ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

AUDITOR CERTIFICATION REPORT & STATEMENT OF REASONS: GLADSTONE FIRE STATION, 5-9 BRESLIN STREET, GLADSTONE, QLD

QUEENSLAND FIRE AND EMERGENCY SERVICES

10 MARCH 2020
719052_GLADSTONE
VERSION 1

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

10 March 2020

Queensland Fire and Emergency Services
24 Corporate Drive
Cannon Hill QLD 4170

Attention: **Dr Raymond Bott**
Inspector

Dear Ray

Auditor Certification and Statement of Reasons: Detailed Site Investigation (DSI) of Gladstone Fire Station, 5-9 Breslin Street, Gladstone, Queensland

Please find enclosed a copy of my report entitled as above. Thank you for the opportunity to undertake this work.

Following evaluation of the site investigation report (SIR) in relation to relevant guidelines, policy and legislation, the Contaminated Land Auditor (CLA) has concluded that the SIR meets the objectives of the project, in that the DSI and SIR:

- was undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation;
- fulfils the objectives of the project with regards to the characterisation of per and poly fluoroalkyl substances (PFAS) impact (concentration and distribution) on and at the boundaries of the subject site; and
- complies with the relevant elements of the *Environmental Protection (EP) Act 1994* (Chapter 7, Part 8, Subsections 389 (1) and (2)).

Based on the above determination, the CLA agrees with the conclusions of the SIR that the site does not currently pose an unacceptable human health risk but that further (off-site) investigation is warranted to quantify potential impacts to off-site receptors (human and ecological).

If you have any queries concerning this report, contact the undersigned on (07) 3852 6666.
For and on behalf of
Environmental Earth Sciences QLD

Report Author
Mark Stuckey
Contaminated Land Auditor

Project Manager/ Auditor Assistant
Kat Spruth
Senior Environmental Scientist

719052_QFES_GST AuditorCert_V1

EXECUTIVE SUMMARY

Environmental Earth Sciences QLD was commissioned by Queensland Fire and Emergency Services (QFES) to undertake the contaminated land auditor (CLA) role for a per and poly fluoroalkyl substances (PFAS) assessment of the Gladstone Fire Station (5-9 Breslin Street, Gladstone, QLD "the site"), legally described as Lots 5 to 10, RP606760. The CLA function was necessary due to QFES's requirement that a third party review all investigation activities and reporting outcomes for the site to ensure compliance with relevant requirements of Chapter 7, Part 8, Subsections 389 (1) and (2) of the *Environmental Protection (EP) Act 1994*.

The following site investigation report (SIR) was provided by AECOM as a Contaminated Land Investigation Document (CLID) and is the subject of this Auditor Certification Report:

- AECOM (2019b). PFAS Detailed Site Investigation Gladstone Fire Station, 6-9 Breslin Street, Gladstone, Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 13 February 2020.

Following evaluation of the SIR in relation to relevant guidelines, policy and legislation (in particular NEPC 2013, HEPA 2018, DES 2018 and the *EP Act 1994*), the CLA has concluded that the SIR meets the objectives of the project, in that the DSI and SIR (CLID):

- was undertaken in accordance with current best-practice methodologies, cognisant of and in accordance with applicable guidance and legislation;
- fulfils the objectives of the project with regards to the characterisation of PFAS impact (concentration and distribution) on and at the boundaries of the subject site; and
- complies with the relevant elements of the *Environmental Protection (EP) Act.1994* (Chapter 7, Part 8, Subsections 389 (1) and (2)).

Based on the above determination, the CLA agrees with the conclusions of the CLID that the site does not currently pose an unacceptable, direct-contact human health risk in the context of on-going commercial/ industrial land use. However, given a number of commercial/ industrial ecological exceedances in shallow, unsealed site soils (in some cases, greater than an order of magnitude above the assessment criteria), the CLA considers that a targeted management/ limited remediation program in these areas is warranted, to remove any direct ecological exposure risk and/or minimise any potential for ongoing leaching and mobilisation of PFAS in the subsurface (following rainfall) or spread of wind-borne dust.

This could include:

- In-situ concrete capping of unsealed areas, to minimise future infiltration; and/or
- Excavation and removal of the most-impacted soil layer (i.e. top 0.5 m) and disposal off-site to a suitably licenced landfill facility.

Furthermore, based on the identification of elevated contaminant concentrations greater than human health and ecological assessment criteria in all six on-site groundwater monitoring bores at and along the boundaries of the site, further (off-site) investigation is warranted.

Specifically, the CLA considers (based on significantly elevated concentrations of PFOS and sum of PFOS and PFHxS observed in western site bores GS_MW01 and GS_MW02 (>100 µg/L)) off-site contaminant migration in groundwater at concentrations greater than the adopted assessment criteria is highly likely. The off-site investigation therefore should seek to confirm to what extent this impacted groundwater (and potentially surface water) has migrated beyond the site boundary, and determine whether this contamination poses a viable, unacceptable human and/or ecological risk to sensitive receptors located down gradient of the site.

The above notwithstanding, the CLA does not consider that PFAS concentrations within the site boundary pose an unacceptable risk to human site users and thus do not preclude on-going use of the site for commercial/ industrial purposes (so long as consideration is given to future management/ remedial measures). Rather, additional off-site investigation should be undertaken to determine if notification, remediation and/ or management actions should be implemented to comply with legislation and mitigate risks to any identified off-site receptors along a complete exposure pathway.

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

TABLE OF CONTENTS

Table of Figures

Tables

Appendices

1 INTRODUCTION

Environmental Earth Sciences QLD was commissioned by Queensland Fire and Emergency Services (QFES) to undertake the contaminated land auditor (CLA) function in relation to the per and poly fluoroalkyl substances (PFAS) assessment project at the Gladstone Fire Station (5-9 Breslin Street, Gladstone, QLD "the site"), legally described as Lots 5 to 10, RP606760.

The CLA function was necessary due to QFES's requirement that a third party CLA review all investigation activities and reporting outcomes for the site to ensure compliance with relevant elements of Chapter 7, Part 8, Subsections 389 (1) and (2) of the *Environmental Protection (EP) Act 1994*.

The following report was provided by AECOM and is the subject of this Auditor Certification Report:

- AECOM 2019. PFAS Detailed Site Investigation Gladstone Fire Station, 5-9 Breslin Street, Gladstone, Queensland. Prepared for Queensland Fire and Emergency Services. Ref: 60609758 Revision 0 (Final). Dated 13 February 2020.

2 OBJECTIVES

The objectives of the CLA works were to:

- evaluate the efficacy of the site investigation and the accompanying site investigation report (SIR) in achieving the objective of characterising PFAS impacts (concentration and distribution) within and adjacent to the boundaries of each site;
- confirm that works were undertaken in accordance with best practice and all relevant national and state legislation/guidelines; and
- certify (or, where justified, propose amendments to ensure) that each SIR report fulfils the Department of Environment and Science (DES) requirements for a site investigation report (SIR) and contaminated land investigation document (CLID)[1].

3 SCOPE OF WORK

The following scope of works was undertaken to meet the objectives:

- Communication with the suitably qualified person (SQP, James Peachy of AECOM) and review of documents regarding the sampling and analysis methodology;

[1] As far as practicable, noting that the investigation was undertaken to target PFAS only.

- Site visits following the soil sampling/ groundwater bore installation program (on 2 August 2019) and groundwater sampling event (on 18 September 2019);
- Review of the CLID, including revisions following the initial review; and
- Provision of this report and appended auditor certification and declaration.

4 SITE IDENTIFICATION AND SETTING

4.1 Location and property description

The regional locality of the site is provided on **Figure 1** and site identification details provided in **Table 1**. The subject property lot and site layout are provided on **Figures 1 and 2**.

Table 1: Site details

Item	Details
Site address	5-9 Breslin Street, Gladstone, QLD 4680
Registered site owner	The State of Queensland
Registered address of site owner	Public Safety Business Agency, L13 Makerston House, 30 Makerston Street, Brisbane, QLD 4000
Site occupier	Queensland Fire and Emergency Services (QFES)
Local government area	Gladstone Regional Council
Zoning/ future zoning	Community facilities/no change
Lot and plan	Lots 5 to 10, RP606760
Tenure	Freehold
Latitude/longitude	-23.858260, 151.249317
Site area	4,630 m^2
Current/future use	Ongoing fire station use (commercial/industrial)
Environmental Management Register (EMR)/Contaminated Land Register (CLR)	Lots 5 to 10, RP606760 are not listed on the EMR or CLR.

Figure 1: Site location plan (reproduced from AECOM 2019b)

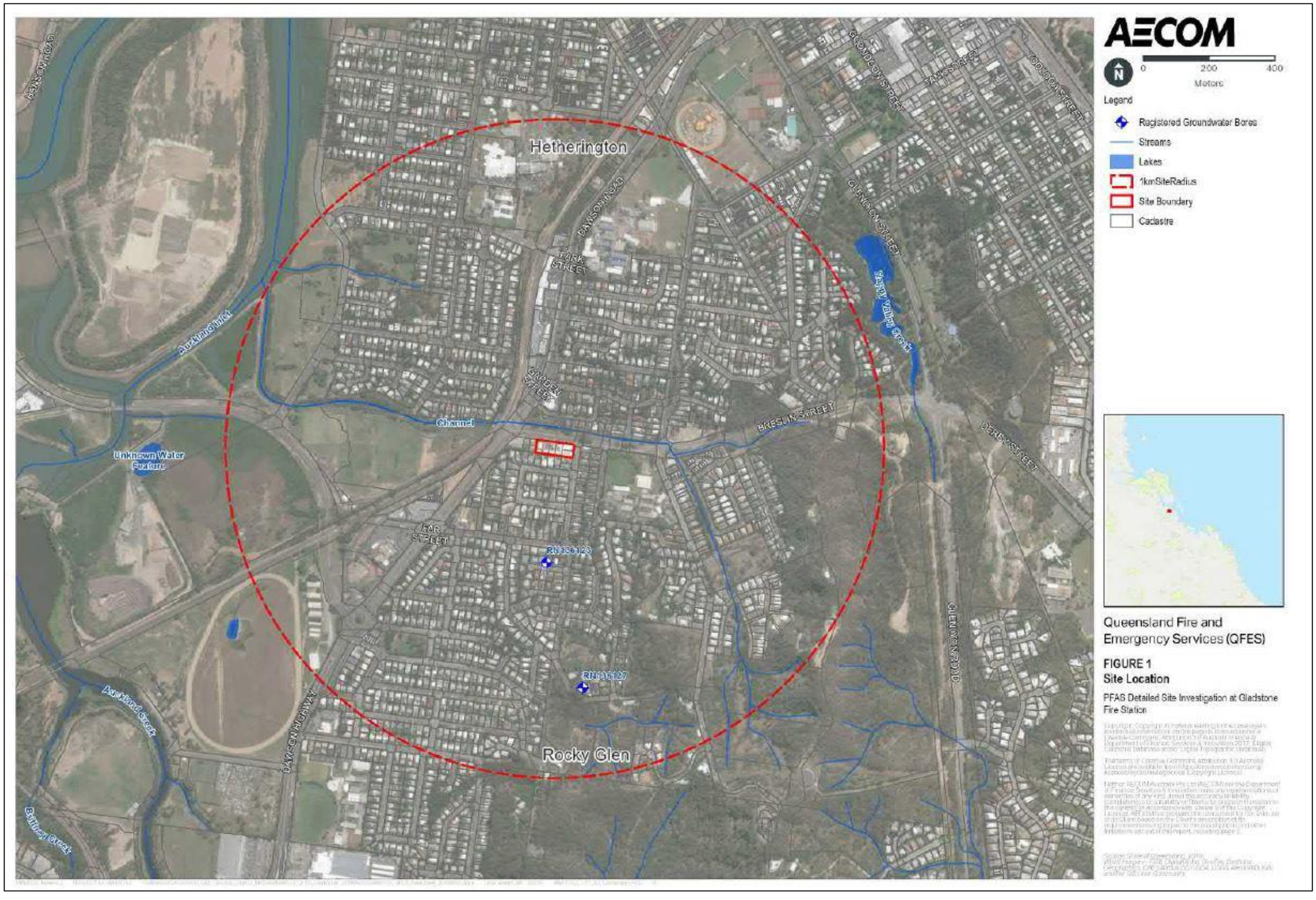


Figure 2: Site layout and sampling locations (reproduced from AECOM 2019b)

4.2 Site description and surrounds

4.2.1 Site

At the time of the inspection, the site was an operational fire station, comprising several buildings relating to the various administration, operational and training activities required to discharge this role. Key site features included:

- One two-storey building at the eastern end of the site housing the main engine bay and a number of interconnected rooms: office/ administration areas, ablution and personnel changing rooms, equipment/ chemical (e.g. foam) storage and desk-based training facilities;
- One five-storey training tower;
- One single storey building housing a former vehicle/ equipment workshop with in-ground truck pit for vehicle inspections;
- A training hut and current foam storage building;
- A former foam storage building (located adjacent to the southern boundary) formerly used as a stockpile supply for use across the greater Gladstone region (Agnes Waters to Mt Larcom and west to the range at Calliope);
- A waste laydown area for temporary storage of general wastes, cardboard, waste oils and batteries;
- A decommissioned[2] concrete in-ground water tank (Case 4 pit) with dimensions of approximately 1.06 metres (m) x 3.8 m (deep) and a former holding capacity of 3,390 L; and
- Concrete hardstand covers approximately 70% of the site, with an open grassed landscaping area present at the western end of the site around the new fire engine shed understood to have historically been used for foam training exercises.

In addition to the above, an old bowser, understood to be connected to an *in-situ* 1,000 L underground storage tank (UST) was observed adjacent to the workshop within the western half of the site. It is understood the UST formerly contained petrol, but is now disused (refer **Figure 2**). According to AECOM (2019a) at the time of the PSI site inspection, the tank contained mostly water and a faint hydrocarbon (unleaded fuel) odour was noted.

A decommissioned well, of approximately 6 – 7 m depth, formerly used to supply water during training exercises, was previously located adjacent to the former workshop. This well is no longer used and was decommissioned via concrete infilling.

[2] Note: The Case 4 pit was not in use at the time of inspection, having been decommissioned via sand infill and concrete capping.

The site is accessed via hardstand driveways from Breslin Street, to the north and Charles Street, to the east.

4.2.2 Surrounds

Surrounding land uses include:

- **North:** Breslin Street with Kooyang Park beyond. A concrete-lined drainage channel runs in an east-west direction, parallel with Breslin Road along the southern boundary of the park, approximately 46 m to the north and 50 m to the north-west of the site boundary, discharging to Auckland Inlet, approximately 950 m to the north west of the site. Residential housing is present beyond the park, approximately 50 m from the northern site boundary, with additional residential properties and a childcare centre located approximately 100 m to the north.

- **East:** Charles Street, with residential properties beyond (at a range of approximately 20 m from the site boundary). Gladstone West State School is located further east, with playing fields located at a distance of 100 m from the site boundary and the nearest school buildings approximately 150 m south-east, beyond Quoin Street.

- **South**: Residential properties are located adjacent to the site, to the south, with Walters Avenue beyond. Additional residential buildings are located along Walters Avenue, along with a motel (Motor Inn);

- **West:** Commercial offices with additional residential properties beyond (at a range of approximately 20 m) followed by additional commercial properties, the Dawson Highway and the North Coast Railway Line (approximately 145 m distance). A former landfill site now converted to sports fields is located at Glen Creek Park, located at a range of 200 m from the western site boundary, at its closest point. The Auckland Inlet is located approximately 950 m to the north-west of the site.

