ATTACHMENT BOOKLET 2

ORDINARY COUNCIL MEETING

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Scotland Island

Review of Social and Environmental Factors

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Northern Beaches Council

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PS Solutions

PRESSURE SYSTEM SOLUTIONS PTY LTD

Scotland Island

DRAFT FINAL REPORT

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1 EXECUTIVE SUMMARY

With 370 dwellings, Scotland Island is one of the largest villages in greater Sydney without a reticulated potable water supply or wastewater service. Scotland Island Residents' Association has been lobbying for improved water and wastewater services for over 30 years.

The drinking water supply consists of household rainwater tanks and an emergency pipeline, originally intended for firefighting purposes and emergency drinking water. The non-potable emergency supply is used regularly by the majority of residents.

This current arrangement carries risk to public health. The water supply is non-potable, provided to residents without monitoring and used after being stored within rainwater tanks. As a result, there is potentially low levels, to zero levels of disinfection. The filling process provides avenues for contamination of the supply, through physical contact, exposure to soil (potentially containing septic runoff) and as a result of having no compliant backflow protection.

Wastewater systems consist of on-site management systems that are generally unsuitable for the topography and geology of the Island. Scotland Island is steep-sided bedrock with shallow soils of sandy loam (highly permeable) with sandy clay loam sub-soils (highly impermeable). Evidence of overflow of septic systems was observed during the site inspection and audit conducted as part of this investigation. Septic odours and high numbers of mosquitos were also observed, supporting anecdotal reports of these issues.

Streams have been found in previous monitoring studies to have elevated nutrient, sediment and bacterial concentrations exceeding the ANZECC (1992) guidelines. Soil testing conducted as part of the site audit conducted on 21st February 2019 identified elevated nutrient and faecal coliform levels within soils, indicative of septic overflow. Exposure to septic overflow, carries public health risks, which in combination with the water supply arrangements discussed above is of particular concern.

With regards to faecal coliform levels, it should be noted that the National Water Quality Management Strategy Guidelines for Sewerage Systems – Use of Reclaimed Water (November 2000) guideline levels recommend a guideline value of less than 10 coliforms per 100mL in reclaimed water used in high contact circumstances (ie urban gardens). Soil testing for faecal coliform levels in excess of 1,500 coliforms per gram of soil in five of the six sites tested.

This review of social and environmental factors has been prepared to review previous environmental and social studies and identify knowledge gaps that would needs to be investigated in the detailed development of options for provision of this infrastructure.

Studies of environmental conditions on, and around the island are dated, with the comprehensive studies last conducted in 1997. This 1997 assessment found that generally, current water and sewerage systems are insufficient and, in many instances, failing.

Northern Beaches Council has indicated that Scotland Island has difficulty with any on-site wastewater management systems on the island being fully compliant with the relevant Australian Standards or guidelines.

Typical compliance issues include:

- Few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distances to a permeant water source;
- Few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distance to boundaries;
- Few properties meet the AS1547 for wet weather storage;
- Few properties meet the AS1547 for reserve land application areas; and
- Scotland Island does not have much vegetation that is in accordance schedule 7 of the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households.

During the site inspection undertaken for this assessment, evidence of significant noxious weed infestation and Eucalyptus dieback was observed. It is likely that altered soil moisture and nutrient characteristics caused by poorly performing on-site wastewater management systems are contributing factors. It this regard, it should be noted that the vegetation on the Island is listed as an endangered ecological community (Pittwater Spotted Gum Forest).

In terms of topography, lot size, geological conditions, environmental sensitivity and development density, Scotland Island is similar to Dangar Island. Challenges relating to the provision of water and wastewater services are also similar. It should also be noted that Scotland Island is in closer proximity to heavily populated areas of Sydney than Dangar Island. When considered in these terms, it is a reasonable community expectation that Scotland Island be provided with the same level of water and wastewater services as Dangar Island.

In order to progress detailed development and approval of water and wastewater servicing solutions for the Island, it is recommended that the following studies be progressed.

1. Surface water quality monitoring and modelling both within Pittwater and within local stormwater system of the island.
2. Effluent discharge modelling (if a discharge option is pursued).
3. Water quality testing of stored rainwater on the island.
4. Flora and Fauna Assessment and
5. Aboriginal Archaeological survey.

2 BACKGROUND AND PURPOSE

Scotland Island covers an area of approximately 55 ha and is one of several islands in the lower Hawkesbury/Nepean estuarine system. With 370 dwellings, Scotland Island is one of the largest villages in greater Sydney without a reticulated potable water supply or wastewater service.

The emergency water supply pipeline set up for firefighting and then later as an emergency drinking water supply, is now used by the majority of residents. This supply is officially non-potable. On-site wastewater systems are of insufficient capacity to cope with the substantial use of the non-potable supply. This has contributed to water quality impacts on the Pittwater Estuary, particularly following rain events.

The Scotland Island Residents Association (SIRA) has taken an active role in lobbying for improved services to the island for over 30 years. Despite being listed on the State Government's Priority Sewerage Program, there is currently no requirement on Sydney Water to service villages on the Program.

The State Government's Stronger Communities Fund has funded a feasibility study for the provision of reticulated water and wastewater infrastructure to Scotland Island.

The purpose of this report is to review previous environmental and social studies and identify knowledge gaps that would needs to be investigated in the detailed development of options for provision of this infrastructure.

Site characteristics

Pittwater catchment

Pittwater Estuary is a drowned river valley located near the mouth of the Hawkesbury-Nepean River system. The estuary is about 10 km in length and 1 km in width, with a maximum depth of 20 metres. Water quality issues in Pittwater are mostly confined to shoreline areas and are more pronounced in the southern part of the waterway. Flushing is restricted in the bay areas, with wind driven currents more dominant than tidal currents in mixing and flushing processes. Dredged areas (common in the southern embayments) also have poorer water quality as flushing is reduced in deeper water.

Water quality in the tributaries, embayments and the main estuary body of Pittwater is poor to extremely poor following rainfall, and otherwise reasonable. Poor water quality following rainfall is mostly due to runoff from developed land areas.

Pittwater is highly valued as an ecological and recreational resource. Numerous primary and secondary contact recreational activities take place, including swimming, sailing, kayaking, fishing, sailboarding, kite-surfing, water skiing and boat and shore fishing.

Scotland Island

Scotland Island is located at the southern end of the Pittwater estuary (see **Figure 1**). In the 2016 Census there were 579 people living in 359 private dwellings on the island. Only 209 of those dwellings were occupied at the time of the census. Over half the population is employed. These figures are down from 700 residents in 344 dwellings in the 2011 Census, with 252 dwellings occupied at the time of the census.

The only option for further development on Scotland Island is redevelopment of existing lots. This takes the form of knock-down-rebuilds or upgrading existing holiday house. Redevelopment has been occurring for a number of years, however the Island's population has seen a decrease since the 2011 Census suggesting development has been focussed on improvements to accommodation and not an increase in capacity. The size of housing is somewhat restricted by a requirement to maintain 80 percent of the property as landscaped area. Associated with an increase in the size and value of dwellings has been an expectation to have upgraded facilities such as dishwashers.

The island is within close proximity to urban areas, being approximately 2.5km north of Mona Vale. Lot sizes are typical of urbanised areas. **Figure 2** displays the regional context and proximity to urbanised areas which are serviced by reticulated water and wastewater systems.

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TITLE : FIGURE 2: REGIONAL CONTEXT

LOCATION : SCOTLAND ISLAND

DATUM: GDA 1994
PROJECTION: GDA 1994 MGA Zone 56

DATE : 15/02/2019
PURPOSE: ENVIRONMENT

VERSION (PLAN BY): B A3 (james.hugo)
PATH:

CLIENT: PRESSURE SYSTEM SOLUTIONS
JOB REF: 18326

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Stakeholders

Key stakeholders include Northern Beaches Council, Scotland Island Residents Association, Sydney Water, NSW Department of Planning and Environment, NSW Office Environment and Heritage (including NSW National Parks and Wildlife Service), NSW Health, residents of Scotland Island, recreational users of the Pittwater waterway, and environmental and community groups associated with Pittwater and its environment.

Existing water and wastewater services

Water supply

There is no true centralised water supply on Scotland Island. Residents rely on rainwater tanks, supplemented by purchases of water from an emergency supply line.

Around 1977, an emergency supply pipeline was built by Warringah Council to supply water for firefighting. The pipe was damaged by boats and replaced one metre below the estuary floor in 1988, at which time Council agreed that the supply could be used as an emergency top-up supply for rainwater tanks in the event of low rainfall.

Sydney Water ownership of the system ends at the connection at Church Point. Northern Beaches Council is responsible for the 37mm ID polyethylene submarine pipeline.

When Pittwater Council attempted to disconnect the line due to safety concerns, SIRA accepted legal responsibility for the lines in 2002 and upgraded the system across the island. SIRA, acting on behalf of the residents, pays Council for the water, and then distributes it from the reservoir to residents for a fee. There are three polyethylene pipelines around the island, maintained by a trust fund derived from SIRA through a user pays arrangement. The pipeline distributes the water to standpipes, where residents can attach a hose to top-up their tanks.

A proportion of households use the emergency supply as their primary supply, as indicated by the daily demand ranging from 72 kL/d (summer 2018) to 48 kL/d (winter 2018) as identified via water bills for the period 1/10/17 to 30/9/18. There is high demand for the emergency supply during drought, when residents have to book in weeks in advance to fill their tanks.

When it was last assessed, the pipe was in poor condition and exposed in many locations, meaning it is susceptible to puncture, burning and melting and at risk of wastewater infiltration. Limited testing of water supplies on Scotland Island in a 1996 study found faecal coliforms present in private rainwater tanks (most likely due to animal droppings) with some exceeding recommended levels for potable water, and in the emergency water supply line (possibly due to backflow wastewater infiltration).

Pittwater Council Policy No. 76 notes that it is a non-potable supply that should be clearly sign-posted for that purpose, to only be used in the manner and for the specific purposes specified under the (unsigned) agreement with Sydney Water. SIRA's agreement for sale also clearly notes that the water is non-potable. While Sydney Water is required to deliver water that meets Australian Drinking Water Guidelines to the connection point, there is no similar requirement on SIRA for the water they deliver to island residents.

In 2017, NSW Health declared that the local kindergarten and community hall must no longer provide or sell food, as it was discovered they were using the non-potable emergency pipeline to top-up rainwater tank supplies.

A small number of properties on Florence Terrace have a private water supply connection to Taylor's Point on the mainland. They operate as the Scotland Island Pipeline Company (SIPCO). SIPCO investigated expanding their scheme in 2013 but abandoned the process due to the cost of submitting a development application.

The emergency water supply has insufficient pressure and flow to use for fire-fighting purposes (despite being originally provided for this). In a study in the 1990's, the Warringah Pittwater Bush Fire Service concluded that there was a high potential for loss of life and property in the event of a bushfire.

Wastewater

There is no centralised wastewater system on the island. Septic systems with soil absorption trenches account for the majority of wastewater disposal. Approximately a third of properties have aerobic wastewater treatment systems (AWTS). It is likely that a percentage of the septic systems have never been pumped out and many could be of a significant age. Most new developments on the island are now required to install an AWTS, so it might be assumed that wastewater management has improved to some degree in recent years.

Disposal areas are generally smaller than recommended in the Australian Standard. Some of the waterfront properties dispose of wastewater directly into estuarine sands, and for some, tidal sea water accesses and 'flushes' their disposal area. In these cases, little post-disposal treatment occurs before the water enters Pittwater.

If a reticulated town water supply were brought to the island without an accompanying reticulated wastewater network, it is likely that the current septic systems would become hydraulically overloaded and fail. It should be noted that this may already occurring with those properties relying on the emergency water supply as their primary supply.

Wastewater treatment and the implications of on-site sewage disposal are high priority issues on Scotland Island. Currently, there are several perceived problems associated with existing water and wastewater management practices including:

1. Possible health risks associated with wastewater disposal;
2. Vegetation dieback associated with water logging and phosphorus toxicity;
3. Degradation of surface-water quality in streams;
4. Poor quality of stormwater runoff and surface ponds in streets during dry weather; and
5. High densities of human occupation and development.

Land capability for wastewater disposal

Scotland Island is steep-sided bedrock with shallow soils of sandy loam (highly permeable) with sandy clay loam sub-soils (highly impermeable). Both layers are highly acidic and encourage nutrients and contaminants to leach away from wastewater disposal areas. Previous mapping has indicated that up to 44 percent of the island is unsuitable for existing wastewater disposal systems due primarily to geological constraints.

The ephemeral streams in 15 water catchments on the island have been found in previous monitoring studies (*Scotland Island Wastewater Impact Study 1997*) to have elevated nutrient, sediment and bacterial concentrations exceeding the ANZECC (1992) guidelines for surface water and saltwater estuaries. More recent data is not available. Streams require rainfall of 2-5mm/hr to generate runoff, after which water flows rapidly to Pittwater. Due to the soil's low capacity to accept and treat wastewater, it is dispersed from land application areas via sub-surface flow and surface runoff.

The steep slopes of the island contribute to an extreme erosion hazard for both non-concentrated and concentrated flows. Continuing redevelopment is contributing to sources of erodible sediment, with many building sites lacking erosion control measures. The isolation of the island has meant ensuring compliance has been difficult with the limited resources available at Council. It is possible that Scotland Island contributes in excess of 14 tonnes per hectare per year of suspended sediment to Pittwater, much of which is likely to be contaminated from exposure to on-site wastewater disposal.

Native vegetation responds poorly to elevated nutrient supplies and some dieback in Eucalypt species has been observed.

When considering soils, drainage lines, slope, proximity to waterways etc, approximately 44 percent of the island is unsuitable or marginal for on-site wastewater disposal.

Other services

In 2015, the State Government made a commitment to investigate the provision of a more secure and reliable energy supply to Scotland Island. Initial investigations are underway, with community consultation completed in 2017, and work may include repairs to the submarine cables.

Coordinating the provision of water, wastewater and energy services to the island may provide cost savings and will reduce the impact to the local community. At the very least the provision of conduits for the installation of future services should be considered.

3 PROJECT CONTEXT AND DRIVERS

Approval pathway analysis and legislative requirements

Statutory consideration	Comment
Infrastructure SEPP designation	The Infrastructure SEPP is the principal instrument which specifies the types of sewerage, stormwater management, and water supply works that may be carried out without development consent (Part 5), with development consent (Part 4) or are exempt development (e.g. routine maintenance). The Infrastructure SEPP overrides the provisions of an LEP in the event of an inconsistency. The proposed works are developments for the purpose of sewerage systems and water supply systems, as defined by the Infrastructure SEPP. In accordance with Clauses 106(3B) and 125(1) of the Infrastructure SEPP, sewer and water reticulation works are permissible without development consent when they are to be carried out by or on behalf of a public authority (dependent upon delivery and asset ownership model). In addition, 106(5)(g) defines routine maintenance as permissible without consent. Clause 5(4) defines routine maintenance works, which is consistent with the proposal. Clause 106 (5f) also permits construction works (defined in Clause 5 to include establishment of temporary site compounds and access ways, temporary structures and clearing of vegetation) as permissible without consent. Clause 125(5) also describes many permissible developments if they are in connection with the water supply system, such as construction works, environmental management works, maintenance depots etc.
Land zoning	Refer to Figure 2 (as per Pittwater LEP, 2014). The majority of Scotland Island is zoned as E3 Environmental Management. The central area of the Island consists of land zoned E2 Environmental Conservation and a small lot zoned as SP2 Infrastructure which is designated for an existing emergency water supply system. There are four areas around the Island zoned RE1 Public Recreation.
Land Tenure	Freehold tenure
Other applicable Environmental Planning Instruments (EPIs)	See below for detail of EPIs.
Other Legislative requirements: Water Management Act, 2000 WICA 2006 Contaminated Land Mngt Act, 1997 Biodiversity Conservation Act, 2016 Heritage Act, 1977 National Parks and Wildlife Act, 1974 Protection of the Environment Operations Act, 1997 Coastal Management Act, 2016	See below for additional Legislative requirements.
Is the project likely to have a significant impact on the environment?	Dependant on preferred servicing option.
Is the project likely to have a significant impact on a Matter of National Environmental Significance as defined under the Environment	Dependant on preferred servicing option, however, no Matters are located on Scotland Island.

Statutory consideration	Comment
Protection and Biodiversity Conservation Act 1999?	
Does the project involve an action on Commonwealth land that is likely to have a significant impact on the environment, or an action outside Commonwealth land that may significantly impact the environment on Commonwealth land?	Dependant on preferred servicing option, however, the project will not involve an action that is likely to have a significant impact on Commonwealth Land.
Does the project require an approval for clearing under the Local Land Services Act 2016 if applicable?	No – the project is located in an area governed by the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017*. Part 5A of the *Local Land Services Act 2013* does not apply to non-rural areas to which the SEPP applies.
Is the project a Scheduled Activity under the Protection of the Environment Operations Act 1997	It is unlikely that the project would be a Scheduled Activity. Scheduled activity *Sewage treatment* is not relevant as the processing of waste would not exceed 2,500 persons equivalent or 750 kilolitres per day.
Does the project require an approval, permit or licence under any environmental legislation?	Dependant on preferred servicing option. For example, if discharge is required or if there is groundwater interactions.
Is the project consistent with the principles of Ecologically Sustainable Development (ESD)?	Dependant on preferred servicing option, however, it is likely that the project would be consistent with the principles of ESD in that it: ▪ Would minimise adverse effects on future generations by replacing a failing system; ▪ Work would reduce the current impact on an endangered ecological community; and ▪ Would prevent risk of failure and minimise long term financial and environmental costs.
Are there any other requirements for the project under environmental legislation? (check consultation requirements of the Infrastructure SEPP)	Clause 13 of *State Environmental Planning Policy (Infrastructure) 2007* states: *Consultation with councils-development with impacts on council-related infrastructure or services:* *(e) involves the installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential.* In accordance with this Clause, consultation would be undertaken with Northern Beaches Council regarding the proposed works and any related impacts on Council assets, including roads and reserves.

TITLE : FIGURE 3: LAND ZONING

LOCATION : SCOTLAND ISLAND

DATUM GDA 1994

PROJECTION: GDA 1994 MGA Zone 56

DATE: 13/02/2019

PURPOSE: ENVIRONMENT

VERSION (PLAN BY): A A3 (james.hugo)

CLIENT: PRESSURE SYSTEM SOLUTIONS
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Local Environmental Plan

The project is located within the Northern Beaches LGA and governed by the Pittwater Local Environmental Plan 2014. The provisions of the Infrastructure SEPP mean that Local Environmental Plans (LEPs), prepared by councils for an LGA, do not apply. However, provisions within the Pittwater LEP should still be considered.

Provision	Relevance to the Proposal
Clause 2.3 – Zone objectives and Land Use Table	Under the Pittwater LEP: • Scotland Island is predominantly zoned as E3 Environmental Management, however there are areas zoned E2 Environmental Conservation, RE1 Public Recreation and SP2 Infrastructure.
Clause 5.10 – Heritage conservation	The objectives of this clause are as follows: (a) to conserve the environmental heritage of Pittwater, (b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views, (c) to conserve archaeological sites, (d) to conserve Aboriginal objects and Aboriginal places of heritage significance. Scotland Island does not contain any known heritage items.
Clause 7.1 – Acid sulfate soils	Under the Pittwater LEP: • Scotland Island is mapped as Class 5 soils Class 5 soils do not typically contain acid sulfate soils. However, it was found in a recent contamination report of the Island undertaken by Ausgrid (refer Appendix E) that the samples taken contained acid sulfate soils.
Clause 7.2 – Earthworks	The objective of this clause is to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land. The project is permissible without development consent under the Infrastructure SEPP, however consideration of the potential impacts and mitigation measures for earthworks should be included if the proposal progresses.
Clause 7.6 – Biodiversity	The objective of this clause is to maintain terrestrial, riparian and aquatic biodiversity by: (a) protecting native fauna and flora, and (b) protecting the ecological processes necessary for their continued existence, and (c) encouraging the conservation and recovery of native fauna and flora and their habitats. Scotland Island is mapped as being a biodiversity area.
Clause 7.7 – Geotechnical hazards	The objectives of this clause are to ensure that development on land susceptible to geotechnical hazards: (a) matches the underlying geotechnical conditions of the land, and (b) is restricted on unsuitable land, and (c) does not endanger life or property. Scotland Island is mapped as an area of geotechnical hazard.

State Legislation

Environmental Planning and Assessment Act 1979

The EP&A Act and associated SEPPs provide the framework for the assessment of environmental impacts and approval of development in NSW. The EP&A Act establishes the process for the assessment and approval of development which requires consent under Part 4. If delivered by or for a public authority, this project (under the Infrastructure SEPP) would not require development consent, however an environmental assessment according to Division 5.1 of the EP&A Act may still be required. If this environmental assessment identifies the potential for the project to have a significant environmental impact, an EIS would be required and consideration of the project would follow the provisions of Division 5.2 of the Act.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the key piece of legislation administered by the Environment Protection Authority (EPA). It aims to protect, restore and enhance the quality of the environment in NSW, having regard to the principles of ecologically sustainable development, and rationalise and strengthen the regulatory framework for environment protection.

Part 3.2 of the POEO Act requires an Environment Protection Licence (EPL) for scheduled development work and the carrying out of scheduled activities. Scheduled activities are listed in Schedule 1 of the Act. The project does not represent a Scheduled Activity, however, if the preferred option includes discharge of treated wastewater, a licence for this discharge would be necessary. Typical conditions for discharge can include: monitoring, recording and testing of discharge; pollution compliance and limits; odour management; maintenance requirements; emergency response; discharge processes and management.

Coastal Management Act 2016

The *Coastal Management Act 2016* establishes a process for managing the coastal environment of New South Wales in a manner consistent with the principles of ecological sustainable development for the social, cultural and economic well-being of the people of the state. It includes objectives related to protecting natural coastal processes, supporting the social and cultural values of the coastal zone and ensuring co-ordination of the polices and activities of government and public authorities related to the coastal zone.

Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* establishes a process for investigating and remediating land that the EPA considers to be contaminated significantly enough to require regulation and ensures that contaminated land is managed with regard to the principles of ecologically sustainable development. Management measures to minimise potential for contamination impacts would be required to be implemented during delivery and operation of the project.

Waste Avoidance and Recovery Act 2001

The *Waste Avoidance and Resource Recovery Act 2001* was established to assist in the achievement of the objectives of the POEO Act. The objectives of this Act are to encourage the most efficient use of resources and to reduce environmental harm; apply resource management through avoidance, resource recovery and appropriate disposal, and provide for the continual reduction in waste generation. Management measures to minimise waste generation would be required to be implemented during delivery and operation of the project.

Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the integrated and sustainable management of water in NSW. The WM Act is based on the concept of ecologically sustainable development to protect water resources and systems for current and future generations.

The major functions of the WM Act include licence of water extraction and the development of water management plans. Currently, groundwater is not used as a water supply for the Island. As it is not anticipated that groundwater would be encountered impacted by any proposed options, approval under the WM Act would not be required.

Biosecurity Act 2015

From the 1st July 2017 the NSW Government replaced the Noxious Weeds Act 1993, and 13 other Acts, with a single Biosecurity Act 2015. Under the Noxious Weeds Act all landowners had a responsibility to control noxious weeds on their property. Under the Biosecurity Act the same responsibility applies and is known as a General Biosecurity Duty.

State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP is the key environmental planning instrument which determines the permissibility of the Proposal and under which part of the EP&A Act an activity or development may be assessed.

Clause 106 (3B) of the Infrastructure SEPP states that:

'Development for the purpose of sewage reticulation systems may be carried out without consent on any land in the prescribed circumstances.'

Clause 106 (1) states development is carried out in the *prescribed circumstances* if the development:

a. Is carried out by or on behalf of a public authority, or

b. consists of the construction or operation of water industry infrastructure and, under the *Water Industry Competition Act 2006*, a network operator's licence is required before the development may be carried out.

Clause 106 (3C) states:

'In any other circumstances, development for the purpose of sewage reticulation systems may be carried out with consent on any land.'

Clause 125 (1) states:

Development for the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land.

Consequently, depending on the delivery method, development consent would not be required for the project, which includes the provision of water and sewage reticulation systems.

State Environmental Planning Policy (State and Regional Development) 2011

The State and Regional Development SEPP identifies development that is State significant development, State significant infrastructure and critical State significant infrastructure and regionally significant infrastructure. In this case an EIS would be required and the project would be assessed via Division 4.7 of the EP&A Act. The project would be defined as State significant development if it meets any of the following criteria.

21 Water storage or water treatment facilities

(1) Development for the purpose of water storage or water treatment facilities (not including desalination plants) that has a capital investment value of more than $30 million.

(2) Development for the purpose of desalination plants that has a capital investment value of more than $10 million.

22 Sewerage systems

Development for the purpose of sewerage systems that:
(a) handles more than 10,000 EP (equivalent population), or

(b) has a capital investment value of more than $30 million, or

(c) has a capital investment value of more than $10 million and is located in an environmentally sensitive area of State significance.

State Environmental Planning Policy (Coastal Management) 2018

The aim of this Policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016. The project is located in a coastal region and therefore the objectives of the SEPP require consideration.

State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017

The aim of this Policy is to protect the biodiversity values of trees and other vegetation in non-rural areas and preserve the amenity of non-rural areas through the preservation of trees and other vegetation. This Policy applies to many LGAs including Northern Beaches, of which the project is located and therefore the objectives of the SEPP require consideration.

SEPP 19 - Bushland in Urban Areas

SEPP 19 aims to protect and preserve bushland within urban areas due to their value to the community as part of the natural heritage, their aesthetic value and their value as recreational, educational and scientific resources. The project is located within land that this SEPP applies.

SEPP 33 – Hazardous and Offensive Development

SEPP 33 defines hazardous and offensive development and establishes the requirements for considering an application to establish hazardous or offensive industries or development.

The project does not require the use of chemicals or processes which would fall under the definition of hazardous or offensive industry. SEPP 33 does not apply.

SEPP 44 – Koala Habitat Protection

SEPP 44 aims to encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas. As there are likely Eucalypt species within the project area, this SEPP is applicable.

SEPP 55 – Remediation of Land

SEPP 55 provides a state-wide planning approach for the remediation of contaminated land. Current EPA records do not contain any contaminated lands on Scotland Island, however wastewater contamination is likely. Due to the Island being partially listed as an area of coastal protection and vegetation listed as an endangered ecological community, a category 1 remediation work is applicable, which requires consent.

Biosecurity Act 2015

This Act has repealed the *Noxious Weeds Act 1993*. Biosecurity is a shared responsibility across government, community and industry, and as such the Act introduces the legally enforceable concept of a General Biosecurity Duty (GBD). The GBD means that any person dealing with plant matter must take measures to prevent, minimise or eliminate the biosecurity (weeds in this case) risk (as far as is reasonably practicable). Weed management on the Island is anticipated to be a crucial component of this project as noxious weeds are extensive and widespread on Scotland Island.

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

The (Commonwealth) EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places - defined in the EPBC Act as 'matters of National Environmental Significance (NES)'. The EPBC Act requires the assessment of whether the Proposal is likely to significantly impact on matters of NES or Commonwealth land.

Other Legislation

***Biodiversity Conservation Act 2016* (BC Act) (NSW)**	Scotland Island's vegetation is identified as an Endangered Ecological Community (EEC) under the BC Act.
***National Parks and Wildlife Act 1974* (NP&W Act)**	Sections 86, 87 and 90 of the NP&W Act require consent from OEH for the destruction or damage of Indigenous objects. The project is not anticipated to disturb any Indigenous objects. However, if unexpected archaeological items or items of Indigenous heritage significance were to be discovered during the construction of the Proposal, all works would cease and appropriate advice would be sought.
Roads Act 1993	The Roads Act regulates the carrying out of various activities on public roads. Under section 138 of the Roads Act, the consent of the appropriate authority (Council, DPI or RMS) is required before a person can (in the example of this project) disturb the surface of a public road. The potential need for road upgrades would be investigated during later stages of this project.

Public health and performance of existing systems

Previously monitored surface water indicated extremely high bacterial concentrations which exceed recommended ANZECC guidelines for primary and secondary contact by several orders of magnitude. Consequently, Island surface water presents a serious health threat in situations where direct contact with exposed skin or ingestion occurs (*Scotland Island Wastewater Impact Study 1997*). **Table 1** summarises wastewater system performance and condition.

Table 1 - Wastewater system performance and condition

Risk rating	Number systems	Current Approval to Operate an On-Site Sewerage Management System	No current Approval to Operate an On-Site Sewerage Management System	Never received an Approval to Operate an On-Site Sewerage Management System	History of Failure requiring action this calendar year	Did not pass initial Approval to Operate an On-Site Sewerage Management System inspection	Local Government Act Notices since keeping of electronic records
Low	43	36	2	5			
Medium	143	126	10	7			
High	157	93	62	2			
Total	**343**	**255**	**74**	**14**	**34**	**104**	**115**

Source: Northern Beaches Council (email, November 2018)

Typical compliance issues include:

- Few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distances to a permeant water source;
- Few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distance to boundaries;
- Few properties meet the AS1547 for wet weather storage;
- Few properties meet the AS1547 for reserve land application areas; and
- Scotland Island does not have much vegetation that is in accordance schedule 7 of the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households.

In summary, regarding on-site sewerage management systems and waste water disposal, the topography of Scotland Island means no system should have been approved on Scotland Island due to difficulty with complying with the relevant Australian Standards or guidelines.

Poorly performing systems pose a potential health risk through:

- direct or indirect exposure to pathogens in effluent or effluent contaminated soil. Direct exposure includes contact with pooled effluent while indirect exposure includes recreation in an affected waterway; or
- exposure to pathogens by recreational users of local waterways.

They can also impact local residential amenity through increased mosquito numbers and the generation of odours.

Environment

Water and soil

There are 343 On-site Sewerage Management Systems listed on Scotland Island, all of which are listed as Domestic Systems. There are two treatment types on the Island for the systems, 118 are listed as Aerated Wastewater Treatment Systems (AWTS) and 225 are listed as septic tank systems.

Each system has an associated land application area which consist of the following:

- 234 absorption trenches
- 77 surface spray
- 25 sub-surface irrigation
- 1 drip line
- 1 mound
- 5 unknown

Under the current operation of wastewater management systems, the environmental impact of the on-site systems is thought to be substantial. The combination of shallow effective soil depths (< 40 cm), high wastewater irrigation depths (due to small dispersion areas), moderate to high soil hydraulic conductivity, steep slopes and subsequent short retention times in trenches have resulted in the continual seepage of effluent to surrounding soils (*Scotland Island Wastewater Impact Study 1997*). Therefore, the quality of surface and any shallow groundwater on and around the Island is considered to be degraded and a potential health risk when exposed (*Scotland Island Wastewater Impact Study 1997*).

Furthermore, due to the steep topography, rainfall events would result in high volumes of surface runoff and can produce high concentrations of bacteria and other contaminants in overland flow. This runoff also has the potential to accumulate in downslope trench areas initiating trench failure, overloading its capacity (*Scotland Island Wastewater Impact Study 1997*).

Beachwatch data sourced from *State of the beaches 2017-2018* for Scotland Island is provided in **Appendix B**. The North and South monitoring points for the Island are graded as Good despite the prominent issues with waste disposal across the Island.

It should also be noted that the data only relates to faecal bacteria and does not include nutrients such as nitrogen and phosphorous which could explain the large extent of noxious weeds and poor health of vegetation through excessive nutrient loads.

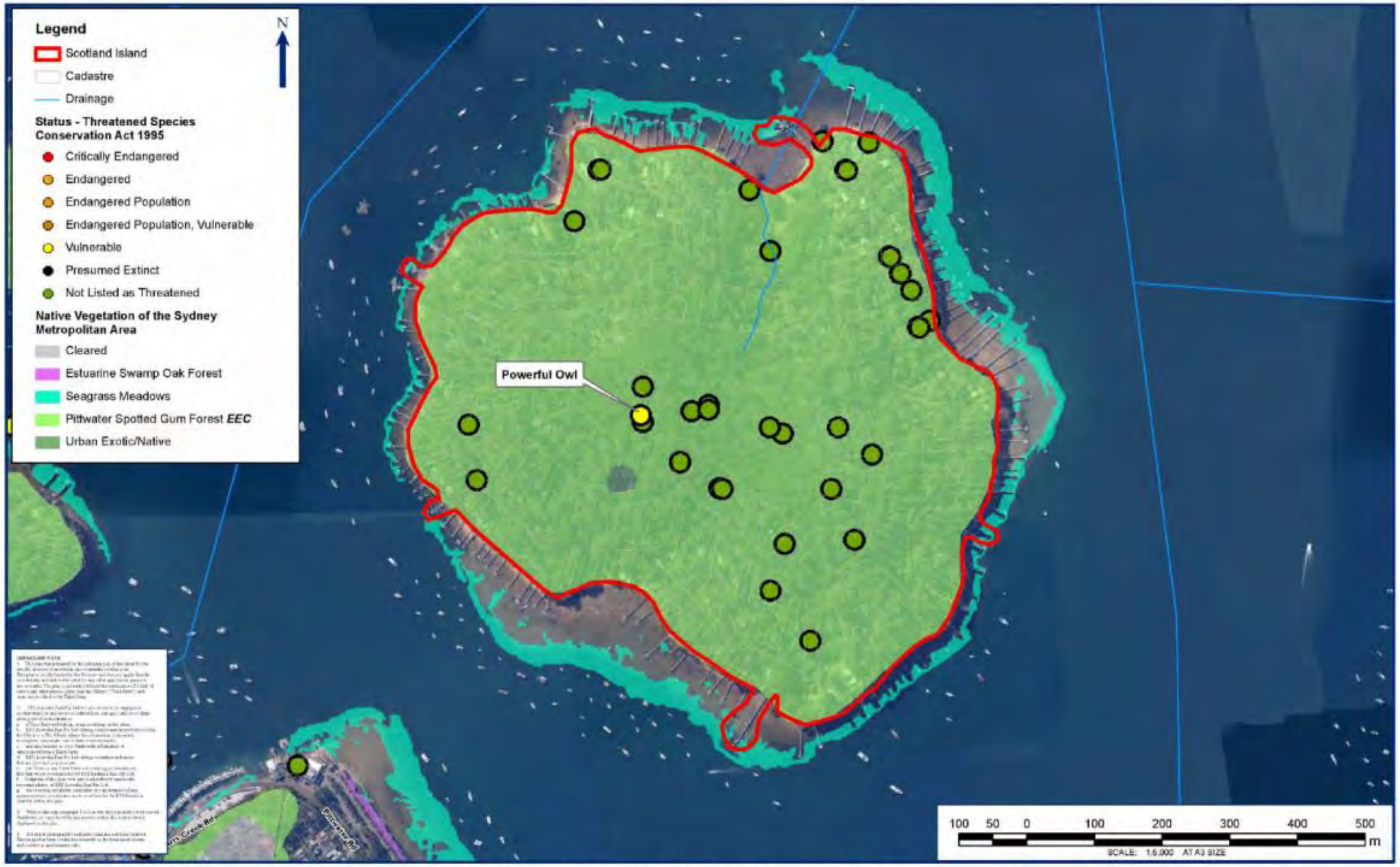
Flora and fauna

Endangered species and endangered ecological communities

Physiochemical degradation of soil due to effluent disposal is expected to be widespread and both surface and ground water resources are expected to be polluted. An implication of this is that native vegetation may be placed at risk and evidence of Eucalyptus dieback has been documented in the past (*Scotland Island Wastewater Impact Study 1997*). The vegetation of the Island is listed as an endangered ecological community (Pittwater Spotted Gum Forest, see **Figure 2**). The presence of this endangered ecological community further increases the implications of this degradation.

Noxious weeds

A site visit was conducted during the preparation of this report (see **Appendix C** for photographs). Extensive and widespread weed growth was observed during the site visit. A failing wastewater system represents a concentrated source of not only faecal matter and bacteria but also nutrients. High nutrient loads are a likely contributing factor to the widespread weed issue and degradation of native vegetation through nutrient overload and weed propagation.



TITLE : FIGURE 4: VEGETATION AND SPECIES SIGHTINGS

LOCATION : SCOTLAND ISLAND

DATUM GDA 1994

PROJECTION: GDA 1994 MGA Zone 56

DATE : 13/02/2019

PURPOSE: ENVIRONMENT

VERSION (PLAN BY): A A3 (james.hugo)

CLIENT: PRESSURE SYSTEM SOLUTIONS
JOB REF: 18326

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
Unit 2A, 45 Fitzroy Street, Carrington, NSW Australia, 2294 PO Box 120, Carrington, NSW 2294
T: 02 4940 4200 F: 02 4940 4299 www.rpsgroup.com.au

Social, community expectations

The Scotland Island Residents' Association is a representative body of the residents of Scotland Island and has been lobbying the Government, Pittwater Council and Sydney Water on behalf of the residents for improved water and wastewater services for over 30 years. A 2015 survey of residents indicated that 96 percent of the 383 respondents wanted a wastewater connection on the condition that the only cost to households was the connection to the mains system.

SIRA has had an active history in advocating for improved infrastructure for the island:

1997 – Scotland Island Landcare Group won a grant, administered by SIRA to investigate the environmental and public health impacts of current on-site wastewater disposal on Scotland Island, and consider water and wastewater options for the island.

2001 – Scotland Island announced as one of 20 villages to receive improved wastewater infrastructure as part of Stage 2 of the Priority Sewerage Program (PSP).

Jun 2005 – SIRA held a workshop with key stakeholders to discuss future water and wastewater infrastructure for Scotland Island.

Mar 2010 – Pittwater Council raised concerns directly with Sydney Water that Scotland Island appeared to have been removed from the program for PSP.

Apr 2010 – The Hon. Rob Stokes (Member for Pittwater) raised in Parliament the question of when PSP work would begin on Scotland Island. The response was that planning would begin in 2011, subject to funding *and a resolution by residents to upgrade local water infrastructure*.

Jan 2011 – Soon to be Premier Barry O'Farrell committed to the fast-tracking of wastewater connections to a number of PSP identified villages in Wollondilly and Hornsby Shires, and said the remaining villages including Scotland Island were a priority.

Dec 2012 – NSW Government commitment in Northern Beaches Regional Action Plan (under NSW 2021) to better manage wastewater and upgrade wastewater treatment facilities to Scotland Island as a matter of priority.

Aug 2014 – SIRA submission to review of Sydney Water's Operating Licence review in support of Sydney Water retaining responsibility for delivery of the Priority Sewage Program as part of their next operating license.

Jan 2015 – PR and letter campaign by SIRA and residents to Minister Humphries, IPART and EPA in response to a concern that Sydney Water was going to be released from the PSP as part of their Operating Licence conditions.

Jun 2015 – Sydney Water's new Operating Licence has no firm commitment to deliver the PSP to Scotland Island.

Aug 2015 – SIRA met with The Hon. Rob Stokes, Member for Pittwater.

Nov 2015 – SIRA met with The Hon. Niall Blair, Minister for Lands and Water regarding installation of wastewater infrastructure plus subsequent correspondence.

Apr 2016 – SIRA met with The Hon. Rob Stokes and decentralised service providers regarding options for water and wastewater provision on Scotland Island.

2016 – Draft Pittwater Waterways Review Discussion Paper notes key issues raised in stakeholder engagement were sewage runoff from Scotland Island.

At the time of preparing this report, a Community Engagement is ongoing, having begun in April 2018. At the current time, a Project Working Group and a 'Have Your Say' webpage has been established and updated as required. A program to consult the community about proposed upgrades to water and sewer services on the Island will be conducted and involve:

- discussions with key stakeholders including statutory authorities and community organisations;
- use of the 'Have Your Say' webpage already established;
- a Project Working Group, consisting of self-nominated community representatives to pursue the interests of the community;
- preparation of FAQ items for general public awareness;
- local newsletter articles produced by SIRA; and
- community workshops should also be organised to allow community engagement and discussion regarding the project. Comments should be taken into consideration when determining appropriate delivery options. Delivery options should also be exhibited at subsequent workshops for further community feedback.

This section will be updated progressively as community and stakeholder consultation progresses.

Priority Sewerage Program

In February 1997, the NSW Government announced the Priority Sewerage Program (PSP), which nominated 16 unsewered villages with high environmental sensitivity for improved sewerage services. All schemes listed in the first stage of the scheme have been completed, including Brooklyn and Dangar Island. Scotland Island was included among another 20 villages identified in Stage 2 of the program, announced in 2001, although delivery of wastewater services has been complicated by the lack of a reticulated water supply. Sydney Water has no program to deliver a centralised water supply to unconnected villages.

Sydney Water funded previous PSP schemes through the Sewer Service Charge that is levied on all existing Sydney Water wastewater customers. Sydney Water's Operating Licences between 2005 and 2015 obligated Sydney Water to implement the PSP in a number of nominated villages.

Sydney Water successfully argued that an obligation to implement the PSP should not be included in their most recent Operating Licence for 2015-2020, as the Operating Licence was meant to ensure a minimum standard of service to existing customers (which residents of Scotland Island are not).

The Independent Pricing and Regulatory Tribunal (IPART) suggested that it might be more appropriate that the PSP be funded directly by the State Government in order to meet their community service obligations. This would also allow the use of a contestable mechanism, where the most efficient (and innovative) option could be selected from options put forward by Sydney Water and other private service providers licenced under the Water Industry Competition (Amending) Act 2014.

Sydney Water's Operating Licence for 2015-20 states that Sydney Water must:

- co-operate with, and participate in, any Government review of the Priority Sewerage Program, and
- if required by the Minister, Sydney Water must implement and comply with any outcomes (including timeframes) of a Government review of the Priority Sewerage Program.

The Government is not planning to review the Priority Sewerage Program at this time.

Sydney Water's Operating Licence is currently under review, and one of the questions being raised by IPART in the review is the future of the Priority Sewerage Program.

Brooklyn, Dangar Island

The townships of Brooklyn and Dangar Island were provided with improved sewerage services as part of the Priority Sewerage Program (PSP). Prior to this, wastewater facilities in Brooklyn and Dangar Island consisted of various on-site management systems that were identified and adversely affecting local waterways and posing potential public health risks (SMEC, 2000).

Studies undertaken by SWC and Hornsby Shire Council (SMEC, 2000) found that the operation of on-site sewage management systems in Brooklyn and Dangar Island:

- affected surface water quality; and
- had potential to affect public health through:

  - direct or indirect exposure to pathogens in effluent or effluent contaminated soil in backyards. Direct exposure includes contact with pooled effluent while indirect exposure includes recreation in an affected waterway; or
  - exposure to pathogens by recreational users of local waterways; or
  - consumption of oysters grown in nearby leases;

- had the potential to impact local residential amenity; and
- generally unsuitable for most residential properties in the two towns due to property size, climate, topography and soils.

In terms of topography, geological conditions, environmental sensitivity and development density, Scotland Island is similar to Dangar Island. Challenges relating to the provision of water and wastewater services are also similar. It should also be noted that Scotland Island is located in closer proximity to heavily populated areas of Sydney than Dangar Island.

As such, it is a reasonable community expectation that Scotland Island be provided with the same level of water and wastewater services as Dangar Island.

4 SOCIAL AND ENVIRONMENTAL FACTORS

Systems audit

An audit of existing systems was undertaken on the 21st February 2019, which included interviews with residents, observation of environmental conditions and soil testing.

Comments received from residents, relevant to social and environmental factors included:

- You do not go swimming for 3 or 4 days after rain, Pittwater is too polluted
- There is a septic smell most days
- Lots of mosquitoes, too much septic water on the ground
- It worries me allowing the kids to play outside when you see the muddy bogs caused by the septic tanks.

Relevant site observations included:

- Wet soil patches in roadways below site disposal septic systems
- Prevalent odour during most times of the day
- Most areas plagued by mosquitos
- Water supply pipeline tied to trees, exposed on ground. Non-compliant installation
- No provision of complaint backflow protection to fill points. In places hoses are connected to the supply pipe outlet with outlet submerged in rainwater tanks with no backflow prevention.

Despite the inspection being conducted during a dry period a number of waterlogged areas downstream of septic systems were identified. Indicative photos follow.

Soil sampling identified elevated levels of Faecal coliform and Total Nitrogen at various sites around the island.

With regards to faecal coliform levels, it should be noted that the National Water Quality Management Strategy Guidelines for Sewerage Systems – Use of Reclaimed Water (November 2000) guideline levels recommend a guideline value of less than 10 coliforms per 100mL in reclaimed water used in high contact circumstances (ie urban gardens). Soil testing for faecal coliform levels in excess of 1,500 coliforms per gram of soil in five of the six sites tested.

Testing locations and results are shown on Figure 5.

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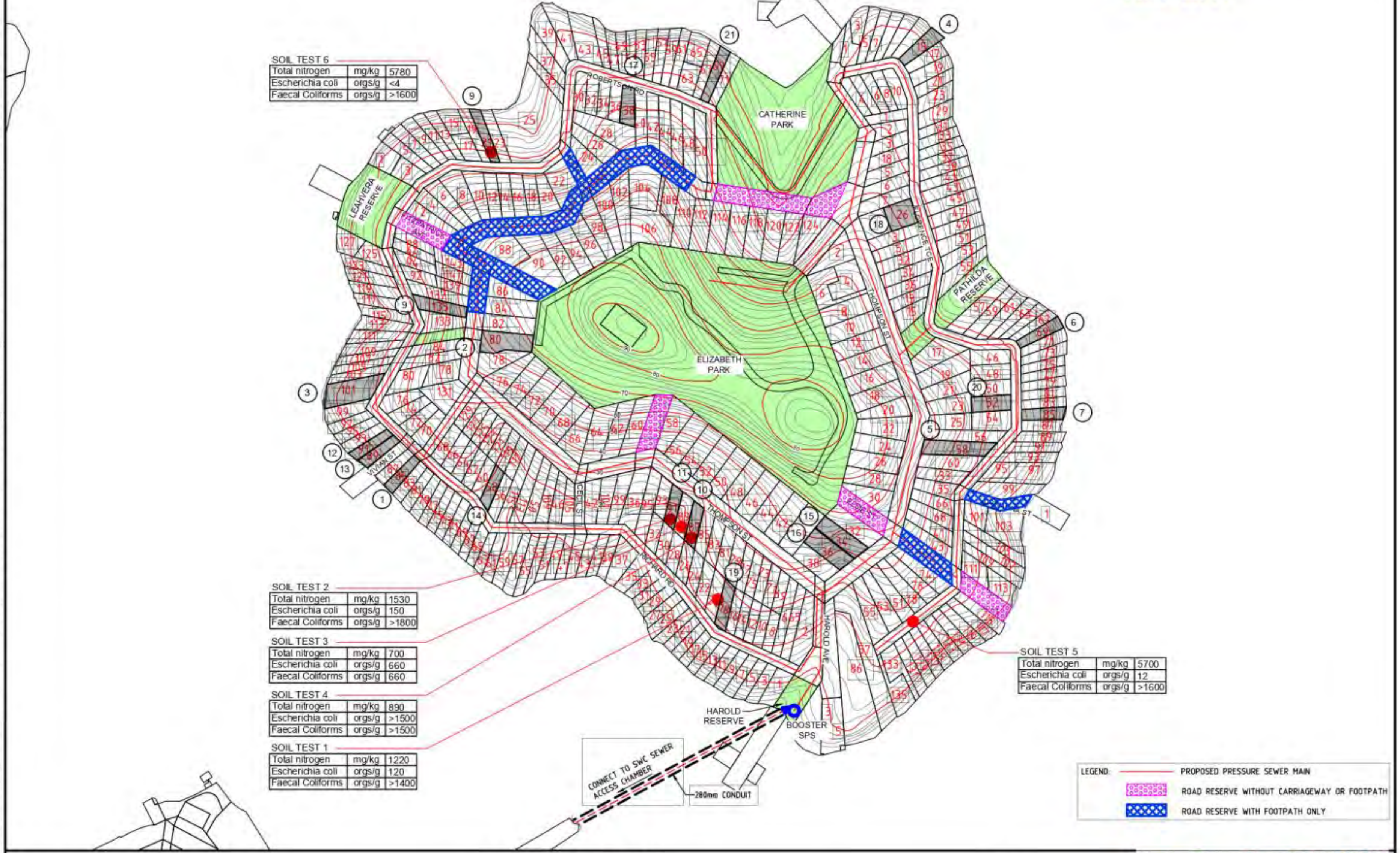
REPORT



SOIL TEST 6

Total nitrogen	mg/kg	5780
Escherichia coli	orgs/g	<4
Faecal Coliforms	orgs/g	>1600

SOIL TEST 2

Total nitrogen	mg/kg	1530
Escherichia coli	orgs/g	150
Faecal Coliforms	orgs/g	>1800

SOIL TEST 3

Total nitrogen	mg/kg	700
Escherichia coli	orgs/g	660
Faecal Coliforms	orgs/g	660

SOIL TEST 4

Total nitrogen	mg/kg	890
Escherichia coli	orgs/g	>1500
Faecal Coliforms	orgs/g	>1500

SOIL TEST 1

Total nitrogen	mg/kg	1220
Escherichia coli	orgs/g	120
Faecal Coliforms	orgs/g	>1400

SOIL TEST 5

Total nitrogen	mg/kg	5700
Escherichia coli	orgs/g	12
Faecal Coliforms	orgs/g	>1600

Date: 12/02/2019
Rev: A
Drawing No: SK05
Scale:

SCOTLAND ISLAND
SOIL TEST LOCATIONS AND RESULTS

Pressure System Solutions Pty Ltd

Saved: 07.03.2019, By: valued customer
J:\700-Projects\702-Current projects\181031 Scotland Island 8-5-01 sw\181031 Scotland Island\720-Design\721-Drawings\730-Street mains\Scotland Island _SK05 Soil Test locations and summary results.dwg

Review of social and environmental factors

A review of the key social and environmental factors relevant to the project is provided in Appendix A. This review is intended to be used during options assessment processes and can be finalised on the basis of a preferred option.

5 FURTHUR STUDY RECOMMENDATIONS

On the basis on this review of existing information it is recommended that the following studies be undertaken in order to facilitate detailed development of a water and wastewater servicing option for the island.

1. Surface water quality monitoring and modelling both within Pittwater and within local stormwater system of the island.
2. Effluent discharge modelling (if a discharge option is pursued).
3. Water quality testing of water used on the island.
4. Flora and Fauna Assessment and
5. Aboriginal Archaeological survey.

6 REFERENCES

Martens & Associates Pty Ltd, 1997, *Scotland Island Wastewater Impact Study*.

Martens & Associates Pty Ltd, 1997, *Water and Sewage Options Study: Scotland Island, Sydney, NSW*.

Office of Environment and Heritage, 2018, 'North Scotland Island' and 'South Scotland Island' in *State of the beaches 2017-2018 Sydney region*.

SMEC, 2000, *Brooklyn and Dangar Island Sewerage Scheme Environmental Impact Statement*

Appendix A Environmental risk check and assessment of potential impacts

Table 1 Topography, geology and soils

Will the project require any excavation or ground disturbance or include irrigation of treated waste waters?
(If no, move to next section. If yes, answer remaining questions in this section)

Construction phase:
Yes – extent of excavation or ground disturbance would vary depending on the service delivery method.

Operation phase:
Yes – maintenance activities may require ground disturbance.

Is the project located in an area of high erosion or landslip risk?

Construction phase assessment
Yes – the island is generally steep sloped and is subject to high erosion, particularly in heavy rains/storms.

Operation phase assessment
Yes – as above

Will the project disturb any natural cliffs /rock shelves / rock outcrops?

Construction phase assessment
Potentially - dependant on preferred option.

Operation phase assessment
No

Will the project disturb contaminated land or contaminated material?
(check NSW EPA Contaminated Lands Records – NSW EPA website)

Construction phase assessment
Possible – a search of the NSW EPA Contaminated Land Recorded returned no results for Scotland Island. Due to the poor performance of existing wastewater systems, it is likely that effluent would be encountered. An Unexpected Finds Protocol for other materials should be employed during construction works.

Operation phase assessment
No

Will the project disturb acid sulphate soils or drawdown groundwater within areas of potential acid sulphate soils?
(check ASS risk maps – NSW Office of Environment and Heritage website)

Construction phase assessment
Yes – A recent contamination study of the Island undertaken by Ausgrid found that the samples taken contained acid sulfate soils (Appendix E). Impacts are most likely to occur where works are located close to the shoreline as Pittwater waterway contains Class 1 acid sulfate soils.

Operation phase assessment
No

Will the works permanently change surface slope or topography?

Construction phase assessment
No – following completion of works, surface conditions will be returned to as close as possible original condition.

Operation phase assessment
No

Will the project potentially alter soil composition / chemistry?

Construction phase assessment
No

Operation phase assessment
Dependant on preferred option.

Table 2 Water and drainage

Will the project potentially impact a waterway (natural or constructed) or groundwater? and/or
Will the project potentially impact an area administered by Water NSW (formerly Sydney Catchment Authority)?
(If no, move to next section. If yes, answer remaining questions in this section)

Construction phase:
Dependant on preferred option. – construction would occur over the island including areas in close proximity to the shores and local drainage (creeks) on the Island.

Operation phase:
Dependant on preferred option. – operations have a potential to impact the surrounding waterway and local drainage (creeks) on the Island.

Is any part of the project within 40m of a waterbody or located in a floodplain?

Construction phase assessment
Yes – construction would occur over the island including areas in close proximity to the shores and local drainage (creeks) on the Island.

Operation phase assessment
Yes

Is any part of the project located on the bank or bed of a natural watercourse?

Construction phase assessment
Yes – sections of work would be near the shores of the island and local drainage (creeks) on the Island.

Operation phase assessment
Yes – as above.

Will the project require diversion of creeks or watercourses?

Construction phase assessment
No

Operation phase assessment
No

Will the project permanently change surface drainage patterns?

Construction phase assessment
No – surface conditions are to be returned to previous conditions following completion of works.

Operation phase assessment
No

Will the project permanently change surface slope or topography?

Construction phase assessment
No – surface conditions are to be returned to previous conditions following completion of works.

Operation phase assessment

No

Will the project require the use or storage of fuels or other chemicals?

Construction phase assessment
Yes

Operation phase assessment
Dependant on preferred option.

Will the project potentially impact a Water Catchment Area administered by Water NSW?
(check Water NSW (SCA maps) – Water NSW website)

Construction phase assessment
If yes, contact Water NSW to determine assessment requirements
No

Operation phase assessment
If yes, contact Water NSW to determine assessment requirements
No

Will the project potentially impact the water quality of recreational or commercial fishing or aquaculture areas (including oyster leases)?
(check NSW DPI Fishing information - https://www.dpi.nsw.gov.au/fishing)

Construction phase assessment
No

Operation phase assessment
Dependant on preferred option.

Will the project interact with groundwater?
(check NSW groundwater and bore log data – https://realtimedata.waternsw.com.au/water.stm)

Construction phase assessment
If yes, can the works be classified as 'minimal impact activity' as per the *Aquifer Interference Policy?* *(http://www.water.nsw.gov.au/__data/assets/pdf_file/0004/549175/nsw_aquifer_interference_policy.pdf)*
No

Operation phase assessment
If yes, can the works be classified as 'minimal impact activity' as per the *Aquifer Interference Policy?* *(http://www.water.nsw.gov.au/__data/assets/pdf_file/0004/549175/nsw_aquifer_interference_policy.pdf)*
No

Table 3 Flora and fauna

Will the project potentially impact native vegetation, native fauna or habitat
(check Biodiversity Conservation Act 2016, National Parks and Wildlife Act 1974, Local Land Services Act 2013)
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase:
Dependant on preferred option. – it is likely that the project will require clearing of native vegetation.

Operation phase:
Dependant on preferred option.

Will the project potentially impact:

- A declared Ramsar wetland? (http://www.environment.gov.au/epbc/what-is-protected/wetlands)
- A wetland protected by State Environmental Planning Policy (Coastal Management) 2018? (http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP_CoastalManagement)

- A wetland of national importance? (http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf)

Construction phase assessment

No

Operation phase assessment

No

Will the project impact any National Park or reserves administered by the NSW Office of Environment and Heritage or land subject to a Conservation Agreement under the National Parks and Wildlife Act 1974 (NPW ACT)?

(Check NPWS data - **https://www.nationalparks.nsw.gov.au/visit-a-park**)

Construction phase assessment

No

Operation phase assessment

No

Will the works impact any threatened species / populations, ecological communities, critical habitat, Coastal Saltmarsh, or migratory species listed in:

- The NSW BioNet Atlas? (http://www.bionet.nsw.gov.au/)
- The EPBC Act 1999 (http://www.environment.gov.au/epbc/protected-matters-search-tool)
- Fisheries Management Act 1994 (https://www.dpi.nsw.gov.au/fishing/threatened-species)
- Biodiversity Conservation Act 2016

Construction phase assessment

Potentially – Scotland Island vegetation is mapped as being an endangered ecological community.

Operation phase assessment

Dependant on preferred option.

Does the project involve Key Threatening Processes? Check:

- Department of Environment and Energy Species Profile and Threats Database? (http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl)
- Biodiversity Conservation Act 2016 (terrestrial flora/fauna and freshwater vegetation)
- Fisheries Management Act 1994 (marine vegetation and fish)

Construction phase assessment

Potentially – clearing of native vegetation may be required during construction.

Operation phase assessment

Dependant on preferred option.

Will the works impact any other legally protected terrestrial, marine or aquatic habitats (e.g. urban bushland, riparian zones, marine parks)? Check –

- Koala habitat (SEPP 44)
- urban bushland (SEPP 19)
- State Environmental Planning Policy (Coastal Management) 2018
- LEP(s)
- aquatic reserves protected under the FM Act? Check: Marine Parks map - https://www.dpi.nsw.gov.au/fishing/marine-protected-areas

Construction phase assessment

Potentially – construction may affect coastal areas according to the Coastal Management SEPP 2018. Additionally, if a pipeline crossing Pittwater is adopted, there is potential for impact to fish and fish habitat.

Operation phase assessment

Dependant on preferred option.

Will the project require clearing noxious or environmental weeds?
(check LGA for list of weeds and weed control/management)

Construction phase assessment
Yes – a site visit confirmed that noxious weeds are widespread across the Island.

Operation phase assessment
No

Table 4 Air

Will the project potentially cause odour, dust or other air pollution
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase:
Potentially – it is expected that construction works would generate dust.

Operation phase:
Dependant on preferred option.

Is the project likely to impact sensitive receivers?

Construction phase assessment
Yes – construction would occur in order to service the residents of the island; therefore, the work would be in close proximity to residential properties.

Operation phase assessment
Dependant on preferred option.

Are there any existing air pollution sources in the vicinity?
Check – National Pollution Inventory (http://www.npi.gov.au/)

The nearest existing air pollution source is the Warriewood Sewage Treatment Plant, located approximately 7 km south from the island.

Table 5 Waste and hazardous materials

Will the project require disturbance and/or disposal of hazardous waste or hazardous building materials (HBM) (eg lead, asbestos, PCB or other substance designated as hazardous)?

Construction phase assessment:
Possible – it is not anticipated that any hazardous materials would be encountered during works.

Operation phase assessment:
No

Will the project potentially require disturbance of asbestos containing materials?

Construction phase assessment
Potentially

Operation phase assessment
No

Table 6 Aboriginal Heritage

Are there any registered Aboriginal heritage objects or declared Aboriginal places within 200m of the project area?
Check - OEH's Aboriginal Heritage Information System
(https://www.environment.nsw.gov.au/licences/AboriginalHeritageInformationManagementSystem.htm)

Yes – an AHIMS search result confirms that there are two Aboriginal sites recorded in the area. Refer to **Appendix D**.

Aboriginal high-risk landscapes

Is the work in a high risk landscape containing features that indicate the likely presence of Aboriginal objects.

Areas that have high archaeological potential are:

1. within 200m of waters
2. in a sand dune system
3. on a ridge top, ridge line or headland (turn on contours)
4. within 200m below or above a cliff face
5. within 20m of or in a cave, rock shelter or cave mouth

Aboriginal culturally modified trees (scarred trees)

Are there any Aboriginal culturally modified trees within 200 metres of the project area?

Non-listed

World, National and Commonwealth Heritage Significance

Could the works affect any world heritage properties, or places on the National Heritage List or Commonwealth Heritage List?

Check:

- Department of Environment and Energy website (http://www.environment.gov.au/epbc/what-is-protected/world-heritage)
- Australian Heritage Database (http://www.environment.gov.au/cgi-bin/ahdb/search.pl)

No – there are no places listed on Scotland Island.

Table 7 Non-Aboriginal Heritage

Is the project located within an area of high archaeological potential (non-Aboriginal, as covered by the relics provision of the Heritage Act 1977)?

Areas of high archaeological potential are areas that have a high likelihood of containing significant archaeological remains in high concentrations.

Examples of areas/towns of high archaeological potential are:

- Central Sydney (CBD)
- The Rocks and Millers Point
- Ultimo/Pyrmont
- Parramatta CBD
- Liverpool CBD
- Richmond
- Windsor
- Castlereagh
- Pitt Town
- Wilberforce
- Blue Mountains (early townships, convict stockades and access roads/tracks, like Cox's Rd)

Check:

- Australian Heritage Database (http://www.environment.gov.au/cgi-bin/ahdb/search.pl)

No

State and Local Heritage significance

Could the project affect any locally or state listed items of State or Local Heritage significance including excavation within their curtilage? Are the works in a heritage conservation area?

Check - LEPs, SEPPs, SREPs and the State Heritage Inventory

No – there are no listed heritage items on the island.

Table 8 Noise and vibration

Will the project generate noise and/or vibration that has the potential to impact receivers?
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase:
Potentially – construction works will generate noise and minimal vibration.

Operation phase:
Dependant on preferred option.

Will the project result in permanent changes to background noise?

No

Are the works likely to exceed noise criteria in the:

- Industrial Noise Policy (https://www.environment.nsw.gov.au/resources/noise/ind_noise.pdf) or
- Interim Construction Noise Guideline (https://www.environment.nsw.gov.au/resources/noise/09265cng.pdf)

Construction phase assessment
No

Operation phase assessment
No

Does noise or vibration generated by the project have the potential to impact sensitive receivers? (such as schools/ other education institutions/, hospitals, nursing homes, places of worship, residential properties or important native fauna populations)?

Construction phase assessment
Potentially – construction works will be in the vicinity of residential properties.

Operation phase assessment
No

Table 9 Traffic and access

Will the project potentially impact traffic or access to property?
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase assessment:
Potentially – property access may be impacted, depending on construction methods.

Operation phase assessment:
No

Will the project involve partial or complete road closures?

Construction phase assessment
Potentially – roads may need to be closed during construction.

Operation phase assessment

No

Will the project affect access to private property?

Construction phase assessment

Potentially – the purpose of the project is to connect the islands population to upgraded water and sewer facilities which will involve property connections.

Operation phase assessment

No

Will the project reduce parking availability?

Construction phase assessment

Potentially – during construction roads may need to be closed therefore reducing street parking, if available.

Operation phase assessment

No

Will the project generate additional traffic?

Construction phase assessment

Potentially – construction workers driving to and from work sites as well as construction machinery will generate additional traffic.

Operation phase assessment

No

Will the project require alterations to road networks?

Construction phase assessment

No – it is not anticipated at this stage.

Operation phase assessment

No

Table 10 Land use, social and visual

Will the project potentially change the land use or visual character of the environment?
(eg installation of above-ground structures, construction of new access roads)
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase assessment:

Potentially – during construction the visual character of the environment would be temporarily impacted via excavations and construction works. Surface conditions are expected to be returned to pre-construction conditions following completion of works.

Operation phase assessment:

Dependant on preferred option.

Will the project affect the use of community recreation areas?

Construction phase assessment

Potentially – construction works may restrict access to recreation areas for a temporary period of time.

Operation phase assessment

Dependant on preferred option.

Will the project impact commercial use?

Construction phase assessment

Potentially – construction may impact a number of businesses where property access may be affected.

Operation phase assessment
No

Will the project disrupt existing services / utilities?

Construction phase assessment
No

Operation phase assessment
No

Is the project located within land managed or regulated by a government authority?

Construction phase assessment
No

Operation phase assessment
No

Is the project located within land owned by the Commonwealth or has the potential to impact Commonwealth land?

Construction phase assessment
No

Operation phase assessment
No

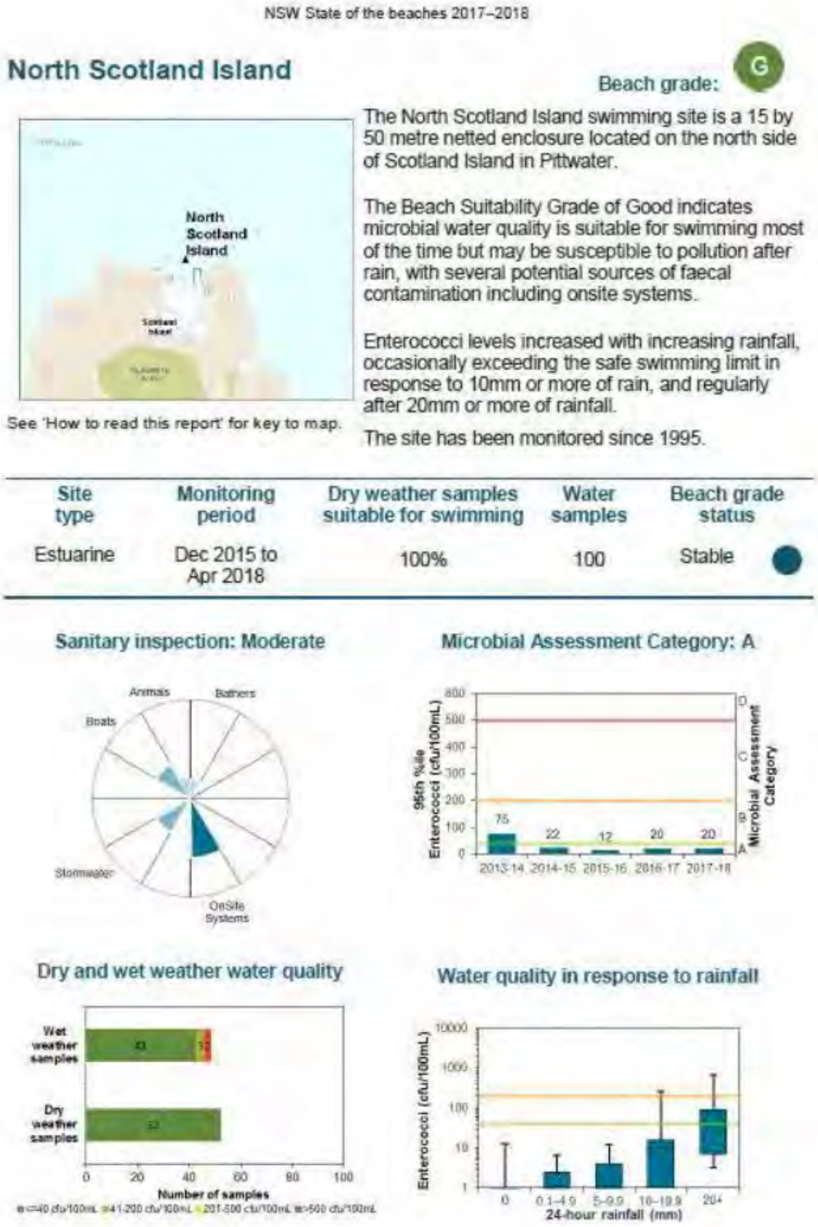
Table 11 Cumulative impacts

Will the project potentially contribute to adverse environmental impacts on receivers from other development / projects in the area?
(if no, move to next section. If yes, answer remaining questions in this section)

Construction phase assessment:
No

Operation phase assessment:
No

Appendix B State of the beaches 2017-2018 Sydney Region



NSW State of the beaches 2017–2018

North Scotland Island

Beach grade: G

See 'How to read this report' for key to map.

The North Scotland Island swimming site is a 15 by 50 metre netted enclosure located on the north side of Scotland Island in Pittwater.

The Beach Suitability Grade of Good indicates microbial water quality is suitable for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including onsite systems.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10mm or more of rain, and regularly after 20mm or more of rainfall.

The site has been monitored since 1995.

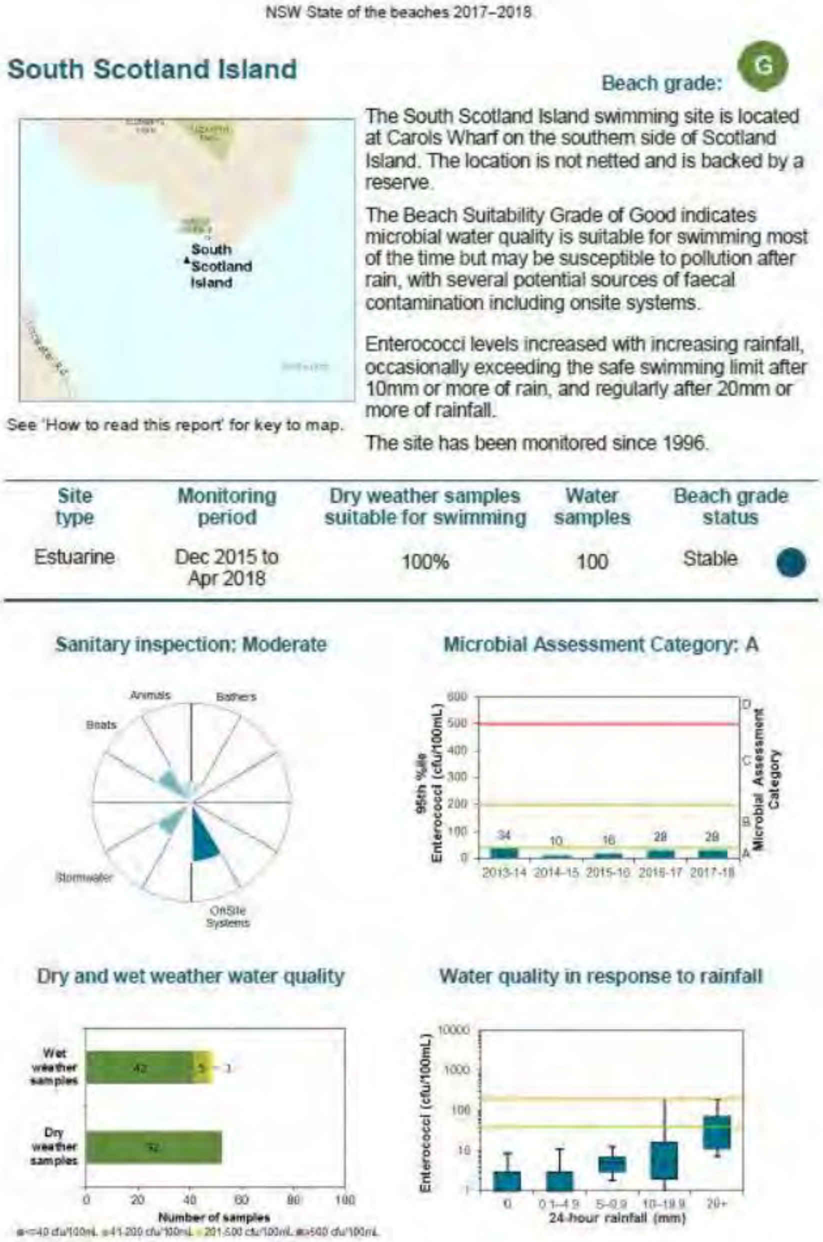
Site type	Monitoring period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2015 to Apr 2018	100%	100	Stable ●

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall



NSW State of the beaches 2017–2018

South Scotland Island

Beach grade: G

See 'How to read this report' for key to map.

The South Scotland Island swimming site is located at Carols Wharf on the southern side of Scotland Island. The location is not netted and is backed by a reserve.

The Beach Suitability Grade of Good indicates microbial water quality is suitable for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination including onsite systems.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after 10mm or more of rain, and regularly after 20mm or more of rainfall.

The site has been monitored since 1996.

Site type	Monitoring period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Estuarine	Dec 2015 to Apr 2018	100%	100	Stable ●

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall

Appendix C Site photographs

Weeds in the vicinity of Catherine Park.

Weeds in the vicinity of Kevin Avenue.

Typical roadside drainage.

Example of rainwater storage arrangements.

Example of rainwater storage arrangements.

