place are being complied with
- Sub-surface fertigation is the preferred method of effluent disposal. Spray disposal of effluent should be applied via boom spray with a boom cover however this would still be limited to paddocks in the centre of the site away from any receptors
- The loafing shed used by dairy cattle should be cleaned at a minimum one time per year to manage odour. If build-up of bedding leads to odour being detected 50 metres downwind of the Farm Hub, then cleaning frequency may need to be increased
- Composting should be located in a central farm location near the Memorial Forest
- Full burial carcass management is recommended if the current burial methods (covered and composted) result in odour impacts in the future
- Vegetation screenings should be used to assist in dust and odour management in the following locations:
  - Between the Farm Hub and proposed primary school
  - At the northern boundary of site, specifically in the north-west (adjacent the service station) and anywhere where no existing vegetation and fencing exist
  - At the southern boundary of the site between the agriculture area and proposed rezoning
- A site weather station should be installed at an appropriate location and used to inform good or poor weather conditions for potential odour impacts
- Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities.

7. Noise

A noise impact assessment was undertaken by GHD (2021) to determine the potential noise impacts from the proposed agricultural activities within the development area. The noise impact assessment is provided in Appendix D and this section provides a summary of the findings.

7.1 Background

Existing and future agricultural activities have the potential to impact on the local environment and land uses, including impacts on environmental values and on future sensitive receivers within the development area.

7.1.1 Study area

The entire site and adjoining residential properties to the north were assessed for potential noise impacts from the future agricultural use on the existing and future sensitive receivers.

The following noise generating operations and equipment have been considered:

- Mobile machinery (tractors, front end loaders, all-terrain vehicle)
- Fixed plant
- Pumps (for example water and/or irrigation pumps)
- Truck deliveries (typically two truck movements per day, with a maximum of eight)
- Animals and animal associated activities
  - Animals during feeding times
  - Milking with robots
  - Flushing of feed alleys
  - Manure screening and pump to tanks
  - Movement of livestock by students and staff.

7.1.2 Relevant policy or background studies

A review was undertaken of available information relevant to the proposed development to gain an understanding of the project background and context, including:

- Noise Policy for Industry (EPA 2017)
- Documentation regarding future development of HAHS and the surrounding proposed developments:
  - Hurlstone Agricultural High School Farm Facilities Redevelopment Concept Masterplan, prepared by Fitzpatrick + Partners Architects (dated 23 September 2020)
  - Education Land Area Plan
  - Height Strategy and Lot Annotations Plan
  - Indicative Layout Plan.

7.2 Key findings

7.2.1 Noise monitoring locations

Sensitive receivers and land uses

Three noise catchment areas (shown in Figure 7-1) were identified within the site area that refer to existing and future receivers which may be impacted from future agricultural activities. These areas have different background and ambient noise environments due to their proximity from noise sources, such as the South Western Freeway and Campbelltown Road and commuter and freight railway lines. The identified noise catchment areas are:

- Noise Catchment Area 1 (NC1) – future residents to the east and south-east of HAHS
- Noise Catchment Area 2 (NC2) – existing residents to the north of HAHS
- Noise Catchment Area 3 (NC3) – future residents to the west and south-west of HAHS

The noise catchment areas have different background and ambient noise environments due to their proximity to the South Western Freeway and Campbelltown Road and the railway lines. Residences within each noise catchment area is shown in Table 7-1.

Table 7-1 Identified noise sensitive receivers

Receiver ID	Receiver Type	Lot Annotation/Address	Future/existing
NCA 1 – Station Precinct and Town Centre			
R01	Residential	ST-6	Future
R02	Residential	ST-4	Future
R03	Residential	ST-3	Future
R04	Residential	ST-2	Future
R05	Residential	TC-2	Future
R06	Residential	TC-1	Future
R07	Residential	TC-11	Future
NCA 2			
R08	Residential	29-39 Three Bees Drive	Existing
R09	Residential	17-27 Three Bees Drive	Existing
R10	Residential	1-11 Three Bees Drive	Existing
R11	Residential	26-44 Mellish Parade	Existing
R12	Residential	11 Mellish Parade/15 Glatton Road	Existing
R13	Residential	19-21 Hindostan Street	Existing
R14	Residential	29-33 Hillsborough Crescent/ 20 Hindostran Road	Existing
R15	Residential	1-9 Boddingtons Road	Existing
R16	Residential	11-25 Boddingtons Road	Existing
R17	Residential	102-112 Northampton Drive	Existing
R18	Residential	1-5 Eleanor Drive/ 94-100 Northampton Drive	Existing
NCA 3			
R19	Residential	SW-29	Future

Receiver ID	Receiver Type	Lot Annotation/Address	Future/existing
R20	Residential	SW17 – SW20	Future
R21	Residential	SW-7 – SW-10	Future
R22	Residential	SW-4	Future
R23	Residential	NW-7	Future
R24	Residential	NW-6	Future
R25	Residential	NW-5	Future
R26	Residential	NW-4	Future
R27	Residential	NW-3	Future
R28	Residential	NW-9	Future
R29	Residential	NW-10	Future
R30	Residential	NW-11	Future
R31	Residential	NW-12	Future
Non-residential sensitive receivers			
R32	School	Proposed primary school	Future
R33	School	HAHS	Existing
R34	School	Campbell House School	Existing
R35 (R07)	Health Facility	Located within TC-11	Future

Noise environment

Background monitoring was undertaken in three locations for a period of 10 days between Friday 4 December to Monday 14 December 2020 as follows:

- Noise monitoring location 1 (M1) is considered representative of the residences to the west and south-west of HAHS, and is referred to as NCA1
- Noise monitoring location 2 (M2) is considered representative of the residences to the north of HAHS, and is referred to as NCA2
- Noise monitoring location 3 (M3) is considered representative of the residences to the east and south-east of HAHS and is referred to as NCA3.

The three locations are considered representative of the background noise environment for the residences surrounding HAHS and are shown in Table 7-1.

Legend

- Site Boundary
- Cadstre
- Noise Monitoring Locations
- Sensitive receivers
- Noise Catchment Areas

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Noise monitoring locations, noise catchment areas and surrounding sensitive receivers

Project No. 12537824
Revision No. -
Date 25/02/2021

FIGURE 7-1

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Print date: 25 Feb 2021 - 12:16

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

7.2.2 Comparison of noise levels between existing and proposed noise generating activities

Comparison of noise levels at NCA1 – town centre and station precinct

The existing noise impacts for receivers in NCA1 are dominated by passenger and freight rail traffic on the rail line directly to the east of these receivers, with some impacts from the South Western Freeway and Campbelltown Road for receivers at the western side of the NCA1. The predicted noise level range for receivers in NCA1 from this rail traffic, assuming the area has been developed, is 46-62 dBA.

The proposed noise impacts for receivers in NCA1 generated by the proposed agricultural activities are:

- Predicted noise from mechanical equipment in the Farm Hub – 31-39 dBA
- Predicted noise from truck deliveries – 29-56 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

Overall, for NCA1 the predicted noise from the site is generally below the existing noise level at the site from external noise impacts, with the exception of truck deliveries at the receivers adjacent to Roy Watts Road.

Comparison of noise levels at NCA2 – existing residences to the north

The existing noise impacts for receivers in NCA2 are from passenger and freight rail traffic on the rail line to the east of these receivers and rom the South Western Freeway and Campbelltown Road to the west. The predicted noise level range at these receivers from this rail and road traffic, assuming the area has been developed, is 48-58 dBA.

The proposed noise impacts for receivers in NCA2 generated by the proposed agricultural activities are:

- Predicted noise from mechanical equipment in the Farm Hub – 27-37 dBA
- Predicted noise from truck deliveries – 19-33 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

Overall, for NCA2 the predicted noise from the site is generally below the existing noise level at the site from external noise impacts.

Comparison of noise levels at NCA3 – north western quarter, south western quarter and southern quarter

The existing noise impacts for receivers in NCA3 are from passenger and freight rail traffic on the rail line to the east of these receivers and rom the South Western Freeway and Campbelltown Road to the west. The predicted noise level range at these receivers from this rail traffic, assuming the area has been developed, is 46-66 dBA.

The proposed noise impacts for receivers in NCA3 generated by the proposed agricultural activities are:

- Predicted noise from mechanical equipment in the Farm Hub – 22-32 dBA
- Predicted noise from truck deliveries – 15-28 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

Overall, for NCA3 the predicted noise from the site is generally below the existing noise level at the site from external noise impacts.

7.2.3 Key issues for masterplan

The key issues for noise generating activities as a result of the proposal are:

- Existing noise levels across the site are impacted by the surrounding rail and road traffic, and are generally predicted to be higher than the predicted noise levels from the future use of the farm facilities
- Noise impacts from animals is difficult to predict due to the varying nature of noise levels, number of animals and location of sheds. General noise mitigation measures are provided to minimise the impacts of noise from animals
- There is potential for sleep disturbance impacts from the animals as feeding may occur prior to 7am each day. It is likely that noise from sheep or cows would not exceed this noise level. It is possible that pigs during feeding time in a group may exceed this level
- Noise from farming equipment is not considered to exceed criteria at future sensitive receivers. Noise is predicted to exceed the criteria at sensitive receivers in NCA2, 20 metres from the paddock, however this is not expected to be significant as the noise source is pre-existing and would only occur over a short period of time
- The type and location of pumps have not yet been determined, however mitigation measures and recommendations have been provided to assist in the design process
- The farm facilities should be able to be designed to achieve compliance with the relevant project noise trigger levels, should the mitigation measures detailed in Section 12 be considered in the design. It is recommended that a detailed acoustic assessment be undertaken during design development to provide specific guidance around appropriate mitigation measures
- Farming activities will continue to operate as it has in the past and noise from farming equipment have the potential to create a noise impact on future receivers. All future buildings will need to be designed to account for existing noise from the school, in particular truck deliveries, tractors and front end loaders.
- Existing and future noise from truck deliveries have the potential to create a noise impact on surrounding receivers including out of day time hours. New development in NCA 1 should consider this in the design
- The assessment of noise generated as a result of the proposed Cambridge Avenue extension was not in the scope of this study. However, consideration for noise walls or noise mounds around Cambridge Avenue is recommended, as this would reduce noise levels generated from the road to the surrounding sensitive receivers.

7.3 Recommendation and mitigation measures

The operation of the HAHS Farm Facilities has the potential to impact the existing and future sensitive receivers surrounding the proposed site, should noise impacts not be considered in the design. Due to the site being an existing agricultural precinct, there will be some noise generating activities that occur in the early morning and evening that cannot always be mitigated.

To reduce the potential impacts on nearby receivers, the in principal noise mitigation measures below should be considered. However, it is noted that not all of these mitigation measures are required and rather a combination of these would be considered when the design is further developed.

7.3.1 Mechanical plant and equipment

Land use control

- Where possible, mechanical plant and equipment should be located on the site to maximise the distance between it and the nearest receivers
- Plant should be located on the northern or western sides of any building structure, where there is a greater distance to noise sensitive receivers

Control at the source, Best Management Practice (BMP) and Best available technology economically achievable (BATEA)

- Selection of the quietest mechanical plant available
- Selection of mechanical plant to not exceed 90 dBA per building within the Farm Hub, or where this noise is greater than 90 dBA, should be mitigated to achieve this level

Control in transmission

- Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design:
  - Locating plant within an enclosure or building
  - Using well designed noise barriers, which should be located as close to the mechanical plant as possible
  - Acoustic louvres on any plant enclosures

Receiver controls

- Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from mechanical plant.

7.3.2 Animal noise

Land use control

- Where possible, animal sheds within the Farm Hub, in particular animal sheds which may generate higher noise levels (such as the pig shed) should be located on the site to maximise the distance between it and the nearest receivers

Control at the source, BMP and BATEA

- Where possible, procedures should be put in place to reduce noise from animals, in particular during feeding times

Control in transmission

- The Farm Hub buildings and animal enclosures should be designed and constructed to contain as many solid facades as possible
- The Farm Hub buildings and animal enclosures should be orientated so opening are facing the west or north-west direction, maximising the distance from the source to the receiver

Receiver controls

- Should the control of noise from animal noise not be possible using the above methods, mitigation measures could be implemented at the nearest sensitive receivers impacted by animal noise. While this is not a preferred option, the following could be implemented:
  - Design of façade with high acoustic insulation levels, including upgraded glazing
  - Location of sensitive internal areas away from the most impacted facades.

7.3.3 Farming equipment

Land use control

- Farming equipment such as tractors and front end loaders may need to be used during sensitive times such as early morning as per existing use. Any new residential areas should consider this in their design.

Control at the source, BMP and BATEA

- Farming equipment, such as tractors and front end loaders should be selected to have the lowest noise level economically available
- The following general mitigation measures could also be considered, as provided in the Noise Policy for Industry (EPA, 2017).
  - considering alternatives to tonal reversing alarms such as broadband alarms (where work health and safety is appropriately considered)
  - using equipment with efficient muffler design
  - using quieter engines, such as electric instead of internal combustion
  - fitting and maintaining noise reduction packages on plant and equipment

Control in transmission

- Control in transmission is not suitable for mobile plant so has not be considered for farming equipment

Receiver controls

- Should additional controls be required following investigation from the above methods, at receiver controls could be considered, as per the details above. It should be noted that noise impacts on existing receivers are possible, and therefore other mitigation measures should be considered rather than at receiver controls.

7.3.4 Truck deliveries

Mitigation measures to control impacts from truck movements are challenging due to the following:

- The trucks are not stationary objects and therefore control in transmission is not possible
- There would be a range of truck delivering goods to the site which aren't under the control of the school, and therefore limiting noise at the source is challenging
- Access to the Farm Hub is only possible via Roy Watts Road, and therefore is required to pass by sensitive receivers in NCA1
- Out of hours deliveries are often needed due to milk trucks, grain and hay deliveries and to avoid trucks when children may be onsite.

The following noise mitigation measures can be investigated to minimise the impacts on the receivers adjacent to Roy Watts Road:

Land use control

- Any residential buildings within NCA 1 may be impacted by existing and future noise from truck deliveries, including early morning and night time. All future buildings will need to be designed to account for existing noise from the school.
- Establish an alternate entrance to access properties at the western end of Roy Watts Roads to minimise impacts on the receivers adjacent to HAHS during both construction and operation

Control at the source, BMP and BATEA

- Trucks accessing the site should be roadworthy and compliant with relevant government noise requirements
- .

7.3.5 Pumps

Land use control

- Where possible, pumps should be located on the site to maximise the distance to the nearest receivers

Control at the source, BMP and BATEA

- Selection of the quietest pumps available
- Selection of pumps to not exceed the levels provided in the buffer distance or where this is not possible, should be mitigated to achieve this level

Control in transmission

- Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design:
  - Locating plant within an enclosure or building
  - Using well designed noise barriers, which should be located as close to the mechanical plant as possible
  - Acoustic louvres on any plant enclosures

Receiver controls

- Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from new mechanical plant.

In addition to the above, .an acoustic assessment should be undertaken during the design process to assist with location, plant selection, and any mitigation measures required to minimise impacts.

8. Soils

A soils assessment was undertaken by GHD (2021) to determine the soil characteristics of the areas to be retained for agricultural purposes and to assess the ability to support intensified farming activities including the arability of the soil within the proposed development. The soils assessment is provided in Appendix E and this section provides a summary of the findings.

8.1 Background

HAHS is planning to continue irrigated cropping on the broader farm areas and in order to support the feed requirements of the current dairy and other agricultural activities. The cropping will require soils that are capable of supporting 8-12 tonnes per hectare of annual grasses or 24 tonnes per hectare of maize.

A key aspect of the proposed plan for the site is to increase the intensification through the installation of sub-surface irrigation allowing for the fertilisation (fertigation) and chemical treatments of crops and pastures.

Agricultural areas will be irrigated by either recycled water or through on-site water harvesting and recycling.

8.1.1 Study area

Soil sampling for the assessment was undertaken at six paddock locations throughout the site and are shown in Figure 8-1.

8.1.2 Relevant policy or background studies

Historical and current agronomic practices across HAHS was discussed with the Farm Manager to understand the expected soil types and variance across the site. Historical soil sampling information was not available.

8.2 Environmental impacts related to soils

8.2.1 Soil quality

Soil quality will require assessment to ensure it is suitable for ongoing crop and livestock production. Organics and trace heavy metals presence can impact on soil quality and the health of crops. Soil quality loss could result in the decline of soils capability to support the required amounts of grasses and maize, which in turn would impact on agricultural animals relying on the food resource.

Poor soil quality also has the potential to impact on waterways within the site area from run off. Higher traces of organics and trace heavy metals can enter the waterway and cause water quality to decline. This is relevant as the site contains several dams and is in proximity to waterways as discussed in Section 2.

8.2.2 Recycled water use

The use of recycled water for irrigation of crops requires assessment to determine if there are any issues associated with grazing of livestock for meat or milk production and growing of crops within irrigated areas. Assessment will be required to confirm produce is fit for human consumption ensure compliance with the relevant guidelines.

Legend

- Soil sampling location
- Site Boundary
- Cadstre

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Project No. **12537824**
Revision No. **-**
Date **25/02/2021**

Soil Sampling Locations

FIGURE 8-1

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Print date: 25 Feb 2021 - 13:39

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

8.3 Key findings

8.3.1 Summary of existing baseline conditions

Table 8-1 provides a summary soil sampling results for the six assessed paddocks (shown in Figure 8-1).

Within the table, a low pH result indicates that the soil is acidic and has the ability to show aluminium toxicities. In range is a typical result for a dairy, and a result of above or below optimal requires the application of product to regulate nutrients.

Table 8-1 Soil sampling results

Paddock	pH	Nitrate Nitrogen	Phosphorus	Sulphur	Potassium
4A	in range	in range	in range	in range	in range
15	low pH demonstrating an acidic soil	below optimal	above optimal	below optimal	below optimal
16	low pH demonstrating an acidic soil	in range	above optimal	below optimal	below optimal
21	low pH demonstrating an acidic soil	below optimal	in range	below optimal	below optimal
23	low pH demonstrating an acidic soil	below optimal	above optimal	below optimal	in range
34	low pH demonstrating an acidic soil	below optimal	above optimal	below optimal	below optimal

The soil analysis results shows that paddocks 15, 16, 21, 23 and 24 require the application of product to ensure the paddocks have macronutrient levels in range for cropping.

Paddock 4A has all macronutrients in range and the treatment of product recommended at the sowing of new crop only.

8.3.2 Key issues for masterplan

The key issues for noise generating activities as a result of the proposal are:

- Ongoing sampling and analysis will be required to ensure soil quality is healthy and suitable for crop production both in the short term and long term
- Monitoring results and inspection details require ongoing, detailed record keeping. Frequency of records to be maintained range from daily, quarterly to annually.

8.4 Recommendations and mitigation measures

The following recommendations are provided for soil quality and management:

- Ongoing sampling and analysis of soil across the six collection sites, including implementing a longer term soil monitoring program
- The recommended levels of product application should be followed in accordance with the results from sample analysis to ensure optimal ranges for cropping are maintained
- Accurate record keeping required to ensure compliance with any conditions of approval which might be placed on HAHS.
- Investigate the use and application of an automatic weather station and other farm sensors across the farm as outlined in the spray drift assessment.

9. Surface Water

A surface water assessment was undertaken by GHD (2021) to identify the water related risks associated with proposed development on the surrounding waterways, receptors, topography, land uses and water infrastructure. The surface water assessment is provided in Appendix F and this section provides a summary of the findings.

9.1 Background

Glenfield Creek is located in the north eastern portion of the site as described in Section 2 and the parts of the site are located within an areas prone to flooding. Due to the proximity to watercourses, a change in the proposed land use as a result of the concept masterplan (Fitzpatrick + Partners, 2020) would have an impact on pervious areas, flow paths and pollution runoff at the HAHS site.

In 2018, a strategy for flood risk management and Water Sensitive Urban design (WSUD) (Mott MacDonald, 2018) was prepared for the site based on the previous concept urban design plan (Group GSA, 2018). This strategy was developed to ensure the concept urban design plan addressed stormwater and flooding principles; however the concept urban design plan encompassed a wider area than the current concept masterplan (Fitzpatrick + Partners, 2020).

9.1.1 Study area

The surface water assessment as part of this Environmental Report reviews the existing strategy (Mott MacDonald, 2018) and provides an indicative surface water management plan based on the new concept masterplan (Fitzpatrick + Partners, 2020).

9.1.2 Relevant policy or background studies

A review of existing information was reviewed to inform the surface water assessment including:

- Concept Masterplan – Hurlstone Agricultural High School Farm Facilities Redevelopment (Fitzpatrick + Partners, 2020)
- Statement of Environmental Effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School (Scibus, 2020)
- Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott MacDonald, 2018).

9.2 Key findings

9.2.1 Summary of existing baseline conditions

Water quality

A comparison assessment was undertaken to compare the land uses proposed in the Group GSA concept urban design plan and the Fitzpatrick + Partners concept masterplan.

A comparison of the Group GSA concept urban design plan and the Fitzpatrick + Partners concept masterplan was undertaken and changes in land use were compared with Water NSW guidelines for the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) (Water NSW, 2012).

The results of this comparison showed one change of land use type needs to be modelled, from residential to agricultural land use.

Flooding

Comparison of runoff

A comparison of the Group GSA concept urban design plan and the Fitzpatrick + Partners concept masterplan was undertaken to determine changes in land use type and estimated impervious fractions.

The results of this comparison for each change in land use, there is a significant reduction in impervious area and therefore a likely reduction in runoff. The impervious fraction of the Farm Hub is unknown. However, as the Farm Hub has a water management system in place, and due to its size compared to the remainder of the site, the risk to flooding due to increased runoff is considered small.

Location of detention basins

The proposed underpass planned in the Fitzpatrick + Partners concept masterplan linking the agricultural areas to the north and the school, is located within a flood zone and within Basin 3 as defined in the Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018). It is recommended that if this location is to be retained, further investigation is required during the design stage to ensure the risks associated with this are mitigated.

Overland flow paths

Due to the level of detail provided in the masterplan, no comment can be made on changes to overland flow paths.

Interaction with groundwater

Due to the relatively deep water table of around 10 metres below ground service combined with a clay profile, it is expected that minimal (if any) surface water to groundwater interaction is expected (refer to the groundwater assessment levels in Appendix F).

Water sourcing and security

The concept masterplan (Fitzpatrick + Partners, 2020) proposes an increase in agricultural areas and the decrease in residential areas at the HAHS site. This will see a decline in urban potable water demand and an increase in demand for stock and irrigation consumption. There is a risk that with the current water servicing strategy, these demands may not be able to be met.

9.2.2 Key issues for masterplan

Water quality

The MUSIC modelling undertaken predicted lower pollutant export from the *Fitzpatrick + Partners Concept Masterplan* compared to the *Group GSA Masterplan.* Therefore, the proposed treatment outlined in the Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018) is predicted to be suitable to manage this comparatively reduced pollutant load.

During the later stages of design, the estimate of the pollutant loads will require updating based on a consideration of the nature of the activities and materials posing a water quality risk. Furthermore, there may also be a need for water quality monitoring dependent on the outcomes.

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Flooding

Apart from the underpass proposed at Basin 3 and in a flood zone, no significant additional risks were identified to those in the Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018). Further flood modelling is required at detailed design to better understand and respond to flooding risks.

Water sourcing and security

To manage the increased demand in stock and irrigation water, the following sources could be further investigated:

- Rainwater harvesting in the farm hub area
- Water reuse in the farm hub area
- Groundwater sources
- Recycled water supply from Sydney Water.

9.3 Recommendations and mitigation measures

Based on the high-level review of surface water for HAHS, the following recommendations are made:

- Investigate the location of the underpass that connects the proposed primary school and agricultural areas to the north of the proposed Cambridge Avenue extension. There is a potential conflict with Basin 3
- Farm management practices should address erosion and pollutant runoff
- HAHS should develop an effluent management plan for the farm area that utilises the information from this report and the SEE to ensure that the disposal of effluent from the farm hub minimises runoff to waterways and is informed by future development of the site
- The farm facilities should be designed to achieve compliance with relevant stormwater pollutant levels and flooding requirements. It is recommended that detailed modelling be undertaken during design development to provide specific guidance around appropriate mitigation measures
- It is likely that stormwater pollutant management can be managed as outlined in Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018) if suitable farming practices are adopted.

10. Groundwater

A groundwater assessment was undertaken by GHD (2021) to assess the potential operational impacts of the proposed development on groundwater and groundwater dependent features. The groundwater assessment is provided in Appendix F and this section provides a summary of the findings.

10.1 Background

The site is located within proximity of two waterways; Glenfield Creek to the north-east and Bunbury Curran Creek to the south east as described in Section 2. Both creeks drain into the Georges River, east of the site and these waterways are most likely shallow groundwater discharge zones.

The proposed development has the potential to affect the existing groundwater conditions from both from a quantity and quality perspective at the site and in the broader region through the use of capturing and recycling water, effluent treatment, solids removal and loafing paddocks.

The groundwater assessment has evaluated potential impacts for both current and proposed practices in relation to the regulatory measures relating to groundwater from both groundwater quantity and quality aspects and any environmental impacts associated with the proposed precinct plan.

10.1.1 Study area

Groundwater was assessed throughout the entire HAHS site via ten groundwater wells to appropriately characterise the physical and chemical properties of groundwater on-site and to adequately inform the impact assessment. Seven existing monitoring wells were located on site and a further three groundwater monitoring wells were installed as part of GHD works in the south and west of the site. The additional three groundwater monitoring wells were required to define groundwater conditions over the entire site and to characterise groundwater quality migrating offsite along the down-gradient site boundary.

10.1.2 Relevant policy or background studies

A number of legislation and policy exists around the use and protection of groundwater resources in NSW. These include:

- Water Act 1912 (progressively being replaced by Water Management Act 2000)
- Water Management Act 2000 (NSW) - (supersedes Water Act 1912)
- Water Management (General) Regulation 2018
- Water Supply / (Critical Needs) Act 2019
- NSW Aquifer Interference Policy
- NSW State Groundwater Policy Framework document
- NSW Groundwater Quality Protection Policy
- NSW State Groundwater Dependent Ecosystem Policy.

Existing groundwater information was reviewed in the PSI report (Senversa, 2017), which was prepared for the HAHS and surrounding lands. This was followed by a DSI Targeted Phase 2 site investigation report in April 2019 (Senversa, 2019).

10.2 Key findings

10.2.1 Existing environment

Climate

Rainfall data has been obtained from the closest Bureau of Meteorology (BoM) weather station at Campbelltown (Georges River Road, Kentlyn – BoM Station number 068160). The Campbelltown weather station, located 9 km from the site, was identified as having the longest climatic record (from June 1966), however the record is incomplete as no data was recorded between July 1988 and December 2000.

Most rainfall occurs in the summer season with the highest average rainfall in March. The lowest mean rainfall occurs in the winter. The average annual rainfall is 754.9 mm.

Different types of aquifers have different responses to climatic variation, generally referred to as the groundwater response time. Shallow unconfined aquifers often respond to a small-scale fluctuation including individual rainfall events, whereas deeper regional scale, and semi-confined aquifers often show trends that are more aligned with larger scale variation.

There is no long-term evapotranspiration data available from BoM Station Number 66161 or in the near vicinity. As groundwater is approximately 10m deep, it is unlikely that groundwater is affected by evapotranspiration, although transpiration may play a role in maintaining a water table at depth.

Topographical setting

The site is located within the local government area of Campbelltown City Council. It was identified in the PSI (Senversa, 2017), that the site had historically been used for farming. The elevation of the Site ranges from approximately 58 metres Australian Height Datum (AHD) on the western portion of the Site to 20 metres AHD at the south east boundary of the Site towards Bunbury Curran Creek.

It is expected that groundwater elevations would mirror topographic contours.

Surface water features

The site is located within the Lower Georges River and Bunbury Curran Creek sub-management zone of the Georges River Management Zone as per the Greater Metropolitan Region unregulated water sources water sharing plan (2011).

The Georges River catchment covers an area of 736 km^2. Generally, the catchment is a medium groundwater sensitivity to inflows.

There are several surface water dams on the site. The PSI (Senversa, 2017), identified an ephemeral drainage line between dams on the northern portion of the site, however it was dry at the time.

There are two waterways located near the site. Glenfield Creek to the north-east and Bunbury Curran Creek to the South-east. Both creeks drain into the Georges River, east of the site. These waterways are most likely shallow groundwater discharge zones.

Geology and sediments

The site is underlain by the Wianamatta Group, characterised by siltstone, carbonaceous claystone, claystone laminate and fine sandstone.

The Site is underlain by the Wianamatta Group, characterised by siltstone, carbonaceous claystone, claystone laminate and fine sandstone and surface soil consisting of Blacktown residual soils, Luddenham erosional soils and South Creek alluvial soils.

A review of NSW Department of Industry, Resources and Energy 1:100,000 geological map indicates the Site has an area of Quaternary sediments (Qha) in the south-east portion of the Site adjacent to the Bunbury Curran Creek. These comprise quartz sand, silty sand, silt and clay. Further north and west of these deposits are three outcropping geological units of the Wianamatta Group comprising:

- Ashfield Shale (Rwa): The majority of the Site, in its eastern portion, is underlain by dark grey to black claystone-siltstone and fine sandstone-siltstone laminate.
- Bringelly Shale (Rwb): The western portion of the Site is underlain by shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.
- Minchinbury Sandstone (Rwm): A thin section of this unit is observed on the middle of the Site, located between the Ashfield Shale and Bringelly Shale unit. This comprises fine to medium-grained quartz-lithic sandstone.

Soil sampling undertaken by Senversa on 6 December 2018 described the sediment as low to medium plasticity, brown, grey and yellow mottled clay or silt. Based on the Soil Landscapes of Sydney (eSpade2.0 Office of Environment and Heritage), most of the site is along Luddenham (9030lu) soil landscape with the northern and western boundaries along the Blacktown (9030bt) and the south-east corner along the South Creek (9030sc).

A review of Acid Sulfate Soil (ASS) maps suggests that the Site is not located within an area likely to contain potential ASS. The Site is not located within an area reported to have naturally occurring asbestos.

Hydrogeological conditions

Aquifer parameters

Ashfield Shale and Bringelly Shale are primarily aquitards, they do have scattered zones of fracture porosity. The Hydrogeology Map of Australia identified the aquifers on as being extensive, porous and of low to moderate productivity.

Regional groundwater within underlying the shale and sandstone bedrock is likely to flow towards the adjacent creeks and tributaries to the east / south-east, where it is likely to discharge. Groundwater flow most likely occurs in zones of higher permeability such as fractured facies, weathered zones, faults and joints, with these features also influencing local flow directions.

Groundwater flow within shallow fill and/or sediments will occur in zones of higher permeability with the local flow regime likely to follow bedrock topography, preferential pathways and temporal recharge conditions, with an overall seepage direction likely to be towards adjacent creeks and tributaries of Georges River.

Groundwater elevations

Groundwater monitoring wells on the site were gauged by Senversa on 18 December 2018. The groundwater elevations ranged between 24.480m AHD (MW02) and 44.730m AHD (MW06). Groundwater flow was proposed to occur in a south-easterly direction for generally across the site and in an easterly direction in the northeast area of the site. The primary discharge of the shallow groundwater system are the local surface water receptors such as Bunbury Curran Creek to the south and the Georges River to the east.

Groundwater recharge

Based on groundwater elevations, groundwater recharge likely occurs at the high elevation in the north-western area of the site and groundwater discharge occurs towards the north-east and south-east area of the site.

The site lies within the Sydney Central Basin Groundwater Source of the Greater Metropolitan Region Water Sharing Plan. The hydrology map of Australia lists aquifers as typically extensive, porous and of low to moderate productivity.

Groundwater users

There are 16 registered groundwater bores within a 2km radius of the site listed on the NSW Department of Primary Industry's (DPI) – Office of Water database (Senversa 2017). Most of these bores are explorational and do not have groundwater records.

Groundwater dependent ecosystems

Two groundwater dependent ecosystems, Cumberland Shale Plains Woodland and Cumberland River Flat Forest, have been identified from the BoM National Groundwater Dependent Ecosystems (GDE) Atlas that have potential to exist on site.

Contaminated sites

A review of existing reports and data indicates that there is a range of potential on-Site and off-Site sources of contamination associated with current and historical land uses that could pose a moderate to high risk of contamination including:

- Agricultural land uses (for example sheep dips)
- Chemical and fuel storage
- Herbicide application
- On-site construction activities
- Surrounding commercial and industrial land uses.

10.2.2 Summary of existing baseline conditions

Groundwater monitoring results

Of the ten groundwater monitoring wells data was assessed at eight of the locations (root obstruction occurred at one well and the other was dry). Groundwater was sampled from eight wells. Wells MW01, MW02, MW04 and MW07 were purged using a peristaltic pump and tubing until field parameters stabilized and then sampled.

- The groundwater is neutral, with pH values ranging from 6.88 to 7.43
- EC is variable across the site, ranging from 3,370 at MW10 to 32,378 at MW09. This is indicative of saline groundwater, typically found in Wianamatta group shales.

Slug tests

A rising head slug test was performed in wells MW04, MW06 and MW09 prior to data loggers being installed. A slug test is a method to determine the hydraulic conductivity (K) of the aquifer.

These values indicate that the groundwater moves between 0.196 m/day to 0.023 m/day across the site. The difference between the wells can be explained by the geology in which they are installed. It is possible that shale fractures in MW04 gives rise to a higher K value, as groundwater transmits more readily in this geological area. Conversely, potentially less fractures in MW06 could explain a lower K value. Clay generally have a K value of approximately 0.05 m/day.

Overall, these K values are consistent with expected values for hydraulic conductivity in this geological formation.

Groundwater elevations

Data loggers were installed in MW04, MW06 and MW09 to determine the relationship between the groundwater elevations beneath the site to the rainfall. Loggers were left in the wells for three weeks.

These wells were chosen for their position across the Site. MW06 is located in the higher elevated area to the west of the Site, MW04 is in the middle and MW09 is near to the south eastern boundary.

The groundwater hydrograph in the MW06 is shown in Figure 3 and indicates that groundwater levels respond to long term weather patterns while the groundwater at the lower elevated area of the Site (MW04 and MW09) show no immediate response to rainfall (shown in Figure 2 and Figure 4 respectively). This would suggest that surface runoff and evapotranspiration play a larger role in rainfall response.

Water quality (groundwater exceedances)

There were two exceedances of the nominated relative percentage difference acceptance criterion of ± 30% for ionic balance and total phosphorous observed between the primary sample MW08 and the intra laboratory duplicate QA01.

The phosphorous exceedance is likely to be associated with the heterogeneity of groundwater. The higher of the two values for the analyte was used as a conservative approach. Given that almost all of the concentrations for total phosphorous exceeded a long-term irrigation assessment criteria (with the exception of QA01 and MW02) the level of precision is considered to be suitable for the purposes of this investigation.

The ionic balance exceedance is not considered a cause for concern given the value for ionic balance is given by %. The small difference between the samples (4.78%) has resulted in a difference of 67% due to the way in which RPDs are calculated.

10.2.3 Key issues for masterplan

Groundwater recharge is likely to occur in the higher elevated parts of the site to the west and mirrors topographic elevation and gradients approximately 10 m below ground surface. Given that the shallow groundwater in the surficial sediments is highly saline reflecting similar water quality to the underlying geological materials (Ashfield Shale and Bringelly Shale), it is more likely, however, that the shallow groundwater is derived from a deeper source rather than rainfall infiltration at the site. The predominant recharge area is therefore more likely to be off-site and is illustrated in the conceptual groundwater model in Figure 10-1.

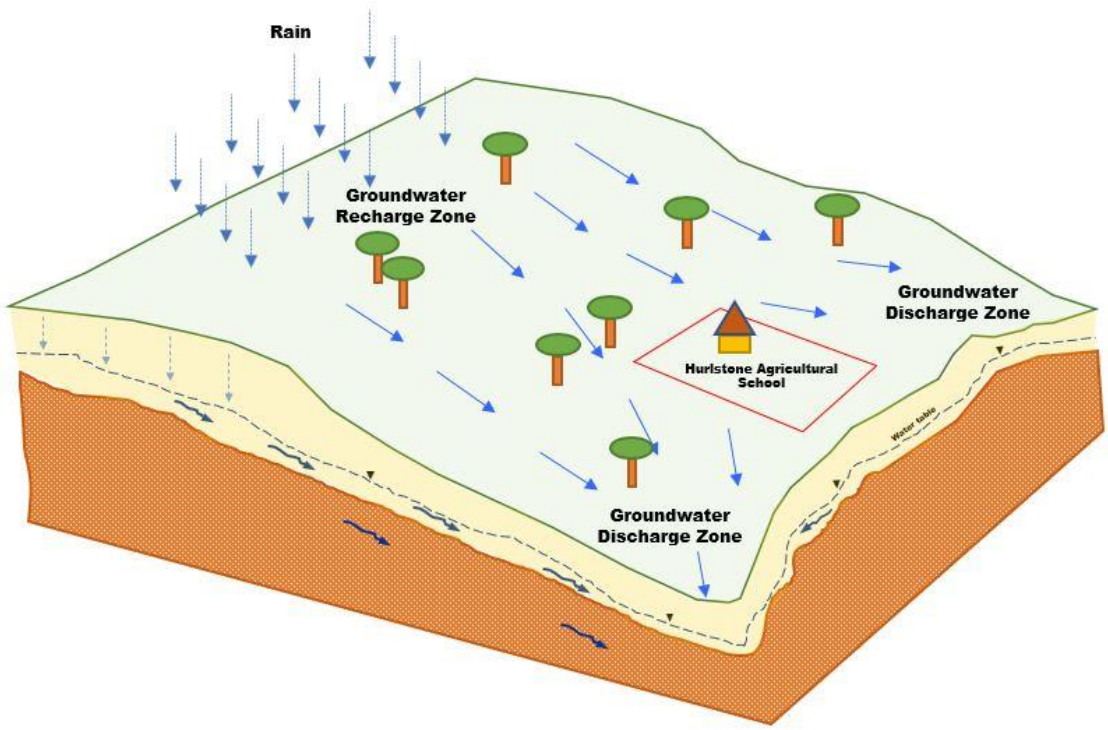

Figure 10-1 Site Conceptual Groundwater Model

Elevated ammonia, phosphates and nitrates in shallow groundwaters that have been observed correlate with nutrients from cattle grazing are reduced by replacing stock feeding with crop and pastures. Nutrient waste that is used on cropping land may maintain nutrient levels in shallow groundwater, although if this is recycled as suggested, this will reduce nutrient levels. As such, the new upgraded facilities have included options that minimalise groundwater impacts. Since the groundwater is already highly saline, its beneficial use is reduced significantly.

The relatively impermeable nature of the soils and clays found at the site indicate that the shallow groundwater does not respond immediately to vertical rainfall infiltration. Recharge is expected to occur off-site and the source of shallow groundwater is likely from the deeper Ashfield Shale and Bringelly Shale which is highly saline and similar water quality to the shallower groundwater in the surficial sediments (clays). The groundwater hydrograph in the higher elevated area to the west of the site indicate that groundwater levels respond to long term weather patterns while the groundwater at the lower elevated area of the site show no immediate response to rainfall. This would suggest that surface runoff and evapotranspiration play a larger role in rainfall response.

Assessment for groundwater contamination has indicated that the groundwater has elevated nutrients (for example Ammonia relative to Australian Drinking Water Guidelines 2011 health guidelines) and several trace metals. Elevated nutrients are most likely associated with cattle farming. Major ions and overall salinity of the groundwater is very high but is part of the natural condition expected in groundwaters associated with the Wianamatta Group shales.

The redevelopment has considered options to minimalise environmental impacts. Capturing and recycling water, effluent treatment, solids removal and loafing paddocks prevents groundwater impact both from a quantity and quality perspective. In addition, low infiltration rates to groundwater combined with these procedures ensure minimal impact to shallow groundwater.

10.3 Recommendations and mitigation measures

The groundwater assessment has evaluated potential impacts for both current and proposed practices in relation to the regulatory measures relating to groundwater from both groundwater quantity and quality aspects and any environmental impacts.

Mitigation options such as recycling nutrient wastes have already been considered in the development of the draft masterplan (as described in Section 7.3 of Appendix F). Therefore, after assessing current hydrogeological conditions, characterising the groundwater system and evaluating possible impacts, it can be concluded that the redevelopment will have minimal impact and, if anything improves groundwater conditions.

Irrigation would have minimal impact to groundwater levels, flow and water quality.

11. Waste

A waste assessment was undertaken by GHD (2021) to gain an understanding of the sources of waste associated with the farming activities including the dairy, piggery, and other farm activities within the proposed development. The waste assessment is provided in this section and draws upon the findings of the odour assessment in Appendix C.

11.1 Background

Improper waste management could result in odour and other emissions, which has the potential to impact on the amenity of existing and future residential and community areas proposed in the masterplan.

11.1.1 Study area

The waste assessment assessed all waste generated by the farming activities including animal related waste (effluent, bedding, manure, and carcasses), solid waste, and chemicals.

Animal waste is generated primarily within the existing farm, within the dairy and piggery, however, the disposal of waste occurs throughout the site within the paddocks.

11.1.2 Relevant policy or background studies

A review of existing information was reviewed to inform the waste assessment includes:

- Statement of Environmental Effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School (Scibus, 2020)
- Hurlstone Agricultural High School Farm Facilities Redevelopment, Concept Masterplan (Fitzpatrick + Partners, 2020).

11.2 Key findings

11.2.1 Existing baseline conditions

Effluent from animal related activities

Effluent is generated from the existing animals within the dairy and piggery. Effluent within these areas is currently disposed of by spraying in paddocks, using a slurry cart or wagon as shown in Figure 11-1.

Effluent from the dairy and piggery is also dispersed by the following activities:

- Wash down from the milking parlour
- Wash down from the piggery.

Figure 11-1 Slurry carts

General solid wastes

General solid wastes are collected in wheelie bins and are understood to be disposed of by waste contractors with school wastes. Relatively small volumes are generated from farm activities. No large bins or waste management compounds are understood to be present on site.

Chemicals (drums)

No chemical drums were observed on site. It is understood that chemical drums are rinsed and collected as part of the Drum muster program. Very few drums are generated each year.

Animal bedding and manure

It is understood that animal bedding and manure is disposed of by on site composting. This was observed to be undertaken over a relatively small area, probably less than 20 metres by 20 metres, south of Roy Watts Road, near the Department of Communications site, and to the west of HAHS.

Carcass disposal

The carcass disposal site is located on an elevated, vegetated area south of Campbell House. The existing area is relatively isolated, screened by trees and is fenced off.

The current method of carcass disposal does not appear to involve full burial, rather covering with hay bales as depicted in Figure 11-2. On average, only one large carcass per year requires disposal.

Figure 11-2 Carcass disposal area

11.2.2 Key issues for masterplan

Effluent from animal related activities

Effluent from animal related activities associated with the future farm have the potential to cause short term impacts at future residential zoned areas if not properly managed.