  A number of off-site potential PFAS sources were also identified to the west, including the Gladstone Power Station (2.9 km west), Gladstone Airport (2.3 km south west) and Calliope River Sewage Treatment Plant (3 km north-west).

Review of available environmentally sensitive area (ESA) mapping indicates that wetlands associated with the Auckland Inlet and Calliope River to the north-west and west of the site (at a distance of between 1.3 km and 1.6 km) are classified as “high potential aquatic groundwater dependant ecosystems (GDEs)”, described as “*artificial/ highly modified wetlands (dams, ring tanks, irrigation channels, drains and canals)*”.

In addition, areas 650 m west, 1.1 m north-west, 2.7 km south-east and 4 km south are designated as “low potential terrestrial GDEs” for vegetation (BOM, 2020). A moderate potential terrestrial GDE “vegetation” is located approximately 814 m south-east and high potential terrestrial GDE “vegetation” is located 4.1 km to the west, adjacent to Calliope River (BOM, 2020).

Vegetation approximately 1 km to the south-east of the site associated with Auckland Inlet is also designated a combination of “Category B Endangered Regional Ecosystems (Biodiversity Status)” and “Category B Marine Plants” ESAs. Further Category B Endangered

Regional Ecosystems (Biodiversity Status) GDEs are located approximately 2.6 – 2.7 km south-east of the site (DES, 2020[3]).

In addition, marine plants along the Gladstone waterfront, approximately 1.6 km to the north-east of the site are listed within the "Directory of Important Wetlands" (DES, 2020).

No subterranean GDEs were identified within 4 km of the site.

See **Figure 1** for these features.

5 SUMMARY OF SITE HISTORY

The site history review detailed by AECOM (AECOM, 2019a) included a review of client-supplied, publicly available and third-party information from the following sources:

- Historical air photographs obtained from the Queensland Governments online mapping portal (QImagery online) from 1959, 1969, 1971, 1973, 1975, 1989, 1996, 2007 and 2014;
- Historical land title details from the Department of Natural Resources, Mines and Energy (DNRME);
- Search of DES's Environmental Management Register (EMR) and Contaminated Land Register (CLR);
- Review of previous environmental reports/ sampling activities undertaken at the site (namely, QFES, 2016 water sampling); and
- Interviews with nominated QFES personnel and site inspection (13 February 2019).

The purpose of the review was to identify potential historic sources of PFAS at and in the vicinity of the site in order to facilitate the development of a robust, PFAS-specific investigation strategy.

The results of the historic data review determined that the site was used as a fire station for approximately 46 years (since 1973). Accordingly, several PFAS sources were identified at the site (primarily via information obtained during site interviews), associated with past fire-fighting activities foam usage (training exercises) and storage practices, specifically:

- Training use/ application of firefighting aqueous film forming foam (AFFF) containing PFAS (3M Lightwater) to sealed/ unsealed areas during training exercises since 1973 (exact period of use is not known from currently available information);
    - This may also include overspray and/ or surface run-off toward then, unsealed areas of the site/ perimeter drainage; and

[3] https://environment.des.qld.gov.au/management/maps-of-environmentally-sensitive-areas/_nocache

- Storage/ transfer of 3M Lightwater (to/ from intermediate bulk containers (IBCs) and/or 20L drums) within the existing fire station buildings and in training areas at the site.
    - It is understood the Gladstone Fire Station has formerly and continues to operate as a central, foam stockpile site for fire stations across the greater Gladstone region. Accordingly, foam inventories are noted to be significantly higher than typically encountered on other regional fire stations of this type. In February 2019 AECOM reported that the current inventory at the site was 8.380 L of Solberg foam stored within IBCs, with additional foam at the site stored in 20 L drums[4];

Although not part of the current investigation, it is also understood, based on available information, that the lot to the immediate west of the site (Lot 4, RP606760) may have previously formed part of the historic fire station, prior to subdivision. Thus, foam storage/ usage activities may have historically occurred in this area. However, no verified information pertaining to this former land use and previous site configuration was available for review.

No inadvertent releases of foam/ significant spillage/ leakage events were recorded.

In addition to the above, the Auditor notes that there are a number of potential off-site sources of PFAS either directly up hydraulic gradient of the site (Gladstone Airport, 2.3 km south-west) or, cross and down-gradient of the site, in the vicinity of local waterways, with the potential to impact upon local aquatic receptors, namely Gladstone Power Station (2.9 km west) and Calliope River Sewage Treatment Plant (3 km north-west).

6 POTENTIAL FOR CONTAMINATION AND CONCEPTUAL SITE MODEL DEVELOPMENT

A conceptual site model (CSM) of the site can be formed by considering the geophysical characteristics at play at the site, the contaminant source, potential receptors and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process constantly being updated during the investigation process as more information becomes available.

6.1 Physical setting topography, hydrology and drainage

The site is located at an elevation of between 10 and 20 metres Australian Height Datum (m AHD) and slopes gently toward the north/ north west.

Stormwater drainage at the site feeds into the municipal system via stormwater pits located midway along the northern boundary of the site and on Charles Street, at the entrance to the

[4] It is noted that Solberg foam, now in use across operational fire station sites is reported by the manufacturer as “PFAS free” and therefore unlikely to contribute to any existing PFAS contamination loading in either soil and groundwater. Inventory comments pertaining to the storage of Solberg foam are supplied to provide an indication of equivalent volumes of AFFF that may have been stored at the site in the past in its “regional stockpile” capacity.

site. Stormwater flows from the pits, via underground, concrete drainage channels to the north, under Breslin Street and into a culvert located adjacent to Kooyong Park. The culvert flows to the west, passing to the north of Glen Creek Park (former landfill) and discharges to Auckland Inlet at a point approximately 950 m to the north-west of the site.

The closest hydrological feature to the site is the Kooyong Park drainage culvert, approximately 45 m to the north of the site, beyond Breslin Street at its closest point. Additional surface water features in the vicinity of the site include:

- Various drainage lines:
    - Two drainage lines located to the east of the site. Both drainage lines confluence at a point approximately 290 m to the east, passing under Breslin Street and draining to the eastern end of the Kooyong Park drainage culvert at a point approximately 280 m to the north-east of the site boundary;
    - One drainage line approximately 605 m north-west of the site, draining to Auckland Creek at a point 930 m to the north-west.
- Drainage lines approximately 800 m to the south east, beyond Matson Crescent,
- An unnamed pond or lake (located at Reg Tanna Park), located approximately 1 km north-east of the site;
- An un-named surface water feature (pond or lake) located at the centre of Gladstone Racecourse, approximately 1 km to the south-west;
- Wetlands, associated with Auckland inlet, located approximately 770 m to the south-west;
- Auckland inlet main channel, located approximately 940 m north-west, 1.2 km west and 1.5 km south west at its closest points; 1 km to the north-west and 2.1 km to the north of the site;
- Calliope River located 3.6 km to the north-west/west of the site at its closest point. The Calliope River runs in a broadly north to south orientation, discharging to Port Curtis at a point, approximately 5 km north-east of the site; and
- Port Curtis (Gladstone Harbour) located approximately 2.8 km north-east of the site at its closest point.

No additional surface water courses and/or features are present within 1 km of the site boundary.

6.2 Geology and soils

According to DNRM (2020), the site is likely to be underlain by miscellaneous unconsolidated sediments of the Holocene epoch (<10,000 years old), comprising "*mud, sandy mud, muddy sand and minor gravel*", associated with former estuarine channels and banks, supratidal flats and coastal grasslands. This in turn is likely to be underlain by the late Devonian-Carboniferous aged (350-370 million year old) Wandilla Formation, described as "*mudstone,*

lithic sandstone (locally containing silicified oolites), siltstone, jasper, chert, slate and local schist."

This is supported by information contained in the DNRMW (2006) Gladstone Special Geological Map[5] and, consistent with lithological observations made in two nearby registered groundwater bores (RN136123 and RN136127) located approximately 325 m south-east and 710 m south of the site which encountered clay and gravel layers underlain by shale clay (Wandilla Formation) and sand and gravel (Quaternary deposits), respectively.

Records held by the Australian Soil Resource Information System (ASRIS) (CSIRO, 2020) indicate soils at the site are classified as "Tenosols". Tenosols are described according to the Australian Soil Classification (ASC, Isbell 2002) as:

"Soils that do not fit the requirements of any other soil orders and generally with one or more of the following:

- *A peaty horizon.*
- *A humose, melacic or melanic horizon, or conspicuously bleached A2 horizon, which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.*
- *A horizons which meet all the conditions for a peaty, humose, melacic or melanic horizon except the depth requirement, and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.*
- *A1 horizons which have more than a weak development of structure and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.*
- *An A2 horizon which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.*
- *Either a tenic B horizon, or a B2 horizon with 15% clay (SL) or less,or a transitional horizon (C/B) occurring in fissures in the parent rock or saprolite which contains between 10 and 50% of B horizon material (including pedogenic carbonate).*
- *A ferric or bauxitic horizon >0.2 m thick.*
- *A calcareous horizon >0.2 m thick."*

[5] The available Department of Natural Resources, Mines and Water (DNRMW, 2006) mapping is an updated version of the Geological Survey of Queensland's (GSQs) original Gladstone Geological Map, first edition, dated 1965.

6.3 Acid Sulfate Soils

Detailed acid sulfate soil (ASS) mapping has been performed by DNRME (2004)[6] in the wider Gladstone area including field reconnaissance, sampling, analysis and reporting. This information (also available on Queensland Globe (DNRM, 2020)),indicates that while the site is located an area "*not assessed for sulfidic materials"* as part of the survey, land to the west of the site, beyond the Dawson Highway is reported as "*acid sulfate soil on disturbed land e.g. reclaimed land, aquaculture, quarry, urban, industrial likely to contain ASS where some partial or full treatment may have been undertaken*." It is noted this information is based on limited field data.

Given the above and, noting the potential for Quaternary Holocene deposits to underlie parts of the site (refer Section 6.2), the Auditor considers that potential acid sulfate soil occurrence does require consideration on this site in the event that soil is excavated or dewatering is undertaken.

6.4 Hydrogeology

6.4.1 Results of registered bore search

Queensland Globe (DNRME, 2020) was used by the Auditor and AECOM (2019b) to search for registered bores in the vicinity of the site. The database indicated there are two registered bores within 1 km of the site (refer **Figure 1**).

Given the expected receptors for groundwater migration (Auckland Inlet, approximately 1 km to the north/ north-west) it is noted that both bores are located hydraulically up-gradient of the site:

- One bore (RN136123), located 325 m south, is listed as "water supply" and is screened from 13 to 17.1 m in gravel (Wandilla Formation) with a yield of 1.0 L/s and a reported standing water level (SWL) of 11.1 m (December 2004). The quality of water is listed as "potable";

- One bore (RN136127), located 710 m south, is listed as "water supply - abandoned, but still useable" and is screened from 17 to 19.7 m in coarse gravel (Quaternary- undefined), with a yield of 2.53 L/s and a reported SWL of 12.7 m (July 2002). Salinity as TDS is listed as 6,000 (assumed mg/L – unit unspecified) indicating water in this bore is unlikely to be suitable for human consumption.

The closest down-gradient registered bore (RN111797) is located approximately 1.2 km to the north. This bore, is also listed as "water supply" and is screened between 16 and 19 m within "mudstone" of the Wandilla formation with a yield of 0.75 L/s and a reported SWL of 9 m (October, 2002). Salinity as electrolytic conductivity (EC) is listed as 2,000 (assumed µS/cm – unit unspecified) indicating water in this bore is also unlikely to be suitable for human consumption.

[6] Department of Natural Resources, Mines and Energu (DNRME, 2004) Acid Sulfate Soils Tannum Sands – Gladstone 1:50,000.

Based on the Groundwater Resources of Queensland 1:2,500,000 mapping it is understood that the aquifer beneath the site comprises metamorphic rocks, has an average yield of <5 L/s and a salinity of <1,500 mg/L (questionable based on the above bore records). Resultantly, groundwater sourced therein is considered suitable for most purposes, although marginal for human consumption and low salt tolerant crops.

The bore cards for the registered bores detailed above have been provided in **Appendix D**.

6.4.2 Aquifers and aquitards

It is anticipated that the uppermost aquifer beneath the site will be present within the Devonian-Carboniferous aged metamorphic Wandilla Formation. This unit is expected to be present from approximately 16 m depth with a variable yield ranging from 0.75 to 2.53 L/s. Based on the limited information available on the bore cards reviewed, water quality appears to vary from potable to unacceptable for human consumption.

6.4.3 Groundwater dependent ecosystems

The Auditor also used BOM (2020) to determine whether local surface ecosystems have been classified as groundwater dependent ecosystems (GDEs). The map indicated:

- High potential aquatic GDEs described as "*wetland: artificial/highly modified wetlands (dams, ring tanks, irrigation channels, drains and canals)"* were identified to the west of the site at a distance of between 900 m and 1.6 km, associated with the Auckland Inlet and Calliope River;
- High potential terrestrial GDE "Vegetation": was identified 4.1 km to the west, adjacent to Calliope River;
- Moderate potential terrestrial GDEs "vegetation" were identified approximately 814 m south-east; and
- Low potential terrestrial GDEs "vegetation" were identified 650 m west, 1.1 km north west, 2.7 km south-east and 4 km south.

No subterranean GDEs were recorded at or within a 4 km radius of the site.

6.4.4 Summary of groundwater usage and potential receptors

With reference to the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* and AECOM (2019b, Sections 3.6-3.8) a review of potential groundwater receptors and likely impacts to receptors/ users of the receiving water body has been undertaken.

Given the proximity of Auckland Inlet (part of the Calliope River Basin) which drains north, to Port Curtis, environmental values (EVs) for estuarine waters (Auckland Inlet) and groundwater within the Calliope River Basin are deemed most applicable for the site. Relevant EVs therefore include:

- aquatic ecosystems (surface water and groundwater);
- irrigation (groundwater);

- farm supply/ use (groundwater);
- stock water (groundwater);
- aquaculture (surface water);
- human consumption/drinking water (surface water and groundwater);
- secondary and visual recreation (surface water);
- drinking water (groundwater);
- industrial use (surface water and groundwater); and
- cultural and spiritual values (surface water and groundwater).

The Auditor completed a review of the identified potential groundwater/surface water receptors and agrees with those listed in AECOM (2019b). Results have been compared against adopted assessment criteria of aquatic ecosystems and drinking water as these are the most sensitive receptors. In terms of potential length of flow-path to these key potential receptors, the nearest expected down-gradient water supply bore (potential drinking water receptor, RN111797 is 1.2km is distant, whilst the nearest aquatic GDE is 900 m west (wetlands associated with Auckland inlet).

6.5 Chemicals of potential concern

This investigation was undertaken to investigate human health and ecological health risks at the site associated with PFAS contamination only. Accordingly, no assessment and/or commentary is provided pertaining to other chemicals of potential concern (CoPC) that could be present at the site associated with historic activities (e.g. placement of fill, legacy landfilling activities and historic fire station use).

For the purposes of this assessment therefore, CoPCs comprise:

- PFAS compounds (28 analyte suite, refer **Table 2**); and
- PFAS compounds (28 analyte suite – total oxidisable precursor assay (TOPA) analysis).