Appendix D Lotsearch results

LOTSEARCH

LOTSEARCH ENVIRO PROFESSIONAL

Date: 28 Nov 2018 12:34:59

Reference: Sample EP

Address: Scotland Island, Pittwater, NSW 2105

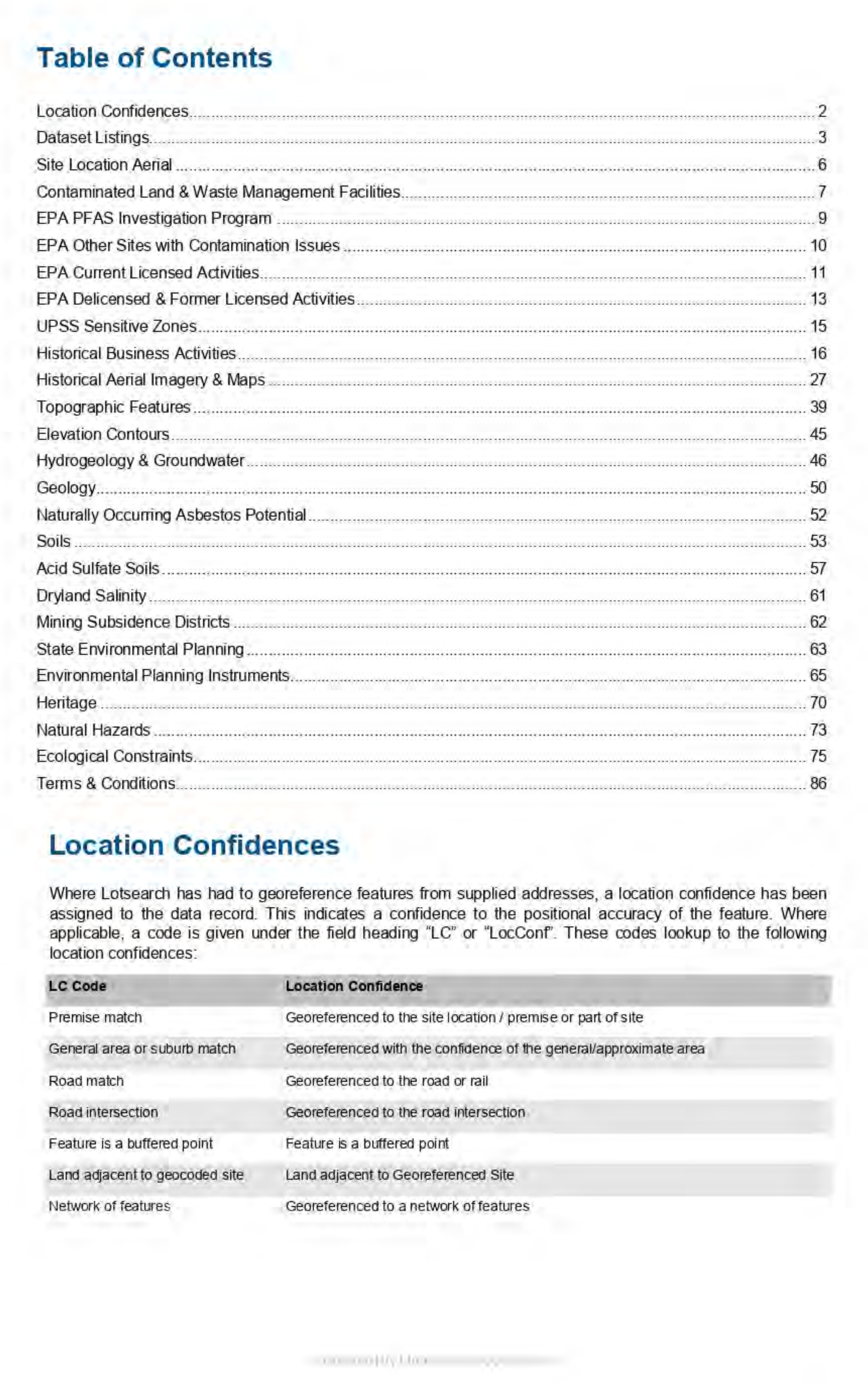


Table of Contents

Location Confidences

Where Lotsearch has had to georeference features from supplied addresses, a location confidence has been assigned to the data record. This indicates a confidence to the positional accuracy of the feature. Where applicable, a code is given under the field heading "LC" or "LocConf". These codes lookup to the following location confidences:

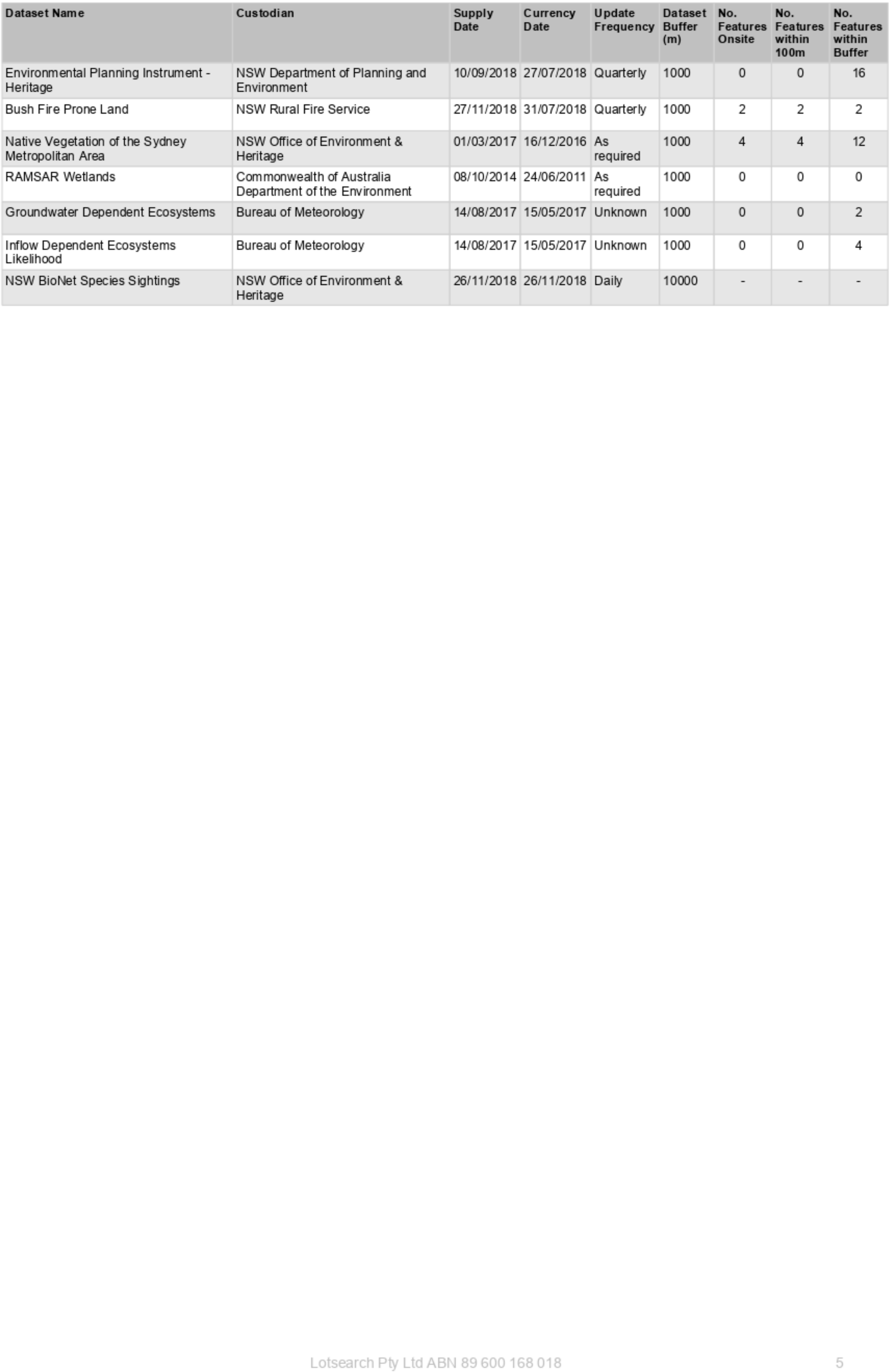
LC Code	Location Confidence
Premise match	Georeferenced to the site location / premise or part of site
General area or suburb match	Georeferenced with the confidence of the general/approximate area
Road match	Georeferenced to the road or rail
Road intersection	Georeferenced to the road intersection
Feature is a buffered point	Feature is a buffered point
Land adjacent to geocoded site	Land adjacent to Georeferenced Site
Network of features	Georeferenced to a network of features

Dataset Listing

Datasets contained within this report, detailing their source and data currency:

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Cadastre Boundaries	Dept. Finance, Services & Innovation	28/11/2018	28/11/2018	Daily	-	-	-	-
Topographic Data	Dept. Finance, Services & Innovation	17/07/2018	17/07/2018	As required	-	-	-	-
List of NSW contaminated sites notified to EPA	Environment Protection Authority	19/11/2018	19/11/2018	Monthly	1000	0	0	0
Contaminated Land Records of Notice	Environment Protection Authority	13/11/2018	13/11/2018	Monthly	1000	0	0	0
Former Gasworks	Environment Protection Authority	06/11/2018	06/11/2018	Monthly	1000	0	0	0
National Waste Management Facilities Database	Geoscience Australia	06/11/2018	07/03/2017	Quarterly	1000	0	0	0
EPA PFAS Investigation Program	Environment Protection Authority	06/11/2018	06/11/2018	Monthly	2000	0	0	0
EPA Other Sites with Contamination Issues	Environment Protection Authority	11/01/2018	11/01/2018	As required	1000	0	0	0
Licensed Activities under the POEO Act 1997	Environment Protection Authority	27/11/2018	27/11/2018	Monthly	1000	0	0	2
Delicensed POEO Activities still Regulated by the EPA	Environment Protection Authority	27/11/2018	27/11/2018	Monthly	1000	0	0	0
Former POEO Licensed Activities now revoked or surrendered	Environment Protection Authority	27/11/2018	27/11/2018	Monthly	1000	3	3	4
UPSS Environmentally Sensitive Zones	Environment Protection Authority	14/04/2015	12/01/2010	As required	1000	1	1	1
UBD Business to Business Directory 1991 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business to Business Directory 1991 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business to Business Directory 1986 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business to Business Directory 1986 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1982 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1982 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1978 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1978 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1975 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1975 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1970 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1970 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1965 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1965 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1961 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1961 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1950 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1950 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
UBD Business Directory Drycleaners & Motor Garages/Service Stations (Premise & Intersection Matches)	Hardie Grant			Not required	500	0	0	1
UBD Business Directory Drycleaners & Motor Garages/Service Stations (Road & Area Matches)	Hardie Grant			Not required	500	-	0	0
Points of Interest	Dept. Finance, Services & Innovation	12/10/2018	12/10/2018	Quarterly	1000	20	20	104
Tanks (Areas)	Dept. Finance, Services & Innovation	15/10/2018	15/10/2018	Quarterly	1000	0	0	0
Tanks (Points)	Dept. Finance, Services & Innovation	15/10/2018	15/10/2018	Quarterly	1000	0	0	1
Major Easements	Dept. Finance, Services & Innovation	12/10/2018	12/10/2018	Quarterly	1000	1	6	7
State Forest	Dept. Finance, Services & Innovation	18/01/2018	18/01/2018	As required	1000	0	0	0
NSW National Parks and Wildlife Service Reserves	NSW Office of Environment & Heritage	18/01/2018	30/09/2017	Annually	1000	0	0	1
Hydrogeology Map of Australia	Commonwealth of Australia (Geoscience Australia)	08/10/2014	17/03/2000	As required	1000	0	1	1
Botany Groundwater Management Zones	NSW Department of Primary Industries	15/03/2018	01/10/2005	As required	1000	0	0	0
Groundwater Boreholes	NSW Dept. of Primary Industries - Water NSW; Commonwealth of Australia (Bureau of Meteorology)	24/07/2018	23/07/2018	Annually	2000	1	1	11
Geological Units 1:100,000	NSW Dept. of Industry, Resources & Energy	20/08/2014		None planned	1000	3	-	4
Geological Structures 1:100,000	NSW Dept. of Industry, Resources & Energy	20/08/2014		None planned	1000	0	-	2
Naturally Occurring Asbestos Potential	NSW Dept. of Industry, Resources & Energy	04/12/2015	24/09/2015	Unknown	1000	0	0	0
Soil Landscapes	NSW Office of Environment & Heritage	12/08/2014		None planned	1000	3	-	6
Atlas of Australian Soils	CSIRO	19/05/2017	17/02/2011	As required	1000	0	0	2
Environmental Planning Instrument - Acid Sulfate Soils	NSW Department of Planning and Environment	23/10/2018	12/10/2018	As required	500	2	-	-
Atlas of Australian Acid Sulfate Soils	CSIRO	19/01/2017	21/02/2013	As required	1000	1	1	3
Dryland Salinity - National Assessment	National Land and Water Resources Audit	18/07/2014	12/05/2013	None planned	1000	0	0	0
Dryland Salinity Potential of Western Sydney	NSW Office of Environment & Heritage	12/05/2017	01/01/2002	None planned	1000	-	-	-
Mining Subsidence Districts	Dept. Finance, Services & Innovation	13/07/2017	01/07/2017	As required	1000	0	0	0
SEPP 14 - Coastal Wetlands	NSW Planning and Environment	17/12/2015	24/10/2008	Annually	1000	0	0	0
SEPP 26 - Littoral Rainforest	NSW Planning and Environment	17/12/2015	05/02/1988	Annually	1000	0	0	0
SEPP 71 - Coastal Protection	NSW Planning and Environment	17/12/2015	01/08/2003	Annually	1000	1	1	1
SEPP Major Developments 2005	NSW Planning and Environment	09/03/2013	25/05/2005	Under Review	1000	0	0	0
SEPP Strategic Land Use Areas	NSW Planning and Environment	01/08/2017	28/01/2014	Annually	1000	0	0	0
EPI - Land Zoning	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	1000	4	5	76
EPI - Minimum Lot Size	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	0	1	-	-
EPI - Height of Buildings	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	0	1	-	-
EPI - Floor Space Ratio	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	0	0	-	-
EPI - Land Application	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	0	1	-	-
EPI - Land Reservation Acquisition	NSW Planning and Environment	23/10/2018	12/10/2018	Quarterly	0	0	-	-
State Heritage Register - Curtilages	NSW Office of Environment & Heritage	18/10/2018	19/01/2018	Quarterly	1000	0	0	0

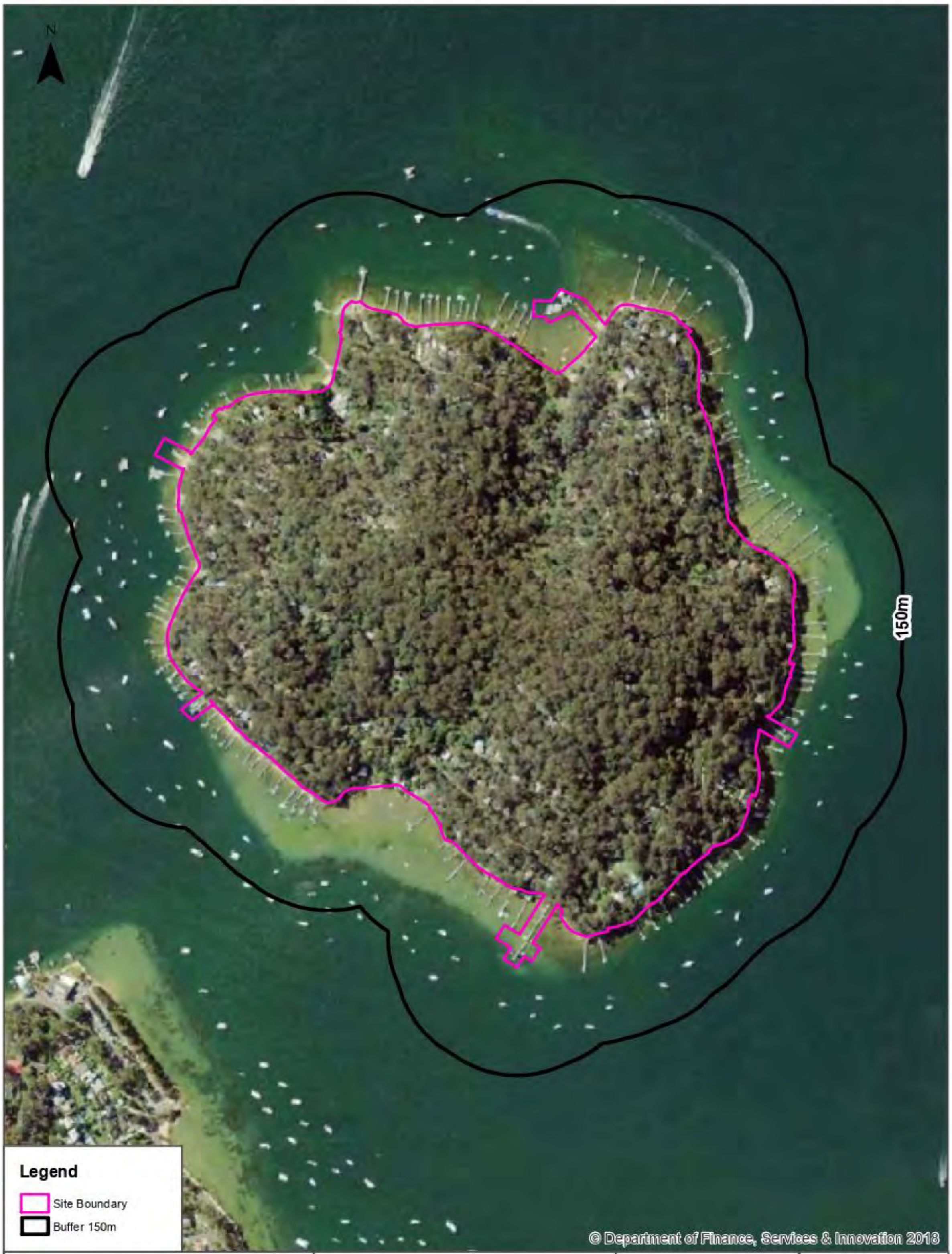


Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Environmental Planning Instrument - Heritage	NSW Department of Planning and Environment	10/09/2018	27/07/2018	Quarterly	1000	0	0	16
Bush Fire Prone Land	NSW Rural Fire Service	27/11/2018	31/07/2018	Quarterly	1000	2	2	2
Native Vegetation of the Sydney Metropolitan Area	NSW Office of Environment & Heritage	01/03/2017	16/12/2016	As required	1000	4	4	12
RAMSAR Wetlands	Commonwealth of Australia Department of the Environment	08/10/2014	24/06/2011	As required	1000	0	0	0
Groundwater Dependent Ecosystems	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	0	0	2
Inflow Dependent Ecosystems Likelihood	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	0	0	4
NSW BioNet Species Sightings	NSW Office of Environment & Heritage	26/11/2018	26/11/2018	Daily	10000	-	-	-

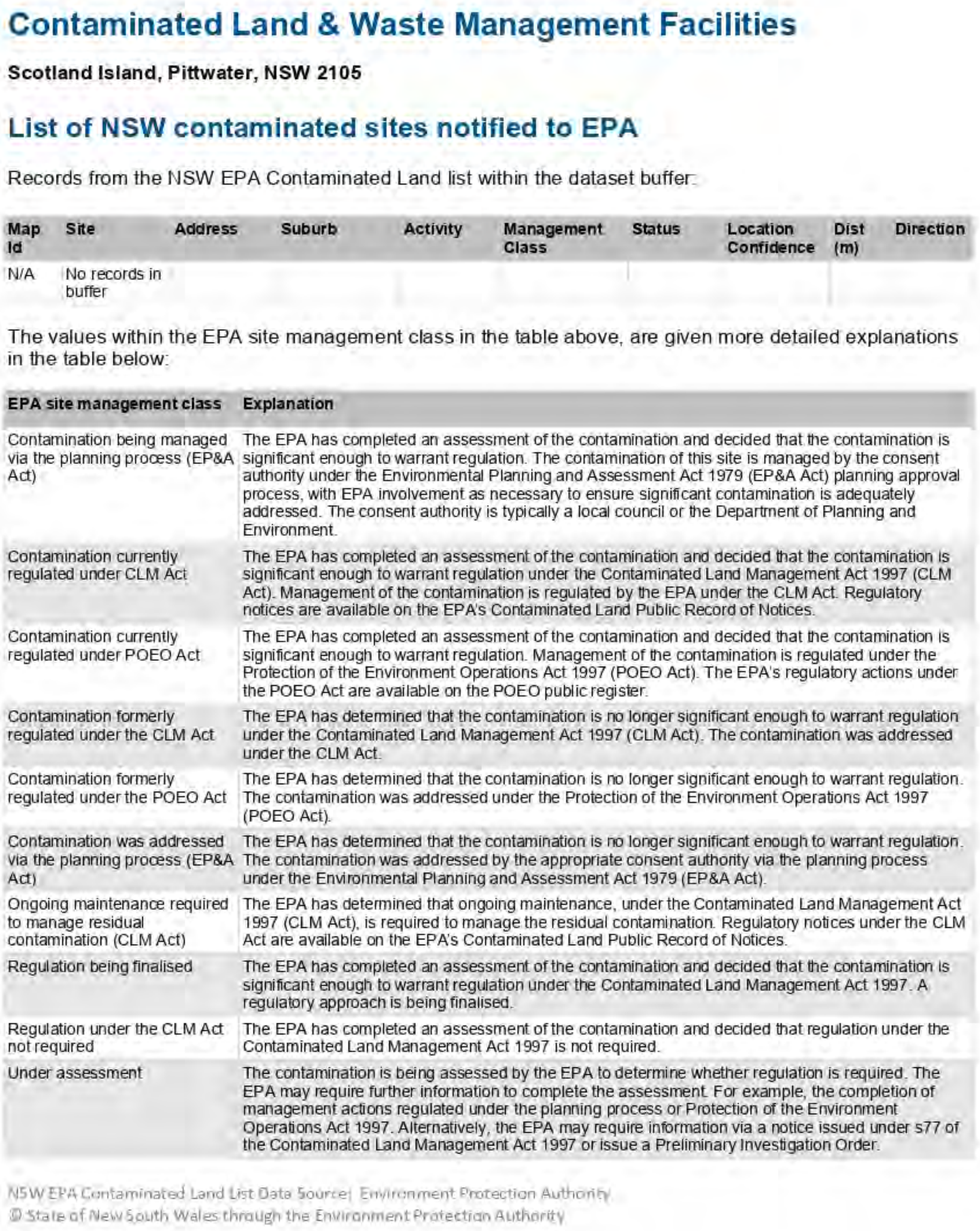
Lotsearch Pty Ltd ABN 89 600 168 018 5

Aerial Imagery 2018

Scotland Island, Pittwater, NSW 2105



Scale: 0 50 100 200 300 Meters	Data Sources: Aerial Imagery © Department Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018



Contaminated Land & Waste Management Facilities

Scotland Island, Pittwater, NSW 2105

List of NSW contaminated sites notified to EPA

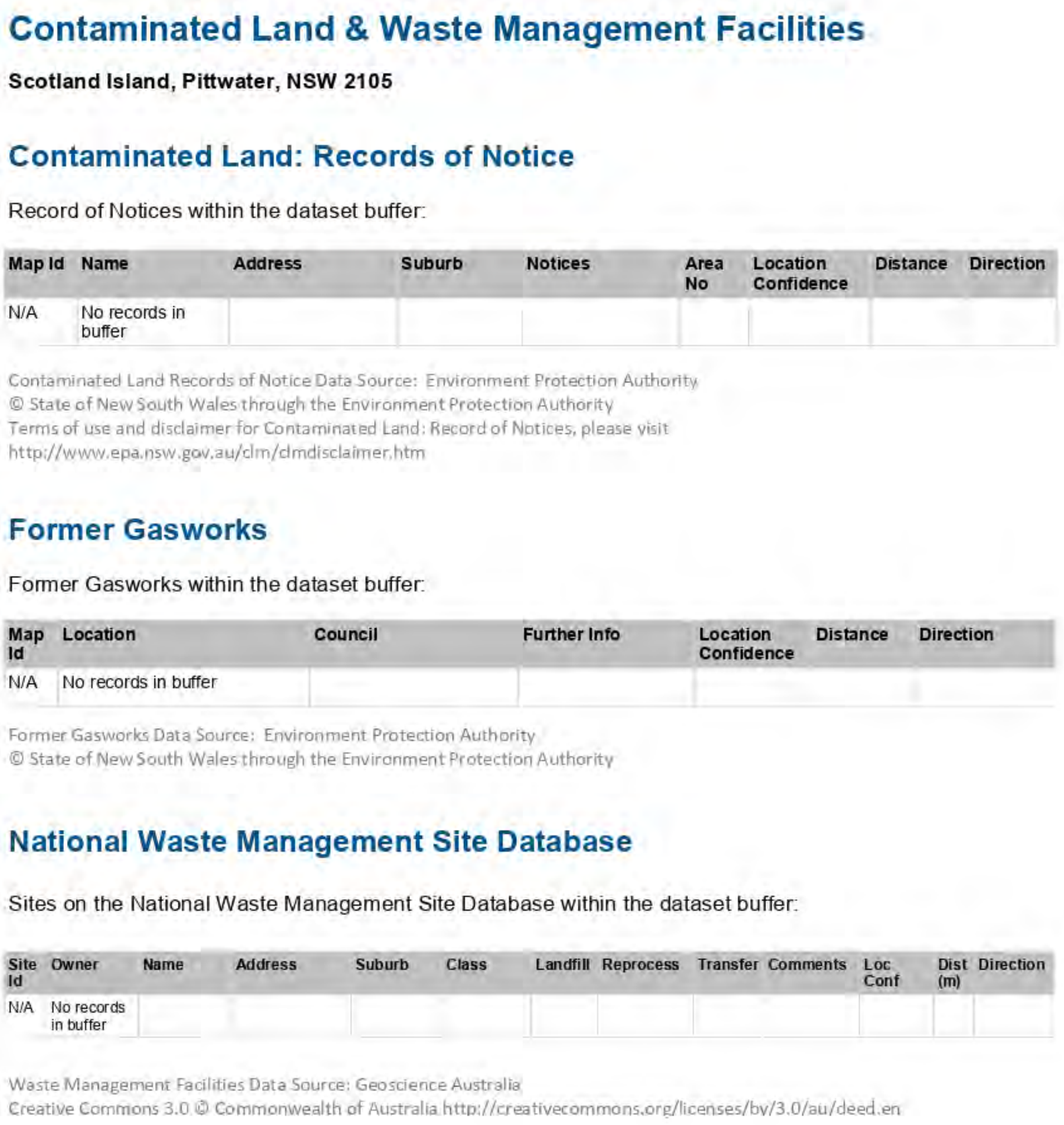
Records from the NSW EPA Contaminated Land list within the dataset buffer:

Map Id	Site	Address	Suburb	Activity	Management Class	Status	Location Confidence	Dist (m)	Direction
N/A	No records in buffer								

The values within the EPA site management class in the table above, are given more detailed explanations in the table below:

EPA site management class	Explanation
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the Environmental Planning and Assessment Act 1979 (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record of Notices.
Contamination currently regulated under POEO Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. Management of the contamination is regulated under the Protection of the Environment Operations Act 1997 (POEO Act). The EPA's regulatory actions under the POEO Act are available on the POEO public register.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the Protection of the Environment Operations Act 1997 (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the Environmental Planning and Assessment Act 1979 (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the Contaminated Land Management Act 1997 (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record of Notices.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997. A regulatory approach is being finalised.
Regulation under the CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the Contaminated Land Management Act 1997 is not required.
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or Protection of the Environment Operations Act 1997. Alternatively, the EPA may require information via a notice issued under s77 of the Contaminated Land Management Act 1997 or issue a Preliminary Investigation Order.

NSW EPA Contaminated Land List Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority



Contaminated Land & Waste Management Facilities

Scotland Island, Pittwater, NSW 2105

Contaminated Land: Records of Notice

Record of Notices within the dataset buffer:

Map Id	Name	Address	Suburb	Notices	Area No	Location Confidence	Distance	Direction
N/A	No records in buffer							

Contaminated Land Records of Notice Data Source: Environment Protection Authority

Former Gasworks

Former Gasworks within the dataset buffer:

Map Id	Location	Council	Further Info	Location Confidence	Distance	Direction
N/A	No records in buffer					

Former Gasworks Data Source: Environment Protection Authority

National Waste Management Site Database

Sites on the National Waste Management Site Database within the dataset buffer:

Site Id	Owner	Name	Address	Suburb	Class	Landfill	Reprocess	Transfer	Comments	Loc Conf	Dist (m)	Direction
N/A	No records in buffer											

Waste Management Facilities Data Source: Geoscience Australia

EPA PFAS Investigation Program

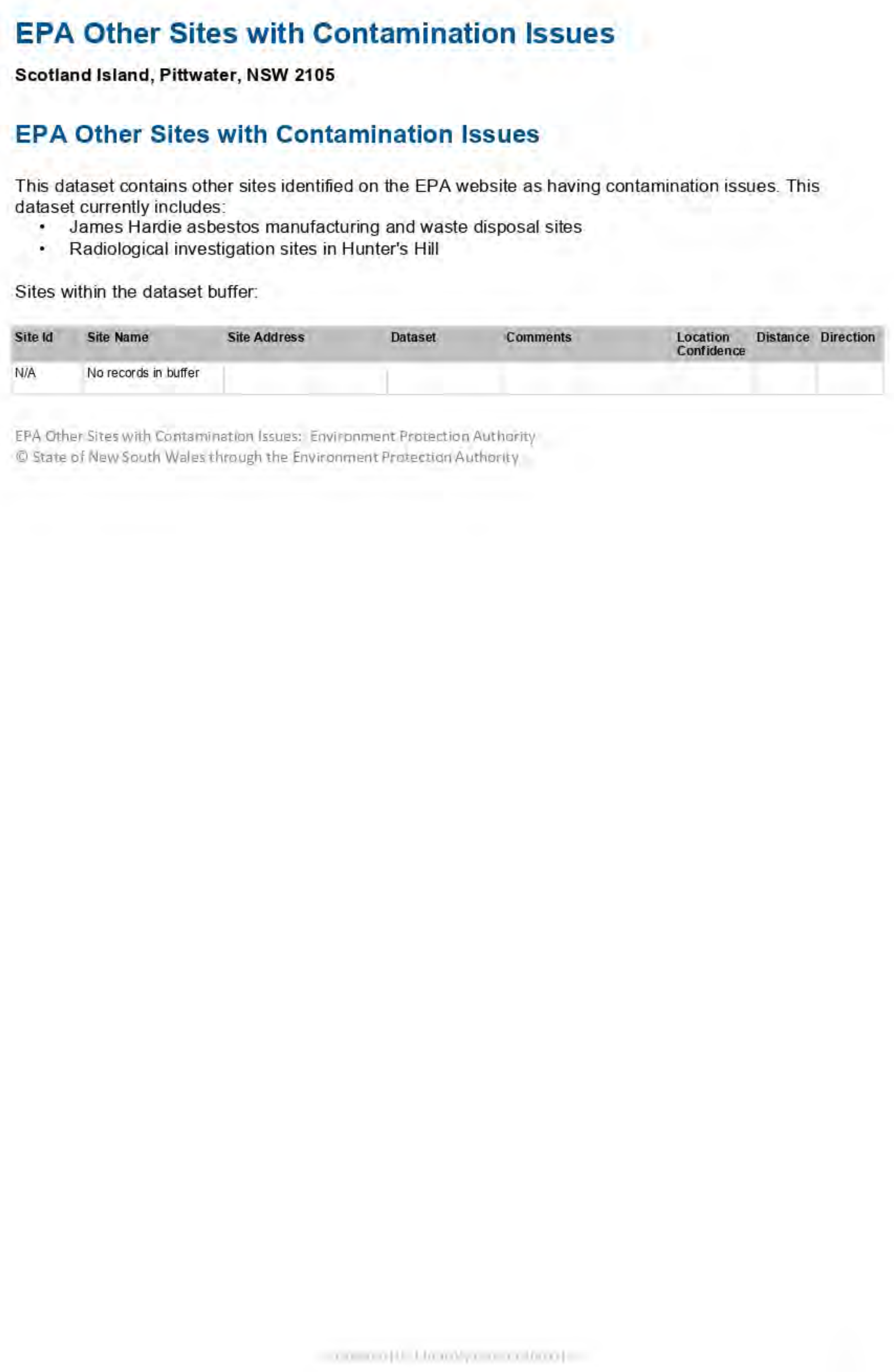
Scotland Island, Pittwater, NSW 2105

EPA PFAS Investigation Program

Sites that are part of the EPA PFAS investigation program, within the dataset buffer:

Id	Site	Address	Location Confidence	Distance	Direction
N/A	No records in buffer				

EPA PFAS Investigation Program: Environment Protection Authority



EPA Other Sites with Contamination Issues

Scotland Island, Pittwater, NSW 2105

EPA Other Sites with Contamination Issues

This dataset contains other sites identified on the EPA website as having contamination issues. This dataset currently includes:

- James Hardie asbestos manufacturing and waste disposal sites
- Radiological investigation sites in Hunter's Hill

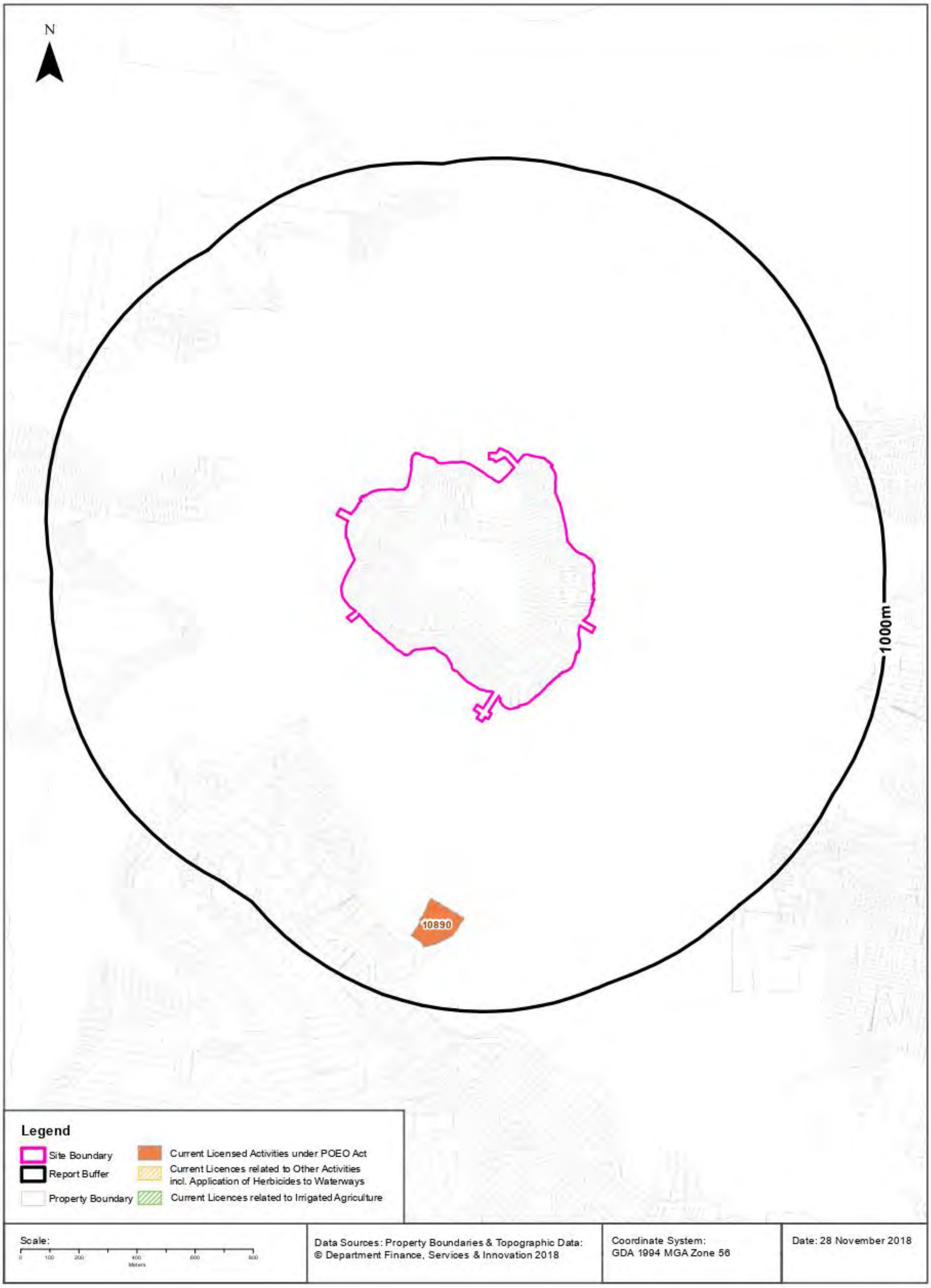
Sites within the dataset buffer:

Site Id	Site Name	Site Address	Dataset	Comments	Location Confidence	Distance	Direction
N/A	No records in buffer						

EPA Other Sites with Contamination Issues: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Current EPA Licensed Activities

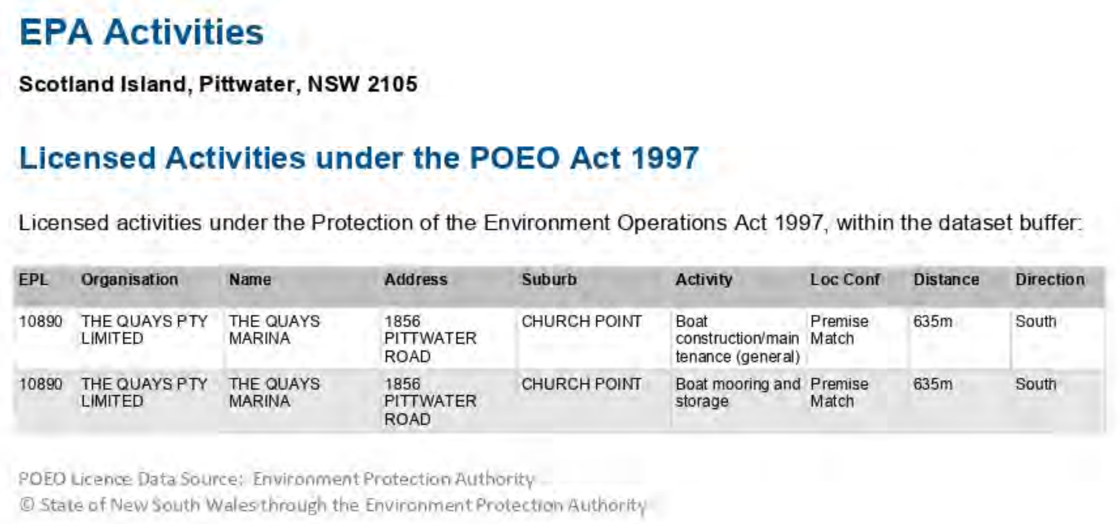
Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data: © Department Finance, Services & Innovation 2018

Coordinate System: GDA 1994 MGA Zone 56

Date: 28 November 2018



EPA Activities

Scotland Island, Pittwater, NSW 2105

Licensed Activities under the POEO Act 1997

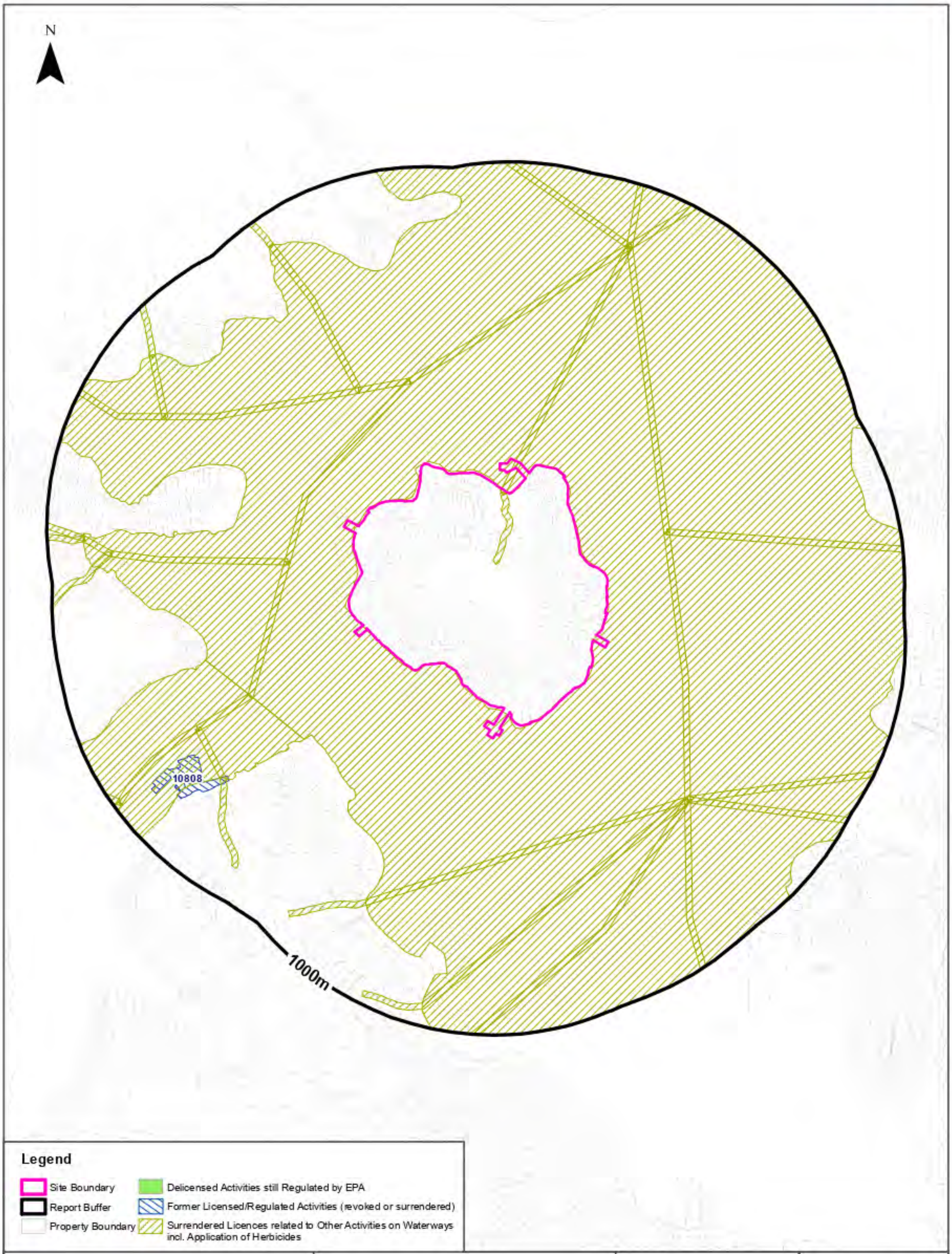
Licensed activities under the Protection of the Environment Operations Act 1997, within the dataset buffer:

EPL	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
10890	THE QUAYS PTY LIMITED	THE QUAYS MARINA	1856 PITTWATER ROAD	CHURCH POINT	Boat construction/maintenance (general)	Premise Match	635m	South
10890	THE QUAYS PTY LIMITED	THE QUAYS MARINA	1856 PITTWATER ROAD	CHURCH POINT	Boat mooring and storage	Premise Match	635m	South

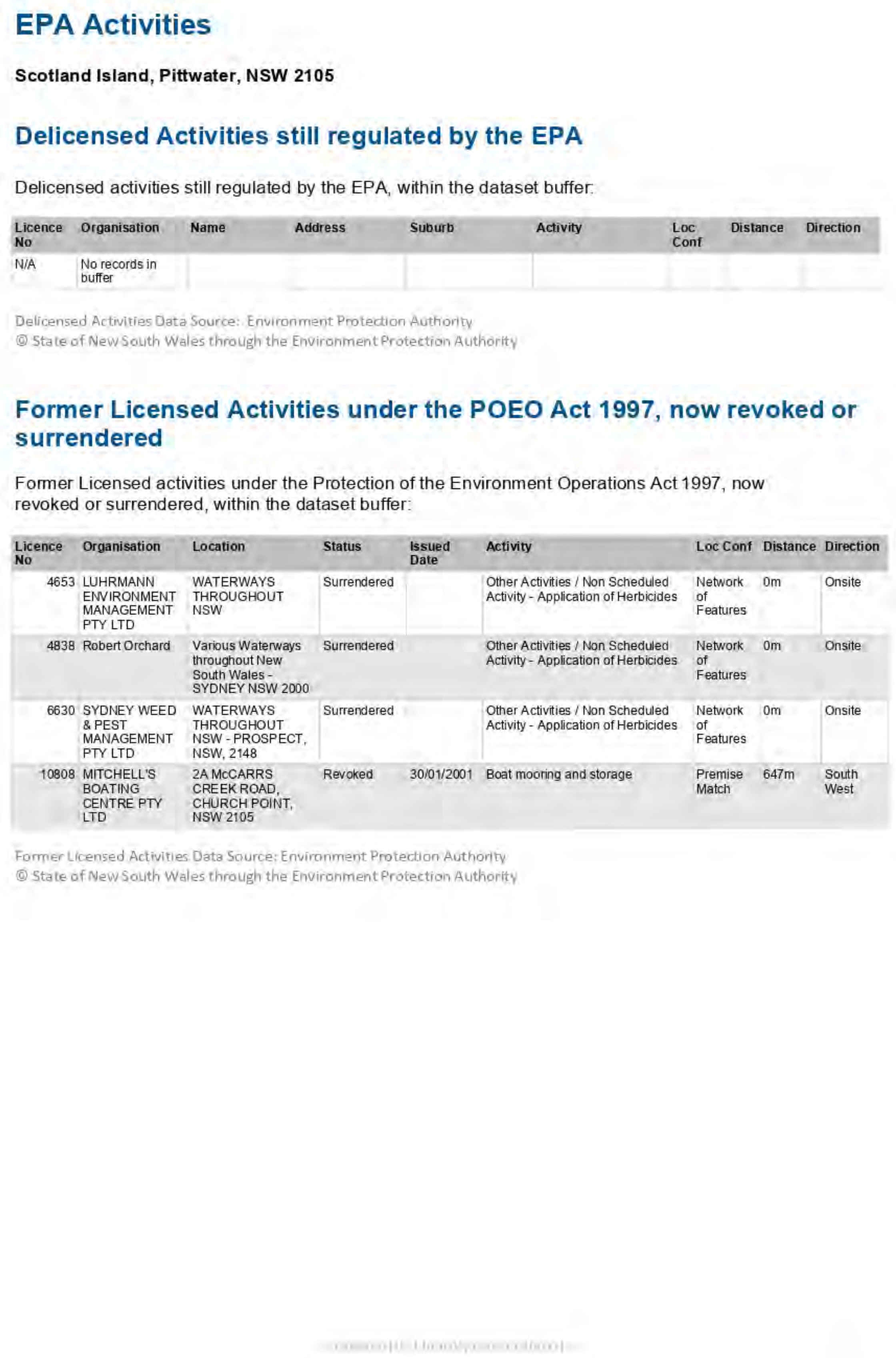
POEO Licence Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Delicensed & Former Licensed EPA Activities

Scotland Island, Pittwater, NSW 2105



Scale: 0 100 200 400 600 800 Meters	Property Boundary Data Source: © Department Finance, Services & Innovation 2018	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018



EPA Activities

Scotland Island, Pittwater, NSW 2105

Delicensed Activities still regulated by the EPA

Delicensed activities still regulated by the EPA, within the dataset buffer:

Licence No	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
N/A	No records in buffer							

Delicensed Activities Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

Former Licensed Activities under the POEO Act 1997, now revoked or surrendered

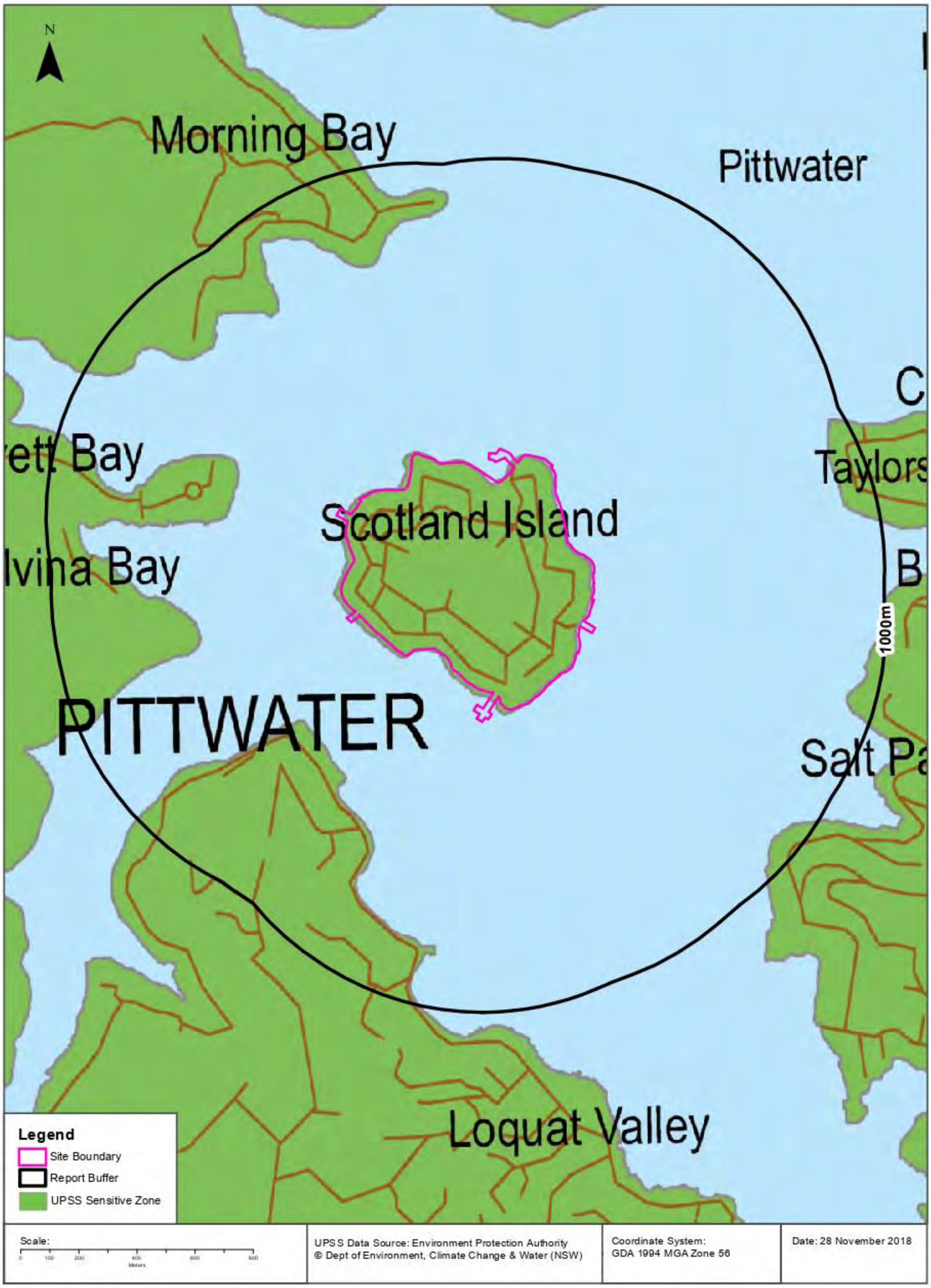
Former Licensed activities under the Protection of the Environment Operations Act 1997, now revoked or surrendered, within the dataset buffer:

Licence No	Organisation	Location	Status	Issued Date	Activity	Loc Conf	Distance	Direction
4653	LUHRMANN ENVIRONMENT MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	Onsite
4838	Robert Orchard	Various Waterways throughout New South Wales - SYDNEY NSW 2000	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	Onsite
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW - PROSPECT, NSW, 2148	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	0m	Onsite
10808	MITCHELL'S BOATING CENTRE PTY LTD	2A McCARRS CREEK ROAD, CHURCH POINT, NSW 2105	Revoked	30/01/2001	Boat mooring and storage	Premise Match	647m	South West

Former Licensed Activities Data Source: Environment Protection Authority
© State of New South Wales through the Environment Protection Authority

UPSS Sensitive Zones

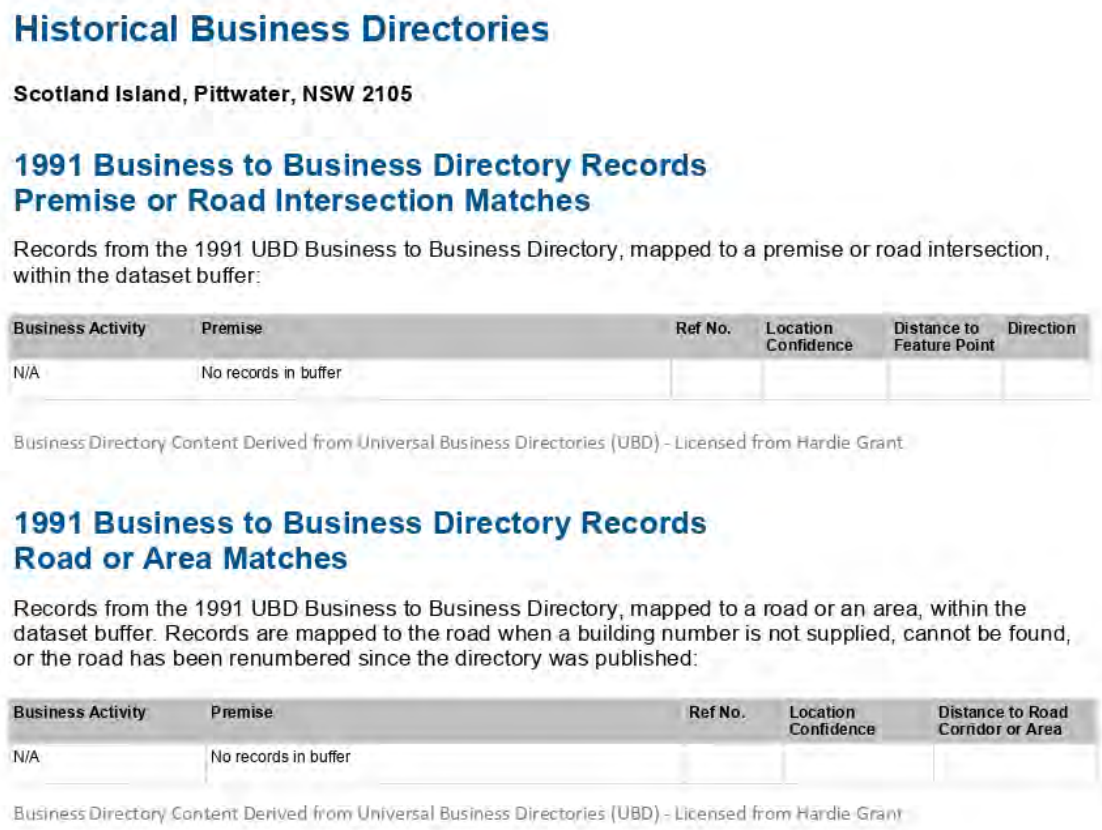
Scotland Island, Pittwater, NSW 2105



UPSS Data Source: Environment Protection Authority
© Dept of Environment, Climate Change & Water (NSW)

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018



Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1991 Business to Business Directory Records Premise or Road Intersection Matches

Records from the 1991 UBD Business to Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1991 Business to Business Directory Records Road or Area Matches

Records from the 1991 UBD Business to Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1986 Business to Business Directory Records Premise or Road Intersection Matches

Records from the 1986 UBD Business to Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1986 Business to Business Directory Records Road or Area Matches

Records from the 1986 UBD Business to Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1982 Business Directory Records Premise or Road Intersection Matches

Records from the 1982 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1982 Business Directory Records Road or Area Matches

Records from the 1982 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1978 Business Directory Records Premise or Road Intersection Matches

Records from the 1978 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

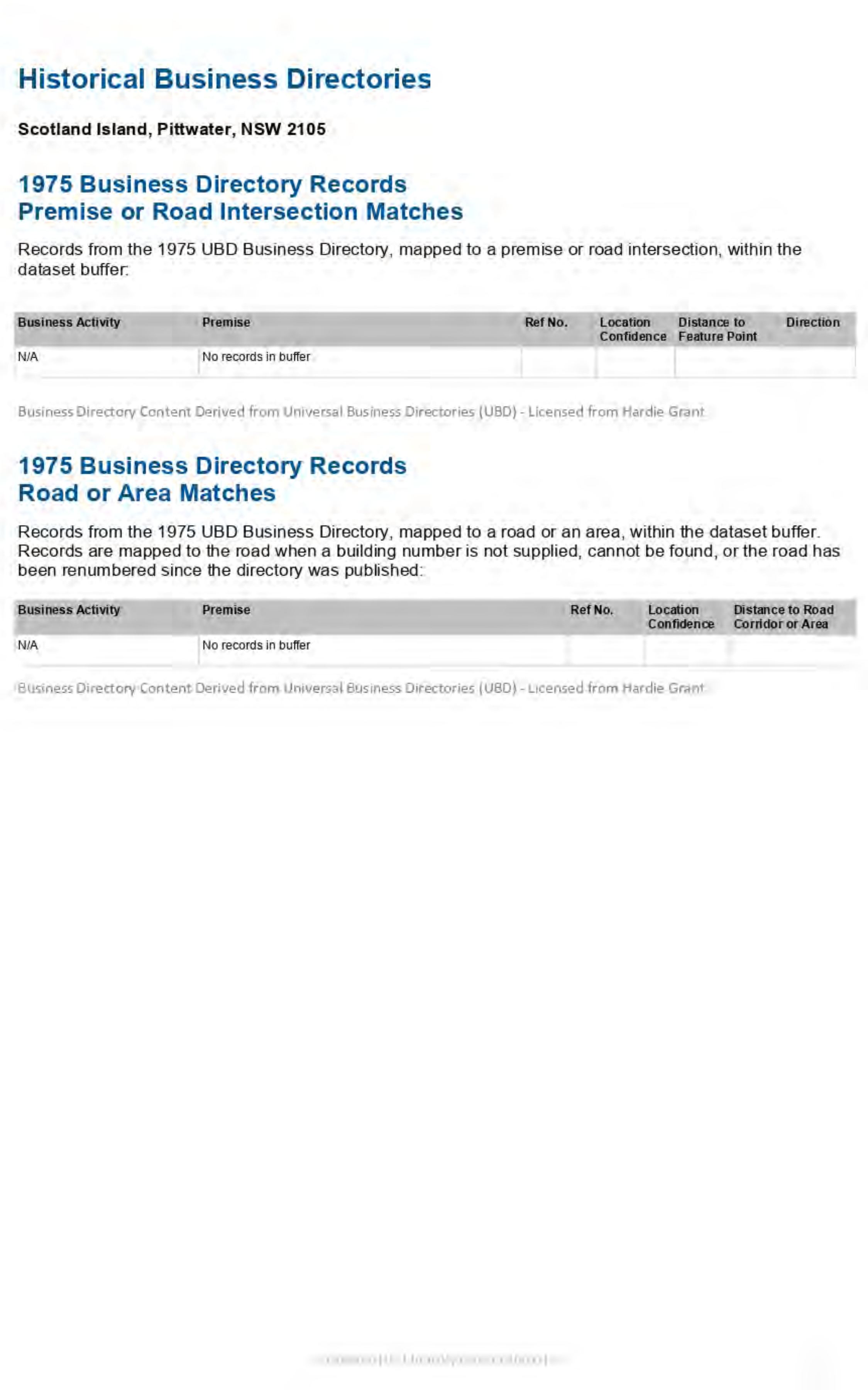
Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1978 Business Directory Records Road or Area Matches

Records from the 1978 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant



Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1975 Business Directory Records Premise or Road Intersection Matches

Records from the 1975 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1975 Business Directory Records Road or Area Matches

Records from the 1975 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

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Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1970 Business Directory Records Premise or Road Intersection Matches

Records from the 1970 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

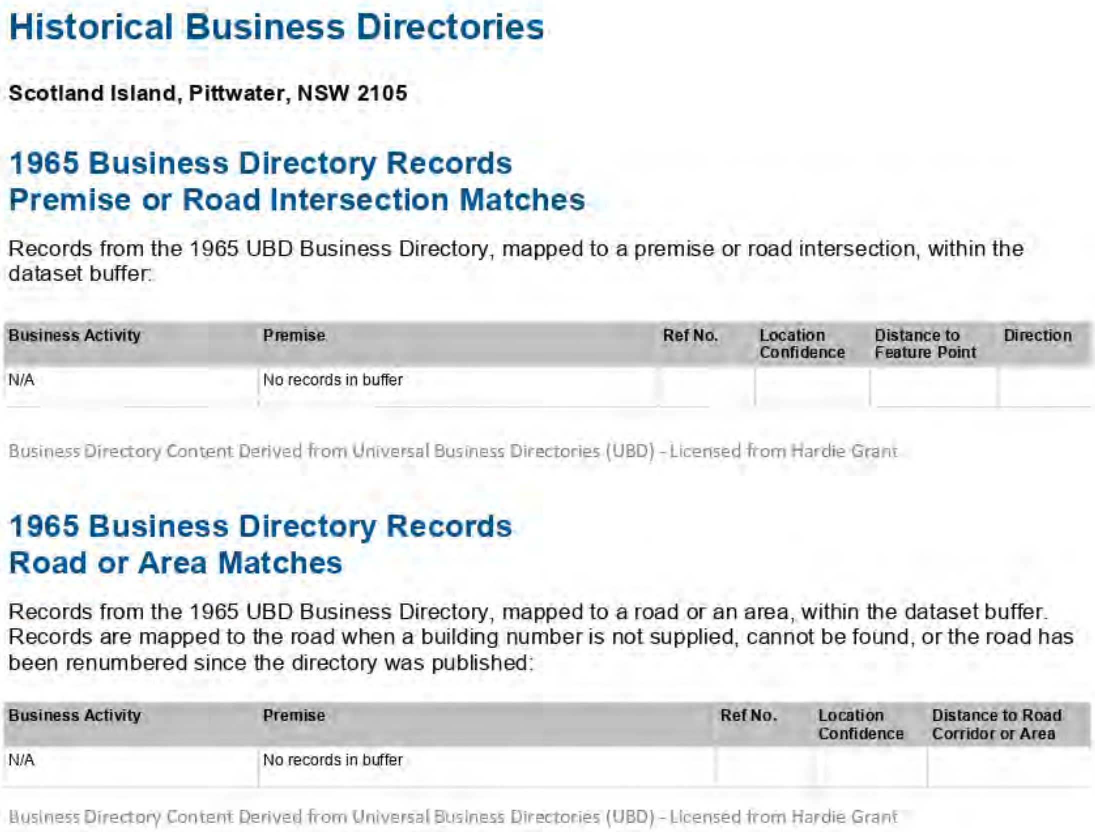
Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1970 Business Directory Records Road or Area Matches

Records from the 1970 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant



Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1965 Business Directory Records Premise or Road Intersection Matches

Records from the 1965 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

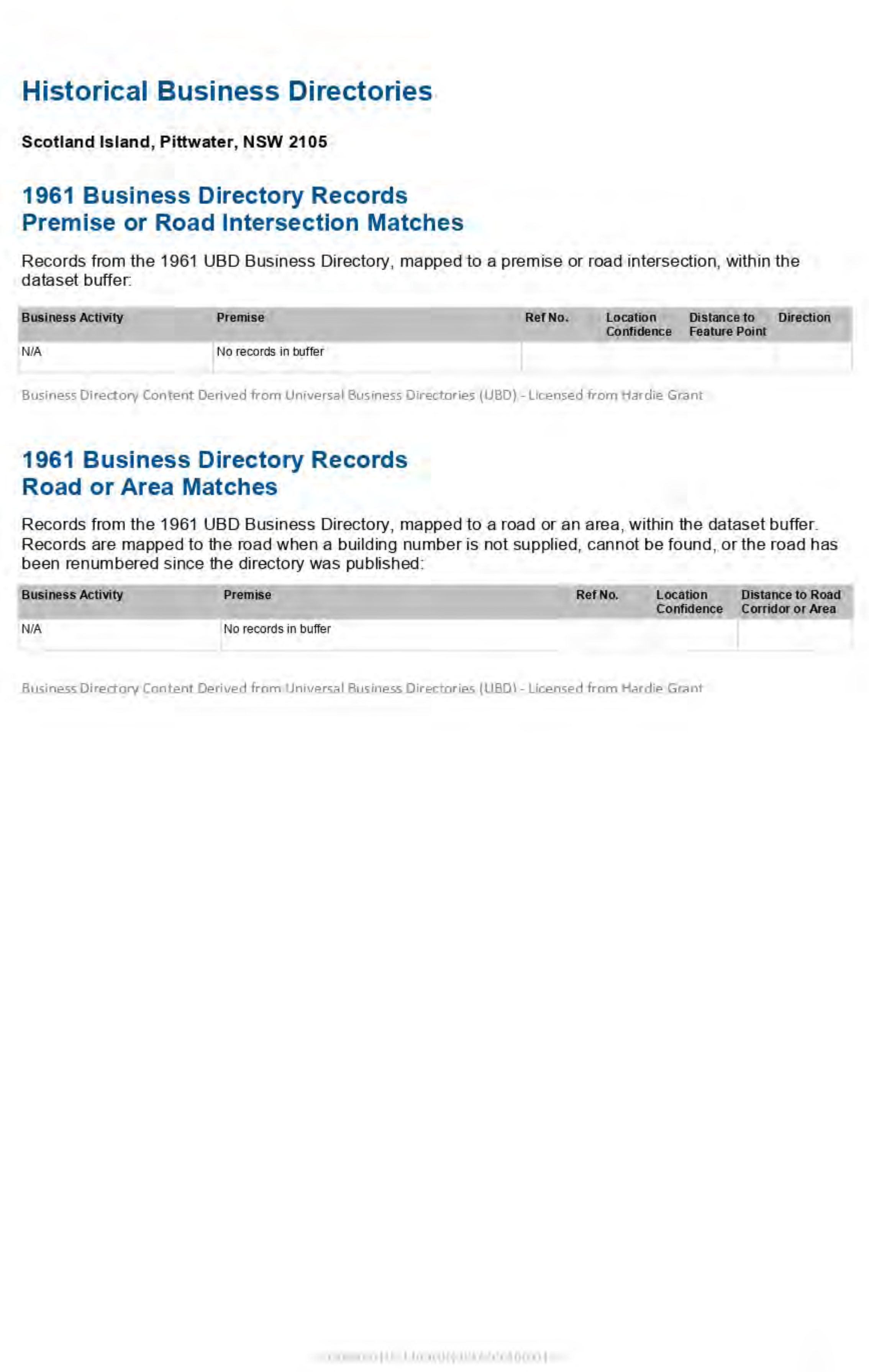
Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1965 Business Directory Records Road or Area Matches

Records from the 1965 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant



Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1961 Business Directory Records Premise or Road Intersection Matches

Records from the 1961 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

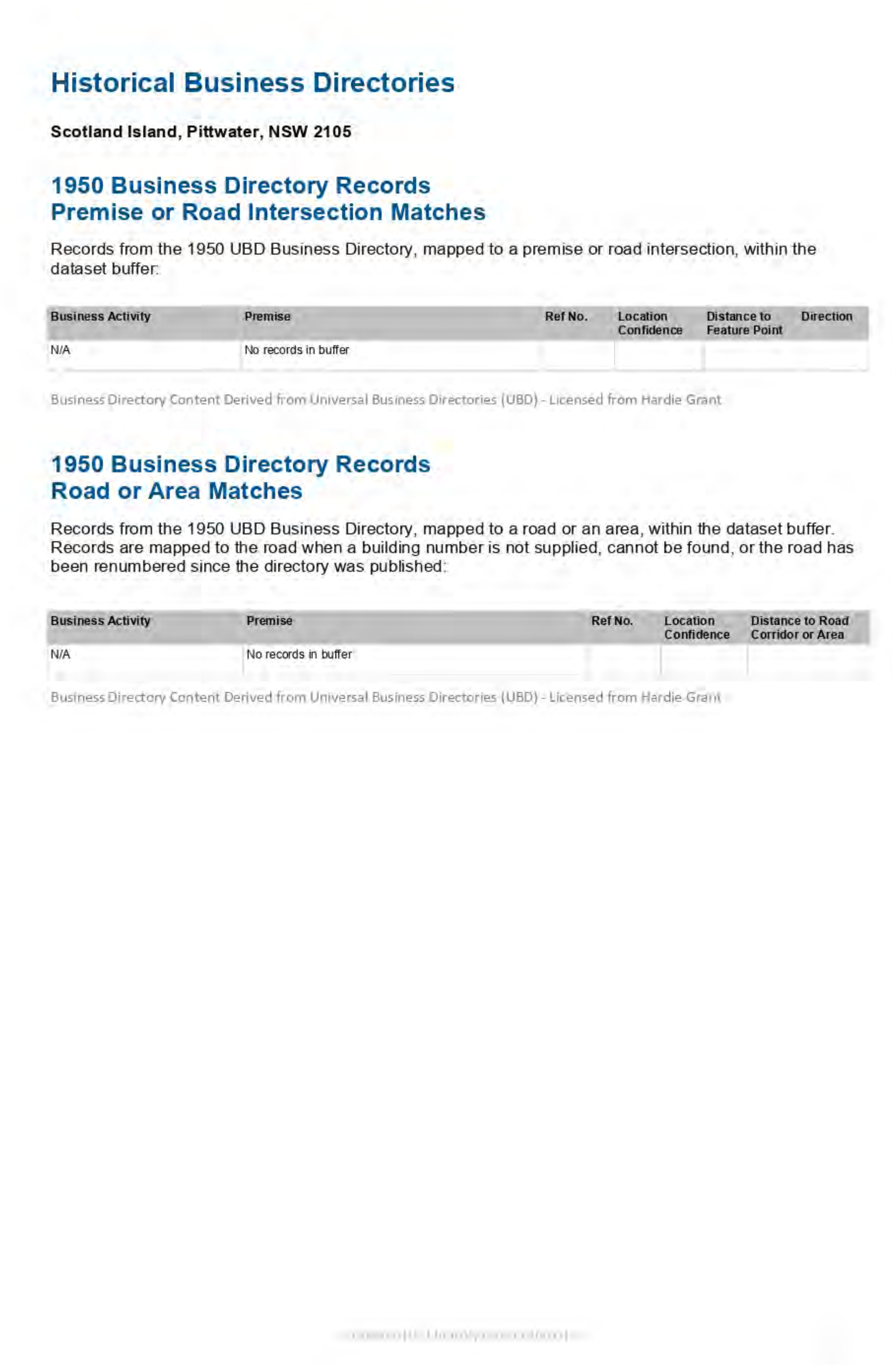
Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1961 Business Directory Records Road or Area Matches

Records from the 1961 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant



Historical Business Directories

Scotland Island, Pittwater, NSW 2105

1950 Business Directory Records Premise or Road Intersection Matches

Records from the 1950 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1950 Business Directory Records Road or Area Matches

Records from the 1950 UBD Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

Scotland Island, Pittwater, NSW 2105

Dry Cleaners, Motor Garages & Service Stations
Premise or Road Intersection Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Feature Point	Direction
MOTOR SERVICE STATIONS-PETROL, Etc.	Pasadena Garage, Church Point	86271	1950	Premise Match	472m	South West

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

Scotland Island, Pittwater, NSW 2105

Dry Cleaners, Motor Garages & Service Stations Road or Area Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Aerial Imagery 2009

Scotland Island, Pittwater, NSW 2105

Scale: 0 100 200 400 Meters

Data Source Aerial Imagery: © 2018 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.

Coordinate System: GDA 1994 MGA Zone 56

Date: 29 November 2018

Aerial Imagery 2003

Scotland Island, Pittwater, NSW 2105

Scale: 0 100 200 400 Meters	Data Source Aerial Imagery: © 2018 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 56	Date: 29 November 2018

Aerial Imagery 1991

Scotland Island, Pittwater, NSW 2105

Data Sources: Aerial Imagery © Department of Finance, Services & Innovation

Coordinate System: GDA 1994 MGA Zone 56

Date: 28 November 2018

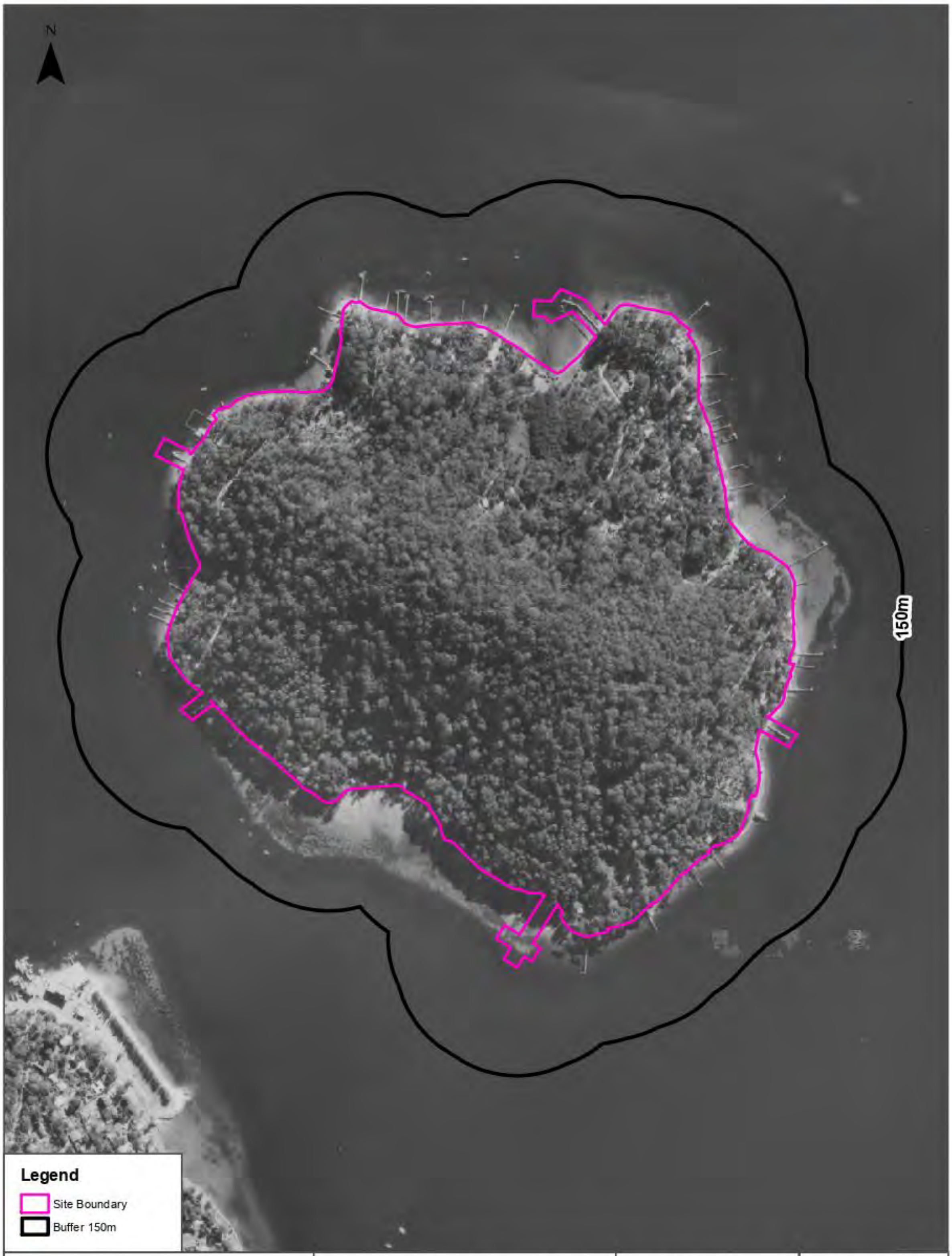
Aerial Imagery 1982

Scotland Island, Pittwater, NSW 2105

Scale: 0 25 50 100 150 200 250 Meters	Data Sources: Aerial Imagery © Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018

Aerial Imagery 1970

Scotland Island, Pittwater, NSW 2105



Scale:
0 25 50 100 150 200 250
Meters

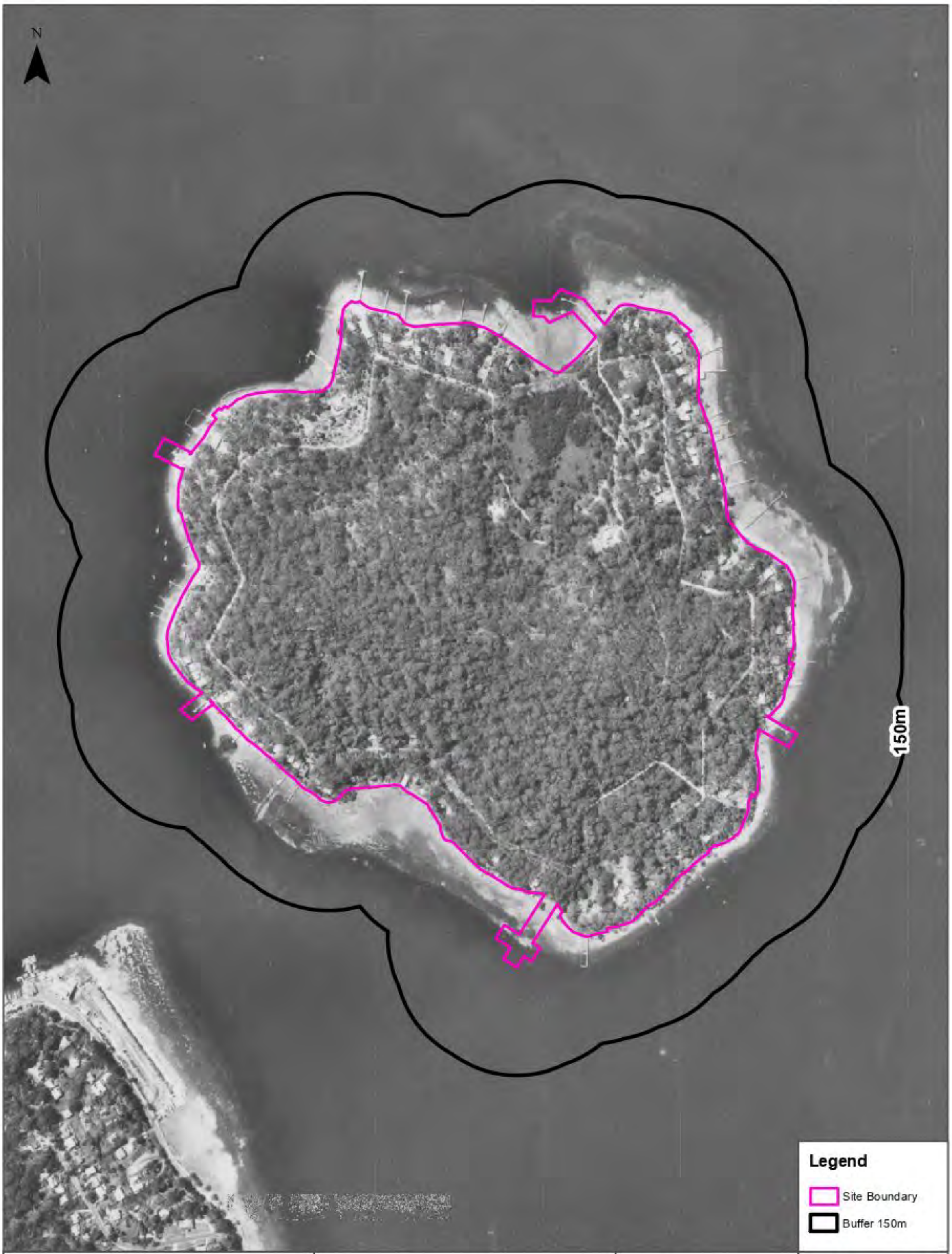
Data Sources: Aerial Imagery © Department of Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Aerial Imagery 1965

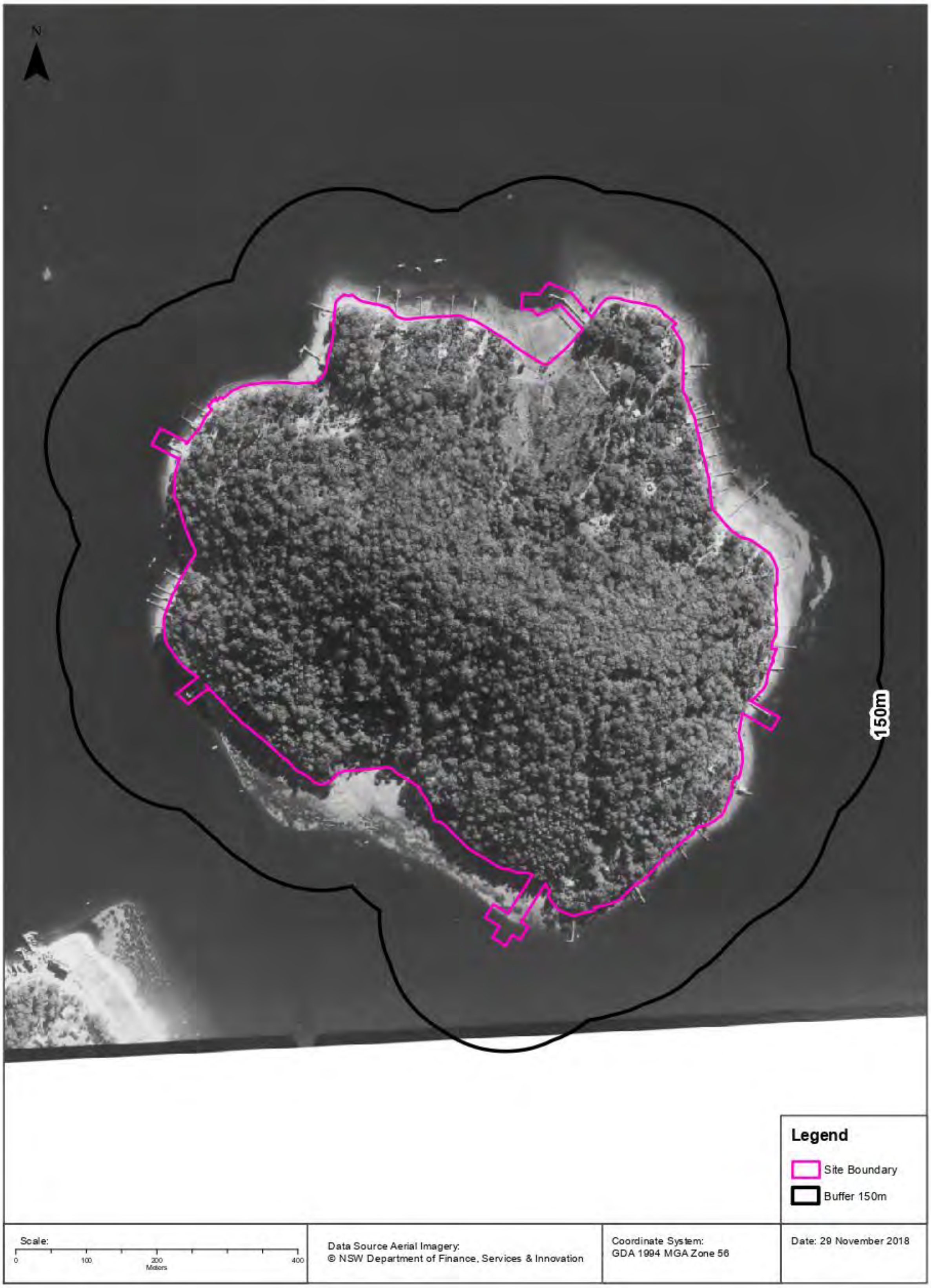
Scotland Island, Pittwater, NSW 2105



Scale: 0 100 200 Meters 400	Data Source Aerial Imagery: © NSW Department of Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 29 November 2018

Aerial Imagery 1961

Scotland Island, Pittwater, NSW 2105



Scale:

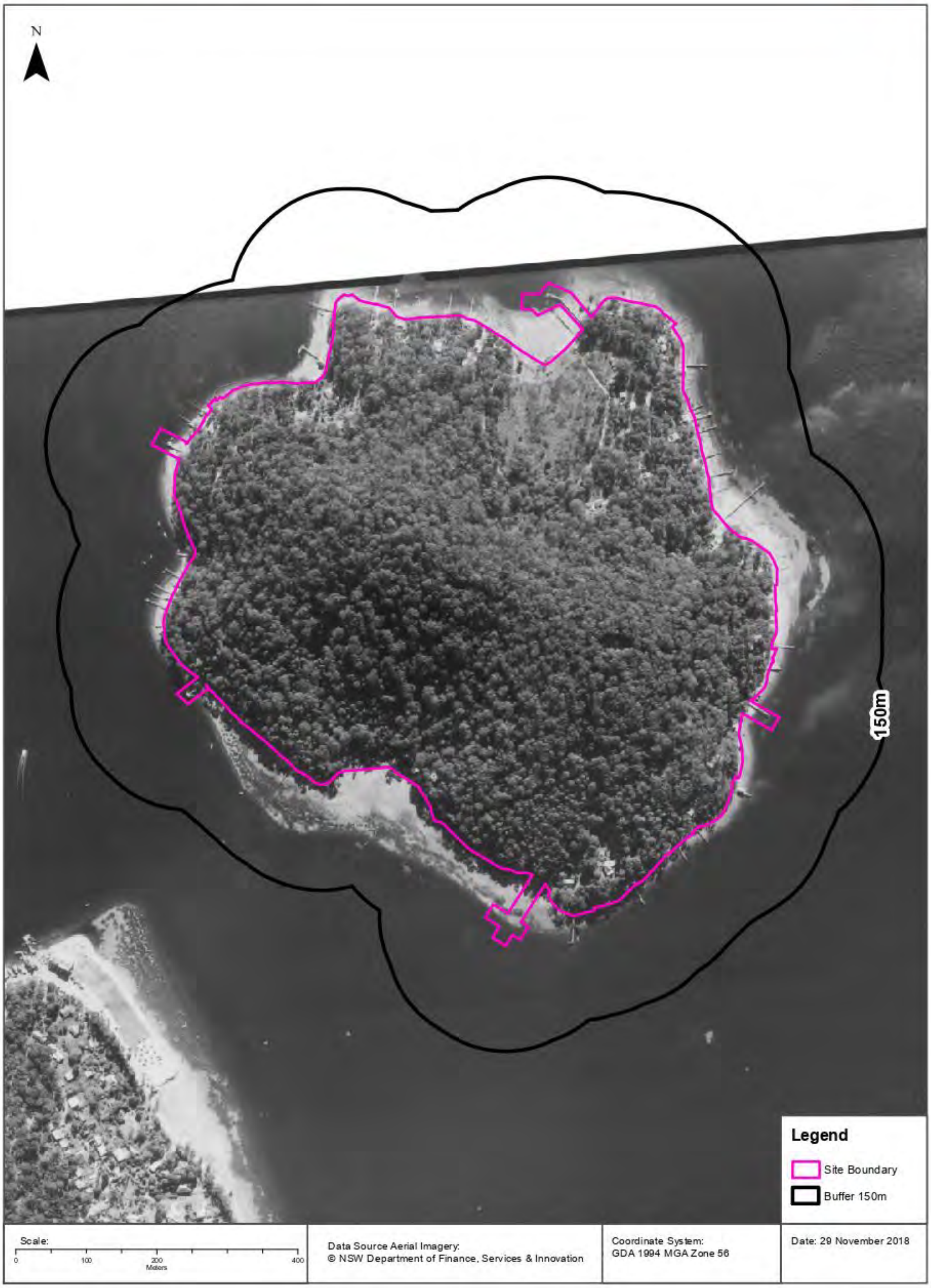
Data Source Aerial Imagery:
© NSW Department of Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 29 November 2018

Aerial Imagery 1961

Scotland Island, Pittwater, NSW 2105



Data Source Aerial Imagery:
© NSW Department of Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 29 November 2018

Topographic Map 2015

Scotland Island, Pittwater, NSW 2105

Scale:

0 100 200 400 600 800 Metres

Data Sources: Topographic Map Data
© NSW Land and Property Information

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Historical Map 1975

Scotland Island, Pittwater, NSW 2105

Please note that due to the inaccuracies in the original maps, the site may not allign to the map correctly.