- A new effluent management system is proposed for the site associated with the creation of the Farm Hub. The new effluent management system includes sub-surface application of effluent with irrigation, which would be considered best practice for effluent application. The effluent treatment plant and areas irrigated with effluent would need to be away from residential areas to avoid odour impacts.

Additional information on effluent management is provided in Section 5 of Appendix C.

Animal bedding and manure

The existing animal bedding and manure composting area is located in proximity to the HAHS and appears to be a sufficient distance from future residential areas within the proposed precinct plan. It is also noted that the composting area is likely to only handle a small quantity of material, therefore the current location is unlikely to affect the amenity of future residents.

Carcass disposal

It is proposed that the future animal numbers will be similar to existing operations, therefore it is not expected that odour will increase from this activity in the future.

The area is well screened by vegetation, unlike most parts of the site, so relocation is not proposed. However, the existing disposal area is adjacent residential areas within the proposed precinct plan and, as the current disposal method appears to be partial burial, full burial methods may need to be employed.

General solid wastes and chemicals (drums)

- General solid wastes and chemical drums seem to be well managed and would not be impacted by future residential areas within the proposed precinct plan.

11.3 Recommendations and mitigation measures

The waste assessment has taken into consideration the existing and proposed waste generating activities associated with the project. The following recommendations are provided for waste:

- The existing animal bedding and manure composting area composting area should be relocated to a central farm location, near to the Memorial Forest. Having the compost west of the Memorial Forest will increase the buffer distance to the school and future zoned receptors to the east
- Animal carcass disposal methods should include full burial.

No specific mitigation measures have been identified as part of this waste assessment.

12. Recommended mitigation measures

Table 12-1 provides a full list of the recommended mitigation measures provided by the environmental assessments for air quality, odour, noise, soils, surface water, groundwater and waste, that are relevant to the project.

Should any changes to the proposed concept masterplan or project design be required, then this table should be reviewed and updated as required.

Table 12-1 Recommended mitigation measures

Environmental factor	Area	Mitigation measure
Air quality	Prior to spraying	• Spray operators are to be formally trained and hold the relevant certification/accreditation such as ChemCert and have undergone onsite training. • Review safety data and relevant instructions for each product to be sprayed. • Equipment selected which is considered industry best practice, and would achieve at a minimum: – Minimise spray release height. – Maximise droplet size whilst maintaining application efficiency. – Spray orientated towards the ground. • Spray equipment to be checked regularly for damage and maintained/calibrated in accordance with equipment specifications. • Review forecast weather conditions when planning spraying activities.
Air quality	During spraying	• Do not spray during weather conditions which are likely to reduce product application efficiency as well as lead to increased spray drift hazard. Weather conditions favourable to spraying include: – Wind speeds between 2-10 km/hour for most applications. – Wind direction away from any sensitive location. – Conditions with both temperature greater than 30 C and/or relative humidity <40% for application of water-based products are to be avoided. – Periods where a surface temperature inversion is not present. – Periods of neutral, or close to neutral atmospheric stability. Highly unstable conditions should be avoided. • Spraying should be halted where conditions change and any unfavourable weather conditions arise. • Maintain a downwind buffer within which spraying should not occur where sensitive locations are downwind.

Environmental factor	Area	Mitigation measure
Odour	Distance separation – pigs	• A vegetation buffer is to be designed on the southern boundary to help reduce dust and odour impacts. • The number of sows should be limited to 10, without additional assessment first being carried out which would demonstrate that any increase in number would not lead to unacceptable impacts. • An odour management plan be prepared which ensures regular cleaning of bedding and manure.
Odour	Distance separation – dairy and cattle	• Loafing shed to be cleaned at minimum one time per year. If build up of bedding leads to odour being detected 50 m downwind of the farm hub, then cleaning frequency may need to be increased. • An odour audit of the farm including Farm Hub should conducted annually.
Odour	Effluent management	• Effluent fertigation should where possible be undertaken via underground irrigation infrastructure. Where spraying of effluent is required this should be avoided in paddocks directly adjacent to residential premises. • Any new machinery needed to apply effluent such as boom, shall be fitted with shields to minimise spray. • Investigate the use of vegetation screening around the Farm Hub (as well as farm boundary fence lines). Any vegetative screening up close to sources such as sheds would need to consider natural airflow to naturally ventilated sheds. • Vegetative screens typically consist of a mix of indigenous shrub and tree species, and be as wide as practicable.
Odour	Dust management	• Application of water to key sources of dust. Given the future farm will have a permanent water supply from Glenfield Sewage Treatment Plant, ample water should be available all year to apply as needed to dust generating surfaces such as an unvegetated paddock. • The proposed cattle shed will have a concrete pad and covered loafing area. This will significantly reduce dust from current conditions. • Use of vegetation buffers around key sources of dust and at boundaries with sensitive zoned residential areas.

Environmental factor	Area	Mitigation measure
		• Use of an on site weather station to reduce or stop activity during certain weather conditions (ie high wind on a dry day, blowing towards nearest receptor). • Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities.
Noise	Mechanical plant and equipment	*Land use control* • Where possible, mechanical plant and equipment should be located on the site to maximise the distance between it and the nearest receivers • Plant should be located on the northern or western sides of any building structure, where there is a greater distance to noise sensitive receivers Control at the source, BMP and BATEA • Selection of the quietest mechanical plant available • Selection of mechanical plant to not exceed 90 dBA per building within the Farm Hub, or where this noise is greater than 90 dBA, should be mitigated to achieve this level Control in transmission • Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design: • Locating plant within an enclosure or building • Using well designed noise barriers, which should be located as close to the mechanical plant as possible • Acoustic louvres on any plant enclosures *Receiver controls* • Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from mechanical plant

Environmental factor	Area	Mitigation measure
Noise	Animal noise	*Land use control* • Where possible, animal sheds within the Farm Hub, in particular animal sheds which may generate higher noise levels (such as the pig shed) should be located on the site to maximise the distance between it and the nearest receivers Control at the source, BMP and BATEA • Where possible, procedures should be put in place to reduce noise from animals, in particular during feeding times Control in transmission • The Farm Hub buildings and animal enclosures should be designed and constructed to contain as many solid facades as possible • The Farm Hub buildings and animal enclosures should be orientated so opening are facing the west or north-west direction, maximising the distance from the source to the receiver *Receiver controls* • Should the control of noise from animal noise not be possible using the above methods, mitigation measures could be implemented at the nearest sensitive receivers impacted by animal noise. While this is not a preferred option, the following could be implemented: • Design of façade with high acoustic insulation levels, including upgraded glazing • Location of sensitive internal areas away from the most impacted facades
Noise	Farming equipment	*Land use control* • Farming equipment such as tractors and front end loaders may need to be used during sensitive times such as early morning as per existing use. Any new residential areas should consider this in their design Control at the source, BMP and BATEA

Environmental factor	Area	Mitigation measure
		• Farming equipment, such as tractors and front end loaders should be selected to have the lowest noise level economically available • The following general mitigation measures could also be considered, as provided in the Noise Policy for Industry (EPA, 2017) • considering alternatives to tonal reversing alarms such as broadband alarms (where work health and safety is appropriately considered) • using equipment with efficient muffler design • using quieter engines, such as electric instead of internal combustion • fitting and maintaining noise reduction packages on plant and equipment Control in transmission • Control in transmission is not suitable for mobile plant so has not be considered for farming equipment *Receiver controls* • Should additional controls be required following investigation from the above methods, at receiver controls could be considered, as per the details above. It should be noted that noise impacts on existing receivers are possible, and therefore other mitigation measures should be considered rather than at receiver controls
Noise	Truck deliveries	Land use control • Any residential buildings within NCA 1 may be impacted by existing and future noise from truck deliveries, including early morning and night time. All future buildings will need to be designed to account for existing noise from the school. Control at the source, BMP and BATEA • Trucks accessing the site should be roadworthy and compliant with relevant government noise requirements

Environmental factor	Area	Mitigation measure
Noise	Pumps	Land use control • Where possible, pumps should be located on the site to maximise the distance between it and the nearest receivers (see buffer distance assessment in Section 9.2.3 of Appendix C). Control at the source, BMP and BATEA • Selection of the quietest pumps available • Selection of pumps to not exceed the levels provided in the buffer distance detailed in Section 9.2.3 of Appendix C or where this is not possible, should be mitigated to achieve this level Control in transmission • Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design: • Locating plant within an enclosure or building • Using well designed noise barriers, which should be located as close to the mechanical plant as possible • Acoustic louvres on any plant enclosures Receiver controls • Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from new mechanical plant
Soils	Site investigation and management	• Routine soil sampling and analysis across the site is necessary to determine the suitability of soil for crop production and regular monitoring ensures there is no negative impact from the intensification of the educational farm facility. In addition to the regular soil sampling and monitoring program, it is recommended that a longer-term soil monitoring program is implemented to test for organics and trace (and heavy) metals. Sampling should be undertaken at regular intervals (e.g. three to five years) with both surface and sub-soil sampling undertaken (sample location to a depth of 1 m) at each of the six collection sites. For

Environmental factor	Area	Mitigation measure
		sub-soil samples should be collected from each key soil horizon or nominally at 0–20 cm, 20–40 cm, 40–70 and 70–100 cm. The routine testing and advice allows targeted application of fertilisers to meet current soil conditions while preventing over-application.
Soils	Compliance and environmental monitoring	• Ensure that monitoring results and inspection details are recorded for compliance and environmental monitoring. An example of some of the records that could be maintained include: – Farm activity register – Farm Management Plan (refer to Section 4 of Appendix D for further details).

13. Conclusion and recommendation

This section provides the conclusion and key design considerations for the proposal.

13.1 Conclusion

This Environmental Report has been prepared to assess the environmental impact associated with the upgrading of HAHS educational dairy and agricultural facilities. As part of the upgrade, an overall concept masterplan has been prepared proposing a redevelopment of the entire site to meet future residential, educational and agricultural needs.

GHD have undertaken environmental assessments in air quality (spray drift), odour, noise, soils, water (surface water and groundwater), and waste, to assess the impacts associated with the upgrade of the educational dairy and agricultural facilities and identified potential land use conflicts between existing and future sensitive receptors.

This Environmental Report has found the key potential environmental issues of the proposal include:

- Meteorological conditions are a primary constraint on spraying operations and the greatest opportunity for spraying is in the winter months during the morning and lesser extent in the afternoon
- Proposed future residential areas would reduce the distance between receptors and odour sources and may be impacted by odour related to effluent dispersal and composing as a result of the existing waste practices
- Noise impacts from the proposed agricultural activities from mechanical plant and pumps, farming equipment (tractors and front end loaders), and truck deliveries have the potential to create a noise impact on existing and future surrounding receivers
- Overall soil analysis recorded low pH acidic soils across the site. Routine soil sampling and analysis and regular monitoring ensures across the site is necessary to ensure there is no negative impact from the intensification of the educational farm facility and the crop, meat and dairy are fit for human consumption
- Further stormwater quality monitoring at detailed design is required to better understand water quality risk, to manage the risk of increased stormwater pollutants entering waterbodies
- The proposal would have minimal impact to groundwater levels, however if groundwater drilled at depth was considered as a potential water source option for stock and domestic purposes in the future, consideration of the Water Sharing Plan rules must be considered.

13.2 Key design considerations

To reduce impacts as a result of the proposal, this Environmental Report has provided recommendations for each study as noted in Sections 5 to 11. Of these recommendations, the key design considerations recommended to be implemented in the proposal design are summarised below.

Spray drift

- Create vegetation buffer interface zones between cropping areas and receptors

- Crops that require extensive pesticide use, such as brassica crops, should be located in paddocks where receptors are least frequently downwind, and far away from receptors to the north-west
- A site weather station should be installed at an appropriate location and used to inform good or poor conditions for odour and dust dispersion.
- Controlled droplet applicators (CDA) are preferred typical nozzles (pressure over orifice), as they produce a spray with limited variability from target droplet size
- Boom sprayers should be fitted with shields which act to improve deposition of product on target and reduce spray drift
- A digital system can incorporate real-time weather data to inform daily planning of spraying activities and reduce the risk of spray drift impacts.

Odour

- Vegetation screenings should be used around the boundary of the site to assist in dust and odour management
- Composting should be located in a central farm location near the Memorial Forest
- Effluent fertigation should where possible be undertaken via underground irrigation infrastructure
- Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities

Noise

- Design the location of the mechanical plant and equipment (including pumps) in areas to maximise the distance to the nearest receivers. If this is not possible, the following design measures could be considered:
  - Locating plant within an enclosure or building
  - Using well designed noise barriers, which should be located as close to the mechanical plant as possible
  - Acoustic louvres on any plant enclosures
- Locate animal sheds and enclosures (particularly the pig shed) in areas to maximise the distance to the nearest receivers and orientated so opening are facing the west or north-west direction, maximising the distance from the source to the receiver. If this is not possible, the following design measures could be considered:
  - Design the façade with high acoustic insulation levels, including upgraded glazing
  - Locate sensitive internal areas away from the most impacted facades
- Establish an alternate entrance to access properties at the western end of Roy Watts Roads to minimise impacts on the receivers adjacent to HAHS during both construction and operation
- An acoustic assessment should be undertaken during the design of the pumps to assist with location, plant selection, and any mitigation measures required to minimise impacts

Soils

- Investigate the use and application of an automatic weather station and other farm sensors across the farm as indicated in the spray drift assessment

Surface water

- If the location of the underpass at Basin 3 that connects the agricultural areas to the north of the proposed Cambridge Avenue extension is retailed, further flood modelling is required as this is within a flood zone

Waste

- The existing animal bedding and manure composting area composting area should be relocated to a central farm location, near to the Memorial Forest .

14. References

APVMA. (2020). *Spray drift management*. Retrieved from Australia Government Australian Pesticides and Veterinary Medicines Authority: https://apvma.gov.au/node/10796

CSIRO. (2002). *Spray Drift Management Principles, Strategies and Supporting Information PISC* (SCARM) Report 82. Primary Industries Standing Committee. Collingwood: CSIRO Publishing.

DPIE (2020). *Hurlstone Agricultural School Environmental scope.*

Ecological Australia. (2016a). *Biodiversity Constraints Assessment Hurlstone Development Project.*

Ecological Australia. (2016b). *Tree Survey Hurlstone Development Project.*

Environment Protection Authority. (2016). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Sydney:* State of NSW and Environment Protection Authority.

Fitzpatrick + Partners. (2020). *Hurlstone Agricultural High School Farm Facilities Redevelopment Concept Masterplan*.

Mott Macdonald. (2018). *Glenfield Planned Precinct Western Precinct Water Cycle Report.* Sydney: Property NSW.

NSW DPI. (2015). *Reducing herbicide spray drift*. Retrieved from NSW Government Department of Primary Industries: https://www.dpi.nsw.gov.au/biosecurity/weeds/weed-control/herbicides/spray-drift.

Scibus. (2020). *Statement of Environmental Effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School*.

Senversa. (2017) *Preliminary Site Investigation.*

Senversa. (2019). *Detailed Site Investigation (DSI) – Targeted Phase 2 Site Investigation.*

Appendices

Appendix A – HAHS Farm Facilities Redevelopment (concept masterplan)

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HURLSTONE AGRICULTURAL HIGH SCHOOL
FARM FACILITIES REDEVELOPMENT

ROY WATTS ROAD, GLENFIELD, NSW 2167

PREPARED FOR:
DEPARTMENT OF EDUCATION
SCHOOL INFRASTRUCTURE NSW

CONCEPT MASTERPLAN
DATE: 23 SEPTEMBER 2020

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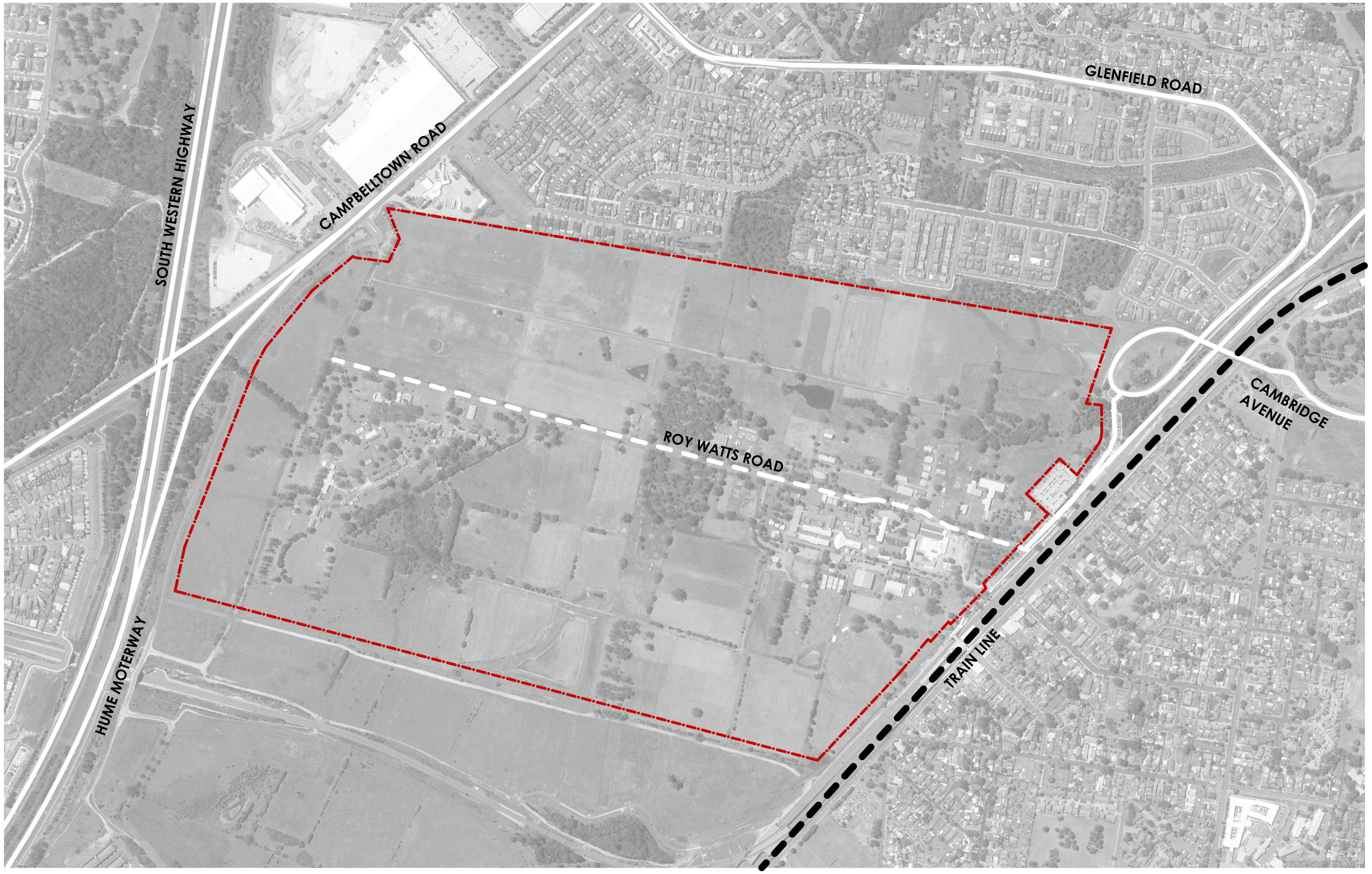
INTRODUCTION

HURSLSTONE AGRICULTURAL HIGH SCHOOL (HAHS) FARM FACILITIES REDEVELOPMENT

This report focuses on the Concept Masterplanning of the proposed Farm Facility Upgrades at Hurlstone Agricultural High School. The project features a Farm Hub which will be located in the heart of the campus.

The masterplan aims to improve safe and a walkable distance to the existing Hurlstone Agricultural High School. Students will have access to state of the art farming facilities at their 'door step' so to optimise their accessibility to hands on experience in the contemporary agricultural enterprises.



( ) EXISTING SITE BOUNDARY

This document has been prepared by Fitzpatrick+Partners Architects for School Infrastructure NSW

NSW GOVERNMENT Education School Infrastructure

In support of a master plan proposal for Hurlstone Agricultural High School.

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issue	date/check
	23/09/2020
revision 06	prep: JL check: EC

SCALE 1:10,000 @ A3

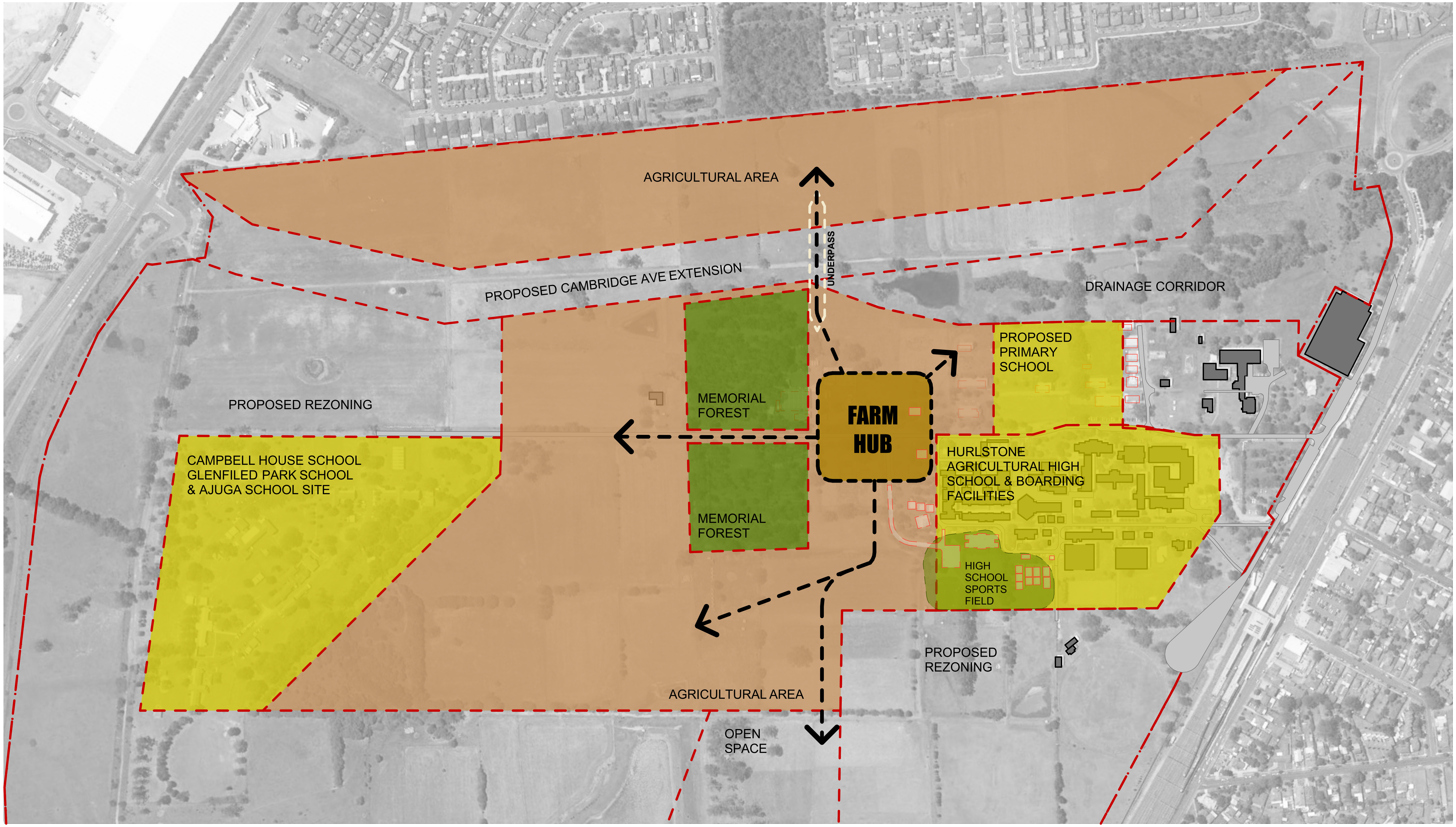
HAHS - FARM FACILITIES REDEVELOPMENT

PRECINCT CONCEPT PLAN

First and foremost, the school and community support the importance in maintaining a strong presence of an Agricultural Facilty in the precinct. This results in a nearly 50% (74 hectares) of the Department of Education Glenfield site is being retained for ongoing educational use. A significant portion of the site, at approximately 48 hectares, is allocated as farmland for Hurlstone Agricultural High School.

EDUCATION & AGRICULTURAL SITES

Centrally located on the Glenfield Education Site, The Farm Hub will optimise efficiency in the management of this siginificant education/agricultural facility.



HAHS - FARM FACILITIES REDEVELOPMENT

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SCALE 1:5000 @ A3

( ) DEMOLITION WORKS

THE FARM HUB

The Farm Hub will consist of the following new facilities:

- Dairy shed
- Milking parlour
- Dairy processing equipment
- Viewing gallery
- Co-located learning space
- Calf, beef, and pig sheds
- Horticulture
- Commodity shed and storage facilities
- New equipment
- Irrigation systems

... and including the relocation & reconstruction of the following facilities:

- Sheep shed
- Chicken pens
- Aquaculture facility

This Masterplan has been prepared in consultation with:

- SINSW
- Hurlstone Agricultural High School
- Scibus, Agricultural Consultant
- Trio Property Group

( ) DEMOLITION WORKS

SCALE 1:1000 @ A3

HAHS - FARM FACILITIES REDEVELOPMENT




Architecture is the fine balance between innovative design solutions and the practical importance of fitting buildings to people, the environment and budgets.

Since its foundation, we have created an inspiring architectural response to unique problems throughout Australasia.

Our work originates from a particular stream of architecture that is independent of the self-conscious style based approach and is more about technical problem solving.

Our approach is much closer to engineering than the high aesthetic ground, but is not unaware or unconcerned about the aesthetic outcome. Instead, we see this as more of a result of good thinking, than as a goal in and of itself.

We create and inventive solutions related to the immediate environment and the context of the project, resulting in buildings that are a pleasure in which to live and work.

Our studio does not limit itself to a particular scale or typography or project, preferring to work across all scales and building uses,where we believe we can add value to the design and construction process.

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Appendix B – Spray drift assessment

NSW Department of Planning Industry and Environment

Hurlstone Agricultural High School

Spray Drift Assessment

May 2021

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Acronyms and Abbreviations

Acronym/abbreviation	Full Name
APVMA	Australian Pesticides and Veterinary Medicines Authority
AWS	Automatic Weather Station
CDA	Controlled droplet applicators
DPI	Department of Primary Industry
DPIE	Department of Planning, Industry and Environment
EPA	Environment Protection Agency
FQPA	*Food Quality Protection Act of 1996* (USA)
GHD	GHD Pty Ltd
HAHS	Hurlstone Agricultural High School
USEPA	United States EPA

1. Background

Agricultural spray drift is a potential source of nuisance (mist, odour) and importantly a health risk where associated with application of chemicals including herbicides, pesticides, fungicides.

The existing farm operation incudes spray irrigation and application of herbicides, pesticides via boom sprays across all crop areas. Measures are currently employed for the protection of the health of surrounding land uses through employment of a set-back distance as well as thorough consideration of meteorological conditions during spraying. The Farm Manager has advised he has specific concerns about spraying in the north west corner of the site in close proximity to the service station/roadhouse.

The proposed farm development will see major changes to irrigation and chemical application procedures through use of sub-surface irrigation. In addition to mitigating the risk of spray drift associated with irrigation and fertigation (odour), sub-surface chemigation (herbicides, pesticides incorporated into the irrigation stream) will reduce the frequency of above surface chemical spraying required.

This spray drift assessment is required to understand the risk associated with chemical spraying at the proposed development and will provide recommendation to manage any identified risks.

2. Description of spraying activities

2.1 Requirement for spraying

Sub-surface irrigation will allow for chemigation of crops without spray drift risk, however some herbicides or pesticides are required to be applied to foliage of the crop, and consequently some risk of spray drift impacts is associated with use of these products. Overall, the use of sub-surface irrigation will reduce the risk of spray drift in comparison to the existing operation.

2.2 Location of spraying

Spraying of herbicides and pesticides is expected to be carried out as required on all paddocks allocated for cropping within the precinct. Figure 2-1 below shows the location of cropping paddocks as well as the location of existing residential locations and proposed development locations.

It should be noted that paddocks nearest the Farm Hub are allocated as cattle run (grazing) and therefore that herbicides and pesticides are not expected to be applied to these areas. Further, paddock, allocated as 'horticulture' is located adjacent to the proposed primary school and any chemical application is likely to be by hand and therefore risk will be reduced significantly.

Figure 2-1 shows that agricultural areas (paddocks potentially allocated for cropping) are located directly adjacent to existing residential locations (to the north) and to proposed residential (and other human sensitive) locations to the west, south, and south-east. Existing residential properties to the north are a combination of one and two-storey houses. Proposed development will allow for residential properties from two storeys up to 6 storeys, directly adjacent to cropping paddocks.

As exists there will be vegetative buffers between potential spraying activities and high-density residential locations.

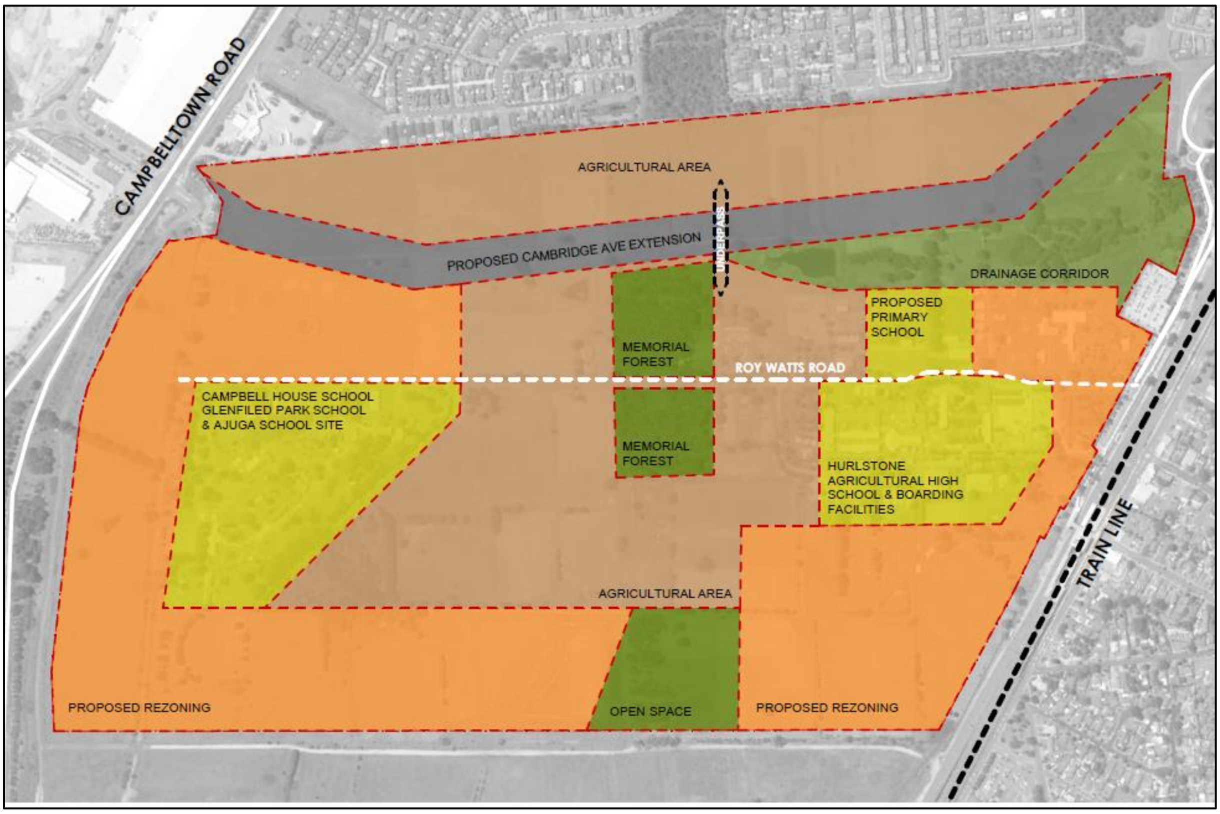

Figure 2-1 Site layout drawing showing location of Hurlstone Agricultural High School (HAHS) agricultural areas (potentially cropped areas)[1]

2.3 Products

A list of herbicides that could be utilised at any stage through the preparation of a crop is presented in Table 2-1. This list may change depending on future activities at the farm.

Table 2-1 Herbicides and pesticides

Product name	Primary active ingredient	APVMA approval number
Roundup Ultra Max	Glyphosate	68506
Jaguar	Bromoxynil, Diflufenican	40383
Tigrex	MCPA, Diflufenican	31525
Agritone 750	MCPA	60505
Buttress	2,4-DB	46043
NA	Dicamba	NA
Broadstrike	Flumetsulam	40714
Le-Mat	Omethoate	45672

2.4 Application methods

The design of the chemical product application system for the proposal has not yet been finalised. The existing farm operation includes application of chemical herbicides and pesticides by boom with nozzles producing large droplet size.

[1] Fitzpatrick Partners Architects 2020, Hurlstone Agricultural High School Farm Facilities Redevelopment

At this stage of farm design, boom irrigation is likely to be the primary method of chemical application. Droplet control nozzle are considered and may be incorporated into the design depending on the outcomes of this assessment.

2.5 Standard control measures

In application of chemical products to crops at the proposed farm, it is expected that a minimum standard of spray drift control would be implemented, as per the guidance outlined in the following:

- Spray Drift Management Principles, Strategies and Supporting Information PISC (SCARM) Report 82 (CSIRO, 2002)
- Spray drift management (APVMA, 2020)
- Reducing herbicide spray drift (NSW DPI, 2015)

The trained operator should be cognisant of the following measures in order to ensure no impacts on surrounding areas.

2.5.1 Prior to spraying

- Spray operators are to be formally trained and hold the relevant certification/accreditation such as ChemCert and have undergone onsite training.
- Review safety data and relevant instructions for each product to be sprayed
- Equipment selected which is considered industry best practice, and would achieve at a minimum:
  - Minimise spray release height
  - Maximise droplet size whilst maintaining application efficiency
  - Spray orientated towards the ground
- Spray equipment to be checked regularly for damage and maintained/calibrated in accordance with equipment specifications
- Review forecast weather conditions when planning spraying activities

2.5.2 During spraying

- Do not spray during weather conditions which are likely to reduce product application efficiency as well as lead to increased spray drift hazard. Weather conditions favourable to spraying include:
  - Wind speeds between 2-10 kilometres per hour for most applications
  - Wind direction away from any sensitive location
  - Conditions with both temperature greater than 30 degrees Celsius and/or relative humidity <40 per cent for application of water-based products are to be avoided
  - Periods where a surface temperature inversion is not present
  - Periods of neutral, or close to neutral atmospheric stability. Highly unstable conditions should be avoided.
- Spraying should be halted where conditions change, and any unfavourable weather conditions arise
- Maintain a downwind buffer within which spraying should not occur where sensitive locations are downwind.

3. Potential impacts associated with spray drift

Off-target movement of chemical spray droplets (and particulates within spray) has the potential to lead to impacts on human health. The human health risk associated with spray drift is highly variable between each farm and from day-to-day, on the following critical parameters:

- Risk of inhalation and dermal ingestion associated with each product
- Rate of spraying (L/ha) and extent of spraying (ha/hour)
- Equipment specifications, boom length, boom height, nozzle type (droplet size)
- Distance to nearest residences
- Meteorological conditions on each day.

Based on the variability of each of the above parameters, and the complexity of interaction between each parameter, quantitative impact assessment is not considered a practical or reliable method for understand potential risk posed due to chemical spray. Furthermore, prescribed buffer distances, which are typically used for protection of human health and amenity for many sources of emission to air, are not readily available for chemical spray drift applications.

Understanding of the risk to human health associated with chemical spray drift can be indicated through the assessment and subsequent registration of each chemical by regulators, including the United States Environment Protection Agency (USEPA) and the Australian Pesticides and Veterinary Medicines Authority (APVMA).

All pesticides (insecticides, fungicides and herbicides) used for agricultural use are required to be registered as safe for use. This includes registration, after extensive examination for safety of environmental exposure, by USEPA: *"In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. To implement provisions of the Food Quality Protection Act of 1996 (FQPA), EPA considers the special sensitivity of infants and children to pesticides, as well as aggregate exposure of the public to pesticide residues from all sources, and the cumulative effects of pesticides and other compounds with common mechanisms of toxicity. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that meet the safety standard of the FQPA and can be used without posing unreasonable risks to human health or the environment."* (USEPA, 1999), p 2. Therefore, when used and applied according to industry leading practice, use of registered pesticides is considered to be within safe exposure levels. This includes dermal and inhalation from aerial spraying but also from any residues that may occur off-site.

In Australia, the APVMA is the government statutory authority with the same functions as the USEPA concerning pesticide use. It was established in 1993, from separate State bodies of the time, to centralise the registration of all agricultural chemical products into the Australian marketplace. Using the same protocol as in the USA, pesticides cannot be sold and used in Australia unless they are both safe and registered.

All products proposed to be utilised at the farm are registered by the APVMA and therefore are considered in effect safe for application where robust spray drift measures are in place (as outlined in section 2.5). The inclusion of a downwind buffer is recommended as a measure, however limited guidance is provided other than a suggestion that the buffer be *"incrop, for example keeping a boom's width from the downwind edge of the field"* (NSW DPI, 2015), as is proposed at the site. The APVMA provides a buffer calculation tool which can be utilised to develop a site specific buffer distance; however, this requires details of proposed application rate and extent which are not currently available.

For the purposes of this assessment, it is considered that where the measures (as outlined in section 5) are effectively incorporated in to the chemical application methodology, that the sole physical constraint on the activity would be requirement to keep a single boom width from the downwind edge of the field.

4. Meteorological risk assessment

Meteorological conditions have significant influence on the potential for spray drift impacts and as such act as a primary constraint on spraying operations. An assessment of local meteorological conditions allows for an understanding of the frequency of occurrence of periods where spraying would not be permitted anywhere at the farm and can be utilised to inform farm planning as well design of chemical spraying systems.

Currently, site-specific weather data are not available, with the nearest weather station being located at the Department of Planning, Industry and Environment (DPIE) Air Quality Monitoring Station at Liverpool, approximately 4 kilometres north-northeast of the farm. In the absence of site-specific data, the observations from the Liverpool station are used in a preliminary meteorological risk assessment for the site.

Weather observations at the Liverpool station are used to demonstrate the general limitations at the site, however the risk assessment should be updated based on site-specific data prior to being used to inform any operational procedures or management plans.

Parameters at the Liverpool site include wind speed, wind direction, temperature, and relative humidity. Data from this station are downloaded and analysed for five years, from 2016 through 2020.

4.1 General wind pattern

A wind rose for the Liverpool station is presented in Figure 4-1. The wind rose shows:

- The average wind speed is 1.9 metres per second (~6.8 kilometres per hour)
- Winds are most frequent from the west, specifically from the south-southwest
- The lightest winds (<1 metres per second) are most frequent from the west, specifically from the south-southwest
- The fastest winds (>5 metres per second) are most frequent from the east, west and south-southwest.

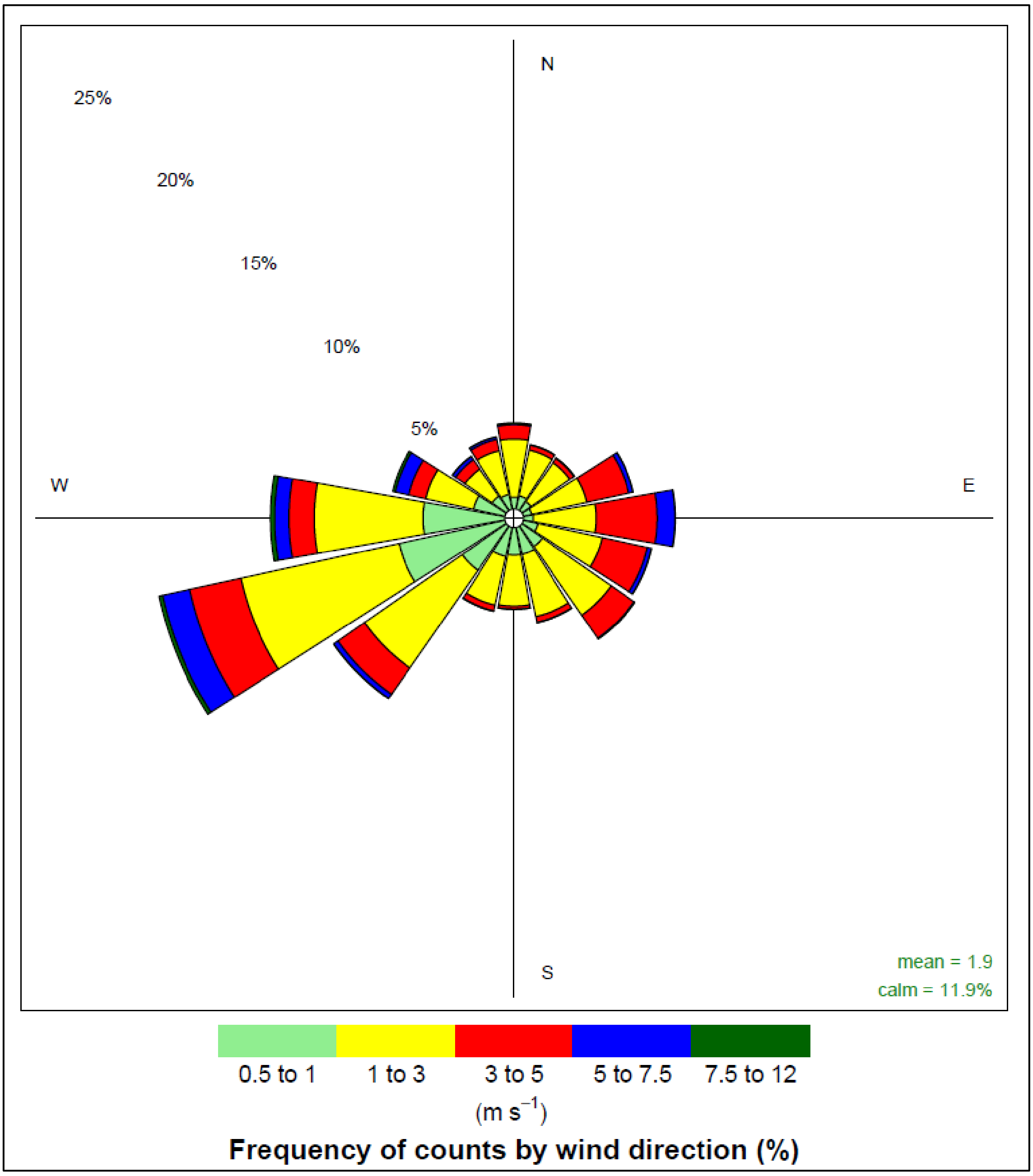

Figure 4-1 Wind rose for Liverpool Station (2016-2020)

4.2 General limitations for spraying

Based on the standard control measures, as outlined in section 2.5, the trained spray operator will make judgment of the risk of spray being in contact with surrounding properties and this risk will be informed by data from the onsite weather station.