Table 2: PFAS Compounds (28 analyte suite) – CoPCs

PFAS Group	Compound	Acronym	Carbon Chain Length	CAS No.
Perfluoroalkyl Sulfonic Acids	Perfluoro butane sulfonic acid	PFBS	4	375-73-5
	Perfluoropentane sulfonic acid	PFPeS	5	2706-91-4
	Perfluorohexane sulfonic acid	PFHxS	6	355-46-4
	Perfluoroheptane sulfonic acid	PFHpS	7	375-92-8
	Perfluorooctane sulfonic acid	PFOS	8	1763-23-1
	Perfluorodecane sulfonic acid	PFDS	10	335-77-3
Perfluoroalkyl Carboxylic Acids	Perfluorobutanoic acid	PFBA	4	375-22-4
	Perfluoropentanoic acid	PFPeA	5	2706-90-3
	Perfluorohexanoic acid PFHxA	PFHxA	6	307-24-4
	Perfluoroheptanoic acid	PFHpA	7	375-85-9
	Perfluorooctanoic acid	PFOA	8	335-67-1
	Perfluorononanoic acid	PFNA	8	375-95-1
	Perfluorodecanoic acid	PFDcA	10	335-76-2
	Perfluoroundecanoic acid	PFUnDA	11	2058-94-8
	Perfluorododecanoic acid	PFDoDA	12	307-55-1
	Perfluorotridecanoic acid	PFTrDA	12	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	14	376-06-7
Perfluoroalkyl Sulfonamides	Perfluorooctane sulphonamide	FOSA	8	754-91-6
	N-Methyl perfluorooctane	MeFOSA	8	31506-32-8
	N-Ethyl perfluorooctane	EtFOSA	8	4151-50-2
	N-Methyl perfluorooctane	MeFOSE	8	2448-09-7
	N-Ethyl perfluorooctane	EtFOSE	8	1691-99-2
	N-Methyl perfluorooctane	MeFOSAA	8	N 2355-31-9
	N-Ethyl perfluorooctane	EtFOSAA	8	2991-50-6
Fluorotelomer Sulfonic Acids	4:2 Fluorotelomer sulfonic acid	4:2 FTS	4	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2 FTS	6	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2 FTS	8	39108-34-4
	10:2 Fluorotelomer sulfonic	10:2 FTS	10	120226-60-0

6.6 Source to receptor pathway evaluation

AECOM (2019a)[7] developed a source, pathway and receptor exposure model for the site in both graphical and written form. This included consideration of the site's physical

[7] AECOM (2019a) *Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES,* April 2019

characteristics that could provide a pathway to potential receptors for the CoPCs that may be identified in environmental media on the site.

The site history assessment allowed for a preliminary conceptualisation of the potential location and likely distribution of these chemicals in environmental media at the site. This in turn, facilitated the design of a robust sampling and analytical program to identify and quantify such chemicals at the site and along the site boundaries, if present.

The Auditor reviewed and approved (following discussion) the preliminary CSM and the corresponding sampling plan for the SI works (AECOM, 2019a) in March 2019 prior to the commencement of intrusive works.

7 FIELD PROGRAM

7.1 Auditor site inspection

The Auditor's representative visited the site on 2 August 2019 to confirm in-field methodologies utilised by AECOM and ground-truth the site setting details identified during the data review phase. Due to the rapidity of the drilling program and mobilisation limitations, the Auditor was unable to attend site during soil sampling and bore installation. However, a site inspection and validation of the works completed by the SQP's site representative (permanent bore installation locations, soil bore, sediment/ surface water sampling locations) was undertaken immediately thereafter. The Auditor inspected the site surrounds on 18 September 2019.

Final soil sampling and permanent groundwater monitoring bore locations are presented on **Figure 2** above.

During the audit the entire site was traversed on foot. The surface of the site consisted of a relatively flat area sloping slightly to north/ northwest containing a combination of concrete hardstand, unsealed, grassed areas and fire station buildings and sheds associated with ongoing site operations.

No sub-surface infrastructure was observed on the site at the time of the inspections that could "be affected by contaminants" or "be a barrier to or facilitate the migration of contaminants", other than the stormwater and sewer networks potentially providing a conduit to contaminant migration. However, the Auditor's representative noted:

- An old bowser (vehicle refuelling infrastructure) to the south of the existing workshop building. According to available information (AECOM, 2019b) it is understood the bowser is connected to a disused 1,000 L UST which remains *in-situ*, underlying the concrete hardstand (refer **Figure 2**). At time of the preliminary assessment (AECOM, 2019a) a faint hydrocarbon odour was observed associated with the tank but, it is understood the tank now contains primarily water and is no longer used for refuelling activities. Tank bedding sands, present *in-situ* around this tank could impact upon contaminant migration pathways; and

- It is understood a concrete, in-ground tank (the Case 4 pit) formerly used to store water, was decommissioned *in-situ* at the site via pump-out, sand infill and capping with concrete. Bedding sands in the vicinity of this tank could also influence contaminant migration.

It was observed that there were no obvious indications of uses for, or activities carried out on, the surrounding land that could affect the safety of or cause environmental harm to the subject land. No soil stockpiles or inert waste was present across the site at the time of the inspection beyond general waste (e.g. cardboard, plastics) retained within Council-provided general waste and/or recycling bins located within the waste laydown area.

It is therefore concluded that no "waste storage, treatment or disposal" has occurred on the site as per the definition in Schedule 3 of the EP Act 1994 (Notifiable Activity no.37), hence no waste has been "disposed of or stored on the land". As per the definition of "waste" in s.13(1), (2) and (3) of the EP Act 1994 "including anything" that is "left over" or "surplus" to an activity, it is considered that the "left over" and "surplus" material does not constitute "waste" as per the definition in s.389(1)(d) because it was not "disposed of or stored".

In addition to the above, and with particular reference to s.389(1)(d)(ii) of the EP Act 1994, there was no evidence of any potential contamination of the land or the presence of any hazardous contaminant on the site at the time of the inspection.

7.2 Field investigations

Field investigations comprised the following events:

- Preliminary Site Investigation (PSI, reported in AECOM, 2019a, summarised in AECOM, 2019b)
    - **Event 1** (13 February 2019): site inspection to identify areas of potential environmental concern (including interviews with selected QFES personnel regarding historic site activities) – reported in (AECOM, 2019a)
- Detailed Site Investigation (DSI, reported in AECOM, 2019b):
    - **Event 2** (1 August 2019):
        - Drilling of six soil bores (GS_BH01 to GS_BH06), installation of six monitoring bores (GS_MW01 to GS_MW06) and bore development; and
        - Advancement of three shallow bores (GS_SS01 to GS_SS03);
    - **Event 3** (12-13 August 2019):
        - Groundwater monitoring event (GS_MW01 to GS_MW06) and monitoring bore survey;
        - Collection of one surface soil sample (GS_SS4);
        - Collection of one sediment samples (GS_SED01); and

- Collection of one surface water sample (GS_SW03)

Sampling locations are presented on **Figure 2**.

7.2.1 Sampling method

Boreholes were advanced to a clearance depth of 1.5 metres below ground level (m BGL) via non-destructive drilling techniques (NDD) prior to follow-on with a mechanical drill rig (Geoprobe equipped with push-tube) to the maximum target depth of approximately 7.4 m BGL for soil sample collection and logging. Each bore was subsequently "reamed out" to target depth by Proactive using a Geoprobe drilling rig equipped with solid stem augers for groundwater monitoring bore installation at each location.

Hole diameters were 60 mm and 100 mm for soil and groundwater bores respectively. All boreholes were advanced to natural material.

Shallow soil bores (GS_SS1 to GS_SS3) were advanced via hand auger to a maximum depth of 0.5 m BGL to assess shallow soil conditions. Surface sample GS_SS4 was collected from the site surface using hand tools.

Samples were generally collected from each borehole from surface (or materials immediately underlying the concrete slab) (0-0.2 m), subsurface (0.2 – 0.5 m) and every metre thereafter, or, where a change in lithology or visual/olfactory signs of contamination were evident until the target depth was achieved.

Samples were collected from each location, directly from the push-tube liner, solid stem auger cuttings and/or hand auger, by hand, using a fresh, clean pair of nitrile gloves for each sampling interval. Soil samples were collected into laboratory-supplied PFAS-suitable containers and immediately stored on ice for transport to the laboratory under appropriate, chain of custody (COC) control.

Representative samples were submitted for laboratory analysis for the identified contaminants of concern as per the agreed SAQP, namely:

- Three samples from each borehole/ monitoring bore installation (two within the 0 to 1 m bgl depth interval and one at depth, within the saturated zone); and
- Two samples from each shallow bore (GS_SS1 to GS_SS3), within the 0 to 1 m depth interval.

7.2.2 Lithology encountered

The lithology encountered at the site generally comprised an average 1.5 metre thickness of fill (ranging from 1.1 m (GS_BH04) to 1.8 m (GS_BH01, BH02 and BH03)) overlying disturbed natural, then natural materials described as brown silty clay with some proportion of white, weathered rock (quartz arenite), with increasing moisture content, with depth.

Fill material observed was generally consistent across the site, described as silty and sandy clays with volcaniclastic sedimentary rock (conglomerate) identified between 0.45 m BGL and approximately 1 m BGL in bores GS_BH01, GS_BH03, GS_BH04 and GS_MW06.

No visual and/or olfactory evidence of contamination (e.g. foreign materials, odour or stain) was identified during the drilling program.

7.2.3 Groundwater assessment

Six groundwater bores (GS_MW01 to GS_MW06) were installed by AECOM (2019b). Each bore was screened within the natural, silty clays/sandy clay horizon, where a water strike (very moist or wet) material was observed.

During the gauging and sampling event, undertaken post-drilling, in August 2019, stabilised standing water levels (SWLs) in all six monitoring bores were reported above the screened interval at depths of between 1.5 and 2.4 m bgl. Screened intervals ranged in all six bores from 3.8-7.4 m bgl in sand.

Based on the groundwater elevations reported, local groundwater flow direction was inferred to be toward the west/ north-west.

Due to a malfunction of the water quality meter (WQM) AECOM were unable to collect *in-situ* field data for any of the sampled bores, to determine field chemistry. It is noted that, despite the malfunction, laboratory analysis of these parameters to provide indicative information on pH and/or TDS was not requested.

No visual and/or olfactory evidence of contamination (e.g. odour, sheen, foaming) was identified during the groundwater sampling program.

7.2.4 Surface water and sediment assessment

One sediment sample was collected from site drainage channels for assessment, while a surface water sample was collected from one location only, given the majority of the site drainage channels were dry at time of collection. See **Figure 2** for locations.

The surface water sample was collected using the laboratory-supplied container to collect water from the centre of the drain, while sediment samples were collected as grab samples, at each location, using a gloved hand. To minimise potential for cross-contamination, a fresh, clean pair of nitrile gloves was donned prior to sample collection at each location.

Each sampling container (bottle or jar) was filled to zero headspace prior to capping, storage on ice and submission to the nominated laboratory.

7.3 Auditor's comments

Laboratory analysis for pH, electrical conductivity (EC) and total dissolved solids (TDS) could have been requested to provide an indication of local groundwater chemistry following WQM malfunction. The Auditor notes that field assessment is preferred as laboratory holding times (particular pH and EC – 6 hours) are rarely met and these parameters may change in transit.

Although information on field chemistry would have been useful during this phase of investigation, this data gap can be addressed during the subsequent phase of work, intended to focus on off-site assessment (refer Sections 11 and 12 below), albeit given one set of measurements will be collected, any assessment of seasonal changes to local groundwater chemistry will not be possible.

The Auditor considers that the sampling and analytical program was suitable to fulfil the requirements of the investigation and the majority of the assessment works were performed in accordance with best practice methodologies. The Auditor does not consider the absence of field parameters, in this instance to significantly impact upon the data quality or, unduly influence the conclusions of the report.

8 LABORATORY ANALYTICAL PROGRAM REVIEW

Samples were analysed by Australian Laboratory Services (ALS) as the primary laboratory and National Measurement Institute (NMI) as the secondary. Both laboratories are accredited with the National Association of Testing Authorities (NATA) for the methods used.

Primary samples, intra laboratory duplicates and rinsates were sent to ALS in Stafford (QLD), inter laboratory duplicates were sent to NMI in Ryde (NSW).

Intra and inter laboratory duplicates and rinsates were analysed as part of AECOMs quality assurance/quality control (QA/QC) procedures.

8.1 Analytical schedule and suites

The following analytical schedule detailed in **Table 3** was used for the sampling events.

Table 3: Analytical schedule

Sampling Location	Analyte	Primary samples	QA/QC		
			Intra laboratory duplicate	Inter laboratory duplicate	Rinsate
SOIL & SEDIMENT					
GS_BH01-GS_BH06	PFAS (28)	5			4
GY_SS1 – GY_SS4	PFAS (28)	1	1	1	
GS_SED01	PFAS (28)	5			
GS_BH-2	TOPA	1			
GROUNDWATER, SURFACE WATER					
GS_MW01 – GS_MW06	PFAS (28)	4	1	1	1
GS_SW03	PFAS (28	1			
GS_MW02	TOPA	1			

The Auditor agrees with the analytical schedule used and that it is considered sufficient to characterise PFAS impacts (concentration and distribution) within and adjacent to the boundaries of the site and identify the potential for off-site contaminant migration.

8.2 Procedures for quality control and quality assurance

Quality control is achieved by using NATA registered laboratories using ASTM standard methods supported by internal duplicates, the checking of high, abnormal or otherwise anomalous results against background and other chemical results for the sample concerned.

Quality assurance is achieved by confirming that field results, or anticipated results based upon comparison with field observations, are consistent with laboratory results. Also, that sampling methods are uniform, and decontamination is thorough. In addition, the laboratory undertakes additional internal quality assurance procedures and tests.

These quality assurance/quality control (QA/QC) processes were undertaken as part of this assessment, including collection and analysis of intra and inter laboratory duplicates and rinsate blanks. No trip blanks and/or trip spikes were analysed as part of this assessment.

Field observations are compared with laboratory results when they are not as expected. Confirmation, re-sampling and re-analysis of a sample are undertaken if the results are not consistent with field observations and/or measurements. In addition, field duplicate sample results have to be within the acceptable range of reproducibility. A discussion of the quality of internal laboratory results and field duplicate relative percentage difference (RPD) calculations was included in AECOM (2019b) Appendix G and are discussed below.

The following was noted with regards to the QA/QC procedures:

- Sample integrity and container requirements were documented as acceptable;
- Holding time compliances were documented as acceptable with the exception of moisture content associated with sample GS_BH02_0.5 (TOPA), batch EB1921187;
    - It is noted the moisture content holding time exceedance is associated with the required re-batching of samples for TOPA analysis and moisture content was undertaken within the required holding time, as part of the initial, standard PFAS analytical run,
- Laboratory matrix spike results were mostly within acceptable control limits;
    - It is noted that a number of matrix interferences were recorded primarily for anonymous samples from batch ES1925572, potentially indicative of suppressed analyte recovery in this sample;
- Laboratory duplicate % RPD results were acceptable;
- All laboratory QA/QC method blanks were found to be acceptable; and
- Field replicate and triplicate RPD values were acceptable or, where non-conformances were identified, were appropriately assessed and deemed acceptable for use.

It is therefore the opinion of AECOM (2019b) and the Auditor that the data quality process for both field and laboratory components of the investigation were appropriate to enable the report conclusions to be relied upon.