Scale: 0 175 350 700 1,050 1,400 1,750 Meters

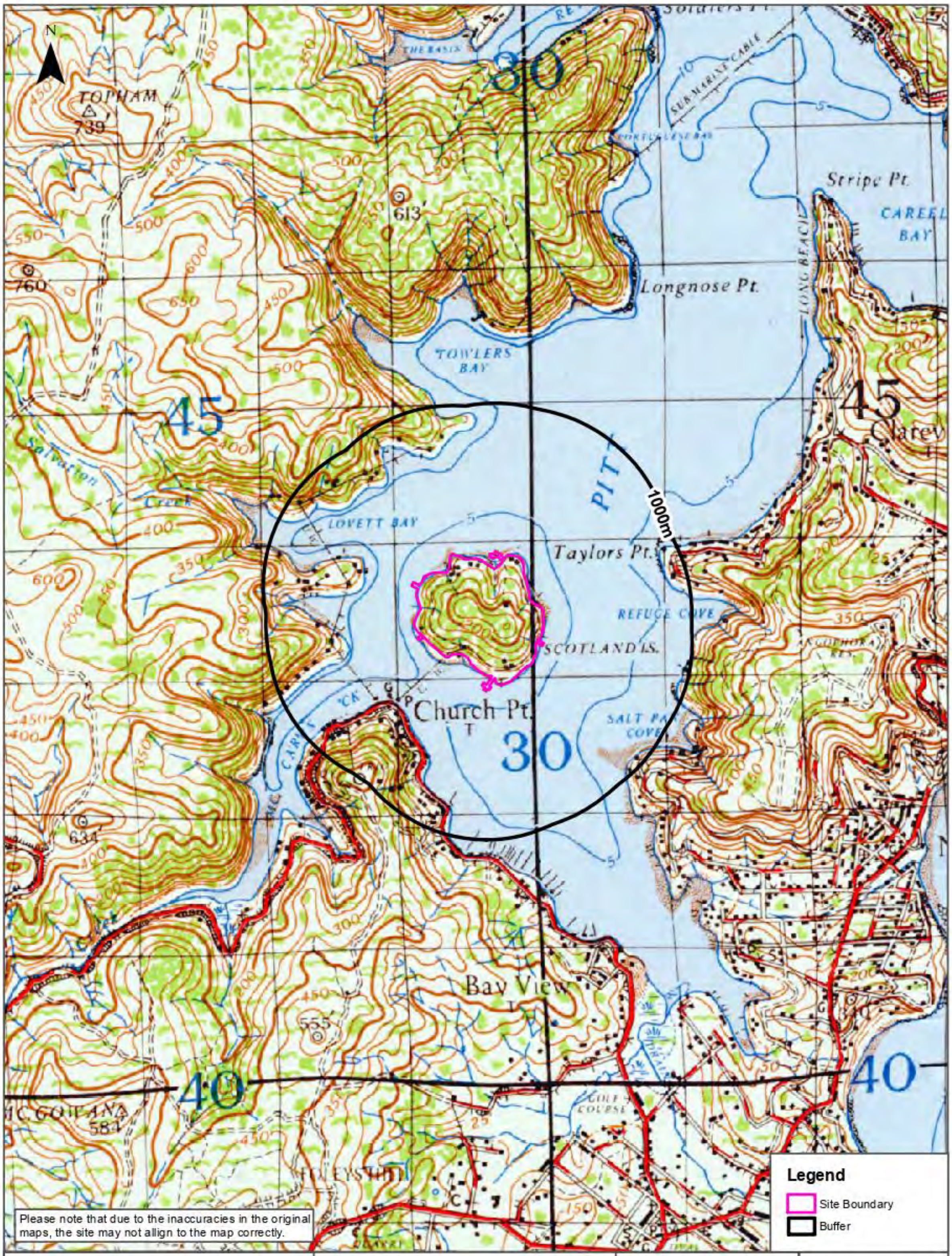
Data Sources: NATMAP 1:100,000 Topographic Maps Geoscience Australia

Coordinate System: GDA 1994 MGA Zone 56

Date: 28 November 2018

Historical Map 1942

Scotland Island, Pittwater, NSW 2105



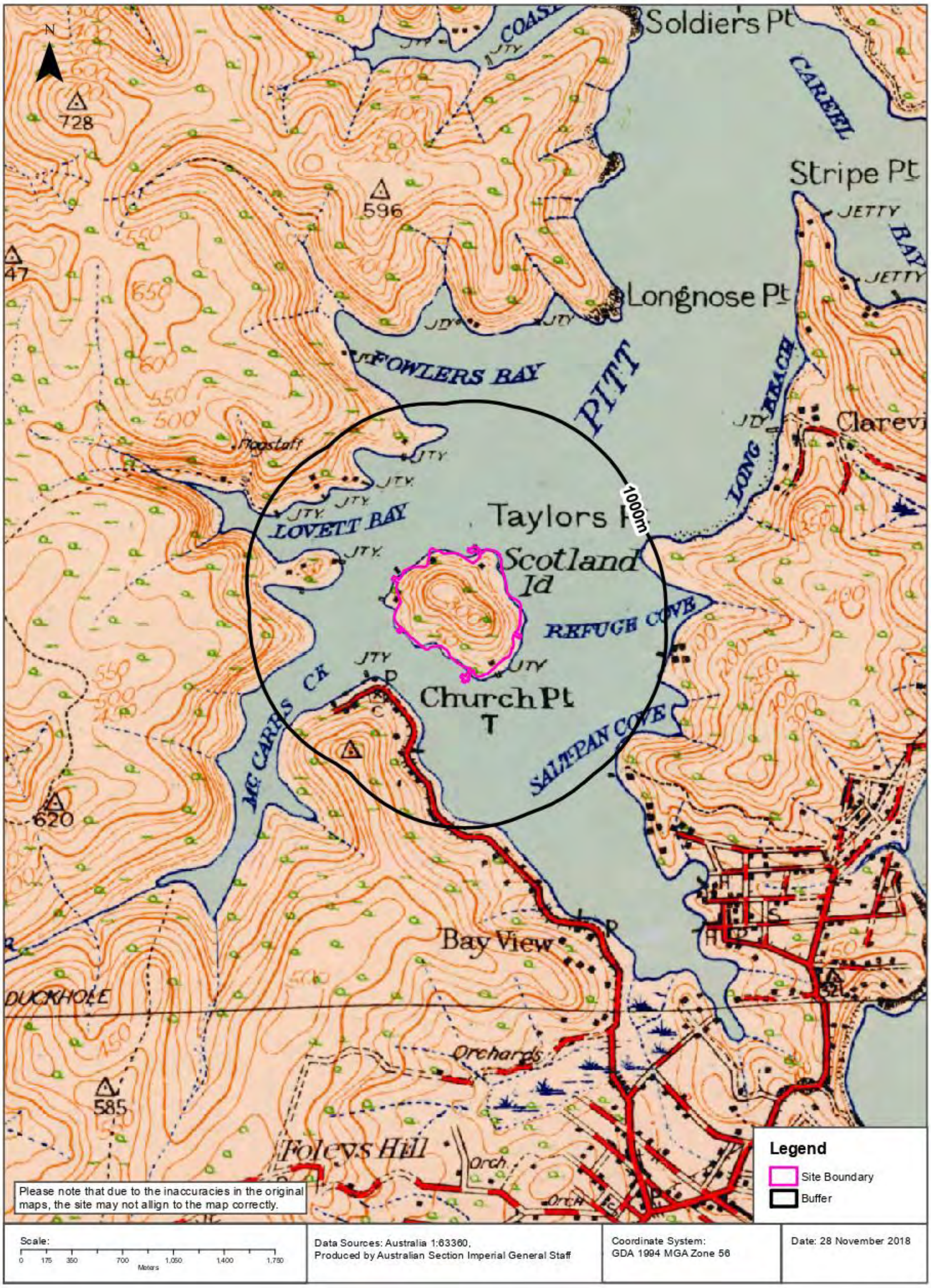
Please note that due to the inaccuracies in the original maps, the site may not allign to the map correctly.

Legend
- 🟪 Site Boundary
- ⬛ Buffer

Scale: 0 175 350 700 1,050 1,400 1,750 Meters	Data Sources: Australia 1:63360, Produced by Australian Section Imperial General Staff	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018

Historical Map 1920

Scotland Island, Pittwater, NSW 2105



Please note that due to the inaccuracies in the original maps, the site may not allign to the map correctly.

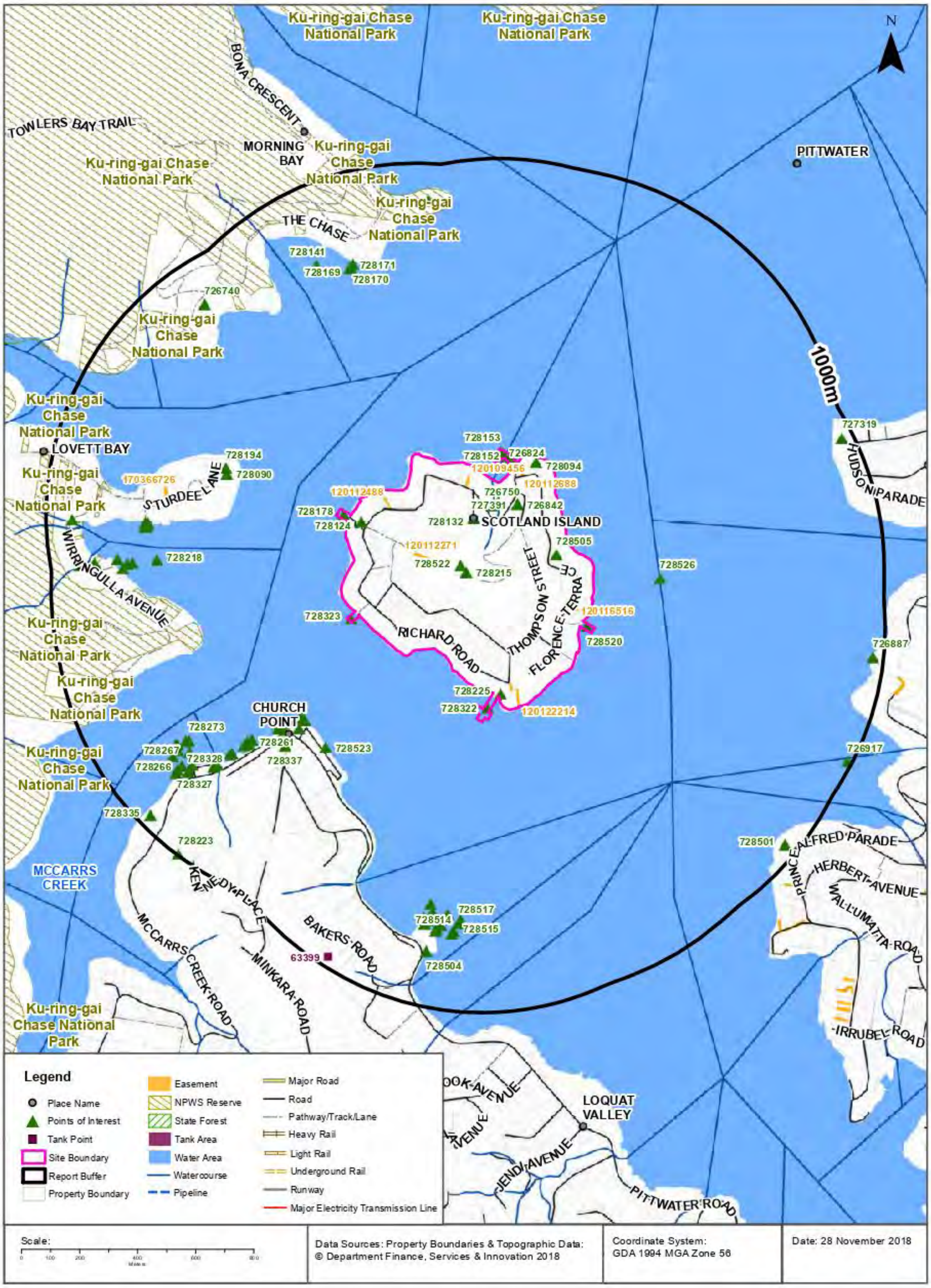
Data Sources: Australia 1:63360,
Produced by Australian Section Imperial General Staff

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Topographic Features

Scotland Island, Pittwater, NSW 2105



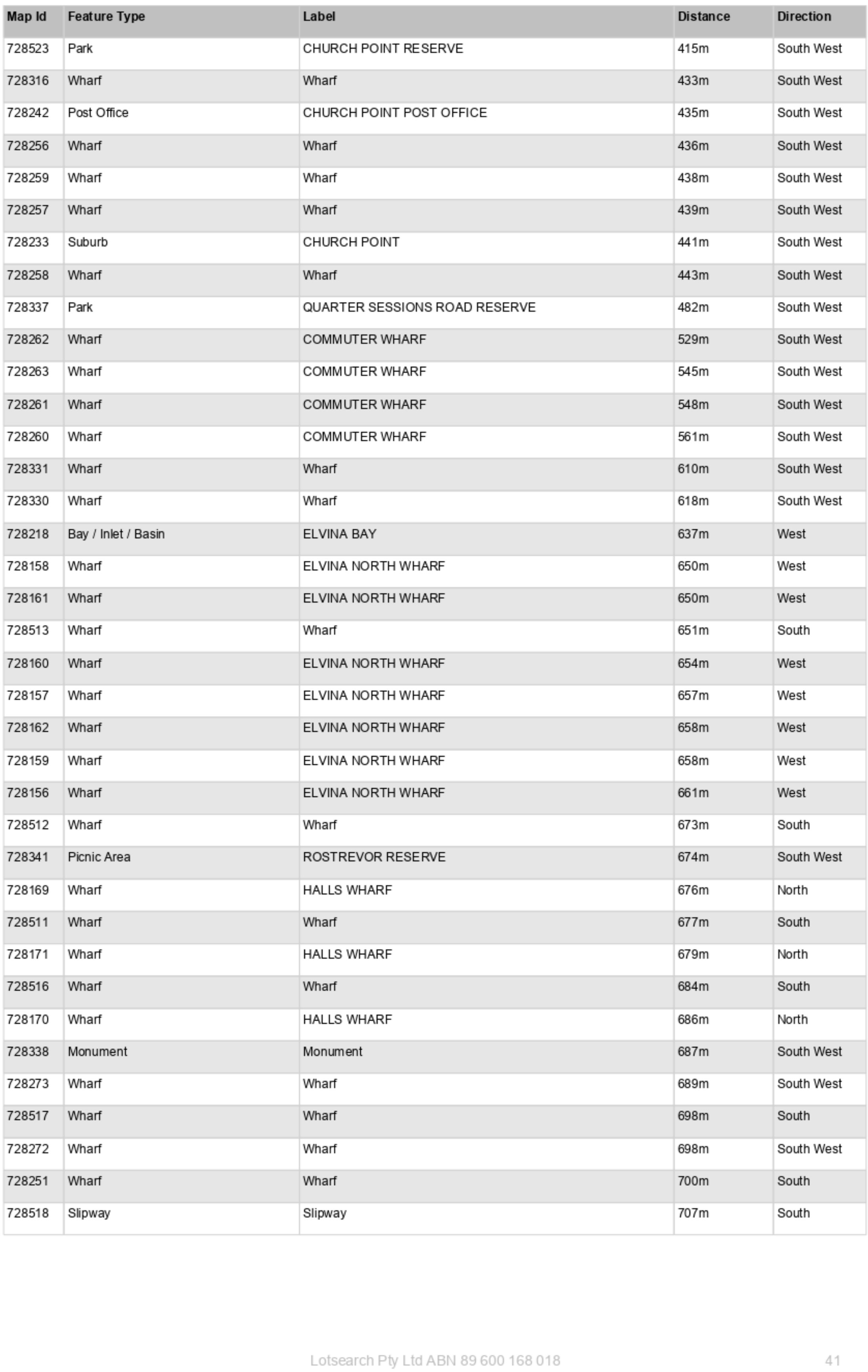
Topographic Features

Scotland Island, Pittwater, NSW 2105

Points of Interest

What Points of Interest exist within the dataset buffer?

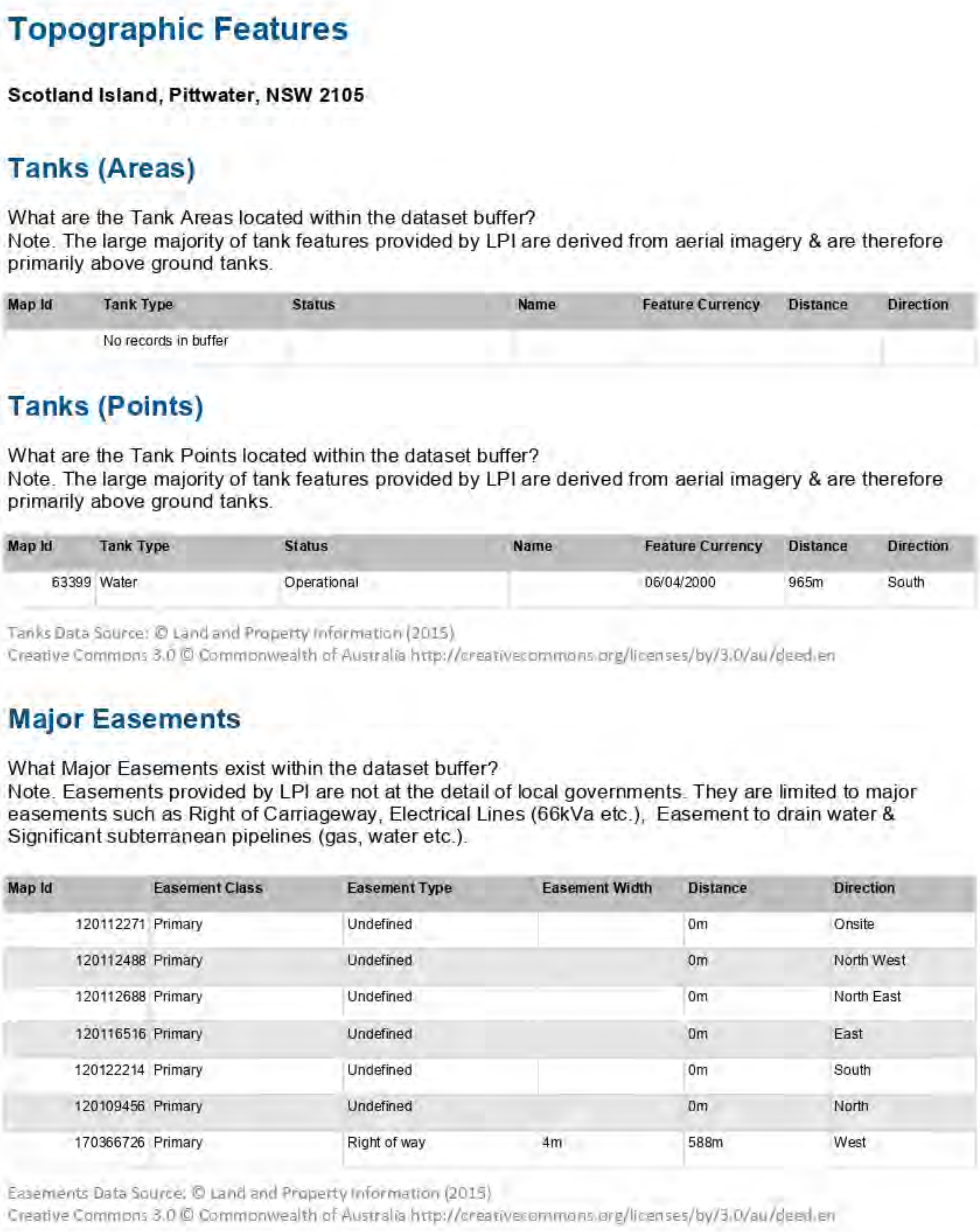
Map Id	Feature Type	Label	Distance	Direction
726750	Community Facility	SCOTLAND ISLAND COMMUNITY HALL	0m	Onsite
726824	Wharf	TENNIS WHARF	0m	Onsite
726842	Ambulance Station	SCOTLAND ISLAND CFR	0m	Onsite
727391	Firestation - Bush	SCOTLAND ISLAND RFB	0m	Onsite
728094	Headland	PITT POINT	0m	Onsite
728105	Park	CATHERINE PARK	0m	Onsite
728152	Wharf	TENNIS WHARF	0m	Onsite
728153	Wharf	TENNIS WHARF	0m	Onsite
728154	Wharf	TENNIS WHARF	0m	Onsite
728155	Wharf	TENNIS WHARF	0m	Onsite
728124	Park	LEAHVERA RESERVE	0m	Onsite
728132	Suburb	SCOTLAND ISLAND	0m	Onsite
728178	Wharf	CARGO WHARF	0m	Onsite
728215	Island	SCOTLAND ISLAND	0m	Onsite
728225	Park	HAROLD RESERVE	0m	Onsite
728322	Wharf	CAROLS WHARF	0m	Onsite
728323	Wharf	BELL WHARF	0m	Onsite
728505	Park	PATHILDA RESERVE	0m	Onsite
728520	Wharf	EASTERN WHARF	0m	Onsite
728522	Park	ELIZABETH PARK	0m	Onsite
728526	Bay Like	PITTWATER	228m	East
728254	Wharf	Wharf	367m	South West
728253	Wharf	Wharf	370m	South West
728255	Wharf	Wharf	371m	South West
728226	Park	SIR THOMAS STEPHENS RESERVE	374m	South West
728325	Boat Ramp	Boat Ramp	402m	South West
728090	Headland	ROCKY POINT	404m	West
728217	Headland	CHURCH POINT	406m	South West
728194	Park	ROCKY POINT	414m	North West
728315	Wharf	CHURCH POINT FERRY WHARF	415m	South West



Map Id	Feature Type	Label	Distance	Direction
728523	Park	CHURCH POINT RESERVE	415m	South West
728316	Wharf	Wharf	433m	South West
728242	Post Office	CHURCH POINT POST OFFICE	435m	South West
728256	Wharf	Wharf	436m	South West
728259	Wharf	Wharf	438m	South West
728257	Wharf	Wharf	439m	South West
728233	Suburb	CHURCH POINT	441m	South West
728258	Wharf	Wharf	443m	South West
728337	Park	QUARTER SESSIONS ROAD RESERVE	482m	South West
728262	Wharf	COMMUTER WHARF	529m	South West
728263	Wharf	COMMUTER WHARF	545m	South West
728261	Wharf	COMMUTER WHARF	548m	South West
728260	Wharf	COMMUTER WHARF	561m	South West
728331	Wharf	Wharf	610m	South West
728330	Wharf	Wharf	618m	South West
728218	Bay / Inlet / Basin	ELVINA BAY	637m	West
728158	Wharf	ELVINA NORTH WHARF	650m	West
728161	Wharf	ELVINA NORTH WHARF	650m	West
728513	Wharf	Wharf	651m	South
728160	Wharf	ELVINA NORTH WHARF	654m	West
728157	Wharf	ELVINA NORTH WHARF	657m	West
728162	Wharf	ELVINA NORTH WHARF	658m	West
728159	Wharf	ELVINA NORTH WHARF	658m	West
728156	Wharf	ELVINA NORTH WHARF	661m	West
728512	Wharf	Wharf	673m	South
728341	Picnic Area	ROSTREVOR RESERVE	674m	South West
728169	Wharf	HALLS WHARF	676m	North
728511	Wharf	Wharf	677m	South
728171	Wharf	HALLS WHARF	679m	North
728516	Wharf	Wharf	684m	South
728170	Wharf	HALLS WHARF	686m	North
728338	Monument	Monument	687m	South West
728273	Wharf	Wharf	689m	South West
728517	Wharf	Wharf	698m	South
728272	Wharf	Wharf	698m	South West
728251	Wharf	Wharf	700m	South
728518	Slipway	Slipway	707m	South

Map Id	Feature Type	Label	Distance	Direction
728250	Wharf	Wharf	708m	South
728252	Wharf	Wharf	712m	South
728267	Wharf	Wharf	712m	South West
728280	Wharf	ELVINA BAY WHARF	721m	West
728249	Wharf	Wharf	722m	South
728515	Wharf	Wharf	726m	South
728240	Marina	THE QUAYS	727m	South
728271	Wharf	Wharf	728m	South West
728141	Bay / Inlet / Basin	LITTLE LOVETT BAY	732m	North West
728265	Wharf	Wharf	733m	South West
728270	Wharf	Wharf	735m	South West
728514	Wharf	Wharf	736m	South
728248	Wharf	Wharf	738m	South
728269	Wharf	Wharf	740m	South West
728281	Wharf	ELVINA BAY WHARF	740m	West
728279	Wharf	ELVINA BAY WHARF	755m	West
728213	Police Station	BROKEN BAY WATER POLICE	755m	South West
728266	Wharf	Wharf	762m	South West
728328	Marina	HOLME PORT MARINA	763m	South West
728268	Wharf	Wharf	766m	South West
728278	Wharf	Wharf	769m	West
728327	Wharf	Wharf	783m	South West
728264	Slipway	Slipway	795m	South West
728504	Park	GRIFFIN PARK	812m	South
726740	Firestation - Bush	WEST PITTWATER (LOVETT) RFB	846m	North West
727401	Firestation - Bush	WEST PITTWATER (ELVINA) RFB	848m	West
728096	Headland	WOODY POINT	872m	North
728232	Suburb	ELVINA BAY	900m	West
728110	Park	ELVINA PARK	910m	West
728501	Headland	SALT PAN POINT	954m	South East
728335	Park	MCCARRS CREEK ROAD RESERVE	958m	South West
728179	Wharf	MORNING BAY WHARF	959m	North
727319	Headland	TAYLORS POINT	960m	East
726887	Beach	SOUTH BEACH	963m	East
726917	Bay / Inlet / Basin	SALT PAN COVE	984m	South East
728097	Bay / Inlet / Basin	LOVETT BAY	988m	North West
728223	Park	KENNEDY PARK	996m	South West

Topographic Data Source: © Land and Property Information (2015)
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en



Topographic Features

Scotland Island, Pittwater, NSW 2105

Tanks (Areas)

What are the Tank Areas located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
	No records in buffer					

Tanks (Points)

What are the Tank Points located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
63399	Water	Operational		06/04/2000	965m	South

Tanks Data Source: © Land and Property Information (2015)
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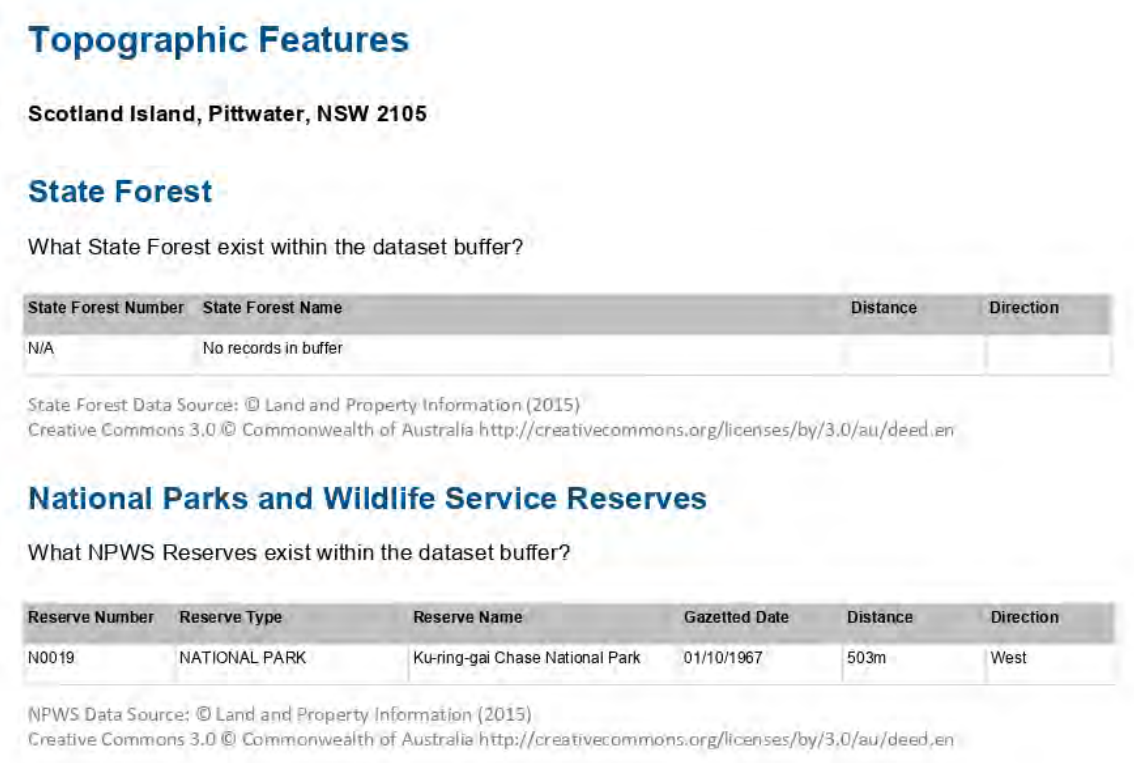
Major Easements

What Major Easements exist within the dataset buffer?
Note. Easements provided by LPI are not at the detail of local governments. They are limited to major easements such as Right of Carriageway, Electrical Lines (66kVa etc.), Easement to drain water & Significant subterranean pipelines (gas, water etc.).

Map Id	Easement Class	Easement Type	Easement Width	Distance	Direction
120112271	Primary	Undefined		0m	Onsite
120112488	Primary	Undefined		0m	North West
120112688	Primary	Undefined		0m	North East
120116516	Primary	Undefined		0m	East
120122214	Primary	Undefined		0m	South
120109456	Primary	Undefined		0m	North
170366726	Primary	Right of way	4m	588m	West

Easements Data Source: © Land and Property Information (2015)
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en



Topographic Features

Scotland Island, Pittwater, NSW 2105

State Forest

What State Forest exist within the dataset buffer?

State Forest Number	State Forest Name	Distance	Direction
N/A	No records in buffer		

State Forest Data Source: © Land and Property Information (2015)
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National Parks and Wildlife Service Reserves

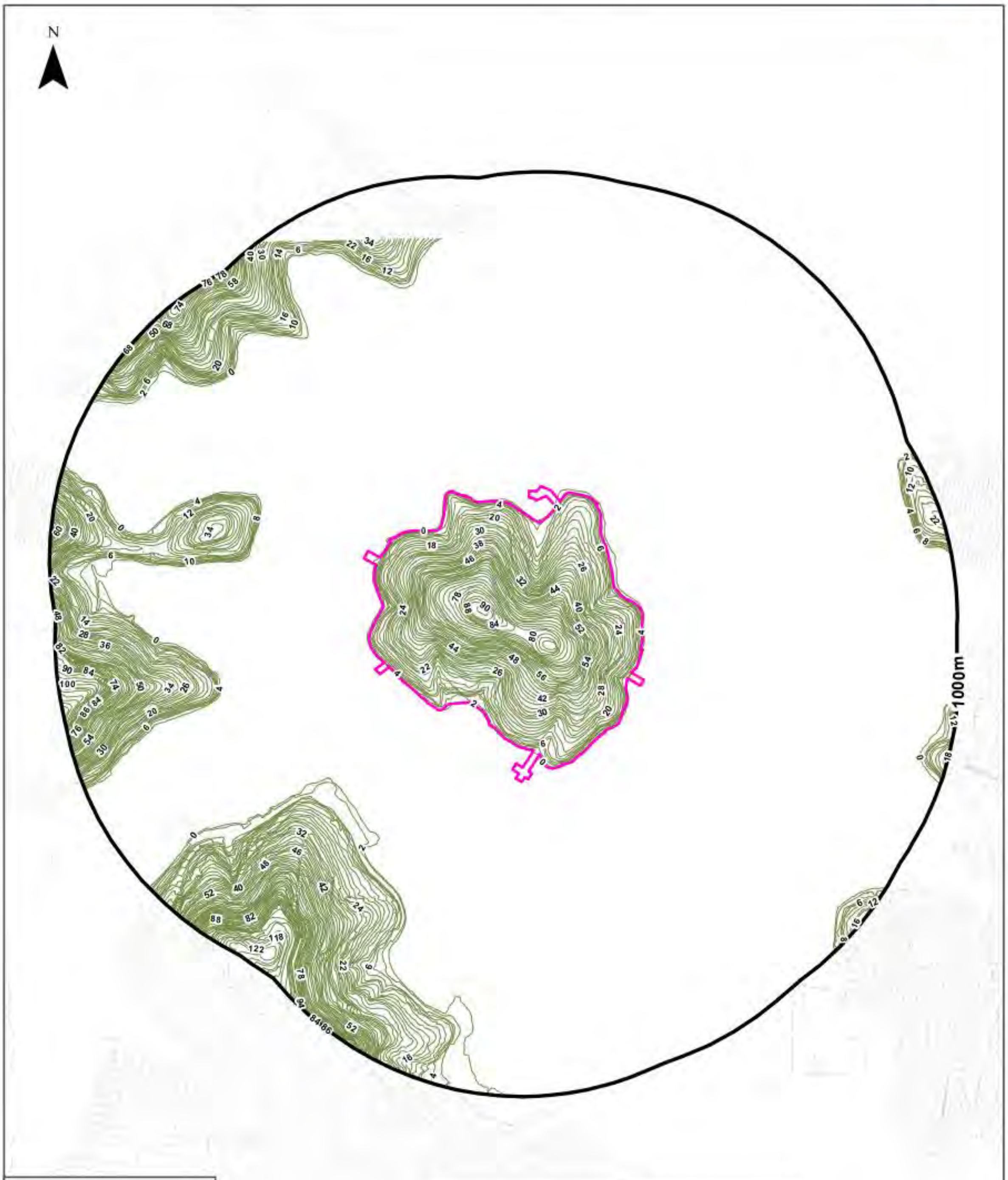
What NPWS Reserves exist within the dataset buffer?

Reserve Number	Reserve Type	Reserve Name	Gazetted Date	Distance	Direction
N0019	NATIONAL PARK	Ku-ring-gai Chase National Park	01/10/1967	503m	West

NPWS Data Source: © Land and Property Information (2015)
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Elevation Contours (m AHD)

Scotland Island, Pittwater, NSW 2105

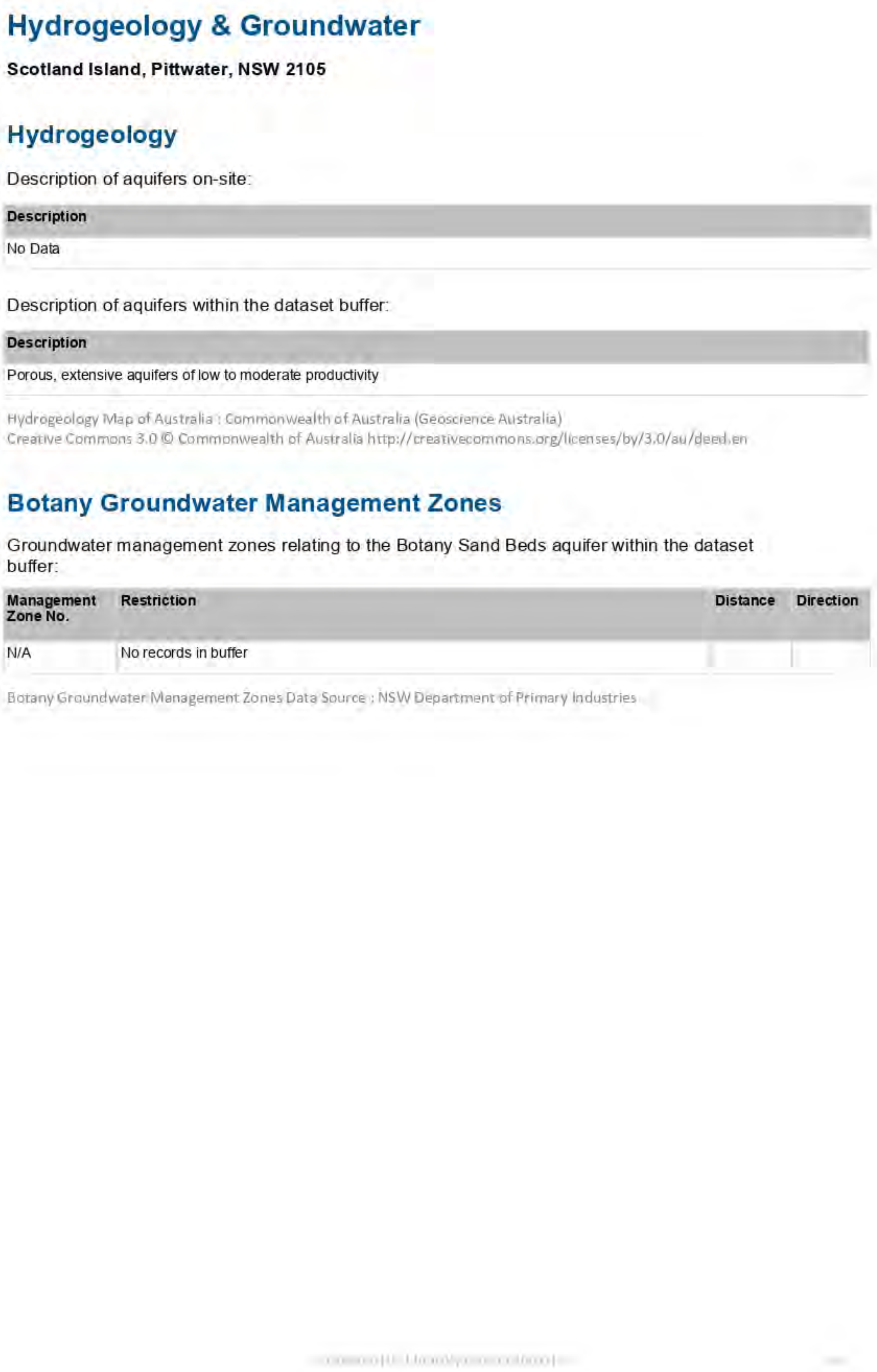


Legend

- — Elevation Contour (m AHD)
- ▭ Site Boundary
- ■ Report Buffer
- ▭ Property Boundary

Accuracy & Currency: This contour data can be up to 0.4 of the contour interval out in height and must therefore not be used for any design or engineering works, but only as a general guide to topography. Gaps may occur along contour lines due to vertical topography, obscured topography in the source photography such as buildings, dense vegetation or dead ground, or the fact that original buildings have been replaced in the intervening thirty years since the original contour capture.

Scale: 0 100 200 400 Meters	Data Sources: Property Boundaries & Topographic Data: © Department Finance, Services & Innovation 2018	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018



Hydrogeology & Groundwater

Scotland Island, Pittwater, NSW 2105

Hydrogeology

Description of aquifers on-site:

Description
No Data

Description of aquifers within the dataset buffer:

Description
Porous, extensive aquifers of low to moderate productivity

Hydrogeology Map of Australia : Commonwealth of Australia (Geoscience Australia)
Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Botany Groundwater Management Zones

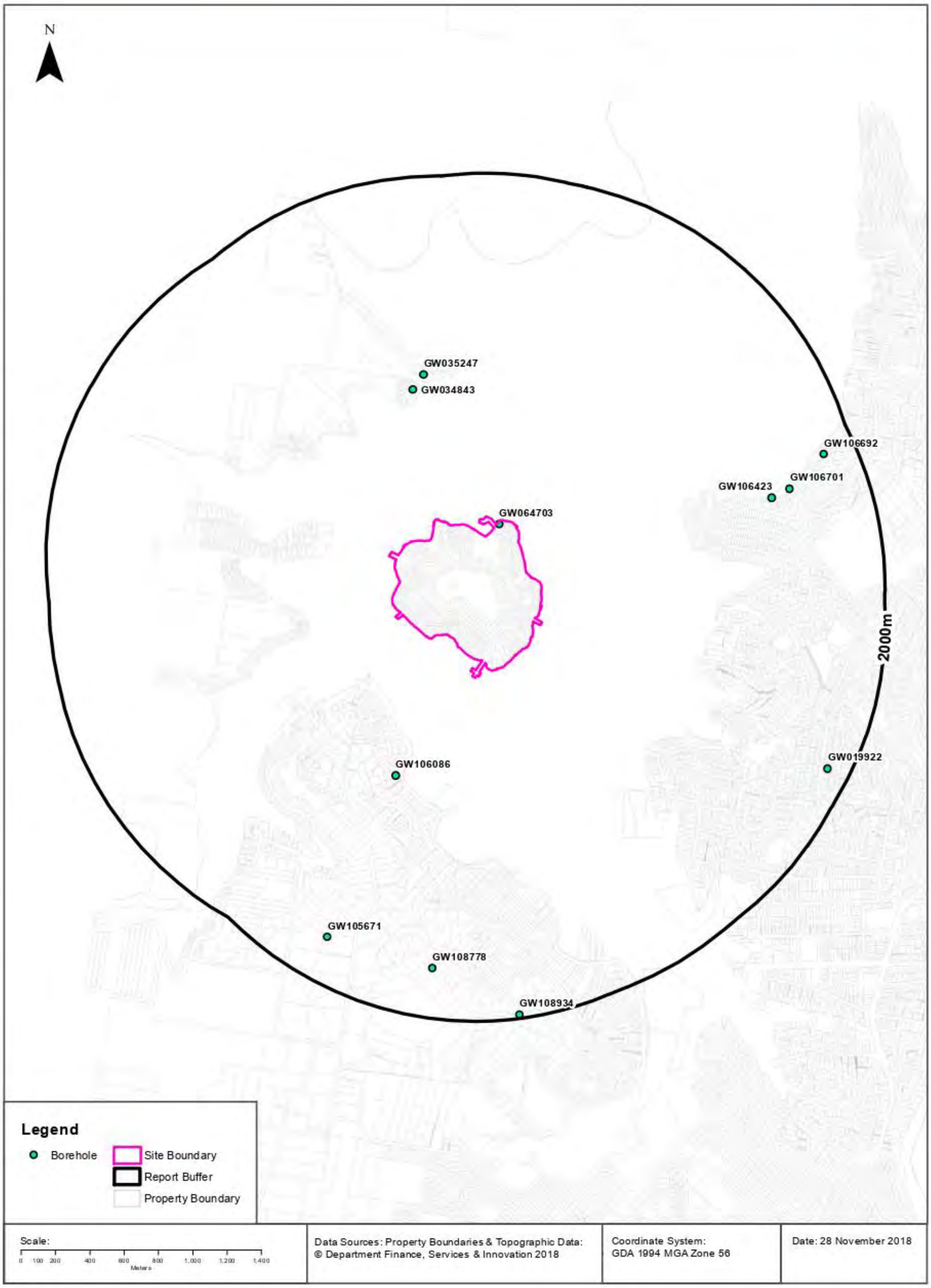
Groundwater management zones relating to the Botany Sand Beds aquifer within the dataset buffer:

Management Zone No.	Restriction	Distance	Direction
N/A	No records in buffer		

Botany Groundwater Management Zones Data Source : NSW Department of Primary Industries

Groundwater Boreholes

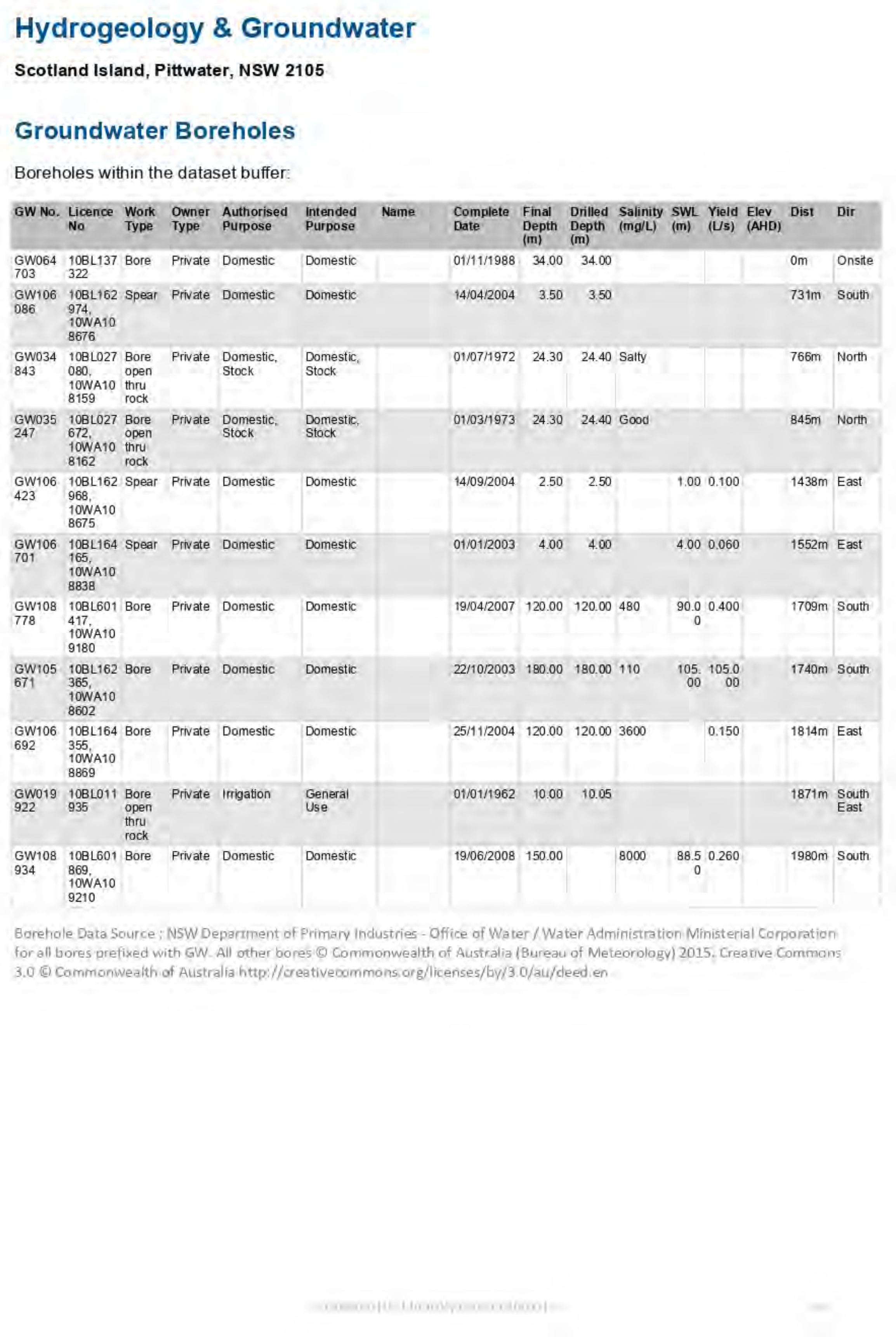
Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data:
© Department Finance, Services & Innovation 2018

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018



Hydrogeology & Groundwater

Scotland Island, Pittwater, NSW 2105

Groundwater Boreholes

Boreholes within the dataset buffer:

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW064703	10BL137322	Bore	Private	Domestic	Domestic		01/11/1988	34.00	34.00					0m	Onsite
GW106086	10BL162974, 10WA108676	Spear	Private	Domestic	Domestic		14/04/2004	3.50	3.50					731m	South
GW034843	10BL027080, 10WA108159	Bore open thru rock	Private	Domestic, Stock	Domestic, Stock		01/07/1972	24.30	24.40	Salty				766m	North
GW035247	10BL027672, 10WA108162	Bore open thru rock	Private	Domestic, Stock	Domestic, Stock		01/03/1973	24.30	24.40	Good				845m	North
GW106423	10BL162968, 10WA108675	Spear	Private	Domestic	Domestic		14/09/2004	2.50	2.50		1.00	0.100		1438m	East
GW106701	10BL164165, 10WA108838	Spear	Private	Domestic	Domestic		01/01/2003	4.00	4.00		4.00	0.060		1552m	East
GW108778	10BL601417, 10WA109180	Bore	Private	Domestic	Domestic		19/04/2007	120.00	120.00	480	90.00	0.400		1709m	South
GW105671	10BL162365, 10WA108602	Bore	Private	Domestic	Domestic		22/10/2003	180.00	180.00	110	105.00	105.000		1740m	South
GW106692	10BL164355, 10WA108869	Bore	Private	Domestic	Domestic		25/11/2004	120.00	120.00	3600		0.150		1814m	East
GW019922	10BL011935	Bore open thru rock	Private	Irrigation	General Use		01/01/1962	10.00	10.05					1871m	South East
GW108934	10BL601869, 10WA109210	Bore	Private	Domestic	Domestic		19/06/2008	150.00		8000	88.50	0.260		1980m	South

Borehole Data Source : NSW Department of Primary Industries - Office of Water / Water Administration Ministerial Corporation for all bores prefixed with GW. All other bores © Commonwealth of Australia (Bureau of Meteorology) 2015. Creative Commons 3.0 © Commonwealth of Australia http://creativecommons.org/licenses/by/3.0/au/deed.en

Hydrogeology & Groundwater

Scotland Island, Pittwater, NSW 2105

Driller's Logs

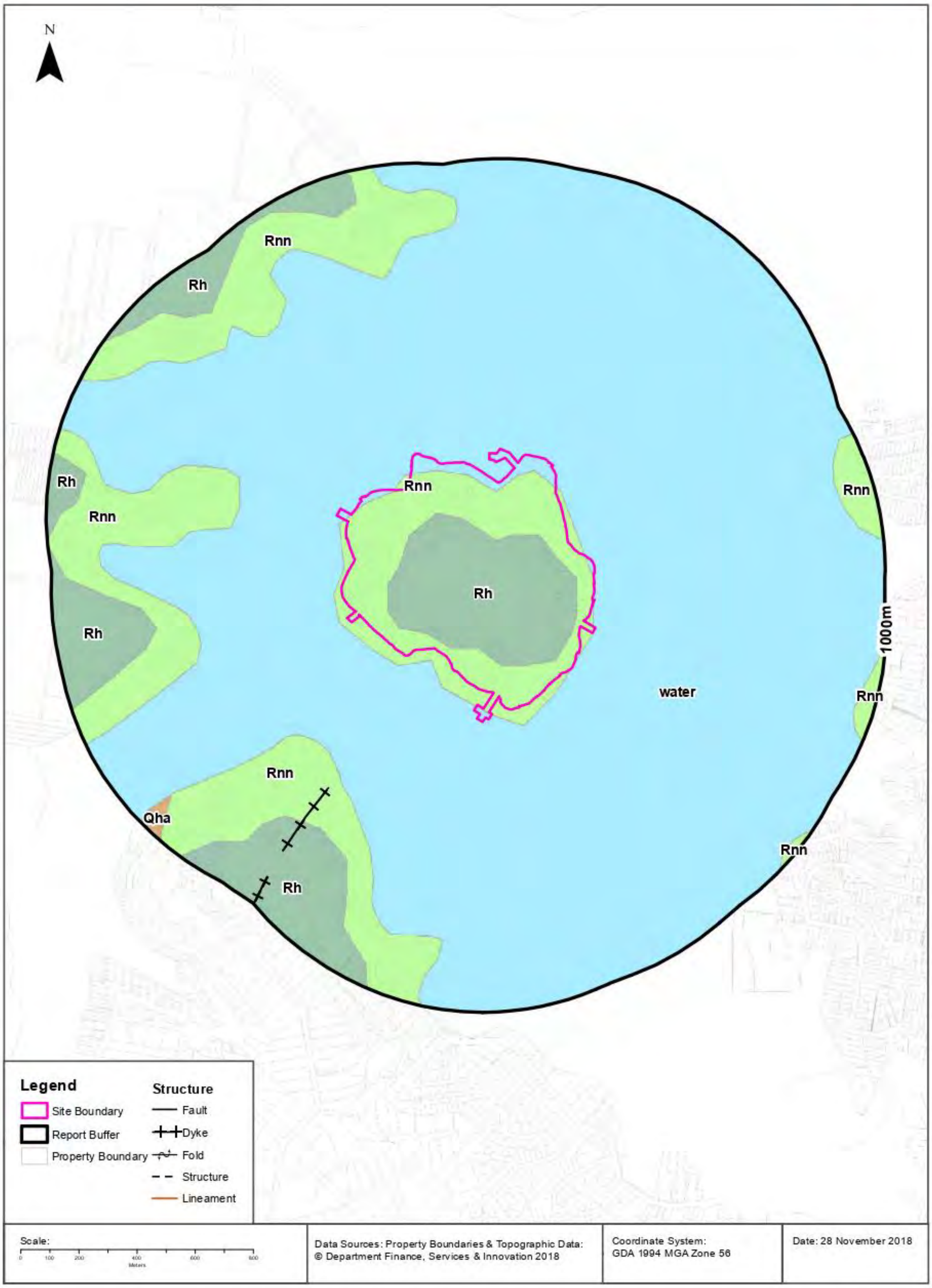
Drill log data relevant to the boreholes within the dataset buffer:

Groundwater No	Drillers Log	Distance	Direction
GW064703	0.00m-0.50m Soil Sandy 0.50m-1.80m Shale Clay 1.80m-2.40m Sandstone Yellow 2.40m-3.10m Clay Sandy 3.10m-8.70m Sandstone Yellow Silty 8.70m-27.30m Sandstone Grey Silty 8.70m-27.30m Shale Some 27.30m-28.10m Shale 28.10m-28.40m Sandstone Grey Water Bearing Coarse Water Supply 28.40m-34.00m Sandstone Grey Some Shale	0m	Onsite
GW106086	0.00m-1.50m sandy, loam 1.50m-2.00m clay 2.00m-2.60m sand, tight packed 2.60m-3.50m clay	731m	South
GW034843	0.00m-9.14m Clay Rock 9.14m-12.80m Sandstone Soft 12.80m-24.38m Shale Water Supply	766m	North
GW035247	0.00m-1.52m Topsoil 1.52m-3.66m Clay Heavy 3.66m-16.76m Sandstone Water Supply 16.76m-24.38m Shale	845m	North
GW106423	0.00m-0.30m topsoil 0.30m-2.50m brown sitly sand grey clay	1438m	East
GW108778	0.00m-1.00m clay, sandy 1.00m-2.40m sandstone, weathered 2.40m-10.00m sandstone, yellow 10.00m-10.50m ironstone 10.50m-14.50m sandstone, grey 14.50m-15.00m ironstone 15.00m-16.00m sandstone, yellow 16.00m-16.50m ironstone 16.50m-28.00m sandstone, grey 28.00m-32.00m sandstone, quartz 32.00m-36.00m sandstone, yellow 36.00m-40.00m sandstone, quartz 40.00m-41.00m shale, clay band 41.00m-44.50m sandstone, grey 44.50m-59.00m shale, clay band 59.00m-72.00m sandstone, grey 72.00m-78.00m shale, clay band 78.00m-81.00m siltstone 81.00m-95.50m sandstone, grey 95.50m-97.00m siltstone 97.00m-99.00m sandstone, quartz 99.00m-112.50m sandstone, grey 112.50m-115.00m siltstone 115.00m-120.00m sandstone, grey	1709m	South
GW105671	0.00m-1.00m soil, dirt 1.00m-3.00m clay 3.00m-66.00m sandstone, soft yellow 66.00m-150.00m sandstone, shale 150.00m-174.00m shale 174.00m-180.00m shale, red	1740m	South
GW106692	0.00m-2.20m clay, brown sand 2.20m-10.40m sandstone, brown 10.40m-10.90m quartz, grey clay 10.90m-14.00m sandstone, grey 14.00m-14.20m clay, brown 14.20m-58.40m sandstone, grey, with bands of red 58.40m-59.30m tuff, medium grained 59.30m-60.90m limestone, grey 60.90m-63.40m sandstone, dark grey 63.40m-65.00m tuff, grey, clay 65.00m-76.70m shale, grey, brown, red, green 76.70m-120.00m sandstone, grey banded with grey siltstone	1814m	East
GW019922	0.00m-0.60m Soil 0.60m-10.05m Sandstone	1871m	South East

Drill Log Data Source: NSW Department of Primary Industries - Office of Water / Water Administration Ministerial Corp

Geology 1:100,000

Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data:
© Department Finance, Services & Innovation 2018

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Geology

Scotland Island, Pittwater, NSW 2105

Geological Units

What are the Geological Units onsite?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dom Lith	Map Sheet	Dataset
Rh	Medium to coarse grained quartz sandstone, very minor shale and laminate lenses				Triassic		Sydney	1:100,000
Rnn	Interbedded laminate, shale and quartz, to lithic quartz sandstone. Minor red claystone north of Hawkesbury River. Clay pellet sandstone (Garie Fm) south of Hawkesbury River	Newport Formation and Garie Formation	Narrabeen Group		Triassic		Sydney	1:100,000
water							Sydney	1:100,000

What are the Geological Units within the dataset buffer?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dom Lith	Map Sheet	Dataset
Qha	Silty to peaty quartz sand, silt, and clay. Ferruginous and humic cementation in places. Common shell layers				Quaternary		Sydney	1:100,000
Rh	Medium to coarse grained quartz sandstone, very minor shale and laminate lenses				Triassic		Sydney	1:100,000
Rnn	Interbedded laminate, shale and quartz, to lithic quartz sandstone. Minor red claystone north of Hawkesbury River. Clay pellet sandstone (Garie Fm) south of Hawkesbury River	Newport Formation and Garie Formation	Narrabeen Group		Triassic		Sydney	1:100,000
water							Sydney	1:100,000

Geological Structures

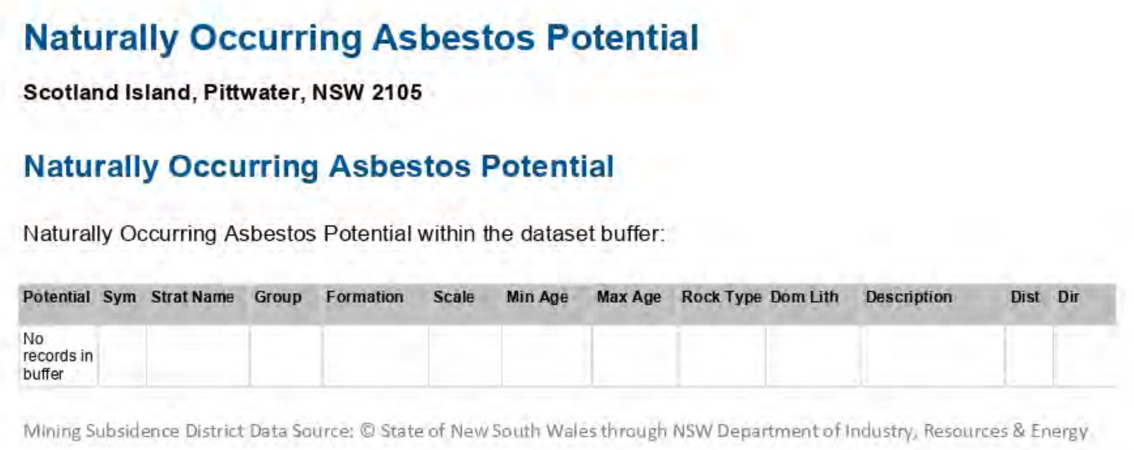
What are the Geological Structures onsite?

Feature	Name	Description	Map Sheet	Dataset
No features				1:100,000

What are the Geological Structures within the dataset buffer?

Feature	Name	Description	Map Sheet	Dataset
Dyke			Sydney	1:100,000
Dyke			Sydney	1:100,000

Geological Data Source : NSW Department of Industry, Resources & Energy



Naturally Occurring Asbestos Potential

Scotland Island, Pittwater, NSW 2105

Naturally Occurring Asbestos Potential

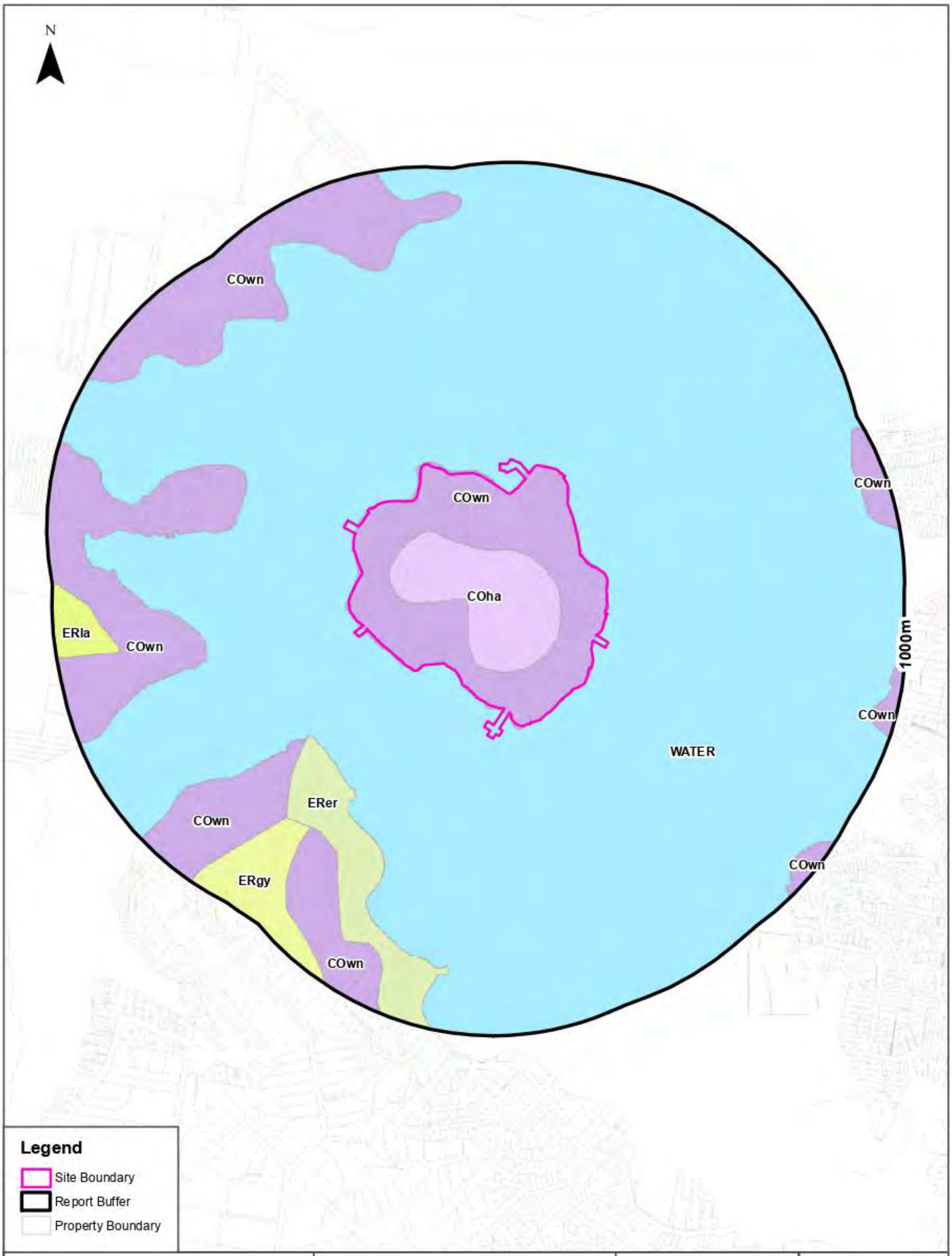
Naturally Occurring Asbestos Potential within the dataset buffer:

Potential	Sym	Strat Name	Group	Formation	Scale	Min Age	Max Age	Rock Type	Dom Lith	Description	Dist	Dir
No records in buffer												

Mining Subsidence District Data Source: © State of New South Wales through NSW Department of Industry, Resources & Energy

Soil Landscapes

Scotland Island, Pittwater, NSW 2105

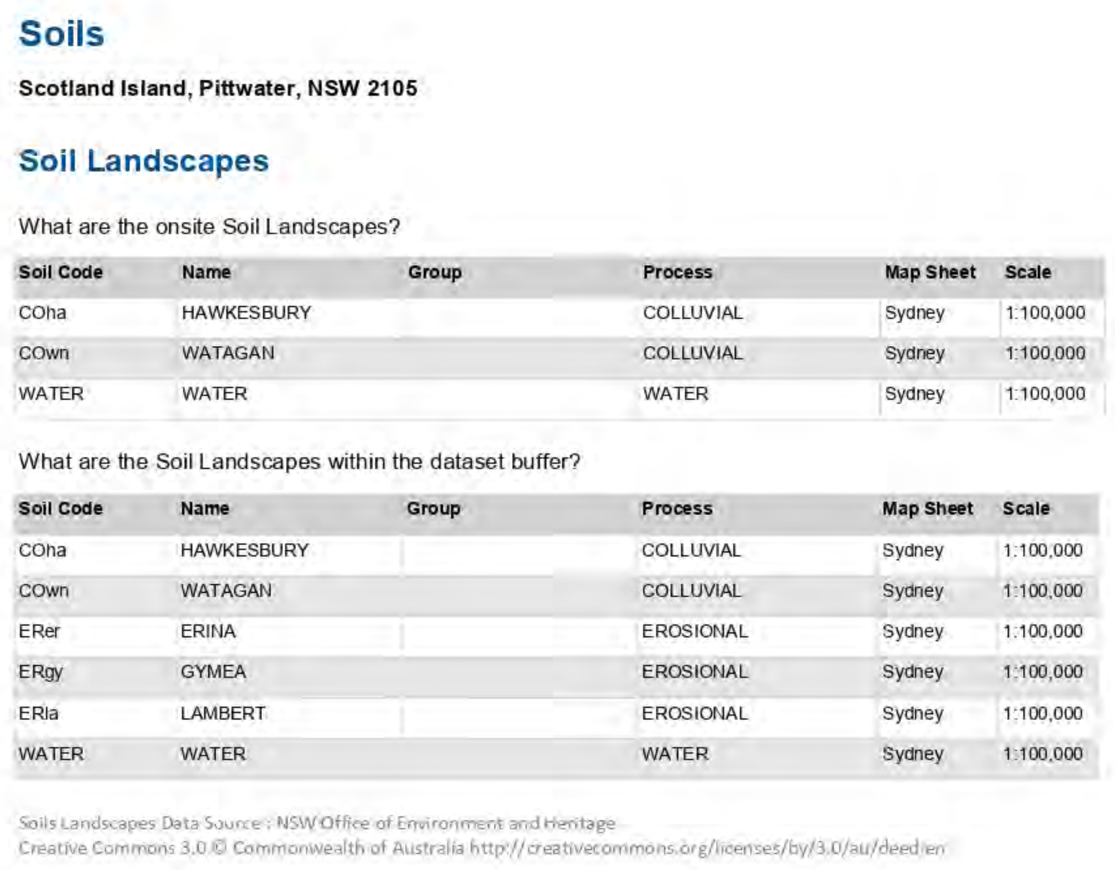


Scale:
0 100 200 400 600 800
Meters

Data Sources: Property Boundaries & Topographic Data:
© Department Finance, Services & Innovation 2018

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018



Soils

Scotland Island, Pittwater, NSW 2105

Soil Landscapes

What are the onsite Soil Landscapes?

Soil Code	Name	Group	Process	Map Sheet	Scale
COha	HAWKESBURY		COLLUVIAL	Sydney	1:100,000
COwn	WATAGAN		COLLUVIAL	Sydney	1:100,000
WATER	WATER		WATER	Sydney	1:100,000

What are the Soil Landscapes within the dataset buffer?