The following general criteria will guide the site operator when to conduct spraying:

- Be within farm operational hours (assume 6 am to 6 pm)
- Be during wind speed between 2 kilometres per hour and 10 kilometres per hour (0.56 metres per second to 2.8 metres per second)
- Not be during highly stable or highly unstable meteorological conditions (A, B or F, G class Pasquil-Gifford stability class classifications)
- Not be during temperatures greater than 30 degrees Celsius

- Not be during relative humidity less than 40 per cent.

Ultimately spraying will be conducted at the discretion of the trained operator based on training, experience and site conditions at the time.

While there is no site-specific weather data available, assessment of the operational constraints associated with meteorological conditions at Liverpool has been carried out and results presented in Table 4-1. This has been done to demonstrate that weather conditions will not be favourable for spraying all of the time and the importance of incorporating design and mitigation measures at the site and having an experienced, trained operator.

The table shows the percentage of time where spraying will be able to occur when considering each meteorological condition as listed above. The data presented in the table suggest that when all meteorological conditions are considered only 11 per cent of daytime hours throughout the year will be appropriate for conducting chemical spraying.

The most significant constraints are wind speed and stability class. Constraint associated with temperature and humidity are low, as it is expected that highest temperature days will most commonly coincide with unstable conditions and high wind speeds.

Table 4-1 Comparitive review of daytime hours appropriate for spraying

Meteorological condition	Percentage of daytime hours appropriate for spraying
No consideration of meteorological conditions	100
Consideration of winds speeds (2-10 kilometres per hour) only	56
Consideration of wind speeds and stability classes (C, D, E only)	11
Consideration of wind speeds, stability class and temperature (<30 degrees Celsius)	11
Consideration of wind speeds, stability class and relative humidity (>40 per cent)	11

Other general observations from Liverpool meteorological station with regards to spraying include:

- The greatest opportunity for spraying occurs during the winter months, where spraying could occur for up to 20 per cent of the time (June). Summer months have meteorological conditions which are less conducive to spraying, and spraying would be appropriate less often between November through March. This pattern is consistent with the higher frequency of very unstable conditions and higher windspeeds that are expected during warmer months.
- The greatest opportunity for spraying generally occurs during the morning, and to a lesser extent in the afternoon. This pattern is consistent with a higher frequency of high wind speeds and very unstable conditions occurring during the middle of the day where solar radiation is greatest.

5. Recommendations

The assessment of potential impacts of spray drift on human health has found that where control measures are effectively employed to the chemical spraying operations, then the risk is considered low.

A comparative review of weather conditions at Liverpool has found that opportunities for spraying during low-risk periods would be limited based on meteorological conditions (wind speed, stability class etc) and would mean that spraying would also be influenced by season and time of day.

Any opportunities where meteorological conditions are appropriate for spraying will need to be taken as identified by the certified and trained operator, and consequently the requirement to maintain an expansive (conservative) downwind buffer may be reduced.

In order to further reduce risk of any spray drift impact without significant cost to operations (crop health), the following principles would need to be observed:

1. Create interface zones between cropping areas and receptors – to increase buffer and reduce drift

Landscaping of farm boundaries at the interface between any cropping paddocks and residential premises should be incorporated into the farm design. A vegetative interface will increase the minimum possible distance between spraying activities and human receptors, ‘filter’ spray drift and improve visual amenity.

2. Allowing for sufficient buffering of high spray demand crops – relieving pressure on spray operators.

Appropriate buffering of high spray demand crops can be achieved through allowing for incorporation of agronomic strategies during design of paddock layout. Crops that require extensive pesticide use, such as brassica crops, will be located in paddocks where receptors are least frequently downwind. For example, given the high frequency of south-westerly winds, the crop should be placed far away from any receptors to the north-west.

Furthermore, when designing the underground irrigation system priority should be given to paddocks which interface with residential premises. This will allow for sub-surface chemigation and reduce the frequency of spraying at these locations. Any paddocks excluded from the sub-surface irrigation program, should be located away from residential premises.

3. Utilising a high standard of spray equipment - to reduce required downwind buffer distance.

Operation of a spray program with high-quality spray equipment is a critical tool to allow for a reduced downwind buffer distance to be observed. The DPIE guidance recommends ‘one boom width’ downwind buffer distance is required, however given the high-density of residences located directly adjacent to paddocks, it would be good practice to increase this distance as much as practical. In some instances, a smaller buffer would be required, and spraying using best practice equipment will increase confidence that impacts will not occur. When sourcing spray equipment, the following should be considered:

- Controlled droplet applicators (CDA) are preferred typical nozzles (pressure over orifice), as they produce a spray with limited variability from target droplet size.
- Boom sprayers should be fitted with shields which act to improve deposition of product on target and reduce spray drift. Studies have shown between 20-50 per cent reduction in spray drift from standard booms where some form of shield is utilised (CSIRO, 2002).

4. Effective understanding of meteorological conditions

Understanding of site-specific meteorological conditions will improve confidence in compliance with management measures and allow for rapid modification to operations as required. It is recommended that an Automatic Weather Station (AWS) is established on site which would measure the following: wind speed and wind direction (at 10 metres), temperature, relative humidity. Observations from the site AWS would at a minimum be presented real-time on an online platform which farm operators could review prior to, and at set intervals during spraying.

5. Digital paddock management system

Possibilities for more sophisticated incorporation of real-time weather data in to farm operations exist and include the development of a site data-hosting platform which could in real-time calculate the spray drift risk associated with spraying in each paddock. This real-time risk assessment could inform daily planning of spraying activities and could provide real-time alerts where changing weather conditions might lead to increased risk of spray drift impacts.

The above system could consider and incorporate many operational and environmental factors, including:

- Paddock details, including location, crop type, age, fertigation/chemical spraying history
- Meteorological conditions as described above.

Any additional environmental data including soils testing, water testing, noise testing.

6. Conclusion

A spray drift assessment for the operation of the HAHS Farm Facilities has been undertaken to understand the risk associated with chemical spraying at the proposed development and provide recommendations to manage the identified risks

The following conclusions can be made from the assessment:

- Sub-surface irrigation will allow for chemigation of crops without spray drift risk, however some herbicides or pesticides are required to be applied to foliage of the crop, and consequently some risk of spray drift impacts is associated with use of these products.
- As exists there will be minimal buffer between potential spraying activities and high-density residential locations and school areas.
- The trained operator should be cognisant of the relevant weather conditions and management measures in order to minimise the risk of impacts on surrounding areas.
- A review of nearby meteorology has been undertaken to demonstrate that weather conditions will not be favourable for spraying all of the time and the importance of incorporating design and mitigation measures at the site and having an experienced, trained operator.
- A number of control measures are identified to further reduce risk of any spray drift impact including:
  - Create interface zones between cropping areas and receptors – to increase buffer and reduce drift.
  - Allowing for sufficient buffering of high spray demand crops – relieving pressure on spray operators.
  - Utilising a high standard of spray equipment - to reduce required downwind buffer distance.
  - Effective understanding of meteorological conditions.
  - Digital paddock management system.

7. References

APVMA. (2020). *Spray drift management*. Retrieved from Australia Government Australian Pesticides and Veterinary Medicine Authority: https://apvma.gov.au/node/10796

CSIRO. (2002). Spray Drift Management Principles, Strategies and Supporting Information PISC (SCARM) Report 82. *Primary Industries Standing Committee*. Collingwood: CSIRO Publishing.

NSW DPI. (2015). *Reducing herbicide spray drift*. Retrieved from NSW Government Department of Primary Industries: https://www.dpi.nsw.gov.au/biosecurity/weeds/weed-control/herbicides/spray-drift

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		Name	Signature	Name	Signature	Date
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Appendix C – Odour assessment

NSW Department of Planning Industry and Environment

Hurlstone Agricultural High School

Odour Assessment

May 2021

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Figure index

Acronyms and Abbreviations

Acronym/abbreviation	Full Name
BoM	Bureau of Meteorology
DPIE	Department of Planning, Industry and Environment
EPA	Environment Protection Agency
FIDOL	• Frequency of the exposure • Intensity of the odour • Duration of the odour episodes • Offensiveness of the odour • Location of the source
GHD	GHD Pty Ltd
HAHS	Hurlstone Agricultural High School
OU	Odour units
SCU	Standard cattle units
SEE	Statement of Environmental Effects
STP	Sewage Treatment Plant
TSP	Total Suspended Particulate

1. Background

Odour from future farm activities has the potential to impact on the amenity of existing residents and future occupants of the land identified the draft master plan. Rezoning of the land surrounding the farm will mean that there is a smaller buffer between potentially odorous activities and residential areas which may be impacted.

Future activities at the farm may also impact on the Hurlstone Agricultural High School (HAHS) and proposed primary school. Whilst the operations of the farm are proposed to be improved significantly, the approximate numbers of animals at the farm is expected to remain constant.

General activities on the existing and proposed farm which are identified to having the potential to lead to odour impacts are:

- Odour from farm animal activities located in the Farm Hub including the following:
  - Dairy cattle, loafing shed and milking shed (~80 cows)
  - 20 dry cows in open paddocks
  - 60 young cow stock
  - Beef handling yards
  - Piggery (12 sows and 120 assumed piglets)
  - Chicken sheds (~120 chickens)
  - Sheep (no details on numbers provided, however based on the small shed in the masterplan not many sheep are expected)
- Collection and management of liquid and solid waste from piggery and dairy.
- Effluent disposal
- Composting
- Agricultural chemical (herbicides, pesticides) application
- Carcass disposal
- General farm waste.

Dust impacts from the proposal are also addressed in this report.

1.1 Observations from site visit

During the site visit, effluent was observed being disposed by way of a slurry wagon (Figure 1-1). The farm manager advised that odour impacts associated with effluent spraying are short term but can be experienced downwind, including at the Ajuga School when spraying effluent in adjacent paddocks. It is likely, that with current practices, effluent disposal would be a source of offensive odour when spraying in paddocks adjacent to sensitive land uses.

Odour from the existing piggery was observed to be strong in the immediate area surrounding the pig shed, however at about 30 metres from the shed the odour was less noticeable.

During site attendance there were no cows in the milking facility. Odours from the milking parlour area were observed to have a manure type characteristic, however were not considered strong or offensive. Odours were not observed from the dairy from downwind at the sports field.

The carcass disposal site is located on an elevated, vegetated area south of Campbell House. The existing site is about 100 metres from the nearest building associated with the Ajuga School site. Odour in the immediate area was very strong and offensive in nature. Due to the high elevated and thick vegetation surrounding the site, and the small size of the odour source, it is unlikely that odour from this site would lead to impacts at any existing receptors. The Farm Manager did not state there had been any odour complaints or issues, even at the school site 100 metres away, which would support this statement.

Figure 1-1 Slurry cart spraying effluent

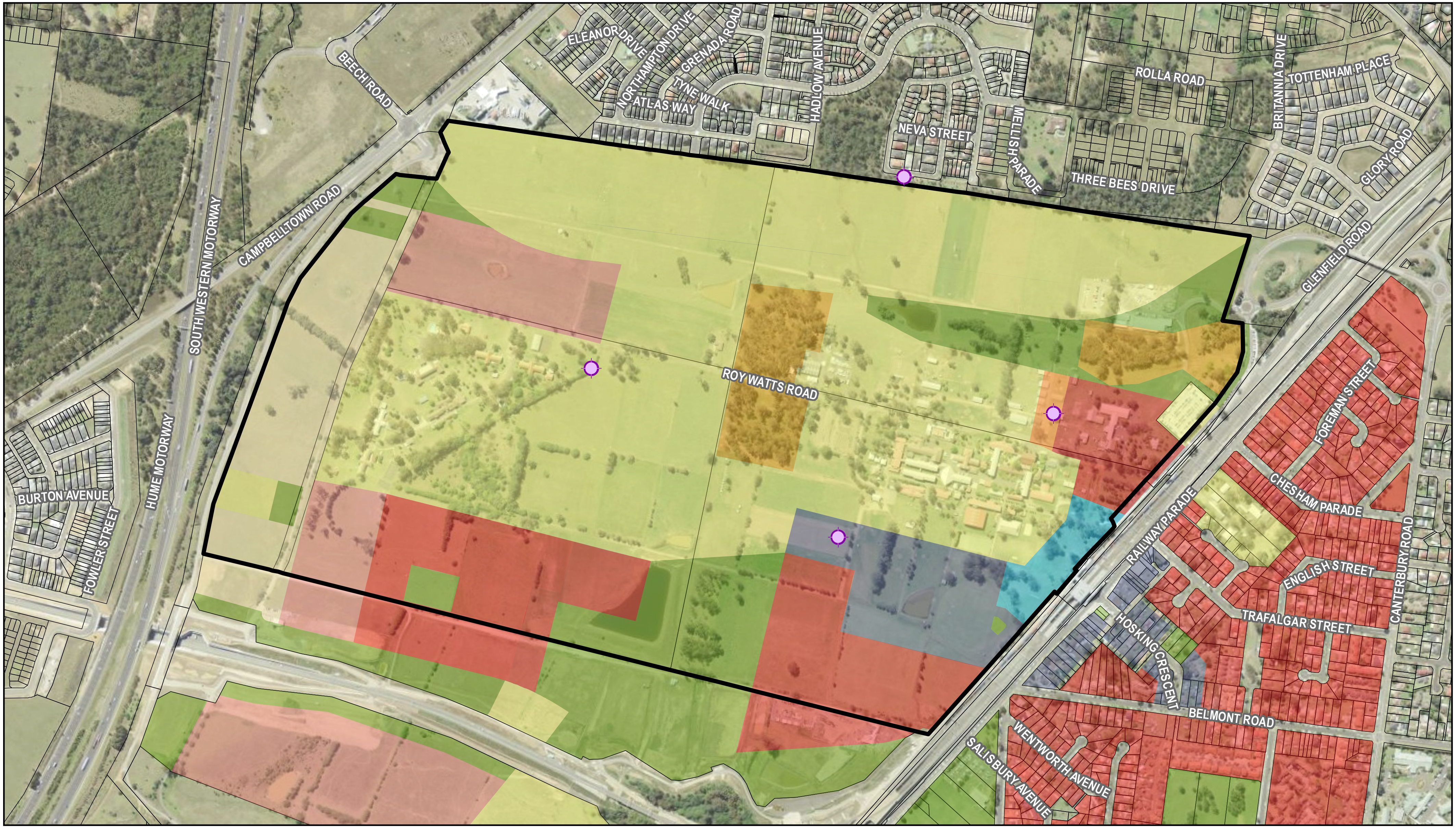
1.2 Nearest future receptors

An important aspect when determining odour impact is the size of the potentially impacted population. The proposed rezoning will result in reduced distances from key odour generating sources to residential receptors as well as a much larger population size who might be exposed to any odours.

The nearest future sensitive receptors to the Farm Hub have been identified below in Table 1-1 and locations used to estimate distances are shown in Figure 1-2. Note these are estimates only based on provided indicative masterplan.

Table 1-1 Approximate distance to Farm Hub receptors

Future receptor	Approximate distance
Proposed primary school	Directly adjacent
HAHS	Directly adjacent
Proposed rezoning to east	300 m (from milk processing and pigs)
Proposed rezoning to south	240 m (from piggery)
Existing residential to north	330 m (from effluent system)
Ajuga school site	450 m (from cattle barn)



Legend

- Assessed receptor location
- Site Boundary
- Cadstre

Proposed Land Rezoning (DPIE)

- B3, Commercial Core
- B4, Mixed Use
- E2, Environmental Conservation
- E4, Environmental Living
- R2, Low Density Residential
- R3, Medium Density Residential
- R4, High Density Residential
- R5, Large Lot Residential
- RE1, Public Recreation
- SP2, Infrastructure

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Approximate locations of assessed future receptors

Project No. **12537824**
Revision No. **-**
Date **24/02/2021**

FIGURE 1-2

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Print date: 24 Feb 2021 - 09:41

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

2. Odour criteria

The *Technical framework: assessment and management of odour from stationary sources in NSW* (NSW Department of Environment and Conservation, 2006a) (the Technical Framework) offers guidance for industry consent authorities, environmental regulators and odour specialists on assessing and managing activities that emit odour. The Technical Framework provides a framework to assess potential odour impacts and defines odour assessment criteria.

The framework adopts the odour assessment criteria in Approved methods for the modelling and assessment of air pollutants in NSW EPA (Environment Protection Authority, 2016) (the Approved Methods).

The impact assessment criteria for odour are applied at the nearest existing or likely future off-site sensitive receptor. The Approved Methods defines odour assessment criteria (measured in odour units (OU))[1] and specifies how they should be applied in dispersion modelling to assess the likelihood of nuisance impacts arising from the emission of odour.

Odour impact is a subjective experience and has been found to depend on many factors, the most important of which are:

- Frequency of the exposure
- Intensity of the odour
- Duration of the odour episodes
- Offensiveness of the odour
- Location of the source.

These factors are often referred to as the 'FIDOL' factors.

The odour assessment criteria are defined to take account of two of these factors (F is set at 99th percentile; I is set at between 2 to 7 OU). The choice of assessment criteria is also dependent on the population of the affected area, as shown in Table 2-1.

Table 2-1 Odour assessment criteria in the Approved Methods

Population of the affected community	Odour performance criteria (nose response odour certainty units at 99th percentile[2])
Single residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 500	3
Urban (≥~2,000)	2

[1] The number of odour units is the concentration of a sample divided by the odour threshold or the number of dilutions required for the sample to reach the threshold. This threshold is the numerical value equivalent to when 50 per cent of a testing panel correctly detect an odour

[2] This is a prediction of the odour level that may occur 99 per cent of the time, or that is below these criteria for 99 hours in every 100. Odour performance criteria are designed to be precautionary, so that impacts on sensitive receivers can be minimised.

The criteria assume that 7 OU at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases, there is a chance that more sensitive individuals would be encountered. The criterion of 2 OU at the 99th percentile is considered to be acceptable for large populations (more than 2,000 people).

Based on the site and proposed residential zoning surrounding the school, an appropriate impact assessment criteria when assessing potential impacts would be the most stringent criteria of 2 OU. This would apply at all surrounding residential areas.

3. Potential for odour impacts based on local setting

GHD has undertaken a review of the topography and meteorology (Liverpool station) to gain an understanding of how these will influence odour dispersion. Cooler air flows can tend to flow downhill under gravity towards the lower points in the local terrain. The north and west of the farm are generally higher in elevation and slopes to the lowest point in the south east corner of the site. It is possible that under some conditions odour from the Farm Hub would flow down the hill to the south and south east towards future residential areas.

The annual wind rose for the BoM Liverpool weather station (refer Appendix A, section 4.1) shows prevailing winds from the west (including light winds which are known to result in poor dispersion). A higher proportion of winds from the west may result in a higher proportion of odour impacts to the east, which is where current HAHS school facilities are as well as future residential areas.

4. Recommended separation distances from proposed uses

4.1 Chickens

The potential for nearby poultry farms to impact the proposed development was assessed in accordance with the Technical Framework. The Technical Framework references an accompanying document, *Technical notes Assessment and management of odour from stationary sources in NSW* (NSW Department of Environment and Conservation, 2006b) (Technical Notes) which provides detailed guidance and specific methods to assess odour from broiler chicken farms. As the farm has layer chickens GHD has used guidance from Odour Review of Layer Farms and Development of S-factor Formula (Australian Eggs Limited, 2018) in order to estimate an appropriate odour buffer from chicken operations at the future farm hub.

While chicken sheds are small in comparison to commercial operations, undertaking this screening calculation is used to demonstrate odour impacts from this activity are minimal. Assumptions used and results of the screening calculation are provided in Table 4-1.

Separation Distance = (Number of birds/1,000)$^{0.63}$ x S1 x S2 x S3 x S4 (Optional)

Table 4-1 Separation distance calculation for chickens

Parameter	Value	Comment
Number of birds (N)	120	-
Sensitive land use factor (S1)	30	Non rural zone
Surface roughness factor (S2)	1.0	Short grass
Terrain weighting factor (S3)	1.2	Low relief from farm site
Wind frequency factor (S4)	1.0	Not adjusted.
Separation distance	**16 m**	-

Using this guidance, the required separation distance in order to reduce the risk of odour impacts is about 16 metres. This distance is within the distance to the nearest future receptor which is 240 metres to the south of the proposed Farm Hub. Odour from chickens is considered minimal and no specific mitigation recommendations are provided.

4.2 Pigs

In order to get an understanding of potential odour impacts from the piggery, GHD has followed guidance in Australian Pork Limited National Environmental Guidelines for Indoor Piggeries (2018). This guidance has been referenced as it provides screening level calculations based on a number of factors to determine separation distances between a piggery and residential areas. In particular, and relevant to the Farm Hub, it provides calculations based on a number of effluent treatment types which includes covered storage or when effluent is stored and moved offsite.

A level 1 assessment and calculation method has been undertaken with assumptions in Table 4-2. The assumed variables in the table have been used with the following equation:

Separation distance (D) = N$^{0.55}$ x S1 x S2 x S3

Table 4-2 Separation distance calculation for pigs

Parameter	Value	Comment
Number of pigs	10 lactating sows 100 piglets	Up to 10 sows maximum
Standard pigs units (N)	10 * 2.5 100 * 0.5 Total = 100 SPU	
Effluent removal factor (S1)	0.63 (spent bedding stockpiled and composted)	
Receptor factor (S2)	Town = 25 Surface roughness = crops or limited ground cover = 1.0	
Terrain factor (S3)	Gently sloping = 1.2	
Separation distance (D)	**238 m**	

Using this guidance, the required separation distance in order to reduce the risk of odour impacts is about 238 metres. This distance is within the distance to the nearest future receptor which is 240 metres to the south of the proposed Farm Hub. Cumulative odour impacts may occur which would include odour from piggery and dairy.

General recommendations for the farm hub are summarised in Section 9. The following recommendations are made with regards to the operation of the piggery:

- A vegetation buffer is to be designed on the southern boundary to help reduce dust and odour impacts.
- The number of sows should be limited to 10, without additional assessment first being carried out which would demonstrate that any increase in number would not lead to unacceptable impacts.
- An odour management plan be prepared which ensures regular cleaning of bedding and manure.

4.3 Dairy and cattle

The potential for odour from cattle and the dairy to impact the future residential areas was assessed in accordance with the Technical Framework. The Technical Framework references an accompanying document, *Technical notes Assessment and management of odour from stationary sources in NSW* (NSW Department of Environment and Conservation, 2006b) (Technical Notes) which provides guidance and specific methods to assess odour from cattle feedlots. Screening level calculations have been undertaken to assess whether offensive odours from cattle do not cause unreasonable impact to the community. Cattle feedlots are more intensive than proposed dairying activities with respect to potential for odour generation, however can give an indication of worst case impacts (ie when all cattle remain in the shed for a prolonged period of adverse weather).

A level 1 assessment and calculation method has been undertaken with assumptions in Table 4-3. The assumed variables in the table have been used with the following equation:

$D = \sqrt{N} \times S (S1 \times S2 \times S3 \times S4 \times S5)$

Table 4-3 Separation distance calculation for cattle

Parameter	Value for future receptors south	Value for future receptors east	Comment
Number of cattle	100	100	Statement of Environmental Effects (SEE)
Average cattle weight	650 kg	650 kg	SEE
Standard cattle units (SCU)	106	106	Table 7.1 Technical Framework
Feed pad	20 m^2/cow	20 m^2/cow	SEE
Rainfall	868 mm	868 mm	BoM Bankstown
Feedlot class	1	1	Highest standard of design, operation maintenance, pad management and cleaning frequency. As dairy cattle will not be in the shed all the time, it would be recommended that the shed be cleaned at least once per year depending on odour.
Stocking density (S1)	40	40	Roofed design so minimal rainfall (less than 750 mm)
Receptor factor (S2)	1.2	1.2	Medium towns 500-2000 persons
Terrain factor (S3)	1.2	1.2	Low relief from Dairy down to southern future zoned areas
Vegetation factor (S4)	0.7	0.7	Assumed boundary vegetation screen
Wind frequency factor (S5)	0.7	1.0	Low northerly winds towards nearest proposed receptors / high westerly winds towards nearest easterly receptors
Separation distance	290 m	415 m	

Using this guidance, the required separation distance in order to reduce the risk of odour impacts is about 290 metres for receptors to the south and 415 metres for receptors to the east. This distance is more than the distance to the nearest future receptor which is 240 metres to the south of the proposed Farm Hub.

This number is considered a worse-case estimate for the dairy, as cattle will not be permanently in a feed-lot situation. It is useful to demonstrate that odour impacts may be an issue without high level design and management during operation of the facility. The dairy will also have a number of design points which would further reduce odour including new effluent management system with enclosed tanks. A review of the SEE has also identified that a characteristic of composted loafing areas compared to areas with a mud manure interface is a lot lower odour potential.

It is important to note that although the number of cows is not increasing, the above calculation takes into consideration the receiving environment (distance and population density). The same calculation with a smaller receptor type (ie small towns) the corresponding odour separation distance to the south would be 145 metres.

The following recommendations are made in regards to dairy and cattle:

- Loafing shed to be cleaned at minimum one time per year. If build-up of bedding leads to odour being detected 50 metres downwind of the farm hub, then cleaning frequency may need to be increased.
- An odour audit of the farm including Farm Hub should conducted annually.

5. Effluent management

Effluent management is considered the main source of odour from the future farm that has the potential to cause short term elevated odour impacts at future residential zoned areas. Information provided to date details a new effluent management system, which will capture effluent from dairy and piggery operations.

An overview of the proposed system is described in Section 7.1 of the SEE. Key points are:

- All wash down and flush water are directed to enter the effluent system.
- Effluent would run through a solid's separator, with solids being sent to composting area.
- Treated effluent is to be reused as wash down water.
- Effluent used in sub-surface fertigation would be further treated by a sand filter prior to entering the irrigation system to reduce risks of blocking.

Key risks for odour from the system are odour from effluent storage and treatment and odour from application of effluent to land. Preliminary discussions have indicated that the effluent storage tank would likely be covered. Covering the effluent tank would enable the capture of odorous emissions and collection of biogas.

As described in Section 1 existing effluent irrigation is a source of short term odour as it is sprayed into the air over pasture from the slurry wagon. This process is quick however conducive to spray drift and excessive odour.

The proposal includes sub-surface application of effluent with irrigation, which will significantly reduce odour emissions. With pre-treatment, this would be considered best practice for effluent application and is needed to continue to undertake this practice in proximity to future areas of the farm which are adjacent to residential areas.

The following recommendations are made regarding effluent management:

- Where practicable, enclose the effluent treatment system and effluent storage tank in order to reduce fugitive odour emissions.
- Effluent fertigation should where possible be undertaken via underground irrigation infrastructure. Where spraying of effluent is required this should be avoided in paddocks directly adjacent to residential premises.
- Any new machinery needed to apply effluent such as boom, shall be fitted with shields to minimise spray.
- Investigate the use of vegetation screening around the Farm Hub (as well as farm boundary fence lines). Any vegetative screening up close to sources such as sheds would need to consider natural airflow to naturally ventilated sheds.
- Vegetative screens typically consist of a mix of indigenous shrub and tree species, and be as wide as practicable.

6. Composting

Material from cattle loafing areas will be removed at least once a year however will likely be sent directly to paddock rather than composted. Materials from the farm hub and t farm that will likely be composted includes:

- Straw and bedding from chicken and piggery facilities
- Solids separated from effluent.

Estimated quantities of all wastes going to compost are not yet known. Composting can be a source of odour, and the process will generally take up to 12 weeks. Key reasons leading to elevated odour from composting can include:

- Lack of aeration causing the pile to become anaerobic
- Moving or turning the pile can cause short term spikes in odour, this should be carried out during favourable meteorological conditions
- Not having an appropriate mix of materials being composted.

The indicative compost location (thought to be within the southern side of Memorial Forest) is about 260 metres from the nearest future zoned residential area to the southeast. Given the expected low volumes of material to be composted, odour impacts are unlikely to be a source of significant odour however once details quantities are known a detailed odour assessment in accordance with the Approved Methods can determine if any specific mitigation measures are needed such as enclosed systems.

Based on potential composting activities, a review of local meteorology and the draft masterplan, composting should be located in a central farm location, near to the Memorial Forest. Prevailing winds are from the west, meaning odour impacts would likely be more significant to the east. Having the compost west of the Memorial Forest will increase the buffer distance to the school and future zoned receptors to the east.

7. Carcass management

Animal deaths will likely be managed with the same process as currently undertaken, at the elevated, vegetated site to the south of Campbell House. Animals are covered and composted, and although a potential source of offensive odour, current practices have not led to any odour complaint or issues.

Given the future animal numbers will be similar to existing operations, there is no reason to believe that quantities of animals will increase, or odour will increase from this activity in the future. Full burial methods may however reduce the potential for odour impacts in future.

8. Dust impacts

Farm activities have potential to lead to elevated particulate concentrations (total suspended particulate (TSP) and PM_{10}) which can then be deposited as dust on surfaces and the ground. General activities which are a source of potential dust emissions include:

- Cattle loafing areas consist of a mud-manure interface due to cattle on earth (Figure 8-1). During dry weather this can become a source of dust
- Cleaning out animal bedding (chickens, pigs and cattle)
- Ploughing and tilling of paddocks
- Wind erosion of soil from new paddocks yet to have established pastures
- Vehicles travelling on unpaved dirt roads or access tracks
- Handling of soil and material stockpiles.

Figure 8-1 Existing cattle loafing area

Farming practices and crop cycles are not yet known and detailed assessment of wind blown dust has not been undertaken. Most dust generating practices can be managed and mitigated through a few common measures:

- Application of water to key sources of dust. Given the future farm will have a permanent water supply from Glenfield Sewerage Treatment Plant (STP), ample water should be available all year to apply as needed to dust generating surfaces such as an unvegetated paddock.
- The proposed cattle shed will have a concrete pad and covered loafing area. This will significantly reduce dust from current conditions.
- The extensive areas of dust generating laneways will be reduced under the proposed plan.
- Use of vegetation buffers around key sources of dust and at boundaries with sensitive zoned residential areas.
- Use of an on site weather station to reduce or stop activity during certain weather conditions (ie high wind on a dry day, blowing towards nearest receptor).
- Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities.

Dust generation at the future facility should be lower than it is now, however due to the reduction in separation distance, risks associated with dust emissions are still present.

9. Recommendations

Based on the high level review of odour for the farm, the following recommendations are made:

- Investigate covering the effluent storage tank within the Farm Hub. This will reduce odour potential from this system.
- Sub-surface fertigation is the preferred method of effluent disposal. Spray disposal of effluent should be applied via boom spray with a boom cover however this would still be limited to paddocks in the centre of the site away from any receptors.
- Preliminary odour screening assessment identifies that the cattle shed has potential to be a higher risk of odour if in use for prolonged periods of time. This is based on assumptions typically applied to cattle feedlots, and it is likely that odour from the cattle shed will be significantly lower.
- Vegetative screenings should be used around the boundary of the site and consist of a mix of shrubs and trees. Where possible, and with care not to interrupt ventilation of buildings, additional vegetation screens should be applied around the farm hub to assist with management of dust and odour.
- A site weather station should be installed at an appropriate location and used to inform good or poor conditions for odour and dust dispersion.
- Install a real-time dust sampler in school grounds, which can be used as an education tool for air quality (dust, smoke, pollution) and help guide management of farming activities.
- An annual odour audit should be undertaken in order to ensure a high performing site with regards to the management of odour.
- An odour management plan be prepared which ensures regular cleaning of bedding and manure.

Vegetation screening and buffers can play an important role in site aesthetics and reducing potential air quality impacts (odour, dust, spray drift). Buffers and screening should not erode the critical farm land and should be considered along with land in adjoining properties. An effective vegetation barrier will act to enhancing vertical mixing of air which can encourage dispersion of odour, and reduce wind speeds which can reduce dust emissions and spray drift as well as encourage deposition of dust and spray. In summary a well-designed vegetative screen can minimise, impede and dissipate odours, sprays and dust to varying degrees. Vegetative screens will not eliminate the likelihood of odour, spray or dust, however, are a versatile, simple, cost and space effective method for reducing air quality risks.

Vegetation screens should be designed using a variety of plant species including a combination of dense shrubs and larger tree species. Based on spray drift and odour assessments, the following locations have been identified to investigate the use of vegetation screens:

- Between the farm hub and proposed primary school, if required
- At the northern boundary of site, specifically boundary with roadhouse to the northwest and anywhere where no existing vegetation and fencing exist
- At the southern boundary of the site with the new zoned area. The area between open space and HAHS would be susceptible to odour, dust and spray impacts.

Indicative vegetation screen locations are shown in Figure 9-1.

Legend

- Indicative vegetation screen
- Site Boundary
- Cadstre

Proposed Land Rezoning (DPIE)

- B3, Commercial Core
- B4, Mixed Use
- E2, Environmental Conservation
- E4, Environmental Living
- R2, Low Density Residential
- R3, Medium Density Residential
- R4, High Density Residential
- R5, Large Lot Residential
- RE1, Public Recreation
- SP2, Infrastructure

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Indicative vegetation screen locations

Project No. **12537824**
Revision No. **-**
Date **31/03/2021**

FIGURE 9-1

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Print date: 31 Mar 2021 - 12:53

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

10. Conclusion

An odour assessment for the operation of the HAHS Farm Facilities has been undertaken to determine potential impacts from the facilities to the existing and future sensitive receivers.

The following conclusions can be made from the assessment:

- The proposed rezoning will result in reduced distances from key odour generating sources to residential receptors as well as a much larger population size who might be exposed to any odours.
- Screening odour assessment has been undertaken based on proposed numbers of pigs, cattle and chickens.
- Odour from chickens is considered minimal and no specific mitigation recommendations are provided.
- The required separation distance in order to reduce the risk of odour impacts from pigs is about 238 metres - this distance is within the distance to the nearest future receptor which is 240 metres.
- The required separation distance in order to reduce the risk of odour impacts from cattle is more than the distance to the nearest future receptor which is 240 metres to the south of the proposed Farm Hub.
- Preliminary odour screening assessment identifies that the cattle shed has potential to be a higher risk of odour if in use for prolonged periods of time. This is based on assumptions typically applied to cattle feedlots, and it is likely that odour from the cattle shed will be significantly lower.
- Key risks for odour from the system are odour from effluent storage and treatment and odour from application of effluent to land. Preliminary discussions have indicated that the effluent storage tank would likely be covered. Covering the effluent tank would enable the capture of odorous emissions and collection of biogas.
- A number of recommendations are provided for the management of odour onsite including screenings, buffers, subsurface effluent disposal and best practice housekeeping for the dairy and piggery.

11. References

Department of Environment and Conservation NSW (2006a). Technical Framework Assessment and management of odour from stationary sources in NSW

Department of Environment and Conservation NSW (2006b). Technical Notes Assessment and management of odour from stationary sources in NSW

Environment Protection Authority. (2016). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Sydney: State of NSW and Environment Protection Authority.

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12537824-53613-44/https://projectsportal.ghd.com/sites/pp15_01/hurlstoneagricultura/ProjectDocs/Odour Asessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	D Craggs	E Smith				26/02/21
0	D Craggs	E Smith		P.Dellow		04/05/21

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Appendix D – Noise impact assessment

NSW Department of Planning Industry and Environment

Hurlstone Agricultural High School

Noise Impact Assessment

April 2021

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Table index

Figure index

Acronyms and Abbreviations

Acronym/abbreviation	Full Name
BATEA	Best available technology economically achievable
BMP	Best Management Practice
CadnaA	Computer Aided Noise Abatement
CRTN	Calculation of Road Traffic Noise
DG11	Department of Education Design Guideline 11
DPIE	Department of Planning, Industry and Environment
EPA	Environment Protection Agency
GHD	GHD Pty Ltd
HAHS	Hurlstone Agricultural High School
INP	Industrial Noise Policy
NCA	Noise Catchment Areas
NIA	Noise Impact Assessment
NPfI	Noise Policy for Industry
RBL	Rating Background Levels

1. Background and objectives

Existing and future agricultural activities planned for the Hurlstone Agricultural High School (HAHS) Farm Facilities have the potential to impact on the local environment and land uses, including impacts on environmental values and on future sensitive receivers within the development area. A Noise Impact Assessment (NIA) was undertaken to determine the potential noise impacts from the agricultural activities.

The main objectives of the NIA are to:

- Undertake noise monitoring to quantify existing noise levels in the study area, including noise from local transport infrastructure
- Identify potential noise impacts from the future agricultural use of the school at existing and future sensitive receivers within the study area with consideration to the Noise Policy for Industry (NPfI) (Environment Protection Agency (EPA) 2017)
- Review possible planning options and mitigation measures to reduce noise impacts from the future agricultural use of the school at sensitive receivers
- Provide an assessment on the acceptability of residual noise impacts on sensitive receivers

2. Methodology

To determine the potential noise impacts on existing and future sensitive receivers, GHD completed the following activities:

2.1 Request for and review of information

A review was undertaken of available information relevant to the proposed development to gain an understanding of the project background and context, including:

- Review of any applicable policies and standards, including:
  - Noise Policy for Industry (NPfI) (EPA 2017)
- Review of the proposed relevant documentation regarding future development of HAHS and the surrounding proposed developments, including:
  - Hurlstone Agricultural High School Farm Facilities Redevelopment Concept Masterplan, prepared by Fitzpatrick + Partners Architects (dated 23 September 2020)
  - Education Land Area Plan
  - Height Strategy and Lot Annotations Plan
  - Indicative Layout Plan.

2.2 Site inspection and noise measurements

The following tasks were undertaken to quantify the existing noise levels in the study area:

- GHD conducted a site visit in order to confirm our understanding of the proposed site operations, terrain and the location of the existing and future sensitive receptors.
- Long-term noise logging was undertaken at three (3) locations to determine the existing background and ambient noise levels in the area. The location of these monitors is provided in Figure 4-1. Existing road traffic noise levels from Hume Highway/Campbelltown Road were measured at M1 and railway noise levels were measured at M2.

2.3 Noise modelling and assessment

The following tasks were undertaken to assess the potential noise impacts from the future agricultural use of school at existing and future sensitive receivers:

- Existing and future noise sensitive receptors and land use were identified using aerial imagery and the masterplan provided.
- The sensitive receptors were be categorised into Noise Catchment Areas (NCAs) and assigned likely background noise levels based on the monitoring data
- Project noise trigger levels were be established for each NCA in accordance with the requirements of the Noise Policy for Industry (NPfI) (EPA 2017).
- A 3D noise model of the study area was developed to determine noise levels of the agricultural use of the educational facility will be predicted to the existing and future sensitive receptors in the study area.
- Provide planning options and mitigation measures to reduce noise impacts from the future agricultural use of the school at sensitive receivers.

3. Review of documentation

A review of the following documents has been undertaken to gain an understanding of the potential impacts from the proposed redevelopment of the HAHS Farm Facilities on the existing and future sensitive receivers surrounding the site.

3.1 Hurlstone Agricultural High School Farm Facilities Redevelopment Concept Masterplan

The Concept Masterplan prepared by Fitzpatrick + Partners Architects details the locations of the following:

- Existing and proposed schools, including HAHS
- Proposed rezoning of school land to the east, south and west of the HAHS site
- Location of the Farm Hub, in relation to the above
- Indicative layout of Farm Hub.

Based on the Concept Masterplan, it can be seen that there is the potential for noise impacts from the Farm Facilities, including the proposed Farm Hub, on existing residents to the north, and sensitive receivers within the proposed rezoning locations surrounding the HAHS site.

3.2 Education Land Area Plan

The Education Land Area Plan provides more detailed information regarding the layout of each of the HAHS farms, in relation to the existing and proposed schools, and future rezoning areas.

3.3 Height Strategy and Lot Annotations

The Height Strategy Plan provides indicative heights for the proposed buildings within the rezoning locations surrounding the HAHS site. This has been used in the noise modelling undertaken for the project, and to determine any shielding provided by the proposed buildings.

The Lot Annotations Plan shows the five (5) proposed precincts surrounding the HAHS site, being:

- Station Precinct
- Town Centre
- Southern Quarter
- South-west Quarter
- North-west Quarter.

This has been used to identify and name sensitive receivers for the purpose of assessing noise impacts.

3.4 Indicative Layout Plan

The Indicative Layout Plan provides details regarding the types of receivers proposed within the rezoning areas surrounding the HAHS site. This has been used to establish relevant noise criteria for the assessment of noise from the HAHS Farm Facilities.

4. Existing environment

4.1 Sensitive receivers and land uses

HAHS is currently located within a SP2 Infrastructure planning zone within the Campbelltown City Council local government area. The site sits on a parcel of land with the South Western Freeway and Campbelltown Road to the west, residential receivers to the north and south, and the T2, T5 and freight rail lines to the east.

Receivers immediately surrounding the site which may be impacted by noise from existing and future agricultural activity are shown in Figure 4-1. Three noise catchment areas have been identified as follows:

- Noise Catchment Area 1 – future residents to the east and south-east of the school (refer to the Station Precinct and Town Centre in the Lot Annotation Plan)
- Noise Catchment Area 2 – existing residents to the north of the school
- Noise Catchment Area 3 – future residents to the west and south-west of the school (refer to the North-west Quarter, South-west Quarter and Southern Quarter in the Lot Annotation Plan).

There are additional existing and proposed receivers to the east and south of the rail line. These are not included in the assessment as noise levels will be lower than those directly adjacent to the school site, which have been assessed, and are likely to be insignificant at these receivers.

These areas have different background and ambient noise environments due to their proximity to the South Western Freeway and Campbelltown Road and the T2, T5 and freight rail lines. Residences within each noise catchment area is shown in Figure 4-1.

Noise sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise receivers could include residences, educational institutes, hospitals, places of worship, recreational areas and commercial/industrial premises.

These sensitive receivers are tabulated in Table 4-1 and are shown on Figure 4-1.