9 ASSESSMENT CRITERIA REVIEW

9.1 Soil

Site investigation criteria were selected to provide an appropriate indication of the environmental status of the site with consideration given to the current and future land uses as determined by existing site zoning and information provided by QFES and potential human health and/or ecological risk posed to off-site and down hydraulic gradient sensitive receptors. The adopted assessment criteria and rationale for their selection is detailed in Section 5.0 (AECOM, 2019b).

Typically for a soil contaminant concentration to be considered acceptable for the respective land use criteria, the data set must conform to the following requirements:

- the 95% upper confidence limit (UCL) of the arithmetic mean of analytical results is below the site criteria;
- the arithmetic (or geometric in cases where the data is log normally distributed) mean is below the site criteria;
- the standard deviation is less than 50% of the site criteria; and
- no single sample analytical result is greater than 250% of the site criteria.

Soil analytical results have been tabulated (AECOM 2019b, Appendix B) and compared to NEMP (2018) guidelines for human health and ecological indirect exposure, namely:

- human health- guidance value (commercial/ industrial – direct contact);
- ecological guideline values for indirect exposure (commercial/ industrial); and
- ecological guideline values for indirect exposure (residential).

The Auditor notes that although the site is and is intended to continue as a commercial/ industrial property, AECOM has also assessed the soil analytical results against ecological guideline values for indirect exposure for the residential land-use exposure setting given:

- Parts of the site (particularly around the new fire station shed, to the west) and areas adjacent to the site (to the north) are unsealed therefore there is a potential (albeit low) for exposure of terrestrial organisms (albeit transient as a result of ongoing land-uses) in these areas; and
- The PFAS DRAFT NEMP Version 2.0 (HEPA 2019 unpublished, draft for consultation) intends to adopt, the current residential guideline (0.01 mg/kg) as standard for both

exposure scenarios, albeit endorsing modification of the guideline[8] for commercial/ industrial sites on a case by case basis where use of a residential exposure scenario is deemed too conservative, for example:

- The site is intensively developed with the percentage of the surface area covered by hard surfaces higher than 80% of each hectare (to be applied separately to each hectare).
- Secondary consumers are effectively absent from the site;
- The site is situated in an extensively built-up urban setting; and
- The site is not in close proximity to waterways, drainage networks or groundwater.

9.2 Groundwater and surface water

Groundwater and surface water analytical results have been tabulated (AECOM 2019b, Appendix B) and compared to the guidelines presented in **Table 4** below, as summarised in:

- NHMRC (2019) Guidance on Per and Polyfluoroalkyl Substances in Recreational Water; and
- HEPA (2018) PFAS National Environmental Plan (NEMP), January 2018.

Table 4: Adopted assessment criteria - groundwater

Media	Environmental value	PFAS compound	Applicable guideline value (µg/L)
Groundwater	Human health – drinking water	Sum of PFHxS & PFOS	**0.07**
		PFOA	**0.56**
Groundwater discharging to surface water/ surface water	Aquatic ecosystem protection – 99%	PFOS	**0.00023**
			0.051
		PFOA	**19**
	Human health – recreational contact	Sum of PFHxS & PFOS	**2.0**
		PFOA	**10**

Notes:

0.07: (NEMP, 2018),

[8] Up to a maximum guideline concentration of 0.14 mg/kg, equivalent to the currently endorsed commercial/ industrial ecological guideline criteria for indirect exposure.

0.051: (Batley *et al*., 2018 – draft guidance, after AECOM 2019b);
2.0: (NHMRC, 2019)

9.3 Sediment

No published and/or endorsed criteria are currently available for the assessment of PFAS in sediment.

9.4 Auditor's comments

The Auditor has reviewed the results and confirms that the criteria have been correctly applied, noting that the draft guidance applied by AECOM (2019b) for ecosystem protection has not been ratified by Australian regulators.

Furthermore, it is noted that in the absence of endorsed assessment criteria for sediments, the laboratory limit of reporting (LOR) has been used as an initial screening (presence/ absence) assessment for sediments. The identification of a detectable concentration of PFAS, above LOR in sediment, does not necessarily constitute a human and/ or ecological health risk. Rather, any detection above LOR in sediments should be considered a trigger for further assessment/ consideration in relation to potential, complete, exposure pathways.

10 REVIEW OF RESULTS

10.1 Soil results compared to guidelines

10.1.1 Discussion

Detectable concentrations of PFAS, greater than the laboratory LOR, were recorded in all 23 soil samples analysed. The highest proportion of PFAS was generally observed at shallow depth (in fill materials) consistent with a "top-down" mode of contamination associated with historic application of AFFF during training activities followed by leaching and/or vertical infiltration through the soil profile.

Compositional analysis indicates that while the widest range of PFAS compounds were detected within the shallow depth interval 0.1 to 0.5 m bgl, the PFAS signature was not completely dominated by PFOS and PFHxS. In the shallow soil interval (0.1-0.5 m) the carboxylic acids PFNA, PFUnDA and PFTrDA made up close to 50% of the total PFAS mass, with PFNA (along with PFOS and PFHxS) dominating throughout the lower (≥1 m) soil profile and into the water-table (see Table 20 in AECOM 2019b).

Comparison with the adopted assessment criteria confirmed:

- No exceedances of the human health assessment criteria (commercial/ industrial land use scenario);

- Six exceedances of the ecological guideline criterion for PFOS (ecological indirect exposure, commercial/ industrial scenario, criteria 0.14 mg/kg);
    - Surface & near surface samples: GS_SS1 at 0.1 m bgl, (0.144 mg/kg); GS_SS2 at 0.5 m bgl (0.217 mg/kg); GS_SS3 at 0.1 m bgl (2.45 mg/kg) and GS_SS4 (surface) (0.452 mg/kg); and
    - Boreholes GS_BH02 at 0.1 m bgl (0.519mg/kg) and 0.5 m bgl (3.91 m bgl)

  It is noted the highest ecological guideline exceedances were identified at SS3 and BH02, in unsealed areas, in the north-western corner of the site;
- Thirteen exceedances of the ecological guideline criterion for PFOS (ecological indirect exposure, residential scenario, criteria 0.01 mg/kg) within the uppermost 2-3 metres, for which ecological assessment criteria typically applies;
    - Noting (as discussed in Section 9 above) that assessment against the ecological indirect exposure limits was undertaken as a conservative measure, to account for the southern, unsealed portion of the site where secondary consumers such as insectivorous birds and/or mammals could forage; and
- An additional ecological exceedance was reported at a depth of 7 m BGL at GS_BH02, although, as per above, typically a 2-3 m vertical limit is placed on ecological assessment, associated with typical root zone depths and anticipated activity zone for invertebrate and vertebrate organisms within the soil profile.

10.1.2 Auditor interpretation of soil PFAS data

Given the site is understood to have been subject to ongoing commercial/ industrial use for the past 64 years and is intended for continued fire station use, any ecological receptors at the site are likely to be transient in nature and therefore unlikely to be significantly impacted by the ecological guideline exceedances noted at the western end of the site.

However, given the exceedances were identified on unsealed areas and, in some cases, (GS_SS3 0.1 m bgl and BH02_0.5 m bgl) are greater than an order of magnitude above the assessment criteria, the CLA considers that rainfall and subsequent infiltration in these areas could result in leaching and mobilisation of PFAS in the subsurface.

While (refer to Section 10.2 below) PFAS is already present in groundwater, the CLA considers that further PFAS mobilisation could be limited by targeted management/ limited site remediation which could include:

- *In-situ* concrete capping of the unsealed areas, to minimise future infiltration; and/or
- Excavation and removal of the most-impacted soil layer (i.e. top 0.5 m) and disposal off-site to a suitably licenced landfill facility.

Furthermore, while widespread exceedances of the residential ecological indirect exposure limit were identified, as noted above, assessment against residential criteria is a conservative approach, given the likely transient nature of wildlife likely to be directly exposed on site, given ongoing commercial/ industrial activities associated with operational fire station use.

10.2 Groundwater results compared to guidelines

10.2.1 Discussion

Detectable concentrations of PFAS were recorded in all six monitoring bores at the site with compositional analysis confirming the PFAS groundwater signature to be dominated PFOS and PFHxS (approximately 45% of the PFAS mass present) with a further five compounds accounting for 40% (PFNA >PFHxA >PFPeS >PFBS >PFUnDA – see Table 20 in AECOM 2019b). This distribution is deemed indicative of potential higher mobility of shorter-chain compounds in the subsurface and/or higher solubility of shorter chain compounds in groundwater (in particular sulfonic acids).

Comparison with the adopted assessment criteria confirmed:

- Sum of PFOS and PFHxS concentrations exceeded the human health assessment criterion for drinking water (0.07 µg/L) and recreational water (2.0 µg/L) in all six monitoring bores (GS_MW01 – GS_MW06), with the highest concentration reported in bore GS_MW02, located adjacent in the north-western corner of the site, within the former AFFF training area (See **Figure 2**);

- PFOA concentrations in two groundwater bores (GS_MW01, 6.81 µg/L and GS_MW02, 8.02 µg/L) exceeded the human health assessment criterion for drinking water (0.56 µg/L); and

- PFOS concentrations in all four groundwater bores exceeded the adopted ecological guideline value (99% species protection – fresh water).

10.2.2 Auditor interpretation of groundwater PFAS data

Given the above, and based on the assessment completed to date, the Auditor considers that the extent of PFAS in groundwater has not yet been fully delineated. Given the observed concentrations of PFOS and PFHxS in groundwater in particular in site boundary wells GS_MW01 and GS_MW02 it is likely that these compounds have migrated beyond the site boundaries (particularly to the north and north-west) at concentrations greater than human health and ecological assessment criteria.

The concentrations observed (>100 µg/L at the site boundary) and the location and proximity of the nearest down-gradient surface water receptor (drainage culvert 50-75 m north/ north-west, draining to Auckland Inlet) warrants further investigation.

In addition to the above, given the highest concentrations of PFHxS and PFOS in groundwater were observed at the western end of the site and it is understood the current commercial/ industrial lot (Lot 4, RP606760) immediately to the west may have previously formed part of the fire station, it is recommended that any additional investigation seek to confirm if PFAS has been historically used and/or stored on this Lot. The investigation should also seek to confirm if, in turn, groundwater underlying the residential lot, further west, may have been impacted.

10.3 TOPA analysis

The results of the TOPA analysis (completed on one soil and one groundwater sample) determined that the soil and groundwater analytical results are likely indicative of a degraded PFAS product that is unlikely to significantly increase or alter via biotransformation or oxidation processes, over time.

10.4 Surface water and sediment results

10.4.1 Discussion – surface water

Detectable concentrations of fourteen PFAS compounds were reported in the surface water sample collected from the concrete lined drainage pit located on the exterior western wall of the workshop (noted to collect run-off from the concrete slab at the centre of site). Although additional samples were originally proposed for collection from concrete stormwater drains, co-located with sediment samples (refer Section 10.4.2 below) the additional surface water samples could not be collected as other drains were dry at time of fieldwork.

Consistent with soil and groundwater samples analysed during the investigation, the surface water signature was dominated by PFOS and PFHxS (54.3%) although detectable concentrations of a range of other compounds were also reported (in particular the carboxylic acids PFNA and PFUnDA and fluorotelomer sulfonic acids 8:2 and 10:2 FTS – see Table 21 of AECOM 2019b).

Comparison with the adopted assessment criteria confirmed:

- All detectable PFAS compounds were reported at concentrations less than adopted assessment criteria for recreational water and/or the laboratory LOR;
- The PFOS concentration (0.0434 µg/L) exceeded the existing (0.00023 µg/L – NEMP (2019) ecological guideline value (99% species protection for freshwater).
    - It is noted the PFOS exceedance did not exceed the draft, non-ratified freshwater ecological guideline for 99% species protection – freshwater (0.051 µg/L – AECOM 2019b).

10.4.2 Discussion – sediment

No published criteria are currently available to directly assess human health and/or ecological risks associated with PFAS in sediments therefore the sediment assessment was undertaken as a screening assessment to determine presence/absence of PFAS compounds in sediment.

The sediment PFAS signature was dominated by three compounds, namely PFUnDA (0.23 mg/kg), PFTrDA (0.15 mg/kg) and PFNA (0.015 mg/kg).

10.4.3 Auditor interpretation of surface water and sediment PFAS data

The presence of detectable PFAS compounds in surface water and sediment samples collected at the site indicates that drains along the boundaries of the site have, in the past,

captured contaminated surface run-off and could act as preferential pathways for the migration of PFAS via surface water drainage and sediment transport.

Given the site stormwater drainage system is directly connected to the municipal system, draining from the site directly north (under Breslin Street) to a drainage culvert located less than 50 m north of the site boundary, there is a potential that contaminated surface water (and to a lesser extent PFAS-impacted sediments) have migrated beyond the site boundary and entered the drainage system to the north.

As the drainage system eventually discharges to Auckland Inlet (approximately 950 m to the north-west of the site), the main aquatic receptor in the area, this warrants further investigation. However, the CLA considers (based on the distance of the Auckland Inlet from site and the data available to date) that the ecological risk to this receptor is likely to be low.

Furthermore, the above notwithstanding, it should be noted (as discussed above) that detectable concentrations of PFAS compounds in sediment, in the absence of a ratified assessment criteria, do not necessarily confirm the existence of a viable human and/or ecological health risk, rather, provide confirmation of contaminant presence and that further assessment of viable source-pathway-receptor relationships may be required to appropriately quantify the risk.

10.5 Data quality, data gaps and other considerations

Based on the results obtained from the assessment, including QA/ QC data, it is concluded that the data quality is appropriate and as such the results can be relied upon.

AECOM (2019b) outlined that any RPD exceedances were a result of heterogeneity and did not affect the outcomes of the report. AECOM (2019b) also reviewed document completeness, data completeness, data comparability, data representativeness and precision and accuracy for sampling and analysis. No outliers were reported when compared to the adopted evaluation criteria.

The Auditor has undertaken his own assessment of the data and arrived at the same conclusions as the SQP. This assessment has included a check of RPD calculations (discussed above), as well as comparison of field and laboratory collected data (where available).

10.6 Confirmation of conceptual site model and source-receptor pathway linkages

Based on the findings of the CLID (AECOM, 2019b), it can be confirmed that all possible source to receptor pathway linkages have been identified and quantified to the extent practicable within the limitations of this investigation:

- AECOM (2019b) concludes there is no unacceptable human health and/ or ecological risk associated with the identified PFAS concentrations on-site, within the commercial/ industrial exposure context; and
- AECOM (2019b) considers that, based on the groundwater investigation completed to date, there is a potential that impacted groundwater may have or be migrating beyond the

site boundary at concentrations greater than human health (drinking water/ recreational) and/ or ecological assessment criteria and that further investigation to appropriately delineate the PFAS plume and quantify risks posed to down-gradient sensitive receptors should be undertaken.

The Auditor concurs with AECOMs conclusions and considers further off-site investigation is warranted to appropriately assess risk to off-site receptors and determine appropriate management and/or remediation strategies, if required.

Specifically, the potential exposure pathway associated with off-site groundwater migration and subsequent groundwater use (potable/ other) and discharge to sensitive receptors needs to be investigated and quantified in order to allow an assessment of environmental harm.

11 ASSESSMENT OF REPORT AGAINST S389 OF EP ACT 1994

11.1 Key descriptive elements; (S389 (1)), EP Act (1994)

In summary, it is the Auditor's opinion that the CLID reviewed has provided adequate information about the land, as it has described the relevant elements, and the Auditor has assessed these descriptions against s.389(1) of the EP Act (1994).

A summary of the findings of the Audit is provided in this report (statement of reasons), with a reference table for each element in **Table 5** below.