Soil Code	Name	Group	Process	Map Sheet	Scale
COha	HAWKESBURY		COLLUVIAL	Sydney	1:100,000
COwn	WATAGAN		COLLUVIAL	Sydney	1:100,000
ERer	ERINA		EROSIONAL	Sydney	1:100,000
ERgy	GYMEA		EROSIONAL	Sydney	1:100,000
ERla	LAMBERT		EROSIONAL	Sydney	1:100,000
WATER	WATER		WATER	Sydney	1:100,000

Soils Landscapes Data Source : NSW Office of Environment and Heritage
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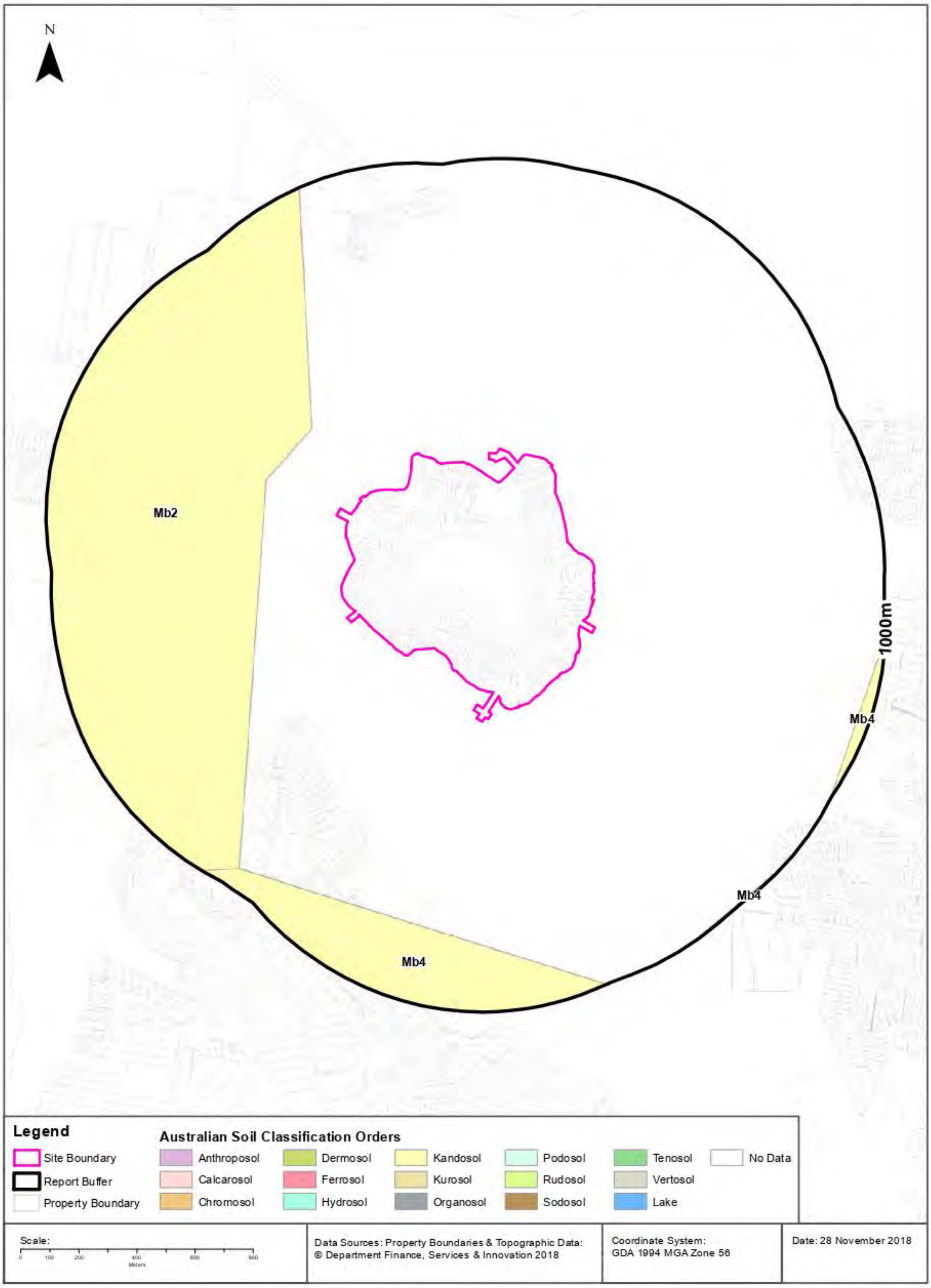
Atlas of Australian Soils

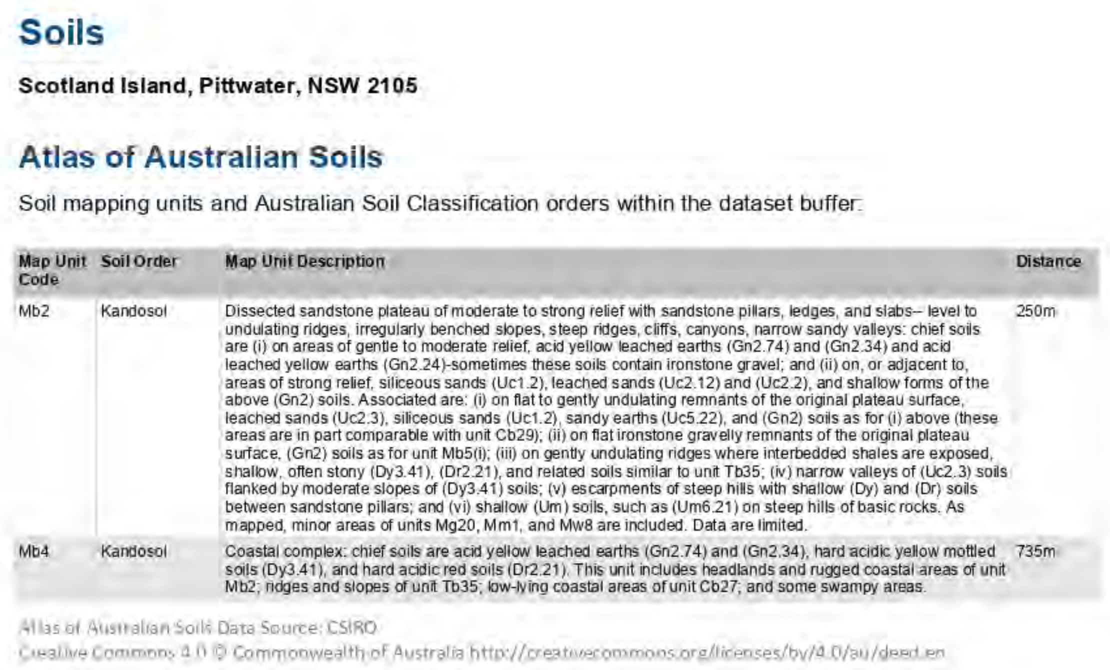
Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data: © Department Finance, Services & Innovation 2018

Coordinate System: GDA 1994 MGA Zone 56

Date: 28 November 2018



Soils

Scotland Island, Pittwater, NSW 2105

Atlas of Australian Soils

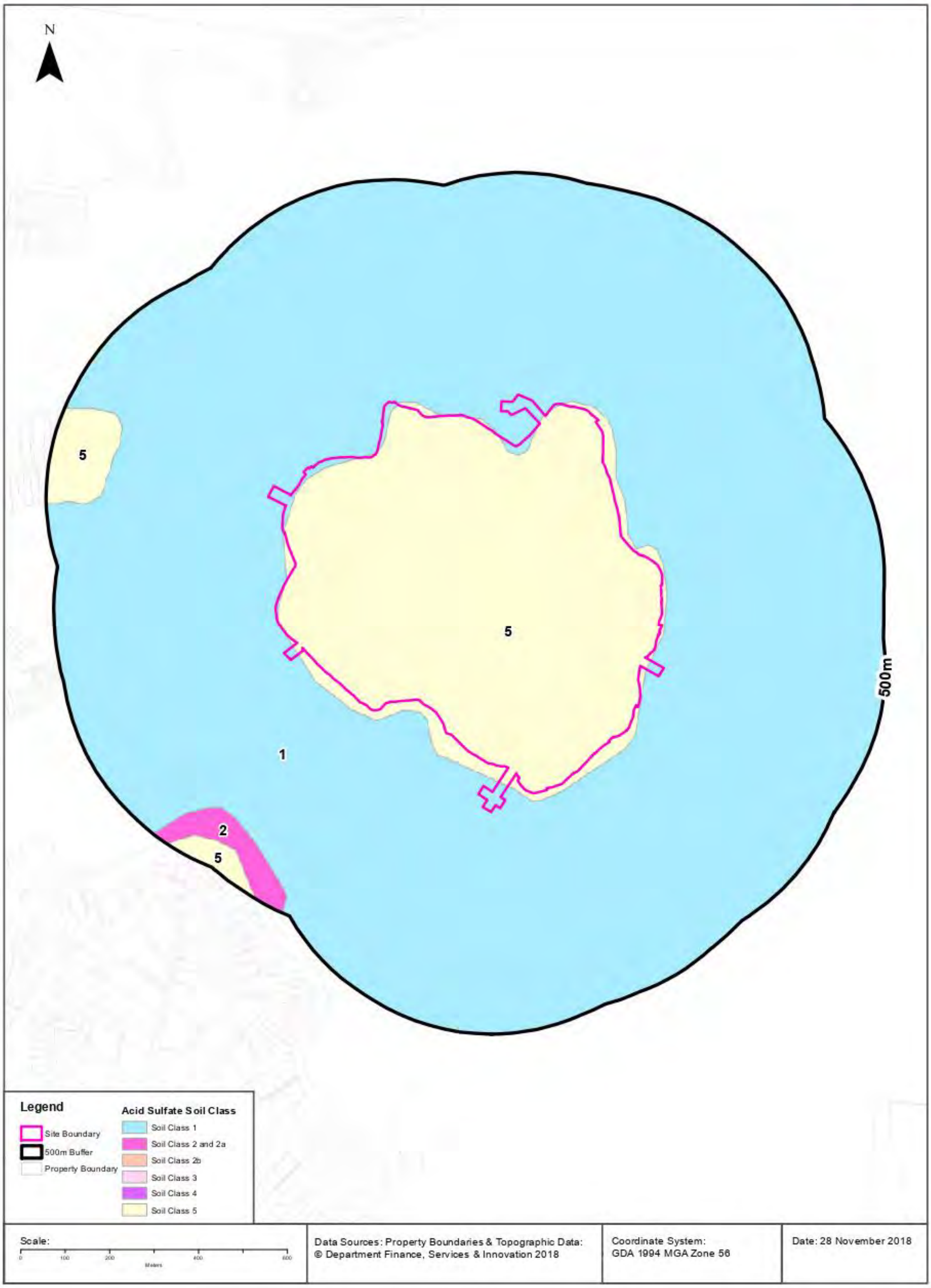
Soil mapping units and Australian Soil Classification orders within the dataset buffer:

Map Unit Code	Soil Order	Map Unit Description	Distance
Mb2	Kandosol	Dissected sandstone plateau of moderate to strong relief with sandstone pillars, ledges, and slabs-- level to undulating ridges, irregularly benched slopes, steep ridges, cliffs, canyons, narrow sandy valleys: chief soils are (i) on areas of gentle to moderate relief, acid yellow leached earths (Gn2.74) and (Gn2.34) and acid leached yellow earths (Gn2.24)-sometimes these soils contain ironstone gravel; and (ii) on, or adjacent to, areas of strong relief, siliceous sands (Uc1.2), leached sands (Uc2.12) and (Uc2.2), and shallow forms of the above (Gn2) soils. Associated are: (i) on flat to gently undulating remnants of the original plateau surface, leached sands (Uc2.3), siliceous sands (Uc1.2), sandy earths (Uc5.22), and (Gn2) soils as for (i) above (these areas are in part comparable with unit Cb29); (ii) on flat ironstone gravelly remnants of the original plateau surface, (Gn2) soils as for unit Mb5(i); (iii) on gently undulating ridges where interbedded shales are exposed, shallow, often stony (Dy3.41), (Dr2.21), and related soils similar to unit Tb35; (iv) narrow valleys of (Uc2.3) soils flanked by moderate slopes of (Dy3.41) soils; (v) escarpments of steep hills with shallow (Dy) and (Dr) soils between sandstone pillars; and (vi) shallow (Um) soils, such as (Um6.21) on steep hills of basic rocks. As mapped, minor areas of units Mg20, Mm1, and Mw8 are included. Data are limited.	250m
Mb4	Kandosol	Coastal complex: chief soils are acid yellow leached earths (Gn2.74) and (Gn2.34), hard acidic yellow mottled soils (Dy3.41), and hard acidic red soils (Dr2.21). This unit includes headlands and rugged coastal areas of unit Mb2; ridges and slopes of unit Tb35; low-lying coastal areas of unit Cb27; and some swampy areas.	735m

Atlas of Australian Soils Data Source: CSIRO

Acid Sulfate Soils

Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data:
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Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Acid Sulfate Soils

Scotland Island, Pittwater, NSW 2105

Environmental Planning Instrument - Acid Sulfate Soils

What is the on-site Acid Sulfate Soil Plan Class that presents the largest environmental risk?

Soil Class	Description	EPI
1	Any works present an environmental risk	Pittwater Local Environmental Plan 2014

If the on-site Soil Class is 5, what other soil classes exist within 500m?

Soil Class	Description	EPI	Distance	Direction
N/A				

Acid Sulfate Data Source Accessed 23/10/2018: NSW Crown Copyright - Planning and Environment
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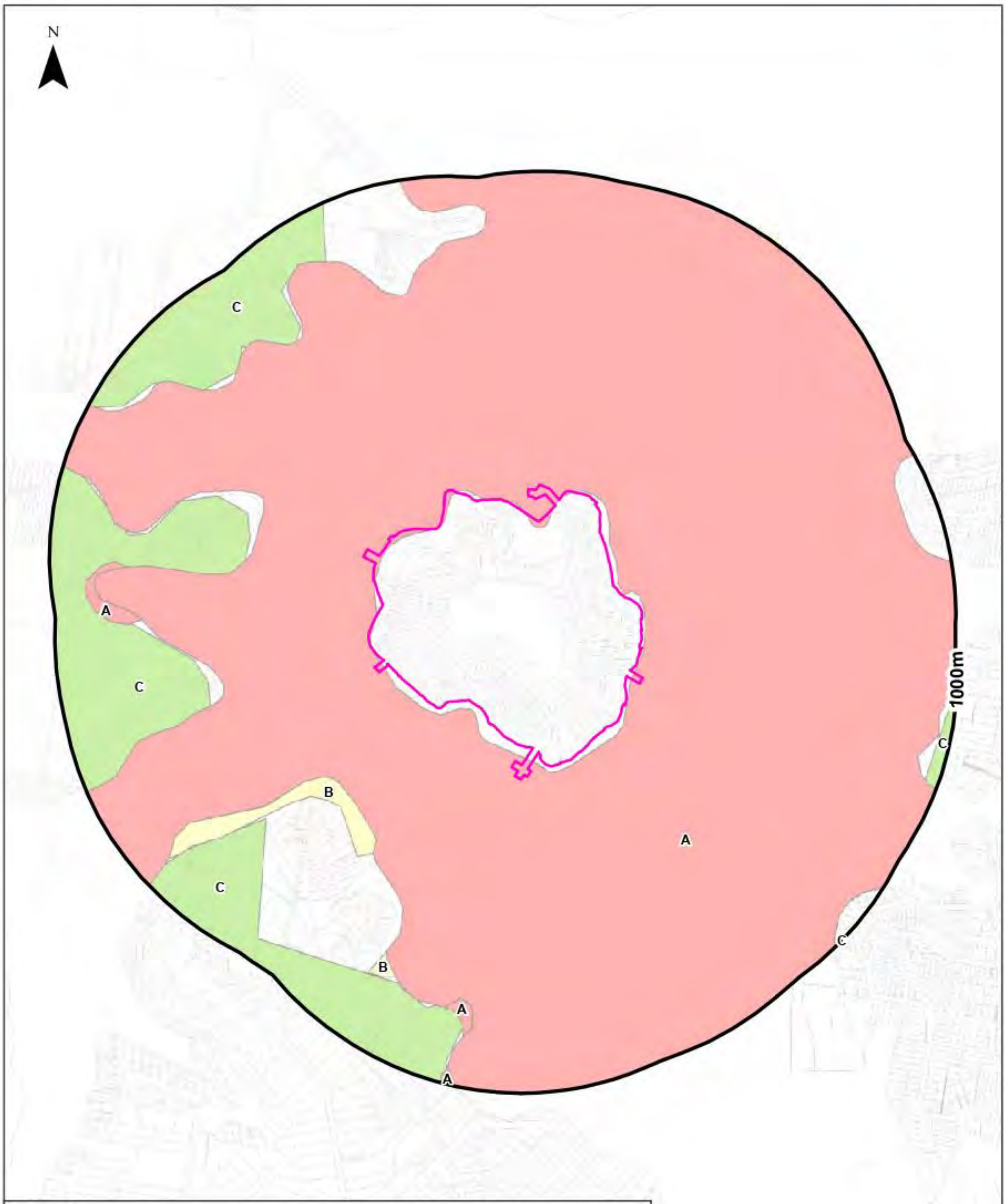
Atlas of Australian Acid Sulfate Soils

Scotland Island, Pittwater, NSW 2105



Legend

☐ Site Boundary
☐ Report Buffer
☐ Property Boundary

Probability of occurrence of Acid Sulfate Soils

🟥 A. High (>70%)
🟨 B. Low (6-70%)
🟩 C. Extremely Low (1-5%)
⬜ D. No Chance (0%)
☐ No Data

Scale: 0 100 200 400 600 800 Meters

Data Sources: Property Boundaries & Topographic Data:
© Department Finance, Services & Innovation 2018

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28November 2018

Acid Sulfate Soils

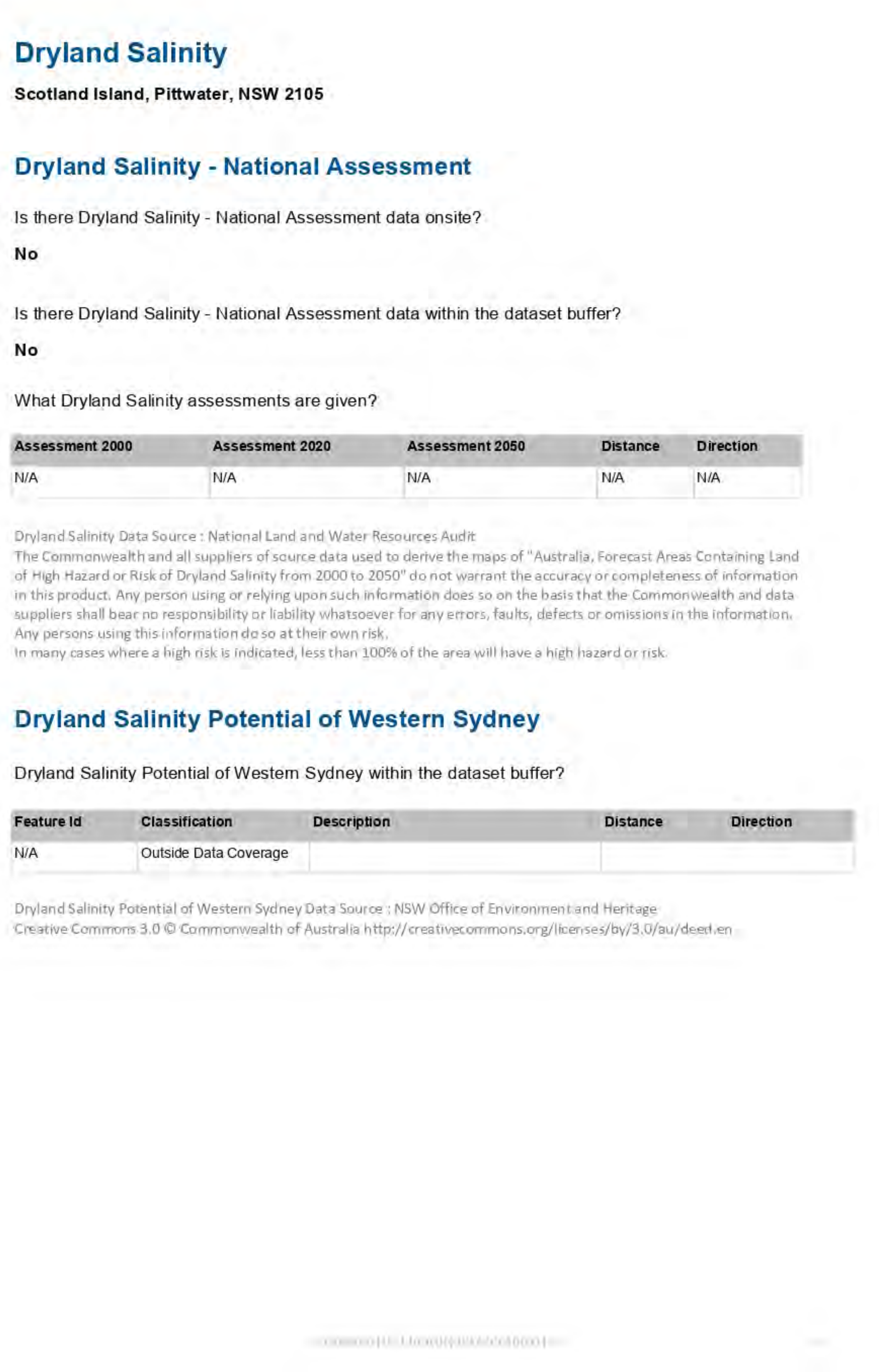
Scotland Island, Pittwater, NSW 2105

Atlas of Australian Acid Sulfate Soils

Atlas of Australian Acid Sulfate Soil categories within the dataset buffer:

Class	Description	Distance
A	High Probability of occurrence. >70% chance of occurrence.	0m
C	Extremely low probability of occurrence. 1-5% chance of occurrence with occurrences in small localised areas.	367m
B	Low Probability of occurrence. 6-70% chance of occurrence.	370m

Atlas of Australian Acid Sulfate Soils Data Source: CSIRO



Dryland Salinity

Scotland Island, Pittwater, NSW 2105

Dryland Salinity - National Assessment

Is there Dryland Salinity - National Assessment data onsite?

No

Is there Dryland Salinity - National Assessment data within the dataset buffer?

No

What Dryland Salinity assessments are given?

Assessment 2000	Assessment 2020	Assessment 2050	Distance	Direction
N/A	N/A	N/A	N/A	N/A

Dryland Salinity Data Source : National Land and Water Resources Audit
The Commonwealth and all suppliers of source data used to derive the maps of "Australia, Forecast Areas Containing Land of High Hazard or Risk of Dryland Salinity from 2000 to 2050" do not warrant the accuracy or completeness of information in this product. Any person using or relying upon such information does so on the basis that the Commonwealth and data suppliers shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information. Any persons using this information do so at their own risk.
In many cases where a high risk is indicated, less than 100% of the area will have a high hazard or risk.

Dryland Salinity Potential of Western Sydney

Dryland Salinity Potential of Western Sydney within the dataset buffer?

Feature Id	Classification	Description	Distance	Direction
N/A	Outside Data Coverage			

Dryland Salinity Potential of Western Sydney Data Source : NSW Office of Environment and Heritage
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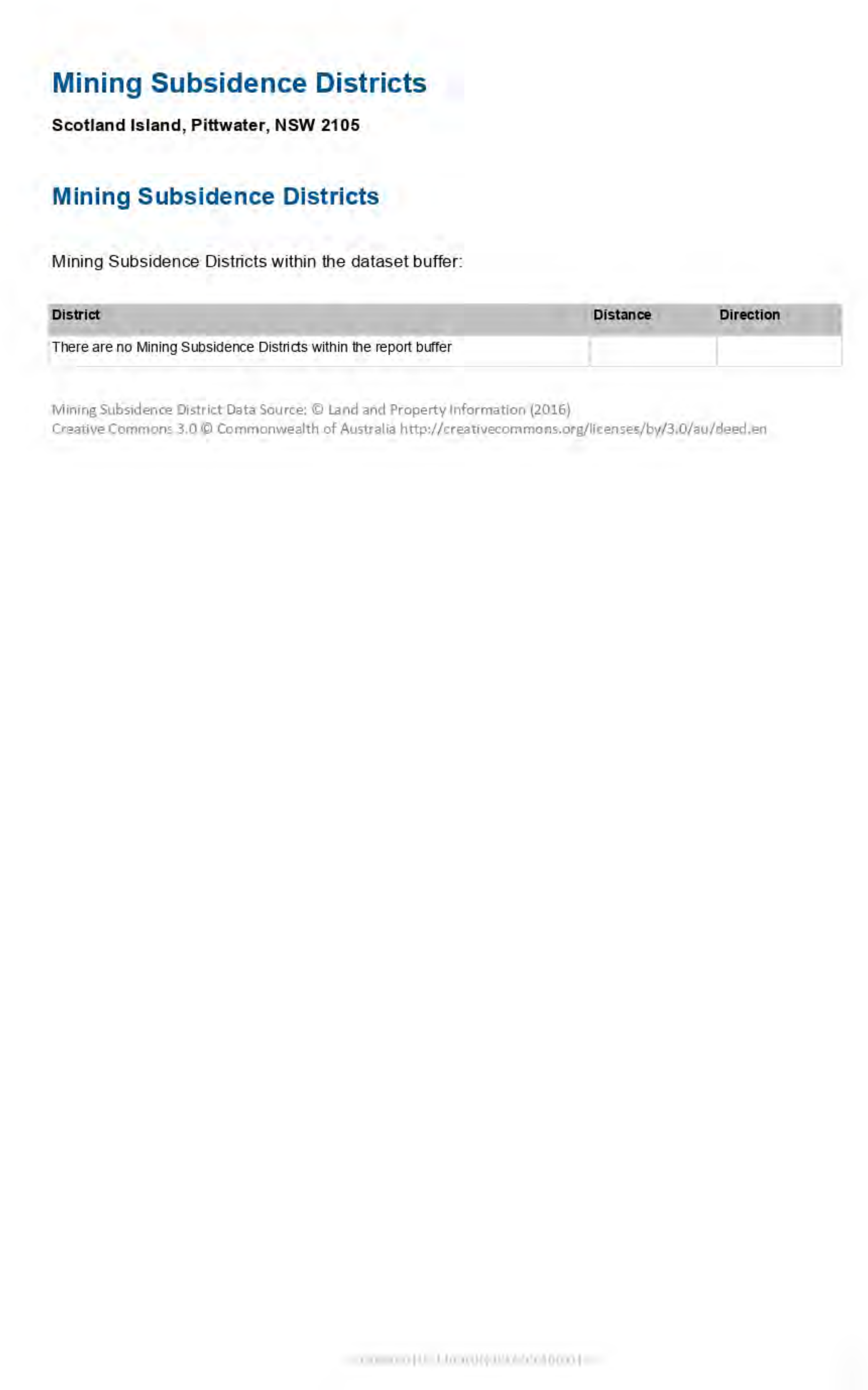

Mining Subsidence Districts

Scotland Island, Pittwater, NSW 2105

Mining Subsidence Districts

Mining Subsidence Districts within the dataset buffer:

District	Distance	Direction
There are no Mining Subsidence Districts within the report buffer		

Mining Subsidence District Data Source: © Land and Property Information (2016)
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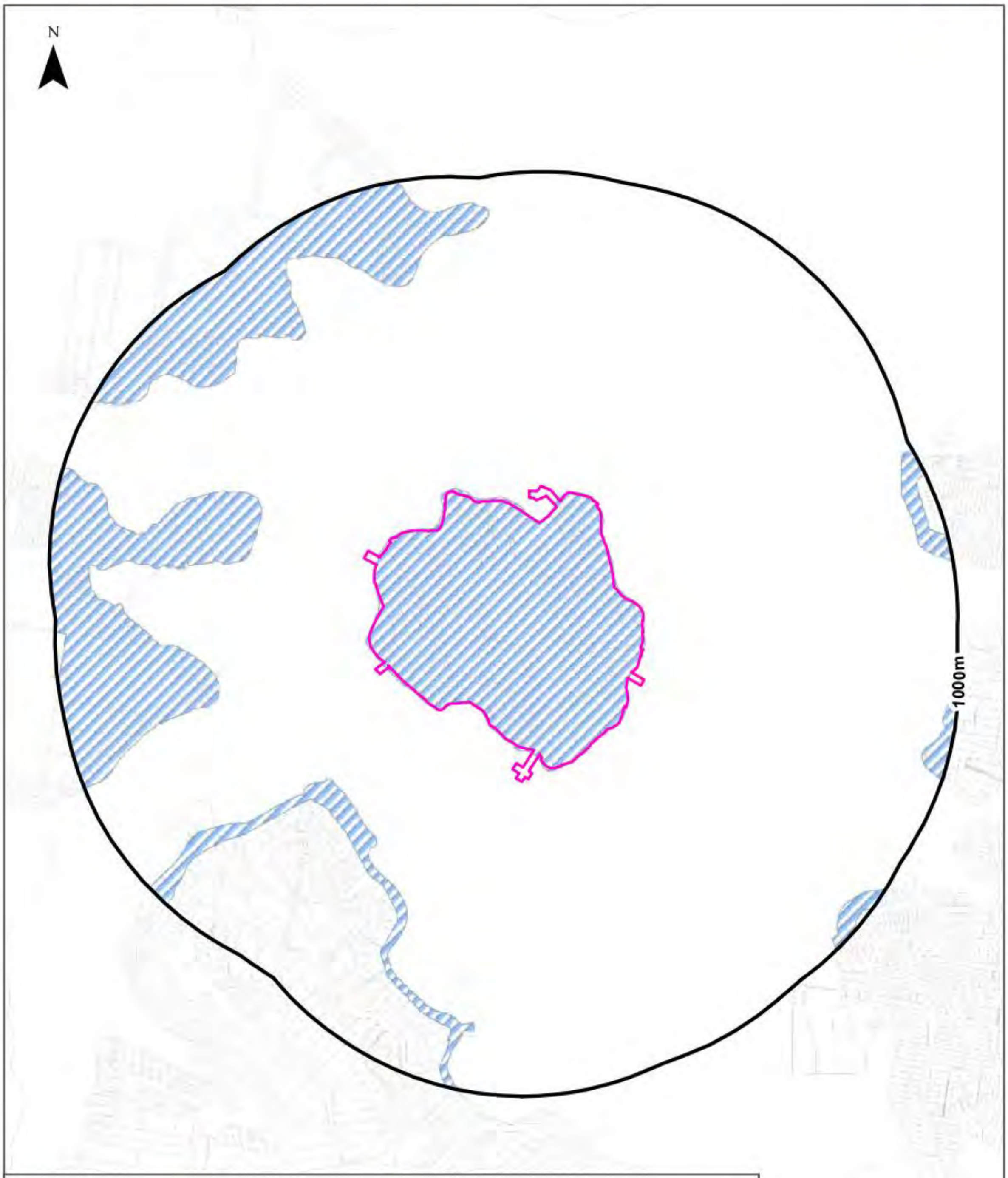
State Environmental Planning Policy

Scotland Island, Pittwater, NSW 2105



Legend

- ▭ Site Boundary
- ▭ Report Buffer
- ▭ Property Boundary
- 🟦 SEPP 14 - Coastal Wetlands
- 🟩 SEPP 26 - Littoral Rainforests
- ▨ SEPP 71 - Coastal Protection
- 🟧 SEPP Major Developments 2005
- ▨ Strategic Land Use - Future Residential Growth Areas
- ▨ Strategic Land Use - Additional Rural Village Land
- ▨ Strategic Land Use -Biophysical Strategic Agricultural Land
- ▨ Strategic Land Use -Critical Industry Cluster (Equine)
- ▨ Strategic Land Use -Critical Industry Cluster (Viticulture)

Scale: 0 100 200 400 600 800 Meters	Data Sources: Property Boundaries & Topographic Data: © Department Finance, Services & Innovation 2018	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018

Environmental Zoning

Scotland Island, Pittwater, NSW 2105

State Environmental Planning Policy Protected Areas

Are there any State Environmental Planning Policy Protected Areas onsite or within the dataset buffer?

Dataset	Onsite	Within Site Buffer	Distance
SEPP14 - Coastal Wetlands	No	No	N/A
SEPP26 - Littoral Rainforests	No	No	N/A
SEPP71 - Coastal Protection Zone	Yes - SEPP71 covers 98.32% of the site	Yes	0m

SEPP Protected Areas Data Source: NSW Department of Planning & Environment

State Environmental Planning Policy Major Developments (2005)

State Environmental Planning Policy Major Developments within the dataset buffer:

Map Id	Feature	Effective Date	Distance	Direction
N/A	No records within buffer			

SEPP Major Development Data Source: NSW Department of Planning & Environment

State Environmental Planning Policy Strategic Land Use Areas

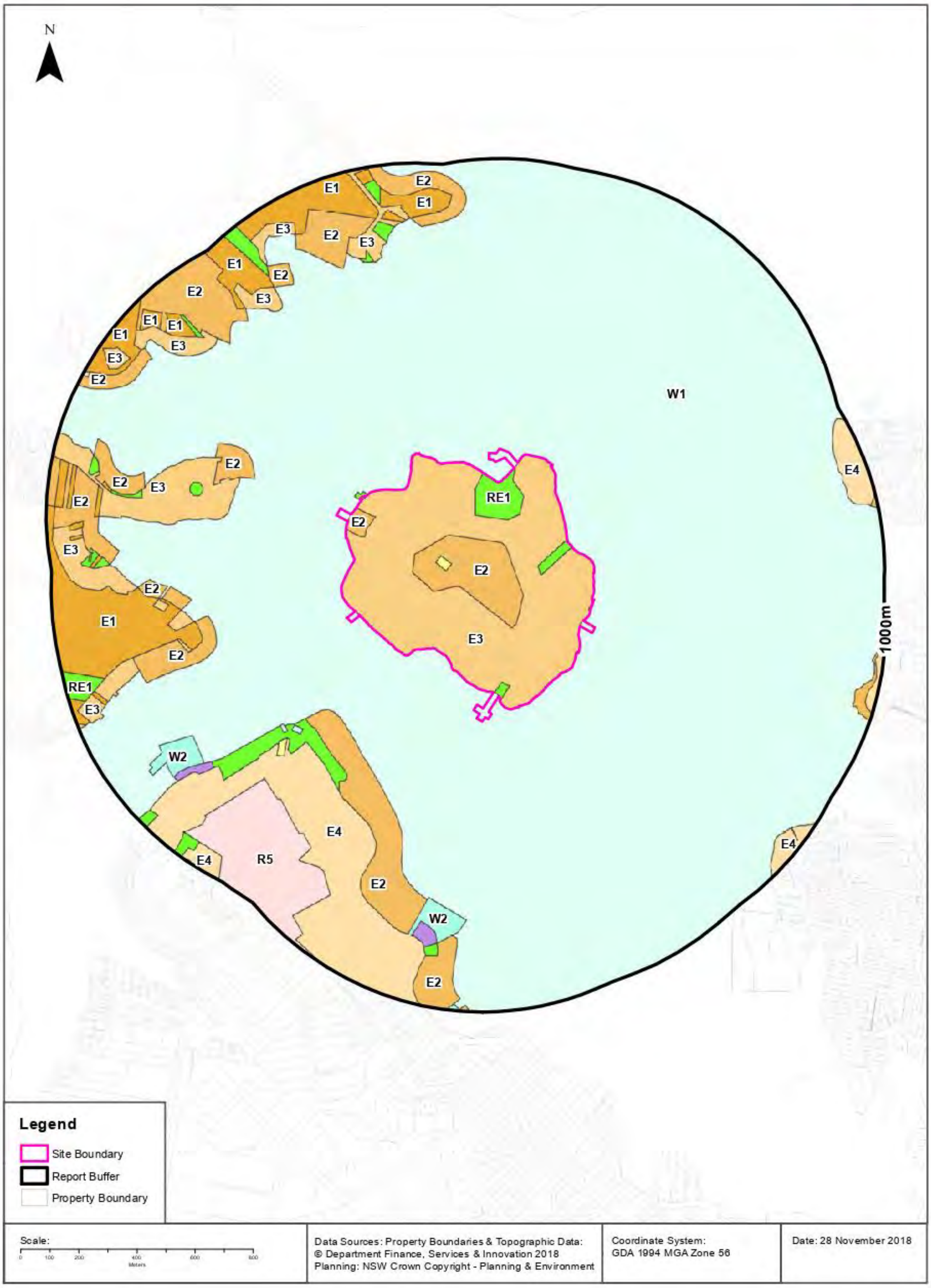
State Environmental Planning Policy Strategic Land Use Areas onsite or within the dataset buffer:

Strategic Land Use	SEPPNo	Effective Date	Amendment	Amendment Year	Distance	Direction
No records within buffer						

SEPP Strategic Land Use Data Source: NSW Department of Planning & Environment

EPI Planning Zones

Scotland Island, Pittwater, NSW 2105



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Coordinate System:
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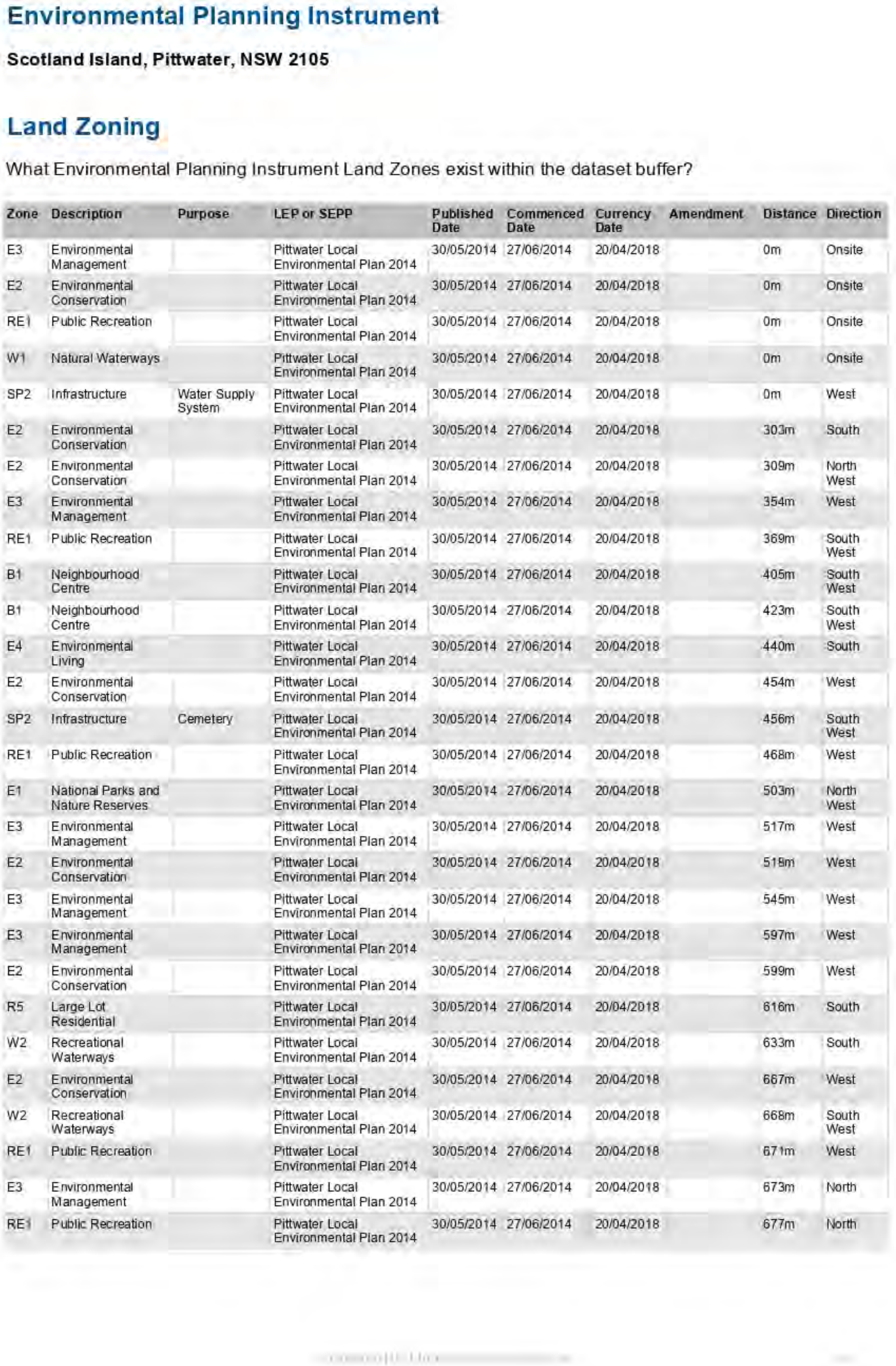
Date: 28 November 2018



Environmental Planning Instrument

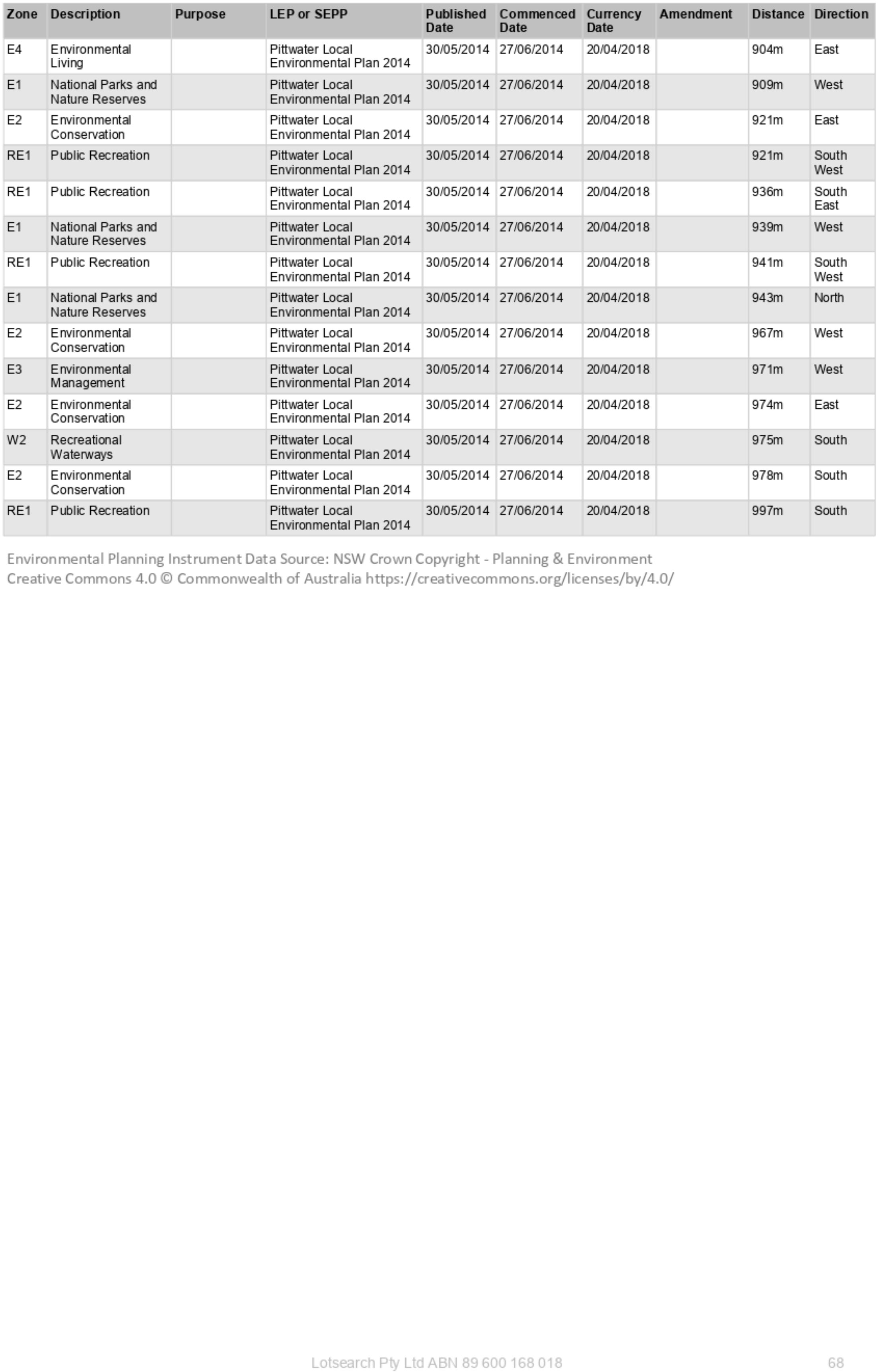
Scotland Island, Pittwater, NSW 2105

Land Zoning

What Environmental Planning Instrument Land Zones exist within the dataset buffer?

Zone	Description	Purpose	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		0m	Onsite
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		0m	Onsite
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		0m	Onsite
W1	Natural Waterways		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		0m	Onsite
SP2	Infrastructure	Water Supply System	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		0m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		303m	South
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		309m	North West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		354m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		369m	South West
B1	Neighbourhood Centre		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		405m	South West
B1	Neighbourhood Centre		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		423m	South West
E4	Environmental Living		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		440m	South
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		454m	West
SP2	Infrastructure	Cemetery	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		456m	South West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		468m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		503m	North West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		517m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		519m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		545m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		597m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		599m	West
R5	Large Lot Residential		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		616m	South
W2	Recreational Waterways		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		633m	South
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		667m	West
W2	Recreational Waterways		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		668m	South West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		671m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		673m	North
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		677m	North

Zone	Description	Purpose	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		679m	North West
IN4	Working Waterfront		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		680m	South West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		682m	North West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		684m	North West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		701m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		708m	North West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		719m	North West
IN4	Working Waterfront		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		719m	South
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		735m	North
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		738m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		743m	South
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		751m	North West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		759m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		768m	North West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		780m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		780m	South
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		782m	North
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		787m	North West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		798m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		799m	North
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		810m	North
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		820m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		824m	North West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		827m	North West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		830m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		831m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		858m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		862m	North
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		871m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		873m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		875m	West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		877m	North West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		884m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		889m	North West



Zone	Description	Purpose	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
E4	Environmental Living		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		904m	East
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		909m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		921m	East
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		921m	South West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		936m	South East
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		939m	West
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		941m	South West
E1	National Parks and Nature Reserves		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		943m	North
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		967m	West
E3	Environmental Management		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		971m	West
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		974m	East
W2	Recreational Waterways		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		975m	South
E2	Environmental Conservation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		978m	South
RE1	Public Recreation		Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		997m	South

Environmental Planning Instrument Data Source: NSW Crown Copyright - Planning & Environment
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Environmental Planning Instrument

Scotland Island, Pittwater, NSW 2105

Minimum Lot Size

What are the onsite Environmental Planning Instrument Minimum Lot Sizes?

Symbol	Minimum Lot Size	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
X1	5800 m²	Pittwater Local Environmental Plan 2014	17/07/2015	17/07/2015	25/09/2015	Amendment No 4	79.49

Maximum Height of Buildings

What are the onsite Environmental Planning Instrument Maximum Height of Buildings?

Symbol	Maximum Height of Building	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
9	8.50 m	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	20/04/2018		98.3

Floor Space Ratio

What are the onsite Environmental Planning Instrument Floor Space Ratios?

Symbol	Floor Space Ratio	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
No Data							

Land Application

What are the onsite Environmental Planning Instrument Land Applications?

Application Type	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
Included	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	27/06/2014		100

Land Reservation Acquisition

What are the onsite Environmental Planning Instrument Land Reservation Acquisitions?

Reservation	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Comments	Percentage of Site Area
No Data							

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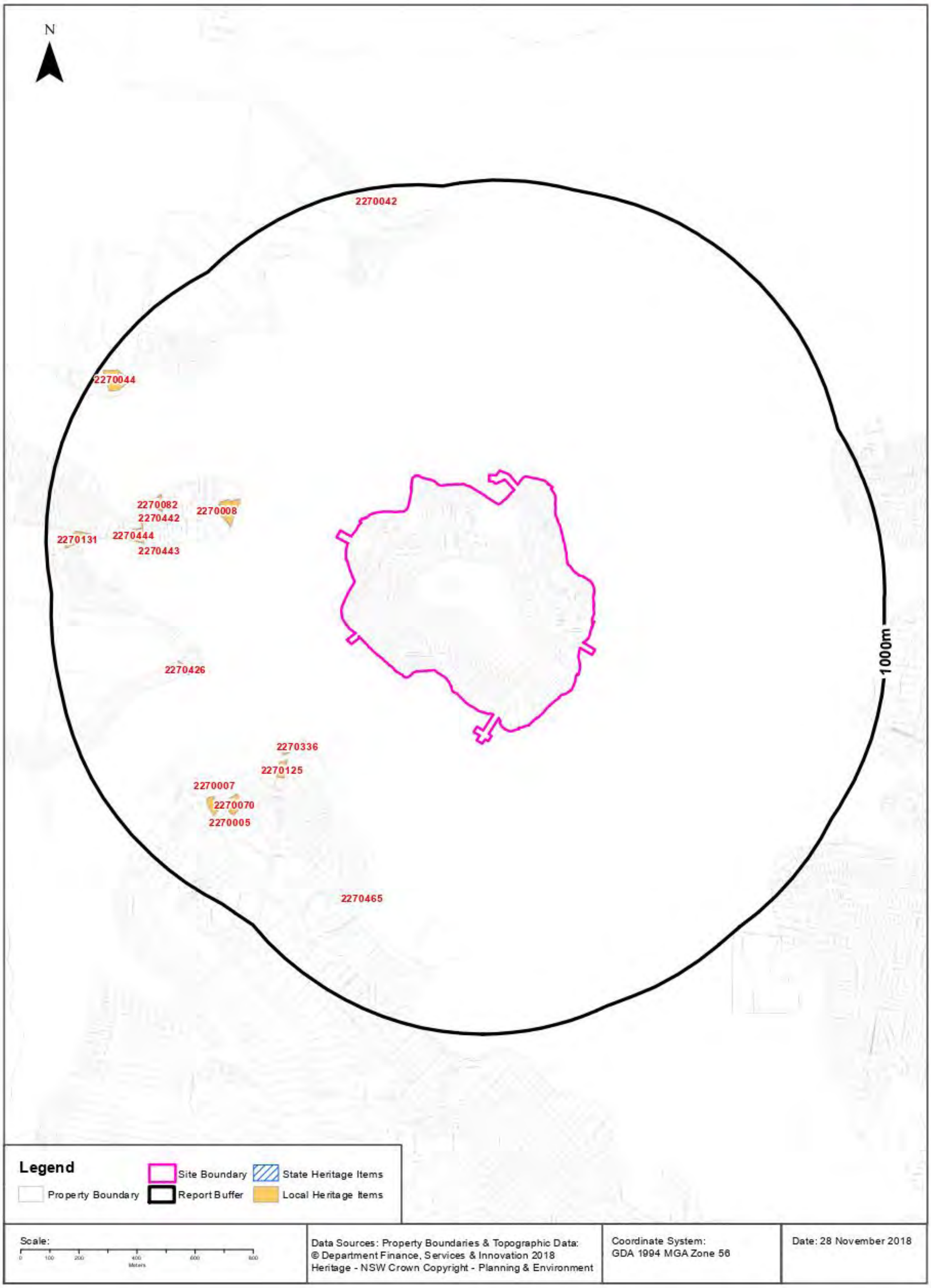
Heritage Items

Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data:
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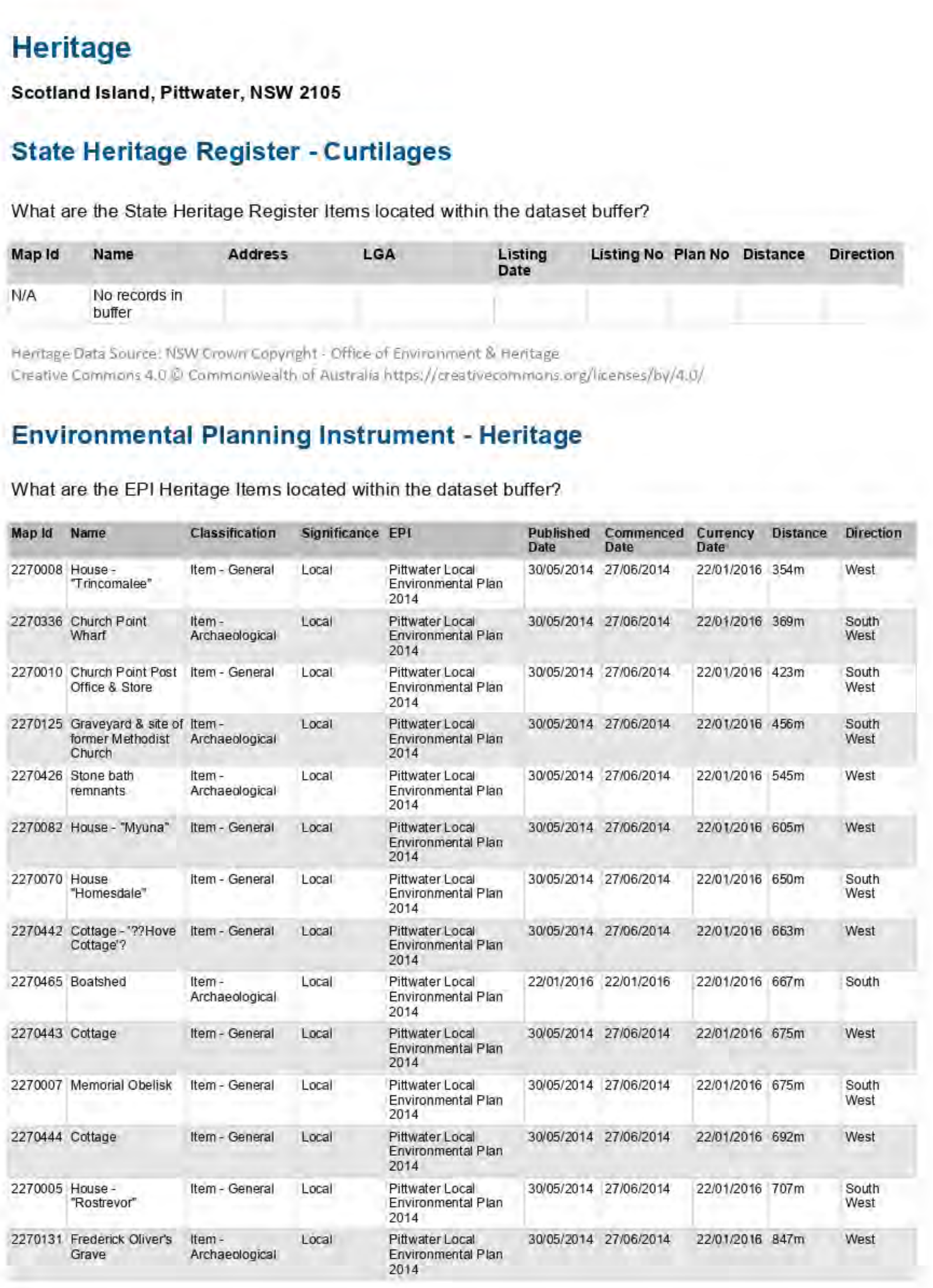
Heritage - NSW Crown Copyright - Planning & Environment

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018



Heritage

Scotland Island, Pittwater, NSW 2105

State Heritage Register - Curtilages

What are the State Heritage Register Items located within the dataset buffer?

Map Id	Name	Address	LGA	Listing Date	Listing No	Plan No	Distance	Direction
N/A	No records in buffer							

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Environmental Planning Instrument - Heritage

What are the EPI Heritage Items located within the dataset buffer?

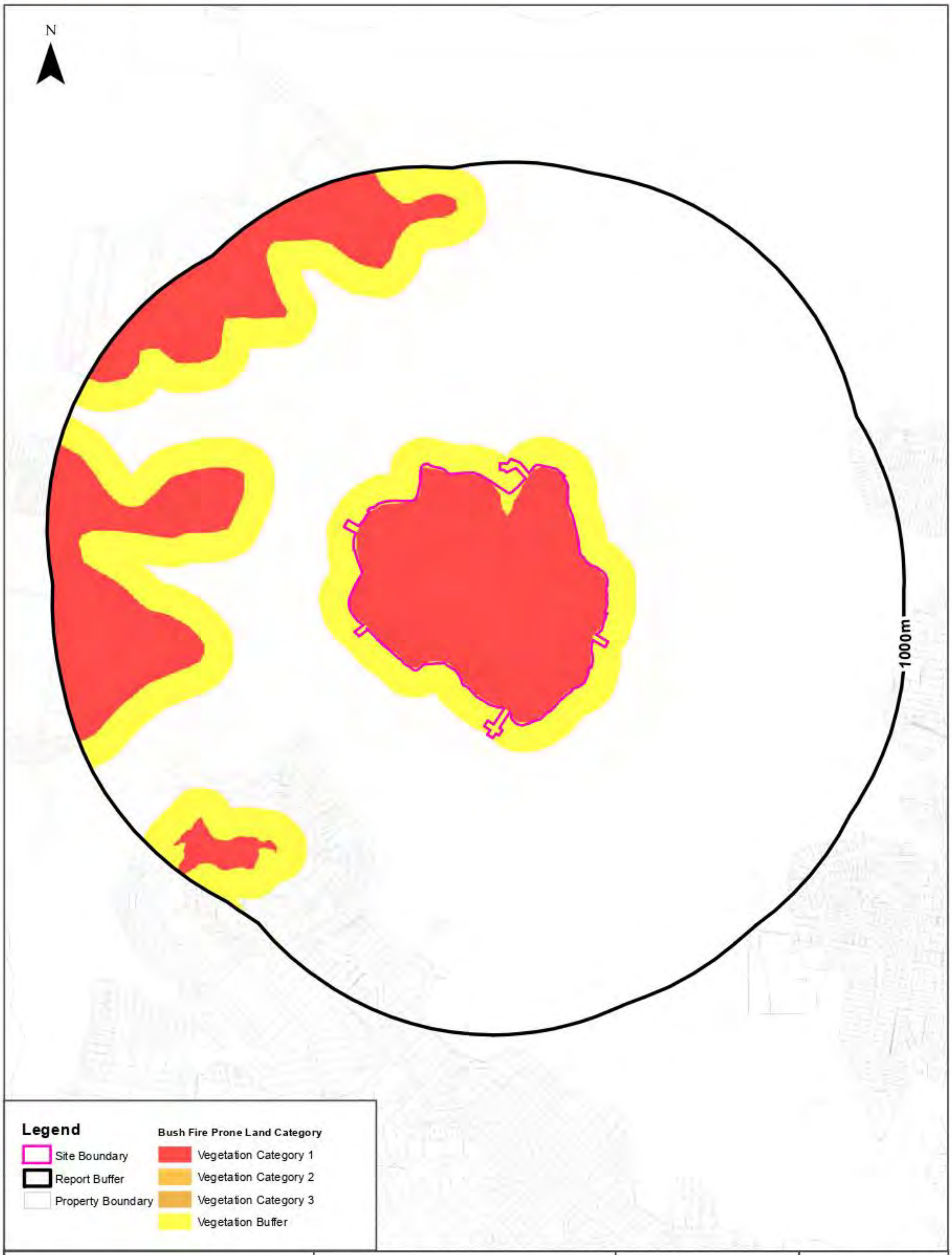
Map Id	Name	Classification	Significance	EPI	Published Date	Commenced Date	Currency Date	Distance	Direction
2270008	House - "Trincomalee"	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	354m	West
2270336	Church Point Wharf	Item - Archaeological	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	369m	South West
2270010	Church Point Post Office & Store	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	423m	South West
2270125	Graveyard & site of former Methodist Church	Item - Archaeological	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	456m	South West
2270426	Stone bath remnants	Item - Archaeological	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	545m	West
2270082	House - "Myuna"	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	605m	West
2270070	House "Homesdale"	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	650m	South West
2270442	Cottage - "??Hove Cottage"?	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	663m	West
2270465	Boatshed	Item - Archaeological	Local	Pittwater Local Environmental Plan 2014	22/01/2016	22/01/2016	22/01/2016	667m	South
2270443	Cottage	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	675m	West
2270007	Memorial Obelisk	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	675m	South West
2270444	Cottage	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	692m	West
2270005	House - "Rostrevor"	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	707m	South West
2270131	Frederick Oliver's Grave	Item - Archaeological	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	847m	West

Map Id	Name	Classification	Significance	EPI	Published Date	Commenced Date	Currency Date	Distance	Direction
2270044	House - "Tarrangaua"	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	889m	North West
2270042	Store, jetty & shed	Item - General	Local	Pittwater Local Environmental Plan 2014	30/05/2014	27/06/2014	22/01/2016	950m	North

Heritage Data Source: NSW Crown Copyright - Planning & Environment

Natural Hazards - Bush Fire Prone Land

Scotland Island, Pittwater, NSW 2105



Legend

☐	Site Boundary	🟥	Vegetation Category 1
☐	Report Buffer	🟧	Vegetation Category 2
☐	Property Boundary	🟧	Vegetation Category 3
		🟨	Vegetation Buffer

Bush Fire Prone Land Category

Scale: 0 100 200 400 600 800 Meters	Data Sources: Bush Fire Prone Land: © NSW Rural Fire Service 2018. Property Boundaries: © Department Finance, Services & Innovation 2018	Coordinate System: GDA 1994 MGA Zone 56	Date: 28 November 2018

Natural Hazards

Scotland Island, Pittwater, NSW 2105

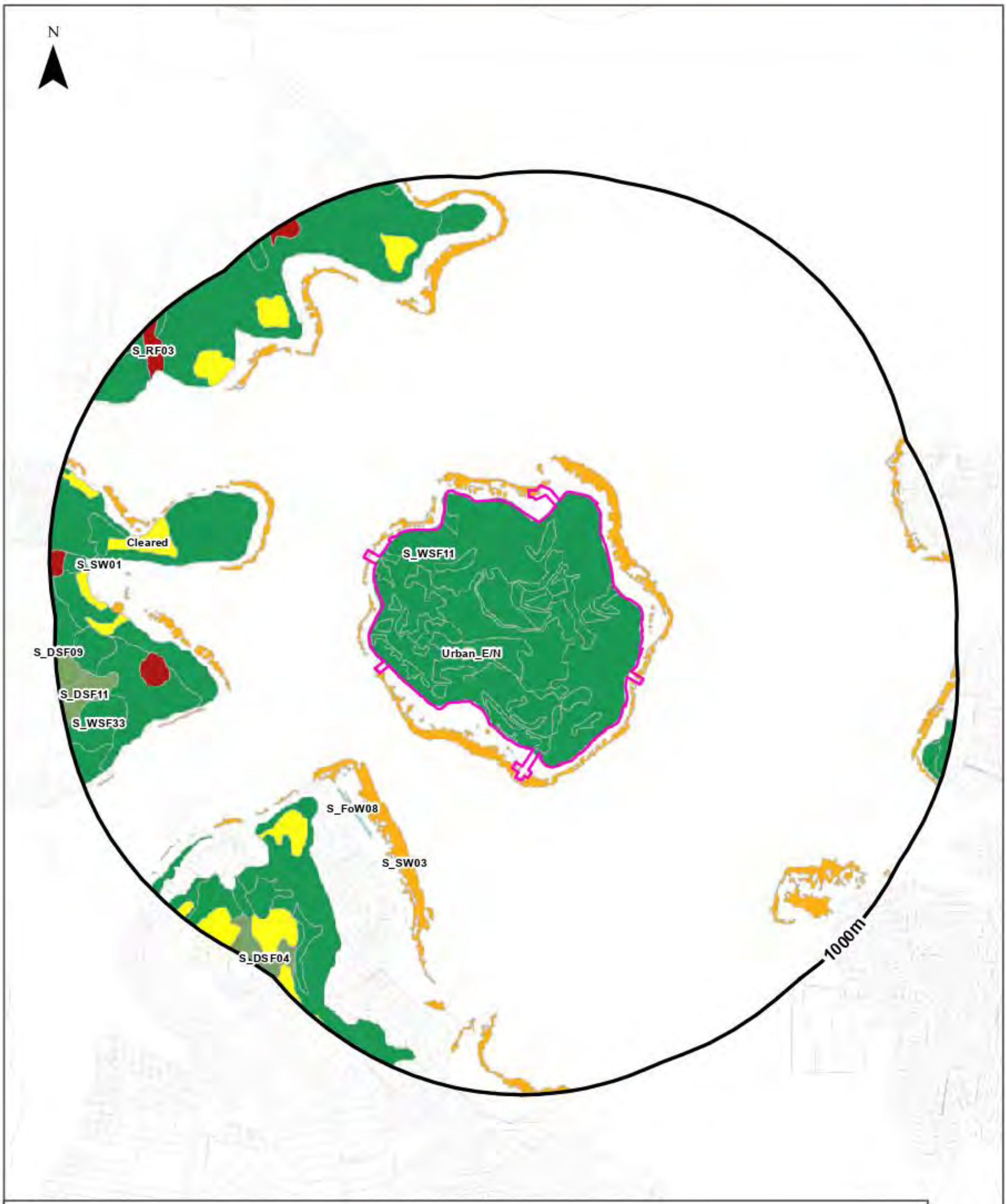
Bush Fire Prone Land

What are the nearest Bush Fire Prone Land Categories that exist within the dataset buffer?

Bush Fire Prone Land Category	Distance	Direction
Vegetation Buffer	0m	Onsite
Vegetation Category 1	0m	Onsite

Ecological Constraints - Native Vegetation & RAMSAR Wetlands

Scotland Island, Pittwater, NSW 2105



Legend

- ☐ Site Boundary
- ☐ Report Buffer
- ☐ Property Boundary
- 🟥 Rainforest
- 🟩 Wet Sclerophyll Forests
- 🟩 Dry Sclerophyll Forests
- 🟦 Forested Wetlands
- 🟪 Grassy Woodlands
- 🟪 Heathlands
- 🟪 Grasslands
- 🟦 Freshwater Wetlands
- 🟧 Saline Wetlands
- 🟦 Artificial Wetlands
- ▨ RAMSAR Wetlands
- 🟦 Water
- 🟨 Other

Scale: 0 100 200 400 600 800 Meters

Propert Boundary Data Source:
© Department Finance, Services & Innovation 2018

Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Ecological Constraints

Scotland Island, Pittwater, NSW 2105

Native Vegetation

What native vegetation exists within the dataset buffer?

Map ID	Map Unit Name	Threatened Ecological Community NSW	Threatened Ecological Community EPBC Act	Understorey	Disturbance	Disturbance Index	Dominant Species	Dist	Direction
S_SW03	S_SW03: Seagrass Meadows			00: Not assessed	00: Not assessed	0: Not assessed	Seagrass (DPI)	0m	Onsite
S_WSF11	S_WSF11: Pittwater Spotted Gum Forest	Pittwater Spotted Gum Forest		00: Not assessed	00: Not assessed	0: Not assessed	C.maculata/E.paniculata/S.glomulifera/E.umbra	0m	Onsite
S_WSF11	S_WSF11: Pittwater Spotted Gum Forest	Pittwater Spotted Gum Forest		24: Urban and hard surface	24: Urban mixed use	4: Very high	C.maculata/E.paniculata/S.glomulifera/E.umbra	0m	Onsite
Urban_E/N	Urban_E/N: Urban Exotic/Native			00: Not assessed	00: Not assessed	0: Not assessed	Urban Exotic/Native	0m	Onsite
S_FoW08	S_FoW08: Estuarine Swamp Oak Forest	Swamp Oak Floodplain Forest		00: Not assessed	00: Not assessed	0: Not assessed	C.glauca	392m	South West
Cleared	Cleared			00: Not assessed	00: Not assessed	0: Not assessed	Cleared	512m	South West
S_RF03	S_RF03: Coastal Warm Temperate Rainforest			10: Mesic/rainforest	15: Regrowth	2: Moderate	C.apetalum/A.smithii/L.australis/S.glandulosum	641m	West
S_SW01	S_SW01: Estuarine Mangrove Forest			00: Not assessed	00: Not assessed	0: Not assessed	Mangroves	746m	South
S_WSF33	S_WSF33: Central Coast Escarpment Moist Forest			11: Semi sheltered dry/mesic	24: Urban mixed use	4: Very high	Eucalyptus botryoides/A.costata/E.paniculata/S.glomulifera/E.piperita	788m	West
S_DSF11	S_DSF11: Sydney North Exposed Sandstone Woodland			12: Dry xeric shrubs	99: No visible disturbance	5: No visible disturbance	E.haemastoma/B.serrata	806m	West
S_DSF04	S_DSF04: Coastal Enriched Sandstone Dry Forest			24: Urban and hard surface	24: Urban mixed use	4: Very high	A.costata/E.botryoides/E.piperata	874m	South West
S_DSF09	S_DSF09: Coastal Sandstone Gully Forest			11: Semi sheltered dry/mesic	99: No visible disturbance	5: No visible disturbance	A.costata/E.piperita/C.gummifera/S.glomulifera/E.resinifera	896m	West

Native Vegetation of the Sydney Metropolitan Area : NSW Office of Environment and Heritage

RAMSAR Wetlands

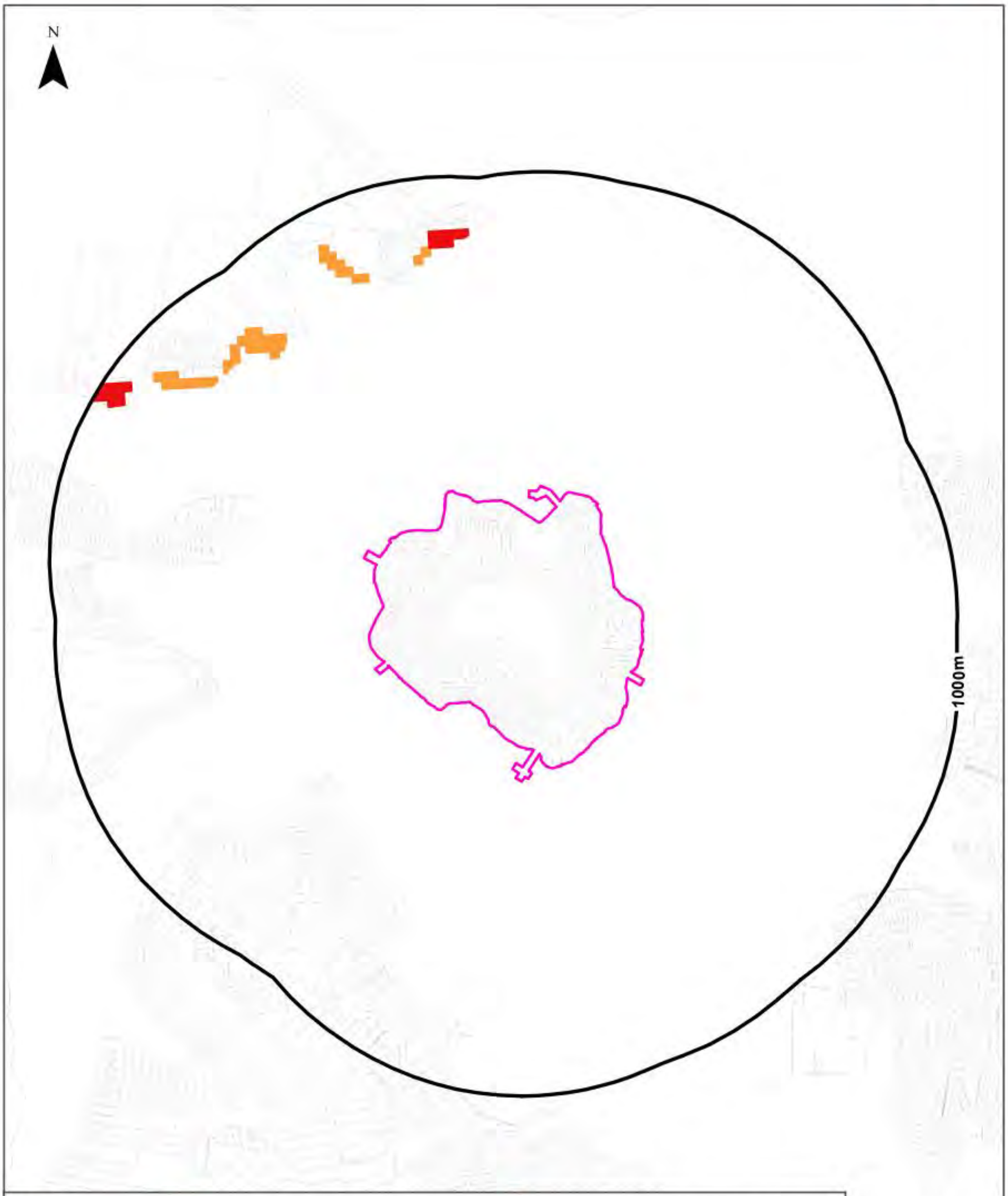
What RAMSAR Wetland areas exist within the dataset buffer?