Table 4-1 Identified noise sensitive receivers

Receiver ID	Receiver Type	Lot Annotation/Address[1]	Future/existing
NCA 1 – Station Precinct and Town Centre			
R01	Residential	ST-6	Future
R02	Residential	ST-4	Future
R03	Residential	ST-3	Future
R04	Residential	ST-2	Future
R05	Residential	TC-2	Future
R06	Residential	TC-1	Future
R07	Residential	TC-11	Future
NCA 2			
R08	Residential	29-39 Three Bees Drive	Existing
R09	Residential	17-27 Three Bees Drive	Existing
R10	Residential	1-11 Three Bees Drive	Existing
R11	Residential	26-44 Mellish Parade	Existing

Receiver ID	Receiver Type	Lot Annotation/Address[1]	Future/existing
R12	Residential	11 Mellish Parade/15 Glatton Road	Existing
R13	Residential	19-21 Hindostan Street	Existing
R14	Residential	29-33 Hillsborough Crescent/ 20 Hindostran Road	Existing
R15	Residential	1-9 Boddingtons Road	Existing
R16	Residential	11-25 Boddingtons Road	Existing
R17	Residential	102-112 Northampton Drive	Existing
R18	Residential	1-5 Eleanor Drive/ 94-100 Northampton Drive	Existing
NCA 3			
R19	Residential	SW-29	Future
R20	Residential	SW17 – SW20	Future
R21	Residential	SW-7 – SW-10	Future
R22	Residential	SW-4	Future
R23	Residential	NW-7	Future
R24	Residential	NW-6	Future
R25	Residential	NW-5	Future
R26	Residential	NW-4	Future
R27	Residential	NW-3	Future
R28	Residential	NW-9	Future
R29	Residential	NW-10	Future
R30	Residential	NW-11	Future
R31	Residential	NW-12	Future
Non-residential sensitive receivers			
R32	School	Proposed primary school	Future
R33	School	HAHS	Existing
R34	School	Campbell House School	Existing
R35 (R07)	Health Facility	Located within TC-11	Future

Note: 1. The reference IDs in this column (eg ST-6) has been taken from the Lot Annotations Plan

Legend

- Site Boundary
- Cadstre
- Noise Monitoring Locations
- Sensitive receivers
- Noise Catchment Areas

Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Noise monitoring locations, noise catchment areas and surrounding sensitive receivers

Project No. **12537824**
Revision No. **-**
Date **25/02/2021**

FIGURE 4-1

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z007_Noise_MonitoringLocations.mxd
Print date: 25 Feb 2021 - 12:16

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

4.2 Existing noise environment

Background noise monitoring was undertaken to establish the noise criteria for the Project. Background noise monitoring was conducted at the locations presented in Table 4-2 for a period of 10 days between Friday 4 December to Monday 14 December 2020, in accordance with the *Noise Policy for Industry* (NPI) (EPA 2017) to determine the rating background levels and ambient noise levels. Background monitoring was undertaken in three locations which was considered representative of the background noise environment for the residences surrounding the school.

Noise monitoring location 1 (M1) is considered representative of the residences to the west and south-west of the school, and is referred to as Noise Catchment Area 1 (NCA1) in this report.

Noise monitoring location 2 (M2) is considered representative of the residences to the north of the school, and is referred to as Noise Catchment Area 2 (NCA2) in this report.

Noise monitoring location 3 (M3) is considered representative of the residences to the east and south-east of the school, and is referred to as Noise Catchment Area 3 (NCA3) in this report.

The methodology of the noise monitoring is as follows:

- Noise monitoring was undertaken using three Rion NL-52 noise logger environmental noise loggers. All noise loggers were programmed to accumulate the L_{A90}, L_{A10} and L_{Aeq} noise descriptors continuously over the entire monitoring period.
- Meteorological data was sourced from the Bureau of Meteorology's Holsworthy Airport AWS.
- A calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dBA at 1 kHz. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 0.5 Dba.
- The data collected by the loggers was downloaded and analysed. Data was excluded during periods where average wind speeds were greater than 7 metres per second or when rainfall occurred.

A summary of the noise monitoring locations and equipment details is provided in Table 4-2. Noise monitoring locations are shown in Figure 4-1.

Table 4-2 Noise monitoring location and equipment details

ID	Location	Equipment details	Equipment photo	Equipment settings
M1	Western corner of school site, representative of future development to the east and south-east of the school	Rion NL-52 Type 1 SN: 131631		A-weighted Fast time response 15 minute intervals Pre to post calibration check: 0.1 dB
M2	Northern boundary of school site, representative of existing residential receivers to the north of the school	Rion NL-52 Type 1 SN: 131632		A-weighted Fast time response 15 minute intervals Pre to post calibration check: 0.2 dB
M3	South-eastern corner of school site, representative of future development to the west and south-west of the school	Rion NL-52 Type 1 SN: 131629		A-weighted Fast time response 15 minute intervals Pre to post calibration check: 0.0 dB

4.3 Noise monitoring results summary

Background noise monitoring data was used to determine the Rating Background Levels (RBL) for the day, evening and night-time periods. The rating background levels are summarised in Table 4-3 to Table 4-5.

The road and rail noise levels received at each monitoring location are presented in Table 4-6 to Table 4-8. Daily noise level charts for the entire monitoring period are presented in Appendix A.

Table 4-3 Summary of M1 noise monitoring results (background and ambient), dBA

Date	Rating background level (RBL), 90th percentile $L_{A90(period)}$ [1]			Ambient noise levels, $L_{Aeq(period)}$ [1]		
	Day	Evening	Night	Day	Evening	Night
Friday 4-Dec-20	40	41	34	54	55	50
Saturday 5-Dec-20	39	42	40	57	55	54
Sunday 6-Dec-20	44	45	36	54	54	57
Monday 7-Dec-20	46	44	40	55	54	53
Tuesday 8-Dec-20	41	37	37	56	57	55
Wednesday 9-Dec-20	40	39	38	54	55	55
Thursday 10-Dec-20	37	42	33	55	58	54
Friday 11-Dec-20	43	39	33	61	56	53
Saturday 12-Dec-20	38	41	33	57	56	54
Sunday 13-Dec-20	38	44	34	59	57	60
Monday 14-Dec-20	43			55		
RBL and Leq Overall	**40**	**42**	**35**	**57**	**56**	**56**

Note: 1. The NPI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 1 pm Sunday and Public Holidays, Evening 6 pm to 10 pm and Night as the remaining periods

Table 4-4 Summary of M2 noise monitoring results (background and ambient), dBA

Date	Rating background level (RBL), 90th percentile $L_{A90(period)}$ [1]			Ambient noise levels, $L_{Aeq(period)}$ [1]		
	Day	Evening	Night	Day	Evening	Night
Friday-4-Dec-20	41	39	36	63	44	42
Saturday-5-Dec-20	34	39	39	44	46	44
Sunday-6-Dec-20	42	44	35	49	49	48
Monday-7-Dec-20	44	44	41	49	47	48
Tuesday-8-Dec-20	41	38	38	47	44	46
Wednesday 9-Dec-20	37	37	33	47	42	45
Thursday 10-Dec-20	36	43	34	45	48	43
RBL and Leq Overall	**41**	**39**	**36**	**55**	**46**	**46**

Note: 1. The NPI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 1 pm Sunday and Public Holidays, Evening 6 pm to 10 pm and Night as the remaining periods

Table 4-5 Summary of M3 noise monitoring results (background and ambient), dBA

Date	Rating background level (RBL), 90th percentile $L_{A90(period)}$[1]			Ambient noise levels, $L_{Aeq(period)}$[1]		
	Day	Evening	Night	Day	Evening	Night
Friday-4-Dec-20	46	46	43	57	53	49
Saturday-5-Dec-20	46	54	49	54	58	57
Sunday-6-Dec-20	57	57	45	60	62	58
Monday-7-Dec-20	58	54	49	61	59	58
Tuesday-8-Dec-20	50	44	47	56	52	55
Wednesday-9-Dec-20	48	47	46	54	54	54
Thursday-10-Dec-20	47	50	40	52	53	49
Friday-11-Dec-20	46	47	43	49	52	50
Saturday-12-Dec-20	43	43	43	53	50	50
Sunday-13-Dec-20	42	44	41	47	49	50
Monday-14-Dec-20	48			54		
RBL and Leq Overall	**47**	**47**	**44**	**56**	**56**	**55**

Note: 1. The NPI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 1 pm Sunday and Public Holidays, Evening 6 pm to 10 pm and Night as the remaining periods

Table 4-6 Summary of M1 noise monitoring results (rail traffic), dBA

Date	Rail traffic noise level $L_{Aeq(period)}$		Road traffic noise level $L_{Aeq(1hour)}$	
	Day (15 hour)	Night (9 hour)	Day	Night
Friday-4-Dec-20	54	50	57	53
Saturday-5-Dec-20	57	55	59	59
Sunday-6-Dec-20	54	57	58	59
Monday-7-Dec-20	55	54	56	55
Tuesday-8-Dec-20	56	55	58	57
Wednesday-9-Dec-20	54	55	56	59
Thursday-10-Dec-20	56	54	58	57
Friday-11-Dec-20	58	53	61	55
Saturday-12-Dec-20	57	54	60	58
Sunday-13-Dec-20	58	61	60	58
Monday-14-Dec-20	55	-	57	-
Overall	**56**	**56**	**58**	**57**
Overall (weekday)	**56**	**54**	**57**	**56**

Table 4-7 Summary of M2 noise monitoring results (road and rail traffic), dBA

Date	Road and rail traffic noise level $L_{Aeq(period)}$		Road traffic noise level $L_{Aeq(1hour)}$	
	Day (15 hour)	Night (9 hour)	Day	Night
Friday-4-Dec-20	61	42	54	45
Saturday-5-Dec-20	45	44	48	46
Sunday-6-Dec-20	49	48	51	53
Monday-7-Dec-20	49	48	50	50
Tuesday-8-Dec-20	46	46	49	48
Wednesday-9-Dec-20	46	45	48	49
Thursday-10-Dec-20	46	43	48	46
Overall (weekday)	**54**	**45**	**49**	**48**

Note: 1. Average of the weekday road traffic noise levels

Table 4-8 Summary of M3 noise monitoring results (road traffic), dBA

Date	Road traffic noise level $L_{Aeq(period)}$		Road traffic noise level $L_{Aeq(1hour)}$	
	Day (15 hour)	Night (9 hour)	Day	Night
Friday-4-Dec-20	56	49	59	52
Saturday-5-Dec-20	55	57	58	58
Sunday-6-Dec-20	61	58	62	60
Monday-7-Dec-20	60	58	62	61
Tuesday-8-Dec-20	54	55	58	57
Wednesday-9-Dec-20	54	54	55	57
Thursday-10-Dec-20	52	49	53	52
Friday-11-Dec-20	51	50	52	53
Saturday-12-Dec-20	52	50	55	51
Sunday-13-Dec-20	48	50	50	53
Monday-14-Dec-20	54	-	55	-
Overall	**56**	**55**	**55**	**55**
Overall (weekday)	**56**	**54**	**55**	**55**

5. Operational noise emission criteria

5.1 NSW Department of Education (DG11)

The Department of Education Design Guideline 11 (DG11) provides the following guidance on the noise emission from educational developments.

5.1.1 Emission Criteria

'Generally noise emission to the environment from mechanical services noise sources (such as air conditioners) are the subject of a development consent conditions. In NSW the development consent conditions will refer to the Industrial Noise Policy (INP) or Local Council requirement.

Where no condition regarding noise sources exists for a school development, noise emission from such sources should be designed, in-principle, to satisfy the requirements of the Industrial Noise Policy.

Noise associated with school activity (such as music or sport within a hall) are not a stationary noise source and is not subject to the INP requirements.'

Note should be made that the Industrial Noise Policy (EPA 2000) has been superseded by the Noise Policy for Industry (EPA 2017).

5.2 Noise Policy for Industry (EPA, 2017)

The DG11 refers to the INP (now superseded by the Noise Policy for Industry) which can be used for guidance on the assessment of operational noise impacts. The guideline includes both intrusive and amenity criteria that are designed to protect receivers from noise significantly louder than the background level and to limit the total noise level from all sources near a receiver.

The NPI project noise trigger levels provide an objective for assessing a proposal and are not mandatory limits required by legislation. The project noise trigger levels assist the regulatory authorities to establish licensing conditions. Where project noise trigger levels are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. In circumstances where noise criteria cannot be achieved, residual noise impacts are used to assess noise impacts and manage noise from the site in negotiation between the regulatory authority and community. The regulatory authority then sets statutory compliance levels that reflect the achievable and agreed noise limits from the development.

The intrusiveness noise level controls the relative audibility of operational noise compared to the background level at residential receivers. The amenity noise level limit the total level of extraneous noise for all receiver types. Both levels are calculated and the lower of the two in each time period is set as the project noise trigger level. The intrusiveness noise level is assessed over a 15 minute period however the amenity noise level is assessed over the day, evening or night time period. For the purposes of assessment to standardise the approach the NPI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA unless an alternative approach can be justified.

5.3 Intrusiveness noise level

The intrusiveness noise level is determined by a 5 dB addition to the measured or adopted background noise level with a minimum intrusiveness noise level of 35 dBA for the evening and night period and 40 dBA for the day period. The NPI recommends that the intrusiveness noise level for the evening and day period should not exceed the daytime period. The intrusiveness noise levels are only applicable to residential receivers.

5.4 Project amenity noise level

The recommended amenity noise level applies to all industrial noise in the area which when combined should remain below the recommended amenity noise level. The recommended amenity noise level represents the total industrial noise at a receiver location and a Project Amenity Noise Level is set at 5 dBA below the recommended amenity noise level.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses and the existing level of noise from industry and road traffic. With consideration to the NPI 'noise amenity area' classification, the residential receivers identified for this assessment should be classified as 'Rural Residential' and "Suburban Residential" and all other nearby commercial sites are classified as 'Commercial premises'.

The NPfI provides the following commentary regarding the effects of changing land use:

> *"When land uses in an area are undergoing significant change, for example, residential subdivisions with associated development of local and regional roads, the background noise levels would be expected to change, sometimes significantly. The impact of noise from an existing industry on a proposed new residential area should be made using the recommended amenity noise level for the residential land use, not the project intrusiveness noise level. Where impacts exceed the amenity noise level, consideration should be given to how these impacts can be avoided or mitigated, such as modifying the location of the proposed residential development, placing screening land uses in-between the proposed residences and existing industry, or ensuring residences are built in a manner that provides acceptable indoor noise amenity."*

In view of the above, the project amenity noise levels has been used to establish the project noise trigger levels for the future residences within NCA1 and NCA3.

6. Summary of project noise trigger levels

For residential receivers, the project noise trigger levels are provided in Table 6-1.

NCA1 and NCA3 are future sensitive receivers surrounding the site, and following the construction of these areas, the background and ambient noise levels are anticipated to be change significantly due to the proposed urban growth. As such, it is appropriate to use the amenity noise levels for suburban residential in these NCAs.

NCA2 consists of existing residential receivers and the most stringent of the intrusiveness and project amenity noise level is appropriate for this NCA.

Table 6-1 Project noise trigger levels – residential noise receivers, dBA

Criteria $L_{Aeq(15min)}$	Residential Receivers		
	Day	Evening	Night
Project amenity noise level (suburban residential)	53	48	43
Project noise trigger levels (NCA1) – amenity	52	48	43
Project noise trigger levels (NCA2) – intrusive	46	44	41
Project noise trigger levels (NCA3) – amenity	52	48	43

Notes:

- The NPI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 1 pm Sunday and Public Holidays, Evening 6 pm to 10 pm and Night as the remaining periods.
- Noise from the site is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the project noise trigger levels, except where otherwise specified below.

For non-residential receivers, the project noise trigger levels are provided in Table 6-2 below.

Table 6-2 Project noise trigger levels – non-residential receivers

Receiver	Non-residential receivers	
	Time of day	L_{Aeq}, dBA
Commercial premises	When in use	65 (external)
School classroom (future primary school and HAHS)	When in use	35 (internal) 45 (external)
Active recreation (HAHS playground and future sporting fields)	When in use	65
Passive recreation	When in use	50
Hospital ward[1]	When in use	35 (internal) 50 (external)

Note: 1. The potential medical facility identified on the Indicative Layout Plan has been assumed to be a hospital as a worst case

6.1 Sleep disturbance

The NPI (EPA 2017) recommends a detailed maximum noise level event assessment be undertaken where night-time noise levels from a development exceed the following levels when assessed externally at the nearest residential location:

- $L_{Aeq(15min)}$ 40 dBA or the prevailing RBL + 5 dBA (whichever is greater); and/or
- L_{AFmax} 52 dBA or the prevailing RBL + 15 dBA (whichever is greater)

Sleep disturbance impacts may occur during the morning shoulder period between 5 am and 7 am due to animals being fed. No other activities are proposed during this time.

A summary of the sleep disturbance screening level for each Noise Catchment Area is provided in Table 6-3

Table 6-3 Sleep disturbance screening level, dBA

NCA	Night-time RBL	Sleep disturbance screening level, L_{Amax}
NCA 1	35	52
NCA 2	36	52
NCA 3	44	59

7. Noise modelling parameters

Noise modelling was undertaken using the Computer Aided Noise Abatement (CadnaA) modelling software to predict the effects of airborne noise from the site.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to a number of different algorithms. In this assessment ISO 9613-2, "*Acoustics – Attenuation of Sound During Propagation Outdoors"* algorithm*.* Propagation calculations using the ISO 9613 take into account sound intensity losses due to hemispherical spreading, atmospheric absorption, ground absorption and the presence of a well-developed moderate ground based temperature inversion, such as that which commonly occurs on clear, calm nights or during 'downwind' conditions, which are favourable to sound propagation.

In this assessment both the Calculation of Road Traffic Noise (CRTN) and the Nordic Prediction Method were utilised to model the existing impacts from road and rail noise.

The following general settings were used in the model:

- Ground absorption was taken into account in the calculations. A general ground absorption coefficient of 0.75 was used throughout the model to represent the surrounding ground type, representing generally absorptive ground.
- Sensitive receptors were modelled at 1.5 metres height above ground, as well as a representative upper level (6 metres for proposed apartment blocks and 4.5 metres for existing residential receivers), in accordance with AS 1055: *Acoustics – Description and Measurement of Environmental Noise.*
- Site topography and three-dimensional terrain with 5 metre contour resolution have been used in the noise model.

8. Noise impacts on existing and future development

The HAHS site is located within close proximity to several road and rail infrastructure, including:

- South Western Freeway to the west
- Campbelltown Road to the west
- T2, T5 and freight rail lines to the east.

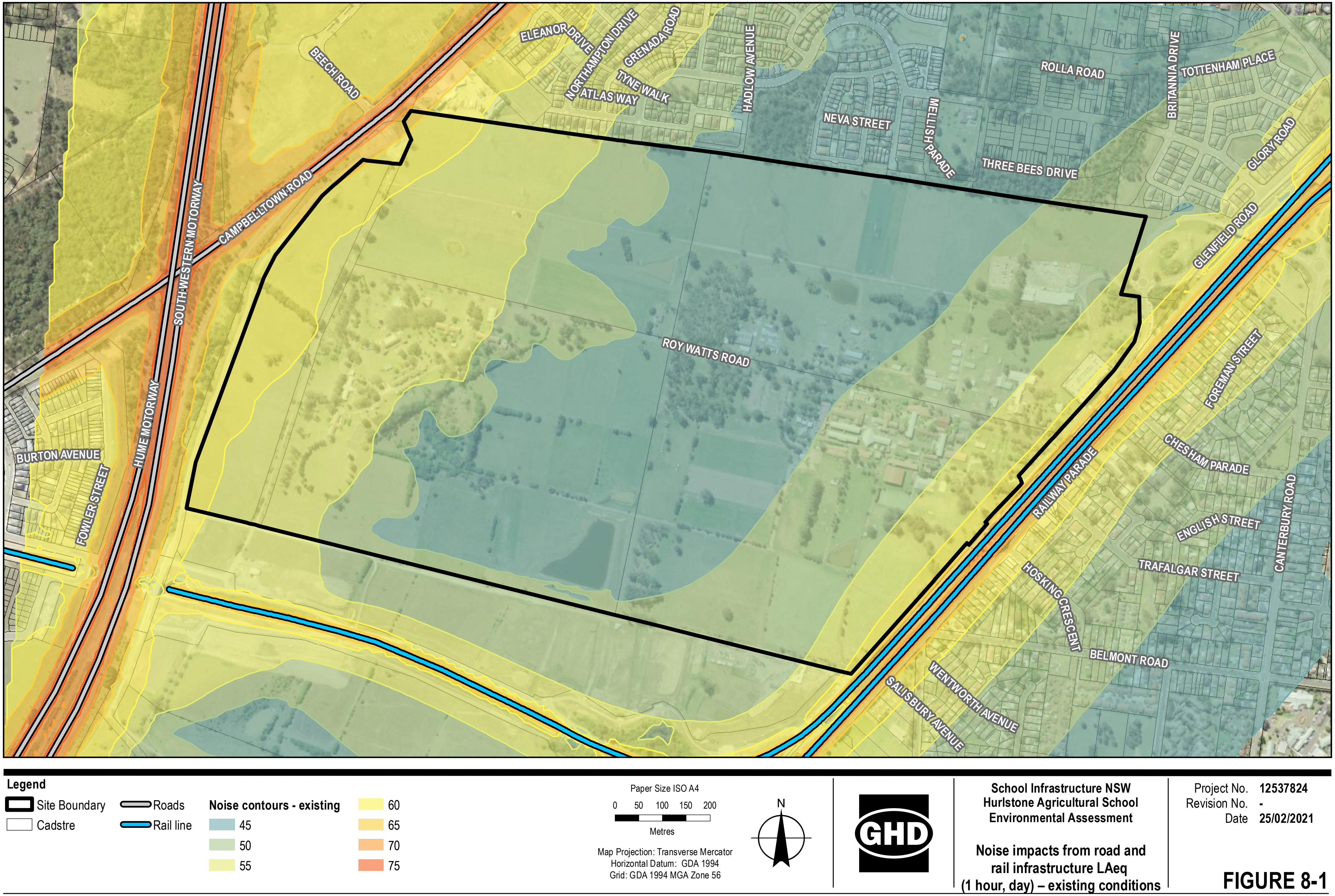
As the existing background noise environment in the study area is dominated by transport infrastructure, the noise environment will change subsequent to the rezoning of the land within Hursltone Agricultural High School.

The noise monitoring data presented in Table 4-6 to Table 4-8 provide transport noise levels at each of the monitoring locations, including $L_{Aeq(15\ hour\ -\ day)}$, $L_{Aeq(9\ hour\ -\ night)}$, $L_{Aeq(1\ hour\ -\ day)}$ and $L_{Aeq(1\ hour\ -\ night)}$ noise levels.

Noise modelling was undertaken using CadnaA 2020 and calibrated against the 1 hour noise levels (peak hour day and peak hour night) at each of the monitoring locations to predict the existing transport infrastructure noise levels across the study area. Noise contour maps of the existing and future (built-up) $L_{Aeq(1\ hour,\ day)}$ are shown in Figure 8-1 and Figure 8-2.

The future scenario assumes that the road and rail traffic volumes are consistent with the existing volumes and do not account for growth. As such, these noise contours maps have been provided for reference only to show the acoustic shielding effects of built up areas.

Note should be made that the future transport infrastructure noise levels do not include local roads or proposed roads within the study area. There is a proposed road (Cambridge Avenue Upgrade) that would run east-west across the northern portion of the site. Consideration should be given to allowing space for noise walls or noise mounds should noise mitigation be required to reduce road noise levels to the future location of the school and its associated agricultural components.



School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Noise impacts from road and rail infrastructure LAeq (1 hour, day) – existing conditions

Project No. 12537824
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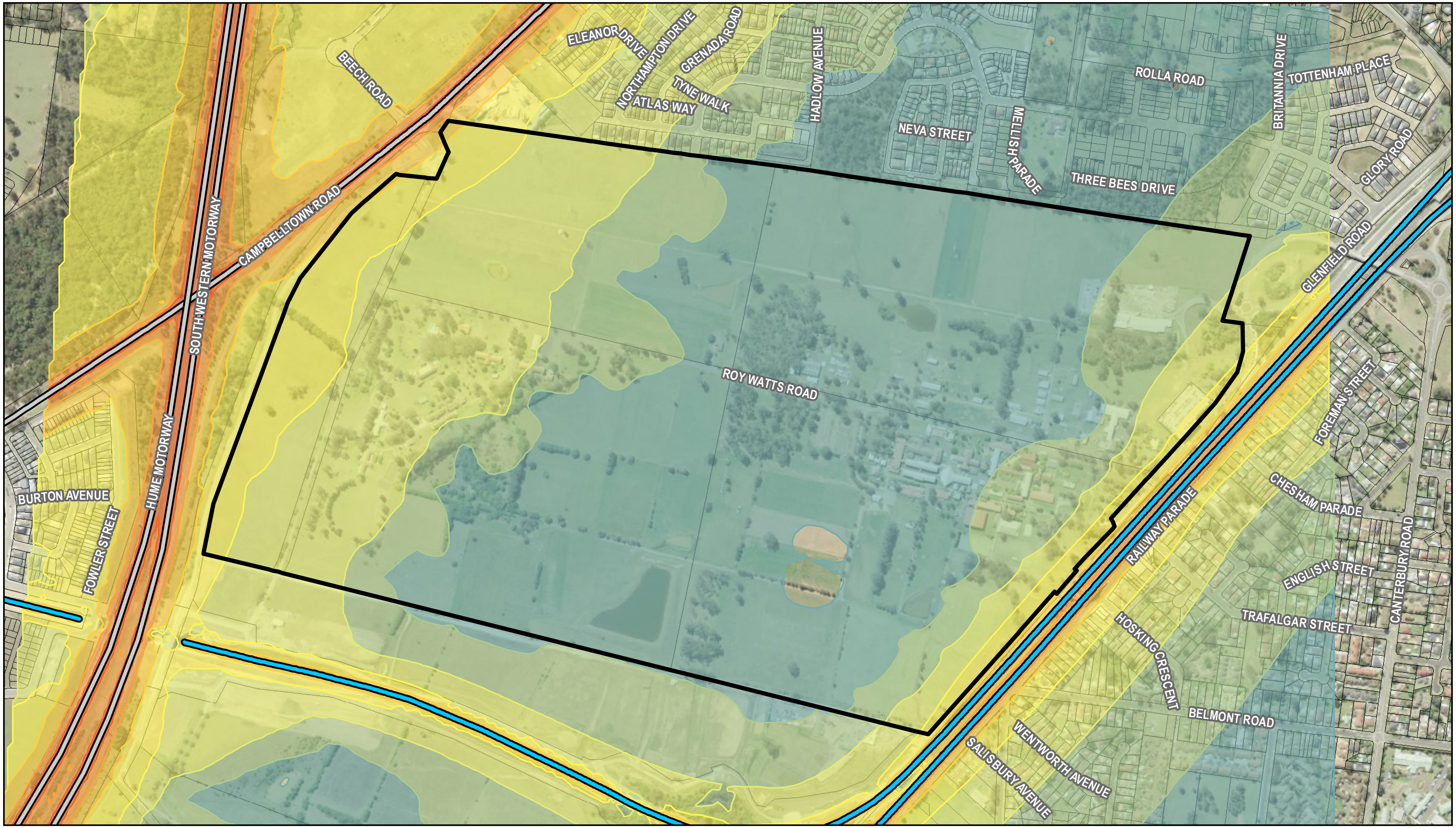
Date 25/02/2021

FIGURE 8-1

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z008_Noise_RailRoadImpacts_Existing.mxd
Print date: 25 Feb 2021 - 13:18

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson



Legend

Site Boundary | Roads
Cadstre | Rail line

Noise contours - future

45, 50, 55, 60, 65, 70, 75

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Noise impacts from road and rail infrastructure LAeq (1 hour, day) – with future development

Project No. **12537824**
Revision No. **-**
Date **25/02/2021**

FIGURE 8-2

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z009_Noise_RailRoadImpacts_Future.mxd
Print date: 25 Feb 2021 - 13:22

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

9. Noise impact assessment

9.1 Assumptions and basis of assessment

The following operations and equipment which has the potential to generate noise have been assumed as a basis for the assessment:

- Mobile machinery, including:
  - Tractors/Front End Loaders – Case Maxxum 125 Front End Loader, Kubota M6030 Front End Loader, Kubota M70303
  - All-Terrain Vehicle – 4 Can-Am 450 ATV
  - Some additional machinery due to change in operations, however this has not been selected at this stage
- Fixed plant – no selections or locations are determined at this stage
- Pumps – no selections or location are determined at this stage
- Irrigation is proposed to be sub-surface, and as such will not generate any noise
- Truck deliveries – Typical truck movements of 2 per day, with a maximum of 8 per day. Access is via Roy Watts Road
- Noise from animals and associated activities, including:
  - Animals during feeding times
  - Milking with robots
  - Flushing of feed alleys
  - Manure screening and pump to tanks
  - Movement of livestock by students and staff.

9.2 Noise from Farm Hub

A noise assessment has been undertaken to determine the impacts of the use and operation of the proposed Farm Hub. The proposed layout of the Farm Hub is provided in Figure 9-1 below.

Figure 9-1 Farm Hub layout (prepared by Fitzpatrick + Partners, dated 23 September 2020)

It is assumed that the following noise generating activities and equipment will be associated with the Farm Hub:

- Associated mechanical plant and equipment
- Animal noise, in particular during feeding time

9.2.1 Mechanical plant and equipment

Mechanical plant and equipment are generally considered constant noise sources, and as such should be assessed to minimise impacts on surrounding receivers. At this stage of the project, the location and type of fixed mechanical plant and equipment has not been selected. To determine potential impacts from fixed plant, a reverse noise assessment has been undertaken to determine maximum noise levels permitted on site to enable compliance at the existing and future sensitive receivers.

As a basis for the assessment of mechanical plant impacts, the following has been assumed:

- Each building shown in Figure 9-1 above has at least one (1) item of mechanical plant
- The cumulative noise level from the mechanical plant servicing each building has a sound power level of 90 dBA
- There is no shielding from any buildings
- No mitigation measures have been applied to the mechanical plant.

Based on these assumptions, the resultant noise levels shown in Table 9-1 are predicted at each of the surrounding sensitive receivers. These have been assessed against the night-time criteria, as the mechanical plant may run during this time period.

Noise levels have been predicted at the following heights:

- Ground floor (1.5 metres)
- Representative upper floor, being:
  - Second floor for proposed apartment buildings (6 metres)
  - First floor for existing residential and school buildings (4.5 metres)

Table 9-1 Noise levels at existing and future receivers – mechanical plant within Farm Hub

Receiver ID	Predicted noise level, dBA		Project noise trigger level (night-time) dBA
	Ground floor	Representative upper floor[1]	
NCA 1			
R01	35	38	43
R02	31	36	
R03	31	35	
R04	32	34	
R05	34	36	
R06	37	39	
R07	37	39	
NCA 2			
R08	29	32	41
R09	29	33	
R10	30	34	
R11	32	35	
R12	30	35	
R13	33	37	
R14	33	37	
R15	32	36	
R16	32	35	
R17	31	34	
R18	27	29	
NCA 3			
R19	29	30	43
R20	27	28	
R21	26	26	
R22	23	25	
R23	22	22	
R24	23	23	
R25	23	23	
R26	23	23	
R27	23	23	
R28	25	25	

Receiver ID	Predicted noise level, dBA		Project noise trigger level (night-time) dBA
	Ground floor	Representative upper floor[1]	
R29	26	26	
R30	27	28	
R31	29	32	
Other receivers			
R32	42	45	45
R33	46	48	

Note: 1. The representative higher floor for NCA1 and NCA3 (future) is the second floor, where NCA 2 (existing) is for first floor

It is noted that the criteria is exceeded at the nearest façade of a school building within HAHS (R33). Given this is part of the subject site, it doesn't technically need to achieve the specific noise emission criteria, and the school would be currently exposed to noise from farming operations. Nevertheless, care should be taken when selecting the type and location of any mechanical plant servicing the Farm Hub.

9.2.2 Animal noise – $L_{Aeq,\ 15\ minute}$ assessment

The impacts of noise from animals is difficult to predict, given the varying nature of the noise source, varying numbers of animals, and the configuration of the sheds.

As such, a numerical assessment has not been provided to predict the noise levels at the surrounding sensitive receivers. General noise mitigation measures are provided in the following section to minimise the impacts of noise from animals.

9.2.3 Animal noise – L_{Amax} sleep disturbance assessment

There is the potential for sleep disturbance impacts from the animals, as feeding may occur prior to 7 am. This is likely to occur every day.

The following high-level assessment of sleep disturbance impacts is provided, based on a maximum noise event from an animal, assumed to be located in the centre of the Farm Hub with no shielding effects:

An L_{Amax} sound power level of **117 dBA** would result in a worst-case noise level of 52 dBA, at the nearest sensitive receivers in NCA 1 located approximately 270 metres from the centre of the Farm Hub. It is likely that noise from sheep or cows would not exceed this noise level. It is possible that pigs during feeding time in a group may exceed this level.

9.3 Farming equipment

To determine the impacts of the use of farming equipment within the paddocks within the sites, a distance-based assessment has been undertaken.

The following parameters have been established for this assessment:

- The paddock size is 300 metres by 160 metres, representing one of the larger paddocks on the site
- One tractor or front end loader operating continually within this area for one (1) hour with a sound power level of **105 dBA**. This has been distributed over the area of the paddock
- Receivers have been located at varying distances from the area source, located at the centre of the long edge of the area source, which is considered worst case

Based on the above parameters, the following predicted noise results at varying distances from the area are provided in Table 9-2.

Table 9-2 Noise levels at existing and future receivers – farming equipment

Distance from closest edge of paddock	Predicted noise level, $L_{Aeq,\ 15\ min}$ dBA	Project noise trigger level, $L_{Aeq,\ 15\ min}$ (daytime) dBA
10 metres	52	NCA 1 – 52 dBA NCA 2 – 46 dBA NCA 3 – 52 dBA
20 metres	49	
50 metres	46	
100 metres	44	
200 metres	41	

Based on the above results, the following can be seen:

- NCA 1 – at a distance of 10 metres, noise levels from the farming equipment (tractor or front end loader) is predicted to achieve compliance with the daytime project noise trigger level
- NCA 2 – at a distance of 50 metres, noise levels from the farming equipment (tractor or front end loader) is predicted to achieve compliance with the daytime project noise trigger level
- NCA 3 – at a distance of 10 metres, noise levels from the farming equipment (tractor or front end loader) is predicted to achieve compliance with the daytime project noise trigger level

Although noise is predicted to exceed the criteria at sensitive receivers within NCA2, the impacts are not expected to be significant due to the following:

- Residents in NCA2 are existing and have been exposed to these noise sources from the existing operations of the school
- Noise impacts would only occur for a short period of time and would not likely occur every day.

9.4 Pump buffer zone assessment

At this stage, the type and location of pumps have not been determined. To provide guidance on the selection and location of pumps, a buffer zone assessment has been undertaken to achieve compliance with the relevant project trigger noise levels, based on varying pump sound power levels.

The buffer distances for each NCA, based on a range of sound power levels is provided in Table 9-3. Note that noise levels have been assessed to achieve 5 dB below the project noise trigger level to allow for cumulative contribution from the site.

Table 9-3 Buffer zones for pumps

Sound power level of pump, dBA	NCA	Project noise trigger level, $L_{Aeq,\ 15\ min}$ (night) dBA	Buffer distance to have PNTL – 5 dB
70	NCA 1	43	10 metres
	NCA 2	41	14 metres
	NCA 3	43	10 metres
80	NCA 1	43	31 metres
	NCA 2	41	40 metres
	NCA 3	43	31 metres
90	NCA 1	43	85 metres
	NCA 2	41	103 metres
	NCA 3	43	85 metres

9.5 Trucks deliveries

To determine noise impacts from trucks entering and exiting the site, a noise assessment has been undertaken using CadnaA.

The following assumptions have been made, based on information provided by the client:

- Typical – two (2) truck movements per day (assumed 2 movement (1 truck entering and exiting) in any worst case 1 hour period)
- Maximum – eight (8) truck movements per day (assumed 4 movement (2 trucks entering and exiting) in any worst case 1 hour period)
- Assumed sound power level – 110 dBA, based on a 44 tonne truck (taken from British Standard *BS 5228-1:2009 Code of Practice for noise and vibration control on construction and open site – Part 1: Noise)*
- Access is via Roy Watts Road
- Speed – 10 kilometres per hour.

Based on the above assumptions, results for typical and maximum truck movements are provided in Table 9-4.

Table 9-4 Noise levels at existing and future receivers – truck deliveries

Receiver ID	Predicted noise level, dBA		Project noise trigger level, dBA
	Maximum	Typical	
NCA 1			
R01	56	53	52 (day) 48 (evening) 43 (night)
R02	47	44	
R03	37	34	
R04	36	33	
R05	34	31	
R06	34	31	
R07	32	29	

Receiver ID	Predicted noise level, dBA		Project noise trigger level, dBA
	Maximum	Typical	
NCA 2			
R08	30	27	46 (day) 44 (evening) 41 (night)
R09	31	28	
R10	31	28	
R11	33	30	
R12	28	25	
R13	33	30	
R14	32	29	
R15	30	27	
R16	29	26	
R17	28	25	
R18	22	19	
NCA 3			
R19	23	20	52 (day) 48 (evening) 43 (night)
R20	22	19	
R21	26	23	
R22	18	15	
R23	18	15	
R24	18	15	
R25	18	15	
R26	18	15	
R27	18	15	
R28	20	17	
R29	21	18	
R30	21	18	
R31	28	25	
Other receivers			
R32	51	48	45
R33	48	45	

The results above show that receivers adjacent to Roy Watts Road are predicted to receiver noise levels above the project noise trigger level. Mitigation measures are provided in Section 11 to minimise the impacts of truck deliveries on these receivers.

10. Comparison of noise levels

10.1 NCA1 – Town centre and Station Precinct

The following summary of noise impacts from the HAHS Farm Facilities for receivers within NCA 1 are provided for comparison with existing noise levels at the site from surrounding noise generating infrastructure:

- Predicted noise from mechanical equipment in the Farm Hub – 31-39 dBA
- Predicted noise from truck deliveries – 29-56 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

The existing noise impacts for receivers in NCA 1 are dominated by passenger and freight rail traffic on the rail line directly to the east of these receivers, with some impacts from the South Western Freeway and Campbelltown Road for receivers at the western side of the NCA. The predicted noise level range at these receivers from this rail traffic, assuming the area has been developed, is 46-62 dBA.

It can be seen that predicted noise from the site is generally below the existing noise level at the site from external noise impacts, with the exception of truck deliveries at the receivers adjacent to Roy Watts Road.

10.2 NCA2 – Existing residences to the north

The following summary of noise impacts from the HAHS Farm Facilities for receivers within NCA 2 are provided for comparison with existing noise levels at the site from surrounding noise generating infrastructure:

- Predicted noise from mechanical equipment in the Farm Hub – 27-37 dBA
- Predicted noise from truck deliveries – 19-33 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

The existing noise impacts for receivers in NCA 2 are from passenger and freight rail traffic on the rail line to the east of these receivers and rom the South Western Freeway and Campbelltown Road to the west. The predicted noise level range at these receivers from this rail and road traffic, assuming the area has been developed, is 48-58 dBA.

It can be seen that predicted noise from the site is generally below the existing noise level at the site from external noise impacts.

10.3 NCA3 – NW Quarter, SW Quarter and Southern Quarter

The following summary of noise impacts from the HAHS Farm Facilities for receivers within NCA 3 are provided for comparison with existing noise levels at the site from surrounding noise generating infrastructure:

- Predicted noise from mechanical equipment in the Farm Hub – 22-32 dBA
- Predicted noise from truck deliveries – 15-28 dBA
- Predicted maximum impacts from tractor/front end loader, based on the distance to the nearest receiver being 10 metres-52 dBA.

The existing noise impacts for receivers in NCA 3 are from passenger and freight rail traffic on the rail line to the east of these receivers and rom the South Western Freeway and Campbelltown Road to the west. The predicted noise level range at these receivers from this rail traffic, assuming the area has been developed, is 46-66 dBA.

It can be seen that predicted noise from the site is generally below the existing noise level at the site from external noise impacts.

11. Potential mitigation measures

It can be seen from the results of the assessments in Section 9 above, there is the potential that the operation of the HAHS Farm Facilities to impact the existing and future sensitive receivers surrounding the proposed site, should noise impacts not be considered in the design. Due to the site being an existing agricultural precinct, there will be some noise generating activities that occur in the early morning and evening that cannot always be mitigated.

To reduce the potential impacts on nearby receivers, the in principal noise mitigation measures below should be considered, however it is noted that not all of these mitigation measures are required. A combination of these would be considered when the design is further developed.

The EPA's Noise Policy for Industry provides a hierarchy of noise mitigation strategies based on most to least preferred. The following extract of the hierarchy is taken from the NPI:

> ***Land-use controls*** *– essentially separating noise-producing industries from sensitive areas, which avoids more expensive short-term measures.*
>
> ***Control at the source****,* ***Best Management Practice*** *(****BMP) and Best available technology economically achievable (BATEA)*** *used in conjunction – these strategies are the best after land-use planning, as they serve to reduce the noise output of the source so that the surrounding environment is protected against noise.*
>
> ***Control in transmission*** *– the next-best strategy to controlling noise at the source as it serves to reduce the noise level at specific receivers but not necessarily the broader environment surrounding the source.*
>
> ***Receiver controls*** *– the least-preferred option, as it protects only the internal environment of specific receivers and not the external noise environment.*

The hierarchy has been used to develop a strategy for the mitigation of noise from each noise generating equipment or activity on site.

11.1 Mechanical plant and equipment

To reduce the potential impacts of noise from mechanical plant and equipment, the following could be considered in the design.

Land use control

- Where possible, mechanical plant and equipment should be located on the site to maximise the distance between it and the nearest receivers
- Plant should be located on the northern or western sides of any building structure, where there is a greater distance to noise sensitive receivers

Control at the source, BMP and BATEA

- Selection of the quietest mechanical plant available
- Selection of mechanical plant to not exceed 90 dBA per building within the Farm Hub, or where this noise is greater than 90 dBA, should be mitigated to achieve this level

Control in transmission

- Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design:
  - Locating plant within an enclosure or building

- Using well designed noise barriers, which should be located as close to the mechanical plant as possible
- Acoustic louvres on any plant enclosures

Receiver controls

- Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from mechanical plant.

11.2 Animal noise

To reduce the potential impacts of animal noise, the following could be considered in the design.

Land use control

- Where possible, animal sheds within the Farm Hub, in particular animal sheds which may generate higher noise levels (such as the pig shed) should be located on the site to maximise the distance between it and the nearest receivers

Control at the source, BMP and BATEA

- Where possible, procedures should be put in place to reduce noise from animals, in particular during feeding times

Control in transmission

- The Farm Hub buildings and animal enclosures should be designed and constructed to contain as many solid facades as possible
- The Farm Hub buildings and animal enclosures should be orientated so opening are facing the west or north-west direction, maximising the distance from the source to the receiver

Receiver controls

- Should the control of noise from animal noise not be possible using the above methods, mitigation measures could be implemented at the nearest sensitive receivers impacted by animal noise. While this is not a preferred option, the following could be implemented:
  - Design of façade with high acoustic insulation levels, including upgraded glazing
  - Location of sensitive internal areas away from the most impacted facades.

11.3 Farming equipment

To reduce the potential impacts of farming equipment, the following could be considered in the operations.

Land use control

- Farming equipment such as tractors and front end loaders may need to be used during sensitive times such as early morning as per existing use. Any new residential areas should consider this in their design.

Control at the source, BMP and BATEA

- Farming equipment, such as tractors and front end loaders should be selected to have the lowest noise level economically available
- The following general mitigation measures could also be considered, as provided in the NPI
  - considering alternatives to tonal reversing alarms such as broadband alarms (where work health and safety is appropriately considered)

- using equipment with efficient muffler design
- using quieter engines, such as electric instead of internal combustion
- fitting and maintaining noise reduction packages on plant and equipment

Control in transmission

- Control in transmission is not suitable for mobile plant so has not be considered for farming equipment

Receiver controls

- Should additional controls be required following investigation from the above methods, at receiver controls could be considered, as per the details above. It should be noted that noise impacts on existing receivers are possible, and therefore other mitigation measures should be considered rather than at receiver controls.