11.2 Endorsement of statements under S389 (2) of the EP Act (1994)

Following on from the above summary of reasons for accepting the CLID, the Auditor is able to endorse the statements made in the CLID relating to s.389(2) of the EP Act (1994):

- Insufficient data has been collected (chemical and physical) beyond the site boundary to determine whether the site is prescribed contaminated land;
- The extent of PFAS contamination on the land has been assessed to an acceptable degree and it has been determined that the site is suitable for on-going commercial/ industrial land-use;
- Further data is required to be collected off-site to determine the extent that the land is impacting, or has the potential to impact on, any receptors or beneficial uses of groundwater; and
- It is the Auditor's opinion that the CLID complies with the contaminated land NEPM (NEPC, 2013).

Table 5: Auditors assessment of CLID contents

Subsections of section 389 of the *Environmental Protection Act 1994*		Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act	Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant
(1)(a)	the reasons particulars of the land have been recorded in a relevant land register	Table 2	Section 4
(1)(b)	a description of all surface and subsurface infrastructure on the land, including details of the location, size and type of the infrastructure	Section 2.2 Site Layout and features/Figure 2	Sections 4.2 and 7.1
(1)(c)	a description of the surrounding area of the land, including a description of each of the following in the surrounding area:	Section 3	Section 4.2
(1)(c)(i)	- all environmentally sensitive areas	Section 3.7 GDEs and Environmentally sensitive areas	Section 4.2 and 6.4.3
(1)(c)(ii)	- the location of all water, watercourses and wetlands	Section 3.4 Hydrology, Section 3.7 GDEs and Environmentally sensitive areas	Sections 6.1 and 6.4.3
(1)(c)(iii)	- the location of all storm water drainage	Section 2.2 Site layout and features/ Figure 2, Section 2.4 Previous environmental investigation, Section 3.4 Hydrology	Sections 6.1 and 7.1
(1)(c)(iv)	- all uses of the land, including uses that may affect the safety of the relevant land or cause environmental harm	Section 2.2 Site Layout and features, Section 2.3 Surrounding land use	Sections 4 and 5
(1)(c)(v)	- all activities carried out that may affect the safety of the relevant land or cause environmental harm	Section 2.4 Previous environmental investigations/ Table 1	Section 5
(1)(d)	for waste disposed of or stored on the land that contains, or may potentially contain, hazardous contaminants:		
(1)(d)(i)	- details of the location, volume and type of the waste	Section 2.4 Previous environmental investigation	Section 7.1

Subsections of section 389 of the *Environmental Protection Act 1994*		**Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act**	**Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant**
(1)(d)(ii)	- details of any potential contamination of the land caused by disposing of or storing the waste on the land	Section 2.4 Previous environmental investigation	Section 10
(1)(e)	a description of the geology and hydrogeology of the land	Section 3.2 Soil type and ASS; Section 3.3 Geology; Section 3.5 Hydrogeology	Sections 6.2, 6.3 and 6.4
(1)(f)	details of any environmentally relevant activities or notifiable activities carried out on the land, including the materials used and waste produced during the carrying out of the activities	Section 2.1 Site Identification, Section 2.4 Previous Environmental Investigation	Sections 1 and 5
(1)(g)	details of any earthworks carried out on the land, including the materials used and waste produced during the earthworks	Section 2.2 Site layout and features, Section 2.4 Previous Environmental Investigation, Section 4.0 fieldwork	Sections 5 and 7
(1)(h)	if work has been carried out on the land to remediate the contamination of the land—the contamination levels recorded on the land before and after the work was carried out	Not applicable	Not applicable
(1)(i)	for a draft site management plan:		
(1)(i)(i)	- the proposed objectives to be achieved and maintained under the plan	N/A	N/A
(1)(i)(ii)	- the proposed methods for achieving and maintaining the objectives	N/A	N/A
(1)(i)(iii)	- the proposed monitoring and reporting compliance measures for the land	N/A	N/A
(2)(a)	a statement (a *site suitability statement*) of the uses or activities for which the site is suitable	-	Cover Letter and Section 12

Subsections of section 389 of the *Environmental Protection Act 1994*		Reference to CLID (i.e. sections, pages and/or paragraphs) that comply with the corresponding subsection of section 389 of EP Act	Reference to auditor's statement of reasons (i.e. sections, pages and/or paragraphs) of why each requirement has been deemed compliant
(2)(b)	a statement of the following matters:		
(2)(b)(i)	- whether the land is prescribed contaminated land	Section 6: Results, Section 7: Discussion, Figs 2-5	Sections 10 and 11.2
(2)(b)(ii)	- if the land is contaminated—the extent to which the land is contaminated		
(2)(b)(iii)	- for a draft site management plan—whether the proposed objectives, methods and measures stated in the plan under subsection (1)(i) are appropriate	N/A	N/A
(2)(b)(iv)	- the extent to which the assessment of the land is in accordance with the contaminated land ASC NEPM	Section 1.3: Objectives, Section 4: Fieldwork- DSI, Section 8: Conceptual site model, Appendix G: Data quality evaluation	Sections 11 and 12

12 AUDITOR CONCLUSION AND RECOMMENDATIONS

The following evaluation has been made on the CLID (AECOM, 2019b):

- the SIR adequately justifies the conclusions in the context of site history, level of assessment, development of a robust CSM, and relevant aspects of NEPC (2013), NEMP (2018) and DES (2015 and 2018) in particular;
    - the CSM developed for the site (AECOM, 2019b) adequately identifies CoPC including their sources and potential pathways to identified receptors at and about the site, and then allocates appropriate Tier 1 criteria to ensure the identified potential receptors are protected by concentrations at the source/s; and
    - the conclusions of the final CLID (AECOM 2019b) are therefore underpinned by a robust assessment and consistent with the appropriate guidelines and legislation.

In summary, the CLID findings have determined that while soil contamination in excess of adopted ecological indirect exposure guidelines exists at the site, given the ongoing and legacy commercial/ industrial use of the site, this does not constitute a significant ecological risk and the site is suitable for on-going commercial/ industrial use.

However, given the exceedances were identified on unsealed areas and, in some cases (GS_SS3 0.1 m bgl and BH02_0.5 m bgl) are greater than an order of magnitude above the assessment criteria, the CLA considers that rainfall and subsequent infiltration in these areas could result in leaching and mobilisation of PFAS in the subsurface.

While (refer Section 10.2 above) PFAS is already present in groundwater, the CLA considers that further PFAS mobilisation could be limited by targeted management/ limited site remediation which could include:

- *In-situ* concrete capping of the unsealed areas, to minimise future infiltration; and/or
- Excavation and removal of the most-impacted soil layer (i.e. top 0.5 m) and disposal off-site to a suitably licenced landfill facility.

In addition, based on the identification of elevated contaminant concentrations greater than human health and ecological assessment criteria in all six groundwater monitoring bores at and along the boundaries of the site, further (off-site) investigation is warranted.

Specifically, the CLA considers based on the significantly elevated concentrations of PFOS and sum of PFOS and PFHxS observed in western site bores GS_MW01 and GS_MW02 (>100 µg/L) off-site contaminant migration in groundwater at concentrations greater than the adopted assessment criteria is very likely. The off-site investigation therefore should seek to confirm to what extent this impacted groundwater has migrated beyond the site boundary,

and whether this contamination poses a viable, unacceptable human and/or ecological risk to sensitive receptors located down-gradient of the site.

The above notwithstanding, the CLA does not consider that contaminant concentrations within the site boundary pose a risk to human and/ or ecological site users and thus do not preclude on-going use of the site for commercial/ industrial purposes (so long as consideration is given to future management/ remedial measures). Rather, additional off-site investigation should be undertaken to determine if notification, remediation and/ or management actions should be implemented to comply with legislation and mitigate risks to any identified off-site receptors along a complete exposure pathway.

13 LIMITATIONS

Mark Stuckey of Environmental Earth Sciences has prepared this CLA report (719052_QFES_GST_AuditorCert_V1) in accordance with Section 568 of the *EP Act 1994* and DES (2018). The Report has been prepared solely to support the CLA's (Mark Stuckey's) certification of the CLID prepared by the SQP for the site.

The Report relates only to those matters relevant to certification of the CLID under relevant provisions of the *EP Act 1994*. It is not intended, nor is it suitable, for any other purpose and should not be relied upon for any other purpose.

The Report only considers the contaminated land aspects of the site (in relation to PFAS compounds only) and does not provide an opinion regarding other aspects of the site or the environment not related to site contamination such as (but not limited to):

- hazardous building materials in buildings or structures;
- structures, footings, infrastructure and the like (whether above or below ground);
- the suitability of fill materials for any use and any geotechnical considerations;
- regulatory responsibilities or obligations (for which a legal opinion should be sought);
- work health and safety legislation; or
- the suitability of any engineering design.

If specialist technical review of such additional issues is required, then separate advice should be obtained from appropriate specialists.

The Auditor is not one of the specialists who prepared the CLID. The Auditor has independently evaluated the CLID and its site suitability statement prepared by the SQP in order to certify that the CLID complies with the content requirements of Sections 389(1) and 389(2) of the EP Act as far as practicable, noting the investigation was undertaken to characterise PFAS contamination, only. In preparing the Report, the Auditor has assessed the suitability of the SQP to prepare the CLID in accordance with the *EP Act*, and has relied on the experience, expertise and integrity of the SQP, as declared by the SQP.

Whilst the Auditor has taken reasonable measures to verify the accuracy and completeness of information presented by the SQP and included in the CLID, neither the Auditor nor Environmental Earth Sciences accepts any liability for misrepresentation of information or for the omission of any information in the CLID that is material to the Auditor's certification.

Sampling and chemical analysis of environmental media are based on guidance made and approved by the relevant regulatory authorities. Conclusions arising from the assessment of environmental data are based on the sampling and analysis considered appropriate based on these regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants. Ground conditions between sampling locations may vary, and this should be considered when extrapolating between sampling points.

As environmental sampling for this program has been undertaken to characterise the concentration and distribution of PFAS compounds only, no warranty or guarantee is provided that other hazardous and/ or toxic chemicals associated with previous historic land uses do not exist at the site. Furthermore, it is noted that assessment of risk is based on currently available guidance; given regulatory standards change over time and there may be materials present at the site that whilst not considered hazardous at the present time may be considered hazardous in the future.

Changes to the site conditions may occur subsequent to the investigations described in this Report, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this Report are based on the available information at the time of the investigation of the site.

Should new information become available about contamination at the site that may materially affect the validity or appropriateness of the conclusions in the Report, the Auditor reserves the right to review the Report in the context of any such additional information.

14 REFERENCES

AECOM (2019a) *Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES,* April 2019

AECOM (2019b) *PFAS Detailed Site Investigation Gladstone Fire Station, 5-9 Breslin Street, Gladstone, Queensland.* Ref: 60609758 Revision 0 - FINAL. 13 February 2020.

Australian and New Zealand Governments (ANZG) (2018). *Australian and New Zealand guidelines for fresh and marine water quality*.

Buck R C, Franklin J, Berger U, Conder J M, Cousins I T, de Voogt P, Jensen A A, Kannan K, Mabury S A, & van Leeuwen P (2011). *Perfluoroalkyl and Polyfluoroalkyl substances in the environment: Terminology, Classification and Origins*. Integrated Environmental Assessment and Management. V7, N4 pp 513-541.

Bureau of Meteorology (BOM) (2020). *Groundwater Dependent Ecosystems Atlas*, available at: http://www.bom.gov.au/water/groundwater/gde/index.shtml

CSIRO Land and Water (2018) Atlas of Australian Acid Sulphate Soils Version 2,

CSIRO (2020). *Australian Soil Resource Information System (ASRIS)*, <http://www.asris.csiro.au/index_other.html>.

Concawe (2016). *Environmental fate and effects of poly- and perfluoroalkyl substances (PFAS)*. Report no. 8/16, Brussels, June 2016.

CRC CARE (2018). *Practitioner guide to risk-based assessment, remediation and management of PFAS site contamination*. CRC CARE Technical Report No. 43.

Department of Environment and Science (DES) (2013). *Queensland Water Quality Guidelines 2009*. July 2013.

DES (2014) Environmental Protection (Water) Policy 2009 Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives, November 2014.

DES (2015). *Guideline: listing and removing land on the land registers*. ESR/2016/2044 Version 1.01, 29 September 2015.

DES (2018). *Queensland auditor handbook for contaminated land. Module 6: Content requirements for contaminated land investigation documents, certificates and audit reports*. ESR/2018/4224 Version 2.01, 7 February 2019.

DES (2019). *Environmental Protection Policy (Water and Wetland Biodiversity) 2019*.

Department of Health (DoH) (2017). *Health Based Guidance Values for PFAS – for use in site investigations in Australia*. Fact sheet.

Department of Natural Resources, Mines and Energy (DNRME) (2014) Acid Sulfate Soil Tannum Sands – Gladstone 1:50,000.

Department of Mines and Natural Resources (DNRM) (2006). Gladstone Special 1:100,000 Geological Special Series Sheet 9150 and Part Sheet 9151

DNRM (2018) *Detailed Surface Geology – Queensland, June 2018* (accessed February 2020).

DNRM (2020 Queensland Globe: groundwater, contour, geoscientific information and land parcel tenure layers. QLD government

enHealth (2012a). *Environmental Health Risk Assessment – Guidelines for Assessing Human Health Risks from Environmental Hazards*. Department of Health and Ageing and enHealth Council (enHealth), Canberra.

enHealth (2012b). *Australian Exposure Factor Guide*. enHealth Council, Canberra.

enHealth (2016). *Interim national guidance on human health reference values for per- and poly-fluoroalkyl substances for use in site investigations in Australia*. June 2016.

enHealth (2019). *Guidance statements on per- and poly-fluoroalkyl substances*. June 2019.

Food Standards Australia and New Zealand (FSANZ) (2017). *Hazard assessment report – Perfluorooctane sulfonate (PFOS), Perfluorooctanoic acid (PFOA), Perfluorohexane sulfonate (PFHxS)*.

Heads of EPAs Australia and New Zealand (HEPA) (2018). *PFAS National Environmental Management Plan*. January 2018.

HEPA (2019). *PFAS National Environmental Management Plan*. Version 2.0 Consultation Draft.

Isbell, R F (2002). *The Australian Soil Classification*, 2nd edn. CSIRO Publishing.

National Environment Protection Council (NEPC) (2013). *National Environment Protection (Assessment of Site Contamination) Amendment Measure*.

National Health and Medical Research Council (NHMRC) (2019). *Guidance on per and polyfluoroalkyl substances (PFAS) in recreational water*. Australian Government.

NHMRC/ Natural Resource Management Ministerial Council (NRMMC) (2011). *Australian drinking water guidelines*. National Water Quality Management Strategy. Section 6.3.3.

NHMRC/ NRMMC (2008). *Guidelines for managing risks in recreational water*. Australian Government, February 2008.

NSW Office of Environment and Heritage (OEH) (2017). *PFAS Screening Criteria (May 2017)*.

Public Safety Business Agency (PSBA) (2019). *Terms of Reference – Audit of Site Investigation Plan for the evaluation of concentration and distribution of per- and poly-fluoroalkyl substances (PFAS) from selected Queensland Fire and Emergency Services facilities*.

United States Environmental Protection Agency (USEPA) (2006). *Guidance on systematic planning using the data quality objectives process*. EPA QA/G-4, February 2006.

ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose.