Map Id	RAMSAR Name	Wetland Name	Designation Date	Source	Distance	Direction
N/A	No records in buffer					

RAMSAR Wetlands Data Source: © Commonwealth of Australia - Department of Environment

Ecological Constraints - Groundwater Dependent Ecosystems Atlas

Scotland Island, Pittwater, NSW 2105



Legend

- 🟪 Site Boundary
- ⬛ Report Buffer
- ⬜ Property Boundaries
- 🟥 High potential GDE - from national assessment
- ▨ High potential GDE - from regional studies
- 🟧 Moderate potential GDE - from national assessment
- ▨ Moderate potential GDE - from regional studies
- 🟦 Low potential GDE - from national assessment
- ▨ Low potential GDE - from regional studies
- ▨ Known GDE - from regional studies
- 🟪 Unclassified potential GDE - from national assessment
- ▨ Unclassified potential GDE - from regional studies

Scale:
0 100 200 400 600 800
Meters

Data Sources: Property Boundaries & Topographic Data:
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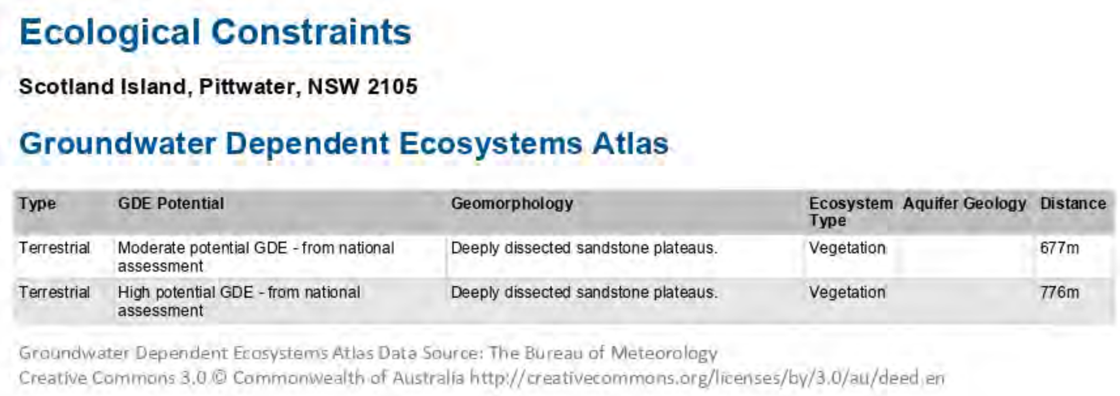
Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018



Ecological Constraints

Scotland Island, Pittwater, NSW 2105

Groundwater Dependent Ecosystems Atlas

Type	GDE Potential	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	Moderate potential GDE - from national assessment	Deeply dissected sandstone plateaus.	Vegetation		677m
Terrestrial	High potential GDE - from national assessment	Deeply dissected sandstone plateaus.	Vegetation		776m

Groundwater Dependent Ecosystems Atlas Data Source: The Bureau of Meteorology
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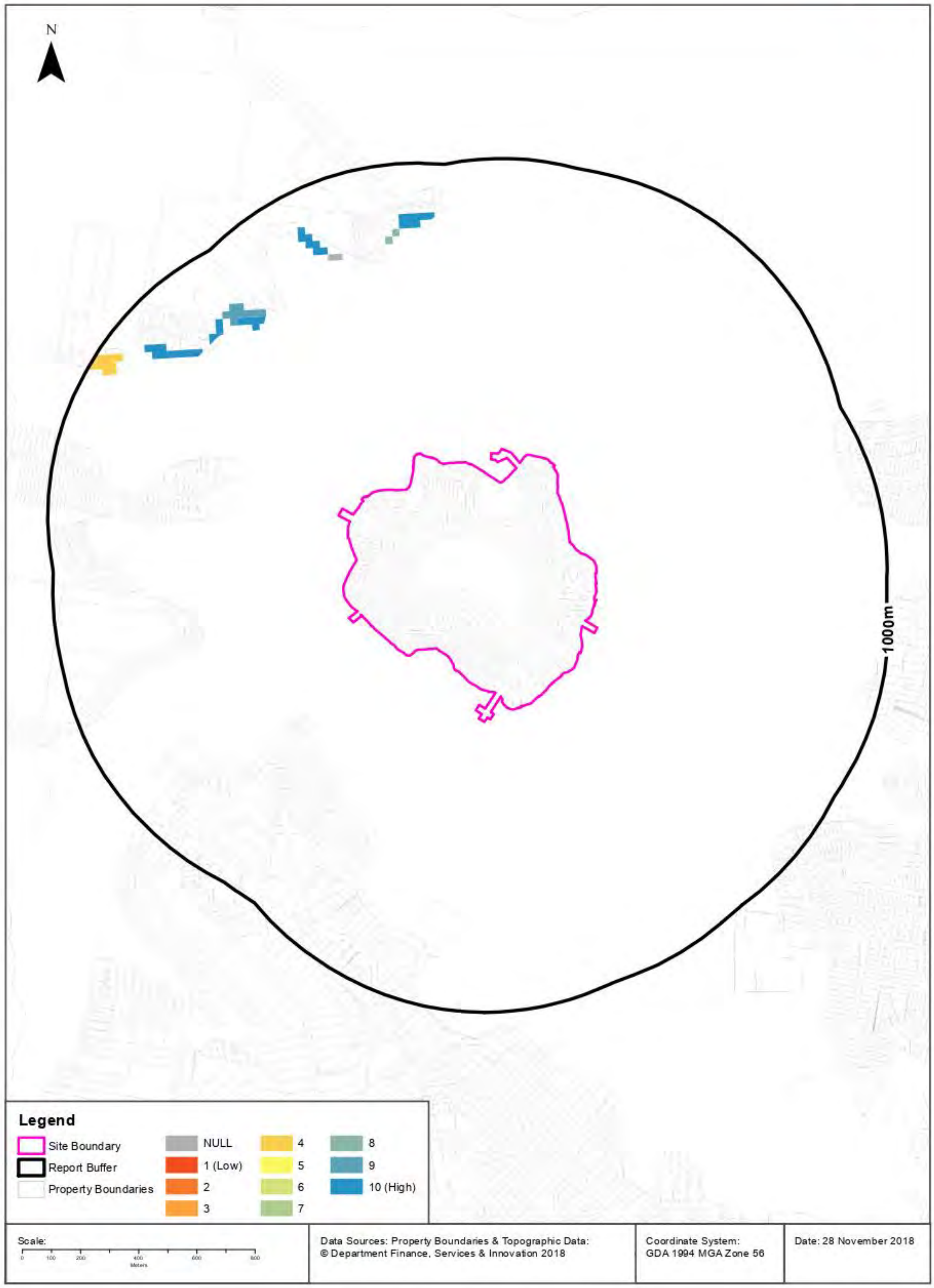
Ecological Constraints - Inflow Dependent Ecosystems Likelihood

Scotland Island, Pittwater, NSW 2105



Data Sources: Property Boundaries & Topographic Data:
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Coordinate System:
GDA 1994 MGA Zone 56

Date: 28 November 2018

Ecological Constraints

Scotland Island, Pittwater, NSW 2105

Inflow Dependent Ecosystems Likelihood

Type	IDE Likelihood	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	10	Deeply dissected sandstone plateaus.	Vegetation		677m
Terrestrial	9	Deeply dissected sandstone plateaus.	Vegetation		702m
Terrestrial	8	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	727m
Terrestrial	4	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	903m

Inflow Dependent Ecosystems Likelihood Data Source: The Bureau of Meteorology
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Ecological Constraints

Scotland Island, Pittwater, NSW 2105

NSW BioNet Atlas

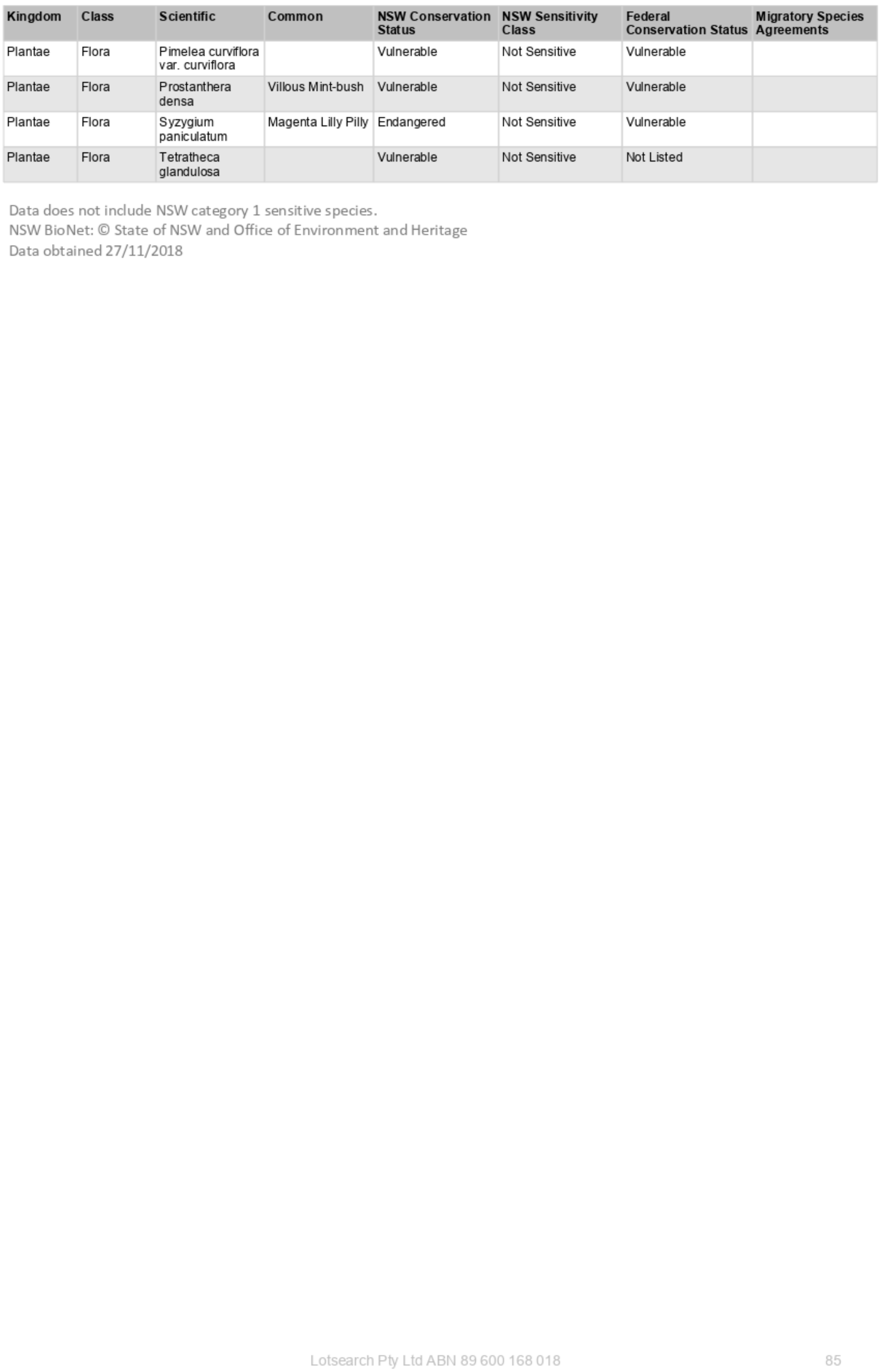
Species on the NSW BioNet Atlas that have a NSW or federal conservation status, a NSW sensitivity status, or are listed under a migratory species agreement, and are within 10km of the site?

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Amphibia	Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Amphibia	Litoria aurea	Green and Golden Bell Frog	Endangered	Not Sensitive	Vulnerable	
Animalia	Amphibia	Pseudophryne australis	Red-crowned Toadlet	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Anous stolidus	Common Noddy	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Not Sensitive	Critically Endangered	
Animalia	Aves	Apus pacificus	Fork-tailed Swift	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Ardea ibis	Cattle Egret	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Ardenna carneipes	Flesh-footed Shearwater	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Ardenna grisea	Sooty Shearwater	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Ardenna pacificus	Wedge-tailed Shearwater	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Ardenna tenuirostris	Short-tailed Shearwater	Not Listed	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Botaurus poiciloptilus	Australasian Bittern	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Burhinus grallarius	Bush Stone-curlew	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Calidris acuminata	Sharp-tailed Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Calidris ruficollis	Red-necked Stint	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies)	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Dasyornis brachypterus	Eastern Bristlebird	Endangered	Category 2	Endangered	
Animalia	Aves	Diomedea exulans	Wandering Albatross	Endangered	Not Sensitive	Endangered	JAMBA
Animalia	Aves	Diomedea gibsoni	Gibson's Albatross	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Aves	Egretta sacra	Eastern Reef Egret	Not Listed	Not Sensitive	Not Listed	CAMBA
Animalia	Aves	Fregata ariel	Lesser Frigatebird	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Gallinago hardwickii	Latham's Snipe	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not Sensitive	Not Listed	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Aves	Haematopus fuliginosus	Sooty Oystercatcher	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Haematopus longirostris	Pied Oystercatcher	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	Not Sensitive	Not Listed	CAMBA
Animalia	Aves	Halobaena caerulea	Blue Petrel	Not Listed	Not Sensitive	Vulnerable	
Animalia	Aves	Hieraaetus morphnoides	Little Eagle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Hirundapus caudacutus	White-throated Needletail	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Hydroprogne caspia	Caspian Tern	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Ixobrychus flavicollis	Black Bittern	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Lathamus discolor	Swift Parrot	Endangered	Category 3	Critically Endangered	
Animalia	Aves	Limosa lapponica	Bar-tailed Godwit	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Lophoictinia isura	Square-tailed Kite	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Macronectes giganteus	Southern Giant Petrel	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Merops ornatus	Rainbow Bee-eater	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Neophema pulchella	Turquoise Parrot	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox connivens	Barking Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox strenua	Powerful Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Numenius madagascariensis	Eastern Curlew	Not Listed	Not Sensitive	Critically Endangered	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Numenius phaeopus	Whimbrel	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Onychoprion fuscata	Sooty Tern	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Pandion cristatus	Eastern Osprey	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Petroica boodang	Scarlet Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Ptilinopus magnificus	Wompoo Fruit-Dove	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Ptilinopus superbus	Superb Fruit-Dove	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Rostratula australis	Australian Painted Snipe	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Thalassarche cauta	Shy Albatross	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Aves	Thalassarche chrysostoma	Grey-headed Albatross	Not Listed	Not Sensitive	Endangered	
Animalia	Aves	Thalassarche melanophris	Black-browed Albatross	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Aves	Tringa brevipes	Grey-tailed Tattler	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Tringa nebularia	Common Greenshank	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA
Animalia	Aves	Tyto novaehollandiae	Masked Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Tyto tenebricosa	Sooty Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Xenus cinereus	Terek Sandpiper	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;CAMBA;JAMBA

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Mammalia	Arctocephalus forsteri	New Zealand Fur-seal	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Arctocephalus pusillus doriferus	Australian Fur-seal	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Not Sensitive	Endangered	
Animalia	Mammalia	Dugong dugon	Dugong	Endangered	Not Sensitive	Not Listed	
Animalia	Mammalia	Eubalaena australis	Southern Right Whale	Endangered	Not Sensitive	Endangered	
Animalia	Mammalia	Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered	Not Sensitive	Endangered	
Animalia	Mammalia	Megaptera novaeangliae	Humpback Whale	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Miniopterus australis	Little Bentwing-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Mormopterus norfolkensis	Eastern Freetail-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Myotis macropus	Southern Myotis	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petauroides volans	Greater Glider	Not Listed	Not Sensitive	Vulnerable	
Animalia	Mammalia	Petaurus norfolcensis	Squirrel Glider	Endangered Population, Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Phascolarctos cinereus	Koala	Endangered Population, Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Phascolarctos cinereus	Koala	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Physeter macrocephalus	Sperm Whale	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Pseudomys novaehollandiae	New Holland Mouse	Not Listed	Not Sensitive	Vulnerable	
Animalia	Mammalia	Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Cacophis harriettae	White-crowned Snake	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Caretta caretta	Loggerhead Turtle	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Chelonia mydas	Green Turtle	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Reptilia	Dermochelys coriacea	Leatherback Turtle	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Eretmochelys imbricata	Hawksbill Turtle	Not Listed	Not Sensitive	Vulnerable	
Animalia	Reptilia	Varanus rosenbergi	Rosenberg's Goanna	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Asterolasia elegans		Endangered	Not Sensitive	Endangered	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Plantae	Flora	Astrotricha crassifolia	Thick-leaf Star-hair	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Boronia umbellata	Orara Boronia	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Brachyscome muelleroides	Claypan Daisy	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Callistemon linearifolius	Netted Bottle Brush	Vulnerable	Category 3	Not Listed	
Plantae	Flora	Chamaesyce psammogeton	Sand Spurge	Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Category 2	Vulnerable	
Plantae	Flora	Davidsonia jerseyana	Davidson's Plum	Endangered	Category 2	Endangered	
Plantae	Flora	Diuris bracteata		Endangered	Category 2	Extinct	
Plantae	Flora	Epacris purpurascens subsp. purpurascens		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Epacris purpurascens var. purpurascens		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Eucalyptus camfieldii	Camfield's Stringybark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Eucalyptus scoparia	Wallangarra White Gum	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Genoplesium baueri	Bauer's Midge Orchid	Endangered	Category 2	Endangered	
Plantae	Flora	Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Category 3	Not Listed	
Plantae	Flora	Grevillea caleyi	Caley's Grevillea	Critically Endangered	Category 3	Critically Endangered	
Plantae	Flora	Grevillea shiressii		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Haloragodendron lucasii		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Isotoma fluviatilis subsp. fluviatilis		Not Listed	Not Sensitive	Extinct	
Plantae	Flora	Kunzea rupestris		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Lasiopetalum joyceae		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Macadamia integrifolia	Macadamia Nut	Not Listed	Not Sensitive	Vulnerable	
Plantae	Flora	Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Maundia triglochinoides		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Melaleuca deanei	Deane's Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Micromyrtus blakelyi		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Microtis angusii	Angus's Onion Orchid	Endangered	Category 2	Endangered	
Plantae	Flora	Persoonia hirsuta	Hairy Geebung	Endangered	Category 3	Endangered	
Plantae	Flora	Persoonia laxa		Presumed Extinct	Not Sensitive	Extinct	
Plantae	Flora	Persoonia marginata	Clandulla Geebung	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Persoonia mollis subsp. maxima		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Persoonia pauciflora	North Rothbury Persoonia	Critically Endangered	Category 3	Critically Endangered	
Plantae	Flora	Pimelea curviflora subsp. curviflora		Vulnerable	Not Sensitive	Vulnerable	



Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Plantae	Flora	Pimelea curviflora var. curviflora		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Prostanthera densa	Villous Mint-bush	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Tetratheca glandulosa		Vulnerable	Not Sensitive	Not Listed	

Data does not include NSW category 1 sensitive species.
NSW BioNet: © State of NSW and Office of Environment and Heritage
Data obtained 27/11/2018

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Appendix E Ausgrid Contamination Investigation Report

GHD

Ausgrid

Scotland Island Energy Reliability Project
Contamination Investigation Report

October 2018

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

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Appendices

1. Introduction

1.1 General

Ausgrid engaged GHD Pty Ltd (GHD) to undertake a contamination assessment as part of the geotechnical investigation for input into detailed design phases of the Scotland Island Energy Reliability Project.

This report presents the findings of the targeted contamination assessment. The findings of the geotechnical investigation are presented under a separate cover (GHD ref. 21-27425-8323).

1.2 Project background

It is understood that Ausgrid are planning to re-enforce the electricity supply to Scotland Island. This is to be done with Horizontal Directional Drilling (HDD) to allow the installation of a second underground 11kV cable to the island between Church Point parking area and Carols Wharf. The HDD will comprise several High Density Polyethylene (HDPE) pipes with a nominal bore bundle diameter of 400mm and length of 650m.

1.3 Objectives

The objectives of this assessment were:

- Undertake a targeted intrusive site assessment in conjunction with the geotechnical investigation, to characterise subsurface conditions at the site and assess concentrations of contaminants of potential concern (COPC), in relation to human health for intrusive and maintenance workers during the construction.
- Use the findings of the intrusive investigation to inform whether environmental management or remediation is required on the site prior to Ausgrid's proposed development.
- Undertake a preliminary waste classification of the site and assess potential impact of human health during the construction and maintenance phase of the development.

1.4 Scope of work

In order to meet the stated objectives, GHD completed the following scope of works:

- Undertake targeted intrusive site investigations to characterise subsurface conditions and the site and assess concentrations of contaminants of potential concern (COPC).
- Laboratory analysis of selected soil samples; and
- Preparation of this factual report documenting the findings of the assessment and recommendations for the proposed development from a contamination perspective.

1.5 Limitations

GHD's limitations to the assessment are provided in **Section 9**.

2. Details of investigation

2.1 Site Setting

2.1.1 Locality

Located between Ku-ringai National Park and the Northern Beaches peninsula, the site is approximately 30km north of Sydney CBD and within the Pittwater Estuary. The proposed HDD alignment will run from the southern end of the Church Point parking area across approximately 650m of waterway to Carols Wharf on Scotland Island.

2.1.2 Geomorphology of Pittwater

Pittwater is a drowned river estuary, formed by rising sea levels (approximately 10,000 years ago) inundating existing valleys and drainage systems along the coastline. The Geology of the Sydney 1:100,000 Sheet 9130, Quaternary Geology Map show the extents of various sediment deposits. The map suggests that the valleys were sculpted into the bedrock by palaeodrainage systems for the Hawksbury and Pittwater, most likely during the Tertiary period (1,600,000 – 65,000,000 years ago).

The infillings of the palaeochannels include:

- 'Recent' marine sediments deposited during the Holocene epoch <10,000 years ago, described in the map as marine sands underlain by estuarine basin 'mud' and sandy 'mud'.
- 'Ancient' sediments deposited during the Pleistocene Epoch from 10,000 to 1,600,000 years ago, described in the map as estuarine clay and sandy clays overlying bedrock units of the Sydney Basin.

2.1.3 Geology

The Geology of the Sydney 1:100,000 Sheet 9130 map shows the extents of major rock units. The map indicates the local landscape is dominated by thick bedded quartz Hawkesbury Sandstone. However, the lower boundary of the Hawkesbury Sandstone unit occurs in the lower slopes of the terrain. Hence, the HDD will likely progress through stratigraphic sequences underlying Hawkesbury Sandstone, i.e.:

- Newport & Garie formations
- Bald Hill Claystone
- Bulgo Sandstone

The Newport Formation can be seen outcropping along the shoreline near Carols Wharf on Scotland Island and further around the shoreline towards the east. The Newport Formation refers to an interbedded shale and sandstone sequence, with grey to dark grey shales and white sandstones becoming grey to orange when weathered.

Underlying the Newport formation and Garie Formation is the Bald Hill Claystone, which is a commonly recognised marker unit due to its consistent and distinct red-brown colour. The rock predominately consists of claystone and siltstone with a thickness in the order of 10 - 20m measured in outcrops on Sydney's Northern Beaches.

Bulgo Sandstone underlies the Bald Hill Claystone. It is a relatively thick unit, reaching a maximum thickness of 260m consisting of mainly sandstone with siltstone and claystone beds.

2.2 Preliminary activities

A Project HSE Plan, including a Job Safety and Environmental Analysis (JSEA), Risk Assessment and Environmental Work Method Statements (EWMS), was prepared prior to conducting the investigation. Subcontractor HSE documentation was reviewed prior to fieldwork commencement and all staff involved in the investigation fieldwork were inducted into the Project HSE Plan by the GHD fieldwork supervisor prior to commencing fieldwork. In addition, daily safety pre-work assessments and environmental inspections were carried out to address any additional hazards associated with the specific site conditions on each day of the fieldwork.

A 'Dial Before You Dig' (DBYD) buried services enquiry was submitted by GHD and buried services plans were collated and reviewed for the proposed investigation locations. A qualified underground services locator was engaged to review the service plans and scan the land-based test location to confirm the area was clear of services prior to the intrusive investigation fieldwork.

2.3 Investigation fieldwork

The investigation fieldwork comprised of both water and land based boreholes. The investigation locations were based on the proposed HDD alignment as shown on **Figure 1, Appendix A**. Five boreholes (GHD-BH1 to GHD-BH5) were drilled along the proposed HDD alignment to allow borehole logging, sampling of soil and rock profiles and installation of a groundwater monitoring well (GHD-BH1). The boreholes were drilled on land (GHD-BH1) and over water (GHD-BH2 to GHD-BH5), utilising a variety of drilling and sampling techniques. Locations GHD-BH6 and GHD-BH7 were completed by hand auger in Harold Reserve.

The borehole locations were surveyed using a Trimble R10 GNSS system for spatial coordinates and ground surface levels. A summary of borehole locations including coordinates, reduced levels and investigation depths is presented below in **Table 1**.

Table 1 – Borehole and hand auger investigation locations

Test Location	Easting (MGA, m)	Northing (MGA, m)	Level (m, AHD)	Water Depth (m)	Collar Level (m,AHD)	Investigated Depth (m)
GHD-BH1	341060.40	6275750.03	1.76	-	1.76	21.0
GHD-BH2	341234.09	6275851.62	0.32	9.0	-8.68	37.5
GHD-BH3	341299.77	6275900.88	0.74	13.0	-12.26	37.0
GHD-BH4	341145.26	6275801.80	0.47	2.4	-1.97	34.8
GHD-BH5	341540.80	6275988.93	0.41	1.7	-1.29	15.6
GHD-BH6	341616.5	6276042.4	-	1.8	0.5	-
GHD-BH7	341622.4	6276049.8	-	3.4	2.0	-

2.3.1 Borehole drilling

Borehole drilling was conducted under the full-time supervision of an experienced GHD geotechnical engineer. The boreholes (BH1-BH5) were drilled using a subcontracted, specialist geotechnical drilling rig. Two hand auger boreholes (BH6 and BH7) located in Harold Reserve were advanced and sampled by a geotechnical engineering from GHD.

The boreholes were commenced with rotary mud wash boring and a casing advancement system when necessary. Standard Penetration Tests (SPT) were carried out at regular depth increments within the soil profile to assess the in-situ material strength and to collect representative samples. Representative disturbed and undisturbed samples were collected from the boreholes for further assessment and laboratory testing. The encountered sub-surface profiles were logged in accordance with Australian Standard AS1726-2017 and GHD's standard procedures.

Upon SPT and/or wash bore refusal, boreholes were continued into bedrock with HQ and NMLC coring techniques. Core samples were boxed, logged and photographed on the completion of coring.

One groundwater monitoring well was installed in GHD-BH1, with the remaining boreholes grouted on completion of all investigation activities.

Borehole logs are provided in **Appendix B** and should be read in conjunction with the Standard Sheets (**Appendix B**), which explain the terms, symbols and abbreviations used, as well as the limitations of the logging procedures.

2.3.2 Surface soil sampling

Six surface soil samples were collected within Harolds Reserve on Scotland Island. The samples (SI01-SI06) were collected using a hand auger by a geotechnical engineer from GHD Surface soil samples were analysed for asbestos only.

2.3.3 Groundwater monitoring well

One groundwater monitoring well instrumented with a vibrating wire piezometer was installed in GHD-BH1 for groundwater sampling and temperature monitoring purposes, from a geotechnical perspective. Contamination sampling was conducted on the 27 September 2018 at this location, utilising disposal bailers. Sampling was conducted in conjunction with sampling for geotechnical parameters.

The construction details of the groundwater well are presented on the GHD-BH1 borehole log in **Appendix B**.

3. Data quality objectives

3.1 Overview

A process for establishing data quality objectives for an investigation site has been defined in the NSW EPA *Contaminated Land Management Draft Guidelines for the NSW Site Auditor Scheme* (3rd edition, 2006). The Data Quality Objectives (DQO) process was applied to the investigation and data assessment, as described below, to ensure that data collection activities were appropriate and achieved the project objectives. The DQO process involved seven steps defined as follows:

3.1.1 Step 1: State the problem

GHD understands the site is proposed to be developed for the installation of a second underground 11kV cable to the island between Church Point parking area and Carols Wharf.

The problems as it stands is that the site needs to be further investigated to characterise the potential for contamination at the site and assess the impact on human health during the development.

3.1.2 Step 2: Identify the decisions

The key decisions to be made in the assessment include:

- Is soil and groundwater contamination present on-site at concentrations exceeding adopted site investigation levels?
- Are the sources of potential contamination (primary or secondary) from on and / or off-site sources?
- Is there an unacceptable risk posed by contamination (if present) to human health (construction and maintenance workers)?
- If soil contamination is identified on-site at concentrations exceeding the adopted site investigation levels, is there a need for further assessment, remediation and/or management of the contamination?

3.1.3 Step 3: Identify inputs to the decision

The sampling program was designed to provide sufficient information to allow a sound scientific evaluation of the questions set out in **Section 3.1.2**. This was achieved by:

- Visual inspection of site areas, along with soils at the investigation locations.
- Collection of soil and groundwater samples to provide data upon which to base subsequent decisions.
- Comparing the soil and groundwater analytical data to applicable guidelines (as defined in **Section 6**) to evaluate the potential for contamination to adversely impact upon human health.

3.1.4 Step 4: Define the study boundaries

With respect to physical boundaries, the lateral boundaries of the investigation area are defined on **Figure 1**, **Appendix A**, and discussed in **Section 1**.

The vertical investigation boundary is defined as up to 37.54 metres below ground level (m bgl) which is the maximum depth of the intrusive investigation.

3.1.5 Step 5: Develop a decision rule

The degree of impact by contaminants and the decisions associated with accepting data was assessed with reference to the chosen site investigation levels, which were established within the framework of guidelines made or approved by NSW EPA. The decision rule is:

- If the data has been collected in an appropriate manner to establish completeness, comparability, representativeness, precision and accuracy, it will be considered suitable for the purposes of this assessment; and
- If soil or groundwater contamination is identified on-site at concentrations exceeding the adopted site investigation levels (**Section 4**), then further assessment and/or management of the contamination may be required.

3.1.6 Step 6: Specify limits on decision errors

Two primary decision error-types may occur due to uncertainties or limitations in the project data set:

- A sample/area may be deemed to pass the nominated criteria, when in fact it does not. This may occur if contamination is 'missed' due to limitations in the sampling plan, or if the project analytical data set is unreliable.
- A sample/area may be deemed to fail the nominated criteria, when in fact it does not. This may occur if the project analytical data set is unreliable, due to inappropriate sampling, sample handling, or analytical procedures.

An assessment will be made as to the likelihood of a decision error being made based on the results of a QA/QC assessment and the closeness of the data to the assessment criteria. The QA/QC assessment will include reference these data quality indicators.

3.1.7 Step 7: Optimise the design for obtaining data

This was achieved through the development of an appropriate sampling and analytical strategy which was reviewed and refined as necessary during the assessment evaluating field observations and analytical results. This included collection and analysis of soil and groundwater samples, and visual, observation for surface asbestos containing materials.

3.2 Data quality indicators

Data quality indicators (DQIs) have been established for completeness, comparability, representativeness, precision and accuracy.

The DQIs for sampling techniques and laboratory analysis of collected samples identifies the acceptable level of error for this investigation. The data quality objectives were assessed by reference to data quality indicators as follows:

Data Representativeness - expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples in an appropriate pattern across the site, and by using an adequate number of sample locations to characterise the site. Consistent and repeatable sampling techniques and methods are utilised throughout the sampling.

Completeness - defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study. If there is insufficient valid data, then additional data are required to be collected.

Comparability - is a qualitative parameter expressing the confidence with which one data set can be compared with the other set. This is achieved through maintaining a level of consistency in techniques used to collect samples and ensuring analysing laboratories use consistent analysis techniques and reporting methods.

Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pairs.

$$RPD\,(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where C_o = Analyte concentration of the original sample

C_d = Analyte concentration of the duplicate sample

GHD adopts a nominal acceptance criterion of 30% RPD for field duplicates and splits for inorganics and a nominal acceptance criterion of 50% RPD for field duplicates and splits for organics. However, it is noted that this will not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations.

Accuracy - measures the bias in a measurement system. Accuracy can be undermined by such factors as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analytical techniques by the analysing laboratory. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes, laboratory blanks and analyses against reference standards.

Accuracy of field works is assessed by examining the level of contamination detected in trip blanks. Blanks should return concentrations of all organic analytes as being less than the practical quantitation limit of the testing laboratory.

4. Basis for assessment

4.1 Relevant guidelines

The framework for the contamination assessment made herein, was developed in accordance with guidelines "made or approved", by the NSW EPA under Section 105 of the *Contaminated Land Management Act, 1997*. These guidelines include, but are not limited to the following:

- ASSMAC (1998), *NSW Acid Sulphate Soils Manual.*
- NSW EPA (1995) *Contaminated Sites: Sampling Design Guidelines*
- NSW EPA (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*
- NEPM (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure (No.1)*, National Environment Protection Council (NEPC)
- NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste.*
- NSW EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*
- NSW EPA (2016) *Contaminated Land Management: Draft Guidelines for NSW Site Auditor Scheme* (3rd edition)

4.2 Assessment criteria

4.2.1 Soil assessment criteria

Site investigation levels have been adopted from assessment criteria presented in NEPM (2013) as discussed below: Given the proposed development of the site is an electrical cable excavation, health screening levels (HSL) and health investigation levels (HIL) for a commercial and industrial land use have been selected as the investigation screening criteria. The investigation levels used to evaluate measured chemical concentrations in soil samples are presented in the results tables in **Appendix D** and are discussed below:

It is noted that some samples collected are considered as sediments (from below water locations at GHD-BH2 to GHD-BH5). In the absence of investigation levels for the protection of human health (i.e. maintenance workers) for sediments, or sediment criteria specifically for waste classification, the data collected from sediment sampling locations BH2 to BH5 have been reviewed with reference to the guidelines outlined below.

Health Screening Levels (HSL) for Petroleum Hydrocarbons

The NEPM (2013) presents Health Screening Levels (HSLs) for fuel derived petroleum hydrocarbons, which are generic criteria based on a series of reasonably conservative assumptions in order to be protective of human health for a variety of land use types. As such they are considered to be appropriate to determine whether further contamination investigation, remediation, management or more detailed risk assessment is required. For the purposes of selecting health based investigation levels for the site, a commercial/industrial exposure setting (HSL-D) is considered to be appropriate for the commercial / industrial exposure for the proposed works.

Note that the NEPM (2013) presents HSLs for vapour intrusion only. For the direct contact and vapour intrusive pathway for intrusive maintenance workers, reference has been made to Friebel and Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and

Groundwater CRC Technical Report No 10. The NEPM HSLs are based on the work by Friebel and Nadebaum, however the direct contact pathway was not included into the NEPM (2013).

Health Investigation Levels (HIL)

For non-petroleum hydrocarbons, the NEPM 2013 Health Investigation Levels have been adopted for a commercial / industrial setting HIL-D. The HILs take into account direct contact pathways, including incidental ingestion and dermal contact.

4.2.2 Groundwater assessment criteria

Human health screening levels

The HSLs for petroleum hydrocarbons for commercial / industrial land use have also been adopted for the assessment of groundwater to characterise the risk posed to receptors by potential hydrocarbon vapour intrusion. Commercial users of the metro/commuters are unlikely to come into contact with the groundwater.

Ecological criteria

Based on the proximity of the site, it has been assumed for this assessment that groundwater in the area has potential to discharge to the nearby aquatic systems of Pittwater and Hawkesbury River. Therefore, the assessment criteria nominated for this assessment are the Marine Waters Groundwater Investigation Levels (GILs) from the NEPM (2013).

4.2.3 Waste classification guidelines

For waste classification, the acid sulphate soils (ASS) potential of the soil must be assessed, as outlined in the *NSW EPA (2014) Waste Classification Guidelines, Part 4: Acid Sulphate Soils*. Where potential ASS can not be classified as VENM or a suitable underwear disposal site at a landfill is not available, the soil must be treated in accordance with the neutralising techniques outlined in the NSW Acid Sulphate Soils Manual (ASSMAC, 1998). After treatment the soil should be chemically assessed as per below.

The concentrations of the chemicals in the samples analysed will be compared to the criteria outlined in Table 2 of the NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste*. The guidelines provide criteria for assessing the appropriate waste classification for material requiring offsite disposal and subsequently assessing the required disposal location for solid and liquid wastes. The classification process for non–liquid wastes focuses on the potential for the waste to release chemical contaminants into the environment through contact with liquids (leachates).

The first test used to chemically assess waste is the Specific Contaminant Concentration (SCC) test, which determines the total concentration of each contaminant in the waste sample. The guidelines set different maximum levels for the total concentration of each contaminant in order for waste to be classified as either general solid waste or restricted solid waste.

The toxicity characteristics leaching procedure (TCLP) test estimates the potential for waste to release chemical contaminants into a leaching liquid. The guidelines set different maximum levels of the leachable concentration of each contaminant in order for waste to be classified as general solid waste, restricted solid waste or hazardous waste.

5. Sampling, analysis and quality assurance/quality control program

5.1 Soil sampling methodology

A total of seven intrusive sampling locations were completed across the site to assess potential for contamination of soils and sediments at the nominated sampling locations including:

- Five borehole locations (GHD-BH1 to GHD-BH5) were drilled using a track mounted rig operated by a licensed driller.
- Two hand auger borehole locations (GHD-BH6 to GHD-BH7) were advanced and sampled by hand operated hand auger by a geotechnical engineer.

During intrusive investigations, soil samples were collected from the profile where changes in the geology or indications of contamination were observed. Samples were recovered either by SPT or recovered from solid flight stem drilling and were placed into laboratory prepared sample jars which were then placed in an ice pack filled cooler and transported to the nominated laboratory under chain of custody documentation. Soils were described on borehole logs in general accordance with the Unified Soil Classification System (USCS), with features such as seepage, discolouration, staining, odours and other indications of contamination being noted. Copies of the borehole logs are included in **Appendix B.**

All soil samples were screened in the field using a hand held photo-ionisation detector (PID). The PID was used to screen concentrations of volatile organic hydrocarbons to inform which samples should be selected for BTEX and light end TPH laboratory analysis. The results of the PID screening are noted on the logs presented in **Appendix B**. The PID calibration sheet is included in **Appendix C**.

All waste soil generated during drilling of the soil bores was used to backfill the boreholes following sampling.

Selected soil samples were submitted to the nominated laboratory for analysis for the contaminants of potential concern (COPC), these contaminants include:

- Heavy metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc).
- Total Recoverable Hydrocarbons (TRH).
- Polycyclic aromatic hydrocarbons (PAH).
- Benzene, toluene, ethyl benzene and xylenes (BTEX).
- Organochloride pesticides (OCP).
- Polychlorinated biphenyls (PCB).
- Asbestos identification (absence / presence).

5.2 Groundwater sampling methodology

Groundwater sampling was carried out at least one week following the installation of the new groundwater well. The sampling was conducted by a GHD geotechnical engineer in conjunction with the sampling for geotechnical parameters.

The groundwater well was purged using disposable Teflon-free plastic bailers, with at least three well volumes removed and well allowed to recharge.

The groundwater sample was retrieved using a clean disposable bailer and transferred immediately into laboratory prepared bottles suitable for the requested analyses. Where required, sample bottles were filled to minimise headspace.

The containers were labelled with the job number, sample identification and date. These were transferred to chilled coolers for preservation for transportation to the project laboratory. Samples were accompanied with chain of custody documentation to the project laboratory and were submitted within holding times appropriate to the analysis required.

The groundwater sample was submitted to the nominated laboratory for analysis for the contaminants of potential concern (COPC), these contaminants include:

- Heavy metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc).
- Total Recoverable Hydrocarbons (TRH).
- Polycyclic aromatic hydrocarbons (PAH).
- Benzene, toluene, ethyl benzene and xylenes (BTEX).
- Organochloride pesticides (OCP).
- Polychlorinated biphenyls (PCB).

No duplicate samples were collected as part of the groundwater sampling.

6. Site investigation results

6.1 Encountered sub-surface profile

Summarised descriptions of the encountered sub-surface profile units are provided below. Reference to the borehole logs should be made for a detailed description of the subsurface conditions encountered at each borehole location. Detailed bore hole logs from the investigation locations are provided in **Appendix B**. Detailed geotechnical information is provided in GHD's geotechnical report presented under a separate cover (GHD ref. 21-27425-8323).

6.1.1 Fill

Fill was only encountered in one borehole during the investigation, GHD-BH1 to a depth of 0.2 m bgl, the fill was described as a dark brown gravelly sand with trace clay. No visual or olfactory evidence of contamination was observed during sampling.

6.1.2 Sediments

The origins of Pittwater estuary (drowned river valley) has generally led to a complex deposition of sediments, with generally granular over land sediments deposited under fluvial (stream) conditions and marine or estuarine sediments deposited in low energy conditions. Further interpretation of layering is discussed in Section 4.

Fluvial deposits

Deposited over-land, under higher energy fluvial conditions, generally these sediments are likely to be sand with little to no fines (cohesive soils). Fluvial deposits encountered are described below:

- Sand was generally found at the surface of the seabed. The sands were brown to grey with little to silt or clay and traces of shell fragments. This sediment layer was typically from 1m to 2m thick.
- Grey and/or brown sand and clayey sand was encountered in GHD-BH2, GHD-BH3 and GHD-BH4, with a thickness of 4.5m to 7.5m thick and described as moderately dense to dense.
- Grey to brown sands had varying proportions of clay throughout were encountered towards the bottom of the soil profile in boreholes GHD-BH2 and GHD-BH3. Fine to coarse sub-rounded quartz gravels were throughout the sediments, suggesting a high-energy overland deposition particularly within the upper extent of these layers

Estuarine/marine deposits

Estuarine and marine sediments are deposited under low energy and submerged conditions, are generally cohesive, dark in colour and normally consolidated. Estuarine/marine deposits encountered are described below:

- Layered deposits of medium to high plasticity, black clay with thicknesses of 2m to 4m and soft to stiff consistency. These materials were encountered in boreholes GHD-BH2, GHD-BH3 and GHD-BH4 below 12.5m depth.
- Low to high plasticity, very stiff to hard grey clay and sandy clay was encountered in boreholes GHD-BH2, GHD-BH3 and GHD-BH4. These materials occurred in 1.5m to 5m thick layers.

6.1.3 Bedrock

Four different Sydney Basin geological formations were encountered. Table 2 below summarises the extents of each formation encountered in the boreholes. The following descriptions are generalised. Reference to the cored borehole logs should be made for detailed descriptions of the bedrock material and defects encountered in each borehole location. Detailed descriptions of bedrock formations are discussed in the GHD geotechnical report (GHD ref. 21-27425-8323).

Table 2 – Bedrock formation summary (boreholes in order of west to east)

Formation	Depth below ground/seabed surface (m)				
	GHD-BH1	GHD-BH4	GHD-BH2	GHD-BH3	GHD-BH5
Newport & Garie Formation	5.5 – 21+	24.5 – 29.3	-	-	9.2 – 15.6+
Bald Hill Claystone	-	29.3 – 34+	-	27.3 – 32	-
Bulgo Sandstone	-	-	28.5 – 37.5+	32 – 37+	-

6.2 Soil laboratory analytical results

The soil investigation laboratory results are presented in **Table D1, Appendix D** and laboratory reports are provided in **Appendix E**. Laboratory analytical results are summarised below.

6.2.1 Heavy metals

The majority of soil samples submitted for analysis reported heavy metal concentrations below the applicable human health guidelines.

6.2.2 TRH / BTEX

The majority of soil samples submitted for analysis reported concentrations of TRH and BTEX below the laboratory limit of reporting and below the nominated soil screening criteria for the applicable human health guidelines.

6.2.3 PAH / OCP / PCB

The majority of soil samples submitted for analysis reported concentrations of PAH, OCP and PCBs below the laboratory limit of reporting and below the nominated screening criteria for human health

6.2.4 Asbestos

A total of 14 soil samples were submitted for analysis for asbestos in soils. No asbestos was detected in any of the samples.

Six surface soil samples (GHD-SI01 to GHD-SI06) were submitted for analysis of asbestos. No asbestos was detected in these samples.

6.3 Groundwater laboratory analytical results

The groundwater investigation laboratory results are presented in **Table D3, Appendix D** and laboratory reports are provided in **Appendix E**. Laboratory analytical results are summarised below.

6.3.1 Heavy metals

The groundwater sample, GHD-BH1, submitted for analysis reported heavy metal concentrations below the applicable human health guidelines. Minor exceedances for copper, nickel and zinc above the ecological guideline NEPM 2013 Marine Water guidelines. It is considered that these exceedances are indicative of naturally occurring background concentrations in the groundwater of this area.

6.3.2 TRH / BTEX

The groundwater sample, GHD-BH1, submitted for analysis reported concentrations of TRH and BTEX below the laboratory limit of reporting and below the nominated groundwater screening criteria for the applicable human health guidelines.

6.3.3 PAH / OCP / PCB

The groundwater sample, GHD-BH1, submitted for analysis reported concentrations of PAH, OCP and PCBs below the laboratory limit of reporting and below the nominated groundwater screening criteria for the applicable human health guidelines.

6.4 Waste classification

As outlined in Section 5.3 of the geotechnical report, ASS and PASS are present at the site. If disposal of the material is required offsite, the soil must be treated in accordance with the ASSMAC guidelines as described in GHD's geotechnical report, prior to disposal at a facility licenced to accept General Solid Waste.

7. QA/QC data quality assessment

7.1.1 Field QA/QC

Soil RPDs

As part of the GHD QA/QC program, three blind duplicate samples were collected and analysed during the investigation. These duplicate samples were analysed for metals, TRH/BTEX, PAH, OCP and PCB. For analytes with detected concentrations reported, RPDs were within the acceptable range with the exception of exceedances shown in **Table D4, Appendix D.**

Equipment rinsate

As part of the GHD QA/QC program, one rinsate was taken from the soil sampling equipment during the investigation. This sample was analysed for PAHs. The sample resulted in all analytes below the laboratory detection limit. Results are presented in **Table D5, Appendix D**.

7.1.2 Laboratory quality control

Holding times

All analytes were extracted within the laboratory's technical holding times.

Laboratory program

The NATA certified laboratories utilised for this assessment (Eurofins MGT Sydney) undertook their own quality assurance and quality control procedures for sample analysis. GHD has reviewed the internal laboratory control data provided within the laboratory reports, which are attached as **Appendix E**.

Method blank results were less than the PQL, and surrogate spike and laboratory control sample recoveries were within laboratory acceptance criteria.

7.1.3 Discussion

The results of the QA/QC programme are considered to provide an acceptable degree of confidence in the analytical program completed. Overall, the analytical data set is considered to be valid and acceptable to base conclusions on the contamination status of the site.

8. Conclusions and Recommendations

In accordance with the objectives detailed in **Section 1.3**, based on the information contained within this assessment, the following conclusions are made (subject to the limitations outlined in **Section 9**).

- A targeted intrusive contamination assessment was conducted in conjunction with the geotechnical investigation.
- The subsurface conditions across the proposed development route comprise of a thin layer of fill and natural materials in the land based investigation location, and marine sediments in the overwater locations, followed by natural bedrock.
- Fill was encountered in one, land based, investigation location, GHD-BH1 to a depth of 0.2 m bgl. No visual or olfactory evidence of contamination was observed during sampling.
- Concentrations of the COPC including metals, BTEX, TRH, PAH, OCP and PCB in analysed soil samples were below the adopted human health screening levels.
- Asbestos was not identified in any of the sample submitted for analysis.
- Concentrations of COPC including BTEX, TRH, PAH, OCP and PCB, were reported below the laboratory limit of reporting in the groundwater sample collected for analysis. Some heavy metals, including copper, nickel and zinc, were reported at levels which exceed the ecological screening criteria for marine waters. The presence of these heavy metals in groundwater is likely indicative of background concentrations in the local aquifer and not representative of a wider contamination issue which may impact on, or require management, as part of the proposed works.
- Acid sulphate soils were detected in the sediment samples submitted for analysis
- Soils and sediments must be treated as per the ASSMAC guidelines and geotechnical investigation report, prior to disposal offsite (if required). The preliminary waste classification of the material indicates General Solid Waste. However, it is noted that this classification does not take into consideration any drilling fluids or chemicals used as part of the construction works.
- The findings of the investigation do not indicate the presence of contamination impacting the proposed works. However, an unexpected finds protocol should be in place during the construction works, in the event that visual or olfactory signs of potential contamination are encountered.
- The surface samples (GHD-SI01 to GHD-SI06) within Harolds Reserve were analysed for asbestos in soil only. No asbestos was reported in these samples. If any excavation is required in this area as part of the proposed works soils should be stockpiled separately for waste classification prior to off-site disposal if required.

9. Limitations

This report: has been prepared by GHD for Ausgrid and may only be used and relied on by Ausgrid for the purpose agreed between GHD and the Ausgrid as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Ausgrid arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

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

GHD has prepared this report on the basis of information provided by Ausgrid and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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

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

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

Appendix A – Figures


SCOTLAND ISLAND
HAROLD AVENUE
RICHARD ROAD
GHD-BH5
SI05
GHD-BH7
SI06
GHD-BH6
SI04
SI02
SI03
SI01
GHD-BH3
GHD-BH2
GHD-BH4
PITTWATER
GHD-BH1
PITTWATER ROAD
CHURCH POINT
EASTVIEW ROAD
Regional Locality Map
Site Location
GREAT MACKEREL BEACH
THE BASIN
PALM BEACH
WHALE BEACH
PITTWATER
AVALON
BILGOLA BEACH
NEWPORT
LOVETT BAY
MCCARRS CREEK
BAYVIEW
INGLESIDE
WARRIEWOOD
NORTH NARRABEEN
NARRABEEN
ELANORA HEIGHTS
TERREY HILLS
AKUNA BAY
COTTAGE POINT
DUFFYS FOREST
PEACH TREES
COLLAROY
CROMER
LONG REEF
BELROSE
FORESTVILLE
NORTH ST IVES
ST IVES
GUNDAROO
COWAN
0
20
40
60
80
100
Metres
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56
N
LEGEND
NSW LPI Cadastre
NSW LPI Roads
Borehole Location (GHD, 2018)
Groundwater Well Location (GHD, 2018) - Geotechnical
Hand Auger Location (GHD, 2018)
Surface Soil Sample Location (GHD, 2018)
GHD
Ausgrid
Church Point Scotland Island
Geotechnical and Contamination Investigation
Investigation Locations
Job Number 21-27425
Revision A
Date 11 Oct 2018
Figure 1
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Appendix B – Borehole Logs

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

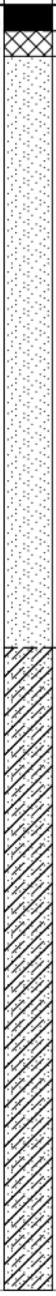
Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

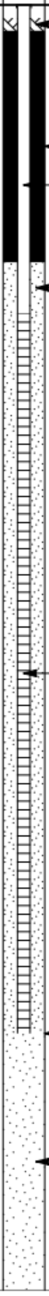
HOLE No. GHD-BH1

SHEET 1 OF 6

Position : 341060.4 E 6275750.0 N MGA94/ 56 **Surface RL:** 1.76m AHD **Angle from Horiz. :** 90° **Processed :** MAG
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 8/8/2018 **Date Completed :** 9/8/2018 **Logged by :** CT **Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log





DRILLING					MATERIAL						PIEZOMETER
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations	Components
	SFA	Nil		D	0.10	-	ASPHALT, black.	-	-	0.00-0.10m, JAR,BAG PID<1ppm	Gatic cover Cement
					0.20	-	Gravelly SAND, dark brown, fine to coarse grained, fine to medium gravels, trace of clay (fill).	M	-		
						SP	SAND, pale brown, fine to coarse grained, poorly graded (alluvium).	M	VL		
				D						0.50-0.60m, JAR, BAG, DUP03 PID<1ppm	Bentonite 50mm PVC casing
1				SPT 1/1/1 N=2						1.00-1.45m, JAR, BAG PID<1ppm	2mm Sand Backfill
2			2.0m	D			From 2.00m, brown grey, trace fine to medium sub-rounded gravels.	W		2.00-2.10m, JAR, BAG PID<1ppm	
				SPT 3/4/4 N=8	2.50	SC - CL	Sandy CLAY / Clayey SAND, grey mottled red, low plasticity, fine to medium grained sand, iron staining (alluvium).	w>PL	St		Slotted Screen
3				U75						3.00-3.10m, Sample collected from U75 collapse, JAR, BAG PID<1ppm	
4				ES SPT 6/8/10 N=18					VSt	3.90-4.00m, JAR, BAG PID<1ppm	Base of piezo @ 4m
				U75						4.50m, U75 refusal	2mm Sand Backfill
5				ES	5.00					4.90-5.00m, JAR,	

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
21-27425

BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH1

SHEET 2 OF 6

Position : 341060.4 E 6275750.0 N MGA94/ 56	**Surface RL:** 1.76m AHD		**Angle from Horiz. :** 90°		**Processed :** MAG
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR		**Checked :** JK
Date Started : 8/8/2018		**Date Completed :** 9/8/2018	**Logged by :** CT		**Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					**MATERIAL**							**PIEZOMETER**	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**	Piezometer Log	**Components**
	SFA	Nil			5.50		SC - CL	Sandy CLAY / Clayey SAND, as previous.	w>PL	VSt	BAG, DUP04 PID<1ppm		
6 7	RW(m)	HWT Casing		SPT 10/16/20 N=36 SPT 13/29/ 11 for 80mm N=ref	7.70			SANDSTONE, pale grey, fine to coarse grained, completely to extremely weathered, extremely low strength, iron stained. From 7.00m, becoming red orange.	-	-			Bentonite Grout
8 9 10								Start of coring at 7.7 metres. For cored interval, see Core Log Sheet.					

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

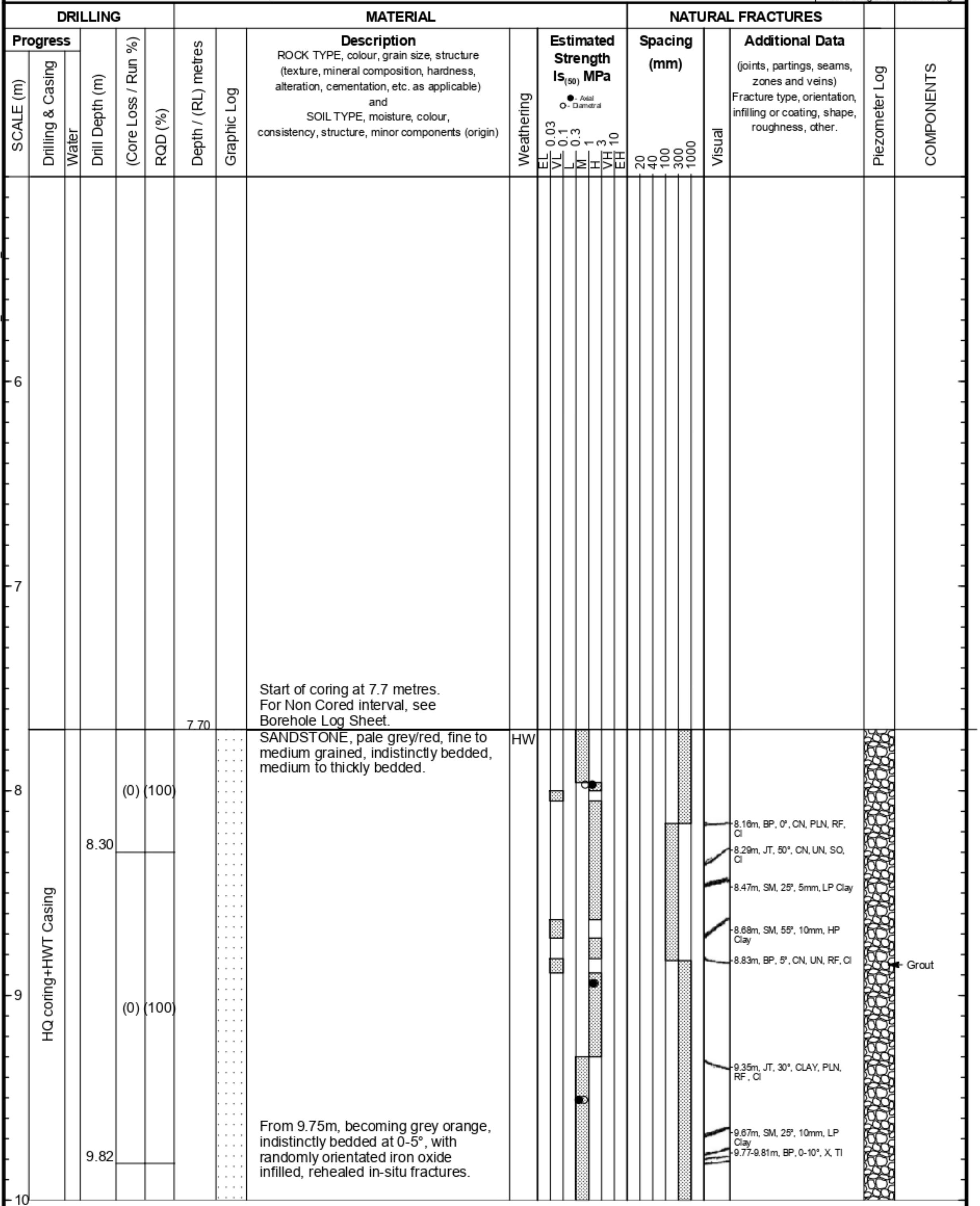
CORE LOG SHEET WITH STANDPIPE PIEZOMETER

HOLE No. GHD-BH1

SHEET 3 OF 6

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

Position : 341060.4 E 6275750.0 N MGA94/ 56	**Surface RL:** 1.76m AHD		**Angle from Horiz. :** 90°	**Processed :** MAG
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Casing Dia. : HQ	**Barrel (m) :** 1.5m	**Bit :** Surface set	**Bit Condition :** New	**Date:** 31/08/2018
Date Started : 8/8/2018	**Date Completed :** 9/8/2018	**Logged by :** CT	**Date Logged :** 9/8/2018	Note: * indicates signatures on original issue of log or last revision of log



Drilling & Casing	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering	Additional Data
					Start of coring at 7.7 metres. For Non Cored interval, see Borehole Log Sheet.		
HQ coring+HWT Casing	8.30	(0)	(100)	7.70	SANDSTONE, pale grey/red, fine to medium grained, indistinctly bedded, medium to thickly bedded.	HW	8.16m, BP, 0°, CN, PLN, RF, CI 8.29m, JT, 50°, CN, UN, SO, CI
	9.82	(0)	(100)				8.47m, SM, 25°, 5mm, LP Clay 8.68m, SM, 55°, 10mm, HP Clay 8.83m, BP, 5°, CN, UN, RF, CI 9.35m, JT, 30°, CLAY, PLN, RF , CI
					From 9.75m, becoming grey orange, indistinctly bedded at 0-5°, with randomly orientated iron oxide infilled, rehealed in-situ fractures.		9.67m, SM, 25°, 10mm, LP Clay 9.77-9.81m, BP, 0-10°, X, TI

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

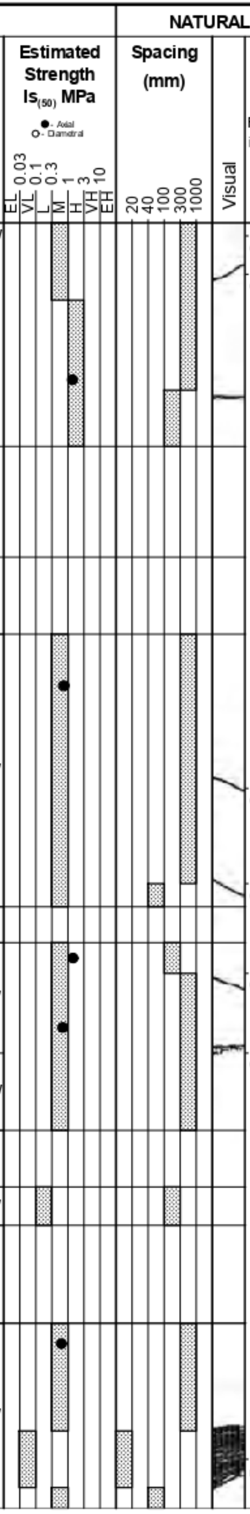
CORE LOG SHEET WITH STANDPIPE PIEZOMETER

HOLE No. GHD-BH1

SHEET 4 OF 6

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341060.4 E 6275750.0 N MGA94/ 56 **Surface RL:** 1.76m AHD **Angle from Horiz. :** 90° **Processed :** MAG
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HQ **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 8/8/2018 **Date Completed :** 9/8/2018 **Logged by :** CT **Date Logged :** 9/8/2018
Note: * indicates signatures on original issue of log or last revision of log

Drilling & Casing	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering	Additional Data	Components
HQ coring+HWT Casing		(29)	(72)		SANDSTONE, as previous. 10.70m, becoming coarse grained, with fine to coarse, sub-rounded gravel sized clasts.	MW	10.05m, BP, 0°, CN, PLN, RF, CI 10.20m, JT, 25°, CN, UN, RF, CI	
				10.87	CORE LOSS 430mm.			
	11.30	(75)	(25)	11.30	CORE LOSS 300mm.			
	11.70	(13)	(77)	11.60	SANDSTONE, pale grey with very minor orange brown staining, fine grained, indistinctly bedded at 0-5°, thickly bedded.	SW	12.20m, JT, 32°, FE, PLN, RF, CI 12.57m, JT, 33°, FE, PLN, RF, CI	Grout
				12.66	CORE LOSS 140mm.			
	12.80	(0)	(100)	12.80	SANDSTONE, as above. 13.23m, fine gravel sized clasts at base of bed, randomly orientated iron indurated re-healed in-situ fractures.	SW MW	12.92m, JT, 33°, RF, UN, FE, CI 13.23m, BP, 0°, CN, UN, RF, CI	
	13.35	(55)	(100)	13.53	CORE LOSS 220mm.			
HMLC coring+HWT Casing	13.75	(0)	(100)	13.75	SANDSTONE, as previous, but stained orange.	SW		
	13.90	(35)	(45)	13.90	CORE LOSS 380mm.			
				14.28	SANDSTONE, as previous.	SW	14.81m, SM, 0°, 220mm, EW rock	
	15.00							



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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

CORE LOG SHEET WITH STANDPIPE PIEZOMETER

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH1

SHEET 5 OF 6

Position : 341060.4 E 6275750.0 N MGA94/ 56
Surface RL: 1.76m AHD
Angle from Horiz. : 90°
Processed : MAG
Rig Type : HydraP Trekker
Mounting: Track
Contractor : Stratacore
Driller : TR
Checked : JK
Casing Dia. : HQ
Barrel (m) : 1.5m
Bit : Surface set
Bit Condition : New
Date: 31/08/2018
Date Started : 8/8/2018
Date Completed : 9/8/2018
Logged by : CT
Date Logged : 9/8/2018

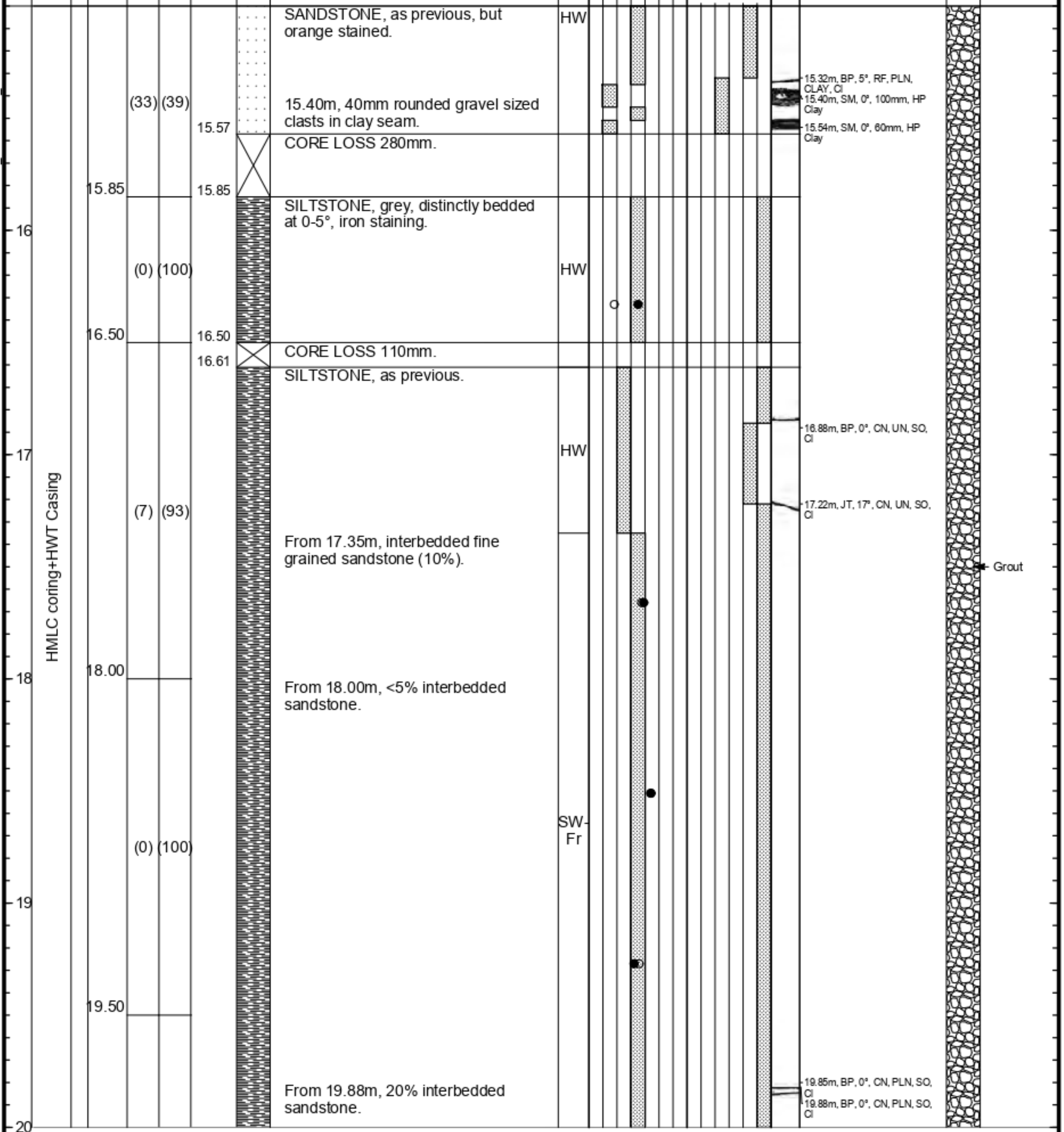
Note: * indicates signatures on original issue of log or last revision of log

DRILLING — Progress: SCALE (m), Drilling & Casing, Water; Drill Depth (m); (Core Loss / Run %); RQD (%)

MATERIAL — Depth / (RL) metres; Graphic Log; **Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin); Weathering; **Estimated Strength $Is_{(50)}$ MPa** (● - Axial, ○ - Diametral) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH

NATURAL FRACTURES — **Spacing (mm)** 20 40 100 300 1000; Visual; **Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.

Piezometer Log; COMPONENTS



Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering	Additional Data
	(33)	(39)		SANDSTONE, as previous, but orange stained.	HW	15.32m, BP, 5°, RF, PLN, CLAY, Cl 15.40m, SM, 0°, 100mm, HP Clay 15.54m, SM, 0°, 60mm, HP Clay
			15.57	15.40m, 40mm rounded gravel sized clasts in clay seam.		
15.85			15.85	CORE LOSS 280mm.		
	(0)	(100)		SILTSTONE, grey, distinctly bedded at 0-5°, iron staining.	HW	
16.50			16.50	CORE LOSS 110mm.		
	(7)	(93)	16.61	SILTSTONE, as previous.	HW	16.88m, BP, 0°, CN, UN, SO, Cl 17.22m, JT, 17°, CN, UN, SO, Cl
				From 17.35m, interbedded fine grained sandstone (10%).		
18.00	(0)	(100)		From 18.00m, <5% interbedded sandstone.	SW-Fr	
19.50				From 19.88m, 20% interbedded sandstone.		19.85m, BP, 0°, CN, PLN, SO, Cl 19.88m, BP, 0°, CN, PLN, SO, Cl

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CORE LOG SHEET WITH STANDPIPE PIEZOMETER

GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

HOLE No. GHD-BH1

SHEET 6 OF 6

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341060.4 E 6275750.0 N MGA94/ 56 **Surface RL:** 1.76m AHD **Angle from Horiz. :** 90° **Processed :** MAG
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HQ **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 8/8/2018 **Date Completed :** 9/8/2018 **Logged by :** CT **Date Logged :** 9/8/2018
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DRILLING						MATERIAL				NATURAL FRACTURES				
SCALE (m)	Progress: Drilling & Casing	Progress: Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength $Is_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.	Piezometer Log / COMPONENTS
	HMLC coring+HWT Casing			(0)	(100)			SILTSTONE, as previous.	SW-Fr	●○				Grout
21			21.00			21.00		End of Borehole at 21 metres. Target Depth						
22														
23														
24														
25														

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 1 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56 **Surface RL:** -8.68m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 23/7/2018 **Date Completed :** 27/7/2018 **Logged by :** CT **Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing					SW	SAND, pale grey, fine to coarse grained, with fine gravel/ shell fragments (alluvium).	W	-	Note: 'TR' = undisturbed sample for Thermal Resistivity testing *Denotes SPT terminated early due to difficulties extracting sampler on floating barge. Inferred N value.
1					1.00		SC-CL	Sandy CLAY, grey, low plasticity, fine to coarse grained sand (alluvium).	w>PL	-	
				U75						VSt-H	1.70-1.90m, U75 (TR)
2				SPT 14/22/15 N=37						H	1.90-2.35m, JAR, BAG, DUP01 PID=2.2ppm
3											
				SPT 5/12/13 N=25						VSt	3.50-3.95m, JAR, BAG, DUP02 PID=10.7ppm
4											
				U75	4.80		SC/CL	Clayey SAND/Sandy CLAY, grey, fine to coarse grained sand, low plasticity clay (alluvium).	W	H	4.80m, attempt U75 no retained sample
5											

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 2 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56
Surface RL: -8.68m AHD
Angle from Horiz. : 90°
Processed : RCO
Rig Type : HydraP Trekker **Mounting:** Track
Contractor : Stratacore
Driller : TR
Checked : JK
Date Started : 23/7/2018
Date Completed : 27/7/2018
Logged by : CT
Date: 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing		SPT 5/13/20 N=33			SC/ CL	Clayey SAND/Sandy CLAY, as previous.	W	H	5.00-5.45m, JAR, BAG PID=16.7ppm
6											
7											
8				SPT 1/2/9 N=11	8.00		SP	SAND, grey, fine to coarse grained, poorly graded, with clay (alluvium).	W	MD	8.00m, SPT top 300mm possible cave in 8.00-8.45m, JAR, BAG PID=10.4ppm
9											
10											

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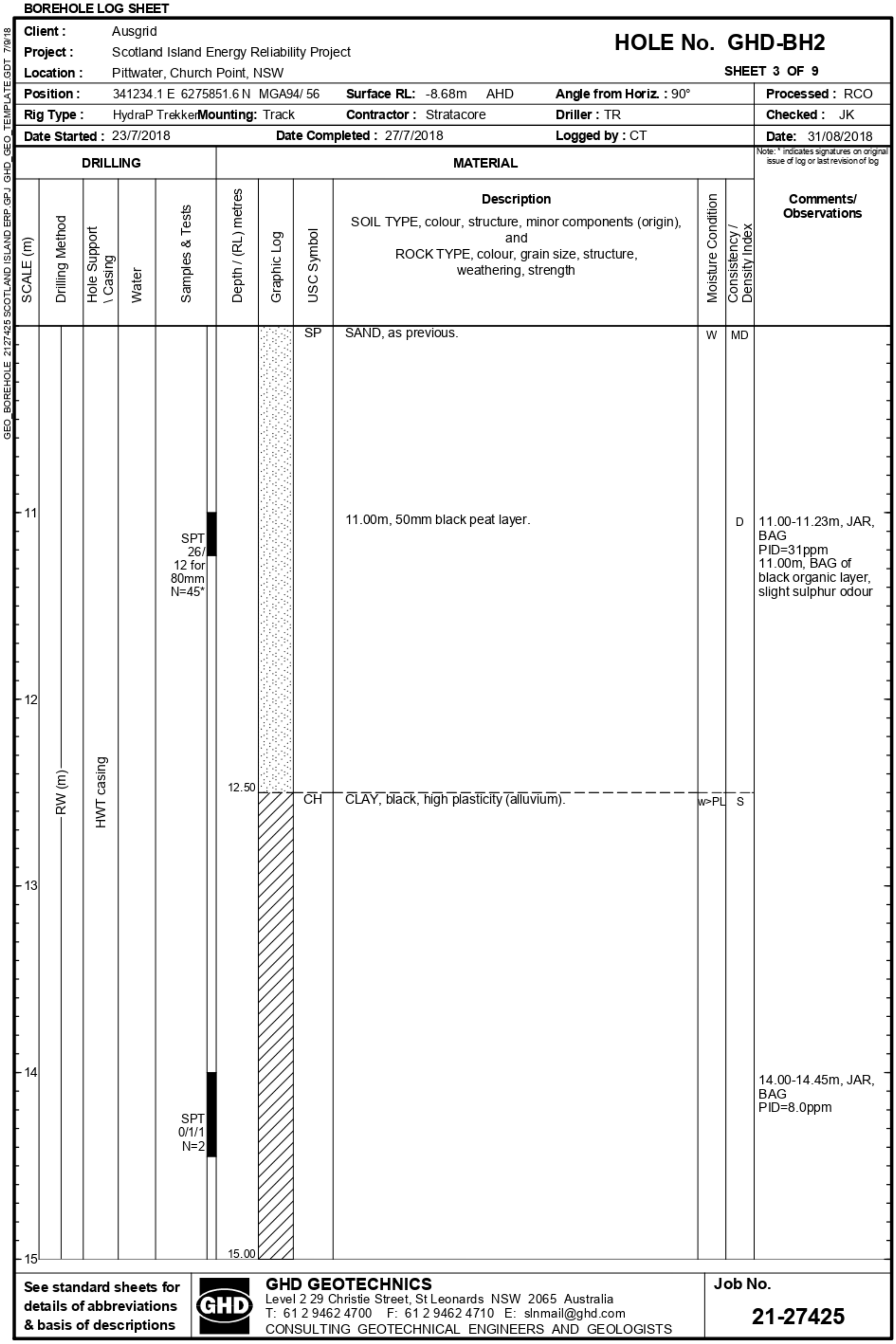

BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2
SHEET 3 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56
Surface RL: -8.68m AHD
Angle from Horiz. : 90°
Processed : RCO
Rig Type : HydraP Trekker **Mounting:** Track
Contractor : Stratacore
Driller : TR
Checked : JK
Date Started : 23/7/2018
Date Completed : 27/7/2018
Logged by : CT
Date: 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
							SP	SAND, as previous.	W	MD	
11				SPT 26/ 12 for 80mm N=45*				11.00m, 50mm black peat layer.		D	11.00-11.23m, JAR, BAG PID=31ppm 11.00m, BAG of black organic layer, slight sulphur odour
12											
	RW (m)	HWT casing			12.50		CH	CLAY, black, high plasticity (alluvium).	w>PL	S	
13											
14				SPT 0/1/1 N=2							14.00-14.45m, JAR, BAG PID=8.0ppm
15					15.00						

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BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 4 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56	**Surface RL:** -8.68m AHD	**Angle from Horiz. :** 90°		**Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR		**Checked :** JK
Date Started : 23/7/2018	**Date Completed :** 27/7/2018	**Logged by :** CT		**Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing		U75			CH	CLAY, as previous.	w>PL	F	
16				SPT 0/2/8 N=10			CL	16.00m, becoming / grading to, dark grey, low plasticity, with fine to coarse grained sand.		St	16.00m, first 300mm SPT values from cave in 16.00-16.45, BAG
17											
				SPT 15/ 25 for 120mm N=45*	17.50		SC	Clayey SAND, dark grey-brown, fine to medium grained, trace clay (alluvium).	W	D	17.50-17.77m, BAG
18											
19				SPT 18/15/17 N=32				From 19.00m, trace medium to coarse, sub-angular to rounded quartz gravel.			19.00-19.45m, BAG
20											

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BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 5 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56 **Surface RL:** -8.68m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 23/7/2018 **Date Completed :** 27/7/2018 **Logged by :** CT **Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing					SC	Clayey SAND, as previous.	W	D	
21					21.00		CI	CLAY, black, medium plasticity (alluvium).	w>PL	St	
22				SPT 5/6/6 N=12							22.00-22.45m, BAG, JAR
23											
24					24.00		SW	SAND, grey, fine to coarse grained, well graded, with fine to coarse, sub-rounded to rounded quartz gravels, trace clay (alluvium).	W	VD	
25											

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BOREHOLE LOG SHEET

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Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 6 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56
Surface RL: -8.68m AHD
Angle from Horiz. : 90°
Processed : RCO
Rig Type : HydraP Trekker **Mounting:** Track
Contractor : Stratacore
Driller : TR
Checked : JK
Date Started : 23/7/2018
Date Completed : 27/7/2018
Logged by : CT
Date: 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing		SPT 24/ 22 for 80mm N>50*			SW	SAND, as previous.	W	VD	
26											
27					27.00		-	CLAYSTONE, pale grey, extremely weathered, extremely low strength (bedrock).	-	-	
28				SPT 17/25/ 4 for 10mm N=ref	28.50			Start of coring at 28.5 metres. For cored interval, see Core Log Sheet.			
29											
30											

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

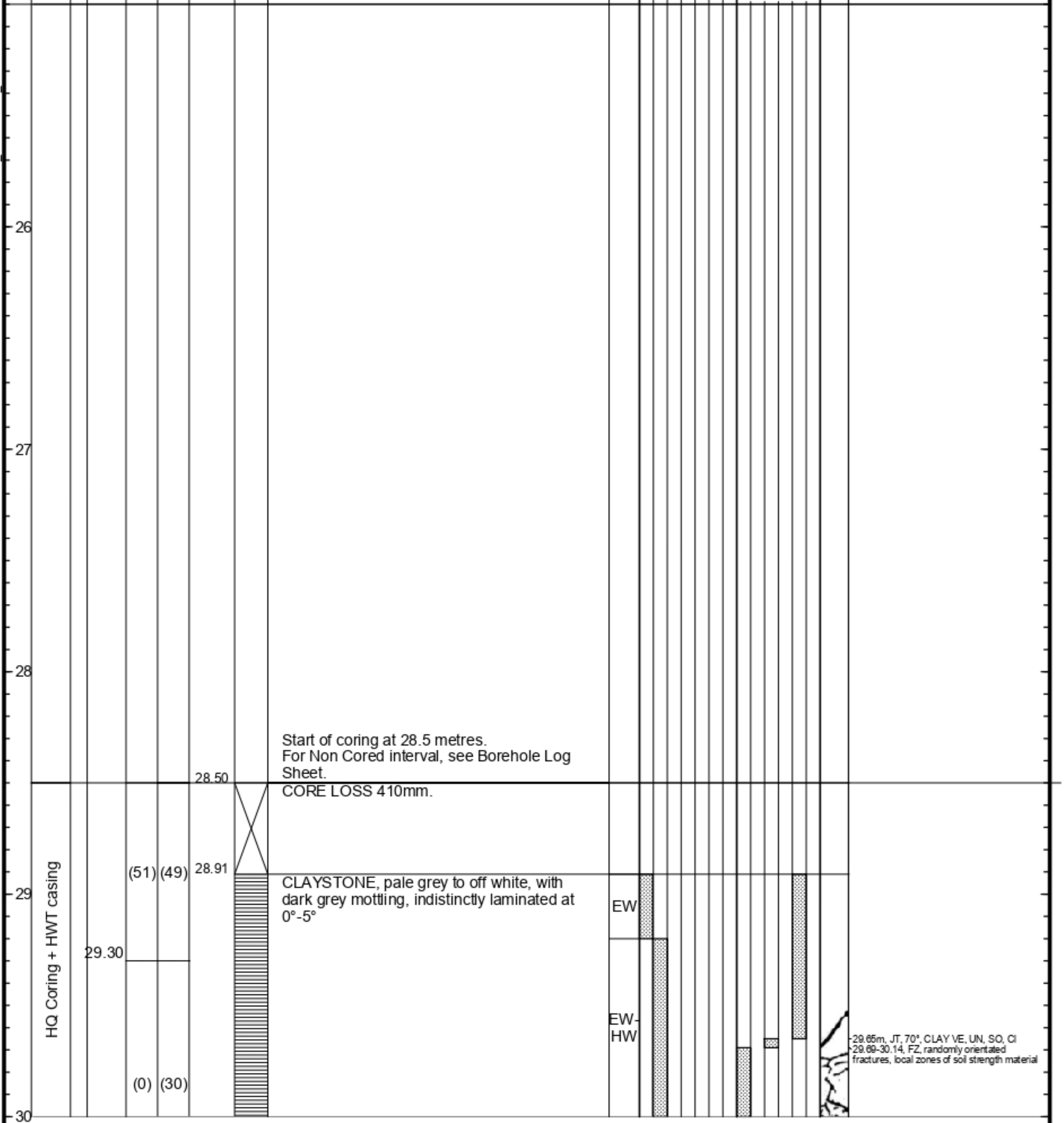
CORE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 7 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56 **Surface RL:** -8.68m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 23/7/2018 **Date Completed :** 27/7/2018 **Logged by :** CT **Date Logged :** 27/7/2018 Note: * indicates signatures on original issue of log or last revision of log