11.4 Truck deliveries

Mitigation measures to control impacts from truck movements are challenging due to the following:

- The trucks are not stationary objects and therefore control in transmission is not possible
- There would be a range of truck delivering goods to the site which aren't under the control of the school, and therefore limiting noise at the source is challenging
- Access to the Farm Hub is only possible via Roy Watts Road, and therefore is required to pass by sensitive receivers in NCA 1
- Out of hours deliveries are often needed due to milk trucks, grain and hay deliveries and to avoid trucks when children may be onsite.

The following noise mitigation measures can be investigated to minimise the impacts on the receivers adjacent to Roy Watts Road:

Land use control

- Any residential buildings within NCA 1 may be impacted by existing and future noise from truck deliveries, including early morning and night time. All future buildings will need to be designed to account for existing noise from the school.
- Establish an alternate entrance to access properties at the western end of Roy Watts Roads to minimise impacts on the receivers adjacent to HAHS during both construction and operation.

Control at the source, BMP and BATEA

- Trucks accessing the site should be roadworthy and compliant with relevant government noise requirements.

11.5 Pumps

Noise impacts from pumps are not anticipated (refer Section 9.4). The following general recommendations could be considered in the operations.

Land use control

- Where practicable, pumps should be located on the site to maximise the distance between it and the nearest receivers (see buffer distance assessment above in Section 9.4).

Control at the source, BMP and BATEA

- Selection of the quietest pumps available

- Selection of pumps to not exceed the levels provided in the buffer distance detailed in Section 9.4, or where this is not possible, should be mitigated to achieve this level

Control in transmission

- Where plant can't be selected or located to achieve compliance at the surrounding sensitive receivers, the following in-transmission mitigation measures could be considered in the design:
  – Locating plant within an enclosure or building
  – Using well designed noise barriers, which should be located as close to the mechanical plant as possible
  – Acoustic louvres on any plant enclosures

Receiver controls

- Noise from mechanical plant and equipment should be designed to achieve compliance with the project noise trigger levels and it is not appropriate to recommend receiver controls for impacts from new mechanical plant.

In addition to the above, an acoustic assessment should be undertaken during the design process to assist with location, plant selection, and any mitigation measures required to minimise impacts.

12. Conclusion

A noise impact assessment for the operation of the HAHS Farm Facilities has been undertaken to determine potential noise impacts from the facilities to the existing and future sensitive receivers.

The following conclusions can be made from the assessment:

- Existing noise levels across the site are impacted by the surrounding rail and road traffic, and are generally predicted to be higher than the predicted noise levels from the future use of the farm facilities.
- The farm facilities should be able to be designed to achieve compliance with the relevant project noise trigger levels, should the mitigation measures detailed in Section 11 be considered in the design. It is recommended that a detailed acoustic assessment be undertaken during design development to provide specific guidance around appropriate mitigation measures.
- It is likely that noise from mechanical plant and pumps can be mitigated to compliant levels with a range of mitigation measures possible.
- Farming activities will continue to operate as it has in the past and noise from farming equipment have the potential to create a noise impact on future receivers. All future buildings will need to be designed to account for existing noise from the school, in particular truck deliveries, tractors and front end loaders.
- Existing and future noise from truck deliveries have the potential to create a noise impact on surrounding receivers including out of day time hours. New development in NCA 1 should consider this in the design
- Noise impacts from animals is difficult to predict due to the varying nature of noise levels. Design of the animal sheds should be considered to minimise the potential impacts, as detailed in Section 11.

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Revision	Author	Reviewer		Approved for Issue		
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Appendix E – Soils assessment

NSW Department of Planning Industry and Environment

Hurlstone Agricultural High School
Soils Assessment

April 2021

Table of contents

Figure index

Appendices

Acronyms and abbreviations

Acronym/abbreviation	Full Name
CEC	Cation exchange capacity
DPIE	Department of Planning, Industry and Environment
ESP	Exchangeable sodium percentage
GHD	GHD Pty Ltd
HAHS	Hurlstone Agricultural High School
K	Potassium
MOP	muriate of potash
N	Nitrate Nitrogen
P	Phosphorus
S	Suplhur

1. Background

A soils assessment was undertaken to determine the soil characteristics of the areas to be retained for agricultural purposes and to assess the ability to support intensified farming activities including the arability of the soil.

The school is planning to continue irrigated cropping on the broader farm areas and in order to support the feed requirements of the current dairy and other agricultural activities will require soils that are capable of supporting 8-12 tonnes per hectare of annual grasses or 24 tonnes per hectare of maize. A key aspect of the proposed plan for the site is to increase the intensification through the installation of sub-surface irrigation allowing for the fertilisation (fertigation) and chemical treatments of crops and pastures. Agricultural areas will be irrigated by either recycled water or through on-site water harvesting and recycling.

This base line soils assessment assesses the current soil characteristics across the site and identifies the potential amelioration requirements in order to meet the soil attributes benchmark.

2. Methodology

To determine if the soils across the site meet the required soil targets, GHD completed the following activities:

- Review any historical soil sampling information of the site to understand the expected soil types and variance across the site.
- In consultation with the Farm Manager, determined suitable reference points across the site for soil sampling, with at least one reference point identified within each soil type and a control location (ie non-irrigated area). All sampling locations were from areas that would be retained for agricultural related purposes into the future.
- Collection of six surface soil samples from across the site (depth of 0-10 centimetres) and along a fixed transect. Care was given to avoid the collection of any surface material such as grass, leaf or organic matter. The cores were collected in a clean bucket, mixed well, poured into a clean plastic bag and clearly labelled. Figure 2-1 identifies the six soil sampling locations and can be used for the collection of future soil samples to ensure consistency across the site and to monitor changes in soil fertility.
- Soils were analysed and interpreted by an accredited laboratory for the following analytes:
  - Soil moisture
  - Electrical conductivity (EC)
  - pH
  - Nitrate, available phosphorus (Colwell)
  - Sodium, potassium, calcium, magnesium and exchangeable cations
  - Exchangeable sodium percentage (ESP)
  - Cation exchange capacity (CEC)
  - Salinity
  - Organic matter content.

Legend

Soil sampling location

Site Boundary

Cadstre

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Project No. **12537824**
Revision No. **-**
Date **25/02/2021**

Soil Sampling Locations

FIGURE 2-1

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z005_Geotech_SoilSamplingLocations.mxd
Print date: 25 Feb 2021 - 13:39

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

3. Results

3.1.1 Paddock 4A

3.1.1.1 Baseline sampling analysis

This paddock has all macronutrients in range and a pH of above 5.2, thus aluminium is not at a toxic level in the soil. Currently it is under irrigation with oats and rye; to sow a pasture/crop next year a starter fertiliser of 70 kg/ha of croplift (14.6% Nitrate Nitrogen (N), 12% Phosphorus (P), 11.6% Sulphur (S) will be sufficient.

3.1.1.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Croplift	70	Sown with the seed	At sowing

3.1.2 Paddock 16

3.1.2.1 Baseline sampling analysis

pH: The pH is quite low, demonstrating an acidic soil. A pH below 5.2 has the ability to show aluminium toxicities. Based on the soil's texture class, clay loam. You should apply 2.5 t/ha of lime or 1.35 t/ha of Calciprill to achieve an optimal pH of 5.5.

Nitrate Nitrogen (N): The nitrogen levels are within range for this paddock; nitrogen is essential at sowing to promote early vigour of the crop. Nitrogen will still be applied in a blend at sowing but the focus will be on increasing the sulphur levels.

Phosphorus (P): The current level of 310 mg/kg is above optimal; Phosphorus is essential for cell division and development of young plants and is vital at sowing. Phosphorus will still be applied at sowing but the focus will be on increasing sulphur levels.

Sulphur (S): The sulphur levels are below optimum at 9, sulphur is important in the formation of plant proteins. At this current level an application of 7 kg of sulphur is required to bring the current level to within optimum range. This would include an application of 70 kg/ha of croplift to increase the sulphur levels to an optimum level.

Potassium (K): is an essential nutrient in the regulation of water throughout the plant. The biggest responses to K will be seen through the clover content of the pasture. Applying K should only be done once the clover percentage comprises more than 20 per cent of the pasture base. Greater pasture growth responses will be noted from applying all other nutrients prior to an application of K. Applications of K can be done after the initial graze in conjunction with Nitrogen.

3.1.2.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Lime (or Calciprill)	2500 (1350)	Broadcast and incorporation	6-8 weeks prior to sowing
Croplift	70	Sown with the seed	At sowing

3.1.3 Paddock 15

3.1.3.1 Baseline sampling analysis

pH: The pH is quite low, demonstrating an acidic soil. A pH below 5.2 has the ability to show aluminium toxicities. Based on the soil's texture class, clay loam. You should apply 2 t/ha of lime or 1.1 t/ha of Calciprill to achieve an optimal pH of 5.5.

Nitrate Nitrogen (N): This is the plant available form of N. The current level is below optimal level. Nitrogen should be used at sowing to promote early vigour of the crop. Due to the low level of nitrogen an application after the initial first graze would be needed.

Phosphorus (P): The current level of 370 mg/kg is above optimal; Phosphorus is essential for cell division and development of young plants and is vital at sowing. Phosphorus will still be applied at sowing but the focus will be on increasing sulphur levels.

Sulphur (S): The sulphur levels are below optimum at 9, sulphur is important in the formation of plant proteins. At this current level an application of 7 kg of sulphur is required to bring the current level to within optimum range. This would include an application of 70 kg/ha of croplift to increase the sulphur levels to an optimum level.

Potassium (K): The current level is very low, the application of K can be done after the initial graze in conjunction with nitrogen. Greentop K (32.8% N 11% K 2.9% S) at a rate of 200 kg/ha after the initial graze will increase potassium to an optimal level, whilst increasing nitrogen levels at the same time.

3.1.3.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Lime (or Calciprill)	2000 (1100)	Broadcast and incorporation	6-8 weeks prior to sowing
Croplift	70	Sown with the seed	At sowing
Greentop K	200	Broadcast	After first graze

3.1.4 Paddock 21

3.1.4.1 Baseline sampling analysis

pH: The pH is low, demonstrating an acidic soil. Based on the soil's texture class, clay loam. You should apply 1 t/ha of lime or 300 kg/ha of Calciprill to achieve an optimal pH of 5.5.

Nitrate Nitrogen (N): This is the plant available form of N. The current level is below optimal level. Due to the low level of nitrogen an application after the initial first graze would be needed. Nitrogen will still be applied in a blend but the focus will be on increasing the sulphur levels.

Phosphorus (P): The current level of 170 mg/kg is optimal; Phosphorus is essential for cell division and development of young plants.

Sulphur (S): The sulphur levels are below optimum at 6, sulphur is important in the formation of plant proteins. At this current level an application of 7 kg of sulphur is required to bring the current level to within optimum range. This would include an application of 60 kg of gran-am (20.2% N, 24% S) broadcast with muriate of potash (MOP).

Potassium (K): The current level is very low, due to this being an existing Lucerne stand, Greentop K has a high nitrogen content that may have a negative effect on the Lucerne. Thus why we have used gran-am. Using 200 kg/ha of MOP in conjunction with gran-am will increase the potassium levels to within optimum range.

3.1.4.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Lime (or Calciprill)	1000 (300)	Broadcast	6-8 weeks prior to sowing
Gran-Am	60	Broadcast with MOP	Prior to rain event or irrigate
Muriate of Potash (MOP)	200	Broadcast with Gran-Am	Prior to rain event or irrigate

3.1.5 Paddock 23

3.1.5.1 Baseline sampling analysis

pH: The pH is quite low, demonstrating an acidic soil. A pH below 5.2 has the ability to show aluminium toxicities. Based on the soil's texture class, clay loam. You should apply 2 t/ha of lime or 1.2 t/ha of Calciprill to achieve an optimal pH of 5.5.

Nitrate Nitrogen (N): This is the plant available form of N. The current level is below optimal level. Nitrogen should be used at sowing to promote early vigour of the crop. Due to the low level of nitrogen an application after the initial first graze would be needed. Urea applied after the first graze

Phosphorus (P): The current level of 110 mg/kg is above optimal; Phosphorus is essential for cell division and development of young plants and is vital at sowing. Phosphorus will still be applied at sowing but the focus will be on increasing sulphur levels.

Sulphur (S): The sulphur levels are below optimum at 9, sulphur is important in the formation of plant proteins. At this current level an application of 7 kg of sulphur is required to bring the current level to within optimum range. This would include an application of 70 kg/ha of croplift to increase the sulphur levels to an optimum level.

Potassium (K): is an essential nutrient in the regulation of water throughout the plant. The biggest responses to K will be seen through the clover content of the pasture. Applying K should only be done once the clover percentage comprises more than 20 per cent of the pasture base. Greater pasture growth responses will be noted from applying all other nutrients prior to an application of K. Applications of K can be done after the initial graze in conjunction with Nitrogen.

3.1.5.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Lime (or Calciprill)	2000 (1100)	Broadcast and incorporation	6-8 weeks prior to sowing
Croplift	70	Sown with the seed	At sowing

3.1.6 Paddock 34

3.1.6.1 Baseline sampling analysis

pH: The pH is quite low, demonstrating an acidic soil. A pH below 5.2 has the ability to show aluminium toxicities. Based on the soil's texture class, clay loam. You should apply 2 t/ha of lime or 1.1 t/ha of Calciprill to achieve an optimal pH of 5.5.

Nitrate Nitrogen (N): This is the plant available form of N. The current level is below optimal level. Nitrogen should be used at sowing to promote early vigour of the crop. Due to the low level of nitrogen an application after the initial first graze would be needed.

Phosphorus (P): The current level of 98 mg/kg is above optimal; Phosphorus is essential for cell division and development of young plants and is vital at sowing. Phosphorus will still be applied at sowing but the focus will be on increasing sulphur levels.

Sulphur (S): The sulphur levels are below optimum at 8, sulphur is important in the formation of plant proteins. At this current level an application of 7 kg of sulphur is required to bring the current level to within optimum range. This would include an application of 70 kg/ha of croplift to increase the sulphur levels to an optimum level.

Potassium (K): The current level is very low, the application of K can be done after the initial graze in conjunction with nitrogen. Greentop K (32.8% N 11% K 2.9% S) can be split at a rate of 100 kg/ha after the initial graze/harvest with a follow up application following subsequent grazing / harvest. This will increase potassium to an optimal level, whilst increasing nitrogen levels at the same time.

3.1.6.2 Recommendations

Product	Rate (kg/ha)	Application	Timing
Lime (or Calciprill)	2000 (1100)	Broadcast and incorporation	6-8 weeks prior to sowing
Croplift	70	Sown with the seed	At sowing
Greentop K	2 applications following grazing/ harvest at 100 kg / ha	Broadcast	After first graze/ harvest

4. Recommendations

Based on the analysis of the soil sampling results from the farm, the following recommendations are made:

- Routine soil sampling and analysis across the site is necessary to determine the suitability of soil for crop production and regular monitoring ensures there is no negative impact from the intensification of the educational farm facility. In addition to the regular soil sampling and monitoring program, it is recommended that a longer-term soil monitoring program is implemented to test for organics and trace (and heavy) metals. Sampling should be undertaken at regular intervals (eg three to five years) with both surface and sub-soil sampling undertaken (sample location to a depth of 1 metres) at each of the six collection sites. For sub-soil samples should be collected from each key soil horizon or nominally at 0-20 cm, 20-40 cm, 40-70 and 70-100 centimetres. The routine testing and advice allows targeted application of fertilisers to meet current soil conditions while preventing over-application.
- Ensure that monitoring results and inspection details are recorded for compliance and environmental monitoring. The following table provides an example of some of the records that could be maintained:

Name	Frequency	Requirement
Farm Activity Register	Daily as required	Ensure that farm activities and irrigation records are logged. This could also include details of routine agricultural operations, livestock summaries and agronomic inputs. In addition, a log of the following data should also be maintained: • Rain (mm) • Wind speed (km/h) • Soil moisture (per cent) at the nominated monitoring locations • Irrigation timing, volume and location. The use of an on-site weather station is discussed in Section 8 of Appendix B Odour assessment
Farm Management Plan	Annual	Farm Manager to continue the process of preparing an annual Farm Management Plan allowing for increased inputs to maximise yield from intensification of remaining paddocks. This Farm Management Plan should consider opportunities for further development and farming practices informed by budgetary processes.

Appendices

Appendix A – Sampling analysis

SUMMARY REPORT

GHD		**Service Provider:**	ELDERS - Goulburn
		Advisor/Contact:	Daniel Lewis
Dubbo		**Phone:**	0457 863 855
NSW		**Purchase Order:**	KN 8880

Sample No		**022320239**	**022320243**	**022320245**
Paddock Name		4A	21	34
Sample Name				
Sample Depth (cm)		0 - 10	0 - 10	0 - 10
Sampling Date		30/11/2020	30/11/2020	30/11/2020
Test Code		E13	E13	E13
Sample Type		Soil	Soil	Soil
Analyte	**Unit**	**Result**	**Result**	**Result**
Soil Colour		Brown	Brown	Brown
Soil Texture		Sandy Loam	Clay	Clay
Moisture	%	21	8	7
pH (1:5 Water)		6.6	6.2	5.8
pH (1:5 CaCl2)		5.9	5.3	4.8
Electrical Conductivity (1:5 water)	dS/m	0.23	0.05	0.05
Electrical Conductivity (Sat. Ext.)	dS/m	2.4	0.3	0.3
Chloride	mg/kg	34	<10	12
Organic Carbon (W&B)	%	8.4	2.8	3.0
Nitrate Nitrogen	mg/kg	38.0	2.1	2.8
Ammonium Nitrogen	mg/kg	10.0	1.4	1.8
Phosphorus (Colwell)	mg/kg	540	170	98
Phosphorus Buffer Index		170	110	140
Sulphur (KCl40)	mg/kg	16	6	8
Cation Exch. Cap. (CEC)	cmol(+)/kg	22.9	10.7	9.1
Calcium (Amm-acet.)	cmol(+)/kg	13.0	8.4	5.8
Magnesium (Amm-acet.)	cmol(+)/kg	5.9	2.0	2.7
Sodium (Amm-acet.)	cmol(+)/kg	0.35	0.11	0.14
Potassium (Amm-acet.)	cmol(+)/kg	3.20	0.21	0.30

SUMMARY REPORT

GHD		**Service Provider:**	ELDERS - Goulburn
		Advisor/Contact:	Daniel Lewis
Dubbo		**Phone:**	0457 863 855
NSW		**Purchase Order:**	KN 8880

Available Potassium	mg/kg	1,200	83	120
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	0.2
Aluminium % of Cations	%	<1.0	<1.0	2.1
Calcium % of Cations	%	59.0	78.0	64.0
Magnesium % of Cations	%	26.0	19.0	29.0
Sodium % of Cations (ESP)	%	1.50	1.10	1.50
Potassium % of Cations	%	14.00	2.00	3.30
Calcium/Magnesium Ratio		2.2	4.2	2.1
Zinc (DTPA)	mg/kg	50.00	9.30	7.90
Copper (DTPA)	mg/kg	5.10	5.70	2.30
Iron (DTPA)	mg/kg	280.0	210.0	150.0
Manganese (DTPA)	mg/kg	38.0	18.0	93.0
Boron (Hot CaCl2)	mg/kg	1.6	0.6	0.7

The results in this report pertain only to the sample submitted. Analyses performed on soil dried at 40°C and ground to 2mm or less, excluding moisture tests, or as otherwise indicated. Analyses performed on plant dried at 70°C and ground to 1mm or less, excluding moisture tests, or as otherwise indicated. Water analyses performed on an 'as received' basis. Analytical results reported by the laboratory as 'less than' the level of reporting, will be deemed by NA Pro as being equivalent to the level of reporting for both calculation and interpretive purposes. This document shall not be reproduced except in full.

SUMMARY REPORT

GHD		**Service Provider:**	ELDERS - Goulburn
		Advisor/Contact:	Daniel Lewis
Dubbo		**Phone:**	0457 863 855
NSW		**Purchase Order:**	KN 8880

Sample No		022320242	022320244	022320238
Paddock Name		15	16	23
Sample Name				
Sample Depth (cm)		0 - 10	0 - 10	0 - 10
Sampling Date		30/11/2020	30/11/2020	30/11/2020
Test Code		E13	E13	E13
Sample Type		Soil	Soil	Soil
Analyte	**Unit**	**Result**	**Result**	**Result**
Soil Colour		Brown	Brown	Brown
Soil Texture		Clay Loam	Clay Loam	Clay Loam
Moisture	%	8	13	9
pH (1:5 Water)		5.7	5.3	5.6
pH (1:5 CaCl2)		4.8	4.6	4.7
Electrical Conductivity (1:5 water)	dS/m	0.05	0.08	0.06
Electrical Conductivity (Sat. Ext.)	dS/m	0.4	0.6	0.5
Chloride	mg/kg	<10	17	13
Organic Carbon (W&B)	%	4.0	2.8	3.6
Nitrate Nitrogen	mg/kg	1.9	15.0	2.6
Ammonium Nitrogen	mg/kg	4.9	2.2	3.7
Phosphorus (Colwell)	mg/kg	370	310	110
Phosphorus Buffer Index		220	150	130
Sulphur (KCl40)	mg/kg	9	9	9
Cation Exch. Cap. (CEC)	cmol(+)/kg	8.2	5.0	8.8
Calcium (Amm-acet.)	cmol(+)/kg	5.3	2.8	4.9
Magnesium (Amm-acet.)	cmol(+)/kg	2.3	1.3	3.0
Sodium (Amm-acet.)	cmol(+)/kg	0.11	0.06	0.12
Potassium (Amm-acet.)	cmol(+)/kg	0.28	0.46	0.54

SUMMARY REPORT

GHD		**Service Provider:**	ELDERS - Goulburn
		Advisor/Contact:	Daniel Lewis
Dubbo		**Phone:**	0457 863 855
NSW		**Purchase Order:**	KN 8880

Available Potassium	mg/kg	110	180	210
Aluminium (KCl)	cmol(+)/kg	0.2	0.3	0.3
Aluminium % of Cations	%	2.4	6.7	3.3
Calcium % of Cations	%	64.0	56.0	56.0
Magnesium % of Cations	%	28.0	27.0	34.0
Sodium % of Cations (ESP)	%	1.30	1.20	1.40
Potassium % of Cations	%	3.40	9.10	6.10
Calcium/Magnesium Ratio		2.3	2.2	1.6
Zinc (DTPA)	mg/kg	18.00	29.00	14.00
Copper (DTPA)	mg/kg	10.00	12.00	2.70
Iron (DTPA)	mg/kg	480.0	480.0	230.0
Manganese (DTPA)	mg/kg	25.0	19.0	58.0
Boron (Hot CaCl2)	mg/kg	0.6	0.4	0.6

The results in this report pertain only to the sample submitted. Analyses performed on soil dried at 40°C and ground to 2mm or less, excluding moisture tests, or as otherwise indicated. Analyses performed on plant dried at 70°C and ground to 1mm or less, excluding moisture tests, or as otherwise indicated. Water analyses performed on an 'as received' basis. Analytical results reported by the laboratory as 'less than' the level of reporting, will be deemed by NA Pro as being equivalent to the level of reporting for both calculation and interpretive purposes. This document shall not be reproduced except in full.

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	P Dellow	W Davies		P.Dellow		13.04.21

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Appendix F – Surface water assessment

NSW Department of Planning Industry and Environment

Hurlstone Agricultural School

Surface Water Assessment

April 2021

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Table index

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1. Background

GHD Pty Ltd (GHD) has been engaged by the Department of Planning, Industry and Environment (DPIE) to assess the environmental impact associated with the upgrading of Hurlstone Agricultural High School's (HAHS) educational dairy and agricultural facilities (the proposal).

The site encompasses an area of about 120 hectares and is located on Roy Watts Road, Glenfield about 13 kilometres north of Campbelltown and is within the Campbelltown local government area (LGA).

The future agricultural activities planned for the site have the potential to impact on the existing local environment and land uses, including impacts on environmental values and on future sensitive receptors within the proposed masterplan. Accordingly, GHD have prepared an Environmental Report, which outlines the environmental impacts associated with the project.

A masterplan for the development at HAHS was produced by Group GSA (dated 22 January 2018) and is shown in Figure 1 (Mott Macdonald, 2018).

Figure 1 Group GSA Concept Urban Design Plan 22/01/18 (Mott Macdonald, 2018)

Based on the *Group GSA Masterplan* shown in Figure 1, Mott Macdonald prepared a strategy for flood risk management and Water Sensitive Urban design (WSUD) (Mott Macdonald, 2018). Since the Mott Macdonald report was produced, a new Concept Masterplan has been developed by Fitzpatrick + Partners (Fitzpatrick + Partners Architects, 2020). The *Fitzpatrick + Partners Concept Masterplan* is shown in Figure 2.

Figure 2 Fitzpatrick + Partners Concept Masterplan (Fitzpatrick + Partners Architects, 2020)

The development of an indicative surface water management plan based on the Fitzpatrick + Partners Precinct Concept Plan and the water management strategy developed by Mott Macdonald will be the focus of this report.

2. Scope

The scope of works for this project is:

- Review of relevant reports, data, masterplans, proposed activities, layout and features.
- Undertake a surface water risk assessment. This will involve identifying the water related risks associated with the proposed layout and activities, integrating this with an understanding of the surrounding waterways, receptors, topography, land uses and water infrastructure (e.g. basins, drains). Subsequently key water management concepts or features will be developed.
- These risks will then be used to develop an indicative plan of how surface water could potentially be managed for the farm activities as well as potential ongoing monitoring requirements. Specifically, this will consider (as per the requirements of the brief) any ability to utilise the water quality controls proposed to treat runoff from the urban development, and confirm the farm can be integrated into these controls (e.g. Water Quality Control Basins) with respect to groundwater impacts.
- Potential impacts in relation to surface water that could arise if the above plan is implemented will then be assessed and documented in the Environmental Report. These will be of a level of detail necessary to identify key issues that could impact on the viability of the proposal and will include the following:
  - Water sourcing and security
  - Water quality
  - Flooding
  - Water conveyance and stormwater controls
  - Water discharge locations and integration with surrounding water features/topography.

2.1 Limitations

This report has been prepared under the limitations set out in Section 1.4 of *Hurlstone Agricultural High School Environmental Report* (GHD, 2021).

In addition, our scope was on the basis that floodplain filling and drainage layout conditions will not differ from that presented in the Mott MacDonald Water Cycle Report to the extent that re-simulation of the flood modelling undertaken previously is required. Based on our understanding of the proposed revised precinct layout plan we anticipate this assumption is likely to be accurate. Furthermore, we have not allowed for detailed quantification of water related risks for the highest risk water (such as wastewater quality of the water from the piggery areas, etc) on the basis that it would be captured and disposed of as wastewater, nor have we allowed for a detailed water balance quantification, or impacts on groundwater.

We have not allowed for water quality sampling at this stage, based on the level of assessment required. However, it would likely be recommended for future stages.

3. Review of documentation

A review of the following documents has been undertaken to gain an understanding of the potential impacts from the proposed redevelopment of the HAHS Farm Facilities on surface water management.

Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018)

This report provides an assessment of the proposed works to ensure that stormwater and flood risk principles have been satisfactorily considered. The strategy was developed using an integrated approach to flood risk management and Water Sensitive Urban Design (WSUD) principles. The report includes water quality modelling, flood modelling and gives locations for water detention and treatment areas.

This report includes the *Group GSA Masterplan* which gives locations and development types at HAHS (Mott Macdonald, 2018).

Statement of Environmental Effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School (Lean, 2020)

This Statement of Environmental Effects considers the impact on the environment of changes to farming practices at HAHS. Among other topics it describes effluent management, water supply, soil erosion and water reuse.

Hurlstone Agricultural High School Farm Facilities Redevelopment Concept Masterplan (Fitzpatrick + Partners Architects, 2020)

In comparison to the *Group GSA Masterplan*, the *Fitzpatrick + Partners Concept Masterplan* has the following characteristics:

- An increase in agricultural areas and a reduction in residential areas in the centre of the site.
- An increase in agricultural areas and a removal of cycleway and pedestrian areas to the north of the site.
- The addition of a Farm Hub in the centre of the site.

These changes in land uses will have an impact on pervious areas, flow paths and pollution runoff and will therefore have an impact on surface water management at the HAHS site.

4. Risk Assessment

4.1 Stormwater quality

Stormwater quality is influenced by land use. Therefore, changes in the masterplan for HAHS are likely to cause changes in stormwater quality. A comparison of the *Group GSA Masterplan* and the *Fitzpatrick + Partners Concept Masterplan* was undertaken and changes in land use were compared with *WaterNSW guidelines for the Model for Urban Stormwater Improvement Conceptualisation* (MUSIC) (WaterNSW, 2012). Land use changes and a discussion of MUSIC modelling are shown in Table 1.

Table 1 Comparison of land use type between Group GSA Masterplan and Fitzpatrick + Partners Concept Masterplan

No.	Group GSA Masterplan	Fitzapatrick + Partners Precinct Concept Plan	Discussion
1.	Residential	Agricultural	Modelling required.
2.	Residential	Primary school	WaterNSW advise to adopt residential values for schools. Therefore, these have the same pollutant concentrations and do not require modelling.
3.	Residential	Urban space	WaterNSW advise to adopt residential values for urban space. Therefore, these have the same pollutant concentrations and do not require modelling.
4.	Primary school	Farm hub	The Farm Hub will have a separate surface water management system as described in (Lean, 2020). Therefore, no surface water modelling has been undertaken.
5.	Drainage corridor	Primary school	This is less than 1500 m^2 or less than 0.1% of the site. Due to its relative size, it has been excluded from this analysis.
6.	Primary school	Agriculture	WaterNSW advise to adopt residential values for agriculture and schools. Duplicate of 1.

The comparison of land use types and MUSIC modelling guidelines shown in Table 1 demonstrates that one change of land use type needs to be modelled, from residential to agricultural land use.

4.1.1 MUSIC model parameters

A MUSIC model was developed using the parameters from WaterNSW and from *WaterNSW guidelines for the Model for Urban Stormwater Improvement Conceptualisation* (WaterNSW, 2012). This model was established for comparative purposes only.

Rainfall data

Stormwater quality analysis requires historical rainfall data recorded by a pluviograph station. Pluviograph data from Liverpool (67035 – 6-minute interval) has been used for the site. This station was considered appropriate as it is situated relatively close to the site and has periods of dry and wet weather.

Table 2 Liverpool (Whitlam Centre) Pluviograph Data

Station no.	Location	Records	Data interval
067035	Liverpool (Whitlam Centre	1967-1976	6 minute

Pollution generation

The comparison undertaken was between Residential and Agricultural areas. The stormwater pollutant generation parameters for total suspended solids, total phosphorus and total nitrogen were adopted in accordance with WaterNSW guidelines (WaterNSW, 2012). The parameters are specified in Table 5.

Table 3 MUSIC parameters (WaterNSW, 2012)

Soil properties		TSS		TP		TN	
		Mean	St dev	Mean	St dev	Mean	St dev
Residential	Base flow	1.2	0.17	-0.85	-0.6	0.11	0.12
	Storm flow	2.15	0.32	0.25	0.11	0.3	0.19
Agricultural	Base flow	1.4	0.13	-0.88	0.32	0.074	0.13
	Storm flow	2.3	0.31	-0.27	0.074	0.59	0.26

Soil data

The soil characteristics were adopted in accordance with *Glenfield Planned Precinct - Western Precinct Water Cycle Report* (Mott Macdonald, 2018). The parameters are shown in Table 4.

Table 4 MUSIC soil parameters

Soil properties	Residential	Agricultural
Impervious threshold (mm)	1.4	1.4
Soil storage capacity (mm)	170	170
Initial storage (% of capacity)	30	30
Field capacity (mm)	70	70
Infiltration coefficient ‘a’	210	210
Infiltration coefficient ‘b’	4.7	4.7
Initial groundwater depth (mm)	10	10
Daily recharge rate (%)	50	50
Daily baseflow rate (%)	4	4
Daily deep seepage rate (%)	0	0

Comparative results from the MUSIC modelling are shown in Table 5.

Table 5 Comparison of stormwater pollutants between Residential and Agricultural land uses

Pollutant	Annual pollutant load	Mean rainfall event pollutant load	90th percentile rainfall event pollutant load	Maximum rainfall event pollutant load
Total suspended solids	Lower	Lower	Lower	Lower
Total phosphorous (TP)	Lower	Lower	Lower	Higher
Total nitrogen (TN)	Lower	Lower	Lower	Higher
Gross pollutants	Lower	Lower	Lower	Lower

Table 5 shows that target pollutants have a lower annual load from agricultural areas compared to residential areas. Although this trend was also seen in mean and 90th percentile rainfall event pollutant runoff, in maximum rainfall events TP and TN recorded higher values. This is likely due to higher rainfall events leading to higher erosion of soil.

In addition, it is difficult to estimate nutrient runoff from agricultural areas, due to different farming practices both between farms and also over time. Therefore, this risk assessment is preliminary only.

4.2 Flooding

4.2.1 Comparison of flooding

Flood modelling is beyond the scope of this report, a comparison of flood modelling between the *Group GSA Masterplan* and the *Fitzpatrick + Partners Concept Masterplan* has not been undertaken. However, insight into flooding at the site under the *Fitzpatrick + Partners Concept Masterplan* can be gained by examining changes in impervious areas. An decrease in impervious area generally leads to decreased runoff which can lead to decreased flooding. Changes in land use type and estimated impervious fractions have been estimated for the for the two masterplans. Impervious fraction estimates are based on figures from Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018). They are summarised in Table 6.

Table 6 Comparison of runoff percentage between Group GSA Masterplan and Fitzpatrick + Partners Precinct Concept Plan

Land use in "Concept Urban Design Plan" 22 January 2018.	Percentage impervious "Concept Urban Design Plan" 22 January 2018.	Land use "Fitzpatrick + Partners Architects" 23 September 2020	Percentage impervious "Fitzpatrick + Partners Architects" 23 September 2020
High density, medium density, low density small lots < 450 m^2	90	Rural	5
Low density hillside 450 m^2 – 750 m^2	80	Rural	5
Low density large lots 800-1000 m^2	70	Rural	5
Open space	10	Rural	5
Age exclusive precinct	90	Farm hub	Unknown
Primary school	20	Farm hub	Unknown

Table 6 shows that for each change in land use, there is a significant reduction in impervious area and therefore a likely reduction in runoff. The impervious fraction of the farm hub is unknown. However, due to it having a separate water management system (Lean, 2020) and also due to its size compared to the remainder of the site, the risk to flooding of increased runoff is considered small.

In terms of flooding, the reduction in impervious areas identified in Table 6 may decrease runoff and therefore flooding at the site. This will need to be confirmed with flood modelling.

4.2.2 Location of detention basins

A comparison of the location of detention basins in the *Glenfield Planned Precinct - Western Precinct Water Cycle Report* (Mott Macdonald, 2018) and the *Fitzpatrick + Partners Concept Masterplan* found that there is a potential clash between Basin B3 and an underpass in this area, linking the agricultural areas south of the proposed Cambridge Avenue extension. The underpass is also located in a flood zone. This will need to be further investigated at later stages of design.

4.2.3 Overland flow paths

Due to the level of detail provided in the masterplan, no comment can be made on changes to overland flow paths.

4.3 Interaction with groundwater

Groundwater levels have been assessed by GHD in *Hurlstone Agricultural High School Groundwater Assessment* (GHD, 2021). This report found that due to the relatively deep water table of around 10m below ground surface, and a clay profile, minimal, if any, surface water / groundwater interaction is expected.

4.4 Water sourcing and security

The increase in agricultural areas and the decrease in residential areas at the HAHS site will see a decline in urban potable water demand and an increase in demand for stock and irrigation consumption. There is a risk that with the current water servicing strategy, these demands may not be able to be met.

5. Indicative water management plan

5.1 Stormwater quality

The MUSIC modelling undertaken in Section 4.1.1 predicted lower pollutant export from the *Fitzpatrick + Partners Concept Masterplan* compared to the *Group GSA Masterplan.* Therefore, the proposed treatment outlined in the Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018) is predicted to be suitable to manage this comparatively reduced pollutant load.

There is uncertainty of the exact nature of farming methods to be used at HAHS. Therefore, estimating pollutant loads has been undertaken on preliminary information only. This will need to be updated at later stages of design based on specific consideration of the nature of the activities and materials posing a water quality risk. There may also be a need for water quality monitoring dependent on the outcomes of these specific considrations.

5.2 Flooding

The impervious area of the site is predicted to decrease as discussed in Section 4.2.1. It is predicted that this will lead to a decrease in runoff and therefore flooding.

To confirm that flooding risk is acceptable, flood modelling will need to be undertaken.

Impervious areas on farmland can also change over time due to reduced ground cover, soil compaction and other factors. Farm management techniques should consider these risks.

Apart from the underpass proposed at Basin 3 in the *Fitzpatrick + Partners Concept Masterplan*, no significant additional risks were identified to those in the Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018). Further flood modelling is required at detailed design to better understand and respond to flooding risks.

5.3 Water sourcing and security

To manage the increased demand in stock and irrigation water, the following sources could be further investigated:

- Rainwater harvesting in the farm hub area
- Water reuse in the farm hub area
- Groundwater sources
- Recycled water supply from Sydney Water.

6. Recommendations

Based on the high-level review of surface water for HAHS, the following recommendations are made:

- Investigate the location of the underpass that connects the proposed primary school and agricultural areas to the north of the proposed Cambridge Avenue extension. There is a potential conflict with Basin 3.
- Farm management practices should address erosion and pollutant runoff.
- HAHS should develop an effluent management plan for the farm area that utilises the information from this report and the SEE to ensure that the disposal of effluent from the farm hub minimises runoff to waterways and is informed by future development of the site.
- The farm facilities should be designed to achieve compliance with relevant stormwater pollutant levels and flooding requirements. It is recommended that detailed modelling be undertaken during design development to provide specific guidance around appropriate mitigation measures.
- It is likely that stormwater pollutant management can be managed as outlined in Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018) if suitable farming practices are adopted.
- It is likely that flooding can be managed as outlined in Glenfield Planned Precinct - Western Precinct Water Cycle Report (Mott Macdonald, 2018) if consideration of grading, and flow paths are considered.

These recommendations are made on the recognising the limitations set out in Section 2.1.

7. References

Environment Protection Authority. (2016). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Sydney: State of NSW and Environment Protection Authority.

Fitzpatrick + Partners Architects. (2020). *Hurlstone Agricultural High School farm facilities redevelopment. Version 6.*

GHD. (2021). *Hurlstone Agricultural High School Environmental Report.*

GHD. (2021). *Hurlstone Agricultural High School Groundwater Assessment.*

Lean, I. J. (2020). *Statement of environmental effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone Agricultural High School.* Scibus.

Mott Macdonald. (2018). *Glenfield Planned Precinct Western Precinct Water Cycle Report.*

WaterNSW. (2012). *Using MUSIC in Sydney Drinking Water Catchment. A WaterNSW Standard.* Parramatta: WaterNSW.

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Appendix G – Groundwater assessment

NSW Department of Planning, Industry and Environment

Hurlstone Agricultural High School
Groundwater Assessment

April 2021

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Acronyms and Abbreviations

Acronym /abbreviation	Full Name
ADWG	Australian Drinking Water Guidelines
AHD	Australian Height Datum
AIP	Aquifer Interference Policy
ALS	Australian Laboratory Services
ASS	Acid sulfate soils
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
CFU/100 mL	Colony Forming Units Per 100 Millilitres
DPIE	Department of Planning, Industry and Environment
DPIE-Water	Department of Planning, Industry and Environment – Water
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater dependent ecosystem
GHD	GHD Pty Ltd
GMR	Greater Metropolitan Region
HAHS	Hurlstone Agricultural High School
LTAAEL	long-term average annual extraction limit
RPD	Relative Percentage Difference
WM Act	*Water Management Act 2000*
WSPs	Water sharing plans

1. Introduction

1.1 Background

A draft masterplan has been prepared by the Department of Planning, Industry & Environment (DPIE) for the site of the Hurlstone Agricultural High School (HAHS) for a re-development incorporating residential, schools and agricultural components.

The Department of Education is required to obtain a greater understanding of the potential land use conflicts that may occur between these uses and its education farm facility. As such, an environmental impact assessment is required for which groundwater is one component.

1.2 Scope of works

The groundwater assessment scope of works that considers the masterplan includes:

1. Review and summarise any applicable statutory policies and standards relating to groundwater and groundwater contamination.
2. Review of existing reports and existing data to understand the gaps in groundwater characteristics on and off-site.
3. Identification of groundwater receptors and inter-connection with surface water prior to, and after, new works.
4. Identification of the activities that have impacts or potential impacts to groundwater.
5. Install additional field installation of piezometers for monitoring groundwater levels and quality. Undertake slug tests to determine aquifer characteristics that will further refine groundwater receptors and fate of potential contaminants, including discharges to surface water. The purpose of the field component is to fill or close the gaps in base data reviewed in item (2).
6. Background groundwater monitoring in conjunction and coordination of the farm activities to assess the base impact (for comparison demonstrating ‘improvement’ later).
7. Operational recommendation to meet best practice (e.g., odour, herbicide and pesticide spray drift controls and mitigation measures) – this will be done by the broader team; however, groundwater team could provide input from a groundwater perspective.
8. Assess any impacts of irrigation and the farming techniques on the local groundwater system indicating any mitigation measures, if required.
9. Conclusion – Assessment of the proposed impacts of the new facility on those receptors identified in item (3) and item (5).

1.3 Limitations

This report: has been prepared by GHD for NSW Department of Planning, Industry and Environment and may only be used and relied on by NSW Department of Planning, Industry and Environment for the purpose agreed between GHD and NSW Department of Planning, Industry and Environment as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Department of Planning, Industry and Environment arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 7 and 8 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

2. Regulatory Context

A number of legislation and policy exists around the use and protection of groundwater resources in NSW. These include:

- *Water Act 1912 (progressively being replaced by Water Management Act 2000)*
- *Water Management Act 2000 (NSW) - (supersedes Water Act 1912)*
- *Water Management (General) Regulation 2018*
- *Water Supply / (Critical Needs) Act 2019*
- *NSW Aquifer Interference Policy*
- *NSW State Groundwater Policy Framework document*
- *NSW Groundwater Quality Protection Policy*
- *NSW State Groundwater Dependent Ecosystem Policy.*

The relevant legislation and policies to the master plan are detailed in this section.

2.1 Environment Protection and Biodiversity Act 1999

The *Environment Protection and Biodiversity Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance'.

An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' is deemed a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Environment Minister. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

The EPBC Act is also relevant to the determination of the ecological value of a groundwater dependent ecosystem (GDE). If a GDE contains a threatened species as listed under the EPBC Act, the GDE is then taken to have a higher ecological value. These guidelines contain no specific requirements for the consideration of groundwater issues but do require broad consideration of the potential environmental impacts on all aspects of the environment.