APPENDIX A: AUDITOR CERTIFICATION

Certificate

Environmental Protection Act 1994

Certificate of Approval

Approval No: CLAD06400917

This certificate of approval as an auditor is issued by the chief executive[1] *pursuant to section 573 (2)(a) of the* Environmental Protection Act 1994.

1. Approved person

Mark Stuckey

2. Approved auditor functions

The approved person is approved to perform auditor's functions under 568(b) of the *Environmental Protection Act 1994* and relevant auditor's functions pursuant to the provisions of the *Planning Act 2016*.

3. Term of approval

This approval will remain in force until **9 October 2020** unless it is earlier cancelled or suspended.

4. Conditions of approval

The approved person must comply with the most recent version of The Queensland Auditor Handbook for Contaminated Land, Module 4: Code of Professional Conduct.

Signature

09/10/2017

Date

Chris Loveday
Director
Environmental Services and Regulation
Department of Environment and Heritage Protection
Delegate of the chief executive
Environmental Protection Act 1994

Enquiries:
Ralph Riese
A/Manager,
Regulatory Capability and Customer Service
Department of Environment and Heritage Protection
Phone: (07) 3330 5706

[1] The Director-General of the Department of Environment and Heritage Protection is the chief executive under the *Environmental Protection Act 1994*.

APPENDIX B: AUDITOR CERTIFICATION AND DECLARATION

Auditor certification and declaration

Contaminated land investigation document

This template is for use by an auditor, in relation to a function under s. 568(b) of the Environmental Protection Act 1994 (EP Act), to certify a contaminated land investigation document under s. 389(3) of the EP Act, and to make a declaration under s. 574C of the EP Act.

1. Details of the auditor's function

Auditor

Name Mark Stuckey
Company Environmental Earth Sciences
Registered business address Unit 3, 1 Ross Street, Newstead, QLD
Telephone Unit 3, 1 Ross Street, Newstead QLD
Email mstuckey@eesigroup.com
Auditor approval number (Qld) CLAD06400917

Details of the contaminated land investigation document

Title of the contaminated land investigation document: PFAS Detailed Site Investigation: Gladstone Fire Station, 5-9 Breslin Street, Gladstone, Queensland. Rev 0 (FINAL). 13 February 2020. Author: James Peachey (SQP)
The contaminated land investigation document comprises (tick all applicable boxes): ☒ site investigation report ☐ validation report ☐ draft site management plan ☐ draft amended site management plan
Objective of the contaminated land investigation document: ☐ Required by a notice issued by the administering authority under the EP Act (notice reference number:) ☒ Prepared voluntarily to remove, or change details of, land on the environmental management register (EMR) or contaminated land register (CLR) ☐ Other (provide details):
Title(s), version number, date, and author(s) of report(s) or draft site management plan(s) evaluated—for each separate document forming a component of the contaminated land investigation document. AECOM (2019a) Preliminary Site Investigation and Sampling, Analysis and Quality Plan, QFES, April 2019

Title(s), version number, date, and author(s) of any report(s) or plan(s) previously submitted to the administering authority that forms part of the current contaminated land investigation document.

Auditor engagement

Auditor was engaged by:
☒ Owner ☒ Occupier ☐ Developer ☐ Administering authority ☐ Other (provide details):
Name of person/company who engaged the auditor: Raymond Bott, Queensland Fire and Emergency Services
Date auditor was commissioned: 18/07/2019

Relevant land

Lot on plan Lot 5 to 10/ RP606760	Title(s) of attached site plan(s): Ref: 30377116, 30377117 and 30377118
Street address 1 Charles Street, G;adstone, QLD	Postcode 4680
Local government area Gladstone Regional Council	EMR/CLR ID (if applicable)
Registered owner name The State of Queensland (represented by Public Safety Business Agency)	Registered owner address Public Safety Business Agency, Level 13 Makerston House, 30 Makerstne Street, Brisbane, QLD 4000

Is there a radiation impact on site?

☐ Yes—you must provide a support expert's statement
☒ No

Support expert(s) engaged by auditor

☒ No support expert was engaged ☐ One support expert was engaged—the support expert's details are provided below. ☐ More than one support expert was engaged—a full list of each support expert's details is attached.
Name N/A
Company N/A
Describe the matter(s) for which the support expert provided expert advice: N/A
☐ Support expert's report (or other document) attached

2. Auditor's certification and declaration

Certification

I certify that the contaminated land investigation document complies with ss. 389(1) and 389(2) of the *Environmental Protection Act 1994* having regard to the guidance provided in the *Queensland auditor handbook for contaminated land, Module 6: Content requirements for contaminated land investigation documents, certifications and audit reports* (Department of Environment and Science, 2018).

In particular, I certify that the site suitability statement provided in the contaminated land investigation document accurately states the uses or activities for which the land is suitable.

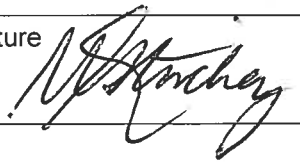
I have attached an audit report, titled *719052_QFES_GST AuditorCert_V1.0*, about my conclusions with respect to the requirements of subsections 389 (1) and 389(2) of the *Environmental Protection Act 1994*. The audit report explains and justifies how I arrived at my decision to certify that the contaminated land investigation document and its site suitability statement comply with ss. 389(1) and 389(2) of the EP Act.

Declaration

I am an auditor approved to undertake a function under s. 568(b) of the *Environmental Protection Act 1994*.

I declare that:

1. I possess qualifications and experience relevant to the audit of the contaminated land investigation document, or, where not, I have engaged an appropriately qualified and experienced support expert.
2. I have not knowingly included false, misleading or incomplete information in my certification of the contaminated land investigation document.
3. I have not knowingly failed to reveal any relevant information or document to the administering authority.
4. The certification of the contaminated land investigation document, including the audit report, addresses the relevant matters for the audit and is factually correct.
5. The opinions I have expressed in the certification and audit report are honestly and reasonably held.

Auditor's name Mark Stuckey
Company Environmental Earth Sciences
Auditor's signature 
Date 10/03/2020

APPENDIX C: CORRESPONDANCE WITH SQP

Table 1: Auditor comments on specific sections of the SIR

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
1	Figures		Noting that the site elevation is generally <10 m above sea level, it is recommended that topography (e.g. 1 m contour from Queensland Globe) be included on each site location/ layout plan to assist in estimation/ discussion of likely groundwater and surface water flow direction if possible to do so.
2	Figures	Figure 1	It may be beneficial to add a "500 m site radius" to the Figure.
3		Figures 4-6	Please consider increasing the font size of the exceedances key at the base of the legend. (While it is noted electronically, this does not pose an issue, at print size A4 this data becomes unreadable in hard copy) As per comment 29 below, please consider presenting additional, individual compounds on relevant exceedance figures for completeness and to aid overall interpretation (e.g. PFHxS and PFHxA, PFUnDA and PFTrDA) as appropriate.
4		Figure 7	• Given this is a CSM and distances are not intended to be represented accurately, consider including off-site water features residential properties/ park as these are identified as receptors. This would then allow receptors C, D and F and pathway 10 to be appropriately represented. • Please review transport pathway 6 and 7 and associated graphic – if migration along stormwater drains (including subsurface) is inferred it would be worthwhile showing this feature. The size of the figure could be amended to account for these additions.
5	Tables – Appendix B	Tables T4-T7	"PFUnA" should be "PFUn**D**A"?
6		Table T3	• Typo (Notes): Millivolt
7		Table T4	• Given that commercial/ industrial criteria are the primary criteria and residential used as secondary consider the following amendment to exceedances mark-up to minimise the potential for external parties mis-reading data: ○ Commercial/ industrial criteria exceedance = purple highlight ○ Residential criteria exceedance = bold text (the use of italic text to present the criteria difference is noted, but this is not as easy to see as bold type).

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
8	Appendices	Appendix G	• Step 3 – Bullet 3, sub-bullet 3 – missing “close bracket” • Commentary should be provided in the QA/QC section regarding the water quality meter malfunction, absence of field data collected during the groundwater monitoring round, actions taken to resolve this data gap (e.g. laboratory analysis scheduled in absence of field parameter collection) and implications for data interpretation. • G 4.2.3: For consideration: Table G1 – noting that the RPD exceedances occurred between the primary and secondary laboratory is it possible, as well as sample heterogeneity, that differing lab methods/ lab quality could be the source of the primary/ triplicate sample RPD discrepancies? It is noted that the secondary lab generally records higher concentrations of PFAS compounds than the primary. • G4.2.4 Matrix spikes – it is noted MS recoveries for a number of compounds were less than the lower data quality objective indicating actual concentrations of these compounds in selected samples may be higher than observed. The record of non-conformances provided is thorough, but brief concluding sentence/ paragraph should be provided as to how this may impact the data set and any significance.
9	Appendices	Appendix H	Some of the analytical laboratory reports provided in Appendix H are pixelated and cannot be used – please ensure laboratory documentation provided in the final report is legible (the CLA notes that the low-resolution version of the report was reviewed and this issue may not exist within the high resolution version.)

10	Executive Summary		Please review and amend as necessary in relation to comments provided on the main body text.
			• Investigation scope
			  ○ “scope of works **was** completed”
			• Key findings of the DSI:
			  ○ Bullet 2: “Groundwater was inferred to locally flow toward the north west”

11	1.4	Scope of works	• Bullet 1, sub-bullet 3: Should this read “Collection of co located surface water and sediment samples from drainage pits on site?”
12	2.1	Site Identification	• Please confirm proposed future zoning is “low density residential” it is understood that the site is to remain a fire station.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			• It is noted that the site comprises a total of 6 lots. However, an EMR search was only completed for one and, given the selected lot was not listed on the EMR, this was taken to be representative of the likely EMR listing status of the other 5. This is not considered to be a valid approach with regard to EMR listing status, given EMR listings can be inherited as a result of historic subdivision/ may affect one of a group of lots due to notifiable activities undertaken in/ or impact by a hazardous contaminant in a specific area. To fulfil the requirements of a CLID, EMR search results for each lot will be required.
13	2.2	Site layout and features	Consider inclusion of dial before you dig (DBYD) service plans to indicate how on-site stormwater and drainage (potential preferential pathways for contaminant migration) connect to municipal supply. • Paragraph 2: Please clarify this refers to current inventory, rather than historic. • Paragraph 3 "*Historically, foam was stored in the training hut and the small building in the southern portion of the site*". Please provide clarification on which building this comment refers to. It is noted on Figure 2 there is an un-named shed/ building/ car park cover to the immediate south of the New Fire Engine shed - is this the location being described? • Paragraph 4 – given anecdotal information has been supplied indicating Lot 4/ RP606760 may have formed part of the fire station prior to historic subdivision it may be worth marking this on a Figure. Did any information reviewed during the PSI (e.g. – title search information? Heritage information?) provide supporting evidence that this Lot as formerly used as part of the fire station and what historic activity (e.g. storage/ use of foams) may have been undertaken in this area?
14	2.3	Surrounding Land use	**Table 3:** • **General:** Based on site orientation, the four site boundaries are – north east/ south east/ south west and north west; surrounding land uses would be better considered in this context, rather than standard compass bearings (north, east, south, west). Please review and amend as necessary. • **Northeast:** Breslin Street and Charles Street junction is present to the north east of the site, with residential properties beyond.
15	2.4	Previous environmental investigation	It is noted Section 2.4 is largely a reproduction/ summary of data provided in the PSI/ SAQP. Please review and ensure consistency. Ensure all relevant information is included.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			• As per comment 13 above – could some comment be made regarding anecdotal evidence indicating the fire station formerly occupied the lot to the west (Lot 4/RP606760) prior to subdivision? • Bullet 6, sub-bullet 3 Typo: “railyards”
16	3.5	Hydrology	• Paragraph 1: typo “Auckland inlet subsequently discharge**s** into…” • Is it worth referencing “Happy Valley Creek” in this section (similar distance from site as the Auckland Inlet)?
17	3.6	Hydrogeology	• Table 5: Given the stated distances of the bores presented, suggest renaming to “within 1 km” of the Gladstone Fire Station. • Table 6: Can a note be added to the table to confirm meaning of the X’s and/or grey shaded boxes (noting in some cases a box is shaded without a corresponding ‘X’ added?
18	3.8	Groundwater dependent ecosystems	• Please provide standard footnotes (as per Airlie Beach) for GDE information sources.
19	4.2.1	Soil Investigation	Table 8 – Service Location; first sentence; “dial before you dig **plans**”?
20	4.2.2	Groundwater Investigation	Table 10 • Well development - Confirm use of foot pump for well development (development at previous sites was completed via bailing). • Was a bladder or peristaltic pump (or both) used? Please clarify.
21	6.1	Soil Conditions	Should a reference to the surface sample collected at GS_SS04 be listed here?
22	6.2.2	Groundwater elevations	Paragraph 2: suggested re-phrase “groundwater is inferred to locally flow toward the north west”
23	6.2.3	Water quality parameters	Please refer to comment 8.
24	6.2.4	Groundwater Field Observations	The phrasing of this paragraph indicates that the sulfurous odour in monitoring wells GS_MW02 and GS_MW06 are indicative of contamination. While the field observation is valid, is the intent to indicate this odour is deemed

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			representative of site contamination, or potentially indicative of contamination and/or associated with decaying vegetation?
25	6.3.2	Groundwater	It is recommended that guideline values are included here in Table 17 as per Tables 15 and 16.
26	6.3.3	TOPA	• Recommend sentence 1 is deleted. • Please review paragraph 3 for sense and consistency with previous report terminology. • It would be pertinent to discuss individual compounds/ chain lengths for the groundwater results, as the TOPA concentration of compounds such as PFHxS, PFBA, PFPeA and PFHxA is significantly elevated compared to the primary sample result, while almost all of the FtS has gone.
27	6.3.4	Surface water	It is recommended that guideline values are included here in Table 19 as per Tables 15 and 16.
28	6.3.5	Sediment	Is there a significance to the sediment moisture content values specified? What is the added value intended in presenting this data?
29	7.1.2	Hydrogeology	• Please refer to earlier comments regarding terminology for groundwater flow direction (i.e. to the northwest, not “from southeast to northwest”). • Paragraph 4, sentence 2. Please review this sentence for sense. • Paragraph 5 – it is valid that backfill around the UST could present preferential pathways for migration? However, perhaps provide an introductory paragraph to confirm the existence of the UST at the site, in this section, before the commentary about preferential pathways associated with coarse backfill.
30	7.2	Soil analytical results	Chart 1 – could consider attempting to overlay soil types (e.g. fill/ natural/ reworked natural) as a background to this chart to provide rapid reference to contaminant occurrence in relation to strata type. If this is too difficult, graphically, would it be possible to provide an indication (point or otherwise) of the fill/ natural interface to aid interpretation? Furthermore – could the accompanying text further draw out observations in relation to PFAS compound occurrence in fill or natural materials? • Given assessment criteria is provided for sum of PFHxS and PFOS only, it is recognised that this has driven analytical result discussion in several sections. However, based on available data it is understood that shorter chain compounds (such as PFHxS) may behave differently (with regard to

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
			mobility and thus potential for offsite migration) therefore consideration of these two compounds together, may mask some information with regard to contaminant distribution. This may be particularly pertinent in consideration of the potential for off-site migration. • It is also noted that, for sediment at least, primary compounds identified included some lesser known compounds including PFUnDA and PFTrDA (no guideline criteria). Could some additional discussion be provided around behaviour and distribution of these other compounds and any implications for their occurrence across the media sampled? Where possible it would be worth presenting concentration of individual compounds (at minimum PFHxS and PFHxA) on the relevant contamination distribution figures, as appropriate.
31	7.3	Groundwater analytical results	As per comment 30 above. • Please refer to earlier comments regarding terminology for groundwater flow direction (i.e. to the northwest, not "from southeast to northwest"). • Paragraph 4 "the geology of bedrock is not known and may be mudstone sandstone" – missing word and/or punctuation. Can bedrock geology be inferred on the basis of overlying deposits encountered? Earlier bedrock of "sandstone" is inferred based on quartz arenite gravels encountered during drilling. Please review and amend for consistency.
32	7.4	Comparison of PFAS composition in soil and groundwater samples	As per comments 30 and 31 above. Paragraph 3 – can conclusions be drawn with regard to differing PFAS source areas/ contaminant transport at the site, noting that while the PFAS signature of bore MW06 differs to other groundwater monitoring wells, there is some consistency with the PFAS signature identified in the site sediment sample (i.e. PFUnDA detected in both)?
33	7.5	Surface water and sediment analytical results	Can further discussion be provided around the prevalence of longer chain compounds (e.g. PFUnDA, PFTrDA) in the sediment sample on site. Implications for contaminant distribution?
34	8.3.2	Secondary sources	Bullet 4 – Are all drains on/ off site earthen lined or concrete? (There is a reference in the earlier text to a "concrete spoon drain" but other references do not provide an earthen or concrete descriptor). Please check and amend if necessary.