DRILLING						MATERIAL					NATURAL FRACTURES		
Progress													
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength $Is_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
26													
27													
28								Start of coring at 28.5 metres. For Non Cored interval, see Borehole Log Sheet.					
	HQ Coring + HWT casing					28.50		CORE LOSS 410mm.					
				(51)	(49)	28.91		CLAYSTONE, pale grey to off white, with dark grey mottling, indistinctly laminated at 0°-5°	EW				
29			29.30										
									EW-HW				29.65m, JT, 70°, CLAY VE, UN, SO, CI 29.69-30.14, FZ, randomly orientated fractures, local zones of soil strength material
				(0)	(30)								
30													

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
21-27425

GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

CORE LOG SHEET

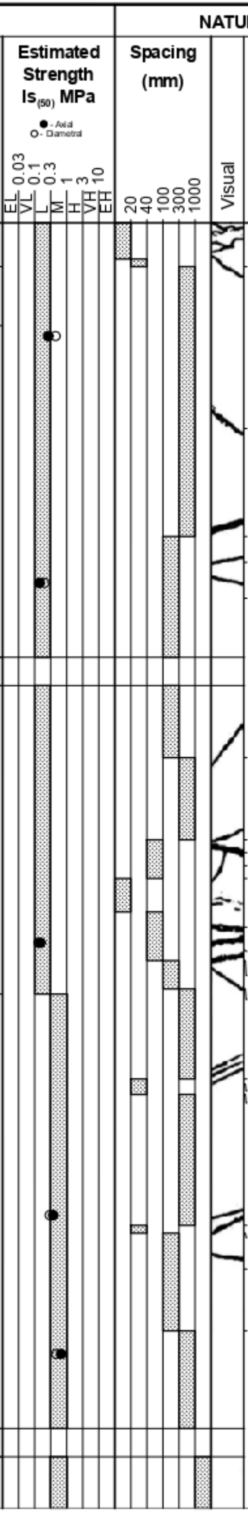
Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH2

SHEET 8 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56	**Surface RL:** -8.68m AHD		**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Casing Dia. : HWT	**Barrel (m) :** 1.5m	**Bit :** Surface set	**Bit Condition :** New	**Date:** 31/08/2018
Date Started : 23/7/2018	**Date Completed :** 27/7/2018	**Logged by :** CT	**Date Logged :** 27/7/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL			NATURAL FRACTURES
Drilling & Casing	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Graphic Log	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
HQ Coring + HWT casing	30.40				CLAYSTONE, as previous.	EW-HW		30.17m, JT, 55°, CLAY, UN, SO, CI
	31.80	(8)	(69)	31.69	From 30.50m, randomly orientated calcite infilled re-healed in-situ fractures (<1%).	HW		30.80m, JT, 45°, CN, UN, SO, CI 32.22m, SM, 25°, 20mm, EW rock 31.32m, JT, 10°, CLAY, UN, SO, CL 31.46m, JT, 17°, CLAY, UN, SO, CL
				31.80	CORE LOSS 110mm.			
	33.28	(0)	(48)	33.00	CLAYSTONE, as previous.	HW		32.08m, JT, 72°, CN, PLN, SO, CL 32.40m, JT, 15°, CN, UN, SO, CL 32.45m, SM, 15°, CLAY, 17mm 32.50m, JT, 80°, CLAY VE, PLN, SO, CL 32.55-32.68m, FZ, randomly orientated microfractures 32.74m, CSm, 15°, CLAY+host rock gravels, 10mm 32.83m, CSm, 15°, CLAY+host rock gravels, 8mm 32.87m, CSm, 10°, CLAY+host rock gravels, 10mm 32.98m, JT, 55°, CLAY VE, PLN, SO, CL
	34.80	(7)	(81)	34.69	Interbedded SILTSTONE/ SANDSTONE, siltstone is dark grey, sandstone is grey to dark grey and fine grained, distinctly and cross bedded at 0-20°, randomly orientated calcite infilled re-healed in-situ fractures (1%).	SW		33.33m, JT, 27°, CLAY VE, PLN, CL 33.35m, JT, 27°, CLAY VE, PLN, CL 33.39m, JT, 27°, CLAY VE, PLN, CL 33.90m, JT, 10°, CLAY VE, UN, RF, CL 33.93m, JT, 40°, CLAY, IR, SO, CL 34.07m, JT, 15°, CN, PLN, SO, CL 34.31m, JT, 20°, CA, PLN, SO, CL
				34.80	CORE LOSS 110mm.			
					Interbedded SILTSTONE / SANDSTONE, as previous.	SW		



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CORE LOG SHEET

GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

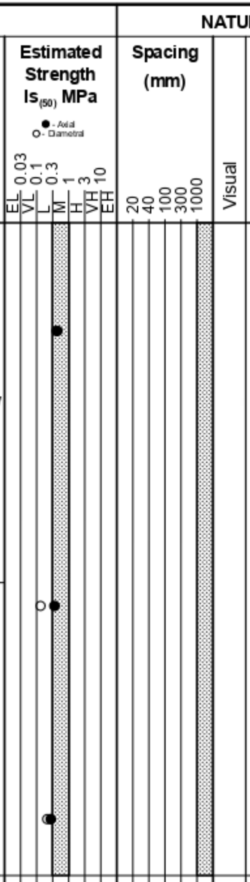
HOLE No. GHD-BH2

SHEET 9 OF 9

Position : 341234.1 E 6275851.6 N MGA94/ 56	**Surface RL:** -8.68m AHD		**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Casing Dia. : HWT	**Barrel (m) :** 1.5m	**Bit :** Surface set	**Bit Condition :** New	**Date:** 31/08/2018
Date Started : 23/7/2018	**Date Completed :** 27/7/2018	**Logged by :** CT	**Date Logged :** 27/7/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING | **MATERIAL** | **NATURAL FRACTURES**

SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering
	HQ Coring + HWT casing			(0)	(100)			Interbedded SILTSTONE / SANDSTONE, as previous.	SW
36			36.25						
				(0)	(100)			36.40m, becoming predominantly dark grey to black.	Fr
37			37.25						
			37.54	(0)	(100)	37.54			
								End of Borehole at 37.54 metres. Target Depth	
38									
39									
40									



Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3

SHEET 1 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56		**Surface RL:** -12.26m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 13/7/2018	**Date Completed :** 13/7/2018		**Logged by :** CT	**Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m) Casing Advancer	HWT					SC	Clayey SAND, grey/brown, fine to medium grained (alluvium).	w>PL	S	Note: 'TR' = undisturbed sample for Thermal Resistivity testing *Denotes SPT terminated early due to difficulties extracting sampler on floating barge. Inferred N value.
1											
				SPT 3/7/12 N=19						VSt	1.50-1.85m, BAG, JAR PID=4ppm
								1.85m, possible increase in stiffness and clay content.	w~PL		
2											
				U75							2.50-2.90m, U75 (TR)
								From 2.90m, increase in clay content, becoming grey, Sandy CLAY/ Clayey SAND matrix.		H	2.90-3.35m, BAG, JAR PID<1ppm
3				SPT 7/15/16 N=31							
4											
				SPT 5/9/10 N=19				From 4.50m, becoming orange brown, with iron indurated zones.		VSt	4.50-4.95m, JAR+BAG PID<1ppm
5					5.00						

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3

SHEET 2 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56 **Surface RL:** -12.26m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 13/7/2018 **Date Completed :** 13/7/2018 **Logged by :** CT **Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
	RW (m) Casing Advancer	HWT					SC	Clayey SAND, as previous.	w~PL	VSt	
6				SPT 5/8/10 N=18	6.00		CH	CLAY, grey, high plasticity, trace fine grained sand (alluvium).	w~PL	VSt	6.00-6.45m, JAR+BAG PID<1ppm
7											
				SPT 2/6/10 N=16	7.50		SC	Clayey SAND, grey, streaked brown, fine to coarse grained (alluvium).	W	MD	7.50-7.95m, BAG
8											
9				SPT 8/7/11 N=18						VD	9.00-9.45m, BAG
10											

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3

SHEET 3 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56		**Surface RL:** -12.26m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 13/7/2018	**Date Completed :** 13/7/2018		**Logged by :** CT	**Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m) Casing Advancer	HWT					SC	Clayey SAND, as previous.	W	MD	
				SPT 24/ 31 for 100mm N>50*				10.50-10.60m, dark grey to black clay band, high plasticity.			10.50-10.66m, BAG 10.66-10.75m, BAG
11											
12											
13											
14											
15					15.00						

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BOREHOLE LOG SHEET

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Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3

SHEET 4 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56 **Surface RL:** -12.26m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 13/7/2018 **Date Completed :** 13/7/2018 **Logged by :** CT **Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m) Casing Advancer	HWT		SPT 13/15/8 N=23			SC	Clayey SAND, as previous.	W	MD	Possible cave in for SPT (sand) 15.00-15.45m, BAG
16											
17											
18				SPT 30/ 11 for 50mm N>50*				From 18.00m, becoming grey-dark grey, trace of silt.		D- VD	18.00-18.20m, BAG
19					18.90		SP	SAND, grey, medium to coarse grained, with fine to coarse, sub-rounded to rounded quartz gravel (alluvium).	W	VD	18.90m, increased drilling resistance. 19.50m, increase and decrease in resistance through gravel layers.
20											

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BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3
SHEET 5 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56	**Surface RL:** -12.26m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 13/7/2018	**Date Completed :** 13/7/2018	**Logged by :** CT	**Date:** 31/08/2018

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DRILLING					**MATERIAL**						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m) Casing Advancer	HWT					SP	SAND, as previous.	W	VD	20.00m, water discharging of the top of drilling casing. Possible hole collapse.
21											From 21.00m, unable to do SPT due to sand cave in.
22											
23											
24											
25											

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH3

SHEET 6 OF 9

Position : 341299.8 E 6275900.9 N MGA94/ 56	**Surface RL:** -12.26m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 13/7/2018	**Date Completed :** 13/7/2018	**Logged by :** CT	**Date:** 31/08/2018

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DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m) Casing Advancer	HWT					SP	SAND, as previous.	W	VD	From 25.50m, variable / increased drilling resistance (possible sediment layering)
26											
					26.40			SILTSTONE, grey, extremely weathered.	-	-	26.40m, consistent increase in drilling resistance
27											27.00m, increased drilling resistance
					27.30			Start of coring at 27.3 metres. For cored interval, see Core Log Sheet.			
28											
29											
30											

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

CORE LOG SHEET

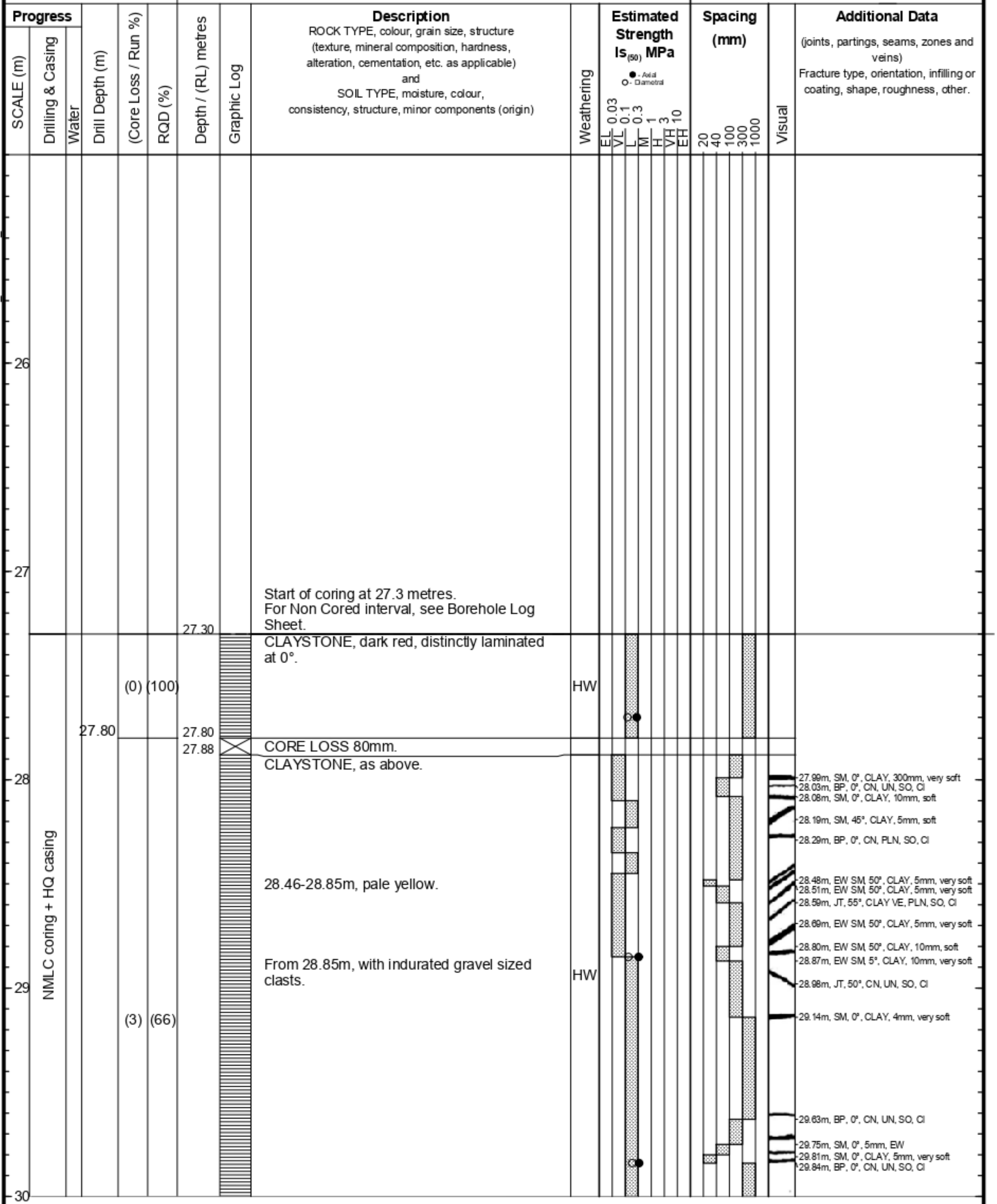
HOLE No. GHD-BH3

SHEET 7 OF 9

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

Position : 341299.8 E 6275900.9 N MGA94/ 56	**Surface RL:** -12.26m AHD		**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker	**Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Casing Dia. : HWT	**Barrel (m) :** 1.5m	**Bit :** Surface set	**Bit Condition :** New	**Date:** 31/08/2018
Date Started : 13/7/2018	**Date Completed :** 13/7/2018	**Logged by :** CT	**Date Logged :** 13/7/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING | **MATERIAL** | **NATURAL FRACTURES**



Description
ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)

Start of coring at 27.3 metres.
For Non Cored interval, see Borehole Log Sheet.

27.30 CLAYSTONE, dark red, distinctly laminated at 0°.

27.80 CORE LOSS 80mm.

27.88 CLAYSTONE, as above.

28.46-28.85m, pale yellow.

From 28.85m, with indurated gravel sized clasts.

Additional Data
(joints, partings, seams, zones and veins)
Fracture type, orientation, infilling or coating, shape, roughness, other.

27.99m, SM, 0°, CLAY, 300mm, very soft
28.03m, BP, 0°, CN, UN, SO, Cl
28.08m, SM, 0°, CLAY, 10mm, soft
28.19m, SM, 45°, CLAY, 5mm, soft
28.29m, BP, 0°, CN, PLN, SO, Cl
28.48m, EW SM, 50°, CLAY, 5mm, very soft
28.51m, EW SM, 50°, CLAY, 5mm, very soft
28.59m, JT, 55°, CLAY VE, PLN, SO, Cl
28.69m, EW SM, 50°, CLAY, 5mm, very soft
28.80m, EW SM, 50°, CLAY, 10mm, soft
28.87m, EW SM, 5°, CLAY, 10mm, very soft
28.98m, JT, 50°, CN, UN, SO, Cl
29.14m, SM, 0°, CLAY, 4mm, very soft
29.63m, BP, 0°, CN, UN, SO, Cl
29.75m, SM, 0°, 5mm, EW
29.81m, SM, 0°, CLAY, 5mm, very soft
29.84m, BP, 0°, CN, UN, SO, Cl

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

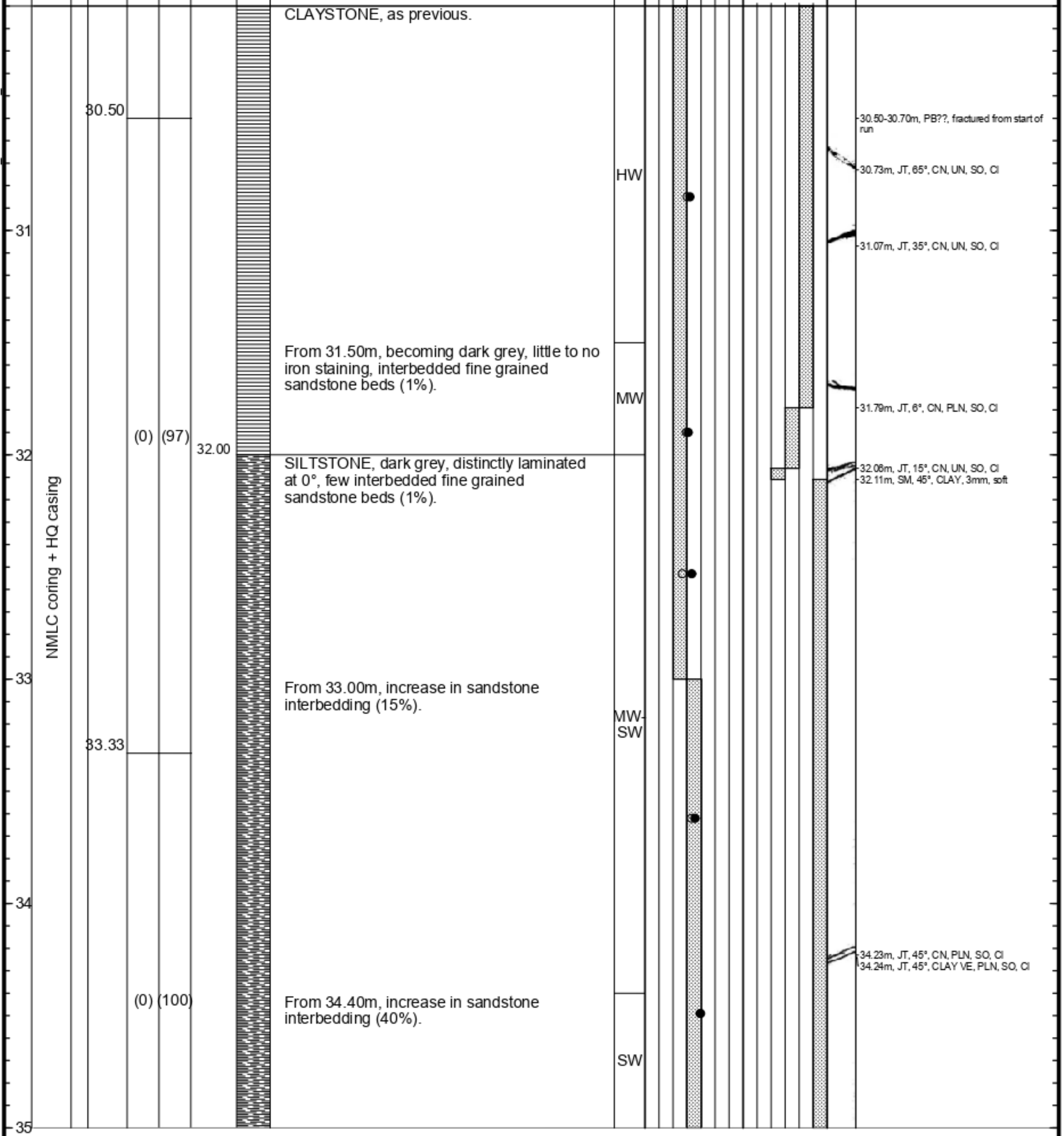
CORE LOG SHEET

HOLE No. GHD-BH3

SHEET 8 OF 9

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341299.8 E 6275900.9 N MGA94/ 56 **Surface RL:** -12.26m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 13/7/2018 **Date Completed :** 13/7/2018 **Logged by :** CT **Date Logged :** 13/7/2018 Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength Is$_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.



CLAYSTONE, as previous.

From 31.50m, becoming dark grey, little to no iron staining, interbedded fine grained sandstone beds (1%).

SILTSTONE, dark grey, distinctly laminated at 0°, few interbedded fine grained sandstone beds (1%).

From 33.00m, increase in sandstone interbedding (15%).

From 34.40m, increase in sandstone interbedding (40%).

30.50-30.70m, PB??, fractured from start of run
30.73m, JT, 65°, CN, UN, SO, CI
31.07m, JT, 35°, CN, UN, SO, CI
31.79m, JT, 6°, CN, PLN, SO, CI
32.08m, JT, 15°, CN, UN, SO, CI
32.11m, SM, 45°, CLAY, 3mm, soft
34.23m, JT, 45°, CN, PLN, SO, CI
34.24m, JT, 45°, CLAY VE, PLN, SO, CI

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

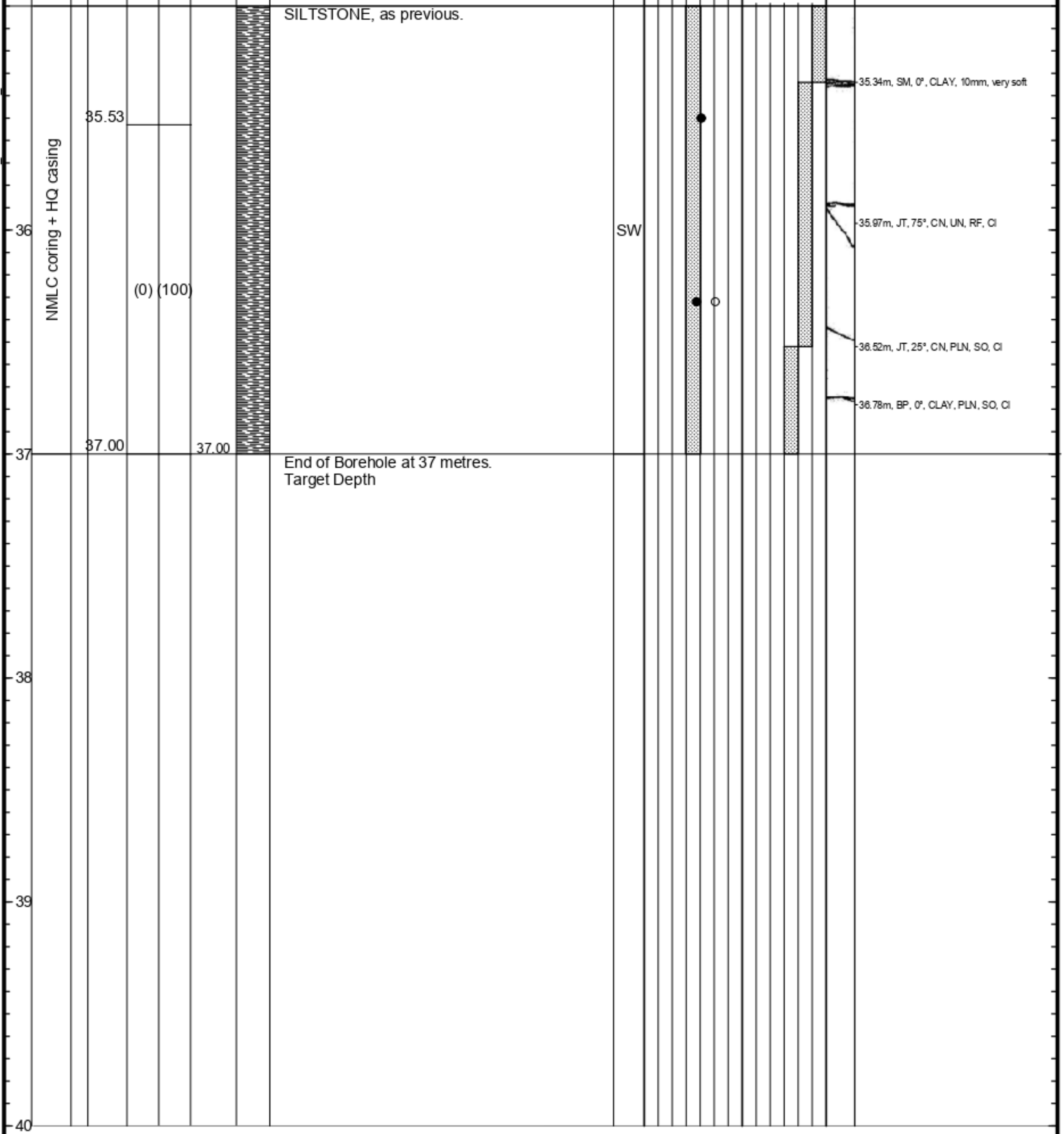
CORE LOG SHEET

HOLE No. GHD-BH3

SHEET 9 OF 9

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341299.8 E 6275900.9 N MGA94/ 56 **Surface RL:** -12.26m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 13/7/2018 **Date Completed :** 13/7/2018 **Logged by :** CT **Date Logged :** 13/7/2018 Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES			
Progress													
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength Is$_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.



SILTSTONE, as previous.

35.34m, SM, 0°, CLAY, 10mm, very soft

35.97m, JT, 75°, CN, UN, RF, CI

36.52m, JT, 25°, CN, PLN, SO, CI

36.78m, BP, 0°, CLAY, PLN, SO, CI

End of Borehole at 37 metres.
Target Depth

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

HOLE No. GHD-BH4

SHEET 1 OF 8

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date:** 31/08/2018

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

DRILLING — Drilling Method: RW (m) (0–5 m); Hole Support \ Casing: HWT casing

MATERIAL — Description: SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength

SCALE (m)	Samples & Tests	Depth / (RL) metres	USC Symbol	Description	Moisture Condition	Consistency / Density Index	Comments/ Observations
0			SW	SAND, pale grey, fine to coarse grained, with fine gravel, shell fragments (alluvium).	W	-	Note: 'TR' = undisturbed sample for Thermal Resistivity testing *Denotes SPT terminated early due to difficulties extracting sampler on floating barge. Inferred N value.
1.5	SPT 0/0/0 N=0	1.50	CL	Sandy CLAY, dark grey to brown, low plasticity, fine to coarse grained sand, shells (alluvium).	w~LL	VS	1.50m, SPT fell under rod weight 1.50-1.95m, JAR, PID=1.9ppm
3	SPT 0/0/1 N=1						3.00-3.45, BAG, JAR PID=12ppm
4.3	U75						4.30m, no sample was retained in U75
4.5	SPT 10/13/11 N=24	4.50	SC	Clayey SAND, brown, fine to coarse grained, well graded, trace fine gravel (alluvium).	W	MD	4.50-4.95m, BAG, JAR PID=7.2ppm
5							

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 2 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
	RW (m)	HWT casing					SC	Clayey SAND, as previous.	W	MD	
6				SPT 5/13/14 N=27	6.00		CL	CLAY, pale grey, low plasticity, with fine to coarse grained sand, iron stained (alluvium).	w~PL	VSt	6.00-6.45m, BAG, JAR PID=13.1ppm
7											
				U75							7.20-7.50, U75 (TR)
				SPT 7/8/14 N=22				From 7.50m, becoming pale grey/brown with iron staining, slight iron induration.			7.50-7.95m, BAG, JAR PID=9.6ppm
8											
9				SPT 10/12/15 N=27				From 9.00m, becoming brown/red from iron staining.			9.00-9.45m, JAR, BAG PID=6.2ppm
10					10.00						

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 3 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing					SW	SAND, pale grey, fine to coarse grained, well graded, trace of clay (alluvium).	W	MD	
				U75							10.30m, disturbed sand retained in U75
				SPT 12/13/14 N=27							10.50-10.95, JAR, BAG PID=2.8ppm
11											
12		Nil		SPT 5/15/16 N=31				From 12.00m, with clay, localised bands of clayey SAND.		D	12.00-12.45m, JAR, BAG PID=11.8ppm
13											
				SPT 6/31/ 4 for 10mm HB N=ref	13.50		CL	Sandy CLAY, grey-brown, low plasticity fine to coarse grained sand (alluvium).	w~PL	H	13.50-13.81m, JAR, BAG PID=4.6ppm
14											
15					15.00						

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 4 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56	**Surface RL:** -1.97m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 30/7/2018	**Date Completed :** 2/8/2018	**Logged by :** CT	**Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
	RW (m)	Nil		SPT 8/10/11 N=21		▨	CH	CLAY, black, medium to high plasticity, with fine to coarse grained sand (alluvium).	w~PL	VSt	15.00-15.45, JAR, BAG PID=43ppm
16											
				SPT 17/24/ * N~45*	16.50	░	SW	SAND, brown-grey, fine to coarse grained, well graded, with clay (alluvium).	W	D	16.50-16.80m, JAR, BAG PID=8.3ppm
17											
18				SPT 6/14/25 N=39			SW-SC	From 18.00m, increase in clay, becoming Clayey SAND.			81.00-18.45m JAR, BAG PID=6.2ppm
19											
20					20.00						

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 5 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56	**Surface RL:** -1.97m AHD	**Angle from Horiz. :** 90°	**Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track	**Contractor :** Stratacore	**Driller :** TR	**Checked :** JK
Date Started : 30/7/2018	**Date Completed :** 2/8/2018	**Logged by :** CT	**Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
							CH	CLAY, dark grey, high plasticity, trace of silt (alluvium).	w~PL	St	
				SPT 8/7/11 N=18							20.40-20.85m, JAR, BAG PID=9.5ppm
21											
22	RW (m)	Nil		SPT 12/15/11 N=26	22.00		CL	Sandy CLAY, brown-grey, low plasticity, fine to coarse grained sand.	w>PL	VSt	22.00-22.45, JAR, BAG PID=5.7ppm
23											
24											
					24.50			Start of coring at 24.5 metres. For cored interval, see Core Log Sheet.			
25											

See standard sheets for details of abbreviations & basis of descriptions

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CORE LOG SHEET

GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 6 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date Logged :** 01/8/2018
Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL					NATURAL FRACTURES		
Progress													
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength Is$_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
21													
22													
23													
24						24.50		Start of coring at 24.5 metres. For Non Cored interval, see Borehole Log Sheet.					
						24.61	☒	CORE LOSS 110mm.					
			24.80	(37)				SANDSTONE, pale grey/pale orange, fine to medium grained, distinctly cross-bedded at 15-25°, very thinly bedded, iron staining.	HW	●			24.89m, BP, 20°, CN, UN, RF, Cl 24.89-25.00m, DB's
25													

See standard sheets for details of abbreviations & basis of descriptions

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CORE LOG SHEET

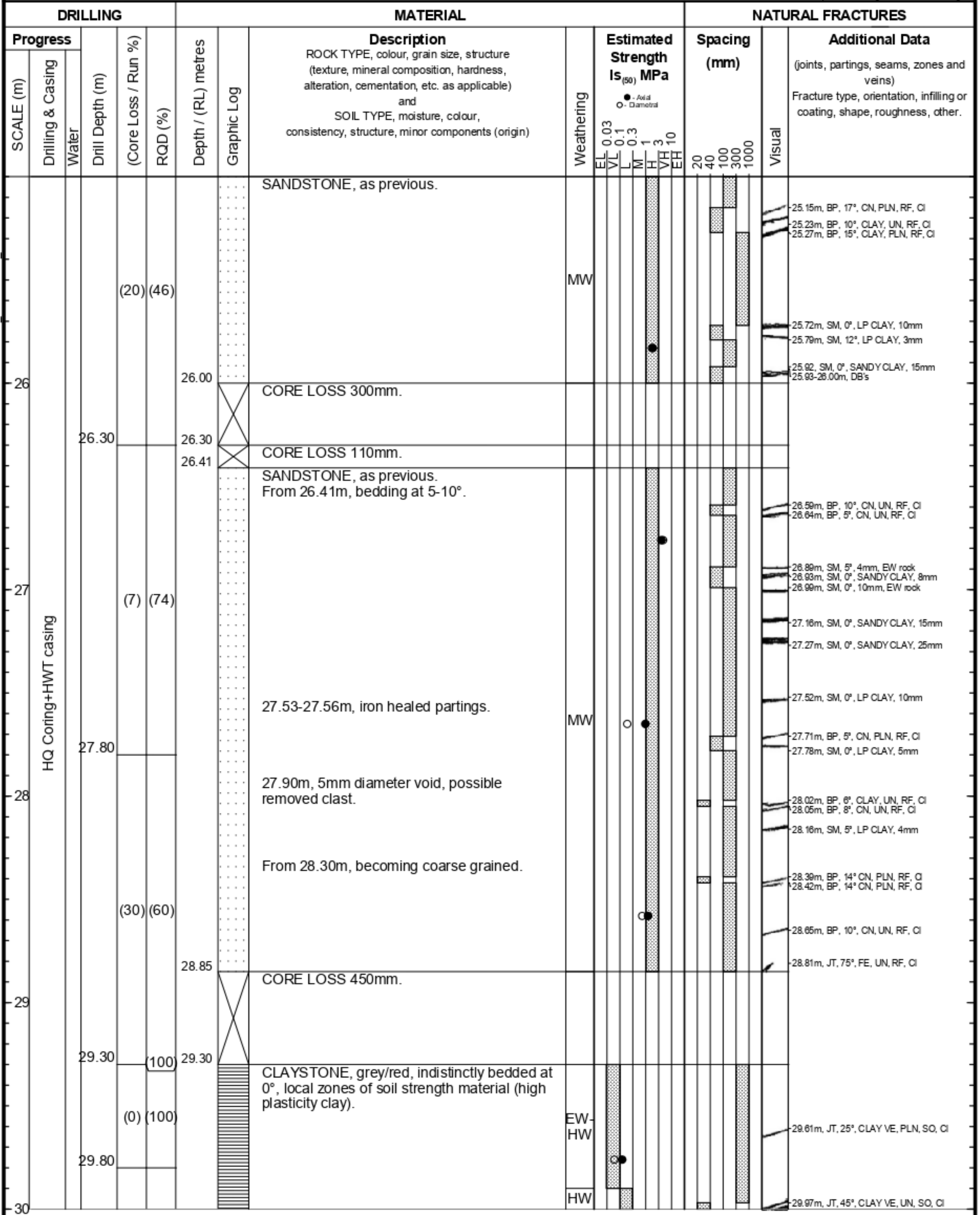
GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 7 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date Logged :** 01/8/2018
Note: * indicates signatures on original issue of log or last revision of log



Description: ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)

Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering
	(20)	(46)		SANDSTONE, as previous.	MW
			26.00	CORE LOSS 300mm.	
26.30			26.30	CORE LOSS 110mm.	
	(7)	(74)	26.41	SANDSTONE, as previous. From 26.41m, bedding at 5-10°. 27.53-27.56m, iron healed partings.	MW
27.80	(30)	(60)		27.90m, 5mm diameter void, possible removed clast. From 28.30m, becoming coarse grained.	
			28.85	CORE LOSS 450mm.	
29.30		(100)	29.30	CLAYSTONE, grey/red, indistinctly bedded at 0°, local zones of soil strength material (high plasticity clay).	EW-HW
	(0)	(100)			
29.80					HW

Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.

25.15m, BP, 17°, CN, PLN, RF, CI
25.23m, BP, 10°, CLAY, UN, RF, CI
25.27m, BP, 15°, CLAY, PLN, RF, CI
25.72m, SM, 0°, LP CLAY, 10mm
25.79m, SM, 12°, LP CLAY, 3mm
25.92, SM, 0°, SANDY CLAY, 15mm
25.93-26.00m, DB's
26.59m, BP, 10°, CN, UN, RF, CI
26.64m, BP, 5°, CN, UN, RF, CI
26.89m, SM, 5°, 4mm, EW rock
26.93m, SM, 0°, SANDY CLAY, 8mm
26.99m, SM, 0°, 10mm, EW rock
27.16m, SM, 0°, SANDY CLAY, 15mm
27.27m, SM, 0°, SANDY CLAY, 25mm
27.52m, SM, 0°, LP CLAY, 10mm
27.71m, BP, 5°, CN, PLN, RF, CI
27.78m, SM, 0°, LP CLAY, 5mm
28.02m, BP, 6°, CLAY, UN, RF, CI
28.05m, BP, 8°, CN, UN, RF, CI
28.16m, SM, 5°, LP CLAY, 4mm
28.39m, BP, 14° CN, PLN, RF, CI
28.42m, BP, 14° CN, PLN, RF, CI
28.65m, BP, 10°, CN, UN, RF, CI
28.81m, JT, 75°, FE, UN, RF, CI
29.61m, JT, 25°, CLAY VE, PLN, SO, CI
29.97m, JT, 45°, CLAY VE, UN, SO, CI

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

CORE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH4

SHEET 8 OF 8

Position : 341145.3 E 6275801.8 N MGA94/ 56 **Surface RL:** -1.97m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 30/7/2018 **Date Completed :** 2/8/2018 **Logged by :** CT **Date Logged :** 01/8/2018
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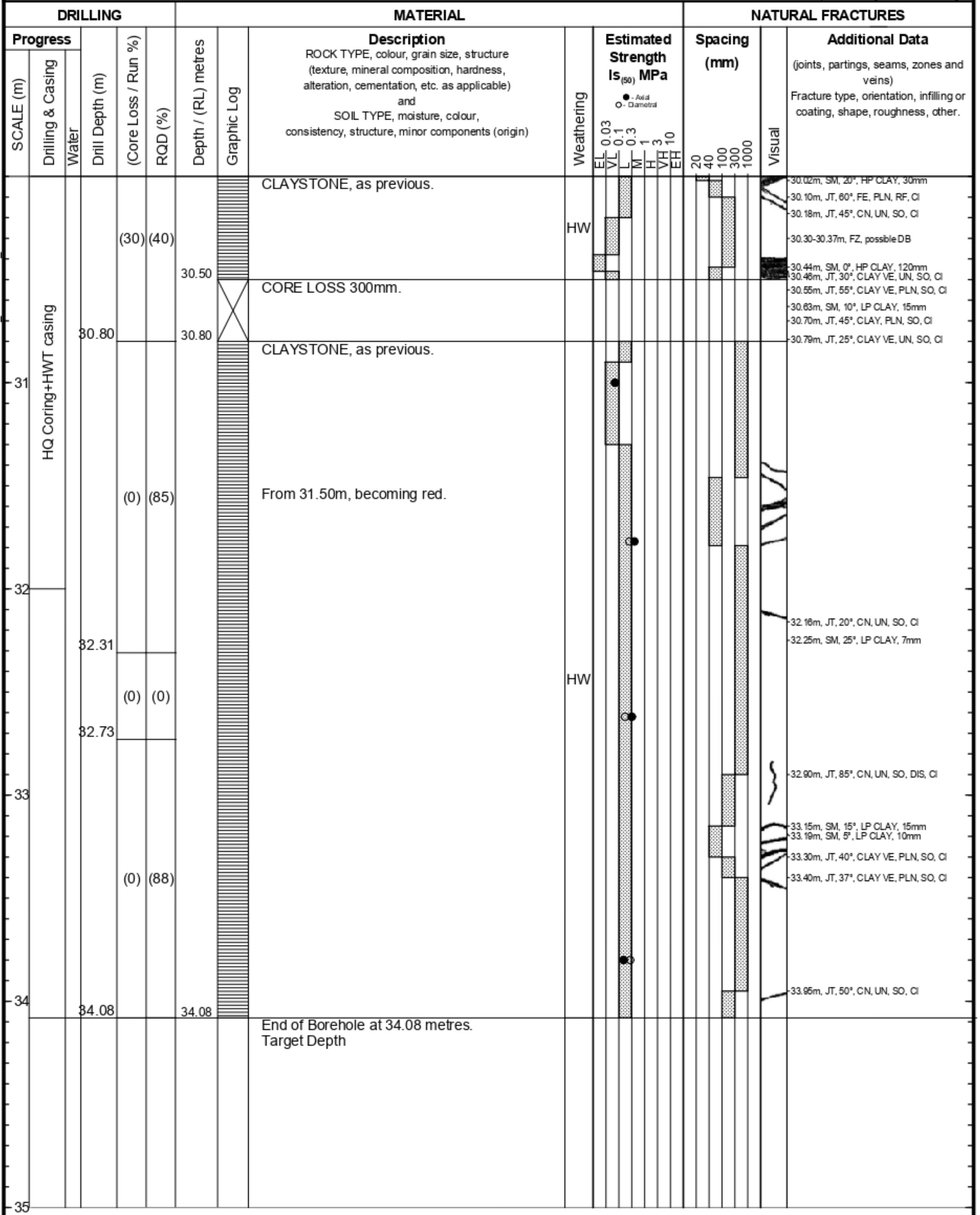

Description
ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)

Additional Data
(joints, partings, seams, zones and veins)
Fracture type, orientation, infilling or coating, shape, roughness, other.

Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering
	(30)	(40)		CLAYSTONE, as previous.	HW
			30.50	CORE LOSS 300mm.	
30.80			30.80	CLAYSTONE, as previous. From 31.50m, becoming red.	HW
	(0)	(85)			
32.31	(0)	(0)			
32.73	(0)	(88)			
34.08			34.08	End of Borehole at 34.08 metres. Target Depth	

30.02m, SM, 20°, HP CLAY, 30mm
30.10m, JT, 60°, FE, PLN, RF, CI
30.18m, JT, 45°, CN, UN, SO, CI
30.30-30.37m, FZ, possible DB
30.44m, SM, 0°, HP CLAY, 120mm
30.46m, JT, 30°, CLAY VE, UN, SO, CI
30.55m, JT, 55°, CLAY VE, PLN, SO, CI
30.63m, SM, 10°, LP CLAY, 15mm
30.70m, JT, 45°, CLAY, PLN, SO, CI
30.79m, JT, 25°, CLAY VE, UN, SO, CI
32.16m, JT, 20°, CN, UN, SO, CI
32.25m, SM, 25°, LP CLAY, 7mm
32.90m, JT, 85°, CN, UN, SO, DIS, CI
33.15m, SM, 15°, LP CLAY, 15mm
33.19m, SM, 5°, LP CLAY, 10mm
33.30m, JT, 40°, CLAY VE, PLN, SO, CI
33.40m, JT, 37°, CLAY VE, PLN, SO, CI
33.95m, JT, 50°, CN, UN, SO, CI

See standard sheets for details of abbreviations & basis of descriptions

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/9/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH5

SHEET 1 OF 5

Position : 341540.8 E 6275988.9 N MGA94/ 56
Surface RL: -1.29m AHD
Angle from Horiz. : 90°
Processed : RCO
Rig Type : HydraP Trekker
Mounting: Track
Contractor : Stratacore
Driller : TR
Checked : JK
Date Started : 10/7/2018
Date Completed : 12/7/2018
Logged by : CT
Date: 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing		SPT 0/0/0 N=0			-	SAND, pale yellow, marine sediments, shells (alluvium).	W	-	Note: 'TR' = undisturbed sample for Thermal Resistivity testing *Denotes SPT terminated early due to difficulties extracting sampler on floating barge. Inferred N value. 0.0m, no sample return SPT falling under rod weight
1											
					1.50		CL	Sandy CLAY, grey/brown, low plasticity, fine to coarse grained sand (alluvium).	w>PL	F-St	1.60-2.05m, JAR+BAG PID=1.0ppm
2				SPT 2/3/5 N=8							2.10-2.40m, TR SAMPLE
				U75							
3				SPT 4/6/9 N=15						St	2.80-3.25m, JAR+BAG PID=1.1ppm
4											
				SPT 5/7/11 N=18				From 4.50m, iron staining and iron cementation.		VSt	4.50-4.95m, JAR+BAG PID=1.0ppm
5					5.00						

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW

HOLE No. GHD-BH5

SHEET 2 OF 5

Position : 341540.8 E 6275988.9 N MGA94/ 56 **Surface RL:** -1.29m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Date Started : 10/7/2018 **Date Completed :** 12/7/2018 **Logged by :** CT **Date:** 31/08/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					**MATERIAL**						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	RW (m)	HWT casing		U75			CL	Sandy CLAY, as previous.	w>PL	St	5.10-5.40m, TR SAMPLE
6				SPT 11/21/20 N=41	6.00		CI	CLAY, grey, medium plasticity, trace of silt, iron staining, iron induration (alluvium).	w~PL	H	6.00-6.45m, BAG
7											
				SPT 18/28/ 8 for 50mm * N~52*							7.50-7.85m, BAG
8				U75							8.00m, soil too stiff for U75 (TR Sample)
9				SPT 11/5 for 10mm HB N=ref	9.20						
								Start of coring at 9.2 metres. For cored interval, see Core Log Sheet.			
10											

See standard sheets for details of abbreviations & basis of descriptions

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

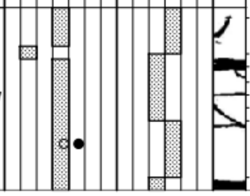
CORE LOG SHEET

HOLE No. GHD-BH5

SHEET 3 OF 5

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341540.8 E 6275988.9 N MGA94/ 56 **Surface RL:** -1.29m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 10/7/2018 **Date Completed :** 12/7/2018 **Logged by :** CT **Date Logged :** 11/7/2018
Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL				NATURAL FRACTURES			
Progress		Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength Is(50) MPa ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
SCALE (m)	Drilling & Casing	Water										
6												
7												
8												
9							Start of coring at 9.2 metres. For Non Cored interval, see Borehole Log Sheet.					
	HQ Coring+HWT casing				9.20		CORE LOSS 90mm.					
			(18)	(23)	9.29		SILTSTONE, red brown, orange brown with minor pale grey bands, distinctly laminated at 0-10°, iron staining, iron indurated zones.	HW				9.33m, SM, 65°, CLAY, 5mm, soft 9.47M, SM, 0°, CLAY, 60mm, very stiff 9.52m, SM, 50°, CLAY, 3mm, soft 9.58m, BP, 0°, CLAY, PLN, RF, CI 9.63m, JT, 65°, CLAY, UN, RF, CI 9.68m, BP, 0°, CLAY VE, PLN, RF, CI 9.73m, BP, 5°, CLAY, UN, RF, CI 9.95m, SM, 0°, CLAY, 50mm, very stiff
10			10.00		10.00							



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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

CORE LOG SHEET

HOLE No. GHD-BH5

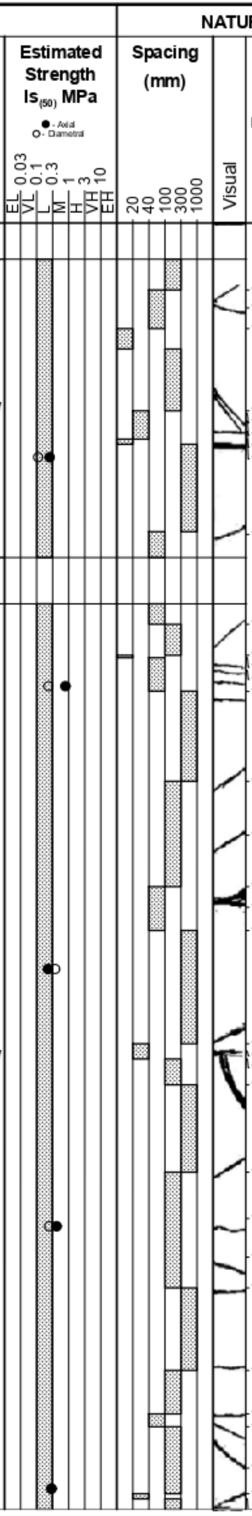
SHEET 4 OF 5

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341540.8 E 6275988.9 N MGA94/ 56 **Surface RL:** -1.29m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 10/7/2018 **Date Completed :** 12/7/2018 **Logged by :** CT **Date Logged :** 11/7/2018
Note: * indicates signatures on original issue of log or last revision of log

DRILLING | **MATERIAL** | **NATURAL FRACTURES**

SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Description	Weathering
	HQ Coring+HWT casing						CORE LOSS 140mm.	
				(11)	(47)	10.14	SILTSTONE, as above. From 10.60m, predominantly grey with minor red-brown and orange brown staining.	HW
11			11.30			11.30	CORE LOSS 180mm.	
				(15)	(54)	11.48	SILTSTONE, as above. From 11.48, interlaminated fine grained sandstone.	
12			12.50	(0)	(0)			
			12.90					
13				(0)	(81)		From 13.00m, sporadic iron oxide healed joints, dipping approx. 50-70°.	HW
14			14.30					
15								

Description: ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)



Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.

- 10.26m, SM, 65°, CLAY, 3mm, soft
- 10.33m, JT, 25°, CN, UN, SO, CI
- 10.41-10.49, FZ, possible DB
- 10.73m, JT, 65°, FE, UN, RF, CI
- 10.74m, JT, 65°, FE, UN, RF, CI
- 10.77m, BP, 5°, CLAY, UN, SO, CI
- 10.81m, SM, 0°, CLAY, 20mm, soft
- 10.84-10.86m, JT's x 4, 45°, FE, UN, SO, CI
- 11.21m, JT, 30°, CLAY VE, UN, SO, CI
- 11.56m, JT, 65°, CN, UN, RF, CI
- 11.68m, BP, 0°, FE, UN, SO, CI
- 11.69m, BP, 0°, FE, UN, SO, CI
- 11.74m, BP, 0°, FE, UN, RF, CI
- 11.82m, BP, 0°, CN, PLN, SO, CI
- 12.17m, JT, 40°, FE, PLN, RF, CI
- 12.38m, JT, 40°, FE, UN, RF, CI
- 12.58m, SM, 0°, CLAY, 40mm, soft
- 12.66m, JT, 75°, FE, UN, RF, CI
- 12.75m, JT, 35°, CLAY VE, PLN, SO, CI
- 13.19m, JT, 45°, CLAY, UN, RF, CI
- 13.22m, BP, 0°, CLAY VE, UN, SO, CI
- 13.25m, BP, 0°, CLAY VE, UN, SO, CI
- 13.35m, EW SM, 70°, CLAY, 13mm, soft
- 13.69m, JT, 40°, FE, PLN, RF, CI
- 13.87m, BP, 5°, CLAY VE, UN, SO, CI
- 14.02m, JT, 45°, FE, UN, RF, CI
- 14.14m, BP, 5°, FE, PLN, RF, CI
- 14.46m, BP, 0°, CN, UN, SO, CI
- 14.63m, BP, 0°, CN, PLN, SO, CI
- 14.68m, JT, 30°, FE, PLN, RF, CI
- 14.84m, JT, 45°, FE, PLN, RF, CI
- 14.94m, JT, 50°, CLAY VE, UN, RF, CI

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GEO_COREHOLE_VISUAL 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 7/8/18

CORE LOG SHEET

HOLE No. GHD-BH5

SHEET 5 OF 5

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Pittwater, Church Point, NSW
Position : 341540.8 E 6275988.9 N MGA94/ 56 **Surface RL:** -1.29m AHD **Angle from Horiz. :** 90° **Processed :** RCO
Rig Type : HydraP Trekker **Mounting:** Track **Contractor :** Stratacore **Driller :** TR **Checked :** JK
Casing Dia. : HWT **Barrel (m) :** 1.5m **Bit :** Surface set **Bit Condition :** New **Date:** 31/08/2018
Date Started : 10/7/2018 **Date Completed :** 12/7/2018 **Logged by :** CT **Date Logged :** 11/7/2018
Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL					NATURAL FRACTURES		
Progress													
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	RQD (%)	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength Is$_{(50)}$ MPa** ● - Axial ○ - Diametral EL VL 0.03 L 0.1 M 0.3 H 1 VH 3 EH 10	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
				(0)	(81)			SILTSTONE, as previous.	HW				*14.96m, BP, 0°, CLAY VE, PLN, SO, CI 15.23m, BP, 0°, CLAY VE, UN, SO, CI 15.48m, BP, 0°, CN, PLN, SO, CI 15.57m, JT, 20°, FE, UN, RF, CI
			15.67			15.67		End of Borehole at 15.67 metres. Target Depth					
16													
17													
18													
19													
20													

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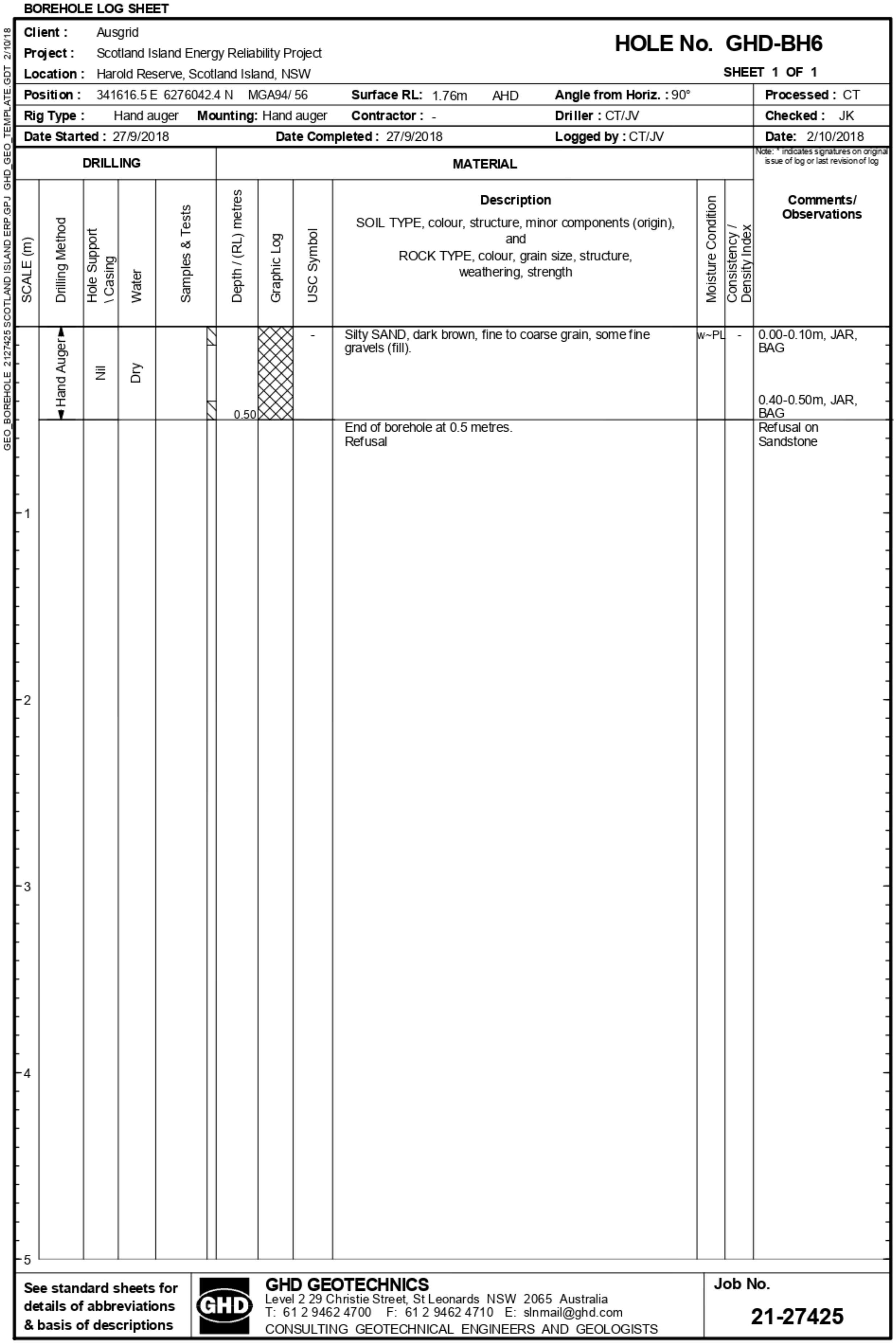

BOREHOLE LOG SHEET

GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 2/10/18

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Harold Reserve, Scotland Island, NSW

HOLE No. GHD-BH6
SHEET 1 OF 1

Position : 341616.5 E 6276042.4 N MGA94/ 56 **Surface RL:** 1.76m AHD **Angle from Horiz. :** 90° **Processed :** CT
Rig Type : Hand auger **Mounting:** Hand auger **Contractor :** - **Driller :** CT/JV **Checked :** JK
Date Started : 27/9/2018 **Date Completed :** 27/9/2018 **Logged by :** CT/JV **Date:** 2/10/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	Hand Auger	Nil	Dry		0.50	▨	-	Silty SAND, dark brown, fine to coarse grain, some fine gravels (fill).	w~PL	-	0.00-0.10m, JAR, BAG 0.40-0.50m, JAR, BAG
								End of borehole at 0.5 metres. Refusal			Refusal on Sandstone
1											
2											
3											
4											
5											

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GEO_BOREHOLE 2127425 SCOTLAND ISLAND ERP.GPJ GHD_GEO_TEMPLATE.GDT 11/10/18

BOREHOLE LOG SHEET

Client : Ausgrid
Project : Scotland Island Energy Reliability Project
Location : Harold Reserve, Scotland Island, NSW

HOLE No. GHD-BH7

SHEET 1 OF 1

Position : 341622.4 E 6276049.8 N MGA94/ 56
Surface RL: 3.43m AHD
Angle from Horiz. : 90°
Processed : CT
Rig Type : Hand auger
Mounting: Hand auger
Contractor : -
Driller : CT/JV
Checked : JK
Date Started : 27/9/2018
Date Completed : 27/9/2018
Logged by : CT/JV
Date: 2/10/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	**Description** SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	**Comments/ Observations**
	Hand Auger	Nil	Dry		0.80		-	CLAY, pale brown, medium plasticity, trace of fine to medium gravels (fill).	w<PL	St VSt	0.00 - 0.10m, JAR, BAG 0.40-0.50m, JAR, BAG
1					1.20		-	Gravelly CLAY, pale brown, low plasticity, fine to coarse gravels, gravels are quartz and sandstone, sub-rounded to angular (fill).	w<PL	St	0.90-1.00m, JAR, BAG
					1.80		-	CLAY, brown streaked red, high plasticity (fill).	w<PL	St VSt	1.50-1.60m, JAR, BAG
					2.00		-	CLAY, pale grey streaked pale orange, high plascitity, trace of fine to medium gravels (fill).	w~PL	VSt	1.90-2.00m, JAR, BAG
2								End of borehole at 2 metres. Limit of investigation			
3											
4											
5											

See standard sheets for details of abbreviations & basis of descriptions

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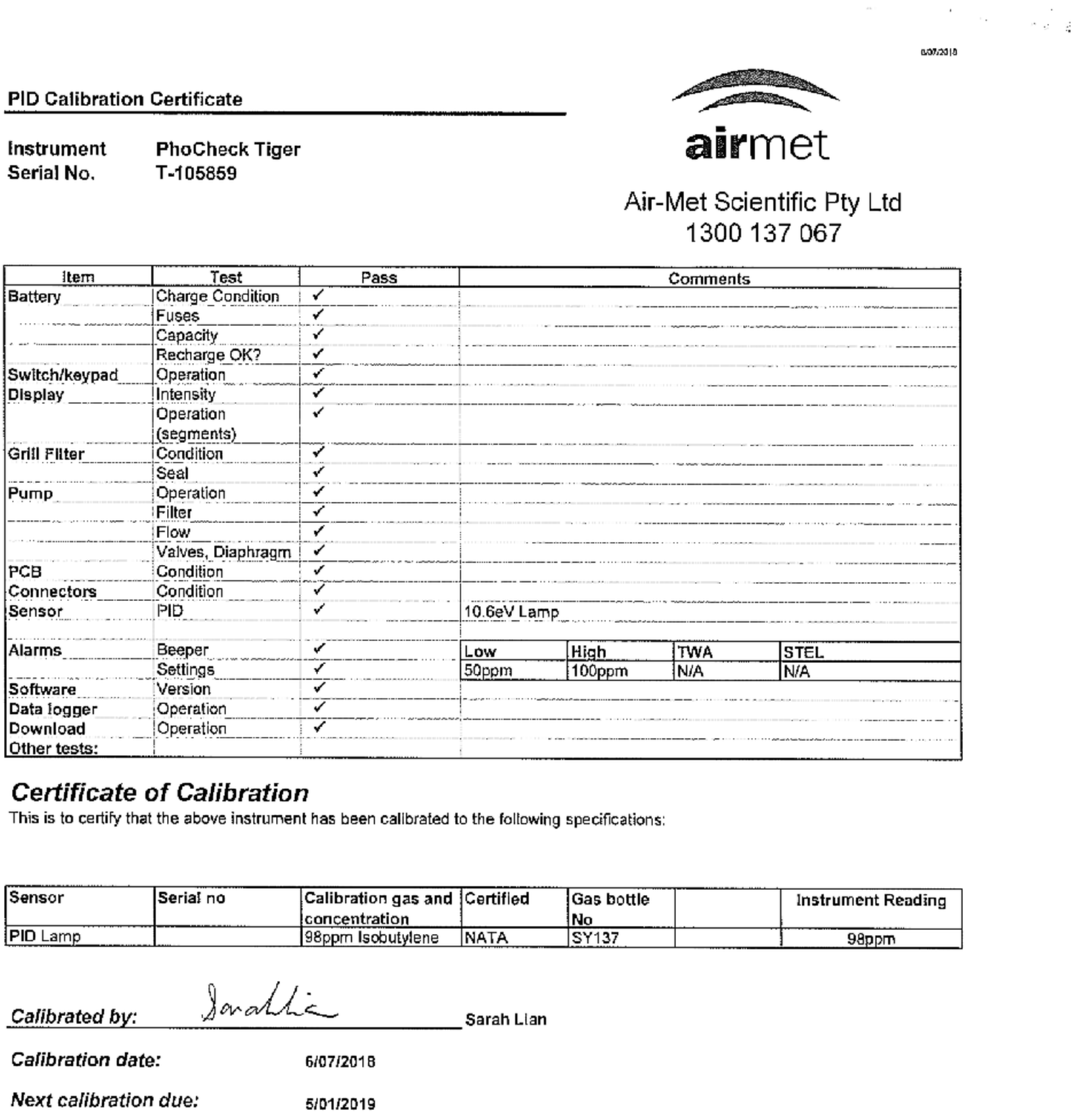
Appendix C – Equipment Calibration Certificates



6/07/2018

PID Calibration Certificate

airmet

Air-Met Scientific Pty Ltd
1300 137 067

Instrument **PhoCheck Tiger**
Serial No. **T-105859**

Item	Test	Pass	Comments			
Battery	Charge Condition	✓				
	Fuses	✓				
	Capacity	✓				
	Recharge OK?	✓				
Switch/keypad	Operation	✓				
Display	Intensity	✓				
	Operation (segments)	✓				
Grill Filter	Condition	✓				
	Seal	✓				
Pump	Operation	✓				
	Filter	✓				
	Flow	✓				
	Valves, Diaphragm	✓				
PCB	Condition	✓				
Connectors	Condition	✓				
Sensor	PID	✓	10.6eV Lamp			
Alarms	Beeper	✓	Low	High	TWA	STEL
	Settings	✓	50ppm	100ppm	N/A	N/A
Software	Version	✓				
Data logger	Operation	✓				
Download	Operation	✓				
Other tests:						

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No		Instrument Reading
PID Lamp		98ppm Isobutylene	NATA	SY137		98ppm

Calibrated by: Sarah Lian

Calibration date: 6/07/2018

Next calibration due: 5/01/2019

Appendix D – Analytical Results Tables

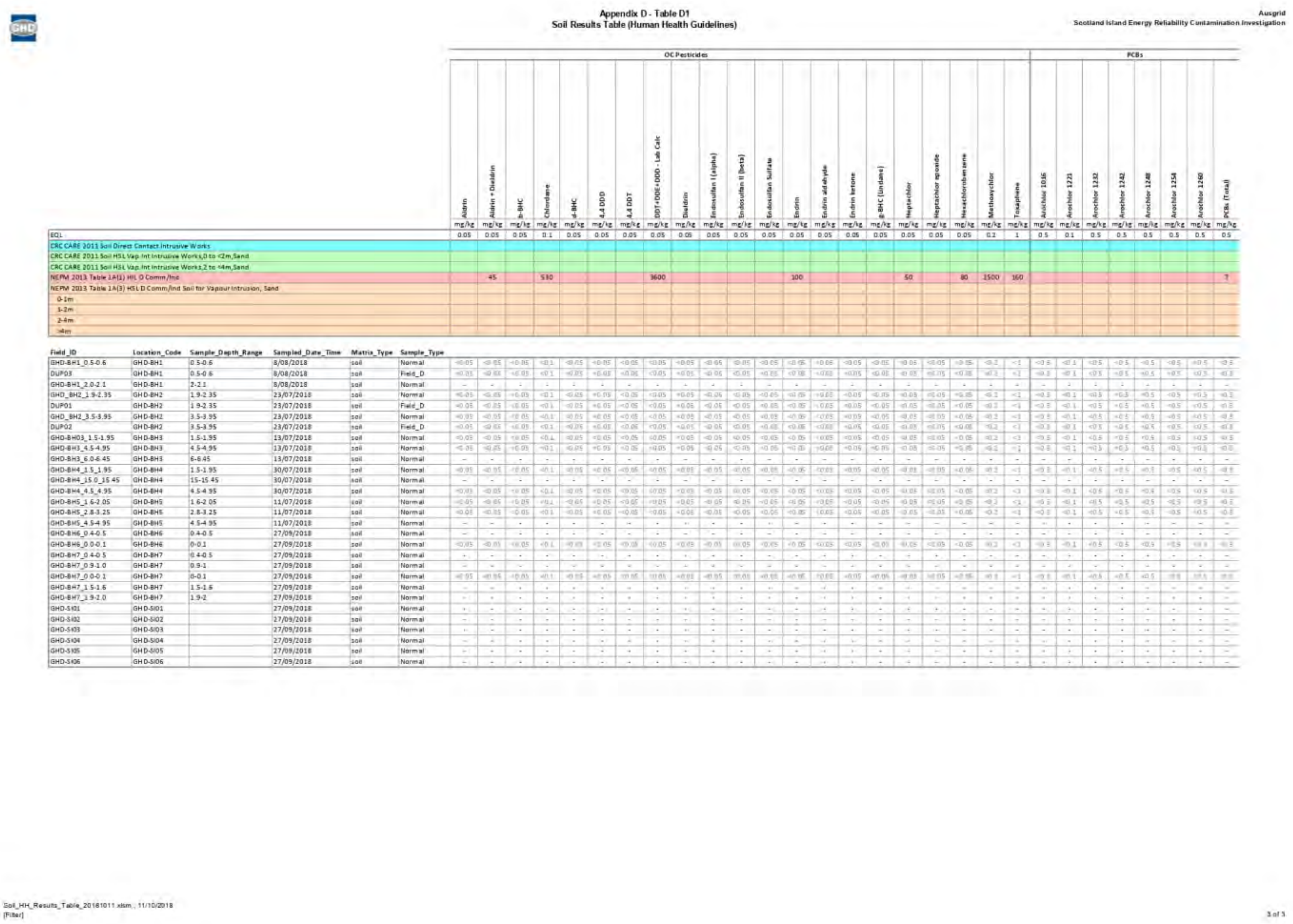
Appendix D - Table D1
Soil Results Table (Human Health Guidelines)

							Field Parameters	Inorganics			Major Ions		Asbestos
						Resistivity*	pH (Field)	Electrical conductivity (lab)	Moisture Content (dried @ 103°C)	pH (aqueous extract)	Chloride	Sulfate	Asbestos Reported Result
						OHM M	pH Units	µS/cm	%	pH Units	mg/kg	mg/kg	Comment
EQL						0.5	0.1	5	1	0.1	10	10	
CRC CARE 2011 Soil Direct Contact Intrusive Works													
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,0 to <2m,Sand													
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,2 to <4m,Sand													
NEPM 2013 Table 1A(1) HIL D Comm/Ind													
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand													
0-1m													
1-2m													
2-4m													
>4m													
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type								
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	-	8.6	-	11	-	-	-	No Asbestos Detected
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	-	-	-	11	-	-	-	-
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	-	8.8	-	21	-	-	-	-
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	-	7	-	13	-	-	-	No Asbestos Detected
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	-	-	-	12	-	-	-	-
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	-	5.1	-	14	-	-	-	-
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	-	-	-	16	-	-	-	-
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	-	6.8	-	12	-	-	-	No Asbestos Detected
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	-	6.1	-	20	-	-	-	-
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	-	6.9	-	21	-	-	-	-
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	-	-	-	43	-	-	-	No Asbestos Detected
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	-	4.9	-	16	-	-	-	-
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	-	4.7	-	10	-	-	-	-
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	-	8.1	-	18	-	-	-	No Asbestos Detected
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	-	6.4	-	18	-	-	-	-
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	-	4.7	-	17	-	-	-	-
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	-	-	-	11	-	-	-	-
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	650	-	77	14	5.9	57	14	No Asbestos Detected
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	-	-	-	11	-	-	-	-
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	940	-	53	11	5.4	27	36	No Asbestos Detected
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	530	-	94	11	5.4	77	13	No Asbestos Detected
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	-	-	-	16	-	-	-	-
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	47	-	1100	18	4.8	42	140	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected

	Metals								BTEXN							TRH - NEPM 2			
	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene (BTEXN)	F1 (C6-C10 minus BTEX)	C6-C10 Fraction	F2 (>C10-C16 minus Naphthalene)	>C10-C16 Fraction
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	2	0.4	5	5	5	0.1	5	5	0.1	0.1	0.1	0.1	0.2	0.3	0.5	20	20	50	50
CRC CARE 2011 Soil Direct Contact Intrusive Works									1100	120000	85000			130000	29000	82000		62000	
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,0 to <2m,Sand									77	NL	NL			NL	NL	NL		NL	
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,2 to <4m,Sand									160	NL	NL			NL	NL	NL		NL	
NEPM 2013 Table 1A(1) HIL D Comm/Ind	3000	900	3600	240000	1500	730	6000	400000											
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand																			
0-1m									3	NL	NL			230	NL	260		NL	
1-2m									3	NL	NL			NL	NL	370		NL	
2-4m									3	NL	NL			NL	NL	630		NL	
>4m									3	NL	NL			NL	NL	NL		NL	
Field_ID																			
GHD-BH1_0.5-0.6	7.8	<0.4	9.9	<5	<5	<0.1	<5	11	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
DUP03	8	<0.4	11	5.2	<5	<0.1	<5	12	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH1_2.0-2.1	5.8	<0.4	5.4	<5	8.1	<0.1	<5	10	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD_BH2_1.9-2.35	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
DUP01	<2	<0.4	6.2	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD_BH2_3.5-3.95	<2	<0.4	5.5	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
DUP02	<2	<0.4	6.1	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH03_1.5-1.95	<2	<0.4	5.3	<5	12	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH3_4.5-4.95	20	<0.4	37	<5	9.5	<0.1	6.7	38	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH3_6.0-6.45	<2	<0.4	27	6.3	15	<0.1	<5	15	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH4_1.5_1.95	18	<0.4	18	<5	5.7	<0.1	7.6	16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<1	<40	<40	<100	<100
GHD-BH4_15.0_15.45	3.8	<0.4	30	11	12	<0.1	5.2	10	<0.1	<0.1	<0.1	<0.1	0.2	<0.3	<0.5	29	29	110	110
GHD-BH4_4.5_4.95	<2	<0.4	6.7	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH5_1.6-2.05	<2	1	5.4	<5	21	<0.1	<5	77	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH5_2.8-3.25	8.4	<0.4	32	<5	6.6	<0.1	<5	13	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH5_4.5-4.95	5.8	<0.4	13	<5	8.7	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH6_0.4-0.5	4.7	<0.4	10	<5	18	<0.1	<5	32	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH6_0.0-0.1	4.1	<0.4	8.3	<5	23	<0.1	<5	39	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH7_0.4-0.5	4	<0.4	9.8	<5	13	<0.1	<5	22	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH7_0.9-1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_1.5-1.6	12	<0.4	25	<5	16	<0.1	<5	5.8	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50
GHD-BH7_1.9-2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D - Table D1
Soil Results Table (Human Health Guidelines)

						013			TRH - NEPM 1999					PAHs																							
						F3 (>C16-C34 Fraction)	F4 (>C34-C40 Fraction)	>C10-C40 (Sum of Total)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene-PAH	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc	Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ)(half LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc	Organochlorine pesticides EPAVic	Other organochlorine pesticides EPAVic	4,4-DDE	a-BHC
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						100	100	100	20	20	50	50	50	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.05	0.05
CRC CARE 2011 Soil Direct Contact Intrusive Works						85000	120000																				29000										
CRC CARE 2011 Soil HSL Vap Int Intrusive Works,0 to <2m,Sand																											NL										
CRC CARE 2011 Soil HSL Vap Int Intrusive Works,2 to <4m,Sand																											NL										
NEPM 2013 Table 1A(1) HIL D Comm/Ind																														4000	40	40	40				
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand																																					
0-1m																											NL										
1-2m																											NL										
2-4m																											NL										
>4m																											NL										
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type																																
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	0.9	1.9	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	0.7	1.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	<100	<100	-	<20	24	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	<100	<100	-	<20	24	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	<200	<200	<100	<40	<40	<100	<100	<100	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	1.2	2.4	<0.1	<0.1	<0.05	<0.05
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	200	<100	310	<20	130	120	130	380	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	<100	<100	-	<20	28	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	<100	<100	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	110	<100	110	<20	<20	65	73	138	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	150	<100	150	<20	<20	82	110	192	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.05	<0.05
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	<100	<100	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Appendix D - Table D1
Soil Results Table (Human Health Guidelines)

Ausgrid
Scotland Island Energy Reliability Contamination Investigation

						OC Pesticides																					PCBs							
						Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	4,4 DDD	4,4 DDT	DDT+DDE+DDD - Lab Calc	Dieldrin	Endosulfan I (alpha)	Endosulfan II (beta)	Endosulfan Sulfate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Total)
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	1	0.5	0.1	0.5	0.5	0.5	0.5	0.5	0.5
CRC CARE 2011 Soil Direct Contact Intrusive Works																																		
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,0 to <2m,Sand																																		
CRC CARE 2011 Soil HSL Vap.Int Intrusive Works,2 to <4m,Sand																																		
NEPM 2013 Table 1A(1) HIL D Comm/Ind							45		530				3600					100				50		80	1500	160								7
NEPM 2013 Table 1A(3) HSL D Comm/Ind Soil for Vapour Intrusion, Sand																																		
0-1m																																		
1-2m																																		
2-4m																																		
>4m																																		
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type																													
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Soil_HH_Results_Table_20181011.xlsm , 11/10/2018
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Scotland Island Energy Reliability Contamination Investigation