2.2 Water Management Act 2000

The *Water Management Act 2000 (*WM Act*)* is administered by DPIE and is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. The WM Act is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. The intent and objectives of the WM Act have been considered as part of this assessment. Specific requirements of the WM Act applicable to this assessment are discussed further below.

2.2.1 Water Access Licence

The WM Act requires that licenses are obtained to install infrastructure (a well) within an aquifer for an intended purpose. It also requires that an access licence is required to take a given volume of water from a groundwater source.

If a license is required, then water extraction monitoring may be required in accordance with the NSW Water Extraction Monitoring Policy (2007). It is up to the discretion of the licensing authority Department of Planning, Industry and Environment – Water (DPIE-Water) to determine if water metering will be required under this guidance.

2.2.2 Water Sharing Plans

The WM Act requires the development of water sharing plans (WSPs) to manage water use and access. The DPIE-Water website states that water sharing plans aim to:

- Clarify the rights of the environment, basic landholder rights users, town water suppliers and other licensed user
- Define the long-term average annual extraction limit (LTAAEL) for water sources
- Set rules to manage impacts of extraction
- Facilitate the trading of water between users.

WSP for the Greater Metropolitan Region Groundwater Sources

The site is located within the Greater Metropolitan Region (GMR) Unregulated River Water Sources – Southern Sydney Rivers.

The WSP for the GMR Groundwater Sources covers 13 groundwater sources on the east coast of NSW. The background document for the WSP lists the Sydney Basin Central groundwater source. This groundwater source is bounded by the main arm of the Hawkesbury River to the north and by the Nepean River to the west and south. Much of Sydney’s population is within this groundwater source (with a total area of 3,757.59 square kilometres), and bores are evenly distributed across the area. The LTAAEL of this groundwater source is 45,915 ML/year.

The WSP provides a legislative basis for sharing the water between the environment and the consumer.

2.3 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) was finalised in September 2012 (NOW, 2012) and clarifies the water licencing and approval requirements for aquifer interference activities in NSW. Many aspects of this Policy will be given legal effect in the future through an Aquifer Interference Regulation. Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011.

The policy indicates that activities with the potential to contaminate groundwater are considered to be an aquifer interference activity.

The NSW AIP states that aquifer interference approval will not be granted unless the “Minister is satisfied that adequate arrangements are in force to ensure that no more than minimal harm will be done to any water source, or its dependent ecosystems, as a consequence of being interfered with” by the activities the approval relates to.

The minimal impact criteria for the groundwater source at the site are summarised below:

- With regard to the water table, impact is considered to be minimal where the water table change is less than 10 percent of the cumulative variation in the water table 40 metres from any high priority GDE or high priority culturally significant site listed in the water sharing plan. If an impact is greater than this it must be demonstrated to the Ministers satisfaction that the variation will not prevent the long-term viability of a GDE of cultural significance. There are no high priority sites listed in the water sharing plan near to the site; however, site specific potential GDEs have been identified that are considered to be high priority and are considered in this report (See Section 3.7.5).

- With regard to the water table, impact is considered to be minimal where there is less than a cumulative 2 metre decline at any water supply work. If the impact is greater make good provisions apply.
- With regard to water pressure, impact is considered to be minimal where the cumulative decline in head is less than 2 metres at any water supply work. If the impact is greater, then further studies are required to satisfy the Minister that long term viability of the affected water supply works will not be affected. Otherwise make good provisions will apply.
- With regard to water quality, impact is considered to be minimal where the change in groundwater quality is within the current beneficial use category of the groundwater source beyond 40 metres from the activity. If this cannot be achieved studies will need to demonstrate that the change will not prevent the long-term viability of the dependent ecosystem or affected water supply works.

If the predicted impacts are less than the minimal impact criteria, then impacts will be considered as acceptable.

Additional restrictions cover the interception of groundwater that underlies Biophysical Strategic Agricultural Land (BSAL), its dependent ecosystems or other water users. This project is not located within or near to BSAL.

The assessment considers the potential impacts identified against the criteria outlined above.

2.4 Policies and guidelines

2.4.1 NSW State Groundwater Policy Framework Document (DLWC, 1997)

The objective of the NSW State Groundwater Policy Framework Document (NSW Government 1997) is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. The NSW groundwater policy has three component parts:

- NSW Groundwater Quantity Protection Policy outlined in DLWC (1997)
- NSW Groundwater Quality Protection Policy (DLWC, 1998)
- NSW Groundwater Dependent Ecosystems Policy (DLWC, 2002).

NSW Groundwater Quantity Protection Policy

The principles of this policy include:

- Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
- Groundwater extraction shall be managed to prevent unacceptable local impacts.
- All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

These principles are implemented under the WM Act and the AIP, which have been discussed above.

NSW Groundwater Quality Protection Policy

The objective of this policy is the ecologically sustainable management of the state's groundwater resources so as to:

- Slow and halt or reverse any degradation in groundwater resources.
- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater.
- Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource.
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

NSW Groundwater Dependent Ecosystems Policy

This policy was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

These criteria will be incorporated into the assessment by assessing the Site against the requirements outlined in the water sharing plan and the AIP.

2.4.2 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) policy and principles document (ARMCANZ/ANZECC, April 1994) provides an overview of the principles for water quality management in Australia. The primary objective of the guideline/policy is:

"to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development."

The policy and principles document states that:

"the generally accepted mechanism for establishing in-stream or aquifer water quality requirements is a two-step process which involves:

- *establishing a set of environmental values, and*
- *establishing scientifically based water quality criteria corresponding to each environmental value."*

Environmental values are often interchanged with the term beneficial use (which is referred to in regard to minimum impact criteria set in the aquifer interference policy in Section 2.3) and are identified in the guidance to include:

- Ecosystem protection
- Recreation and aesthetics
- Drinking water
- Agricultural water (irrigation and stock water)
- Industrial water.

Ecosystem protection, in this context, refers to aquatic ecosystems which depend at least in part on groundwater to maintain ecosystem health (GDEs). Depending on the site setting, this may include surface water bodies such as wetlands, streams and rivers reliant on groundwater base flow, some estuarine and near-shore marine systems, as well as aquifer and cave ecosystems.

Criteria have been developed to characterise water quality relative to these environmental criteria and are outlined in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* and the Australian Drinking Water Guidelines (ADWG) and are discussed further below. The criteria specified in these documents have been used as the basis for assessing the current environmental values for this assessment and the treatment requirements for discharge to receiving water environments.

2.4.3 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The NWQMS provides a national framework for improving water quality in Australia's waterways. The main policy objective of the NWQMS is to achieve sustainable use of the nation's water resources, protecting and enhancing their quality, while maintaining economic and social development. The NWQMS process involves community and government interaction, and implementation of a management plan for each catchment, aquifer, estuary, coastal water or other water body. This includes the use of national guidelines for local implementation.

For this project the national guidelines on water quality benchmarks within the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZAST, 2018) are applicable and provide default trigger values of various analytes for comparison with sampled values. These guidelines were previously known as the ANZECC 2000. Guideline water criteria are presented in the guidelines for:

- Aquatic Ecosystems
- Primary Industries (which includes agricultural and industrial water criteria).

2.4.4 Australian Drinking Water Guidelines

The ADWG (NHMRC, 2013) provide a framework for the appropriate management of drinking water supplies to achieve a safe and appropriate point of supply. The guidelines provide a base standard for aesthetic and health water quality levels.

Where ADWG water quality trigger levels are above the ANZECC and ARMCANZ (2000) guideline levels, the most stringent of triggers between the two guidelines has been considered in the assessment. Characterisation of groundwater quality has been assessed using the ANZECC and ARMCANZ (2000) framework.

2.4.5 Recreational Water Quality

The *Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008) provide a framework to protect the health of humans from threats posed by the recreational use of coastal, estuarine and fresh waters.

Secondary contact of humans with water ways, these criteria (presented in ANZECC, 2000) are recommended for adoption for the protection of human health. Secondary contact criteria generally relate to the presence of toxicants associated with human waste (sewage) and are not considered to be contaminants of concern in site groundwater seepage, however, the *Recreational Waters Health Criteria* (NHMRC, 2008) are recommended as a guide for protecting human health These values are protective of human activities such as swimming and are therefore considered to be conservative.

2.4.6 ANZECC /ARMCANZ (2000) Irrigation – Long term trigger values

The irrigation guideline values were developed to minimise the build-up of contaminants in surface soils during irrigation and to prevent the direct toxicity of contaminants in irrigation waters to standing crops. Two values are presented in the guidance (long term and short-term trigger values). The long-term trigger values have been adopted in this document as they are more conservative, and it is considered that long term irrigation is plausible and more applicable to the sampled sites.

2.4.7 NSW Water Quality and River Flow Objectives

The *NSW Water Quality and River Flow Objectives* are the agreed environmental values and long-term goals for NSW's surface waters. The water quality objectives align with the ANZECC 2000 guidelines. The objectives set out:

- The community's values and uses for our rivers, creek, estuaries and lakes
- Provide a rage of water quality indicators to help assess whether the current conditions of our waterways support those values and uses.

2.4.8 Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales

The document *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (DEC, 2004) lists the sampling and analysis methods to be used when acquiring water samples for compliance with environmental protection legislation, a relevant licence or relevant notice.

2.4.9 Risk Assessment Guidelines for Groundwater Dependent Ecosystems

Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW, 2012) comprises four volumes and provides a conceptual framework for identifying and assessing ecosystems along with worked examples of assessments. The guidelines discuss the identification of high probability GDEs and also discuss the ecological value of GDEs. The results from the groundwater assessment will be used by ecological specialists to assess potential impacts on GDEs.

3. Existing Environment

3.1 Existing Groundwater Information and Data Sources

In September 2017, Senversa prepared a Preliminary Site Investigation (PSI) report for the HAHS and surrounding lands. This was followed by a Targeted Phase 2 site investigation report in April 2019.

3.2 Site Location

The site is located on Roy Watts Road, Glenfield, NSW and includes the HAHS and surrounding lands. A summary of the site location is provided in Table 3-1.

Table 3-1 Site Location

Information	Details
Site Address	HAHS and surrounding lands, Roy Watts Road, Glenfield, NSW
Lot and DP	Lot 1 in DP 177010; Lot 1 in DP 175963; Lot 5 in DP 808118; Lot 11 in DP 1201109; Lot 12 in DP 1201109; Lot 21 in DP 1035516; and Lot 22 in DP 1035516.
Local government area	Campbelltown City Council
Zoning	SP2 – Infrastructure (Educational Establishment; Public Purposes Corridor; Road)
Site Area	Approximately 200 ha
Approximate geographical coordinates	Northwest corner: 304124.725 easting, 6239831.455 northing. Northeast corner: 305660.804 easting, 6239606.404 northing. Southwest corner: 303542.601 easting, 6238630.748 northing. Southeast corner: 304850.699 easting, 6238488.008 northing.

3.3 Climate

Rainfall data has been obtained from the closest Bureau of Meteorology (BoM) weather station at Campbelltown (Georges River Road, Kentlyn – BoM Station number 068160). The Campbelltown weather station, located 9 km from the site, was identified as having the longest climatic record (from June 1966), however the record is incomplete as no data was recorded between July 1988 and December 2000.

Most rainfall occurs in the summer season with the highest average rainfall in March. The lowest mean rainfall occurs in the winter. The average annual rainfall is 754.9 mm.

Figure 3-1 presents the long-term monthly rainfall record for Campbelltown (Georges River Road, Kentlyn – BoM Station number 068160) along with the cumulative deviation from the mean rainfall. The cumulative rainfall departure (CRD) was calculated separately for each section of the rainfall record using the same mean monthly rainfall.

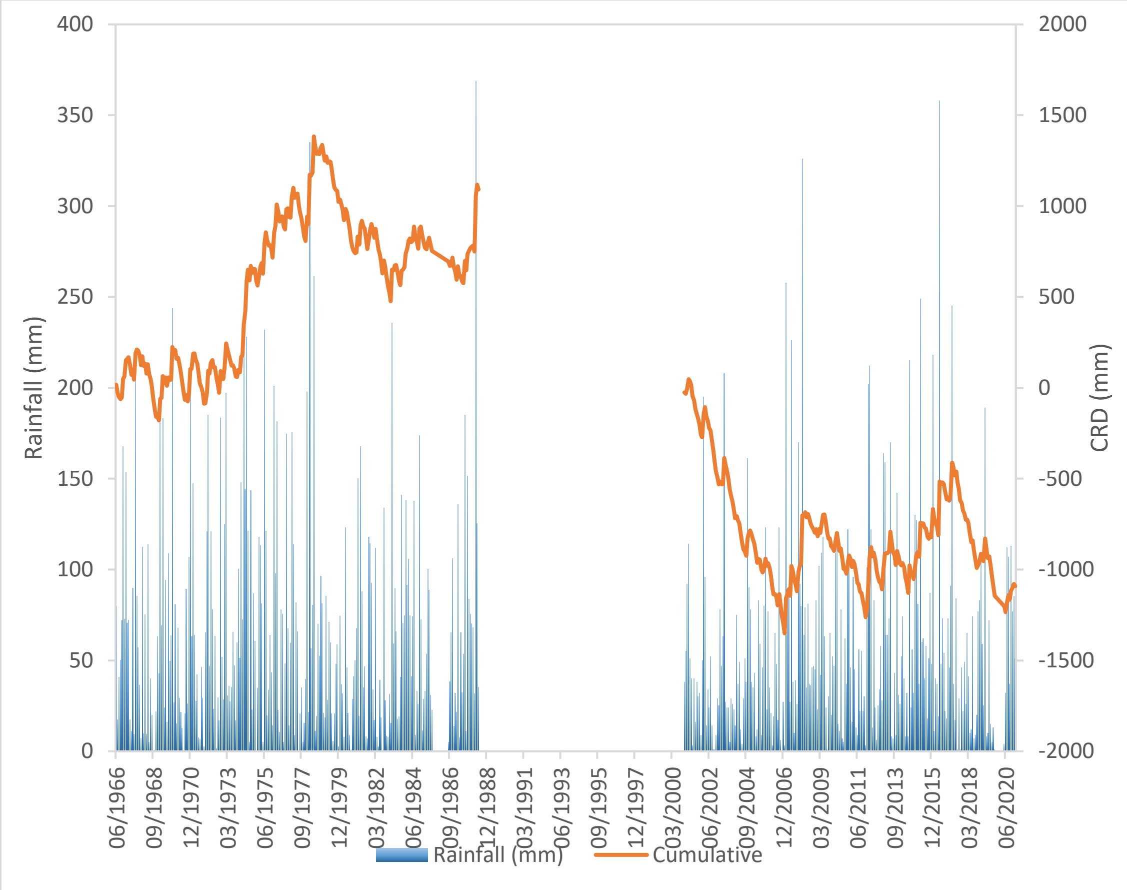


Figure 3-1 Rainfall and CRD for weather station Campbelltown (Georges River Road, Kentlyn – BoM Station number 068160).

The cumulative deviation plot shows distinct periods of above average rainfall between 1973 and 1978 and below average rainfall from 1999 to 2007. The plot also shows numerous small and intermediate scale fluctuation in rainfall.

Different types of aquifers have different responses to climatic variation, generally referred to as the groundwater response time. Shallow unconfined aquifers often respond to a small-scale fluctuation including individual rainfall events, whereas deeper regional scale, and semi-confined aquifers often show trends that are more aligned with larger scale variation.

The average annual rainfall from BoM Station for the available data from the BoM website is provided in Table 3-2.

Table 3-2 Average rainfall (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
068160	77.1	90.2	98.1	64.1	51.7	77.5	34	40.6	37.8	57.7	73	54.2	756

There is no long-term groundwater monitoring near the site. However, it is expected that the shallow groundwater system would reflect the rainfall trend observed in Figure 3-1, especially in recharge areas, although groundwater response time would lag behind rainfall. Recharge at the site is dependent on the infiltration capacity of the surficial attributes such as soil and vegetation and is discussed later.

Mean temperature data for Holsworthy Aerodrome Automatic Weather Station (AWS) (BoM Station Number 66161), located 5.9 km from the site, is provided in Table 3-3.

Temperature is available for 53 years (1968 to present).

Table 3-3 Average temperature (°C) - Holsworthy Aerodrome AWS (BoM Station Number 66161)

Station (66161)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
Mean Max Temp (°C)	28.5	27.9	26.4	23.8	20.6	17.8	17.4	19	21.7	24	25.5	27.5	23.3
Mean Min Temp (C)	18.3	18.2	16.3	12.8	9.4	6.8	5.2	6	8.7	11.9	14.5	16.8	12.1

There is no long-term evapotranspiration data available from BoM Station Number 66161 or in the near vicinity. As groundwater is approximately 10 m deep, it is unlikely that groundwater is affected by evapotranspiration, although transpiration may play a role in maintaining a water table at depth.

3.4 Topographical setting

The site is located within the local government area of Campbelltown City Council. It was identified in the PSI that the site had historically been used for farming. The elevation of the Site ranges from approximately 58 m Australian height datum (AHD) on the western portion of the site to 20 m AHD at the south east boundary of the site towards Bunbury Curran Creek.

It is expected that groundwater elevations would mirror topographic contours.

3.5 Surface water features

The site is located within the Lower Georges River and Bunbury Curran Creek sub-management zone of the Georges River Management Zone as per the GMR unregulated water sources WSP (2011). The Georges River catchment covers an area of 736 km^2. Generally, the catchment is a medium groundwater sensitivity to inflows.

There are several surface water dams on the site. The PSI identified an ephemeral drainage line between dams on the northern portion of the site, however it was dry at the time.

There are two waterways located near the site. Glenfield Creek to the north-east and Bunbury Curran Creek to the South-east. Both creeks drain into the Georges River, east of the site. These waterways are most likely shallow groundwater discharge zones.

3.6 Geology and sediments

The site is underlain by the Wianamatta Group, characterised by siltstone, carbonaceous claystone, claystone laminate and fine sandstone. A review of the NSW Seamless Geology map within NSW Resources and Geoscience's MinView interactive map tool shows four geological units, comprising of:

- Ashfield Shale (Twia): The eastern portion of the site, is underlain by dark grey to black claystone-siltstone and fine sandstone-siltstone laminate.

- Bringelly Shale (Twib): Located along the western portion of the site, it is comprised of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.
- Minchinbury Sandstone (Twim): A thin section observed in the centre of the Site, located between the Ashfield Shale and Bringelly Shale unit. This comprises fine to medium-grained quartz-lithic sandstone.
- Clastic sediment – Alluvium: The south-eastern portion of the site that follows along the Bunbury Curran Creek.

Soil sampling undertaken by Senversa on 6 December 2018 described the sediment as low to medium plasticity, brown, grey and yellow mottled clay or silt. Based on the Soil Landscapes of Sydney (eSpade2.0 Office of Environment and Heritage), most of the site is along Luddenham (9030lu) soil landscape with the northern and western boundaries along the Blacktown (9030bt) and the south-east corner along the South Creek (9030sc).

A review of Acid Sulfate Soil (ASS) maps suggests that the site is not located within an area likely to contain potential ASS. The site is not located within an area reported to have naturally occurring asbestos.

3.7 Hydrogeological conditions

3.7.1 Aquifer parameters

Ashfield Shale is considered to be a low-yielding aquifer or aquitard. Like the Hawkesbury Sandstone, its permeability is controlled by fracture intensity, persistence, and joint aperture. Groundwater within this unit is of high salinity, ranging from 5000-50000 mg/L (McNally, 2004).

Bringelly Shale is the top layer of the Wianamatta Group consisting of interbedded claystone and siltstone. It is interpreted as a coastal alluvial plain sequence grading up from a lagoonal-coastal marsh sequence at the base increasingly more terrestrial, alluvial plain sediments towards the top of the formation. Bringelly shale is weakly cemented. Groundwater yields and water quality is also low and saline respectively, similar to the Ashfield Shale. The groundwater in the shales has very limited environmental value due to poor water quality.

Although both Ashfield Shale and Bringelly Shale are primarily aquitards, they do have scattered zones of fracture porosity.

The Hydrogeology Map of Australia identified the aquifers on as being extensive, porous and of low to moderate productivity.

Regional groundwater within underlying the shale and sandstone bedrock is likely to flow towards the adjacent creeks and tributaries to the east / south-east, where it is likely to discharge. Groundwater flow most likely occurs in zones of higher permeability such as fractured facies, weathered zones, faults and joints, with these features also influencing local flow directions.

Groundwater flow within shallow fill and/or sediments will occur in zones of higher permeability with the local flow regime likely to follow bedrock topography, preferential pathways and temporal recharge conditions, with an overall seepage direction likely to be towards adjacent creeks and tributaries of Georges River.

3.7.2 Groundwater elevations

Groundwater monitoring wells on the site were gauged by Senversa on 18 December 2018. The groundwater elevations ranged between 24.480 m AHD (MW02) and 44.730m AHD (MW06). Groundwater flow was proposed to occur in a south-easterly direction for generally across the site and in an easterly direction in the northeast area of the site. The primary discharge of the shallow groundwater system are the local surface water receptors such as Bunbury Curran Creek to the south and the Georges River to the east.

3.7.3 Groundwater recharge

Based on groundwater elevations, groundwater recharge likely occurs at the high elevation in the north-western area of the site and groundwater discharge occurs towards the north-east and south-east area of the site.

The site lies within the Sydney Central Basin Groundwater Source of the GMR WSP. The hydrology map of Australia lists aquifers as typically extensive, porous and of low to moderate productivity.

3.7.4 Groundwater users

There are 16 registered groundwater bores within 2k m radius listed on the NSW Department of Primary Industry– Office of Water database (Senversa 2017). Most of these bores are explorational and do not have groundwater records.

3.7.5 Groundwater dependent ecosystems

Two groundwater dependent ecosystems, Cumberland Shale Plains Woodland and Cumberland River Flat Forest, have been identified from the BoM National GDE Atlas that have potential to exist on site.

3.8 Contaminated sites

A review of existing reports and data indicates that there is a range of potential on-site and off-site sources of contamination associated with current and historical land uses that could pose a moderate to high risk of contamination including:

- Agricultural land uses (e.g., sheep dips)
- Chemical and fuel storage
- Herbicide application
- On-site construction activities
- Surrounding commercial and industrial land uses.

3.9 Existing water quality

Senversa’s PSI listed the following exceedances for groundwater samples:

Human Health:

- Arsenic - 0.05 mg/L (MW07) against the ADWG criterion of 0.01 mg/L
- Nickel – 0.035 mg/L, 0.045 mg/L, 0.026 mg/L and 0.075 mg/L (MW01, MW03, MW04 and MW07 respectively) against the ADWG criterion of 0.02 mg/L
- Faecal coliform – 1 colony forming unit per 100 millilitres (CFU/100mL) against the ADWG criterion 0 CFU/100mL.

Ecological:

- Arsenic – 0.05 mg/L (MW07) against the criterion of 0.013 mg/L (ANZG 2018 - 95% Protection – Freshwater).

- Copper – 0.059 mg/L, 0.024 mg/L, 0.019 mg/L, 0.015 mg/L, and 0.014 mg/L (MW01, MW02, MW03, MW04 and MW07 respectively) against the criterion of 0.0014 mg/L (ANZG 2018 - 95% Protection – Freshwater).
- Nickel – 0.035 mg/L, 0.045 mg/L, 0.026 mg/L and 0.075 mg/L (MW01, MW03, MW04, and MW07 respectively) against the criterion of 0.011 mg/L (ANZG 2018 - 95% Protection – Freshwater).
- Zinc – in all wells between 0.013 mg/L and 0.124 mg/L against the criterion of 0.008 mg/L (ANZG 2018 - 95% Protection – Freshwater).

Senversa groundwater monitoring (2018) also found total dissolved solids of the groundwater to range between 6,672 mg/L and 13,680 mg/L.

Senversa (2018) concluded that the presence of the metal exceedances in both up and down gradient wells were likely resultant of regional elevated concentrations due to the urban and semi-urban environment.

4. Field investigation

4.1 Monitoring well installation

To appropriately characterise the physical and chemical properties of groundwater on-site and to adequately inform the impact assessment, GHD installed an additional three groundwater monitoring wells in the south and west of the site. The locations were selected to further delineate groundwater conditions over the entire site and to characterise groundwater quality migrating offsite along the down-gradient site boundary.

Terratest was engaged to drill and install the monitoring wells. A geoprobe was used to install all three monitoring wells. Push tubes then augers were used in all three wells, with the exception of MW10 which required the rotary air hammer after the push tubes to drill through the shale. The three wells were advanced in general accordance with GHD procedures, to varying depths specific to each location.

During drilling, soils were described on well logs by an environmental engineer from GHD in general accordance with the Unified Soil Classification System, with features such as discolouration, staining, odours and other indications of contamination being noted and soil samples collected. Soil samples were not deemed to be necessary to characterise the contamination on site, given these wells were not installed in any areas of concern. Well logs are presented in 0.

4.2 Groundwater monitoring

Groundwater was sampled from eight wells. Wells MW01, MW02, MW04 and MW07 were purged using a peristaltic pump and tubing until field parameters stabilized and then sampled.

Due to the low water level in MW06, the peristaltic pump was not able to draw water, hence this well was bailed.

As monitoring wells MW08, MW09 and MW10 were newly installed, they needed to be developed prior to sampling. This requires either purging the well dry or removing at least three times the well volume. MW08 had three times the well volumes removed via bailing, then left overnight to recharge. MW09 was purged dry via the peristaltic pump and left overnight to recharge. The next day (14^{th} January), MW08 and MW09 were purged using a peristaltic pump and tubing until field parameters stabilized and then sampled.

Well MW10 was purged the day before (14^{th} January), left to recharge overnight, and then grab sampled with a bailer due to low recharge rates. After the laboratory bottles were filled, field parameters were taken with the available remaining water.

Field parameters were measured using a YSI water quality meter. The calibration certificate is provided in Appendix B. The stabilised readings from the YSI are provided in Table 4-1.

Table 4-1 Field measured groundwater quality results

Well ID	Dissolved oxygen (mg/L)	Electrical conductivity (uS/cm)	pH	Eh (mv)	Temperature (degrees C)	Comment
MW01	1.58	5903	6.91	-61.1	21	Clear water, no odour, no sheen.
MW02	0.68	15551	6.97	19.9	19.9	Clear water, no odour, no sheen.
MW03	-	-	-	-	-	Roots obstructing well. No water sample could be obtained.

Well ID	Dissolved oxygen (mg/L)	Electrical conductivity (uS/cm)	pH	Eh (mv)	Temperature (degrees C)	Comment
MW04	0.34	10053	6.93	-9.2	20.9	Clear water, no odour, no sheen.
MW05						Dry
MW06	3.8	15897	7.07	-16.1	21.1	Clear water, no odour, no sheen.
MW07	0.25	13034	7.07	-58.8	21	Clear water, no odour, no sheen.
MW08	0.24	24750	6.95	-10.2	19.1	Water had a minor reaction when added to the sulphuric acid and nitric acid preserved laboratory bottles.
MW09	0.64	32,378	6.88	-136.4	21.2	Clear water, no odour, no sheen.
MW10	7.02	3,370	7.43	164.1	19.9	First bail was clear water, second bail was brown and turbid. Metals bottle was filled with clear water.

A review of the information presented in Table 4-1 indicates:

- The groundwater is neutral, with pH values ranging from 6.88 to 7.43.
- Electrical conductivity is variable across the site, ranging from 3,370 at MW10 to 32,378 at MW09. This is indicative of saline groundwater, typically found in Wianamatta group shales.

4.3 Laboratory analysis

Groundwater samples were submitted to a National Association of Testing Authorities certified testing laboratory, Australian Laboratory Services (ALS). A summary of the laboratory results is provided in the tables in Appendix C with laboratory analytical certificates in Appendix D. A summary of these results is provided in Section 5.1.

Laboratory analysis included:

- Major and minor cations and anions
- Nutrients (speciated nitrogen and phosphorus)
- Organo-chloro pesticides
- Organo-phosphate pesticides
- 8 Metals, aluminium, cobalt
- Biochemical Oxygen Demand
- Total Recoverable Hydrocarbons with silica gel clean up
- Benzene, toluene, ethylbenzene, xylene with silica gel clean up.

4.1 Slug tests

A rising head slug test was performed in wells MW04, MW06 and MW09 prior to data loggers being installed. A slug test is a method to determine the hydraulic conductivity (K) of the aquifer.

The “slug test” data can be analysed using the Hvorslev method.

If:

H = the initial head of water (water table or standing water level) prior to the test.

H_0 = the head of water immediately after adding (or removing) the slug of volume V.

h = head of water in the bore at time t after the slug of water was deposited (or removed).

r = radius of the bore screen (or screen plus filter pack).

t = time since the slug of water was deposited (or removed).

t_0 = the lag time determined from the graph where (h-H) / (H_0-H) = 0.37.

L = the length of bore screen below the water table.

The hydraulic conductivity can be calculated from;

$$K = \frac{r^2 \ln\left({}^{L}/_{r}\right)}{2Lt0}$$

Freeze and Cherry (1979) show that, if L > 8R, the mathematical solution to Hvorslev's partial differential equation for the initial conditions h=H_0 and t=0 for a rising head slug test is:

$$\frac{H-h}{H-H0} \approx e^{-t/_{t0}}$$

By plotting the log of (h –H) / (H_0 – H) against time we can determine t_0 and then K.

Well ID	K value (m/day)	Geology at base of well
MW04	0.196	Shale
MW06	0.023	Shale
MW09	0.074	Clay

These values indicate that the groundwater moves between 0.196 m/day to 0.023 m/day across the site. The difference between the wells can be explained by the geology in which they are installed. It is possible that shale fractures in MW04 gives rise to a higher K value, as groundwater transmits more readily in this geological area. Conversely, potentially less fractures in MW06 could explain a lower K value. Clay generally has a K value of approximately 0.05 m/day.

Overall, these K values are consistent with expected values for hydraulic conductivity in this geological formation.

4.2 Groundwater elevations

Data loggers were installed in MW04, MW06 and MW09 to determine the relationship between the groundwater elevations beneath the site to the rainfall. Loggers were left in the wells for three weeks.

These wells were chosen for their position across the Site. MW06 is located in the higher elevated area to the west of the Site, MW04 is in the middle and MW09 is near to the south eastern boundary.

The groundwater hydrograph in the MW06 is shown in Figure 4-2 and indicates that groundwater levels respond to long term weather patterns while the groundwater at the lower elevated area of the site (MW04 and MW09) show no immediate response to rainfall (shown in

Figure 4-1 and Figure 4-3 respectively). This would suggest that surface runoff and evapotranspiration play a larger role in rainfall response.

The groundwater levels in every well were measured prior to purging the wells to collect samples. These groundwater levels were used to produce a contour map as shown in Figure 4-4.

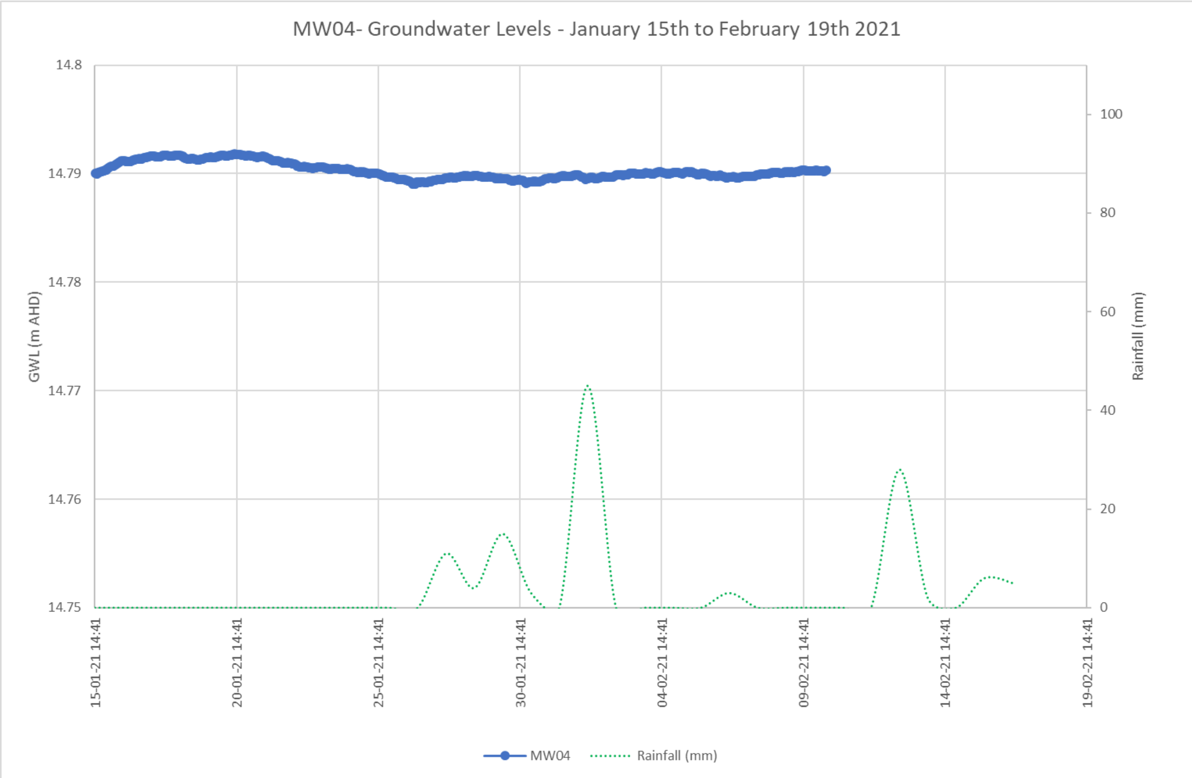


Figure 4-1 MW04 groundwater levels

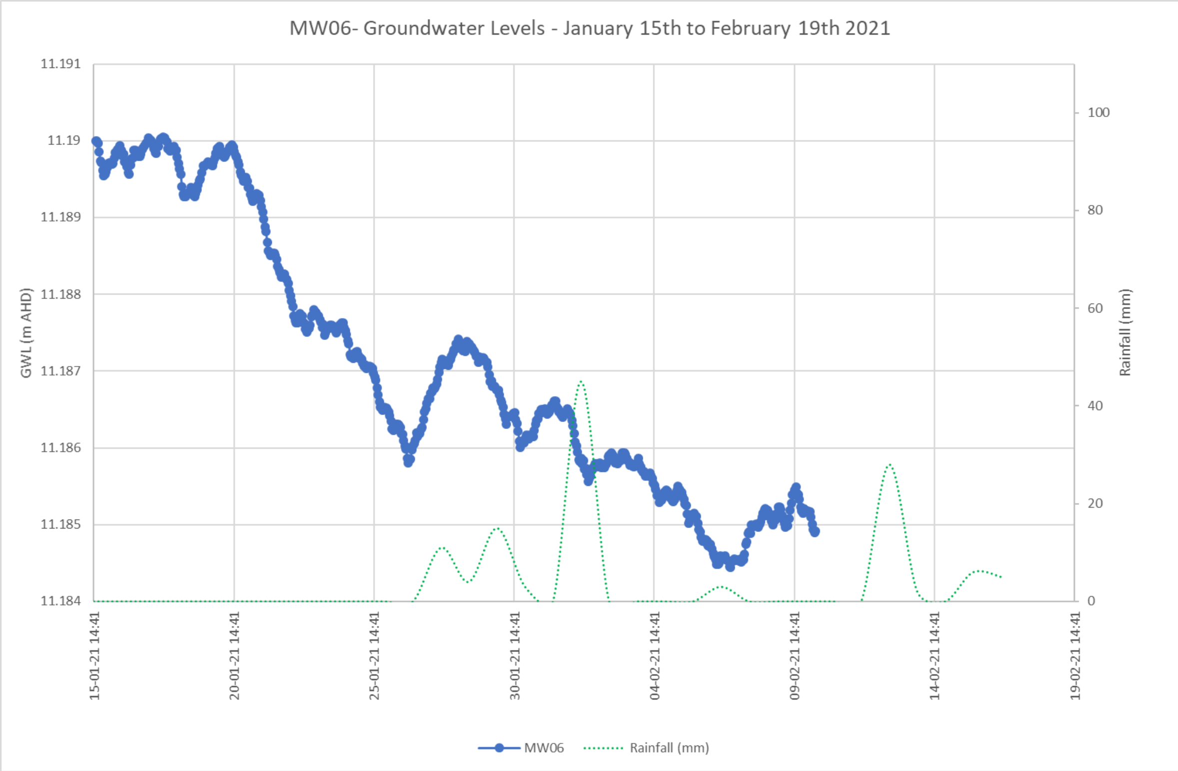


Figure 4-2 MW06 groundwater levels

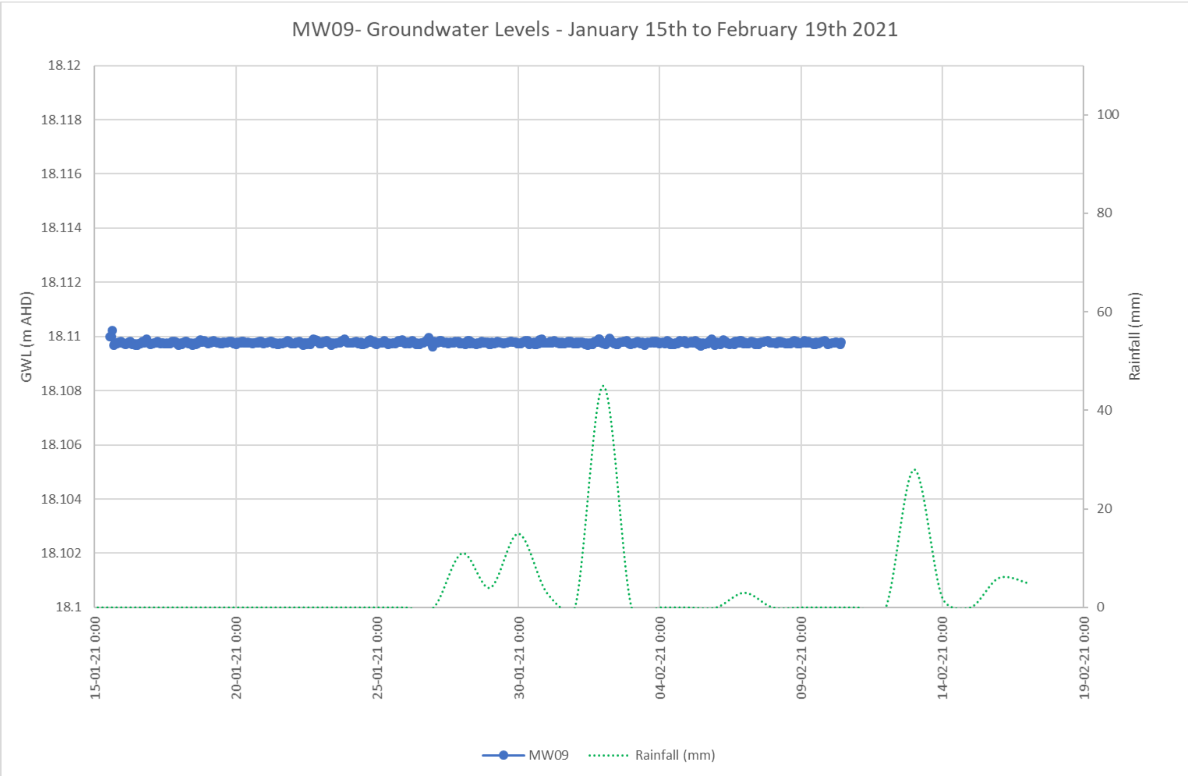


Figure 4-3 MW09 groundwater levels

Legend

Groundwater Monitoring Well

Inferred Groundwater Contour (mAHD)

Site Boundary

Cadstre

Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Project No. **12537824**
Revision No. **-**
Date **26/02/2021**

Groundwater contours

FIGURE 4-4

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z003_Groundwater_Contours.mxd
Print date: 26 Feb 2021 - 09:56

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

5. Water Quality

Groundwater samples taken on the 14th and 15th of January were analysed at ALS between 15th January and 25th January 2020.

5.1 Groundwater exceedances

A number of exceedances of the nominated assessment criteria were detected in groundwater across the site.

5.1.1 ADWG 2011 Health guideline

- Sulfate exceeded the guideline of 500 mg/L in MW09 with a concentration of 976 mg/L
- Arsenic exceeded the guideline of 0.01 mg/L in both MW07 and MW10 with a concentration of 0.032 mg/L and 0.013 mg/L respectively
- Nickel exceeded the guideline of 0.001 mg/L in MW10 with a concentration of 0.023 mg/L.

These exceedances are displayed graphically in Figure 5-1.

5.1.2 ANZECC Fresh Water 95% guideline

- Ammonia as N exceeded the guideline of 0.9 mg/L in MW10 with a concentration of 1.22 mg/L
- Aluminium exceeded the guideline of 0.055 mg/L in MW10 with a concentration of 0.13 mg/L
- Arsenic exceeded the guideline of 0.013 mg/L in MW07 with a concentration of 0.032 mg/L
- Copper exceeded the guideline of 0.0014 mg/L in MW01 with a concentration of 0.002 mg/L
- Nickel exceeded the guideline of 0.0006 mg/L in MW07 and MW10 with a concentration of 0.015 mg/L and 0.023 mg/L respectively
- Zinc exceeded the guideline of 0.008 mg/L in MW01 and MW10 with a concentration of 0.012 mg/L and 0.010 mg/L respectively.

These exceedances are displayed graphically in Figure 5-1.

5.1.3 ANZECC 2000 Irrigation - long term trigger values

- Chloride exceeded the guideline of 350 mg/L in all wells. The maximum in MW09 with a value of 14,000 mg/L
- Phosphorous exceeded the guideline of 0.05 mg/L in all wells except MW04 and MW08 (one of two samples taken from this well). The maximum in MW02 with a value of 0.72 mg/L.

5.2 Quality assurance and quality control

5.2.1 Field program

Fieldwork was conducted in general accordance with GHD's Standard Field Operating Procedures which are aimed at ensuring that all environmental samples are collected by a set of uniform and systematic methods, as required by GHD's Quality Assurance system. Key requirements of these procedures are as follows:

- Appropriately trained and experienced staff who documented site activities using photographs and notes on standard field forms such as daily site records and sampling logs
- Decontamination procedures - including the use of new disposable gloves and tubing for the collection of each groundwater sample and the use of dedicated laboratory provided sampling containers
- Logging procedures – all samples are described using a recognised system
- Calibration procedures – all field monitoring equipment is appropriately calibrated
- Sample identification procedures - collected samples were immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers were clearly labelled with a sample number, sample location, sample depth (for soil samples) and sample date. The sample containers were then transferred to an ice filled cooler for sample preservation during shipment to the testing laboratory
- Chain of custody information requirements - a chain-of-custody form was completed and forwarded to the testing laboratory.

5.2.2 Field quality control

Field quality control procedures used during the project comprised the collection and analysis of the following:

- **Intra-laboratory (blind) duplicates:** Comprise a single sample that is divided into two separate sampling containers. Both samples are sent to the project laboratory. Blind duplicates provide an indication of the analytical precision of the laboratory but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity. One blind duplicates sample was collected and analysed during the investigation

The results of the comparison of the intra-lab duplicate analyses for the groundwater samples are provided in Table 2 of Appendix C.