Item	Section (s) in report	Report Section Name	Environmental Earth Sciences Comments
35	8.4	Migration mechanisms	• As per comment 34 above, if drains are earthen- infiltration via unlined drains should be included as a potential pathway. • Bullet 9 – recommend including reference to UST bedding material e.g. “including UST bedding sands”

36	8.6	Assessment of exposure pathways	Table 11:
			• On-site areas (Secondary sources): As per comment 35 above, please confirm earthen or concrete lined drains and amend as appropriate.
			• PFAS in groundwater - note that the text also indicates the groundwater is borderline potable, indicating that presence for unregistered groundwater abstraction bores down-gradient of the site, while possible, is unlikely.
			• PFAS in surface water –
			  ○ Transport Mechanism – please review reference to Burdekin River.
			  ○ Receptor: recreational users are unlikely to incidentally ingest or come into direct contact with surface water discharging to drainage channels. Further, given the distance of the nearest water body likely used for such recreational activities (Auckland Inlet ~1 km) there is a low likelihood that PFAS sourced from site, has migrated this distance in surface water and/or via sediment transport. It should also be noted a former landfill, a potential source of PFAS, is located down gradient of the site, to the West.
			  ○ Comments “..subsequently discharges”
			• Accumulation of PFAS in creek sediment –
			  ○ Receptor: recreational users are unlikely to incidentally ingest or come into direct contact with sediment transported to drainage channels. Further, given the distance of the nearest water body likely used for such recreational activities (Auckland Inlet ~1 km) there is a low likelihood that PFAS sourced from site, has migrated this distance in surface water and/or via sediment transport. It should also be noted a former landfill, a potential source of PFAS, is located down gradient of the site, to the West.
			  ○ Comments “..subsequently discharges”

37	9.0	Conclusions	Please review and amend as necessary in relation to preceding comments.

Table 2: Requirements of Module 6

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
3.1 Introduction			
State whether the CLID is a site investigation report, validation report, draft site management plan, or a combination of those.	Executive summary, paragraph 3	The report does not meet the definition of a CLID due to the absence of a regulatory trigger. However, the report does state that it is a site investigation report (SIR) for the detailed site investigation (DSI)	No
State why the contaminated land investigation document was prepared and note any statutory triggers.	1.1 General (Introduction)	No statutory triggers listed as none present.	No
State what the desired outcome is (e.g. to have the particulars of the land removed from, or amended on, the relevant land register).	1.3 Objectives	The auditor agrees with the desired outcomes.	No
State whether the document provides final information about the site and its intended use, or whether it is likely that one or more contaminated land investigation documents will be prepared in the foreseeable future for the same site and its same more contaminated land investigation documents will be prepared in the foreseeable future for the same site and its same intended use.	1.2 Background	Table 2 confirms both current and future use.	No
3.2 Site Investigations			
Describe and illustrate all the site investigations that were used when preparing the contaminated land investigation document, including any that may have been undertaken for previous purposes.	Executive summary: Key findings of the PSI; Section 2.4: Previous environmental investigation; Section 7.3 Groundwater analytical results	Information pertaining to previous environmental investigations has been provided appropriately.	No
3.3 Reasons the land is on a relevant land register			
Identify and describe the land by the following information:	Table 2		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
· street address of the site	Table 2		No
· registered lot-on-plan details	Table 2		No
· owner(s) of the land and their registered address	Table 2		No
· current occupier(s) of the land	Table 2		No
· area of the land (m2 or hectares)	Figure 2		No
· map of the site at a suitable scale, showing lot and plan boundaries, and latitude and longitude in decimal degrees	Table 2		No
· relevant local government authority	Table 2		No
· zoning of the site and the surrounding land on the local government's planning scheme (current and proposed)	Table 2		No
· any proposed changes to the zoning of the site and the surrounding land on the local government's planning scheme	Not provided	Not relevant to this report	No
· any existing, pending or proposed development approval or building works approval.	Table 2		No
State whether or not the land is currently listed on the EMR or the CLR, and provide the identifying number on the EMR or CLR. Provide a short history (if available) of when any listing(s) occurred, and any changes that were made to the listings.	Section 2.2: Site layout and features; Section 2.4 Previous environmental investigation		No
Describe the past and current activities and use(s) of the land that resulted in its potential or actual contamination and its listing on the register. Describe and map the locations where those activities occurred. In particular, address any notifiable activities and/or environmentally relevant activities.	Table 2		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
3.4 Surface and subsurface infrastructure			
Describe all surface and subsurface infrastructure on the land, including details of the location, size and type of the infrastructure. Relevant infrastructure includes pipes, tanks, drains, dams, bores, buildings and foundations.	Section 2.2 Site layout and features/ Figure 2	Additional information would be useful, particularly in relation to clarification on existing, marked up site drainage pathways (as per comments above) and potential offsite migration pathways (e.g. dial before you dig (DBYD) search results to be provided.)	**Yes**
Describe any infrastructure that has contributed to contamination of the site, even if that infrastructure has since been removed.	Section 2.2 Site layout and features/Figure 2		No
Describe any infrastructure that may either retard or increase the movement of contaminants and describe how the effect may occur. For example, bedding sand for stormwater drainage or sewerage pipes can act as a preferential pathway for contaminants even if the pipe itself has been removed.	Section 8.4 Migration mechanisms		No
Describe any infrastructure that would need to be removed or repositioned to facilitate any remediation of the site.	Not applicable		No
3.5 Site and surrounding area			
Provide a description of the site and surrounding area of the land. The description of the site and surrounding area must address the following matters (see s. 389(1)(c) of the EP Act):			
· all environmentally sensitive areas	Section 3.8: GDEs and Environmentally sensitive areas		No
· the location of all water, watercourses and wetlands	Section 3.4: Hydrology, Section 3.8 GDEs and Environmentally sensitive areas		No
· the location of all stormwater drainage	Section 2.2 Site layout and features		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
· all uses of the land, including uses that may affect the safety of the relevant land or cause environmental harm	Section 2.3 Surrounding land use Table 1	Please review in relation to minor comments provided.	**Yes**
· all activities carried out that may affect the safety of the relevant land or cause environmental harm	Section 2.4: Previous environmental investigation Table 1		No
Describe the climate of the area of the land, and the vegetation on the site and the surrounding area.	Section 3.1		No
Illustrate the description with maps, diagrams and photographs, and include the topography of the area. If the site and/or its surrounding land have areas of low relief, illustrate the topography on maps with contours at no more than 1m intervals.	Section 3.1 Site topography.	Contour plans with 1 m/10m intervals not provided. This data may be useful to assist in determining likely groundwater and surface water flow directions if feasible, contingent on-site topography.	**Yes**
Describe the stormwater drainage, delineate the catchments, and include any stormwater quality improvement devices, weirs, sediment basins, storage dams, and so on. Include the potential for stormwater drainage to affect the movement of contaminants. Also, address flood risk and locations where significantly large pools of water occur during or after rain events.	Section 2.2 Site layout and features; Section 2.4 Previous environmental investigation; Section 3.5 Hydrology		No
3.6 Waste disposed of or stored on the land			
Provide details of any waste that has been disposed of on the land, or that is or was stored on the land. Under Queensland law, waste is defined by s. 13 of the EP Act. The details should include the location, quantity and type of the waste, and the method(s) of its storage or disposal.	Section 2.4 Previous environmental investigation	Waste storage discussed in terms of PFAS only, which is sufficient to meet the objectives of this report.	No
Address any potential contamination of the land caused by storing or disposing of the waste on the land, such as might occur through the failure or breaching of an underground containment cell, the	Section 2.4 Previous environmental investigation		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
deterioration of storage vessels, or an accident such as a fire. That is, disposal should be taken to include accidental spills or releases.			
The description should also include any waste that may have been extracted, then moved or stored at the site during earthworks (see also section 3.9 below). Suitably qualified persons must search all available records when researching information for this section of the report.	Section 2.2		No
3.7 Geology and hydrogeology			
Describe the geology and hydrogeology of the land, including soils, subsoils, rock strata, aquifers, and aquitards.	Section 3.3 Soil type and ASS; Section 3.4 Geology; Section 3.5 hydrology, Section 3.6 Hydrogeology, Section 6.1 Soil conditions, Section 6.2 Hydrogeology		No
Describe the environmental values to be enhanced or protected under the *Environmental Protection (Water) Policy 2009*.	Section 3.7		No
Guidance: The contaminated land NEPM (particularly its Schedules B2, B3 and B6) provides advice in regard to this requirement. However, there is a large body of research, other texts and sources of information about geology and hydrogeology that should be used to supplement the NEPM. When developing a concept or model of the groundwater system, comply with the *Australian groundwater modelling guidelines* (National Water Commission, June 2012).			No
Assess how the geology and hydrogeology of the land would affect the movement or retention of contaminants within soils, subsoils, and rock strata.	Section 6.1 Hydrogeology and Section 6.3 Soil analytical results, Section 8.0: Conceptual Site Model - PFAS		No
Describe groundwater quality and groundwater levels and flow directions.	Section 3.6: Hydrogeology; Section 6.1 Soil conditions, Section 6.2 Hydrogeology, Section 7.		No
Describe any barriers to, and migration pathways for, the dispersal of contaminants in groundwater.	Section 8.0: Conceptual Site Model - PFAS		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Assess the rate at which any contaminants may move through or out of the ground.	Section 3.6: Hydrogeology; Section 6.1 Hydrogeology; Section 6.1 Soil conditions, Section 6.2 Hydrogeology, Section 7.	Limited information pertaining to the likelihood of “low hydraulic conductivity clays” that may retard vertical and lateral migration of PFAS has been provided. It is noted the purpose of this assessment was to determine the concentration and distribution of PFAS on the site and near the site boundaries. However, now noting that PFAS may be migrating beyond the site boundary, further consideration should be given to the assessment of permeability and hydraulic conductivity of water bearing zones underlying the site, to facilitate the lateral delineation of any PFAS plumes and assessment of risk to off-site receptors. This may be subject to assessment in a subsequent report.	**Yes**
If there has been irrigation of waste water to land, or subsurface injection of waste water, describe the quantity and quality of waste water and the geological material and strata onto or into which the irrigation or injection occurred.	Not provided	Assumed not to occur	No
Describe the natural geochemistry including acid sulfate soils, or sulfide bearing minerals, if they might be present.	Section 3.3		No
Describe any naturally occurring toxicants that are present in quantities or concentrations that might affect the use or management of the site.	Not provided	Not relevant to this assessment	No
Address liquid and gaseous contaminants that may be dispersed in pore spaces, and assess the potential for, and the likely rate of, dispersal of contaminants to the atmosphere.	Not provided	Not relevant to this assessment	No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Assess whether the dispersal of contaminants from the ground could impact on air quality in buildings.	Not provided	Not relevant to this assessment	No
If groundwater remediation is required, assess how effectively the site's contamination could be remediated, describe any limitations, and assess the likely residual contamination.	Not provided	Not relevant to this assessment	No
3.8 Environmentally relevant activities or notifiable activities			
Provide details of any environmentally relevant activities or notifiable activities carried out on the land, whether formerly or currently	Not provided	Please provide reference to ERA search completed during PSI and findings (e.g. no ERAs/ notifiable activities identified at the site)	**Yes**
Focus on the materials used and waste produced during the carrying out of the activities that could be sources of on-site or offsite contamination.	Section 8.4 Receptors and exposure pathways		No
Illustrate on maps where any environmentally relevant activities or notifiable activities were carried out.	Figure F2		No
3.9 Earthworks			
Provide details of any earthworks carried out on the land, including an inventory of any earth taken out to be treated or dumped elsewhere, and/or earth brought on to the site as fill.	Section 2.2		No
Provide maps and cross-sections to illustrate how earthworks have changed the topography and geology of the land.	As above	As above.	No
Integrate the description of any earthworks with the required description of the site's watercourses, wetlands, geology and hydrogeology.	As above	As above.	No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Address whether the earthworks could be a source of contamination.	As above	As above.	No
Assess how earthworks may have affected how water and/or other liquids move over, into or through the ground dispersing contaminants.	As above	As above.	No
3.10 Contamination			
Provide details of the site investigations and the findings of those investigations with regard to contamination of the site, particularly the extent, fate and movement of contamination. Describe in detail all:			
· Desk-top assessments of the site	Section 2.4: Previous environmental investigation	Information is summarised. PSI/SAQP (AECOM, 2019) is referenced for full details of the desktop assessment.	No
· Site inspections	Section 2.2 Site Layout and features; Section 2.4 Previous environmental investigation	Information is summarised. PSI/SAQP (AECOM, 2019) is referenced for full details of site inspection & site interview details.	No
· Sampling of soil, water, and any other media	Section 2.4: Previous environmental investigation (historic data), Section 4: Fieldwork – DSI, Section 6: Results, Section 7: Discussion		No
Provide maps and diagrams, including cross-sections where necessary, to illustrate the site and where sampling has taken place on the site or its surrounds.	Figures: Site layout & sampling locations	Please refer to individual comments regarding recommended amendments to figures.	**Yes**
Provide details of a site conceptual model using text, tables and/or diagrams.	Section 8, Table 19		No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Describe the methods used to take, store, preserve and analyse samples of media. Discuss any limitations to those methods that may affect reliance on the results. Samples must be collected in accordance with appropriate standards, and the chain of custody of samples must be fully recorded. If the samples were handled and/or analysed by a third-party, identify the laboratory or contractor(s) that undertook the work, and state whether or not they are accredited (e.g. by the National Association of Testing Authorities, Australia (NATA)). If the laboratory or contractor is not accredited by NATA or a similar body, explain how the methods have been appropriately validated.	Section 4.0 – Fieldwork Appendix G: Analytical Data Validation	Refer to individual comments regarding additional QA/QC considerations (e.g. water quality meter malfunction)	**Yes**
Describe and validate the methods used to interpolate and extrapolate, from the sampling results, the spatial extent of any contamination.	Section 6: Results, Section 7: Discussion, Figures 2 to 5.		No
s. 389(2)(b)(ii) of the EP Act requires that the contaminated land investigation document states the extent to which the land is contaminated. Describe and illustrate (with data tables, maps, diagrams and cross-sections at suitable scales) the location(s) of any residual contamination, and the quantities or concentrations of contaminants.	Section 6: Results, Section 7: Discussion, Figures 2 to 5.		No
Assess, describe and illustrate the potential risks of contamination either moving off the relevant land to any surrounding area, or moving onto the relevant land from any offsite sources of contamination. The assessment should determine whether there is prescribed contaminated land.	Section 8: Conceptual Site Model - PFAS		No
Assess the levels of contaminants against applicable criteria, considering all relevant environmental values, including human health, amenity, and ecological values.	Section 6.3 Analytical results, Section 7 discussion, Tables T4 and T5.		No
Derive environmental values for water pursuant to the Environmental Protection (Water) Policy 2009 (EPP(Water)),	Section 3.6, Section 5.0	Assessment criteria has been provided in Table 14. However, the NEMP does not	**Yes**