Appendix D - Table D2
Soil Waste Classification Table

							Field Parameters	Inorganics			Major Ions		Asbestos	Metals								BTEXN							TRH - NEPM 2013					
						Resistivity*	pH (Field)	Electrical conductivity (lab)	Moisture Content (dried @ 103°C)	pH (aqueous extract)	Chloride	Sulfate	Asbestos Reported Result	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene (BTEXN)	F1 (C6-C10 minus BTEX)	C6-C10 Fraction	F2 (>C10-C16 minus Naphthalene)	>C10-C16 Fraction	F3 (>C16-C34 Fraction)	F4 (>C34-C40 Fraction)
						OHM.M	pH Units	µS/cm	%	pH Units	mg/kg	mg/kg	Comment	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.5	0.1	5	1	0.1	10	10		2	0.4	5	5	5	0.1	5	5	0.1	0.1	0.1	0.1	0.2	0.3	0.5	20	20	50	50	100	100
NSW EPA (2014) General Solid Waste CT1 (No Leaching)														100	20	100		100	4	40		10	288	600			1000							
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)														400	80	400		400	16	160		40	1152	2400			4000							
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type																													
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	-	8.6	-	11	-	-	-	No Asbestos Detected	7.8	<0.4	9.9	<5	<5	<0.1	<5	11	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	-	-	-	11	-	-	-	-	8	<0.4	11	5.1	<5	<0.1	<5	12	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	-	8.8	-	21	-	-	-	-	5.8	<0.4	5.4	<5	8.2	<0.1	<5	10	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	-	7	-	13	-	-	-	No Asbestos Detected	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	-	-	-	12	-	-	-	-	<2	<0.4	6.2	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	-	5.1	-	14	-	-	-	-	<2	<0.4	5.5	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	-	-	-	16	-	-	-	-	<2	<0.4	6.1	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	-	6.8	-	12	-	-	-	No Asbestos Detected	<2	<0.4	5.3	<5	12	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	-	6.1	-	20	-	-	-	-	20	<0.4	37	<5	9.5	<0.1	6.7	38	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	-	6.9	-	21	-	-	-	-	<2	<0.4	27	6.3	15	<0.1	<5	15	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	-	-	-	43	-	-	-	No Asbestos Detected	18	<0.4	18	<5	5.7	<0.1	7.6	16	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<1	<40	<40	<100	<100	<200	<200
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	-	4.9	-	16	-	-	-	-	3.8	<0.4	30	11	12	<0.1	5.2	10	<0.1	<0.1	<0.1	<0.1	0.2	<0.3	<0.5	29	29	110	110	200	<100
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	-	4.7	-	10	-	-	-	-	<2	<0.4	6.7	<5	<5	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	-	8.1	-	18	-	-	-	No Asbestos Detected	<2	1	5.4	<5	21	<0.1	<5	77	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	-	6.4	-	18	-	-	-	-	8.4	<0.4	32	<5	6.6	<0.1	<5	13	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	-	4.7	-	17	-	-	-	-	5.8	<0.4	13	<5	8.7	<0.1	<5	<5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	-	-	-	11	-	-	-	-	4.7	<0.4	10	<5	18	<0.1	<5	32	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	110	<100
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	650	-	77	14	5.9	57	14	No Asbestos Detected	4.1	<0.4	8.3	<5	23	<0.1	<5	39	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	150	<100
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	-	-	-	11	-	-	-	-	4	<0.4	9.8	<5	13	<0.1	<5	22	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	940	-	53	11	5.4	27	36	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	530	-	94	11	5.4	77	13	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	-	-	-	16	-	-	-	-	12	<0.4	25	<5	16	<0.1	<5	5.8	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	<0.5	<20	<20	<50	<50	<100	<100
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	47	-	1100	18	4.8	42	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	No Asbestos Detected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Soil_WC_Results_Table_20181011.xlsm , 11/10/2018
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Scotland Island Energy Reliability Contamination Investigation

Appendix D - Table D2
Soil Waste Classification Table

							TRH - NEPM 1999					PAHs																									
						>C10-C40 (Sum of Total)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo[b+j]fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene-PAH	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc	Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ)(half LOR) - Lab Calc	Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc	Organochlorine pesticides EPAVic	Other organochlorine pesticides EPAVic	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						100	20	20	50	50	50	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.05
NSW EPA (2014) General Solid Waste CT1 (No Leaching)							650				10000					0.8												200									
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)							2600				40000					3.2												800									
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type																																
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5	0.9	1.9	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	0.7	1.6	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	-	<20	24	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	-	<20	24	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	<100	<40	<40	<100	<100	<100	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	1.2	2.4	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	310	<20	130	120	130	380	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	-	<20	28	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	-	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	110	<20	<20	65	73	138	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	150	<40	<20	82	110	192	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	<100	<20	<20	<50	<50	<50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	-	-	-	-	-	-
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Ausgrid
Scotland Island Energy Reliability Contamination Investigation

Appendix D - Table D2
Soil Waste Classification Table

						OC Pesticides																			PCBs							
						a-BHC	Chlordane	d-BHC	4,4 DDD	4,4 DDT	DDT+DDE+DDD - Lab Calc	Dieldrin	Endosulfan I (alpha)	Endosulfan II (beta)	Endosulfan Sulfate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Total)
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	1	0.5	0.1	0.5	0.5	0.5	0.5	0.5	0.5
NSW EPA (2014) General Solid Waste CT1 (No Leaching)																																50
NSW EPA (2014) Restricted Solid Waste CT2 (No Leaching)																																50
Field_ID	Location_Code	Sample_Depth_Range	Sampled_Date_Time	Matrix_Type	Sample_Type																											
GHD-BH1_0.5-0.6	GHD-BH1	0.5-0.6	8/08/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP03	GHD-BH1	0.5-0.6	8/08/2018	soil	Field_D	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH1_2.0-2.1	GHD-BH1	2-2.1	8/08/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD_BH2_1.9-2.35	GHD-BH2	1.9-2.35	23/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP01	GHD-BH2	1.9-2.35	23/07/2018	soil	Field_D	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD_BH2_3.5-3.95	GHD-BH2	3.5-3.95	23/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
DUP02	GHD-BH2	3.5-3.95	23/07/2018	soil	Field_D	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH03_1.5-1.95	GHD-BH3	1.5-1.95	13/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH3_4.5-4.95	GHD-BH3	4.5-4.95	13/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH3_6.0-6.45	GHD-BH3	6-6.45	13/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH4_1.5_1.95	GHD-BH4	1.5-1.95	30/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH4_15.0_15.45	GHD-BH4	15-15.45	30/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH4_4.5_4.95	GHD-BH4	4.5-4.95	30/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_1.6-2.05	GHD-BH5	1.6-2.05	11/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_2.8-3.25	GHD-BH5	2.8-3.25	11/07/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH5_4.5-4.95	GHD-BH5	4.5-4.95	11/07/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH6_0.4-0.5	GHD-BH6	0.4-0.5	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH6_0.0-0.1	GHD-BH6	0-0.1	27/09/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH7_0.4-0.5	GHD-BH7	0.4-0.5	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.9-1.0	GHD-BH7	0.9-1	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_0.0-0.1	GHD-BH7	0-0.1	27/09/2018	soil	Normal	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
GHD-BH7_1.5-1.6	GHD-BH7	1.5-1.6	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-BH7_1.9-2.0	GHD-BH7	1.9-2	27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI01	GHD-SI01		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI02	GHD-SI02		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI03	GHD-SI03		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI04	GHD-SI04		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI05	GHD-SI05		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GHD-SI06	GHD-SI06		27/09/2018	soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Soil_WC_Results_Table_20181011.xlsm , 11/10/2018
[Filter]

Appendix D - Table D3
Groundwater Results Table

Ausgrid
Scotland Island Energy Reliability Contamination Investigation

					Metals								BTEXN						
					Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	Naphthalene (BTEXN)
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					0.001	0.0002	0.001	0.001	0.001	0.0001	0.001	0.005	1	1	1	1	2	3	10
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Sand																			
3-4m													5000	NL	NL			NL	NL
4-8m													5000	NL	NL			NL	NL
>8m													5000	NL	NL			NL	NL
NEPM 2013 Table 1C GILs, Marine Waters						0.0007	0.0044	0.0013	0.0044	0.0001	0.007	0.015	500						50
Field_ID	Location_Code	Sampled_Date_Time	Sample_Type	Location_Type															
GHD-BH1-GW	GHD-BH1	27/09/2018	Normal	BH	0.002	<0.0002	0.004	0.009	0.003	<0.0001	0.02	0.044	<1	<1	<1	<1	<2	<3	<10

					TRH - NEPM 2013							TRH - NEPM 1999				
					F1 (C6-C10 minus BTEX)	C6-C10 Fraction	F2 (>C10-C16 minus Naphthalene)	>C10-C16 Fraction	F3 (>C16-C34 Fraction)	F4 (>C34-C40 Fraction)	>C10-C40 (Sum of Total)	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 (Sum of Total)
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					20	20	50	50	100	100	100	20	50	100	100	100
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Sand																
3-4m					6000		NL									
4-8m					6000		NL									
>8m					7000		NL									
NEPM 2013 Table 1C GILs, Marine Waters																
Field_ID	Location_Code	Sampled_Date_Time	Sample_Type	Location_Type												
GHD-BH1-GW	GHD-BH1	27/09/2018	Normal	BH	<20	<20	<50	<50	<100	<100	<100	<20	<50	<100	<100	<100

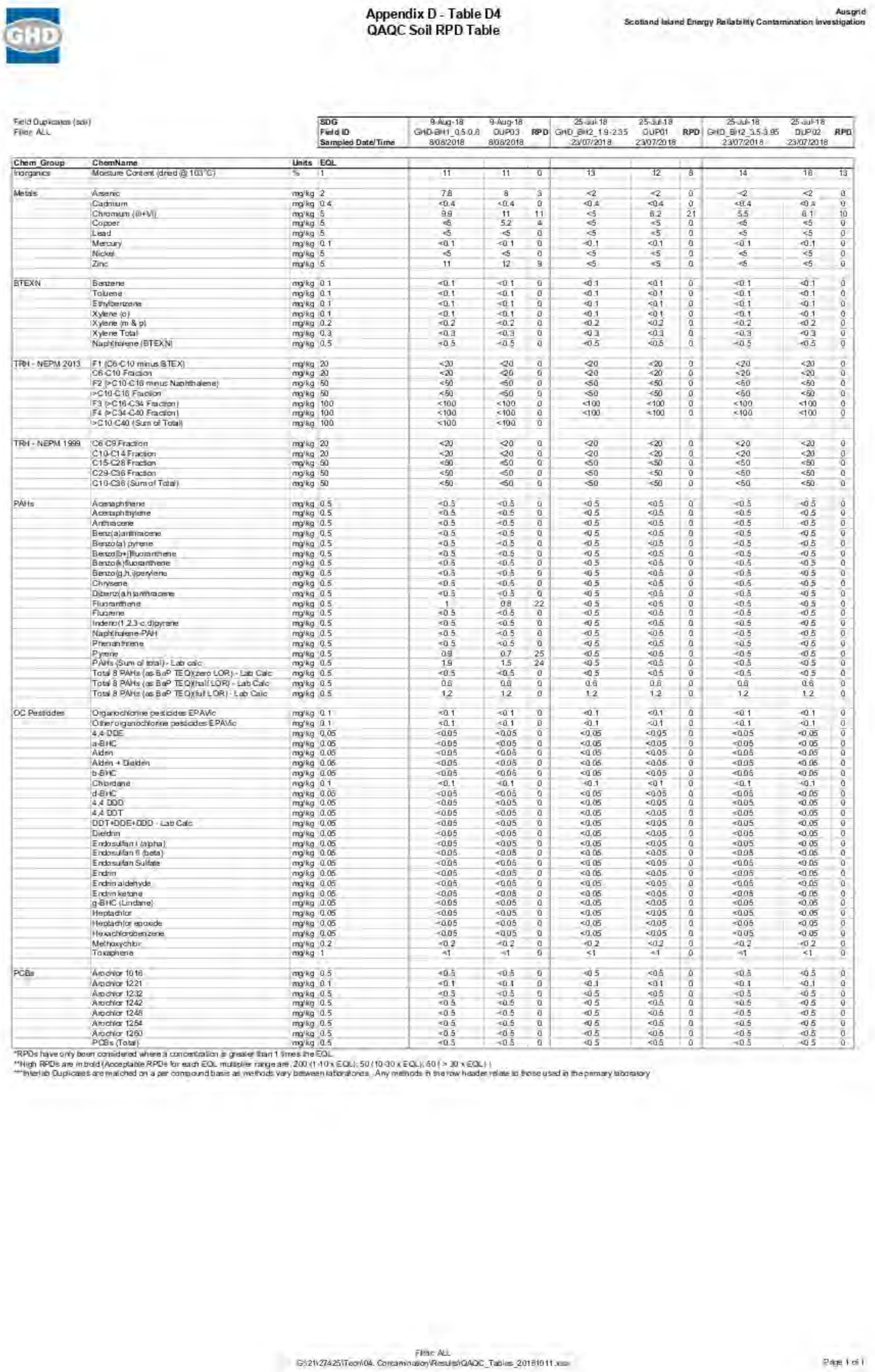
					PAHs									
					Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					1	1	1	1	1	1	1	1	1	1
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Sand														
3-4m														
4-8m														
>8m														
NEPM 2013 Table 1C GILs, Marine Waters														
Field_ID	Location_Code	Sampled_Date_Time	Sample_Type	Location_Type										
GHD-BH1-GW	GHD-BH1	27/09/2018	Normal	BH	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Groundwater_Results_Table_20181011.xlsm , 11/10/2018
[Filter]

Appendix D - Table D3
Groundwater Results Table

												OC Pesticides												
					Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene-PAH	Phenanthrene	Pyrene	PAHs (Sum of total) - Lab calc	Organochlorine pesticides EPAVic	Other organochlorine pesticides EPAVic	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	4,4 DDD	4,4 DDT	DDT+DDE+DDD - Lab Calc	Dieldrin
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					1	1	1	1	1	1	1	1	1	0.1	0.1	0.1	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Sand																								
2-4m								NL																
4-8m								NL																
>8m								NL																
NEPM 2013 Table 1C GILs, Marine Waters								50																
Field_ID	**Location_Code**	**Sampled_Date_Time**	**Sample_Type**	**Location_Type**																				
GHD-BH1-GW	GHD-BH1	27/09/2018	Normal	BH	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1

					OC Pesticides												PCBs							
					Endosulfan I (alpha)	Endosulfan II (beta)	Endosulfan Sulfate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	PCBs (Total)
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL					0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	10	5	1	5	5	5	5	5	1
NEPM 2013 Table 1A(4) HSL D Comm/Ind GW for Vapour Intrusion, Sand																								
2-4m																								
4-8m																								
>8m																								
NEPM 2013 Table 1C GILs, Marine Waters								0.004																
Field_ID	**Location_Code**	**Sampled_Date_Time**	**Sample_Type**	**Location_Type**																				
GHD-BH1-GW	GHD-BH1	27/09/2018	Normal	BH	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<10	<5	<1	<5	<5	<5	<5	<5	<1



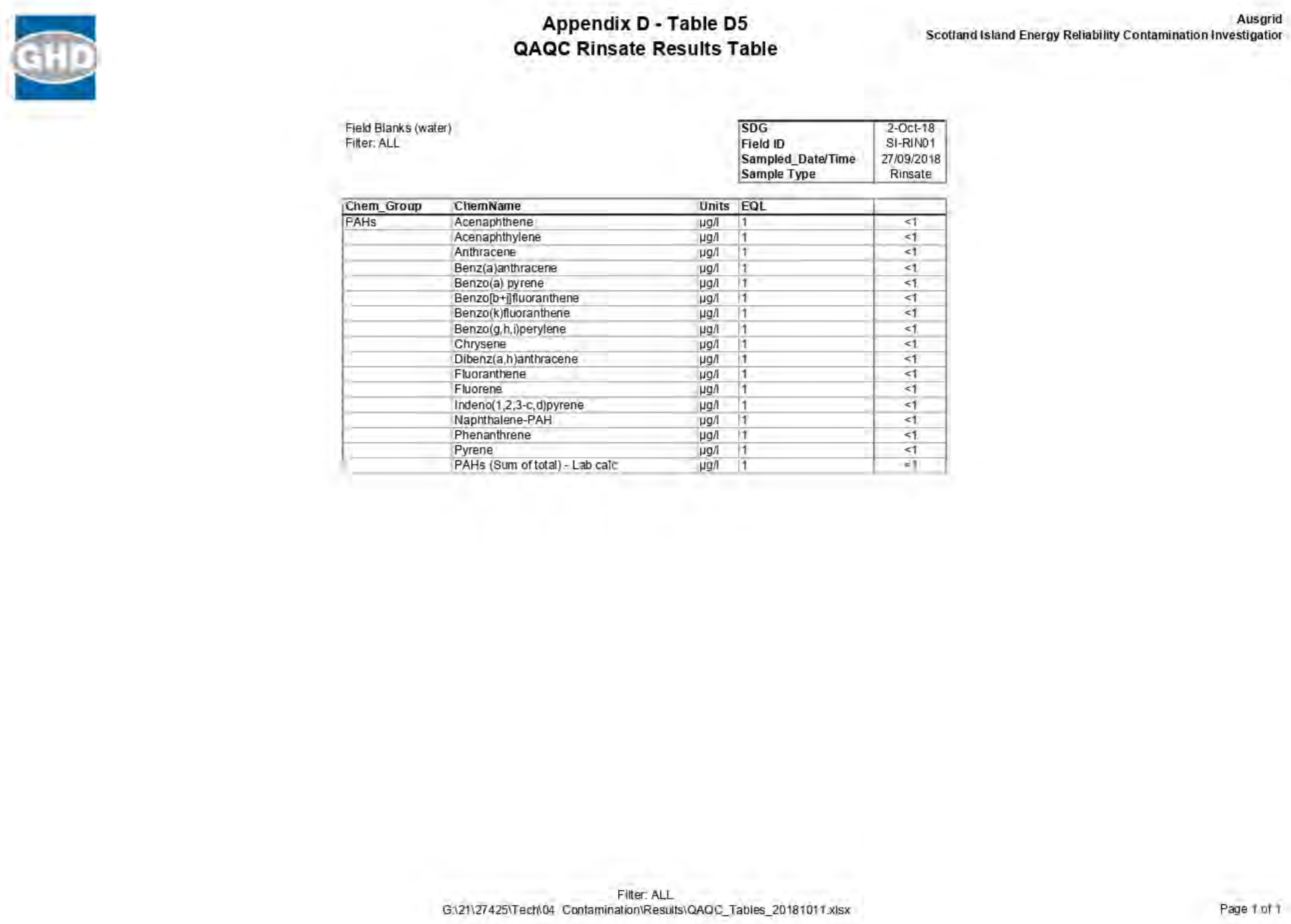
Appendix D - Table D4
QAQC Soil RPD Table

Ausgrid
Scotland Island Energy Reliability Contamination Investigation

Field Duplicates (soil)
Filter: ALL

			SDG	9-Aug-18	9-Aug-18		25-Jul-18	25-Jul-18		25-Jul-18	25-Jul-18	
			Field ID	GHD-BH1_0.5-0.6	DUP03	**RPD**	GHD_BH2_1.9-2.35	DUP01	**RPD**	GHD_BH2_3.5-3.95	DUP02	**RPD**
			Sampled Date/Time	8/08/2018	8/08/2018		23/07/2018	23/07/2018		23/07/2018	23/07/2018	
Chem_Group	**ChemName**	**Units**	**EQL**									
Inorganics	Moisture Content (dried @ 103°C)	%	1	11	11	0	13	12	8	14	16	13
Metals	Arsenic	mg/kg	2	7.8	8	3	<2	<2	0	<2	<2	0
	Cadmium	mg/kg	0.4	<0.4	<0.4	0	<0.4	<0.4	0	<0.4	<0.4	0
	Chromium (III+VI)	mg/kg	5	9.9	11	11	<5	6.2	21	5.5	6.1	10
	Copper	mg/kg	5	<5	5.2	4	<5	<5	0	<5	<5	0
	Lead	mg/kg	5	<5	<5	0	<5	<5	0	<5	<5	0
	Mercury	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Nickel	mg/kg	5	<5	<5	0	<5	<5	0	<5	<5	0
	Zinc	mg/kg	5	11	12	9	<5	<5	0	<5	<5	0
BTEXN	Benzene	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Toluene	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Ethylbenzene	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Xylene (o)	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Xylene (m & p)	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0	<0.2	<0.2	0
	Xylene Total	mg/kg	0.3	<0.3	<0.3	0	<0.3	<0.3	0	<0.3	<0.3	0
	Naphthalene (BTEXN)	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
TRH - NEPM 2013	F1 (C6-C10 minus BTEX)	mg/kg	20	<20	<20	0	<20	<20	0	<20	<20	0
	C6-C10 Fraction	mg/kg	20	<20	<20	0	<20	<20	0	<20	<20	0
	F2 (>C10-C16 minus Naphthalene)	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	>C10-C16 Fraction	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	F3 (>C16-C34 Fraction)	mg/kg	100	<100	<100	0	<100	<100	0	<100	<100	0
	F4 (>C34-C40 Fraction)	mg/kg	100	<100	<100	0	<100	<100	0	<100	<100	0
	>C10-C40 (Sum of Total)	mg/kg	100	<100	<100	0						
TRH - NEPM 1999	C6-C9 Fraction	mg/kg	20	<20	<20	0	<20	<20	0	<20	<20	0
	C10-C14 Fraction	mg/kg	20	<20	<20	0	<20	<20	0	<20	<20	0
	C15-C28 Fraction	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	C29-C36 Fraction	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
	C10-C36 (Sum of Total)	mg/kg	50	<50	<50	0	<50	<50	0	<50	<50	0
PAHs	Acenaphthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Acenaphthylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Benz(a)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(a) pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo[b+j]fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(k)fluoranthene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Benzo(g,h,i)perylene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Chrysene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Dibenz(a,h)anthracene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Fluoranthene	mg/kg	0.5	1	0.8	22	<0.5	<0.5	0	<0.5	<0.5	0
	Fluorene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Naphthalene-PAH	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Phenanthrene	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Pyrene	mg/kg	0.5	0.9	0.7	25	<0.5	<0.5	0	<0.5	<0.5	0
	PAHs (Sum of total) - Lab calc	mg/kg	0.5	1.9	1.5	24	<0.5	<0.5	0	<0.5	<0.5	0
	Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Total 8 PAHs (as BaP TEQ)(half LOR) - Lab Calc	mg/kg	0.5	0.6	0.6	0	0.6	0.6	0	0.6	0.6	0
	Total 8 PAHs (as BaP TEQ)(full LOR) - Lab Calc	mg/kg	0.5	1.2	1.2	0	1.2	1.2	0	1.2	1.2	0
OC Pesticides	Organochlorine pesticides EPAVic	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Other organochlorine pesticides EPAVic	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	4,4-DDE	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	a-BHC	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Aldrin	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Aldrin + Dieldrin	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	b-BHC	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Chlordane	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	d-BHC	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	4,4 DDD	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	4,4 DDT	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	DDT+DDE+DDD - Lab Calc	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Dieldrin	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endosulfan I (alpha)	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endosulfan II (beta)	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endosulfan Sulfate	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endrin	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endrin aldehyde	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Endrin ketone	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	g-BHC (Lindane)	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Heptachlor	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Heptachlor epoxide	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Hexachlorobenzene	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0
	Methoxychlor	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0	<0.2	<0.2	0
	Toxaphene	mg/kg	1	<1	<1	0	<1	<1	0	<1	<1	0
PCBs	Arochlor 1016	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Arochlor 1221	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Arochlor 1232	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Arochlor 1242	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Arochlor 1248	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Arochlor 1254	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	Arochlor 1260	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0
	PCBs (Total)	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0	<0.5	<0.5	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 200 (1-10 x EQL); 50 (10-30 x EQL); 60 (> 30 x EQL))
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory



Ausgrid
Scotland Island Energy Reliability Contamination Investigatior

Appendix D - Table D5
QAQC Rinsate Results Table

Field Blanks (water)
Filter: ALL

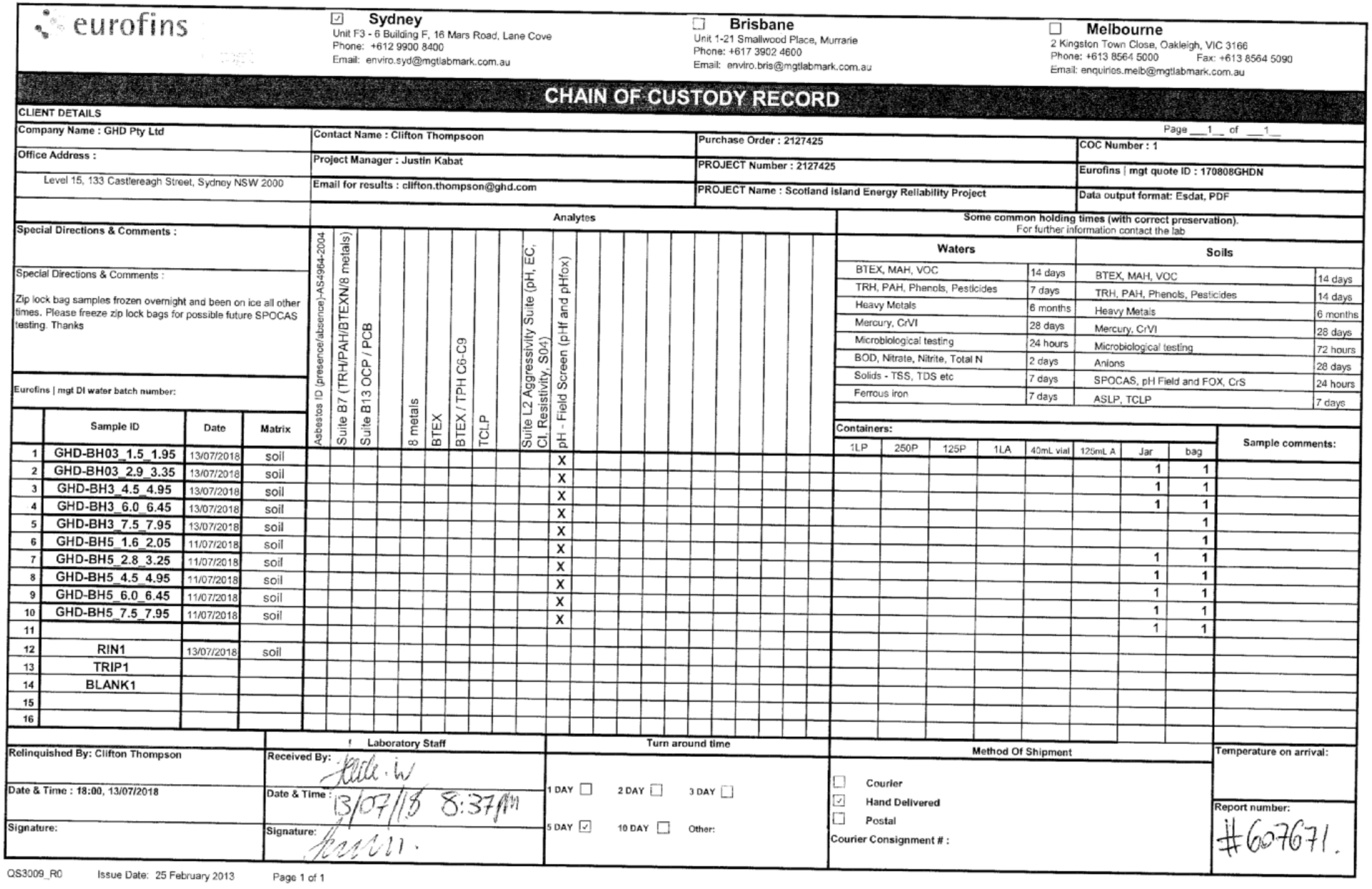
SDG	2-Oct-18
Field ID	SI-RIN01
Sampled_Date/Time	27/09/2018
Sample Type	Rinsate

Chem_Group	ChemName	Units	EQL	
PAHs	Acenaphthene	µg/l	1	<1
	Acenaphthylene	µg/l	1	<1
	Anthracene	µg/l	1	<1
	Benz(a)anthracene	µg/l	1	<1
	Benzo(a) pyrene	µg/l	1	<1
	Benzo[b+j]fluoranthene	µg/l	1	<1
	Benzo(k)fluoranthene	µg/l	1	<1
	Benzo(g,h,i)perylene	µg/l	1	<1
	Chrysene	µg/l	1	<1
	Dibenz(a,h)anthracene	µg/l	1	<1
	Fluoranthene	µg/l	1	<1
	Fluorene	µg/l	1	<1
	Indeno(1,2,3-c,d)pyrene	µg/l	1	<1
	Naphthalene-PAH	µg/l	1	<1
	Phenanthrene	µg/l	1	<1
	Pyrene	µg/l	1	<1
	PAHs (Sum of total) - Lab calc	µg/l	1	<1

Filter: ALL
G:\21\27425\Tech\04 Contamination\Results\QAQC_Tables_20181011.xlsx

Page 1 of 1

Appendix E – Laboratory Certificates



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☐ **Brisbane**
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Email: enviro.bris@mgtlabmark.com.au

☐ **Melbourne**
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Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd
Office Address :
Level 15, 133 Castlereagh Street, Sydney NSW 2000

Contact Name : Clifton Thompsoon
Project Manager : Justin Kabat
Email for results : clifton.thompson@ghd.com

Purchase Order : 2127425
PROJECT Number : 2127425
PROJECT Name : Scotland Island Energy Reliability Project

COC Number : 1
Eurofins | mgt quote ID : 170808GHDN
Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :
Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		**Soils**	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Analytes / **Containers:**

	Sample ID	**Date**	**Matrix**	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	**Sample comments:**
1	GHD-BH03_1.5_1.95	13/07/2018	soil									X							1	1	
2	GHD-BH03_2.9_3.35	13/07/2018	soil									X							1	1	
3	GHD-BH3_4.5_4.95	13/07/2018	soil									X							1	1	
4	GHD-BH3_6.0_6.45	13/07/2018	soil									X								1	
5	GHD-BH3_7.5_7.95	13/07/2018	soil									X								1	
6	GHD-BH5_1.6_2.05	11/07/2018	soil									X							1	1	
7	GHD-BH5_2.8_3.25	11/07/2018	soil									X							1	1	
8	GHD-BH5_4.5_4.95	11/07/2018	soil									X							1	1	
9	GHD-BH5_6.0_6.45	11/07/2018	soil									X							1	1	
10	GHD-BH5_7.5_7.95	11/07/2018	soil									X							1	1	
11																					
12	RIN1	13/07/2018	soil																		
13	TRIP1																				
14	BLANK1																				
15																					
16																					

Relinquished By: Clifton Thompson
Date & Time : 18:00, 13/07/2018
Signature:

Laboratory Staff
Received By: Kelle. W
Date & Time : 13/07/18 8:37pm
Signature:

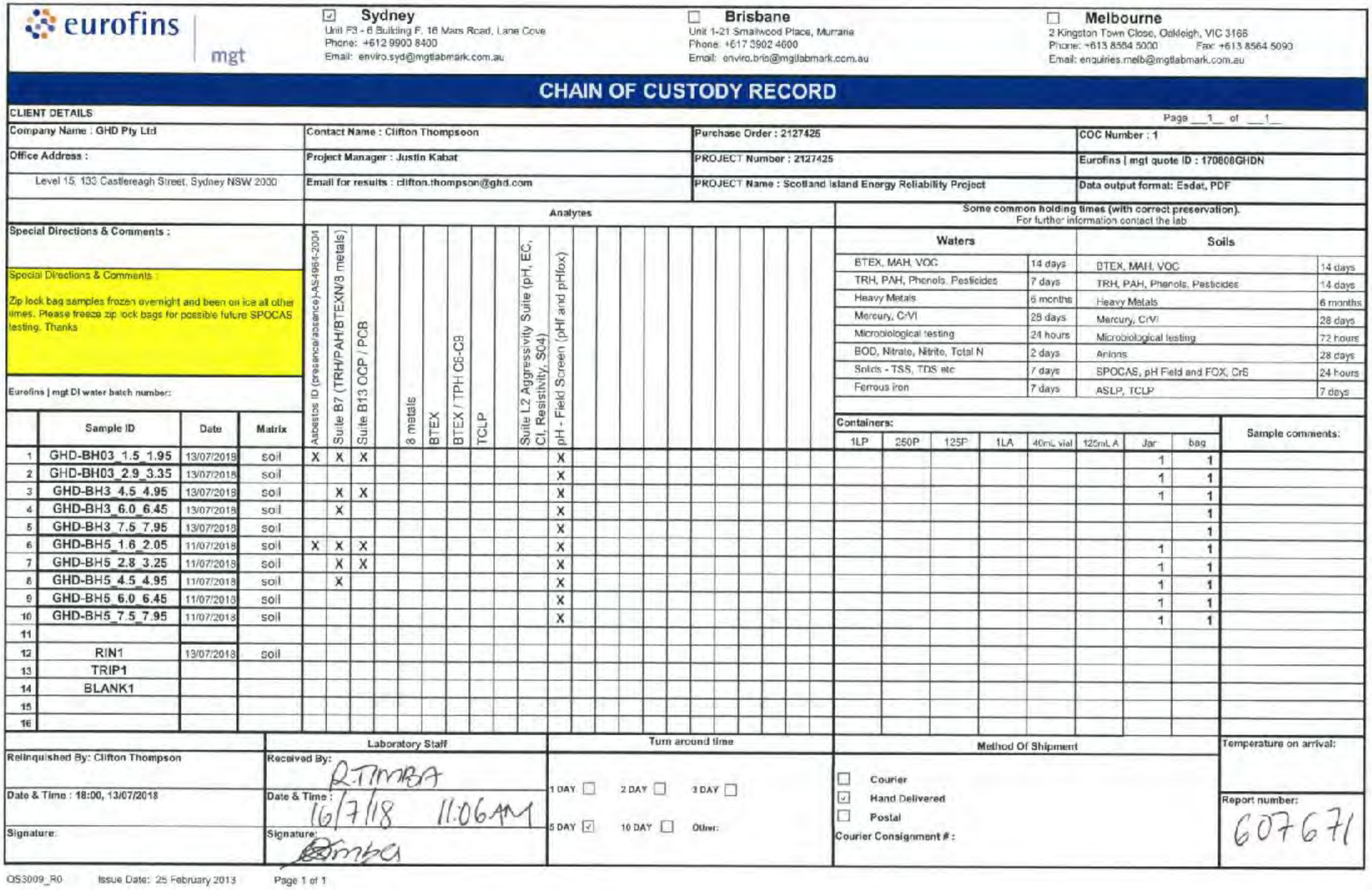
Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival:

Report number: #607671.

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



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Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd	Contact Name : Clifton Thompson	Purchase Order : 2127425	COC Number : 1
Office Address :	Project Manager : Justin Kabat	PROJECT Number : 2127425	Eurofins | mgt quote ID : 170808GHDN
Level 15, 133 Castlereagh Street, Sydney NSW 2000	Email for results : clifton.thompson@ghd.com	PROJECT Name : Scotland Island Energy Reliability Project	Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :

Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
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Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

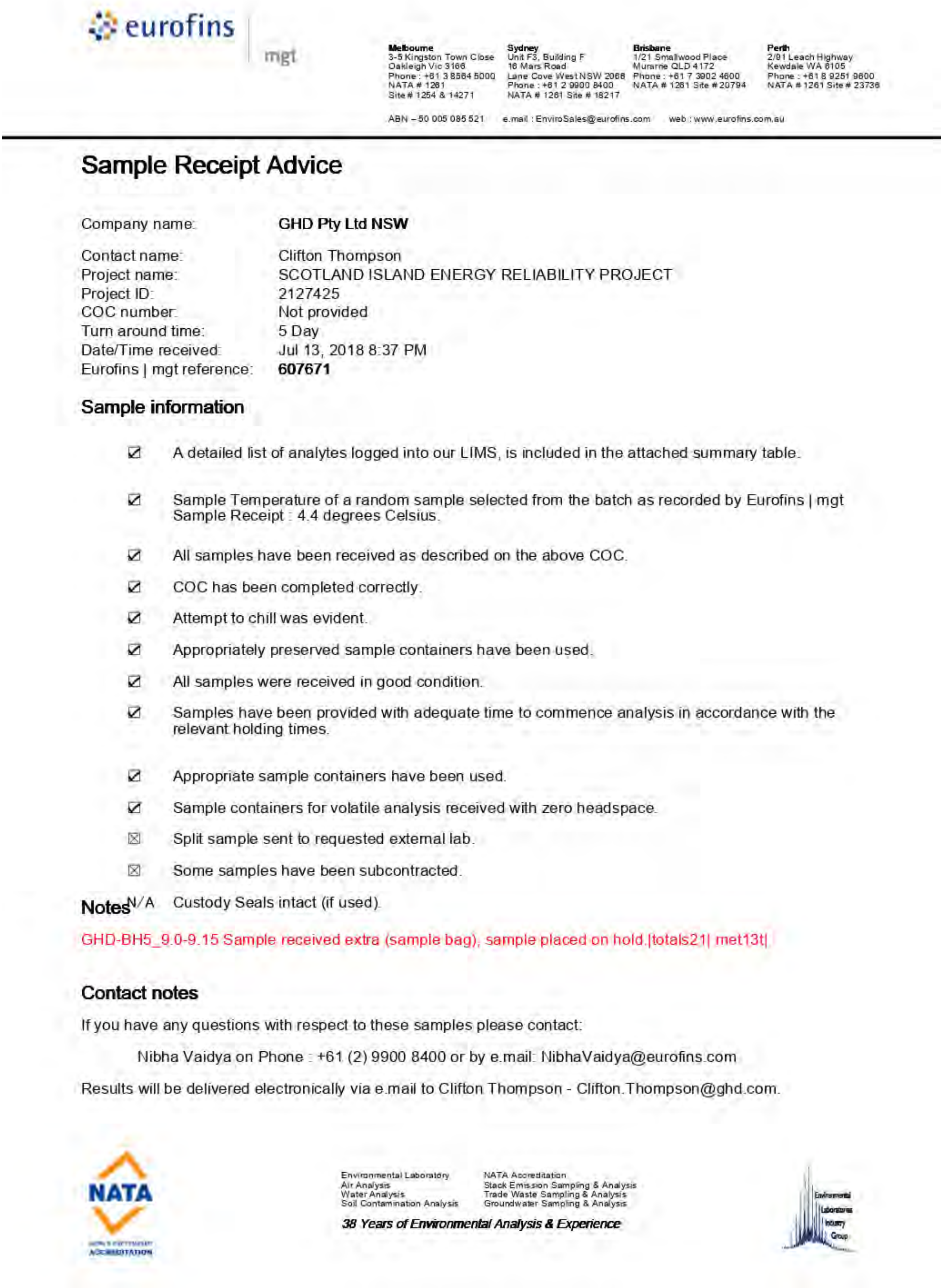
Analytes

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH03_1.5_1.95	13/07/2018	soil	X	X	X						X							1	1	
2	GHD-BH03_2.9_3.35	13/07/2018	soil									X							1	1	
3	GHD-BH3_4.5_4.95	13/07/2018	soil		X	X						X							1	1	
4	GHD-BH3_6.0_6.45	13/07/2018	soil		X							X								1	
5	GHD-BH3_7.5_7.95	13/07/2018	soil									X								1	
6	GHD-BH5_1.6_2.05	11/07/2018	soil	X	X	X						X							1	1	
7	GHD-BH5_2.8_3.25	11/07/2018	soil		X	X						X							1	1	
8	GHD-BH5_4.5_4.95	11/07/2018	soil		X							X							1	1	
9	GHD-BH5_6.0_6.45	11/07/2018	soil									X							1	1	
10	GHD-BH5_7.5_7.95	11/07/2018	soil									X							1	1	
11																					
12	RIN1	13/07/2018	soil																		
13	TRIP1																				
14	BLANK1																				
15																					
16																					

Containers: 1LP, 250P, 125P, 1LA, 40mL vial, 125mL A, Jar, bag

	Laboratory Staff	Turn around time	Method Of Shipment	
Relinquished By: Clifton Thompson	Received By: R.TIMBA	1 DAY ☐ 2 DAY ☐ 3 DAY ☐	☐ Courier ☑ Hand Delivered ☐ Postal	Temperature on arrival:
Date & Time : 18:00, 13/07/2018	Date & Time : 16/7/18 11:06AM	5 DAY ☑ 10 DAY ☐ Other:	Courier Consignment # :	Report number: 607671
Signature:	Signature:			

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



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Site # 1254 & 14271

Sydney
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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name: **GHD Pty Ltd NSW**

Contact name: Clifton Thompson
Project name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425
COC number: Not provided
Turn around time: 5 Day
Date/Time received: Jul 13, 2018 8:37 PM
Eurofins | mgt reference: **607671**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 4.4 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☑ Sample containers for volatile analysis received with zero headspace.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

GHD-BH5_9.0-9.15 Sample received extra (sample bag), sample placed on hold.|totals21| met13t|

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8400 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

NATA WORLD RECOGNISED ACCREDITATION

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

Environmental Laboratories Industry Group

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

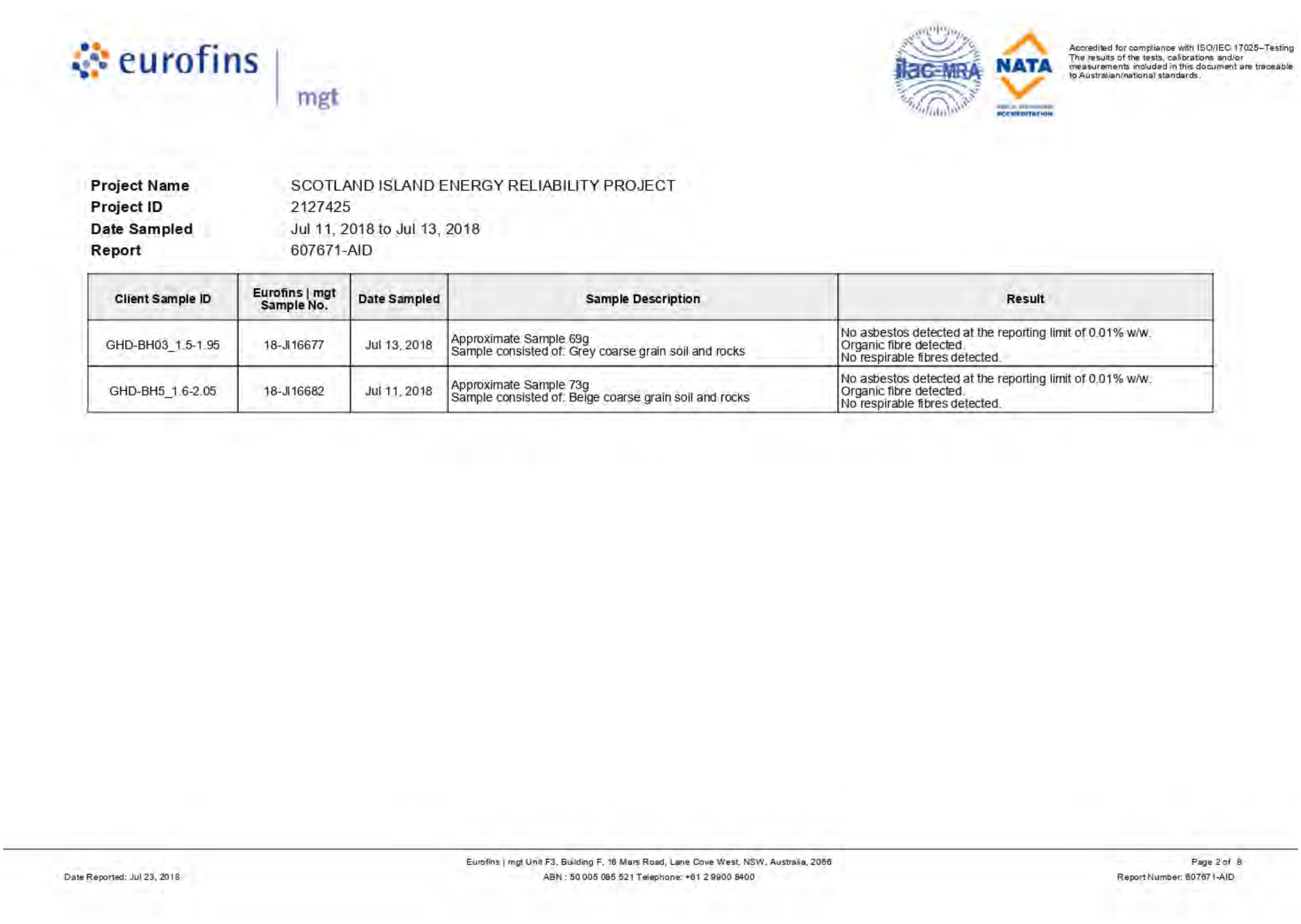
Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	Clifton Thompson
Report	607671-AID
Project Name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Jul 13, 2018
Date Reported	Jul 23, 2018

Methodology:

Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS4964 method for inhomogeneous samples is around 0.1 g/kg (0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis where required, this is considered to be at the nominal reporting limit of 0.01 % (w / w).The examination of large sample sizes(500 mL is recommended) may improve the likelihood of identifying ACM in the > 2mm fraction.The NEPM screening level of 0.001 % (w / w) asbestos in soil for FA(friable asbestos) and AF(asbestos fines) then applies where they are able to be quantified by gravimetric procedures.This quantitative screening is not generally applicable to FF(free fibres) and results of Trace Analysis are referred. *NOTE: NATA News March 2014, p.7, states in relation to AS4964: "This is a qualitative method with a nominal reporting limit of 0.01%" and that currently in Australia "there is no validated method available for the quantification of asbestos". Accordingly, NATA Accreditation does not cover the performance of this service (indicated with an asterisk).* *This report is consistent with the analytical procedures and reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended) and the Western Australia Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, 2009, including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil, June 2011.*



Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Date Sampled Jul 11, 2018 to Jul 13, 2018
Report 607671-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
GHD-BH03_1.5-1.95	18-JI16677	Jul 13, 2018	Approximate Sample 69g Sample consisted of: Grey coarse grain soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-BH5_1.6-2.05	18-JI16682	Jul 11, 2018	Approximate Sample 73g Sample consisted of: Beige coarse grain soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Asbestos - LTM-ASB-8020	Sydney	Jul 16, 2018	Indefinite

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NATA # 1261 Site # 20794

Perth
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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

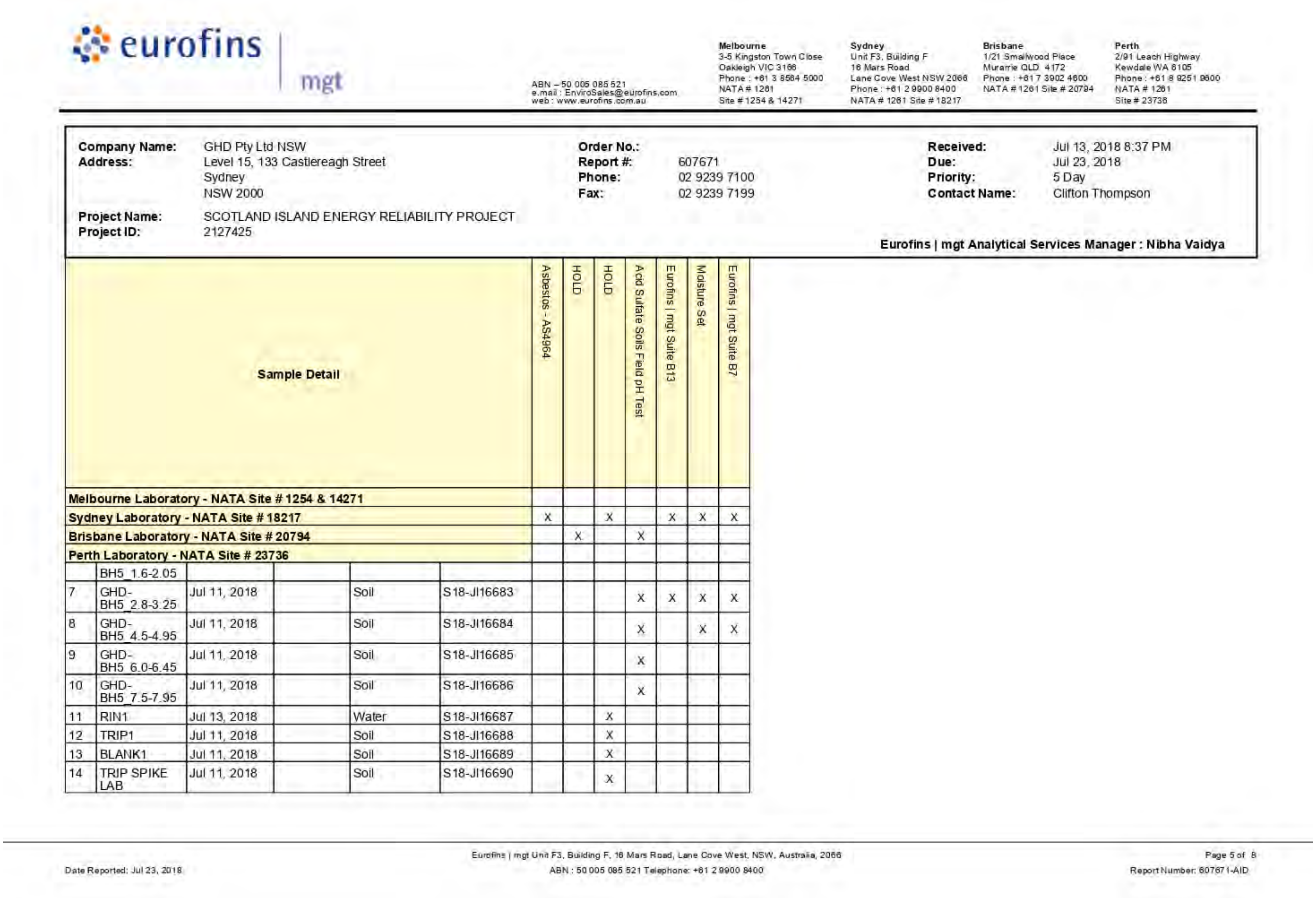
Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.:
Report #: 607671
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 13, 2018 8:37 PM
Due: Jul 23, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD-BH03_1.5-1.95	Jul 13, 2018		Soil	S18-JI16677	X			X	X	X	X
2	GHD-BH03_2.9-3.35	Jul 13, 2018		Soil	S18-JI16678				X			
3	GHD-BH3_4.5-4.95	Jul 13, 2018		Soil	S18-JI16679				X	X	X	X
4	GHD-BH3_6.0-6.45	Jul 13, 2018		Soil	S18-JI16680				X		X	X
5	GHD-BH3_7.5-7.95	Jul 13, 2018		Soil	S18-JI16681				X			
6	GHD-	Jul 11, 2018		Soil	S18-JI16682	X			X	X	X	X



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Project ID: 2127425

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Received: Jul 13, 2018 8:37 PM
Due: Jul 23, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

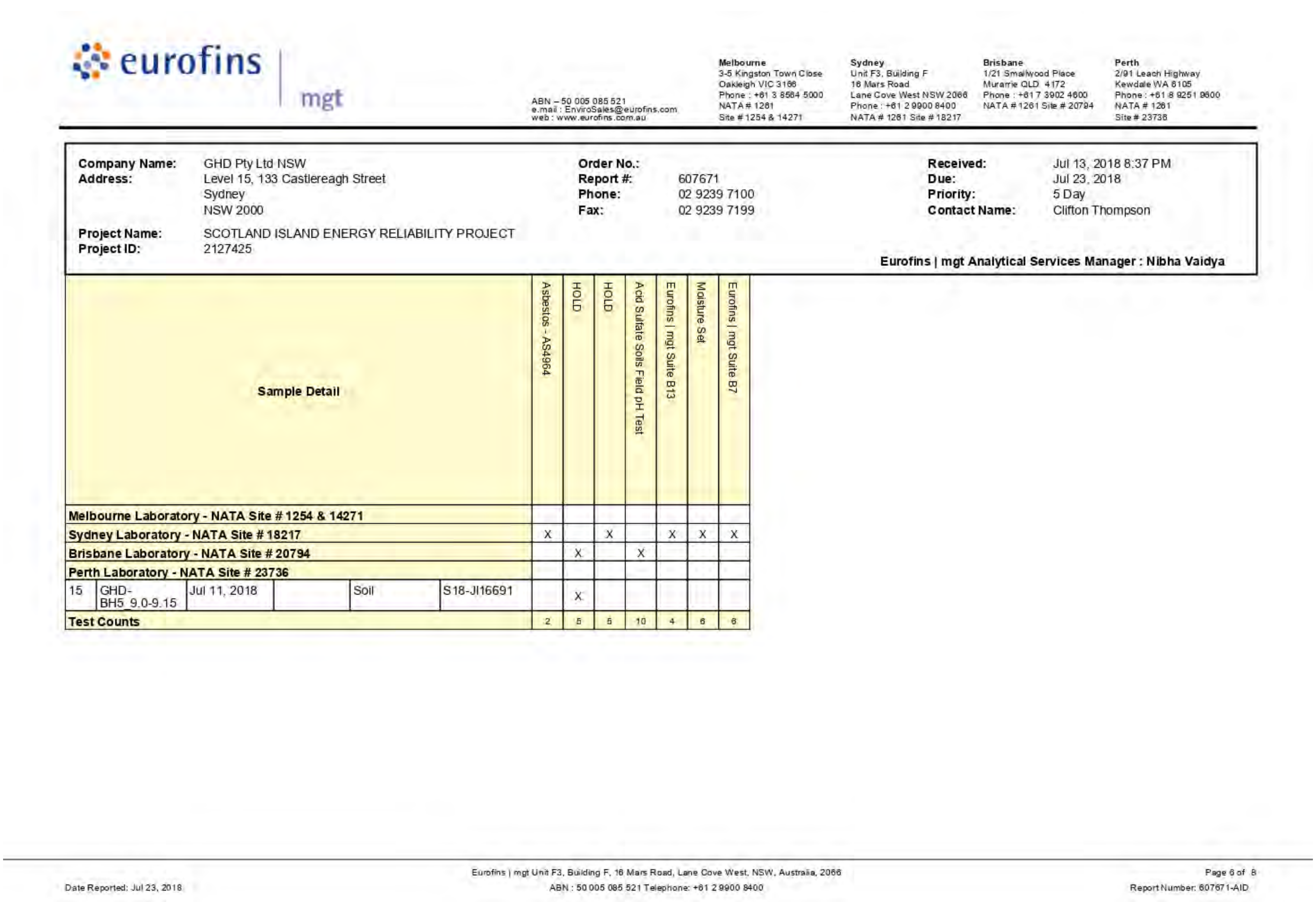
Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
	BH5_1.6-2.05											
7	GHD-BH5_2.8-3.25	Jul 11, 2018		Soil	S18-JI16683				X	X	X	X
8	GHD-BH5_4.5-4.95	Jul 11, 2018		Soil	S18-JI16684				X		X	X
9	GHD-BH5_6.0-6.45	Jul 11, 2018		Soil	S18-JI16685				X			
10	GHD-BH5_7.5-7.95	Jul 11, 2018		Soil	S18-JI16686				X			
11	RIN1	Jul 13, 2018		Water	S18-JI16687			X				
12	TRIP1	Jul 11, 2018		Soil	S18-JI16688			X				
13	BLANK1	Jul 11, 2018		Soil	S18-JI16689			X				
14	TRIP SPIKE LAB	Jul 11, 2018		Soil	S18-JI16690			X				

Date Reported: Jul 23, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Page 5 of 8
Report Number: 607671-AID



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Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 13, 2018 8:37 PM
Due: Jul 23, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
15	GHD-BH5_9.0-9.15	Jul 11, 2018		Soil	S18-JI16691		X					
Test Counts						2	5	5	10	4	6	6

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

Comments

The samples received were not collected in an approved asbestos bag and was therefore sub-sampled from the 250mL glass jar. Valid sub-sampling procedures were applied so as to ensure that the sub-samples to be analysed accurately represented the samples received.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Sayeed Abu	Senior Analyst-Asbestos (NSW)

Authorised by:

Laxman Dias	Senior Analyst-Asbestos (NSW)

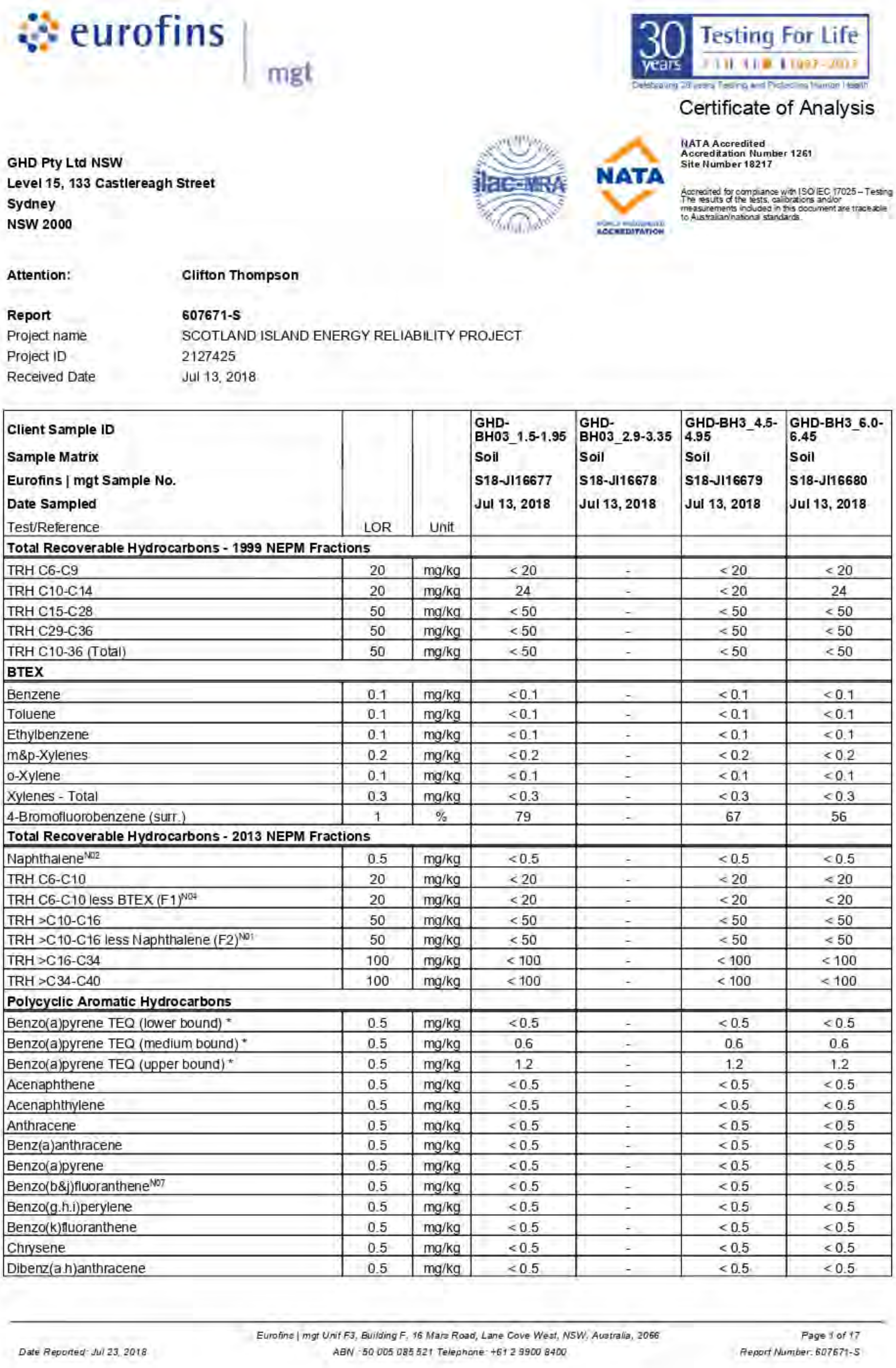
Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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30 years Testing For Life

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention: **Clifton Thompson**

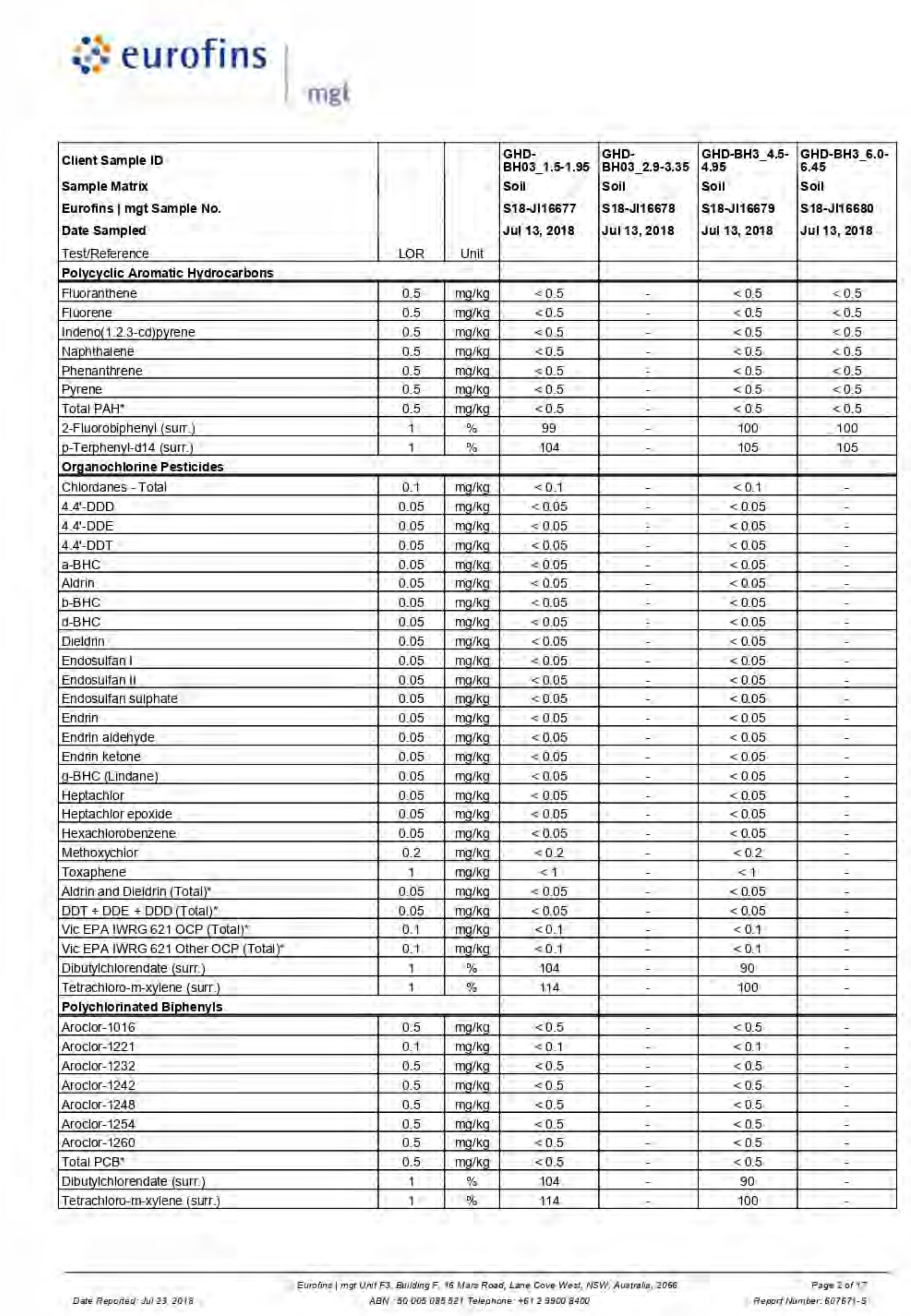
Report **607671-S**
Project name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Received Date Jul 13, 2018

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH03_1.5-1.95** **Soil** **S18-JI16677** **Jul 13, 2018**	**GHD-BH03_2.9-3.35** **Soil** **S18-JI16678** **Jul 13, 2018**	**GHD-BH3_4.5-4.95** **Soil** **S18-JI16679** **Jul 13, 2018**	**GHD-BH3_6.0-6.45** **Soil** **S18-JI16680** **Jul 13, 2018**
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	< 20	< 20
TRH C10-C14	20	mg/kg	24	-	< 20	24
TRH C15-C28	50	mg/kg	< 50	-	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	-	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	< 50	-	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	-	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	79	-	67	56
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	-	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	-	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	-	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	-	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	-	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	-	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5

Date Reported: Jul 23, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Page 1 of 17
Report Number: 607671-S



Client Sample ID			GHD-BH03_1.5-1.95	GHD-BH03_2.9-3.35	GHD-BH3_4.5-4.95	GHD-BH3_6.0-6.45
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Jl16677**	**S18-Jl16678**	**S18-Jl16679**	**S18-Jl16680**
Date Sampled			**Jul 13, 2018**	**Jul 13, 2018**	**Jul 13, 2018**	**Jul 13, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Fluoranthene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	-	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	99	-	100	100
p-Terphenyl-d14 (surr.)	1	%	104	-	105	105
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	< 0.05	-
a-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Aldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
b-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
d-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Dieldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan I	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan II	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin ketone	0.05	mg/kg	< 0.05	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	< 0.05	-
Methoxychlor	0.2	mg/kg	< 0.2	-	< 0.2	-
Toxaphene	1	mg/kg	< 1	-	< 1	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Dibutylchlorendate (surr.)	1	%	104	-	90	-
Tetrachloro-m-xylene (surr.)	1	%	114	-	100	-
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1221	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1232	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1242	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1248	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1254	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1260	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PCB*	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibutylchlorendate (surr.)	1	%	104	-	90	-
Tetrachloro-m-xylene (surr.)	1	%	114	-	100	-

Client Sample ID			**GHD-BH03_1.5-1.95**	**GHD-BH03_2.9-3.35**	**GHD-BH3_4.5-4.95**	**GHD-BH3_6.0-6.45**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-JI16677**	**S18-JI16678**	**S18-JI16679**	**S18-JI16680**
Date Sampled			**Jul 13, 2018**	**Jul 13, 2018**	**Jul 13, 2018**	**Jul 13, 2018**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	< 2	-	20	< 2
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	< 0.4
Chromium	5	mg/kg	5.3	-	37	27
Copper	5	mg/kg	< 5	-	< 5	6.3
Lead	5	mg/kg	12	-	9.5	15
Mercury	0.1	mg/kg	< 0.1	-	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	-	6.7	< 5
Zinc	5	mg/kg	< 5	-	38	15
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.8	6.8	6.1	6.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	6.5	6.0	6.0	7.1
Reaction Ratings*^{S05}		comment	4.0	4.0	4.0	4.0
% Moisture	1	%	12	-	20	21

Client Sample ID			**GHD-BH3_7.5-7.95**	**GHD-BH5_1.6-2.05**	**GHD-BH5_2.8-3.25**	**GHD-BH5_4.5-4.95**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-JI16681**	**S18-JI16682**	**S18-JI16683**	**S18-JI16684**
Date Sampled			**Jul 13, 2018**	**Jul 11, 2018**	**Jul 11, 2018**	**Jul 11, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	-	< 20	28	< 20
TRH C15-C28	50	mg/kg	-	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	-	< 50	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	-	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	-	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	-	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	79	59	70
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene^{N02}	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	-	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)^{N04}	20	mg/kg	-	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	-	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)^{N01}	50	mg/kg	-	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	-	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	-	< 100	< 100	< 100

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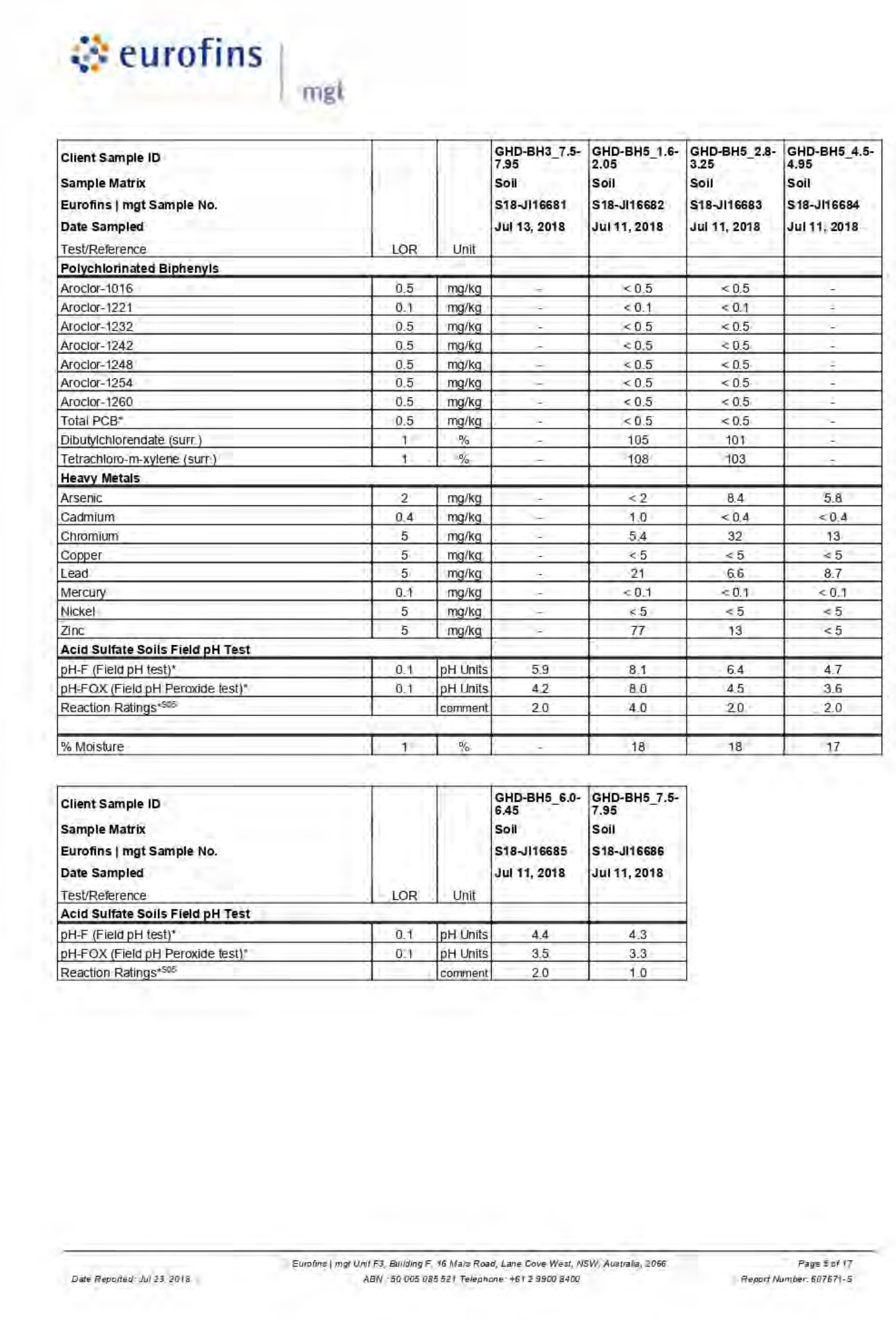
Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH3_7.5-7.95** **Soil** **S18-JI16681** **Jul 13, 2018**	**GHD-BH5_1.6-2.05** **Soil** **S18-JI16682** **Jul 11, 2018**	**GHD-BH5_2.8-3.25** **Soil** **S18-JI16683** **Jul 11, 2018**	**GHD-BH5_4.5-4.95** **Soil** **S18-JI16684** **Jul 11, 2018**
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene^{N07}	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	-	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	-	101	99	100
p-Terphenyl-d14 (surr.)	1	%	-	107	103	104
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	< 0.1	< 0.1	-
4.4'-DDD	0.05	mg/kg	-	< 0.05	< 0.05	-
4.4'-DDE	0.05	mg/kg	-	< 0.05	< 0.05	-
4.4'-DDT	0.05	mg/kg	-	< 0.05	< 0.05	-
a-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
Aldrin	0.05	mg/kg	-	< 0.05	< 0.05	-
b-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
d-BHC	0.05	mg/kg	-	< 0.05	< 0.05	-
Dieldrin	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan I	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan II	0.05	mg/kg	-	< 0.05	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin aldehyde	0.05	mg/kg	-	< 0.05	< 0.05	-
Endrin ketone	0.05	mg/kg	-	< 0.05	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05	< 0.05	-
Heptachlor	0.05	mg/kg	-	< 0.05	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	-	< 0.05	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	-	< 0.05	< 0.05	-
Methoxychlor	0.2	mg/kg	-	< 0.2	< 0.2	-
Toxaphene	1	mg/kg	-	< 1	< 1	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	-	< 0.05	< 0.05	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	-	< 0.05	< 0.05	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	-	< 0.1	< 0.1	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	-	< 0.1	< 0.1	-
Dibutylchlorendate (surr.)	1	%	-	105	101	-
Tetrachloro-m-xylene (surr.)	1	%	-	108	103	-



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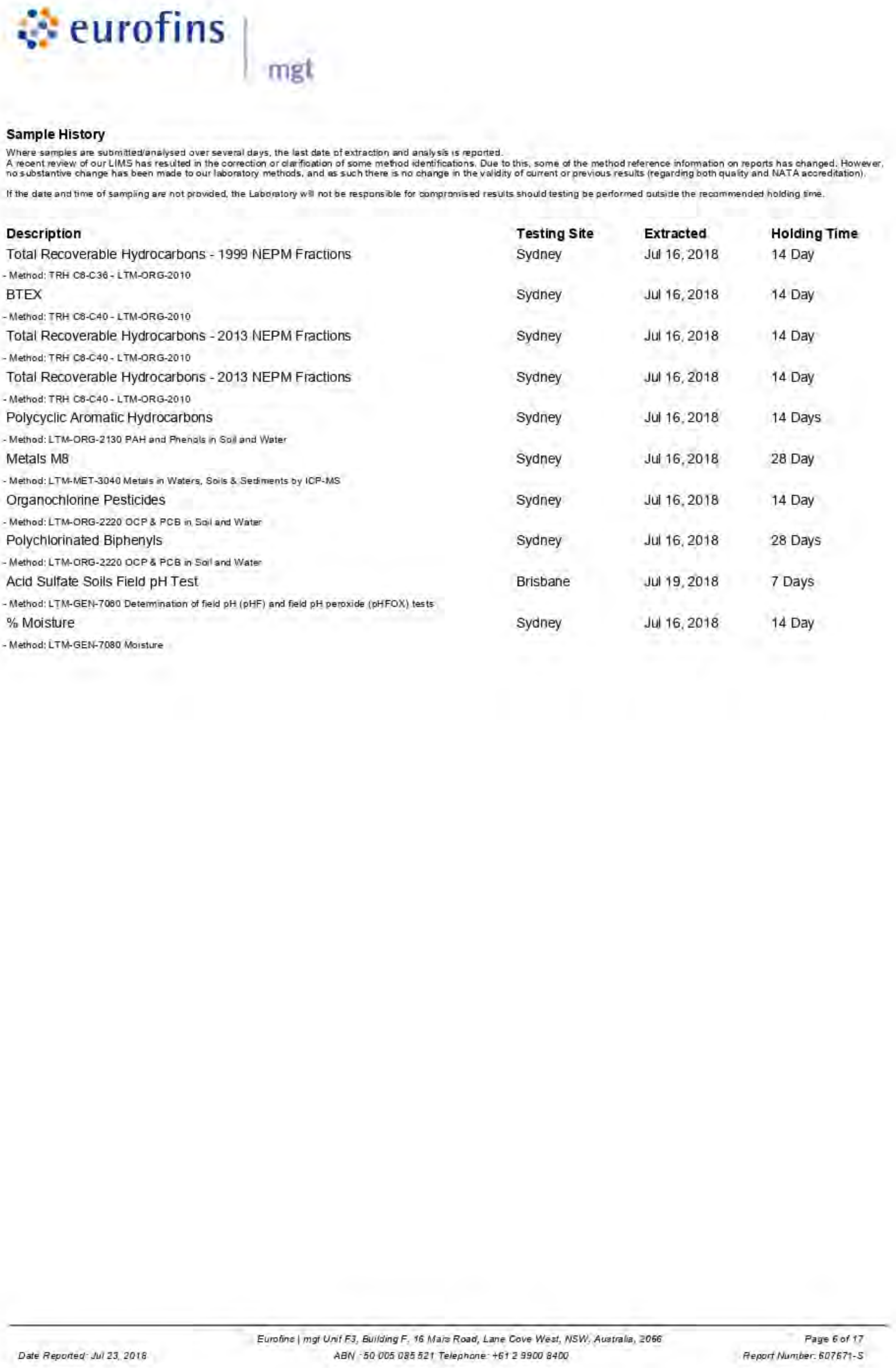
Client Sample ID			**GHD-BH3_7.5-7.95**	**GHD-BH5_1.6-2.05**	**GHD-BH5_2.8-3.25**	**GHD-BH5_4.5-4.95**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Jl16681**	**S18-Jl16682**	**S18-Jl16683**	**S18-Jl16684**
Date Sampled			**Jul 13, 2018**	**Jul 11, 2018**	**Jul 11, 2018**	**Jul 11, 2018**
Test/Reference	LOR	Unit				
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1221	0.1	mg/kg	-	< 0.1	< 0.1	-
Aroclor-1232	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1242	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1248	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1254	0.5	mg/kg	-	< 0.5	< 0.5	-
Aroclor-1260	0.5	mg/kg	-	< 0.5	< 0.5	-
Total PCB*	0.5	mg/kg	-	< 0.5	< 0.5	-
Dibutylchlorendate (surr.)	1	%	-	105	101	-
Tetrachloro-m-xylene (surr.)	1	%	-	108	103	-
Heavy Metals						
Arsenic	2	mg/kg	-	< 2	8.4	5.8
Cadmium	0.4	mg/kg	-	1.0	< 0.4	< 0.4
Chromium	5	mg/kg	-	5.4	32	13
Copper	5	mg/kg	-	< 5	< 5	< 5
Lead	5	mg/kg	-	21	6.6	8.7
Mercury	0.1	mg/kg	-	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	-	< 5	< 5	< 5
Zinc	5	mg/kg	-	77	13	< 5
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	8.1	6.4	4.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.2	8.0	4.5	3.6
Reaction Ratings*S05		comment	2.0	4.0	2.0	2.0
% Moisture	1	%	-	18	18	17