There were two exceedances of the nominated relative percentage difference (RPD) acceptance criterion of ± 30% for ionic balance and total phosphorous observed between the primary sample MW08 and the intra laboratory duplicate QA01.

The phosphorous exceedance is likely to be associated with the heterogeneity of groundwater. The higher of the two values for the analyte was used as a conservative approach. Given that almost all of the concentrations for total phosphorous exceeded a long-term irrigation assessment criterion (with the exception of QA01 and MW02) the level of precision is considered to be suitable for the purposes of this investigation.

The ionic balance exceedance is not considered a cause for concern given the value for ionic balance is given by %. The small difference between the samples (4.78%) has resulted in a difference of 67% due to the way in which RPDs are calculated.

5.2.3 Laboratory quality control

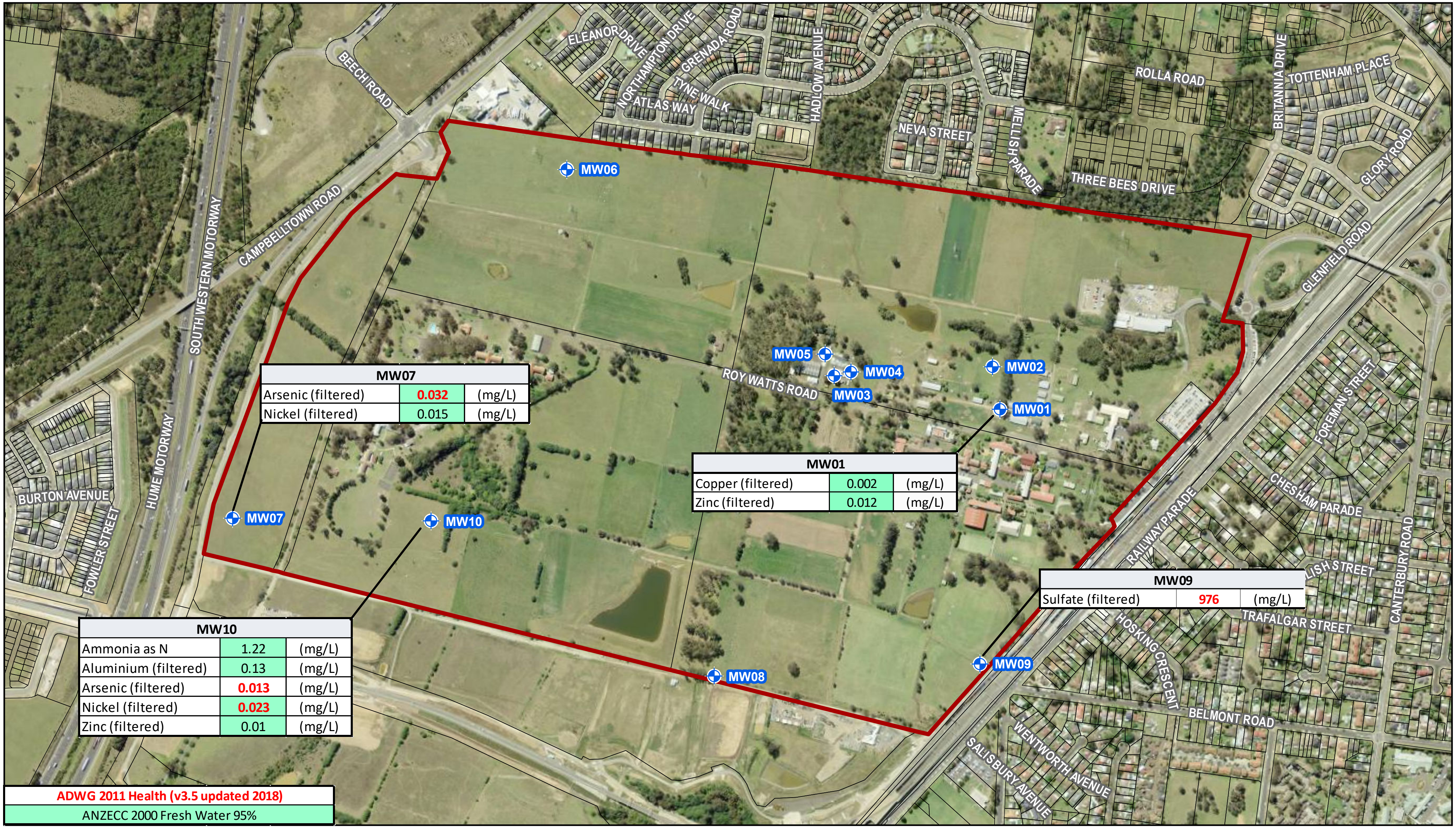
Laboratory quality control procedures used during the project included:

- **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 the analytical precision and reproducibility of the test result
  - No duplicate outliers occurred in this program.
- **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. Spiked samples are analysed for each batch where samples are analysed for organic chemicals of concern.
  - In both laboratory reports, chloride recovery in the matrix spike was not determined due to the background level being greater than or equal to 4 x the spike level
  - In laboratory report ES2101254 sulfate recovery in the matrix spike was not determined due to the background level being greater than or equal to 4 x the spike level
  - All other spikes were recovered.
- **Method Blank**: Usually an organic or aqueous solution that is as free as possible of analytes 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.
  - No method blank outliers occurred in this program.

The laboratory provided this information to GHD. The individual testing laboratory conducted an assessment of the laboratory QC program internally; however, the results were also independently reviewed and assessed by GHD.

All results were analysed within the recommended holding times.

The results of the QA/QC program are considered to provide an acceptable degree of confidence in the field and analytical works completed and, therefore, in the results obtained.



MW07		
Arsenic (filtered)	0.032	(mg/L)
Nickel (filtered)	0.015	(mg/L)

MW01		
Copper (filtered)	0.002	(mg/L)
Zinc (filtered)	0.012	(mg/L)

MW09		
Sulfate (filtered)	976	(mg/L)

MW10		
Ammonia as N	1.22	(mg/L)
Aluminium (filtered)	0.13	(mg/L)
Arsenic (filtered)	0.013	(mg/L)
Nickel (filtered)	0.023	(mg/L)
Zinc (filtered)	0.01	(mg/L)

Legend

- Groundwater Monitoring Well
- Site Boundary
- Cadstre

Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

School Infrastructure NSW
Hurlstone Agricultural School
Environmental Assessment

Groundwater chemistry exceedances

Project No. 12537824
Revision No. -
Date 25/02/2021

FIGURE 5-1

G:\21\12537824\GIS\Maps\Deliverables\12537824_Z004_Groundwater_Exceedances.mxd
Print date: 25 Feb 2021 - 13:38

Data source: Proposed land rezoning, cadastre and roads - DPIE 2021, Aerial© Department of Customer Service 2020. Created by: eibbertson

6. Conceptual Groundwater Model

The groundwater characteristics of the site can be summarised in Figure 6-1. Groundwater recharge is likely to occur in the higher elevated parts of the site to the west and mirrors topographic elevation and gradients approximately 10 m below ground surface. Given that the shallow groundwater in the surficial sediments is highly saline reflecting similar water quality to the underlying geological materials (Ashfield Shale and Bringelly Shale), it is more likely that the shallow groundwater is derived from a deeper source rather than rainfall infiltration at the site. The predominant recharge area is therefore more likely to be off-site.

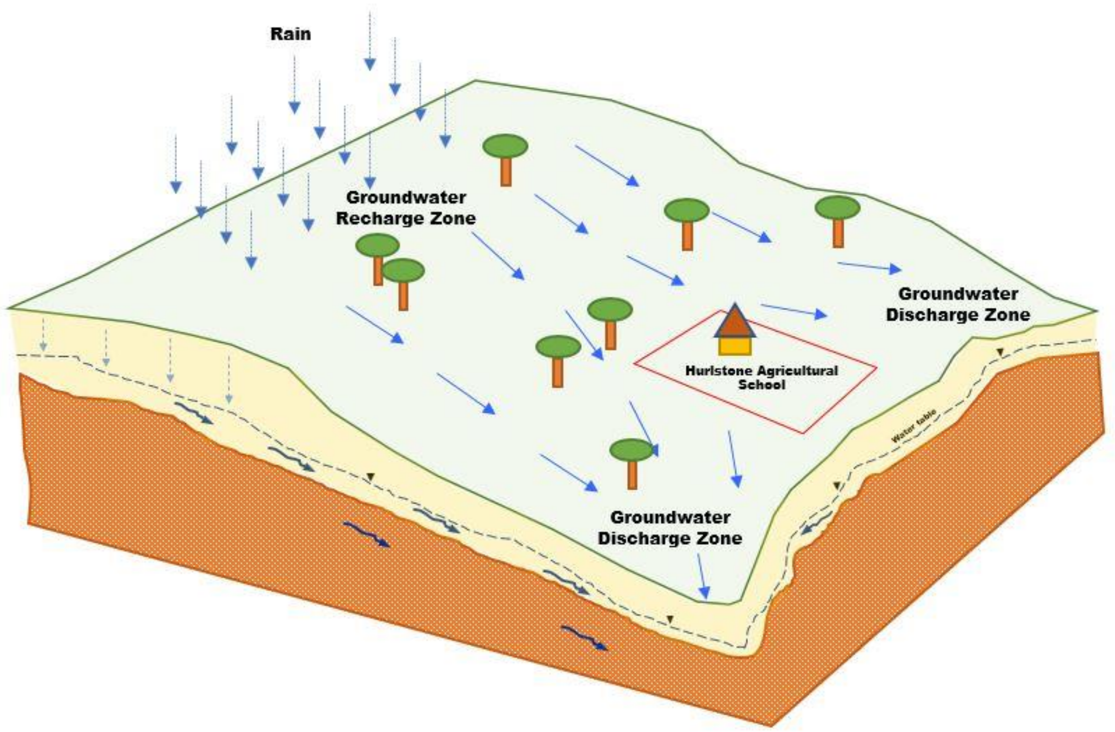


Figure 6-1 Site Conceptual Groundwater Model

7. Impact Assessment

7.1 Previous and current land use practices

The HAHS has had a long history on the site, extending as far back as 1926 and includes classroom blocks, an operational farm, sporting facilities and student accommodation. The farm is primarily used for cattle and pasture.

7.2 Potential Impacts from redevelopment

The draft masterplan outlining redevelopment of the HAHS site includes upgrades to the education dairy and agricultural facilities, and future residential needs. The plans for the upgraded facilities are outlined in Scibus (2020) as well as the proposed improvement descriptions which are:

- A new covered, concrete floored feed pad shed including facilities for the bedding of cattle under shelter in a free-range facility (except under adverse weather) and capture and recycling of water,
- A new integrated milking facility and associated cow handling yards,
- A new machinery shed, workshop and hay / feed storage shed,
- New effluent treatment systems,
- A new solids removal unit to capture manure solids,
- Flushing of the concrete feed pad using recycled wastewater; and
- Loafing paddocks (approximately 10 to 15 ha) to be expanded to cover areas that are currently used to feed, graze and move cattle to reduce dust and mud production.

The redevelopment has considered options to minimise environmental impacts. Capturing and recycling water, effluent treatment, solids removal and loafing paddocks prevents groundwater impact both from a quantity and quality perspective. In addition, low infiltration rates to groundwater combined with these procedures ensure minimal impact to shallow groundwater.

7.3 Mitigation

As stated in Scibus (2020) "*the key aspects of the plan are the development of a concrete, shaded feed pad and loafing area under shade, the capture of waste solids and wastewater in systems designed to capture and re-utilize nutrients. There are plans to provide extensive below-ground irrigation that will allow fertilisation (fertigation) and chemical treatments of crops and pastures, thereby reducing the potential for contamination of neighbouring areas. These developments will allow a more efficient use of land currently affected by stock feeding to be replaced by crop and pasture, for nutrient wastes to be used on cropping land and for water to be recycled*."

Elevated ammonia, phosphates and nitrates in shallow groundwaters that have been observed correlate with nutrients from cattle grazing are reduced by replacing stock feeding with crop and pastures. Nutrient wastes that are used on cropping land may maintain nutrient levels in shallow groundwater, although if this is recycled as suggested, this will reduce nutrient levels. As such, the new upgraded facilities have included options that minimise groundwater impacts.

Since the groundwater is already highly saline, its beneficial use is reduced significantly.

8. Summary and Conclusions

The groundwater assessment has evaluated potential impacts for both current and proposed practices in relation to the regulatory measures relating to groundwater from both groundwater quantity and quality aspects and any environmental impacts.

The relatively impermeable nature of the soils and clays found at the site indicate that the shallow groundwater does not respond immediately to vertical rainfall infiltration. Recharge is expected to occur off-site and the source of shallow groundwater is likely from the deeper Ashfield Shale and Bringelly Shale which is highly saline and similar water quality to the shallower groundwater in the surficial sediments (clays). The groundwater hydrograph in the higher elevated area to the west of the site indicate that groundwater levels respond to long term weather patterns while the groundwater at the lower elevated area of the site show no immediate response to rainfall. This would suggest that surface runoff and evapotranspiration play a larger role in rainfall response.

Assessment for groundwater contamination has indicated that the groundwater has elevated nutrients (eg ammonia relative to ADWG 2011 health guidelines) and several trace metals. Elevated nutrients are most likely associated with cattle farming. Major ions and overall salinity of the groundwater is very high but is part of the natural condition expected in groundwaters associated with the Wianamatta Group shales.

Mitigation options such as recycling nutrient wastes have already been considered in the development of the draft masterplan as described in Section 7.3. Therefore, after assessing current hydrogeological conditions, characterising the groundwater system and evaluating possible impacts, it can be concluded that the redevelopment will have minimal impact and, if anything improves groundwater conditions.

Land under irrigation if considered in the future would therefore have minimal impact to groundwater levels, flow and water quality.

9. References

Scibus, 2020 “Statement of environmental effects for the development of a site to provide new farm hub including improved cow comfort and effluent management for Hurlstone agricultural School.” October 2020.

Senversa, 2017 “Preliminary Site Investigation – Hurlstone Park Agricultural School and surrounding lands.” Prepared for Department of Finance, Services and Innovation, 14 Sep 2017.

Senversa, 2019 “Targeted Phase 2 Site Investigation – Hurlstone Park Agricultural School and surrounding lands, Roy Watts Road, Glenfield NSW.” Prepared for Property NSW, 5 Apr 2017.

Bureau of Meteorology (2012) National Groundwater Dependent Ecosystems Atlas (including WA). Bioregional Assessment Source Dataset. Viewed 13 March 2019, http://data.bioregionalassessments.gov.au/dataset/6dbaee0d-8813-46b1-9c13-1b796e7ed3bf.

Appendices

Appendix A – Well logs

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW08

Client NSW DPIE
Project Hurlstone Agricultural School Environmental Report
Project No. 12537824
Site Hurlstone Park Agricultural School and Surrounding Lands
Location Roy Watts Road
Date Drilled 03/12/2020 - 03/12/2020

Drill Co. Terratest
Driller Jack Warner
Rig Type Geoprobe 7822DT
Drill Method PT, SFA
Total Depth (m) 10.00
Casing Diameter (mm) 50

Easting, Northing ,
Grid Ref GDA2020_MGA_zone_56
Elevation
TOC mAHD -
Logged By FH
Checked By

B.C.L No. N/A **Casing** **Screen** **Surface Completion**

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Lithological Description (Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.)	Moisture	Consistency	Comments/Contaminant Indicators (Odours, staining, waste materials, separate phase liquids, imported fill, ash.)	Elevation (m)
0.0	PT	0.1				Clayey SILT low plasticity, brown with orange mottling, organic matter - rootlets	D		no odour no staining	
0.3		0.1				CLAY high plasticity, tan brown, organic matter - rootlets	D	H		
0.5										-0.5
1										-1
1.5										-1.5
2										-2
2.5					Sand, Bentonite, Backfill					-2.5
2.7						light grey				
3		0.1								-3
3.1	SFA					CLAY brown, red	M		no odour no staining, red staining at 3.1 mbgl	
3.5										-3.5
4										-4
4.5										-4.5
5										-5
5.5										-5.5
6		0.1			Bentonite	CLAY with gravel, high plasticity, brown, red, angular gravels	M		no odour no staining	-6
6.5										-6.5
7						CLAY yellow brown/tan, less gravel	W		no odour no staining	-7
7.5										-7.5
8				∇						-8
8.5					Sand					-8.5
9										-9
9.5										-9.5
10						Termination Depth at:10.00 m				-10

Notes Yellow Monument

This log is not intended for geotechnical purposes.

Drilling Abbreviations

AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler

Moisture Abbreviations

D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated

Consistency Abbreviations

Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense

Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Client NSW DPIE	**Drill Co.** Terratest	**Easting, Northing** ,
Project Hurlstone Agricultural School Environmental Report	**Driller** Jack Warner	**Grid Ref** GDA2020_MGA_zone_56
Project No. 12537824	**Rig Type** Geoprobe 7822DT	**Elevation**
Site Hurlstone Park Agricultural School and Surrounding Lands	**Drill Method** PT, SFA	**TOC mAHD** -
Location Roy Watts Road	**Total Depth (m)** 13.80	**Logged By** FH
Date Drilled 03/12/2020 - 03/12/2020	**Casing Diameter (mm)** 50	**Checked By**

B.C.L No. N/A **Casing** **Screen** **Surface Completion**

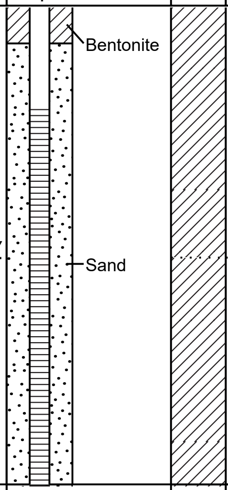
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0.0	PT	0.1				Sandy SILT brown, rounded, poorly graded, minor white gravel, organic matter - rootlets (Topsoil)	D		no odour	
0.2		0.1				CLAY low to medium plasticity, light brown, organic matter - rootlets (Natural)	D	H	no odour no staining	
0.5										-0.5
1						mottled red				-1
1.5						red mottled grey, less organic matter	D			-1.5
2		0.1				grey mottled red, no organic matter	D			-2
2.5						small rocks and gravel				-2.5
3										-3
3.5	SFA									-3.5
4										-4
4.5										-4.5
5					Sand, Backfill					-5
5.5										-5.5
6										-6
6.5										-6.5
7										-7
7.5										-7.5
8						CLAY tan (Natural)	M		no odour no staining	-8
8.5										-8.5
9										-9
9.5					Bentonite					-9.5

Notes Once well installed it was apparent that water was high than 12m. Possibly 10m

This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
10.5					Bentonite						-10.5
11											-11
11.5											-11.5
12				▽	Sand			W			-12
12.5											-12.5
13											-13
13.5											-13.5
14							Termination Depth at:13.80 m. Refusal on Shale.				-14
14.5											-14.5
15											-15
15.5											-15.5
16											-16
16.5											-16.5
17											-17
17.5											-17.5
18											-18
18.5											-18.5
19											-19
19.5											-19.5
20											-20
20.5											-20.5
21											-21
21.5											-21.5



Notes Once well installed it was apparent that water was high than 12m. Possibly 10m

This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW10

Client NSW DPIE	**Drill Co.** Terratest	**Easting, Northing** ,
Project Hurlstone Agricultural School Environmental Report	**Driller** Jack Warner	**Grid Ref** GDA2020_MGA_zone_56
Project No. 12537824	**Rig Type** Geoprobe 7822DT	**Elevation**
Site Hurlstone Park Agricultural School and Surrounding Lands	**Drill Method** PT, AH	**TOC mAHD** -
Location Roy Watts Road	**Total Depth (m)** 22.10	**Logged By** FH
Date Drilled 03/12/2020 - 03/12/2020	**Casing Diameter (mm)** 50	**Checked By**

B.C.L No. N/A **Casing** **Screen** **Surface Completion**

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0.0	PT	0.3			Backfill		Clayey SILT light brown, very fine grained, uniform graded	D		no odour no staining	
0.5		0.3					Silty CLAY trace sand and rocks, low plasticity, red brown with grey mottling, angular sand	D		no odour no staining	-0.5
1							Silty CLAY moderate plasticity, brown grey with yellow mottling	D		no odour no staining	-1
1.5							SILT grey, no clay, minor shale inclusions			no odour no staining	-1.5
2	AH						SILT brown, fine grained, even grading silt, minor clay pockets, shale inclusions, becoming light with depth		H	no odour no staining	-2
2.5											-2.5
3					Backfill						-3
3.5											-3.5
4							SHALE grey		H	no odour no staining	-4
4.5											-4.5
5											-5
5.5											-5.5
6											-6
6.5					Bentonite						-6.5
7											-7
7.5											-7.5
8								D			-8
8.5					Sand						-8.5
9											-9
9.5											-9.5

Notes Yellow Monument

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Drilling Abbreviations	**Moisture Abbreviations**	**Consistency Abbreviations**	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation (m)
10.5											-10.5
11											-11
11.5							driller noted he felt gravel at 11.5mbgl				-11.5
12							moist drill cuttings coming up				-12
12.5											-12.5
13											-13
13.5								D			-13.5
14					Sand						-14
14.5											-14.5
15											-15
15.5											-15.5
16											-16
16.5											-16.5
17											-17
17.5											-17.5
18											-18
18.5											-18.5
19					Bentonite						-19
19.5											-19.5
20											-20
20.5					Sand						-20.5
21											-21
21.5											-21.5

Notes Yellow Monument

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
22					1 2 Sand		Termination Depth at:22.10 m				-22
22.5											-22.5
23											-23
23.5											-23.5
24											-24
24.5											-24.5
25											-25
25.5											-25.5
26											-26
26.5											-26.5
27											-27
27.5											-27.5
28											-28
28.5											-28.5
29											-29
29.5											-29.5
30											-30
30.5											-30.5
31											-31
31.5											-31.5
32											-32
32.5											-32.5
33											-33
33.5											-33.5

Notes Yellow Monument

This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, MR-Mud Rotary, NDD-Non Destructive Drilling, PT-Pushtube, RB-Rotary Blade, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Appendix B – YSI Calibration certificate

7/1/21

Multi Parameter Water Meter

Instrument YSI Quatro Pro Plus
Serial No. 18J104333

airmet
Air-Met Scientific Pty Ltd
1300 137 067

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

Certificate of Calibration

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

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 10.00		pH 10.00		355386	pH 9.73
2. pH 7.00		pH 7.00		355072	pH 7.00
3. pH 4.00		pH 4.00		351412	pH 4.20
4. mV		229.6mV		357172/357173	230.4mV
5. EC		2.76mS		350510	2.74mS
6. D.O		0.00ppm		10959	0.01pm
7. Temp		22.0°C		MultiTherm	21.9°C

Calibrated by: Lauren Tompkins

Calibration date: 7/01/2021

Next calibration due: 8/03/2021

Appendix C – Analytical tables

Appendix C
Table 1
Ground Water Analytical Results

				Minor ions	Acidity & Alkalinity				Major Ions									Nutrients								Organic Indicators	Metals				
				Fluoride	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide as CaCO3)	Alkalinity (total as CaCO3)	Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride	Sulfate (filtered)	Cations Total	Anions Total	Ionic Balance	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Reactive Phosphorus as P	Phosphorus (Total)	BOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
LOR				0.1	1	1	1	1	1	1	1	1	1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.1	0.01	0.01	2	0.01	0.01	0.001	0.001	0.0001
ADWG 2011 Health (v3.5 updated 2018)				1.5										500[#1]					11.29[#2]	0.91[#3]									0.01	0.01	0.002
ADWG 2011 Recreational (v3.5 updated 2018)				15										5,000[#1]					112.9[#2]	9.1[#4]									0.1	0.1	0.02
ANZECC 2000 Irrigation - Long-term Trigger Values				1									350[#10]									5			0.05[#11]		5	5	0.1	0.1	0.01
ANZECC 2000 FW 95%																		0.9	7.2[#5]								0.055	0.055	0.013[#6]	0.013[#6]	0.0002
NEPM 2013 Table 1A(4) HSL C Rec GW for Vapour Intrusion, Sand																															
2-4m																															
4-8m																															
>=8m																															
NEPM 2013 Table 1A(4) HSL A/B Res GW for Vapour Intrusion, Sand																															
2-4m																															
4-8m																															
>=8m																															
Location Code	**Date**	**Field ID**	**Lab Report Number**																												
MW01	14-01-21	MW01	ES2101254	0.5	<1	485	<1	485	50	111	28	1,260	2,260	275	67.2	79.2	8.21	-	0.30	<0.01	0.30	1.3	1.0	<0.01	0.15	<2	-	<0.01	-	<0.001	-
MW02	14-01-21	MW02	ES2101254	1.0	<1	1,280	<1	1,280	122	458	30	2,700	5,990	375	162	202	11.1	-	<0.01	<0.01	<0.01	1.0	1.0	<0.01	0.72	<2	-	<0.01	-	<0.001	-
MW04	14-01-21	MW04	ES2101254	0.7	<1	1,320	<1	1,320	95	301	28	1,670	3,370	317	103	128	10.9	-	<0.01	<0.01	<0.01	<0.2	<0.2	<0.01	0.02	<2	-	<0.01	-	<0.001	-
MW06	14-01-21	MW06	ES2101254	0.2	<1	1,040	<1	1,040	181	464	30	2,780	6,060	440	169	201	8.65	-	0.06	<0.01	0.06	2.6	2.5	<0.01	0.33	<2	-	<0.01	-	<0.001	-
MW07	14-01-21	MW07	ES2101254	0.3	<1	1,180	<1	1,180	126	334	32	2,470	4,930	424	142	171	9.39	-	<0.01	<0.01	<0.01	0.4	0.4	<0.01	0.21	<2	-	<0.01	-	0.032	-
MW08	14-01-21	MW08	ES2101254	0.9	<1	1,500	<1	1,500	221	708	22	4,570	10,100	490	269	325	9.50	-	<0.01	<0.01	<0.01	<0.5	<0.5	0.04	0.18	<2	-	<0.01	-	<0.001	-
MW08	14-01-21	QA01	ES2101254	0.8	<1	1,520	<1	1,520	231	809	26	5,000	10,100	495	296	326	4.72	-	<0.01	<0.01	<0.01	<0.5	<0.5	0.04	0.05	<2	-	<0.01	-	<0.001	-
MW09	14-01-21	MW09	ES2101254	0.7	<1	460	<1	460	143	907	27	6,360	14,000	976	359	424	8.34	-	<0.01	<0.01	<0.01	<0.5	<0.5	<0.01	0.27	6	-	<0.10	-	<0.010	-
MW10	15-01-21	MW10	ES2101428	0.3	<1	1,490	<1	1,490	50	59	13	785	470	106	41.8	45.2	3.91	1.22	0.24	0.20	0.44	2.2	1.8	<0.01	0.06	6	0.13	-	0.013	-	<0.0001

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects
#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427
#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (0.3 mg/L)
by molecular weight (3.2967033).
#4 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L)
by molecular weight (3.2967033).
#5 Trigger corrected Sep 2002 -
https://www.mfe.govt.nz/sites/default/files/anzecc-nitrate-correction-sep02.pdf
#6 As (V) used as conservative value
#7 Cr(VI) guideline has been adopted
#8 Not limiting: Derived water HSL exceeds water solubility limit
#9 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10 Low risk of increasing crop cadmium concentrations at <350 mg/L, may cause
foliar injury (table 9.2.12 and 9.2.13)
#11 Minimise bioclogging of irrigation equipment only
#12 Chromium VI value

				Metals															BTEXN							TRH - NEPM 2013		TRH - NEPM 2013 SG Cleanup			TRH - NEPM 2013 - SG Cleanup	
				Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)	Cobalt	Cobalt (filtered)	Copper	Copper (filtered)	Lead	Lead (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX (Sum of Total) - Lab Calc	F1 (C6-C10 minus BTEX)	C6-C10 Fraction	>C10-C16 SG Cleanup	>C16-C34 SG Cleanup	>C34-C40 SG Cleanup	F2 (>C10-C16 minus Naphthalene) SG Cleanup	>C10-C40 (sum) SG Cleanup
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/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
LOR				0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.005	0.005	1	2	2	2	2	2	1	20	20	100	100	100	100	100
ADWG 2011 Health (v3.5 updated 2018)				0.002					2	2	0.01	0.01	0.001	0.001	0.02	0.02			1	800	300			600								
ADWG 2011 Recreational (v3.5 updated 2018)				0.02					20	20	0.1	0.1	0.01	0.01	0.2	0.2			10	8,000	3,000			6,000								
ANZECC 2000 Irrigation - Long-term Trigger Values				0.01	0.1[#12]	0.1[#12]	0.05	0.05	0.2	0.2	2	2	0.002	0.002	0.2	0.2	2	2														
ANZECC 2000 FW 95%				0.0002	0.001[#7]	0.001[#7]			0.0014	0.0014	0.0034	0.0034	0.0006	0.0006	0.011	0.011	0.008	0.008	950			350										
NEPM 2013 Table 1A(4) HSL C Rec GW for Vapour Intrusion, Sand																																
2-4m																			NL[#8]	NL[#8]	NL[#8]			NL[#8]		NL[#8]						
4-8m																			NL[#8]	NL[#8]	NL[#8]			NL[#8]		NL[#8]						
>=8m																			NL[#8]	NL[#8]	NL[#8]			NL[#8]		NL[#8]						
NEPM 2013 Table 1A(4) HSL A/B Res GW for Vapour Intrusion, Sand																																
2-4m																			800	NL[#8]	NL[#8]			NL[#8]		1,000[#9]						
4-8m																			800	NL[#8]	NL[#8]			NL[#8]		1,000[#9]						
>=8m																			900	NL[#8]	NL[#8]			NL[#8]		1,000[#9]						
Location Code	**Date**	**Field ID**	**Lab Report Number**																													
MW01	14-01-21	MW01	ES2101254	<0.0001	-	<0.001	-	0.008	-	0.002	-	<0.001	-	<0.0001	-	0.006	-	0.012	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW02	14-01-21	MW02	ES2101254	<0.0001	-	<0.001	-	0.006	-	<0.001	-	<0.001	-	<0.0001	-	0.001	-	<0.005	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW04	14-01-21	MW04	ES2101254	<0.0001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.0001	-	0.002	-	<0.005	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW06	14-01-21	MW06	ES2101254	<0.0001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.0001	-	0.004	-	0.005	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW07	14-01-21	MW07	ES2101254	<0.0001	-	<0.001	-	0.020	-	<0.001	-	<0.001	-	<0.0001	-	0.015	-	0.007	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW08	14-01-21	MW08	ES2101254	<0.0001	-	<0.001	-	0.010	-	<0.001	-	<0.001	-	<0.0001	-	0.002	-	<0.005	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW08	14-01-21	QA01	ES2101254	<0.0001	-	<0.001	-	0.011	-	<0.001	-	<0.001	-	<0.0001	-	0.002	-	<0.005	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100
MW09	14-01-21	MW09	ES2101254	<0.0010	-	<0.010	-	0.037	-	<0.010	-	<0.010	-	<0.0001	-	<0.010	-	<0.050	<1	2	<2	<2	<2	<2	2	<20	<20	<100	<100	<100	<100	<100
MW10	15-01-21	MW10	ES2101428	-	<0.001	-	0.013	-	<0.001	-	<0.001	-	<0.0001	-	0.023	-	0.010	-	<1	<2	<2	<2	<2	<2	<1	<20	<20	<100	<100	<100	<100	<100

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects
#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427
#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (0.3 mg/L)
by molecular weight (3.2967033).
#4 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L)
by molecular weight (3.2967033).
#5 Trigger corrected Sep 2002 -
https://www.mfe.govt.nz/sites/default/files/anzecc-nitrate-correction-sep02.pdf
#6 As (V) used as conservative value
#7 Cr(VI) guideline has been adopted
#8 Not limiting: Derived water HSL exceeds water solubility limit
#9 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10 Low risk of increasing crop cadmium concentrations at <350 mg/L, may cause
foliar injury (table 9.2.12 and 9.2.13)
#11 Minimise bioclogging of irrigation equipment only
#12 Chromium VI value

Appendix C
Table 1
Ground Water Analytical Results

Location Code	Date	Field ID	Lab Report Number	TRH - NEPM 1999	TRH - NEPM 1999 - SG Cleanup				PAHs - standard 16	OC Pesticides													
				C6-C9 Fraction	C10-C14 SG Cleanup	C15-C28 SG Cleanup	C29-C36 SG Cleanup	C10-C36 (sum) SG Cleanup	Naphthalene	4,4'-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	4,4 DDD	4,4 DDT	DDT+DDE+DDD - Lab Calc	Dieldrin	Endosulfan I (alpha)
				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
LOR				20	50	100	50	50	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5
ADWG 2011 Health (v3.5 updated 2018)													0.3		2					9			
ADWG 2011 Recreational (v3.5 updated 2018)													3		20					90			
ANZECC 2000 Irrigation - Long-term Trigger Values																							
ANZECC 2000 FW 95%									16						0.08					0.01			
NEPM 2013 Table 1A(4) HSL C Rec GW for Vapour Intrusion, Sand																							
2-4m									NL#8														
4-8m									NL#8														
>=8m									NL#8														
NEPM 2013 Table 1A(4) HSL A/B Res GW for Vapour Intrusion, Sand																							
2-4m									NL#8														
4-8m									NL#8														
>=8m									NL#8														
MW01	14-01-21	MW01	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW02	14-01-21	MW02	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW04	14-01-21	MW04	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW06	14-01-21	MW06	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW07	14-01-21	MW07	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW08	14-01-21	MW08	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW08	14-01-21	QA01	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW09	14-01-21	MW09	ES2101254	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5
MW10	15-01-21	MW10	ES2101428	<20	<50	<100	<50	<50	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects
#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427
#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (0.3 mg/L)
by molecular weight (3.2967033).
#4 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L)
by molecular weight (3.2967033).
#5 Trigger corrected Sep 2002 -
https://www.mfe.govt.nz/sites/default/files/anzecc-nitrate-correction-sep02.pdf
#6 As (V) used as conservative value
#7 Cr(VI) guideline has been adopted
#8 Not limiting: Derived water HSL exceeds water solubility limit
#9 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10 Low risk of increasing crop cadmium concentrations at <350 mg/L, may cause
foliar injury (table 9.2.12 and 9.2.13)
#11 Minimise bioclogging of irrigation equipment only
#12 Chromium VI value

Appendix C
Table 1
Ground Water Analytical Results

Location Code	Date	Field ID	Lab Report Number	OC Pesticides										OP Pesticides																		
				Endosulfan II (beta)	Endosulfan Sulfate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Azinphos methyl	Bromophos-ethyl	Carbophenothion	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Demeton-S-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenamiphos	Fenthion	Malathion	Methyl parathion	Monocrotophos	Parathion	Pirimphos-ethyl	Prothiofos
				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
LOR				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2	2	0.5	0.5
ADWG 2011 Health (v3.5 updated 2018)									10	0.3			300	30	10	0.5	2	10			4	5	7	4	0.5	7	70	0.7	2	20	0.5	
ADWG 2011 Recreational (v3.5 updated 2018)									100	3			3,000	300	100	5	20	100			40	50	70	40	5	70	700	7	20	200	5	
ANZECC 2000 Irrigation - Long-term Trigger Values																																
ANZECC 2000 FW 95%						0.02			0.2	0.09				0.02				0.01			0.01		0.15				0.05			0.004		
NEPM 2013 Table 1A(4) HSL C Rec GW for Vapour Intrusion, Sand																																
2-4m																																
4-8m																																
>=8m																																
NEPM 2013 Table 1A(4) HSL A/B Res GW for Vapour Intrusion, Sand																																
2-4m																																
4-8m																																
>=8m																																
MW01	14-01-21	MW01	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW02	14-01-21	MW02	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW04	14-01-21	MW04	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW06	14-01-21	MW06	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW07	14-01-21	MW07	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW08	14-01-21	MW08	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW08	14-01-21	QA01	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW09	14-01-21	MW09	ES2101254	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5
MW10	15-01-21	MW10	ES2101428	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0	<2.0	<2.0	<0.5	<0.5

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects
#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427
#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (0.3 mg/L) by molecular weight (3.2967033).
#4 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L) by molecular weight (3.2967033).
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#9 To obtain F1 subtract the sum of BTEX concentrations from the C6 - C10 fraction.
#10 Low risk of increasing crop cadmium concentrations at <350 mg/L, may cause foliar injury (table 9.2.12 and 9.2.13)
#11 Minimise bioclogging of irrigation equipment only
#12 Chromium VI value

Appendix C
Table 2
RPDs Analytical Results

		Field ID	MW08	QA01	
		Date	14-01-21	14-01-21	
		Lab Report Number	ES2101254	ES2101254	
		Sample Type	Normal	Field_D	
		Matrix Type	water	water	RPD
Analyte	Unit	LOR			
Minor ions					
Fluoride	mg/L	0.1	0.9	0.8	12
Acidity & Alkalinity					
Alkalinity (Carbonate as CaCO3)	mg/L	1	<1	<1	0
Alkalinity (Bicarbonate as CaCO3)	mg/L	1	1,500	1,520	1
Alkalinity (Hydroxide as CaCO3)	mg/L	1	<1	<1	0
Alkalinity (total as CaCO3)	mg/L	1	1,500	1,520	1
Major Ions					
Calcium (filtered)	mg/L	1	221	231	4
Magnesium (filtered)	mg/L	1	708	809	13
Potassium (filtered)	mg/L	1	22	26	17
Sodium (filtered)	mg/L	1	4,570	5,000	9
Chloride	mg/L	1	10,100	10,100	0
Sulfate (filtered)	mg/L	1	490	495	1
Cations Total	meq/L	0.01	269	296	10
Anions Total	meq/L	0.01	325	326	0
Ionic Balance	%	0.01	9.50	4.72	67
Nutrients					
Nitrate (as N)	mg/L	0.01	<0.01	<0.01	0
Nitrite (as N)	mg/L	0.01	<0.01	<0.01	0
Nitrogen (Total Oxidised) (as N)	mg/L	0.01	<0.01	<0.01	0
Nitrogen (Total)	mg/L	0.1	<0.5	<0.5	0
Kjeldahl Nitrogen Total	mg/L	0.1	<0.5	<0.5	0
Reactive Phosphorus as P	mg/L	0.01	0.04	0.04	0
Phosphorus (Total)	mg/L	0.01	0.18	0.05	113
Organic Indicators					
BOD	mg/L	2	<2	<2	0
Metals					
Aluminium (filtered)	mg/L	0.01	<0.01	<0.01	0
Arsenic (filtered)	mg/L	0.001	<0.001	<0.001	0
Cadmium (filtered)	mg/L	0.0001	<0.0001	<0.0001	0
Chromium (III+VI) (filtered)	mg/L	0.001	<0.001	<0.001	0
Cobalt (filtered)	mg/L	0.001	0.010	0.011	10
Copper (filtered)	mg/L	0.001	<0.001	<0.001	0
Lead (filtered)	mg/L	0.001	<0.001	<0.001	0
Mercury (filtered)	mg/L	0.0001	<0.0001	<0.0001	0
Nickel (filtered)	mg/L	0.001	0.002	0.002	0
Zinc (filtered)	mg/L	0.005	<0.005	<0.005	0
BTEXN					
Benzene	µg/L	1	<1	<1	0
Toluene	µg/L	2	<2	<2	0
Ethylbenzene	µg/L	2	<2	<2	0
Xylene (o)	µg/L	2	<2	<2	0
Xylene (m & p)	µg/L	2	<2	<2	0
Xylene Total	µg/L	2	<2	<2	0
BTEX (Sum of Total) - Lab Calc	µg/L	1	<1	<1	0
TRH - NEPM 2013					
F1 (C6-C10 minus BTEX)	µg/L	20	<20	<20	0
C6-C10 Fraction	µg/L	20	<20	<20	0
TRH - NEPM 2013 - SG Cleanup					
>C10-C16 SG Cleanup	µg/L	100	<100	<100	0

Appendix C
Table 2
RPDs Analytical Results

		Field ID	MW08	QA01	
		Date	14-01-21	14-01-21	
		Lab Report Number	ES2101254	ES2101254	
		Sample Type	Normal	Field_D	
		Matrix Type	water	water	RPD
Analyte	Unit	LOR			
>C16-C34 SG Cleanup	µg/L	100	<100	<100	0
>C34-C40 SG Cleanup	µg/L	100	<100	<100	0
F2 (>C10-C16 minus Naphthalene) SG Cleanup	µg/L	100	<100	<100	0
>C10-C40 (sum) SG Cleanup	µg/L	100	<100	<100	0
TRH - NEPM 1999					
C6-C9 Fraction	µg/L	20	<20	<20	0
TRH - NEPM 1999 - SG Cleanup					
C10-C14 SG Cleanup	µg/L	50	<50	<50	0
C15-C28 SG Cleanup	µg/L	100	<100	<100	0
C29-C36 SG Cleanup	µg/L	50	<50	<50	0
C10-C36 (sum) SG Cleanup	µg/L	50	<50	<50	0
PAHs - standard 16					
Naphthalene	µg/L	5	<5	<5	0
OC Pesticides					
4,4'-DDE	µg/L	0.5	<0.5	<0.5	0
a-BHC	µg/L	0.5	<0.5	<0.5	0
Aldrin	µg/L	0.5	<0.5	<0.5	0
Aldrin + Dieldrin	µg/L	0.5	<0.5	<0.5	0
b-BHC	µg/L	0.5	<0.5	<0.5	0
Chlordane	µg/L	0.5	<0.5	<0.5	0
Chlordane (cis)	µg/L	0.5	<0.5	<0.5	0
Chlordane (trans)	µg/L	0.5	<0.5	<0.5	0
d-BHC	µg/L	0.5	<0.5	<0.5	0
4,4 DDD	µg/L	0.5	<0.5	<0.5	0
4,4 DDT	µg/L	2	<2.0	<2.0	0
DDT+DDE+DDD - Lab Calc	µg/L	0.5	<0.5	<0.5	0
Dieldrin	µg/L	0.5	<0.5	<0.5	0
Endosulfan I (alpha)	µg/L	0.5	<0.5	<0.5	0
Endosulfan II (beta)	µg/L	0.5	<0.5	<0.5	0
Endosulfan Sulfate	µg/L	0.5	<0.5	<0.5	0
Endrin	µg/L	0.5	<0.5	<0.5	0
Endrin aldehyde	µg/L	0.5	<0.5	<0.5	0
Endrin ketone	µg/L	0.5	<0.5	<0.5	0
g-BHC (Lindane)	µg/L	0.5	<0.5	<0.5	0
Heptachlor	µg/L	0.5	<0.5	<0.5	0
Heptachlor epoxide	µg/L	0.5	<0.5	<0.5	0
Hexachlorobenzene	µg/L	0.5	<0.5	<0.5	0
Methoxychlor	µg/L	2	<2.0	<2.0	0
OP Pesticides					
Azinphos methyl	µg/L	0.5	<0.5	<0.5	0
Bromophos-ethyl	µg/L	0.5	<0.5	<0.5	0
Carbophenothion	µg/L	0.5	<0.5	<0.5	0
Chlorfenvinphos	µg/L	0.5	<0.5	<0.5	0
Chlorpyrifos	µg/L	0.5	<0.5	<0.5	0
Chlorpyrifos-methyl	µg/L	0.5	<0.5	<0.5	0
Demeton-S-methyl	µg/L	0.5	<0.5	<0.5	0
Diazinon	µg/L	0.5	<0.5	<0.5	0
Dichlorvos	µg/L	0.5	<0.5	<0.5	0
Dimethoate	µg/L	0.5	<0.5	<0.5	0
Ethion	µg/L	0.5	<0.5	<0.5	0