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
Australian water quality guidelines for fresh and marine waters (ANZECC & ARMCANZ, 2000), and the Queensland water quality guidelines 2009 (EHP, republished in 2013). Include environmental values that relate to potential uses; for example, saline groundwater may be treated by reverse osmosis for potable or stock use during a drought, and therefore has a current environmental value. Furthermore, all environmental values that derive from Queensland's environmental protection policies cannot be subsequently disregarded or diminished by applying the contaminated land NEPM's risk-based process.		provide trigger values for all the identified EVs. Provide commentary on how the adopted assessment criteria will ensure a suitable level of protection for all EVs identified.	
Assess how the levels of contaminants would impact on all current and foreseeable future uses, while taking account of the likely extent that the contamination can be remediated (see also the following section).	Section 8 Conceptual site model	An assessment of contaminant remediation has not been completed at this stage of the assessment.	No
If the land was found to be not contaminated, the contaminated land investigation document should justify how the conclusion was reached, with reference to the site investigations and any remediation (see also the following section).	Not provided	Not relevant to this assessment	No
3.15 Accordance with the NEPM			
As mentioned above, s. 389(2)(b)(iv) of the EP Act requires a contaminated land investigation document to make a statement of the extent to which it is in accordance with the contaminated land NEPM. Nevertheless, the contaminated land NEPM cannot override state legislation or policies. In practice, a contaminated land investigation document must:			
• explicitly reference the various schedules of the NEPM	Various		No
• mention which schedules were or were not applicable when preparing the document	Section 1.6		No
• state the extent to which the applicable schedules were followed	Various	It is noted, given the nature of the investigation (PFAS DSI) that it was undertaken in general accordance with the NEPM, but also with reference to the NEMP.	No

Requirement Section of CLID in which requirement is addressed	Section in CLID Addressing Requirement	Auditors review comments	Action required
		Reference to applicable NEPM schedules and the NEMP have been made.	
• describe the extent of any deviations from the recommendations of the NEPM's schedules	Appendix G- QA/QC		No
• explain whether any deviations were due to overriding state legislation or policies	As above	As above	No
• evaluate with reference to current best practice how effective any alternative methods were in comparison to those of the NEPM.	As above	As above	No
The contaminated land investigation document must demonstrate that the investigation components of an assessment of site contamination listed in Section 1 of Schedule B2 of the contaminated land NEPM have been conducted for every stage of investigation. The components include a conceptual site model, data quality objectives, a sampling strategy, and a sampling and analysis quality plan. Those components should be updated as the investigations acquire better information about the site.	Section 8: Conceptual site model, Appendix G: Data quality objectives, Section 4: Fieldwork- DSI.		No

APPENDIX D: SELECT REGISTERED BORE CARDS

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
136127	Sub-Artesian Facility	Abandoned but Still Usable	19/07/2002	Rockhampton	3360 - GLADSTONE REGIONAL

Details

Description			
Parish	2010 - GLADSTONE		
Original Name			
Driller Name	WILSON, DESMOND NORMAN		
Drill Company	WILSONS DRILLING		
Const Method	ROTARY		
Bore Line			
D/O File No	520/001/66	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles	Water Supply		

Location

Latitude	23-51-53	**Basin**	1320
Longitude	151-14-59	**Sub-area**	
GIS Latitude	-23.8648384	**Lot**	52
GIS Longitude	151.2499228	**Plan**	RP608797
Easting	321794		
Northing	7359636	**Map Scale**	
Zone	56	**Map Series**	
Accuracy	UNKN	**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

4 ***records for RN*** **136127**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	19/07/2002	1	0.00	20.00	Polyvinyl Chloride	5.900	WT - Wall Thickness	140
A	19/07/2002	2	0.00	5.00	Grout			
A	19/07/2002	3	17.00	19.70	Perforated or Slotted Casing	1.250	AP - Aperture Size	140
A	19/07/2002	4	5.00	19.70	Gravel Pack	5.000	GR - Gravel Size	

Strata Logs

4 ***records for RN*** **136127**

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	8.00	SANDY LOAM
2	8.00	11.00	MOIST COARSE SAND
3	11.00	16.00	MEDIUM GRAVEL AND COARSE SAND
4	16.00	20.00	COARSE GRAVEL

Stratigraphies

0 *records for RN* **136127**

Aquifers

1 *records for RN* **136127**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	12.90	20.00	SAGR - Sand and Gravel	19/07/2002	-12.70	N	TDS 6000	2.53	Y	UC	QUATERNARY - UNDEFINED

Pump Tests Part 1

0 *records for RN* **136127**

Pump Tests Part 2

0 *records for RN* **136127**

Bore Conditions

0 *records for RN* **136127**

Elevations

0 *records for RN* **136127**

Water Analysis Part 1

0 *records for RN* **136127**

Water Analysis Part 2

0 *records for RN* **136127**

Water Levels

0 *records for RN* **136127**

Wire Line Logs

0 *records for RN* **136127**

Field Measurements

0 *records for RN* **136127**

Special Water Analysis

0 *records for RN* **136127**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

Permitted use:
- You may use the supplied data for your own purposes (including supply to consultants for a specific consultancy project for you but the consultants must return or destroy the supplied data when the project is finished). You must not sell or distribute the supplied data.
- You must display this copyright notice on any copies of the supplied data however altered, reformatted or redisplayed if you supply to a consultant or copy for back up purposes: "© State of Queensland 2020".
- You may create and distribute hardcopy and digital products based on or containing the supplied data, provided all the following conditions are met:
- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2020. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
- You must include metadata with the product(s) you create that use or incorporate the supplied data and the metadata must incorporate as a minimum the metadata provided with this supplied data.

Obligations:

- You must not use the data for direct marketing or in breach of the privacy laws.

Ownership:

The State of Queensland is the owner of the intellectual property rights in and to the supplied data or has the right to make this supplied data available.

Disclaimer and indemnity:
You agree to accept all responsibility and risks associated with the use of the supplied data. The State makes no representations or warranties in relation to the supplied data, and, you agree that, to the extent permitted by law, all warranties relating to accuracy, reliability, completeness, currency or suitability for any particular purpose and all liability for any loss, damage or costs (including consequential damage) incurred in any way (including but not limited to that arising from negligence) in connection with any use of or reliance on the supplied data are excluded or limited. You agree to continually indemnify the State of Queensland (and its officers and employees) against any loss, cost, expense, damage and liability of any kind (including consequential damage and liability in negligence) arising directly or indirectly from or related to any claim relating to your use of the supplied data or any product made from the data.

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
136123	Sub-Artesian Facility	Existing	18/12/2004	Rockhampton	3360 - GLADSTONE REGIONAL

Details

Description			
Parish	2010 - GLADSTONE		
Original Name			
Driller Name	HENNESSY, LEONARD ARTHUR		
Drill Company	L. A. HENNESSY		
Const Method	CABLE TOOL		
Bore Line			
D/O File No	520/001/66	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date	18/02/2005	**Data Owner**	
Roles	Water Supply		

Location

Latitude	23-51-41	**Basin**	1320
Longitude	151-14-56	**Sub-area**	
GIS Latitude	-23.8613889	**Lot**	147
GIS Longitude	151.2488889	**Plan**	RP608970
Easting	321684		
Northing	7360017	**Map Scale**	
Zone	56	**Map Series**	
Accuracy	GPS	**Map No**	9150
GPS Accuracy	20	**Map Name**	GLADSTONE
Checked	Yes	**Prog Section**	

Casing

3 ***records for RN*** **136123**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	18/12/2004	1	0.00	17.10	Polyvinyl Chloride	5.900	WT - Wall Thickness	140
A	18/12/2004	2	0.00	6.00	Grout			
A	18/12/2004	3	13.00	17.10	Perforated or Slotted Casing			

Strata Logs

5 ***records for RN*** **136123**

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	0.50	GREY SANDY LOAM
2	0.50	1.00	HARD DIRTY GRAVEL
3	1.00	13.00	BROWN SANDY CLAY
4	13.00	17.10	SEAMS WATER BEARING GRAVEL, SILTY
5	17.10	17.30	SHALE CLAY

Stratigraphies

0 *records for RN* **136123**

Aquifers

1 *records for RN* **136123**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	13.00	17.10	GRAV - Gravel	15/12/2004	-11.10	N	POTABLE	1.00	Y	WZ	WANDILLA FORMATION

Pump Tests Part 1

0 *records for RN* **136123**

Pump Tests Part 2

0 *records for RN* **136123**

Bore Conditions

0 *records for RN* **136123**

Elevations

0 *records for RN* **136123**

Water Analysis Part 1

0 *records for RN* **136123**

Water Analysis Part 2

0 *records for RN* **136123**

Water Levels

0 *records for RN* **136123**

Wire Line Logs

0 *records for RN* **136123**

Field Measurements

0 *records for RN* **136123**

Bore Report

From Year:

Special Water Analysis

0 *records for RN* **136123**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

Permitted use:
- You may use the supplied data for your own purposes (including supply to consultants for a specific consultancy project for you but the consultants must return or destroy the supplied data when the project is finished). You must not sell or distribute the supplied data.
- You must display this copyright notice on any copies of the supplied data however altered, reformatted or redisplayed if you supply to a consultant or copy for back up purposes: "© State of Queensland 2020".
- You may create and distribute hardcopy and digital products based on or containing the supplied data, provided all the following conditions are met:
- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2020. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
- You must include metadata with the product(s) you create that use or incorporate the supplied data and the metadata must incorporate as a minimum the metadata provided with this supplied data.

Obligations:

- You must not use the data for direct marketing or in breach of the privacy laws.

Ownership:

The State of Queensland is the owner of the intellectual property rights in and to the supplied data or has the right to make this supplied data available.

Disclaimer and indemnity:
You agree to accept all responsibility and risks associated with the use of the supplied data. The State makes no representations or warranties in relation to the supplied data, and, you agree that, to the extent permitted by law, all warranties relating to accuracy, reliability, completeness, currency or suitability for any particular purpose and all liability for any loss, damage or costs (including consequential damage) incurred in any way (including but not limited to that arising from negligence) in connection with any use of or reliance on the supplied data are excluded or limited. You agree to continually indemnify the State of Queensland (and its officers and employees) against any loss, cost, expense, damage and liability of any kind (including consequential damage and liability in negligence) arising directly or indirectly from or related to any claim relating to your use of the supplied data or any product made from the data.

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
111797	Sub-Artesian Facility	Existing	22/10/2002	Rockhampton	3360 - GLADSTONE REGIONAL

Details

Description			
Parish	2010 - GLADSTONE		
Original Name			
Driller Name	M CROWSON		
Drill Company	GLADSTONE DRILLING		
Const Method	ROTARY		
Bore Line			
D/O File No	520/001(66)	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles	Water Supply		

Location

Latitude	23-50-48	**Basin**	1320
Longitude	151-14-52	**Sub-area**	
GIS Latitude	-23.846885151	**Lot**	2
GIS Longitude	151.247623133	**Plan**	RP605789
Easting	321535		
Northing	7361621	**Map Scale**	253 - 1: 25 000
Zone	56	**Map Series**	M - Metric Series
Accuracy		**Map No**	9150-31
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

3 ***records for RN*** **111797**

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	22/10/2002	1	0.00	19.00	Polyvinyl Chloride	5.900	WT - Wall Thickness	140
A	22/10/2002	2	16.00	19.00	Perforated or Slotted Casing	1.500	AP - Aperture Size	140
A	22/10/2002	3	0.00	3.00	Grout			205

Strata Logs

5 ***records for RN*** **111797**

Bore Report

From Year:

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	5.00	RED SOIL WITH SMALL ROCK
2	5.00	8.00	WHITE CLAY
3	8.00	16.00	CREAMY HARD MUDSTONE
4	16.00	17.00	BROKEN ROCK
5	17.00	19.00	REDISH BROWN ROCK

Stratigraphies

0 *records for RN* **111797**

Aquifers

1 *records for RN* **111797**

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	17.00	19.00	MDST - Mudstone	22/10/2002	-9.00	N	COND 2000	0.75	Y	FR	WANDILLA FORMATION

Pump Tests Part 1

0 *records for RN* **111797**

Pump Tests Part 2

0 *records for RN* **111797**

Bore Conditions

0 *records for RN* **111797**

Elevations

0 *records for RN* **111797**

Water Analysis Part 1

0 *records for RN* **111797**

Water Analysis Part 2

0 *records for RN* **111797**

Water Levels

0 *records for RN* **111797**

Wire Line Logs

0 *records for RN* **111797**

Field Measurements

1 *records for RN* **111797**

Bore Report

From Year:

Pipe	Date	Depth (m)	Conduct (uS/cm)	pH	Temp (C)	NO3 (mg/L)	DO2 (mg/L)	Eh (mV)	Alkalinity (mV)	Samp	Method	Samp	Source
A	22/10/2002	17.00	2000							AI	Air Lifting	GB	Groundwater - from Bore

Special Water Analysis

0 ***records for RN*** **111797**

Bore Report

From Year:

User Licence and Conditions

Disclaimer

Open Licence (Single Supply)

Permitted use:
- You may use the supplied data for your own purposes (including supply to consultants for a specific consultancy project for you but the consultants must return or destroy the supplied data when the project is finished). You must not sell or distribute the supplied data.
- You must display this copyright notice on any copies of the supplied data however altered, reformatted or redisplayed if you supply to a consultant or copy for back up purposes: "© State of Queensland 2020".
- You may create and distribute hardcopy and digital products based on or containing the supplied data, provided all the following conditions are met:
- You must display this acknowledgment on the product(s): "Based on or contains data provided by the State of Queensland 2020. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."
- You must include metadata with the product(s) you create that use or incorporate the supplied data and the metadata must incorporate as a minimum the metadata provided with this supplied data.

Obligations:

- You must not use the data for direct marketing or in breach of the privacy laws.

Ownership:

The State of Queensland is the owner of the intellectual property rights in and to the supplied data or has the right to make this supplied data available.

Disclaimer and indemnity:
You agree to accept all responsibility and risks associated with the use of the supplied data. The State makes no representations or warranties in relation to the supplied data, and, you agree that, to the extent permitted by law, all warranties relating to accuracy, reliability, completeness, currency or suitability for any particular purpose and all liability for any loss, damage or costs (including consequential damage) incurred in any way (including but not limited to that arising from negligence) in connection with any use of or reliance on the supplied data are excluded or limited. You agree to continually indemnify the State of Queensland (and its officers and employees) against any loss, cost, expense, damage and liability of any kind (including consequential damage and liability in negligence) arising directly or indirectly from or related to any claim relating to your use of the supplied data or any product made from the data.