Appendix C
Table 2
RPDs Analytical Results

		Field ID	MW08	QA01	
		Date	14-01-21	14-01-21	
		Lab Report Number	ES2101254	ES2101254	
		Sample Type	Normal	Field_D	
		Matrix Type	water	water	RPD
Analyte	Unit	LOR			
Fenamiphos	µg/L	0.5	<0.5	<0.5	0
Fenthion	µg/L	0.5	<0.5	<0.5	0
Malathion	µg/L	0.5	<0.5	<0.5	0
Methyl parathion	µg/L	2	<2.0	<2.0	0
Monocrotophos	µg/L	2	<2.0	<2.0	0
Parathion	µg/L	2	<2.0	<2.0	0
Pirimphos-ethyl	µg/L	0.5	<0.5	<0.5	0
Prothiofos	µg/L	0.5	<0.5	<0.5	0

***RPDs have only been considered where a concentration is greater than 1 times the EQL.**
****Elevated RPDs are highlighted as per QAQC Profile settings (Acceptable RPDs for each EQL multiplier range are: 1000 (1 - 10 x EQL); 30 (10 - 30 x EQL); 30 (> 30 x EQL))**
*****Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory**

Appendix D – Laboratory certificates of analysis

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
☐BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: NSW Dept of Planning, Industry and Environment
OFFICE: Sydney
PROJECT: Hurlstone Agricultural School Env. Report
ORDER NUMBER: 12537824
PROJECT MANAGER: Evan Smith — CONTACT PH: 9239 7199
SAMPLER: Felicity Harrison — SAMPLER MOBILE: 0439042225
COC emailed to ALS? (YES / NO) — EDD FORMAT (or default):
Email Reports to John.Bradd@ghd.com, Felicity.Harrison@ghd.com
Email Invoice to accountspayableAU@ghd.com
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO: SY/587/20

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: 16.5 °C
Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Felicity H	AND DEW		
DATE/TIME: 14-1-21 6:15pm	DATE/TIME: 14/1/21 6:14 pm	DATE/TIME:	DATE/TIME:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Major and minor cations and anions	Nutrients (speciated N and P)	OCP and OPP	8 metals, Al, Co	BOD	TRH with Silica gel clean up	BTEX with Silica Gel cleanup		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	MW01	14-1-21	W	various	6	X	X	X	X	X	X	X		
2	MW02	↓	↓		↓	X	X	X	X	X	X	X		
3	MW04	↓	↓		↓	X	X	X	X	X	X	X		
4	MW06	↓	↓		↓	X	X	X	X	X	X	X		
5	MW07	↓	↓		↓	X	X	X	X	X	X	X		
6	MW08	↓	↓		↓	X	X	X	X	X	X	X		
7	MW09	↓	↓		↓	X	X	X	X	X	X	X		
8	QA01	↓	↓		↓	X	X	X	X	X	X	X		
						X	X	X	X	X	X	X		
				TOTAL	48									

Environmental Division
Sydney
Work Order Reference
ES2101254

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag

CERTIFICATE OF ANALYSIS

Work Order	: **ES2101254**	Page	: 1 of 11
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: John Bradd	Contact	: Angus Harding
Address	: LEVEL 15, 133 CASTLEREAGH STREET SYDNEY NSW, AUSTRALIA 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env, Report	Date Samples Received	: 14-Jan-2021 18:14
Order number	: 12537824	Date Analysis Commenced	: 15-Jan-2021
C-O-C number	: ----	Issue Date	: 20-Jan-2021 16:33
Sampler	: FELICITY HARRISON		
Site	: ----		
Quote number	: SY/587/20		
No. of samples received	: 8		
No. of samples analysed	: 8		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

- EK061G: LOR raised for TKN on various samples due to sample matrix.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EG020: Some samples were diluted and rerun due to matrix interference and LOR’s have been raised accordingly. (High Total Dissolved Solids)
- EN055: Ionic Balance out of acceptable limits for various samples due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW01	MW02	MW04	MW06	MW07
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00
Compound	CAS Number	LOR	Unit	ES2101254-001	ES2101254-002	ES2101254-003	ES2101254-004	ES2101254-005
				Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**485**	**1280**	**1320**	**1040**	**1180**
Total Alkalinity as CaCO3	----	1	mg/L	**485**	**1280**	**1320**	**1040**	**1180**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**275**	**375**	**317**	**440**	**424**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2260**	**5990**	**3370**	**6060**	**4930**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**50**	**122**	**95**	**181**	**126**
Magnesium	7439-95-4	1	mg/L	**111**	**458**	**301**	**464**	**334**
Sodium	7440-23-5	1	mg/L	**1260**	**2700**	**1670**	**2780**	**2470**
Potassium	7440-09-7	1	mg/L	**28**	**30**	**28**	**30**	**32**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	**0.032**
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.008**	**0.006**	<0.001	<0.001	**0.020**
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.001**	**0.002**	**0.004**	**0.015**
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.012**	<0.005	<0.005	**0.005**	**0.007**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.5**	**1.0**	**0.7**	**0.2**	**0.3**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.30**	<0.01	<0.01	**0.06**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.30**	<0.01	<0.01	**0.06**	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW01	MW02	MW04	MW06	MW07
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00
Compound	CAS Number	LOR	Unit	ES2101254-001	ES2101254-002	ES2101254-003	ES2101254-004	ES2101254-005
				Result	Result	Result	Result	Result
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.0**	**1.0**	<0.2	**2.5**	**0.4**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**1.3**	**1.0**	<0.2	**2.6**	**0.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.15**	**0.72**	**0.02**	**0.33**	**0.21**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**79.2**	**202**	**128**	**201**	**171**
ø Total Cations	----	0.01	meq/L	**67.2**	**162**	**103**	**169**	**142**
ø Ionic Balance	----	0.01	%	**8.21**	**11.1**	**10.9**	**8.65**	**9.39**
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	<2	<2	<2
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	50-29-3	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW01	MW02	MW04	MW06	MW07
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00
Compound	CAS Number	LOR	Unit	ES2101254-001	ES2101254-002	ES2101254-003	ES2101254-004	ES2101254-005
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
Methoxychlor	72-43-5	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	56-38-2	2.0	µg/L	<2.0	<2.0	<2.0	<2.0	<2.0
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup								
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW01	MW02	MW04	MW06	MW07
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00
Compound	CAS Number	LOR	Unit	ES2101254-001	ES2101254-002	ES2101254-003	ES2101254-004	ES2101254-005
				Result	Result	Result	Result	Result
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup - Continued								
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
>C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	**75.6**	**81.2**	**83.0**	**76.8**	**81.1**
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	**79.4**	**82.1**	**85.6**	**83.8**	**83.6**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**126**	**129**	**129**	**130**	**135**
Toluene-D8	2037-26-5	2	%	**117**	**115**	**115**	**115**	**124**
4-Bromofluorobenzene	460-00-4	2	%	**110**	**111**	**110**	**111**	**116**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW08	MW09	QA01	----	----
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2101254-006	ES2101254-007	ES2101254-008	--------	--------
				Result	Result	Result	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1500**	**460**	**1520**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1500**	**460**	**1520**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**490**	**976**	**495**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**10100**	**14000**	**10100**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**221**	**143**	**231**	----	----
Magnesium	7439-95-4	1	mg/L	**708**	**907**	**809**	----	----
Sodium	7440-23-5	1	mg/L	**4570**	**6360**	**5000**	----	----
Potassium	7440-09-7	1	mg/L	**22**	**27**	**26**	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.10	<0.01	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.010	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0010	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.010	<0.001	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.010	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.010**	**0.037**	**0.011**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.010	**0.002**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.010	<0.001	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.050	<0.005	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.9**	**0.7**	**0.8**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW08	MW09	QA01	----	----
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2101254-006	ES2101254-007	ES2101254-008	--------	--------
				Result	Result	Result	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.18**	**0.27**	**0.05**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.04**	<0.01	**0.04**	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**325**	**424**	**326**	----	----
ø Total Cations	----	0.01	meq/L	**269**	**359**	**296**	----	----
ø Ionic Balance	----	0.01	%	**9.50**	**8.34**	**4.72**	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	<2	**6**	<2	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	<0.5	----	----
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	<0.5	----	----
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	<0.5	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	----	----
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
4.4`-DDT	50-29-3	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW08	MW09	QA01	----	----
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2101254-006	ES2101254-007	ES2101254-008	--------	--------
				Result	Result	Result	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
Methoxychlor	72-43-5	2.0	µg/L	<2.0	<2.0	<2.0	----	----
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	<2.0	<2.0	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup								
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	----	----
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW08	MW09	QA01	----	----
			Sampling date / time	14-Jan-2021 00:00	14-Jan-2021 00:00	14-Jan-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	ES2101254-006	ES2101254-007	ES2101254-008	--------	--------
				Result	Result	Result	----	----
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup - Continued								
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	**2**	<2	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	----	----
^ Sum of BTEX	----	1	µg/L	<1	**2**	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	**89.8**	**80.4**	**104**	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	**87.5**	**80.6**	**75.0**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**131**	**131**	**128**	----	----
Toluene-D8	2037-26-5	2	%	**113**	**117**	**110**	----	----
4-Bromofluorobenzene	460-00-4	2	%	**108**	**111**	**108**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	67	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	67	111
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: **ES2101254**	Page	: 1 of 11
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: John Bradd	Contact	: Angus Harding
Address	: LEVEL 15, 133 CASTLEREAGH STREET SYDNEY NSW, AUSTRALIA 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env, Report	Date Samples Received	: 14-Jan-2021
Order number	: 12537824	Date Analysis Commenced	: 15-Jan-2021
C-O-C number	: ----	Issue Date	: 20-Jan-2021
Sampler	: FELICITY HARRISON		
Site	: ----		
Quote number	: SY/587/20		
No. of samples received	: 8		
No. of samples analysed	: 8		

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

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

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 3463828)									
ES2101226-010	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.00	No Limit
ES2101226-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3463831)									
ES2101254-004	MW06	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	1040	1120	7.54	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	1040	1120	7.54	0% - 20%
ES2101265-006	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2	2	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	2	2	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3464245)									
ES2101035-009	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	580	563	3.08	0% - 20%
ES2101284-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	<10	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 3464244)									
ES2101035-009	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	3640	3640	0.0808	0% - 20%
ES2101284-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1260	1350	6.81	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3465921)									

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
ED093F: Dissolved Major Cations (QC Lot: 3465921) - continued									
ES2101226-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	1	1	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	36	37	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
ES2101226-012	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	27	27	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3465919)									
ES2101226-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.012	0.011	0.00	0% - 50%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.13	0.14	0.00	0% - 50%
ES2101226-012	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.020	0.020	0.00	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.010	0.010	0.00	0% - 50%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.025	0.024	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.48	0.47	0.00	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3465922)									
EW2100196-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.01	0.01	0.00	No Limit
EW2100197-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3465922) - continued									
EW2100197-003	Anonymous	EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 3465920)									
ES2101226-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
ES2101226-012	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3463830)									
ES2101254-004	MW06	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
ES2101265-006	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3464242)									
ES2101035-009	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.38	0.38	0.00	0% - 20%
ES2101284-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.10	<0.10	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3466401)									
ES2101254-003	MW04	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2101098-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.09	0.09	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3466397)									
ES2100790-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	26.0	24.9	4.46	0% - 20%
ES2101098-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<1.0	<1.0	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3466398)									
ES2100790-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	3.13	3.11	0.705	0% - 20%
ES2101098-002	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.10	0.39	118	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3466399)									
EW2100178-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	1.29	1.34	3.25	0% - 20%
EW2100166-002	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	5.32	5.48	3.04	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3464243)									
ES2101035-009	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.76	0.81	5.99	0% - 50%
ES2101284-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	30.7	32.2	4.77	0% - 20%
EP030: Biochemical Oxygen Demand (BOD) (QC Lot: 3462518)									
ES2101010-001	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	292	275	6.00	0% - 20%
ES2101224-001	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	1070	902	17.2	0% - 20%
EP030: Biochemical Oxygen Demand (BOD) (QC Lot: 3462519)									
ES2101254-008	QA01	EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	<2	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3463153)									
ES2101242-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES2101254-005	MW07	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3463153)									
ES2101242-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES2101254-005	MW07	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 3463153)									
ES2101242-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES2101254-005	MW07	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

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

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

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 3463828)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	91.4	81.0	111
				----	50 mg/L	114	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 3463831)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	81.0	111
				----	50 mg/L	113	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3464245)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	99.1	82.0	122
				<1	500 mg/L	100	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 3464244)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	106	80.9	127
				<1	1000 mg/L	109	80.9	127
ED093F: Dissolved Major Cations (QCLot: 3465921)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	97.3	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	96.1	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	94.0	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	93.6	85.0	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 3465919)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	89.8	80.0	116
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	86.4	85.0	114
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	87.7	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	88.7	85.0	111
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	91.1	82.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	91.6	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	89.4	83.0	111
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	90.5	82.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	91.7	81.0	117
EG020F: Dissolved Metals by ICP-MS (QCLot: 3465922)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	88.3	80.0	116
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	91.6	85.0	114
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	87.3	84.0	110
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	85.9	85.0	111
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	97.4	82.0	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	97.4	81.0	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	89.0	83.0	111

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3465922) - continued								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	95.8	82.0	112
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.4	81.0	117
EG035F: Dissolved Mercury by FIMS (QCLot: 3465920)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	94.4	83.0	105
EK040P: Fluoride by PC Titrator (QCLot: 3463830)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	112	82.0	116
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3464242)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3466401)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	99.1	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3466397)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	89.8	69.0	101
				<0.1	1 mg/L	88.3	70.0	118
				<0.1	5 mg/L	96.5	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3466398)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	87.6	71.0	101
				<0.01	0.442 mg/L	91.6	72.0	108
				<0.01	1 mg/L	95.9	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3466399)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	84.7	71.0	101
				<0.01	0.442 mg/L	80.0	72.0	108
				<0.01	1 mg/L	88.7	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3464243)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	97.3	85.0	117
EP030: Biochemical Oxygen Demand (BOD) (QCLot: 3462518)								
EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	200 mg/L	97.0	74.0	112
EP030: Biochemical Oxygen Demand (BOD) (QCLot: 3462519)								
EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	200 mg/L	92.5	74.0	112
EP068A: Organochlorine Pesticides (OC) (QCLot: 3463110)								
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	77.7	64.9	107
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	84.4	58.3	111
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	86.1	69.0	117
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	76.6	70.0	112
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	92.7	68.9	110
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	78.9	65.2	108
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	89.9	65.8	109
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	89.6	67.1	107

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 3463110) - continued								
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	91.4	64.1	110
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	88.0	66.7	112
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	88.6	63.2	111
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	91.5	65.2	113
EP068: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	93.4	66.0	112
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	89.2	65.2	113
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	95.1	67.3	114
EP068: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	97.9	72.0	122
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	88.4	66.9	109
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	87.7	65.2	112
EP068: 4.4`-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	84.8	65.2	112
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	84.4	63.8	110
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	80.1	61.1	114
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3463110)								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	87.2	65.6	114
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	94.4	63.7	113
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	24.1	19.7	48.0
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	89.4	69.5	110
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	87.5	71.1	110
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	84.6	77.0	119
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	89.4	70.0	124
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	101	68.4	116
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	91.5	68.6	112
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	92.4	75.0	119
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	89.6	67.0	121
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	97.5	69.0	121
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	90.6	71.8	110
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	92.3	67.5	112
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	100.0	64.1	116
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	92.1	67.8	114
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	92.9	74.0	120
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	86.0	66.2	114
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	60.2	51.6	128
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup (QCLot: 3463109)								
EP071SG: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	79.9	55.8	112
EP071SG: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	101	71.6	113
EP071SG: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	103	56.0	121
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup (QCLot: 3463109)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup (QCLot: 3463109) - continued								
EP071SG: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	87.0	57.9	119
EP071SG: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	98.8	62.5	110
EP071SG: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	96.1	61.5	121
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3463153)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	86.7	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3463153)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	89.4	75.0	127
EP080: BTEXN (QCLot: 3463153)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	96.4	70.0	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	98.2	69.0	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	101	70.0	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	103	69.0	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	102	72.0	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	104	70.0	120

Matrix Spike (MS) Report

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

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3464245)							
ES2101035-009	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3464244)							
ES2101035-009	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	# Not Determined	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3465919)							
ES2100974-001	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	83.6	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	88.2	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	85.9	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	89.1	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	90.1	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	83.8	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	90.3	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	92.1	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3465922)							
EW2100196-003	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	89.5	70.0	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	88.0	70.0	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	84.5	70.0	130
		EG020A-F: Cobalt	7440-48-4	1 mg/L	96.4	70.0	130
		EG020A-F: Copper	7440-50-8	1 mg/L	97.4	70.0	130
		EG020A-F: Lead	7439-92-1	1 mg/L	84.8	70.0	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	96.4	70.0	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	98.8	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3465920)							
ES2101226-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	79.6	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3463830)							
ES2101231-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	91.4	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3464242)							
ES2101035-009	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	98.5	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3466401)							
ES2100790-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	104	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3466397)							
ES2100790-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	50 mg/L	83.1	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3466398)							
ES2100790-002	Anonymous	EK067G: Total Phosphorus as P	----	10 mg/L	83.6	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3466399)							
EW2100166-003	Anonymous	EK067G: Total Phosphorus as P	----	2 mg/L	70.0	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3464243)							
ES2101035-009	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	5 mg/L	93.7	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3463153)							
ES2101242-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	86.8	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3463153)							
ES2101242-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	85.4	70.0	130
EP080: BTEXN (QCLot: 3463153)							
ES2101242-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	83.7	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	83.7	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	88.2	70.0	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	88.4	70.0	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	89.4	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 3463153) - continued							
ES2101242-001	Anonymous	EP080: Naphthalene	91-20-3	25 µg/L	88.2	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES2101254**	Page	: 1 of 9
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: John Bradd	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env, Report	Date Samples Received	: 14-Jan-2021
Site	: ----	Issue Date	: 20-Jan-2021
Sampler	: FELICITY HARRISON	No. of samples received	: 8
Order number	: 12537824	No. of samples analysed	: 8

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

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

Summary of Outliers

Outliers : Quality Control Samples

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

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

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	ES2101035--009	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	ES2101035--009	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Pesticides by GCMS	0	8	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	0	8	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Pesticides by GCMS	0	8	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	0	8	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

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

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

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

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
MW01, MW02, MW04, MW06, MW07, MW08, MW09, QA01	**14-Jan-2021**	**----**	----	----	**15-Jan-2021**	28-Jan-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**15-Jan-2021**	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**15-Jan-2021**	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**18-Jan-2021**	21-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Natural (EG020A-F)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**18-Jan-2021**	13-Jul-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Natural (EG035F)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**19-Jan-2021**	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**15-Jan-2021**	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
MW01,	MW02,	**14-Jan-2021**	**----**	----	----	**15-Jan-2021**	16-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
MW01,	MW02,	14-Jan-2021	----	----	----	18-Jan-2021	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
MW01,	MW02,	14-Jan-2021	18-Jan-2021	11-Feb-2021	✓	18-Jan-2021	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
MW01,	MW02,	14-Jan-2021	18-Jan-2021	11-Feb-2021	✓	18-Jan-2021	11-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G)								
MW01,	MW02,	14-Jan-2021	----	----	----	15-Jan-2021	16-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP030: Biochemical Oxygen Demand (BOD)								
Clear Plastic Bottle - Natural (EP030)								
MW01,	MW02,	14-Jan-2021	----	----	----	15-Jan-2021	16-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP068A: Organochlorine Pesticides (OC)								
Amber Glass Bottle - Unpreserved (EP068)								
MW01,	MW02,	14-Jan-2021	19-Jan-2021	21-Jan-2021	✓	19-Jan-2021	28-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP068B: Organophosphorus Pesticides (OP)								
Amber Glass Bottle - Unpreserved (EP068)								
MW01,	MW02,	14-Jan-2021	19-Jan-2021	21-Jan-2021	✓	19-Jan-2021	28-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup								
Amber Glass Bottle - Unpreserved (EP071SG)								
MW01,	MW02,	**14-Jan-2021**	**19-Jan-2021**	21-Jan-2021	✓	**19-Jan-2021**	28-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
Amber Glass Bottle - Unpreserved (EP071SG)								
MW01,	MW02,	**14-Jan-2021**	**19-Jan-2021**	21-Jan-2021	✓	**19-Jan-2021**	28-Feb-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP080/071: Total Petroleum Hydrocarbons								
Amber VOC Vial - Sulfuric Acid (EP080)								
MW01,	MW02,	**14-Jan-2021**	**15-Jan-2021**	28-Jan-2021	✓	**15-Jan-2021**	28-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Amber VOC Vial - Sulfuric Acid (EP080)								
MW01,	MW02,	**14-Jan-2021**	**15-Jan-2021**	28-Jan-2021	✓	**15-Jan-2021**	28-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080)								
MW01,	MW02,	**14-Jan-2021**	**15-Jan-2021**	28-Jan-2021	✓	**15-Jan-2021**	28-Jan-2021	✓
MW04,	MW06,							
MW07,	MW08,							
MW09,	QA01							

Quality Control Parameter Frequency Compliance

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

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	3	25	**12.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	39	**10.26**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	8	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	0	8	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	6	38	**15.79**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / *Analytical Methods*	*Method*	*Count* QC	*Count* Regular	*Rate (%)* **Actual**	*Rate (%)* **Expected**	*Evaluation*	*Quality Control Specification*
Method Blanks (MB) - Continued							
Biochemical Oxygen Demand (BOD)	EP030	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	8	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	0	8	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
Biochemical Oxygen Demand (BOD)	EP030	WATER	In house: Referenced to APHA 5210 B. The 5-Day BOD test provides an empirical measure of the oxygen consumption capacity of a given water. A portion of the sample is diluted into oxygenated, nutrient rich water, and a seed added to begin biological decay. The initial dissolved oxygen content is measured, then the bottle is sealed and incubated for five days. The remaining dissolved oxygen is measured, and from the difference, the demand for oxygen, by biological decay, is determined. This method is compliant with NEPM Schedule B(3).
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	WATER	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM Schedule B(3).
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

ALS Environmental

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
☐BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: ~~NSW Dept of Planning, Industry and Environment~~ GHD
OFFICE: Sydney
PROJECT: Hurlstone Agricultural School Env. Report
ORDER NUMBER: 12537824
PROJECT MANAGER: Evan Smith CONTACT PH: 9239 7199
SAMPLER: Felicity Harrison SAMPLER MOBILE: 0439042225
COC emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to John.Bradd@ghd.com, Felicity.Harrison@ghd.com
Email Invoice to accountspayableAU@ghd.com

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☒ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO: SY/587/20

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: 8.6 °C
Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
F. Herrison	ANOLEW		
DATE/TIME: 15.1.21 5.50pm	DATE/TIME: 15/01/21 6:00pm	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Major and minor cations and anions	Nutrients (speciated N and P)	OCP and OPP	8 metals, Al, Co	BOD	TRH with Silica gel clean up	BTEX with Silica Gel cleanup		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	MW10	15-1-21	W	Various	6	X	X	X	X	X	X	X		
				TOTAL	6									

HT

Environmental Division
Sydney
Work Order Reference
ES2101428

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: ~~NSW Dept of Planning, Industry and Environment~~ GHD

OFFICE: Sydney

PROJECT: Hurlstone Agricultural School Env. Report

ORDER NUMBER: 12537824

PROJECT MANAGER: Evan Smith — CONTACT PH: 9239 7199

SAMPLER: Felicity Harrison — SAMPLER MOBILE: 0439042225

COC emailed to ALS? (YES / NO) — EDD FORMAT (or default):

Email Reports to John.Bradd@ghd.com, Felicity.Harrison@ghd.com

Email Invoice to accountspayableAU@ghd.com

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)

☒ Standard TAT (List due date):

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO: SY/587/20

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: 8.6 °C
Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
F. Harrison	Andrew		
DATE/TIME: 15.1.21 5.50pm	DATE/TIME: 15/01/21 6:00pm	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	Major and minor cations and anions	Nutrients (speciated N and P)	OCP and OPP	8 metals, Al, Co	BOD	TRH with Silica gel clean up	BTEX with Silica Gel cleanup		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	MW10	15-1-21	W	Various	6	X	X	X	X	X	X	X		
														HT
				TOTAL	6									

Environmental Division
Sydney
Work Order Reference
ES2101428

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

SAMPLE RECEIPT INFORMATION & BOTTLE TYPE

WORKORDER No: ES2101428

To be completed by Sample Receipt

Sorting Times *(Only record for BP, Mobil & URS)*	**Temperature Details**		**Packaging**			**Courier Details** (Mandatory for Quarantine)
Time Sorting Commenced:	Sample Temp:	8.6°C ....°C ....°C	**Security Seal Intact?** ***Circle below*** ☐ **YES** (Security seal intact) ☐ **NO** (Security seal broken) ☑ **NA** (No security seal used)	**Packaging Type**	**No.**	Carrier: client delivery
				Hard Esky	1	Con Note:
Time Placed in Fridge:	Chilling Method - ☑ Ice ☐ Ice Bricks ☐ No Chilling			Foam Esky		**Samples checked, labelled and put in trays by:** Initial: AM 15/1/21
Sorting to Fridge Target Time <1 Hour				Other:		

Client Code: GHOSER

Sample Receipt Advice Comments - To be completed by Sorting Staff

VOC analysis may be compromised as sample containers contained **headspace** *(list)*:

Details of any samples damaged during transit:

Other Information (eg. Were bottles received that weren't completely filled) (eg. If sample temperature is above 6'C add further detail here - Internal use only - Not for SRN):

Tray Numbers: D29 P98B V1S4C M189B

Lab No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Soil Jar	250mL																		
Soil Jar	125mL																		
Bag Plastic	White																		
Bag Plastic	Green																		
Plastic Grey Soil Jar (PFOS / PFOA)	200mL																		
Sterile Plastic Soil Jar	250mL																		
DUST CuS04	4L																		
DUST CuS04	2.5L																		
DUST Unpreserved	4L																		
DUST Unpreserved	2.5L																		
Nat Green	1L																		
Nat Green	500mL	1																	
Nat Green	250mL																		
Nat Green	125mL																		
Nat White	1L																		
Nat White – Lugols Iodine	250mL																		
UT Nutrients	Light Green																		
UT Nutrients	Turquoise																		
Glass Orange	500mL																		
Glass Orange	100mL	1																	
Glass Purple (O&G)	250mL																		
Plastic Purple	250mL																		
Plastic Purple	60mL	1																	
Plastic Grey (PFOS / PFOA)	125mL																		
Plastic Grey (PFOS / PFOA)	60mL																		
Plastic Grey (PFOS / PFOA)	20mL																		
Bacto Black / Thio Grey	250mL																		
Bacto Yellow / Thio Amoeba - No Chill	250mL																		
Sterile Plastic Ice Jar	250mL																		
60mL Nitric Red	STD F																		
60mL Nitric Red	STD T	1																	
60mL Lab Acidified	STD F																		
60mL Lab Acidified	STD T																		
60mL Lab Acidified	ORC F																		
60mL Lab Acidified	ORC T																		
NaOH Hexa Chrome Blue 60mL	F																		
NaOH Hexa Chrome Blue 60mL	T																		
NaOH CN Blue	60mL																		
Plastic NaOH CN - Pb Acetate	60mL																		
Opaque NaOH CN - Pb Acetate	60mL																		
0.5L Glass Brown	Lab Preserved																		
Fluoro Yellow (Sulfide) 250mL	F																		
Fluoro Yellow (Sulfide) 250mL	T																		
Fluoro Orange 250mL (Sulfite)																			
HCl Fe2+ Maroon 60mL	F																		
HCl Fe2+ Maroon 60mL	T																		
Vial H2SO4 Purple 40mL	TOC																		
Vial H2SO4 Purple 40mL	DOC																		
Vial H2SO4 Purple 40mL (VOC)	VOC	2																	
Green Vial (Geos & MIB)																			
Vial NH4Cl Dark Blue 40mL																			
EDA Vial																			
Endo-Toxin Tube																			
Other																			

ENFM 203 Template – Version 0

Pages 2 of 2

Approved Date: /01/2021

CERTIFICATE OF ANALYSIS

Work Order	: **ES2101428**	Page	: 1 of 7
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR EVAN SMITH	Contact	: Angus Harding
Address	: LEVEL 15, 133 CASTLEREAGH STREET SYDNEY NSW, AUSTRALIA 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 3316 3000	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env. Report	Date Samples Received	: 15-Jan-2021 18:00
Order number	: 12537824	Date Analysis Commenced	: 16-Jan-2021
C-O-C number	: ----	Issue Date	: 25-Jan-2021 12:19
Sampler	: Felicity Harrison		
Site	: ----		
Quote number	: SY/587/20		
No. of samples received	: 1		
No. of samples analysed	: 1		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW10	----	----	----	----
			Sampling date / time	15-Jan-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2101428-001	--------	--------	--------	--------
				Result	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1490**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**1490**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**106**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**470**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**50**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**59**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**785**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**13**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.13**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.013**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.013**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.023**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.010**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.22**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.20**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.24**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW10	----	----	----	----
			Sampling date / time	15-Jan-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2101428-001	--------	--------	--------	--------
				Result	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.44**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.8**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.06**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**45.2**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**41.8**	----	----	----	----
ø Ionic Balance	----	0.01	%	**3.91**	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)								
Biochemical Oxygen Demand	----	2	mg/L	**6**	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.5	µg/L	<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L	<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L	<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L	<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L	<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L	<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L	<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L	<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L	<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L	<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MW10	----	----	----	----
			Sampling date / time	15-Jan-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2101428-001	--------	--------	--------	--------
				Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
4.4`-DDT	50-29-3	2.0	µg/L	<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L	<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L	<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.5	µg/L	<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	----	----	----	----
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup								
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	----	----	----	----
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup								
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Sample ID	**MW10**	----	----	----	----
			Sampling date / time	15-Jan-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	**ES2101428-001**	--------	--------	--------	--------
				Result	----	----	----	----
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup - Continued								
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	<20	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ **Total Xylenes**	----	2	µg/L	<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	**69.1**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	**67.0**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**98.6**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**107**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**105**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	67	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	67	111
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: **ES2101428**	Page	: 1 of 9
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR EVAN SMITH	Contact	: Angus Harding
Address	: LEVEL 15, 133 CASTLEREAGH STREET SYDNEY NSW, AUSTRALIA 2000	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 07 3316 3000	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env. Report	Date Samples Received	: 15-Jan-2021
Order number	: 12537824	Date Analysis Commenced	: 16-Jan-2021
C-O-C number	: ----	Issue Date	: 25-Jan-2021
Sampler	: Felicity Harrison		
Site	: ----		
Quote number	: SY/587/20		
No. of samples received	: 1		
No. of samples analysed	: 1		

NATA

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

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

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 3465025)									
ES2101341-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	3	2	44.4	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	3	2	44.4	No Limit
ES2101345-005	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	249	248	0.415	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	249	248	0.415	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3464775)									
ES2101431-008	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	104	102	1.67	0% - 20%
ES2101305-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	<10	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 3464777)									
ES2101305-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	591	589	0.302	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 3470219)									
ES2101138-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	19	20	0.00	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	7	7	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	92	93	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	3	3	0.00	No Limit
ES2101330-008	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	6	6	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	275	269	2.36	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	9	8	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 3471901)									
ES2101428-001	MW10	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 3471901) - continued									
ES2101428-001	MW10	EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.013	0.013	0.00	0% - 50%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.013	0.013	0.00	0% - 50%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.023	0.023	0.00	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.010	0.010	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.13	0.14	0.00	0% - 50%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3475424)									
ES2101105-044	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EW2100259-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3465026)									
EW2100183-006	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EW2100192-006	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3471826)									
ES2101418-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	3.30	3.40	2.98	0% - 20%
ES2101559-004	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	2.52	2.62	3.96	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3464774)									
ES2101333-004	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2101305-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.16	0.16	0.00	0% - 50%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3471825)									
ES2101418-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2101559-004	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	27.2	25.9	4.90	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3471821)									
ES2101180-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.3	0.3	0.00	No Limit
ES2101499-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	18.1	18.4	1.32	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3471822)									
ES2101180-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES2101499-002	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.06	0.08	15.6	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3464776)									
ES2101305-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.07	0.07	0.00	No Limit
EP030: Biochemical Oxygen Demand (BOD) (QC Lot: 3464827)									
ES2101358-001	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	2090	1950	6.92	0% - 20%
ES2101384-001	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	418	401	4.15	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3465657)									
ES2101329-015	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES2101405-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3465657)									

Laboratory Duplicate (DUP) Report

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3465657) - continued									
ES2101329-015	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES2101405-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 3465657)									
ES2101329-015	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES2101405-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

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

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

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 3465025)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	95.0	81.0	111
				----	50 mg/L	108	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3464775)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	98.7	82.0	122
				<1	500 mg/L	94.9	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 3464777)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	50 mg/L	97.4	80.9	127
				<1	1000 mg/L	99.6	80.9	127
ED093F: Dissolved Major Cations (QCLot: 3470219)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	102	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	101	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	99.4	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	100	85.0	113
EG020T: Total Metals by ICP-MS (QCLot: 3471901)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	82.8	82.0	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	91.8	82.0	114
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.7	84.0	112
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	89.2	86.0	116
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	89.4	84.0	116
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	89.4	83.0	118
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	86.7	85.0	115
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	87.2	84.0	116
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	87.6	79.0	117
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3475424)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	96.3	77.0	111
EK040P: Fluoride by PC Titrator (QCLot: 3465026)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	112	82.0	116
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3471826)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	103	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3464774)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3471825)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	102	91.0	113

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3471821)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	87.2	69.0	101
				<0.1	1 mg/L	73.2	70.0	118
				<0.1	5 mg/L	87.4	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3471822)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	82.9	71.0	101
				<0.01	0.442 mg/L	74.5	72.0	108
				<0.01	1 mg/L	89.6	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3464776)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	99.4	85.0	117
EP030: Biochemical Oxygen Demand (BOD) (QCLot: 3464827)								
EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	200 mg/L	95.5	74.0	112
EP068A: Organochlorine Pesticides (OC) (QCLot: 3464950)								
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	85.6	64.9	107
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	93.8	58.3	111
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	108	69.0	117
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	80.2	70.0	112
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	89.0	68.9	110
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	80.7	65.2	108
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	87.6	65.8	109
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	79.8	67.1	107
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	81.2	64.1	110
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	83.5	66.7	112
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	77.0	63.2	111
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	106	65.2	113
EP068: 4.4`-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	81.2	66.0	112
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	106	65.2	113
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	106	67.3	114
EP068: 4.4`-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	100.0	72.0	122
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	83.9	66.9	109
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	97.7	65.2	112
EP068: 4.4`-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	87.1	65.2	112
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	82.7	63.8	110
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	77.8	61.1	114
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3464950)								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	88.5	65.6	114
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	78.0	63.7	113
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	25.2	19.7	48.0
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	91.8	69.5	110

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3464950) - continued								
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	99.1	71.1	110
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	77.6	77.0	119
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	80.1	70.0	124
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	93.0	68.4	116
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	98.4	68.6	112
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	94.4	75.0	119
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	86.7	67.0	121
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	99.6	69.0	121
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	85.6	71.8	110
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	86.8	67.5	112
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	104	64.1	116
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	79.0	67.8	114
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	96.6	74.0	120
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	81.7	66.2	114
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	74.3	51.6	128
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup (QCLot: 3464949)								
EP071SG: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	68.2	55.8	112
EP071SG: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	84.3	71.6	113
EP071SG: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	89.3	56.0	121
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup (QCLot: 3464949)								
EP071SG: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	70.9	57.9	119
EP071SG: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	89.3	62.5	110
EP071SG: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	97.6	61.5	121
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3465657)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	76.0	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3465657)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	76.4	75.0	127
EP080: BTEXN (QCLot: 3465657)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	80.6	70.0	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	78.7	69.0	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	76.0	70.0	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	77.0	69.0	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	81.1	72.0	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	86.4	70.0	120

Matrix Spike (MS) Report

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

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3464775)							
ES2101305-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	119	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3464777)							
ES2101305-001	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	# Not Determined	70.0	130
EG020T: Total Metals by ICP-MS (QCLot: 3471901)							
ES2101978-004	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	83.1	70.0	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	84.7	70.0	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	84.1	70.0	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	81.3	70.0	130
		EG020A-T: Copper	7440-50-8	1 mg/L	81.8	70.0	130
		EG020A-T: Lead	7439-92-1	1 mg/L	80.3	70.0	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	82.3	70.0	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	83.2	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3475424)							
ES2101428-001	MW10	EG035T: Mercury	7439-97-6	0.01 mg/L	74.4	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3465026)							
ES2101419-001	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	103	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3471826)							
ES2101418-001	Anonymous	EK055G: Ammonia as N	7664-41-7	10 mg/L	105	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3464774)							
ES2101305-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	101	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3471825)							
ES2101418-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	107	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3471821)							
ES2101428-001	MW10	EK061G: Total Kjeldahl Nitrogen as N	----	10 mg/L	75.8	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3471822)							
ES2101428-001	MW10	EK067G: Total Phosphorus as P	----	2 mg/L	83.0	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3464776)							
ES2101305-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	96.8	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3465657)							
ES2101329-015	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	85.8	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3465657)							
ES2101329-015	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	86.8	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES2101428**	Page	: 1 of 9
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR EVAN SMITH	Telephone	: +61 2 8784 8555
Project	: Hurlstone Agricultural School Env. Report	Date Samples Received	: 15-Jan-2021
Site	: ----	Issue Date	: 25-Jan-2021
Sampler	: Felicity Harrison	No. of samples received	: 1
Order number	: 12537824	No. of samples analysed	: 1

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

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

Summary of Outliers

Outliers : Quality Control Samples

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

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

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
EP080: BTEXN (QCLot: 3465657)							
ES2101329-015	Anonymous	EP080: Benzene	71-43-2	25 µg/L	75.0	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	83.0	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	84.8	70.0	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	86.6	70.0	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	86.2	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	88.7	70.0	130

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED045G: Chloride by Discrete Analyser	ES2101305--001	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
Pesticides by GCMS	0	1	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	0	3	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Pesticides by GCMS	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	0	3	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

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

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

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

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation* Date extracted	Due for extraction	Evaluation	*Analysis* Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) MW10	**15-Jan-2021**	**----**	----	----	**17-Jan-2021**	29-Jan-2021	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) MW10	**15-Jan-2021**	**----**	----	----	**16-Jan-2021**	12-Feb-2021	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) MW10	**15-Jan-2021**	**----**	----	----	**16-Jan-2021**	12-Feb-2021	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093F) MW10	**15-Jan-2021**	**----**	----	----	**20-Jan-2021**	22-Jan-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
MW10	**15-Jan-2021**	**21-Jan-2021**	14-Jul-2021	✓	**21-Jan-2021**	14-Jul-2021	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
MW10	**15-Jan-2021**	**----**	----	----	**22-Jan-2021**	12-Feb-2021	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
MW10	**15-Jan-2021**	**----**	----	----	**17-Jan-2021**	12-Feb-2021	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
MW10	**15-Jan-2021**	**----**	----	----	**21-Jan-2021**	12-Feb-2021	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
MW10	**15-Jan-2021**	**----**	----	----	**16-Jan-2021**	17-Jan-2021	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
MW10	**15-Jan-2021**	**----**	----	----	**21-Jan-2021**	12-Feb-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
MW10	**15-Jan-2021**	**21-Jan-2021**	12-Feb-2021	✓	**21-Jan-2021**	12-Feb-2021	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
MW10	**15-Jan-2021**	**21-Jan-2021**	12-Feb-2021	✓	**21-Jan-2021**	12-Feb-2021	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
MW10	**15-Jan-2021**	**----**	----	----	**16-Jan-2021**	17-Jan-2021	✓
EP030: Biochemical Oxygen Demand (BOD)							
Clear Plastic Bottle - Natural (EP030)							
MW10	**15-Jan-2021**	**----**	----	----	**16-Jan-2021**	17-Jan-2021	✓
EP068A: Organochlorine Pesticides (OC)							
Amber Glass Bottle - Unpreserved (EP068)							
MW10	**15-Jan-2021**	**18-Jan-2021**	22-Jan-2021	✓	**20-Jan-2021**	27-Feb-2021	✓
EP068B: Organophosphorus Pesticides (OP)							
Amber Glass Bottle - Unpreserved (EP068)							
MW10	**15-Jan-2021**	**18-Jan-2021**	22-Jan-2021	✓	**20-Jan-2021**	27-Feb-2021	✓
EP071 SG: Total Petroleum Hydrocarbons - Silica gel cleanup							
Amber Glass Bottle - Unpreserved (EP071SG)							
MW10	**15-Jan-2021**	**18-Jan-2021**	22-Jan-2021	✓	**21-Jan-2021**	27-Feb-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP071 SG: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Silica gel cleanup							
Amber Glass Bottle - Unpreserved (EP071SG)							
MW10	**15-Jan-2021**	**18-Jan-2021**	22-Jan-2021	✓	**21-Jan-2021**	27-Feb-2021	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber VOC Vial - Sulfuric Acid (EP080)							
MW10	**15-Jan-2021**	**18-Jan-2021**	29-Jan-2021	✓	**18-Jan-2021**	29-Jan-2021	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber VOC Vial - Sulfuric Acid (EP080)							
MW10	**15-Jan-2021**	**18-Jan-2021**	29-Jan-2021	✓	**18-Jan-2021**	29-Jan-2021	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
MW10	**15-Jan-2021**	**18-Jan-2021**	29-Jan-2021	✓	**18-Jan-2021**	29-Jan-2021	✓

Quality Control Parameter Frequency Compliance

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

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	1	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	0	3	**0.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	3	20	**15.00**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	1	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	0	3	**0.00**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
Biochemical Oxygen Demand (BOD)	EP030	WATER	In house: Referenced to APHA 5210 B. The 5-Day BOD test provides an empirical measure of the oxygen consumption capacity of a given water. A portion of the sample is diluted into oxygenated, nutrient rich water, and a seed added to begin biological decay. The initial dissolved oxygen content is measured, then the bottle is sealed and incubated for five days. The remaining dissolved oxygen is measured, and from the difference, the demand for oxygen, by biological decay, is determined. This method is compliant with NEPM Schedule B(3).
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH - Total Recoverable Hydrocarbons - Silica Gel Cleanup	EP071SG	WATER	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM Schedule B(3).
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

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