Client Sample ID			**GHD-BH5_6.0-6.45**	**GHD-BH5_7.5-7.95**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Jl16685**	**S18-Jl16686**
Date Sampled			**Jul 11, 2018**	**Jul 11, 2018**
Test/Reference	LOR	Unit		
Acid Sulfate Soils Field pH Test				
pH-F (Field pH test)*	0.1	pH Units	4.4	4.3
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.5	3.3
Reaction Ratings*S05		comment	2.0	1.0



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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: TRH C6-C36 - LTM-ORG-2010	Sydney	Jul 16, 2018	14 Day
BTEX - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 16, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 16, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 16, 2018	14 Day
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Sydney	Jul 16, 2018	14 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Jul 16, 2018	28 Day
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Jul 16, 2018	14 Day
Polychlorinated Biphenyls - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Jul 16, 2018	28 Days
Acid Sulfate Soils Field pH Test - Method: LTM-GEN-7080 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests	Brisbane	Jul 19, 2018	7 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Sydney	Jul 16, 2018	14 Day

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.:
Report #: 607671
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 13, 2018 8:37 PM
Due: Jul 23, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD-BH03_1.5-1.95	Jul 13, 2018		Soil	S18-JI16677	X			X	X	X	X
2	GHD-BH03_2.9-3.35	Jul 13, 2018		Soil	S18-JI16678				X			
3	GHD-BH3_4.5-4.95	Jul 13, 2018		Soil	S18-JI16679				X	X	X	X
4	GHD-BH3_6.0-6.45	Jul 13, 2018		Soil	S18-JI16680				X		X	X
5	GHD-BH3_7.5-7.95	Jul 13, 2018		Soil	S18-JI16681				X			
6	GHD-	Jul 11, 2018		Soil	S18-JI16682	X			X	X	X	X

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NATA # 1261 Site # 18217

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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
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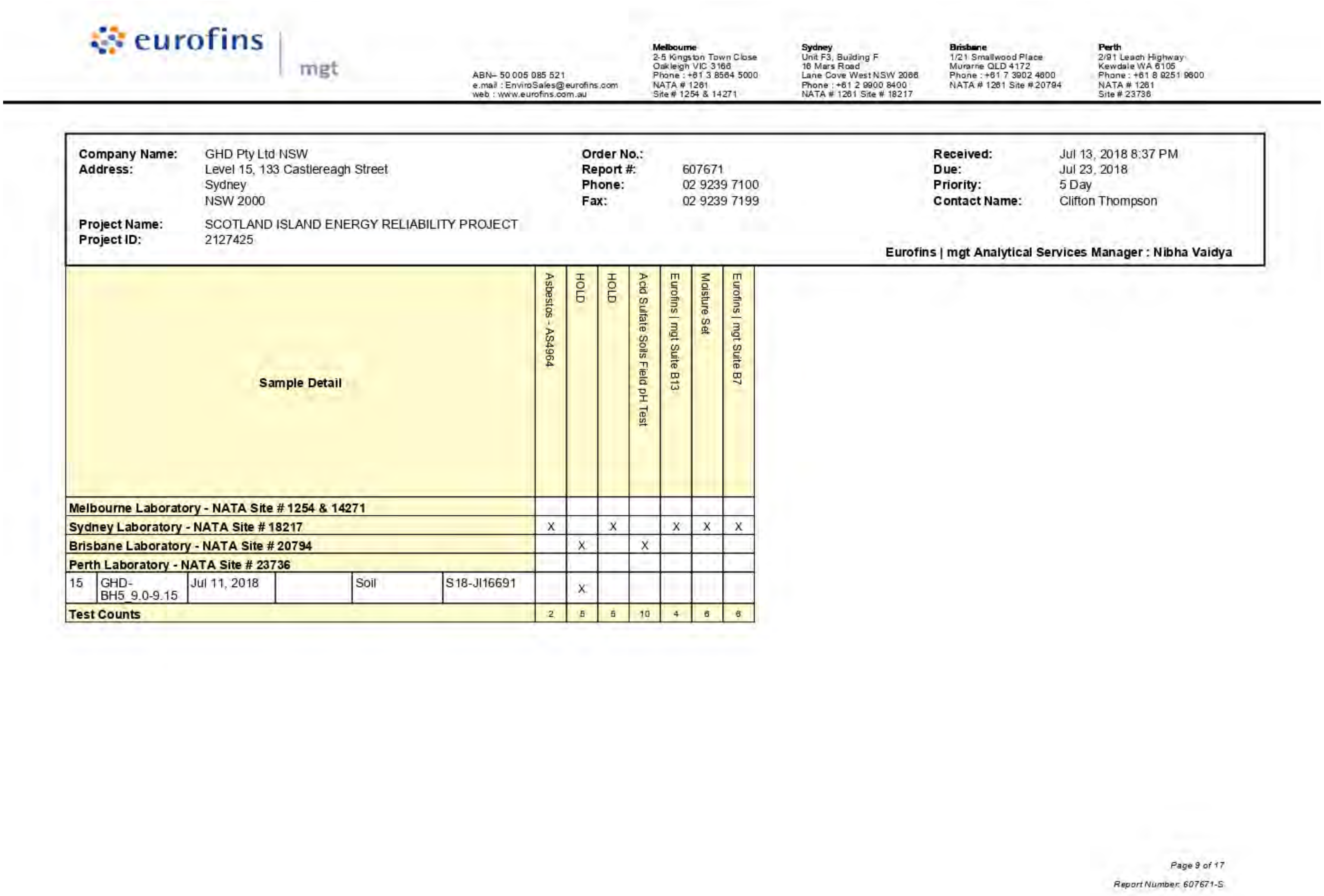
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
	BH5_1.6-2.05											
7	GHD-BH5_2.8-3.25	Jul 11, 2018		Soil	S18-Jl16683				X	X	X	X
8	GHD-BH5_4.5-4.95	Jul 11, 2018		Soil	S18-Jl16684				X		X	X
9	GHD-BH5_6.0-6.45	Jul 11, 2018		Soil	S18-Jl16685				X			
10	GHD-BH5_7.5-7.95	Jul 11, 2018		Soil	S18-Jl16686				X			
11	RIN1	Jul 13, 2018		Water	S18-Jl16687			X				
12	TRIP1	Jul 11, 2018		Soil	S18-Jl16688			X				
13	BLANK1	Jul 11, 2018		Soil	S18-Jl16689			X				
14	TRIP SPIKE LAB	Jul 11, 2018		Soil	S18-Jl16690			X				



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Sample Detail						Asbestos - AS4964	HOLD	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X		X		X	X	X
Brisbane Laboratory - NATA Site # 20794							X		X			
Perth Laboratory - NATA Site # 23736												
15	GHD-BH5_9.0-9.15	Jul 11, 2018		Soil	S18-JI16691		X					
Test Counts						2	5	5	10	4	6	6

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

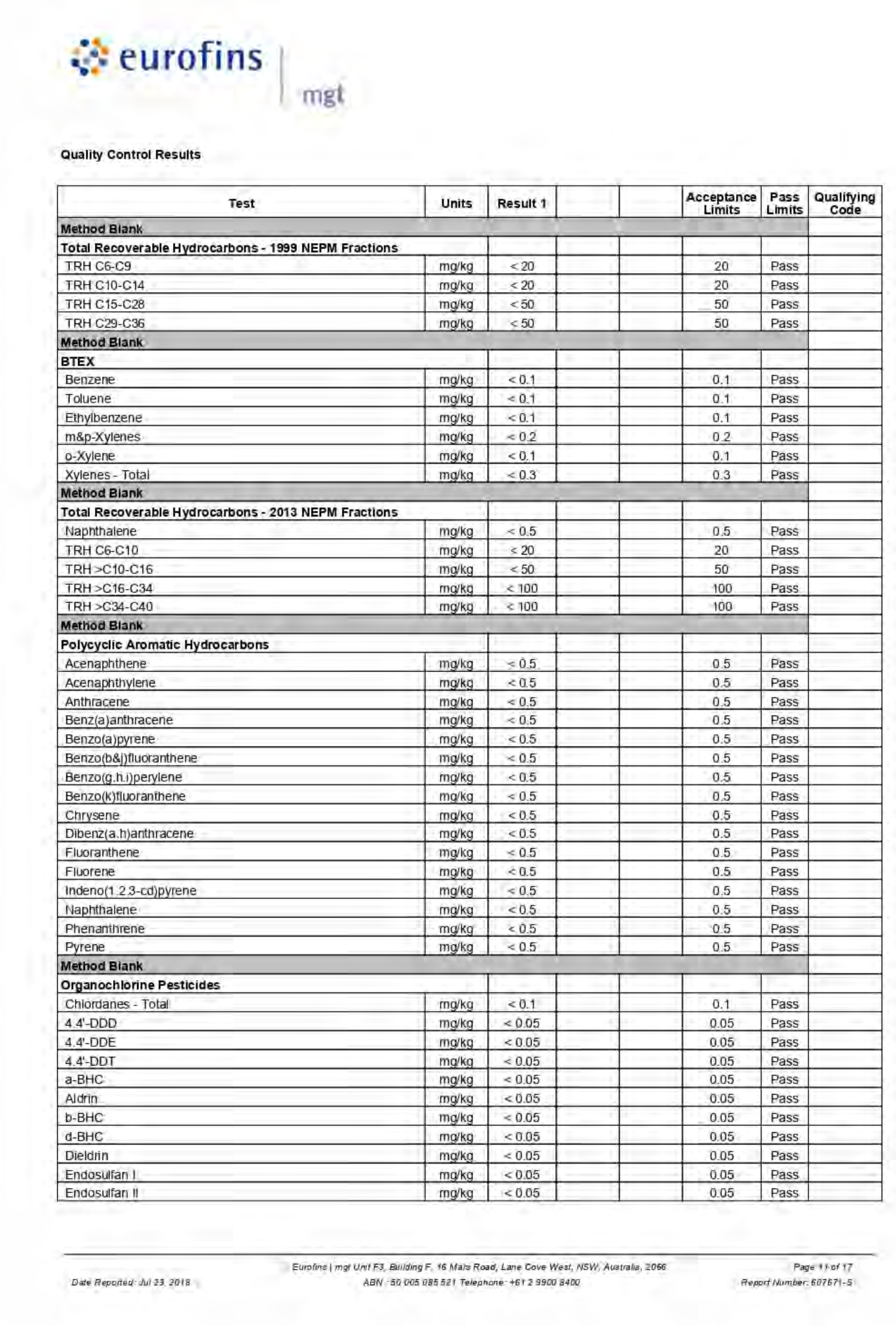
Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



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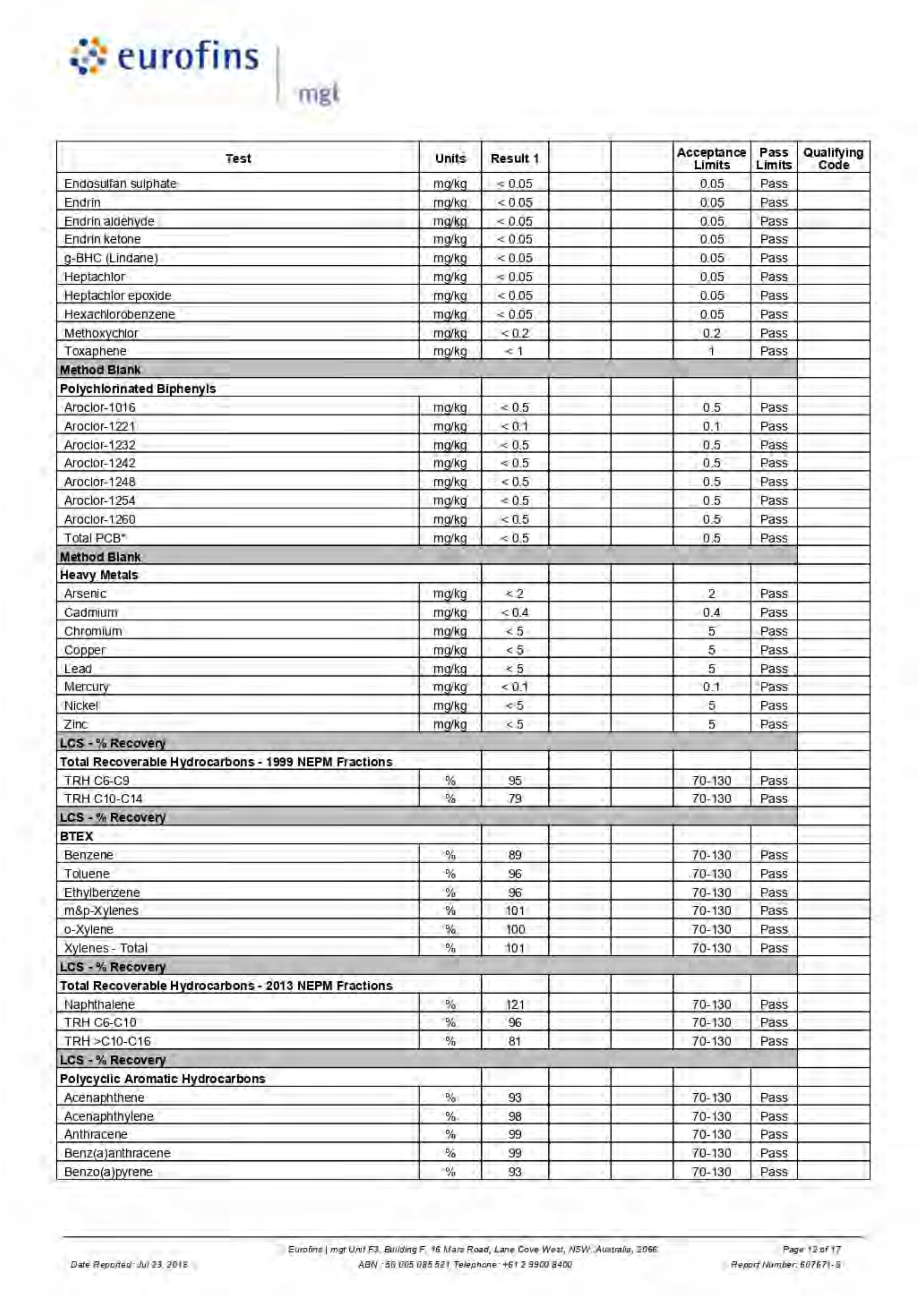
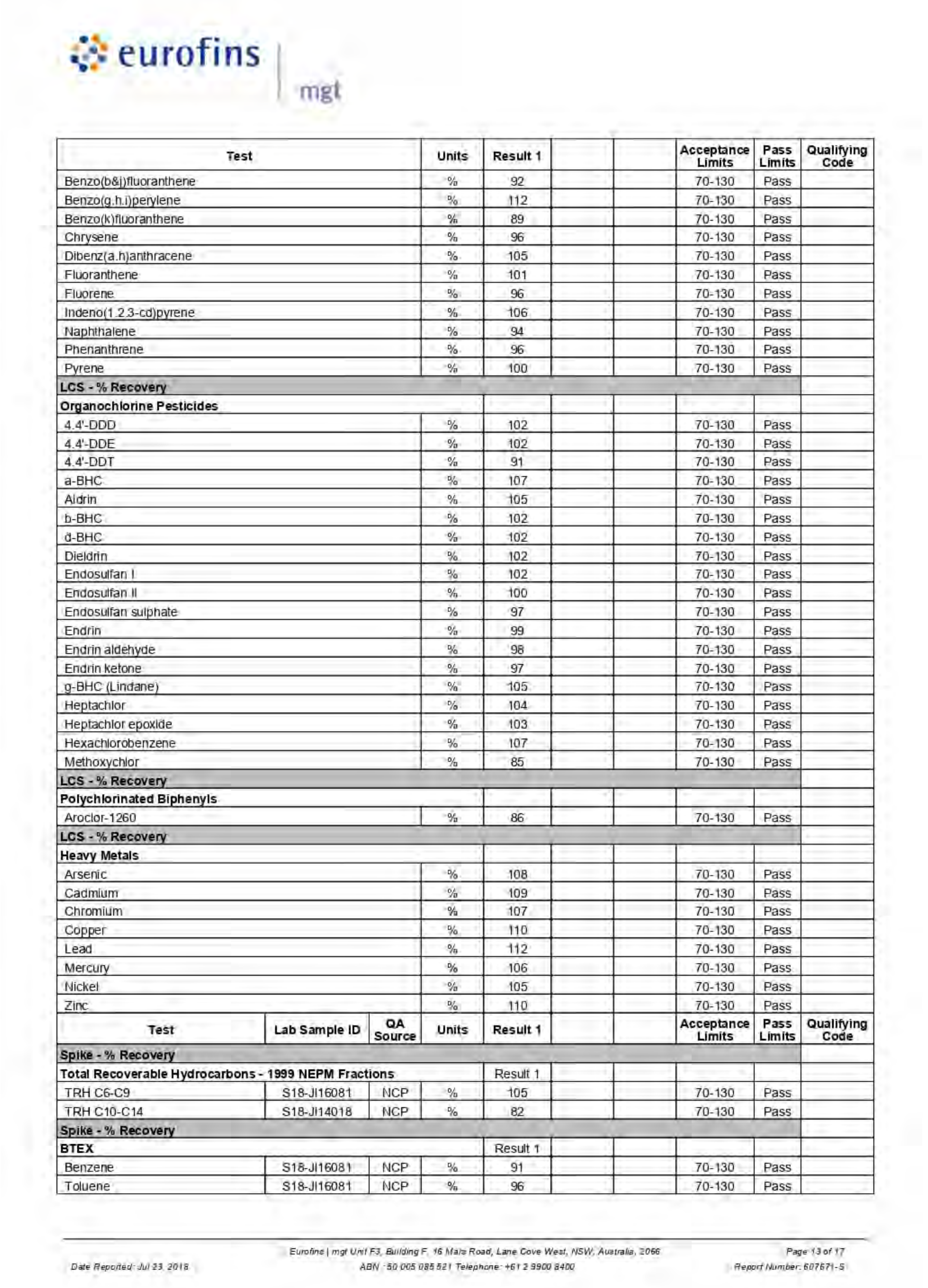
Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	



Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	95			70-130	Pass	
TRH C10-C14	%	79			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	89			70-130	Pass	
Toluene	%	96			70-130	Pass	
Ethylbenzene	%	96			70-130	Pass	
m&p-Xylenes	%	101			70-130	Pass	
o-Xylene	%	100			70-130	Pass	
Xylenes - Total	%	101			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	121			70-130	Pass	
TRH C6-C10	%	96			70-130	Pass	
TRH >C10-C16	%	81			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	93			70-130	Pass	
Acenaphthylene	%	98			70-130	Pass	
Anthracene	%	99			70-130	Pass	
Benz(a)anthracene	%	99			70-130	Pass	
Benzo(a)pyrene	%	93			70-130	Pass	



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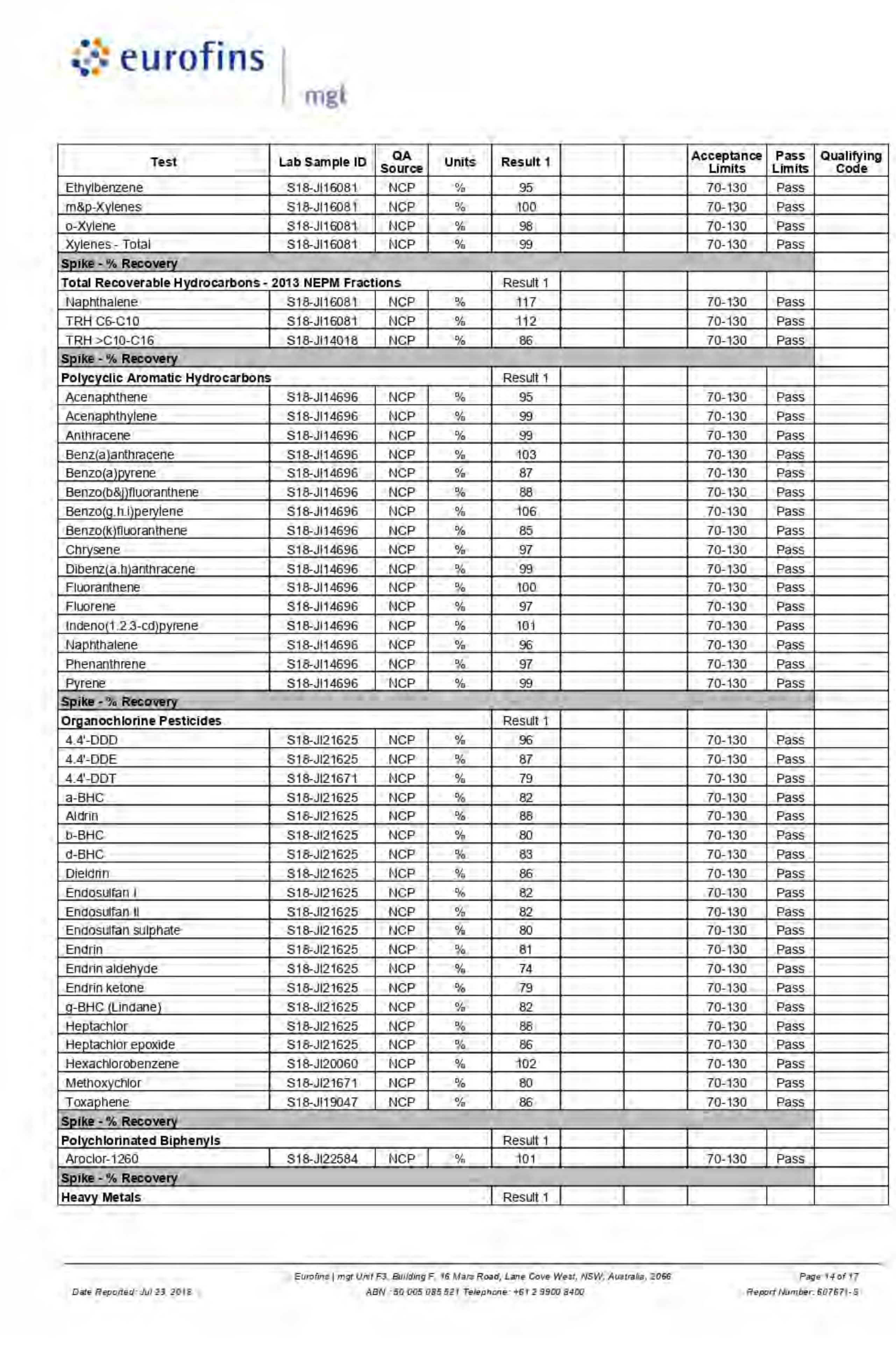
Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	%	92			70-130	Pass	
Benzo(g.h.i)perylene	%	112			70-130	Pass	
Benzo(k)fluoranthene	%	89			70-130	Pass	
Chrysene	%	96			70-130	Pass	
Dibenz(a.h)anthracene	%	105			70-130	Pass	
Fluoranthene	%	101			70-130	Pass	
Fluorene	%	96			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	106			70-130	Pass	
Naphthalene	%	94			70-130	Pass	
Phenanthrene	%	96			70-130	Pass	
Pyrene	%	100			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	102			70-130	Pass	
4.4'-DDE	%	102			70-130	Pass	
4.4'-DDT	%	91			70-130	Pass	
a-BHC	%	107			70-130	Pass	
Aldrin	%	105			70-130	Pass	
b-BHC	%	102			70-130	Pass	
d-BHC	%	102			70-130	Pass	
Dieldrin	%	102			70-130	Pass	
Endosulfan I	%	102			70-130	Pass	
Endosulfan II	%	100			70-130	Pass	
Endosulfan sulphate	%	97			70-130	Pass	
Endrin	%	99			70-130	Pass	
Endrin aldehyde	%	98			70-130	Pass	
Endrin ketone	%	97			70-130	Pass	
g-BHC (Lindane)	%	105			70-130	Pass	
Heptachlor	%	104			70-130	Pass	
Heptachlor epoxide	%	103			70-130	Pass	
Hexachlorobenzene	%	107			70-130	Pass	
Methoxychlor	%	85			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	86			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	108			70-130	Pass	
Cadmium	%	109			70-130	Pass	
Chromium	%	107			70-130	Pass	
Copper	%	110			70-130	Pass	
Lead	%	112			70-130	Pass	
Mercury	%	106			70-130	Pass	
Nickel	%	105			70-130	Pass	
Zinc	%	110			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S18-JI16081	NCP	%	105			70-130	Pass	
TRH C10-C14	S18-JI14018	NCP	%	82			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S18-JI16081	NCP	%	91			70-130	Pass	
Toluene	S18-JI16081	NCP	%	96			70-130	Pass	



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Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Ethylbenzene	S18-Jl16081	NCP	%	95			70-130	Pass	
m&p-Xylenes	S18-Jl16081	NCP	%	100			70-130	Pass	
o-Xylene	S18-Jl16081	NCP	%	98			70-130	Pass	
Xylenes - Total	S18-Jl16081	NCP	%	99			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S18-Jl16081	NCP	%	117			70-130	Pass	
TRH C6-C10	S18-Jl16081	NCP	%	112			70-130	Pass	
TRH >C10-C16	S18-Jl14018	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S18-Jl14696	NCP	%	95			70-130	Pass	
Acenaphthylene	S18-Jl14696	NCP	%	99			70-130	Pass	
Anthracene	S18-Jl14696	NCP	%	99			70-130	Pass	
Benz(a)anthracene	S18-Jl14696	NCP	%	103			70-130	Pass	
Benzo(a)pyrene	S18-Jl14696	NCP	%	87			70-130	Pass	
Benzo(b&j)fluoranthene	S18-Jl14696	NCP	%	88			70-130	Pass	
Benzo(g.h.i)perylene	S18-Jl14696	NCP	%	106			70-130	Pass	
Benzo(k)fluoranthene	S18-Jl14696	NCP	%	85			70-130	Pass	
Chrysene	S18-Jl14696	NCP	%	97			70-130	Pass	
Dibenz(a.h)anthracene	S18-Jl14696	NCP	%	99			70-130	Pass	
Fluoranthene	S18-Jl14696	NCP	%	100			70-130	Pass	
Fluorene	S18-Jl14696	NCP	%	97			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S18-Jl14696	NCP	%	101			70-130	Pass	
Naphthalene	S18-Jl14696	NCP	%	96			70-130	Pass	
Phenanthrene	S18-Jl14696	NCP	%	97			70-130	Pass	
Pyrene	S18-Jl14696	NCP	%	99			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S18-Jl21625	NCP	%	96			70-130	Pass	
4.4'-DDE	S18-Jl21625	NCP	%	87			70-130	Pass	
4.4'-DDT	S18-Jl21671	NCP	%	79			70-130	Pass	
a-BHC	S18-Jl21625	NCP	%	82			70-130	Pass	
Aldrin	S18-Jl21625	NCP	%	88			70-130	Pass	
b-BHC	S18-Jl21625	NCP	%	80			70-130	Pass	
d-BHC	S18-Jl21625	NCP	%	83			70-130	Pass	
Dieldrin	S18-Jl21625	NCP	%	86			70-130	Pass	
Endosulfan I	S18-Jl21625	NCP	%	82			70-130	Pass	
Endosulfan II	S18-Jl21625	NCP	%	82			70-130	Pass	
Endosulfan sulphate	S18-Jl21625	NCP	%	80			70-130	Pass	
Endrin	S18-Jl21625	NCP	%	81			70-130	Pass	
Endrin aldehyde	S18-Jl21625	NCP	%	74			70-130	Pass	
Endrin ketone	S18-Jl21625	NCP	%	79			70-130	Pass	
g-BHC (Lindane)	S18-Jl21625	NCP	%	82			70-130	Pass	
Heptachlor	S18-Jl21625	NCP	%	88			70-130	Pass	
Heptachlor epoxide	S18-Jl21625	NCP	%	86			70-130	Pass	
Hexachlorobenzene	S18-Jl20060	NCP	%	102			70-130	Pass	
Methoxychlor	S18-Jl21671	NCP	%	80			70-130	Pass	
Toxaphene	S18-Jl19047	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S18-Jl22584	NCP	%	101			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					

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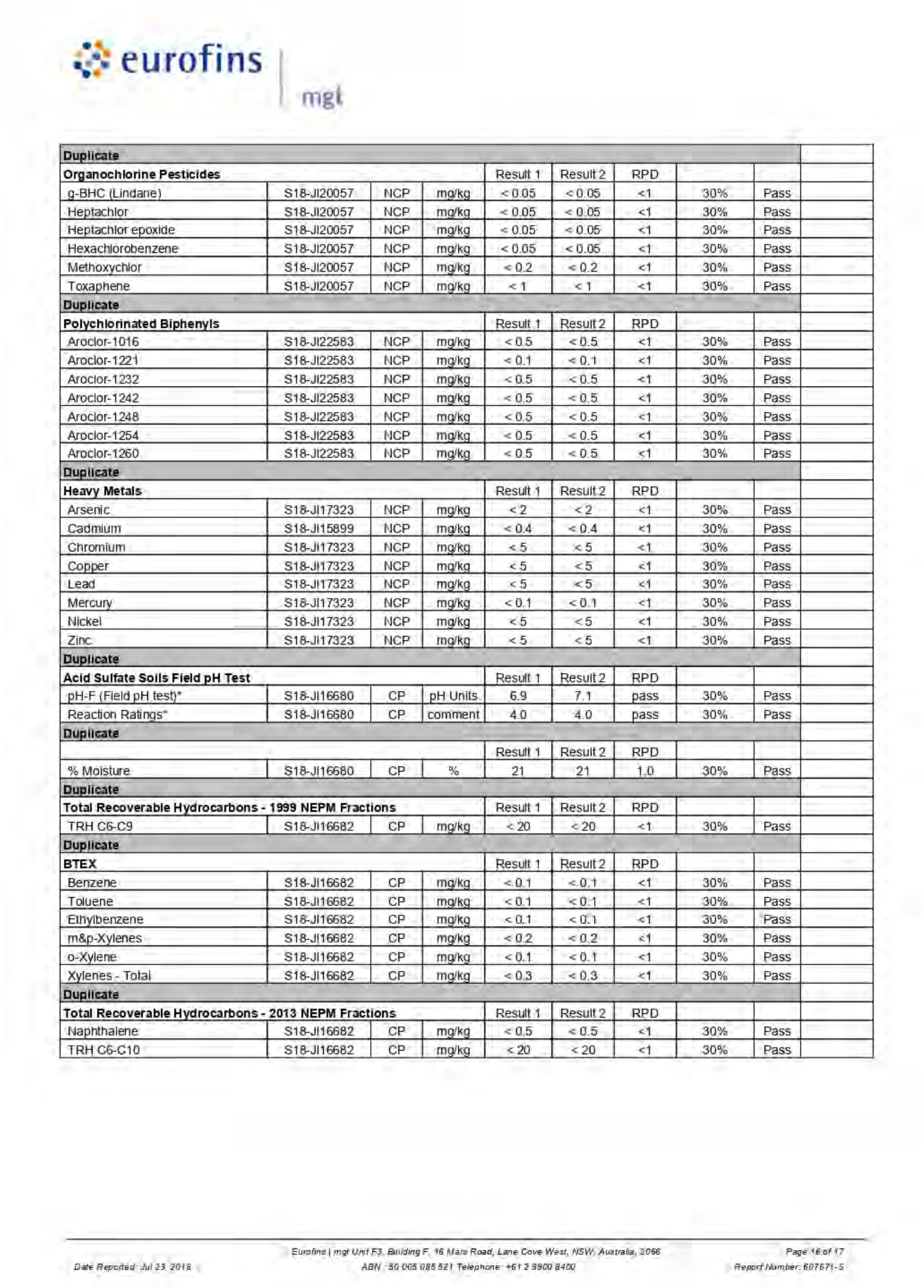
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Arsenic	S18-Jl17324	NCP	%	95			70-130	Pass	
Cadmium	S18-Jl17324	NCP	%	97			70-130	Pass	
Chromium	S18-Jl17324	NCP	%	98			70-130	Pass	
Copper	S18-Jl17324	NCP	%	100			70-130	Pass	
Lead	S18-Jl17324	NCP	%	100			70-130	Pass	
Mercury	S18-Jl17324	NCP	%	97			70-130	Pass	
Nickel	S18-Jl17324	NCP	%	96			70-130	Pass	
Zinc	S18-Jl17324	NCP	%	100			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	S18-Jl17314	NCP	mg/kg	25	24	<1	30%	Pass	
TRH C15-C28	S18-Jl17314	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	S18-Jl17314	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	S18-Jl17314	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S18-Jl17314	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	S18-Jl17314	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	S18-Jl14694	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-Jl20057	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-Jl20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	



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Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
g-BHC (Lindane)	S18-JI20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-JI20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-JI20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-JI20057	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-JI20057	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-JI20057	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S18-JI22583	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S18-JI22583	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-JI17323	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Cadmium	S18-JI15899	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S18-JI17323	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Copper	S18-JI17323	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	S18-JI17323	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	S18-JI17323	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S18-JI17323	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Zinc	S18-JI17323	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S18-JI16680	CP	pH Units	6.9	7.1	pass	30%	Pass	
Reaction Ratings*	S18-JI16680	CP	comment	4.0	4.0	pass	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S18-JI16680	CP	%	21	21	1.0	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-JI16682	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S18-JI16682	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S18-JI16682	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S18-JI16682	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S18-JI16682	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S18-JI16682	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S18-JI16682	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S18-JI16682	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S18-JI16682	CP	mg/kg	< 20	< 20	<1	30%	Pass	

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Date Reported: Jul 23, 2018

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Report Number: 607671-S

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Nibha Vaidya	Analytical Services Manager
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

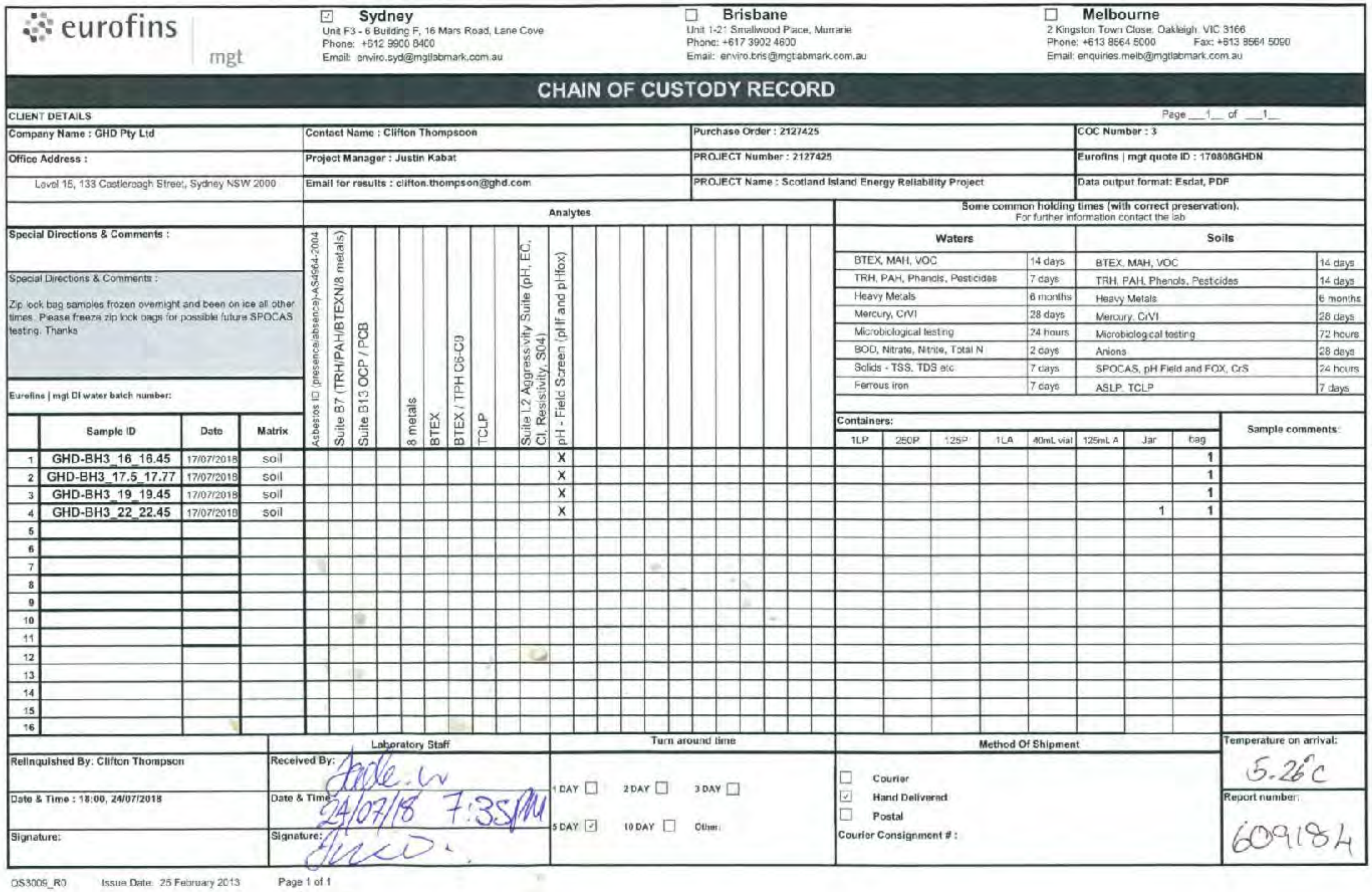
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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☑ **Sydney**
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CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd
Contact Name : Clifton Thompson
Purchase Order : 2127425
COC Number : 3
Office Address :
Level 15, 133 Castlereagh Street, Sydney NSW 2000
Project Manager : Justin Kabat
PROJECT Number : 2127425
Eurofins | mgt quote ID : 170808GHDN
Email for results : clifton.thompson@ghd.com
PROJECT Name : Scotland Island Energy Reliability Project
Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :
Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Analytes / **Containers:**

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB		8 metals	BTEX	BTEX / TPH C6-C9	TCLP		Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH3_16_16.45	17/07/2018	soil											X								1	
2	GHD-BH3_17.5_17.77	17/07/2018	soil											X								1	
3	GHD-BH3_19_19.45	17/07/2018	soil											X								1	
4	GHD-BH3_22_22.45	17/07/2018	soil											X							1	1	
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							
14																							
15																							
16																							

Relinquished By: Clifton Thompson
Date & Time : 18:00, 24/07/2018
Signature:

Laboratory Staff
Received By: Jade.W
Date & Time 24/07/18 7:35PM
Signature:

Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival: 5.26°C
Report number: 609184

DS3009_R0 Issue Date: 25 February 2013 Page 1 of 1

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3-5 Kingston Town Close
Oakleigh Vic 3166
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Site # 1254 & 14271

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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
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NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Clifton Thompson
Project name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID:	2127425
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Jul 24, 2018 7:35 PM
Eurofins | mgt reference:	**609184**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 5.3 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

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30 years Testing For Life 1997 - 2017
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

WORLD RECOGNISED ACCREDITATION

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	**Clifton Thompson**
Report	**609184-S**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Jul 24, 2018

Client Sample ID			**GHD-BH3_16-16.45**	**GHD-BH3_17.5-17.77**	**GHD-BH3_19-19.45**	**GHD-BH3_22-22.45**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-JI28182**	**S18-JI28183**	**S18-JI28184**	**S18-JI28185**
Date Sampled			**Jul 17, 2018**	**Jul 17, 2018**	**Jul 17, 2018**	**Jul 17, 2018**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	5.4	5.2	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.3	2.6	2.8	1.6
Reaction Ratings*S05		comment	4.0	1.0	1.0	4.0

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Acid Sulfate Soils Field pH Test	Brisbane	Jul 26, 2018	7 Days

- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests

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web : www.eurofins.com.au

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Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
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16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Jul 24, 2018 7:35 PM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	609184	**Due:**	Aug 1, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Acid Sulfate Soils Field pH Test
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						X
Perth Laboratory - NATA Site # 23736						
External Laboratory						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**	
1	GHD-BH3_16-16.45	Jul 17, 2018		Soil	S18-JI28182	X
2	GHD-BH3_17.5-17.77	Jul 17, 2018		Soil	S18-JI28183	X
3	GHD-BH3_19-19.45	Jul 17, 2018		Soil	S18-JI28184	X
4	GHD-BH3_22-22.45	Jul 17, 2018		Soil	S18-JI28185	X
Test Counts						4

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S18-Jl28182	CP	pH Units	5.9	5.9	pass	30%	Pass	
Reaction Ratings*	S18-Jl28182	CP	comment	4.0	4.0	pass	30%	Pass	

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Nibha Vaidya	Analytical Services Manager

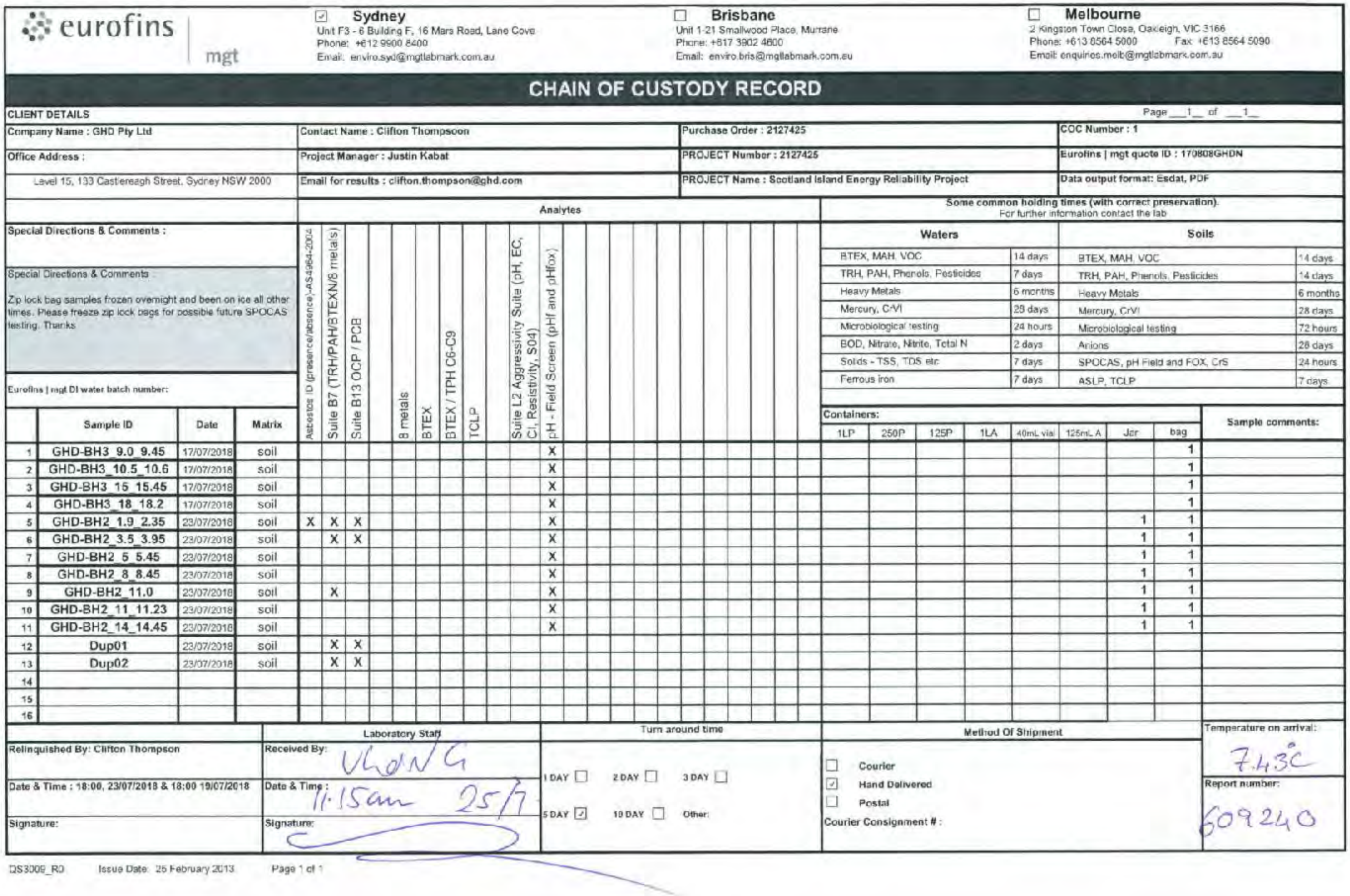
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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☐ **Melbourne**
2 Kingston Town Close, Oakleigh, VIC 3166
Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd
Contact Name : Clifton Thompsoon
Purchase Order : 2127425
COC Number : 1
Office Address : Level 15, 133 Castlereagh Street, Sydney NSW 2000
Project Manager : Justin Kabat
PROJECT Number : 2127425
Eurofins | mgt quote ID : 170808GHDN
Email for results : clifton.thompson@ghd.com
PROJECT Name : Scotland Island Energy Reliability Project
Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :
Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Analytes

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH3_9.0_9.45	17/07/2018	soil									X								1	
2	GHD-BH3_10.5_10.6	17/07/2018	soil									X								1	
3	GHD-BH3_15_15.45	17/07/2018	soil									X								1	
4	GHD-BH3_18_18.2	17/07/2018	soil									X								1	
5	GHD-BH2_1.9_2.35	23/07/2018	soil	X	X	X						X							1	1	
6	GHD-BH2_3.5_3.95	23/07/2018	soil		X	X						X							1	1	
7	GHD-BH2_5_5.45	23/07/2018	soil									X							1	1	
8	GHD-BH2_8_8.45	23/07/2018	soil									X							1	1	
9	GHD-BH2_11.0	23/07/2018	soil		X							X							1	1	
10	GHD-BH2_11_11.23	23/07/2018	soil									X							1	1	
11	GHD-BH2_14_14.45	23/07/2018	soil									X							1	1	
12	Dup01	23/07/2018	soil		X	X															
13	Dup02	23/07/2018	soil		X	X															
14																					
15																					
16																					

Relinquished By: Clifton Thompson
Date & Time : 18:00, 23/07/2018 & 18:00 19/07/2018
Signature:

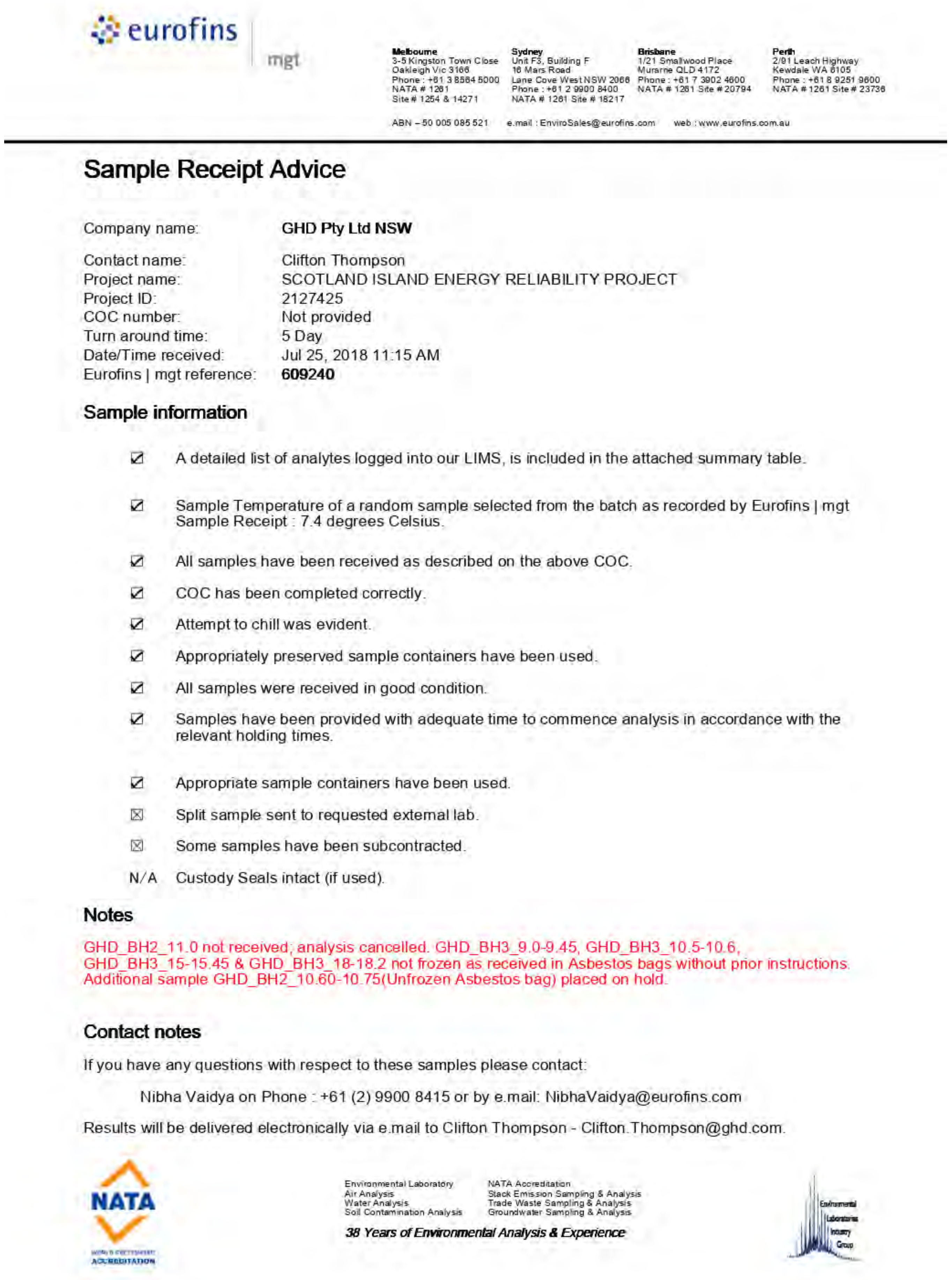
Laboratory Staff
Received By: VLONG
Date & Time: 11:15am 25/7
Signature:

Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival: 7.43°C
Report number: 609240

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



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NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name: **GHD Pty Ltd NSW**

Contact name: Clifton Thompson
Project name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425
COC number: Not provided
Turn around time: 5 Day
Date/Time received: Jul 25, 2018 11:15 AM
Eurofins | mgt reference: **609240**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 7.4 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

GHD_BH2_11.0 not received; analysis cancelled. GHD_BH3_9.0-9.45, GHD_BH3_10.5-10.6, GHD_BH3_15-15.45 & GHD_BH3_18-18.2 not frozen as received in Asbestos bags without prior instructions. Additional sample GHD_BH2_10.60-10.75(Unfrozen Asbestos bag) placed on hold.

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

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30 years Testing For Life

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

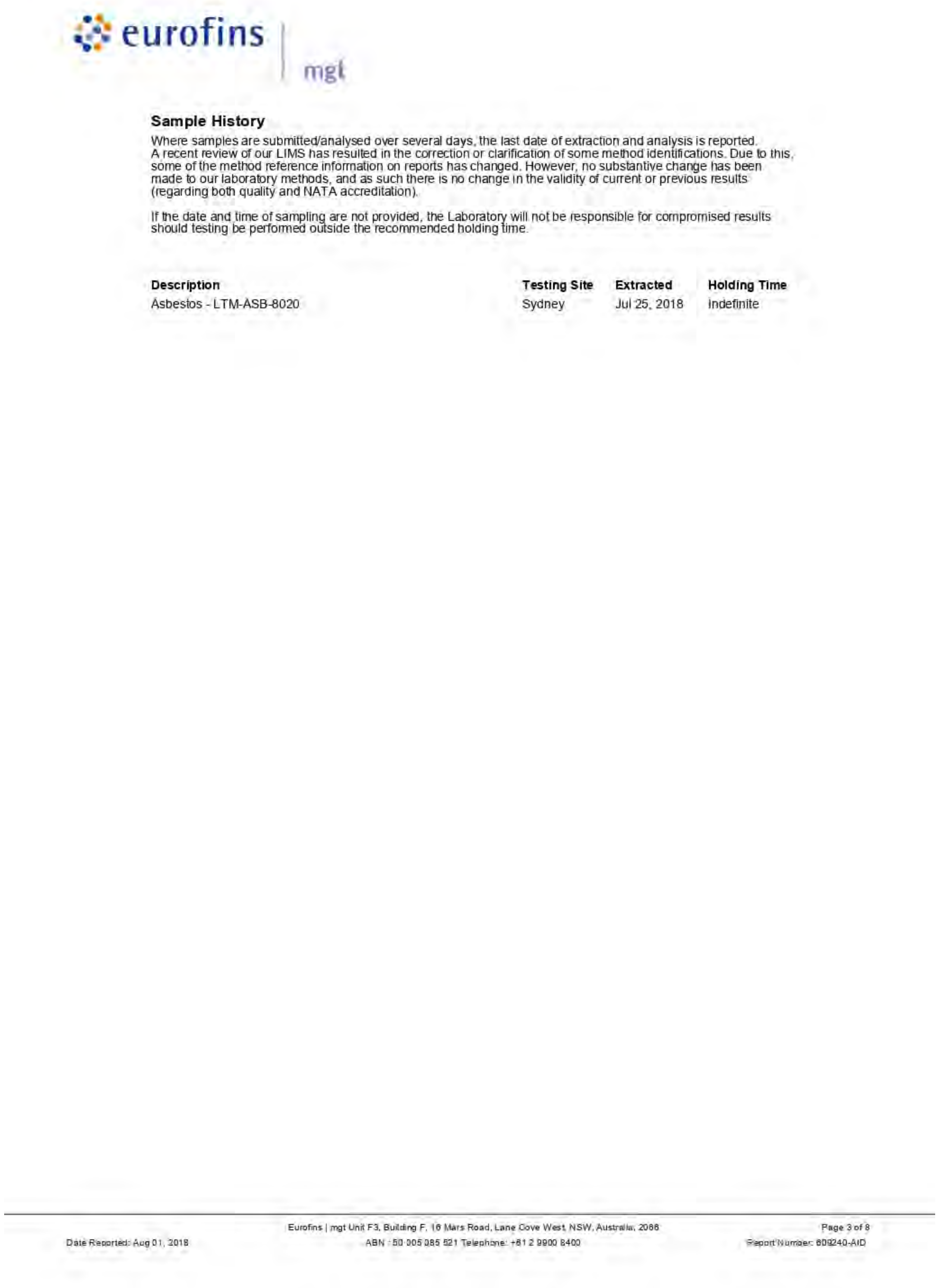
Attention: Clifton Thompson
Report 609240-AID
Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Received Date Jul 25, 2018
Date Reported Aug 01, 2018

Methodology:

Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS4964 method for inhomogeneous samples is around 0.1 g/kg (0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis where required, this is considered to be at the nominal reporting limit of 0.01 % (w / w).The examination of large sample sizes(500 mL is recommended) may improve the likelihood of identifying ACM in the > 2mm fraction.The NEPM screening level of 0.001 % (w / w) asbestos in soil for FA(friable asbestos) and AF(asbestos fines) then applies where they are able to be quantified by gravimetric procedures.This quantitative screening is not generally applicable to FF(free fibres) and results of Trace Analysis are referred. *NOTE: NATA News March 2014, p.7, states in relation to AS4964: "This is a qualitative method with a nominal reporting limit of 0.01%" and that currently in Australia "there is no validated method available for the quantification of asbestos". Accordingly, NATA Accreditation does not cover the performance of this service (indicated with an asterisk).* *This report is consistent with the analytical procedures and reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended) and the Western Australia Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, 2009, including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil, June 2011.*

Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Date Sampled Jul 23, 2018
Report 609240-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
GHD_BH2_1.9-2.35	18-JI28506	Jul 23, 2018	Approximate Sample 45g Sample consisted of: Light grey fine grain soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.



Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Asbestos - LTM-ASB-8020	Sydney	Jul 25, 2018	Indefinite

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Jul 25, 2018 11:15 AM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	609240	**Due:**	Aug 1, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794								X	X			
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD_BH3_9.0-9.45	Jul 17, 2018		Soil	S18-Jl28502				X			
2	GHD_BH3_10.5-10.6	Jul 17, 2018		Soil	S18-Jl28503				X			
3	GHD_BH3_15-15.45	Jul 17, 2018		Soil	S18-Jl28504				X			
4	GHD_BH3_18-18.2	Jul 17, 2018		Soil	S18-Jl28505				X			
5	GHD_BH2_1.9-2.35	Jul 23, 2018		Soil	S18-Jl28506	X			X	X	X	X
6	GHD_BH2_3.5	Jul 23, 2018		Soil	S18-Jl28507				X	X	X	X

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Jul 25, 2018 11:15 AM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	609240	**Due:**	Aug 1, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794								X	X			
Perth Laboratory - NATA Site # 23736												
	-3.95											
7	GHD_BH2_11.0	Jul 23, 2018		Soil	S18-Jl28508		X					
8	DUP01	Jul 23, 2018		Soil	S18-Jl28509					X	X	X
9	DUP02	Jul 23, 2018		Soil	S18-Jl28510					X	X	X
10	GHD_BH2_5-5.45	Jul 23, 2018		Soil	S18-Jl28511				X			
11	GHD_BH2_8-8.45	Jul 23, 2018		Soil	S18-Jl28512				X			
12	GHD_BH2_11-11.23	Jul 23, 2018		Soil	S18-Jl28513				X			
13	GHD_BH2_14-14.45	Jul 23, 2018		Soil	S18-Jl28514				X			
14	GHD_BH3_10.	Jul 16, 2018		Soil	S18-Jl28546			X				

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Brisbane
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Perth
2/91 Leach Highway
Kewdale WA 6105
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NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 609240
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 25, 2018 11:15 AM
Due: Aug 1, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail	Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217	X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794			X	X			
Perth Laboratory - NATA Site # 23736							
60-10.75							
Test Counts	1	1	1	10	4	4	4

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

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Comments

The sample received was not collected in an approved asbestos bag and was therefore sub-sampled from the 250mL glass jar. Valid sub-sampling procedures were applied so as to ensure that the sub-sample to be analysed accurately represented the sample received.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Sayeed Abu	Senior Analyst-Asbestos (NSW)

Authorised by:

Laxman Dias	Senior Analyst-Asbestos (NSW)

Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Date Reported: Aug 01, 2018

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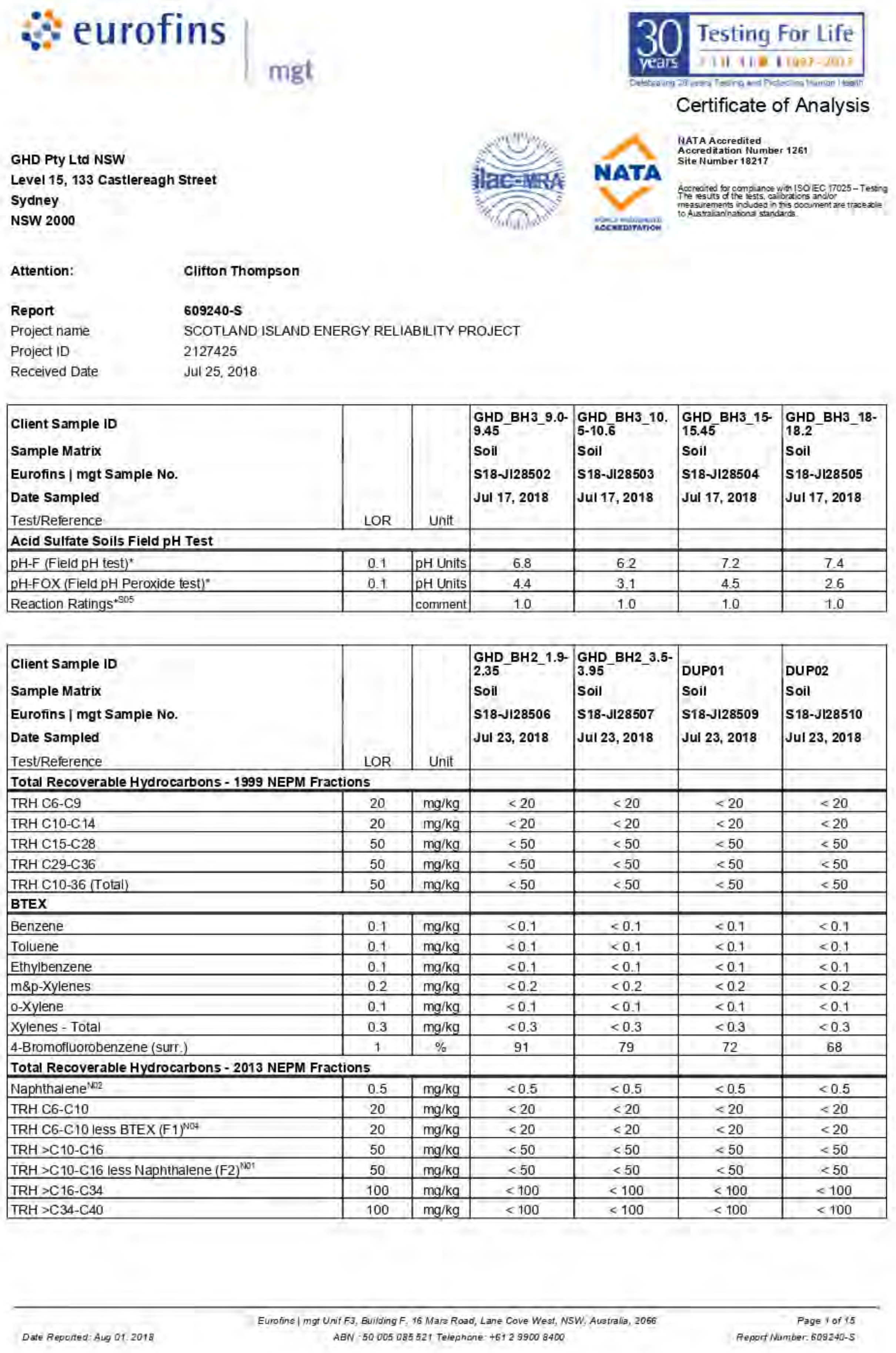
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Page 8 of 8
Report Number: 609240-AID



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30 years Testing For Life

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

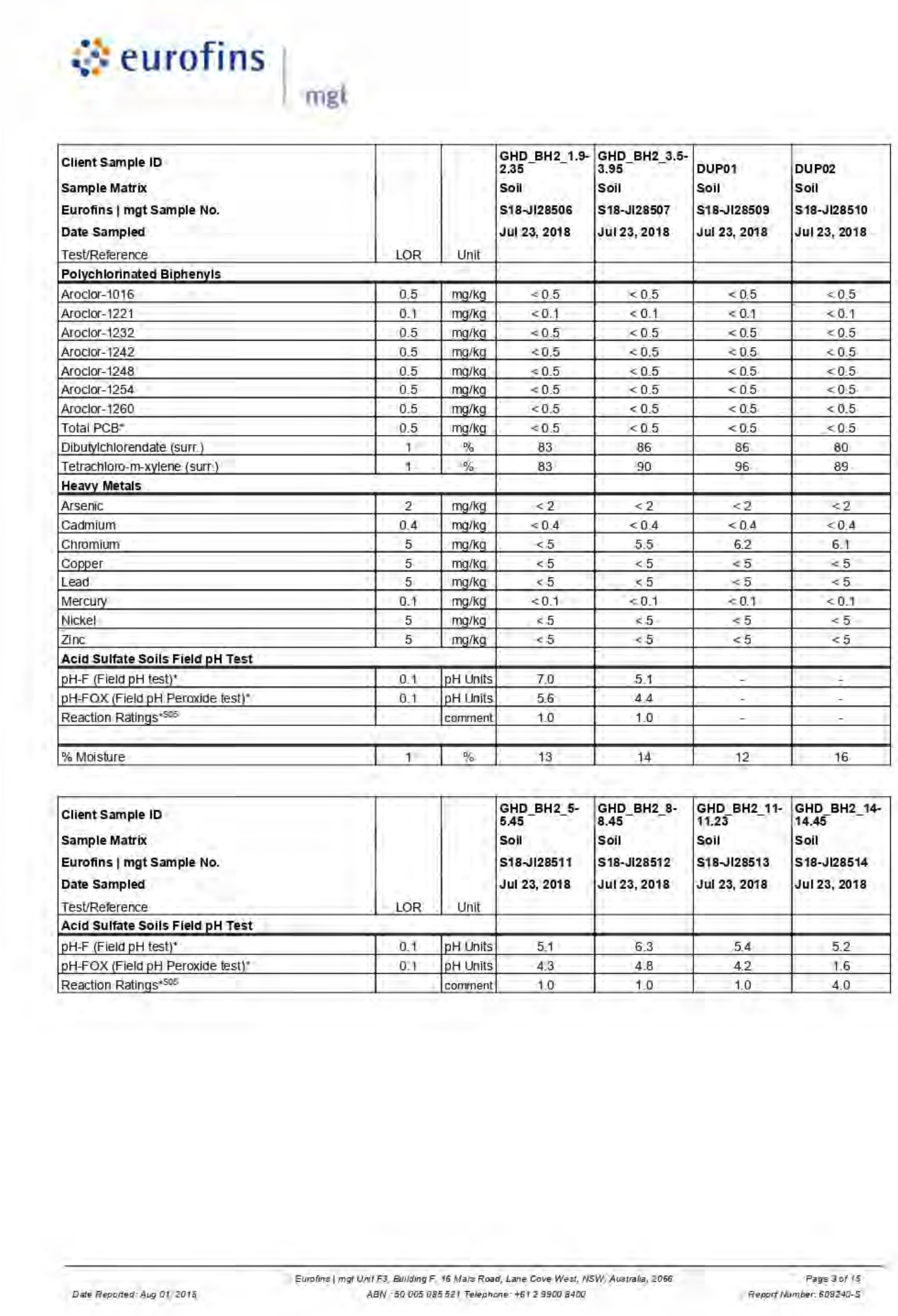
GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	**Clifton Thompson**
Report	**609240-S**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Jul 25, 2018

Client Sample ID			**GHD_BH3_9.0-9.45**	**GHD_BH3_10.5-10.6**	**GHD_BH3_15-15.45**	**GHD_BH3_18-18.2**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Jl28502**	**S18-Jl28503**	**S18-Jl28504**	**S18-Jl28505**
Date Sampled			**Jul 17, 2018**	**Jul 17, 2018**	**Jul 17, 2018**	**Jul 17, 2018**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.8	6.2	7.2	7.4
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.4	3.1	4.5	2.6
Reaction Ratings*S05		comment	1.0	1.0	1.0	1.0

Client Sample ID			**GHD_BH2_1.9-2.35**	**GHD_BH2_3.5-3.95**	**DUP01**	**DUP02**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Jl28506**	**S18-Jl28507**	**S18-Jl28509**	**S18-Jl28510**
Date Sampled			**Jul 23, 2018**	**Jul 23, 2018**	**Jul 23, 2018**	**Jul 23, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	91	79	72	68
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
NaphthaleneN02	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)N04	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)N01	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100

Client Sample ID			**GHD_BH2_1.9-2.35**	**GHD_BH2_3.5-3.95**	**DUP01**	**DUP02**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-JI28506**	**S18-JI28507**	**S18-JI28509**	**S18-JI28510**
Date Sampled			**Jul 23, 2018**	**Jul 23, 2018**	**Jul 23, 2018**	**Jul 23, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene N07	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	133	95	105	83
p-Terphenyl-d14 (surr.)	1	%	123	86	93	83
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
a-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Aldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
b-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
d-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
Toxaphene	1	mg/kg	< 1	< 1	< 1	< 1
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	83	86	86	80
Tetrachloro-m-xylene (surr.)	1	%	83	90	96	89



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Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD_BH2_1.9-2.35** **Soil** **S18-JI28506** **Jul 23, 2018**	**GHD_BH2_3.5-3.95** **Soil** **S18-JI28507** **Jul 23, 2018**	**DUP01** **Soil** **S18-JI28509** **Jul 23, 2018**	**DUP02** **Soil** **S18-JI28510** **Jul 23, 2018**
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1242	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1248	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1254	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Aroclor-1260	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PCB*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibutylchlorendate (surr.)	1	%	83	86	86	80
Tetrachloro-m-xylene (surr.)	1	%	83	90	96	89
Heavy Metals						
Arsenic	2	mg/kg	< 2	< 2	< 2	< 2
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	< 5	5.5	6.2	6.1
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Zinc	5	mg/kg	< 5	< 5	< 5	< 5
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.0	5.1	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.6	4.4	-	-
Reaction Ratings*S05		comment	1.0	1.0	-	-
% Moisture	1	%	13	14	12	16

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD_BH2_5-5.45** **Soil** **S18-JI28511** **Jul 23, 2018**	**GHD_BH2_8-8.45** **Soil** **S18-JI28512** **Jul 23, 2018**	**GHD_BH2_11-11.23** **Soil** **S18-JI28513** **Jul 23, 2018**	**GHD_BH2_14-14.45** **Soil** **S18-JI28514** **Jul 23, 2018**
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.1	6.3	5.4	5.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.8	4.2	1.6
Reaction Ratings*S05		comment	1.0	1.0	1.0	4.0

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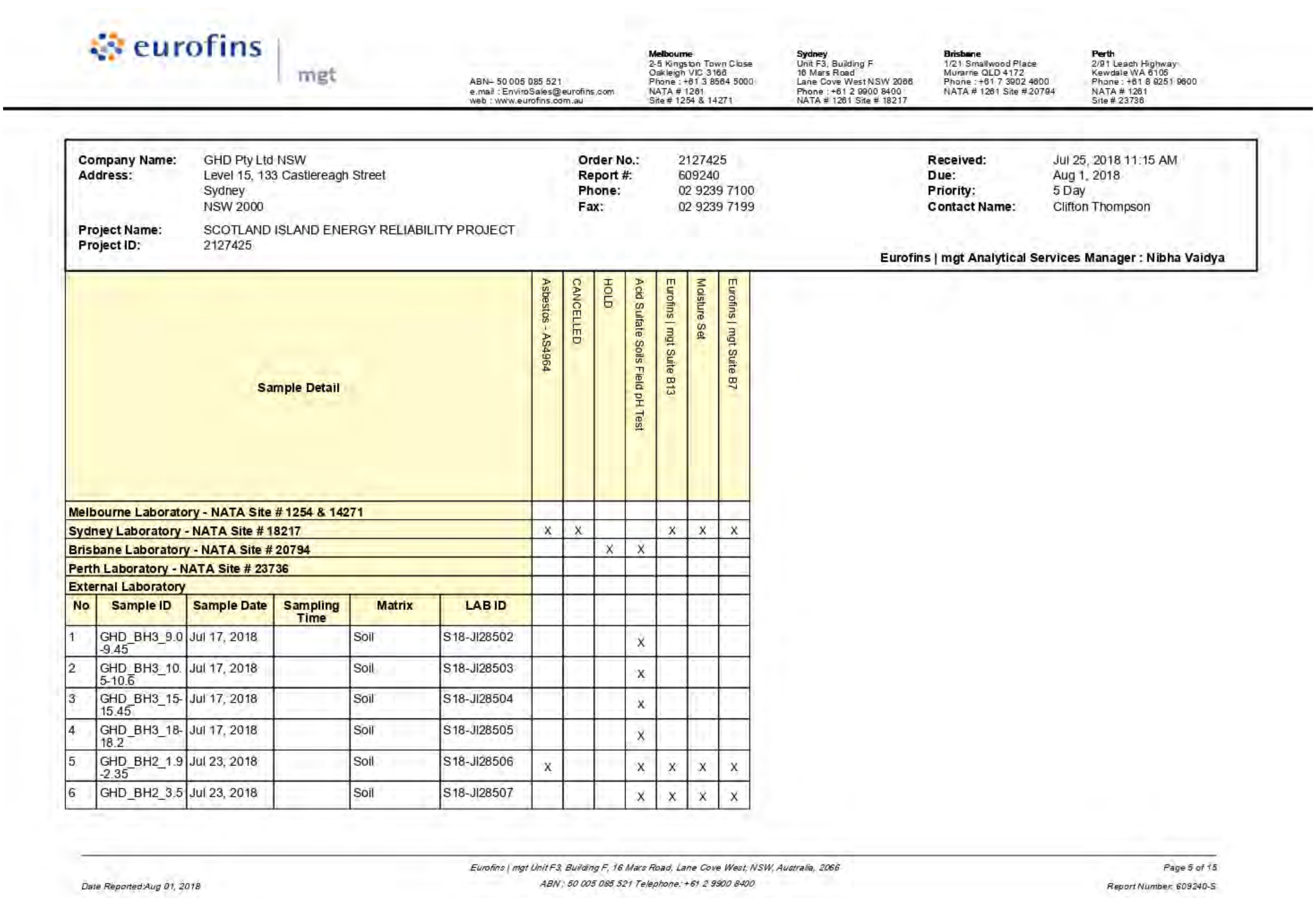
Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	**Testing Site**	**Extracted**	**Holding Time**
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: TRH C6-C36 - LTM-ORG-2010	Sydney	Jul 27, 2018	14 Day
BTEX - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 27, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 27, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Jul 27, 2018	14 Day
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Sydney	Jul 27, 2018	14 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Jul 27, 2018	28 Day
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Jul 27, 2018	14 Day
Polychlorinated Biphenyls - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Jul 27, 2018	28 Days
Acid Sulfate Soils Field pH Test - Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests	Brisbane	Jul 26, 2018	7 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Sydney	Jul 25, 2018	14 Day



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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 609240
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 25, 2018 11:15 AM
Due: Aug 1, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794								X	X			
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD_BH3_9.0-9.45	Jul 17, 2018		Soil	S18-Jl28502				X			
2	GHD_BH3_10.5-10.6	Jul 17, 2018		Soil	S18-Jl28503				X			
3	GHD_BH3_15-15.45	Jul 17, 2018		Soil	S18-Jl28504				X			
4	GHD_BH3_18-18.2	Jul 17, 2018		Soil	S18-Jl28505				X			
5	GHD_BH2_1.9-2.35	Jul 23, 2018		Soil	S18-Jl28506	X			X	X	X	X
6	GHD_BH2_3.5	Jul 23, 2018		Soil	S18-Jl28507				X	X	X	X

Date Reported:Aug 01, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Page 5 of 15
Report Number: 609240-S

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Jul 25, 2018 11:15 AM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	609240	**Due:**	Aug 1, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794								X	X			
Perth Laboratory - NATA Site # 23736												
	-3.95											
7	GHD_BH2_11.0	Jul 23, 2018		Soil	S18-JI28508		X					
8	DUP01	Jul 23, 2018		Soil	S18-JI28509					X	X	X
9	DUP02	Jul 23, 2018		Soil	S18-JI28510					X	X	X
10	GHD_BH2_5-5.45	Jul 23, 2018		Soil	S18-JI28511				X			
11	GHD_BH2_8-8.45	Jul 23, 2018		Soil	S18-JI28512				X			
12	GHD_BH2_11-11.23	Jul 23, 2018		Soil	S18-JI28513				X			
13	GHD_BH2_14-14.45	Jul 23, 2018		Soil	S18-JI28514				X			
14	GHD_BH3_10.	Jul 16, 2018		Soil	S18-JI28546			X				

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 609240
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Jul 25, 2018 11:15 AM
Due: Aug 1, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail	Asbestos - AS4964	CANCELLED	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217	X	X			X	X	X
Brisbane Laboratory - NATA Site # 20794			X	X			
Perth Laboratory - NATA Site # 23736							
60-10.75							
Test Counts	1	1	1	10	4	4	4

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

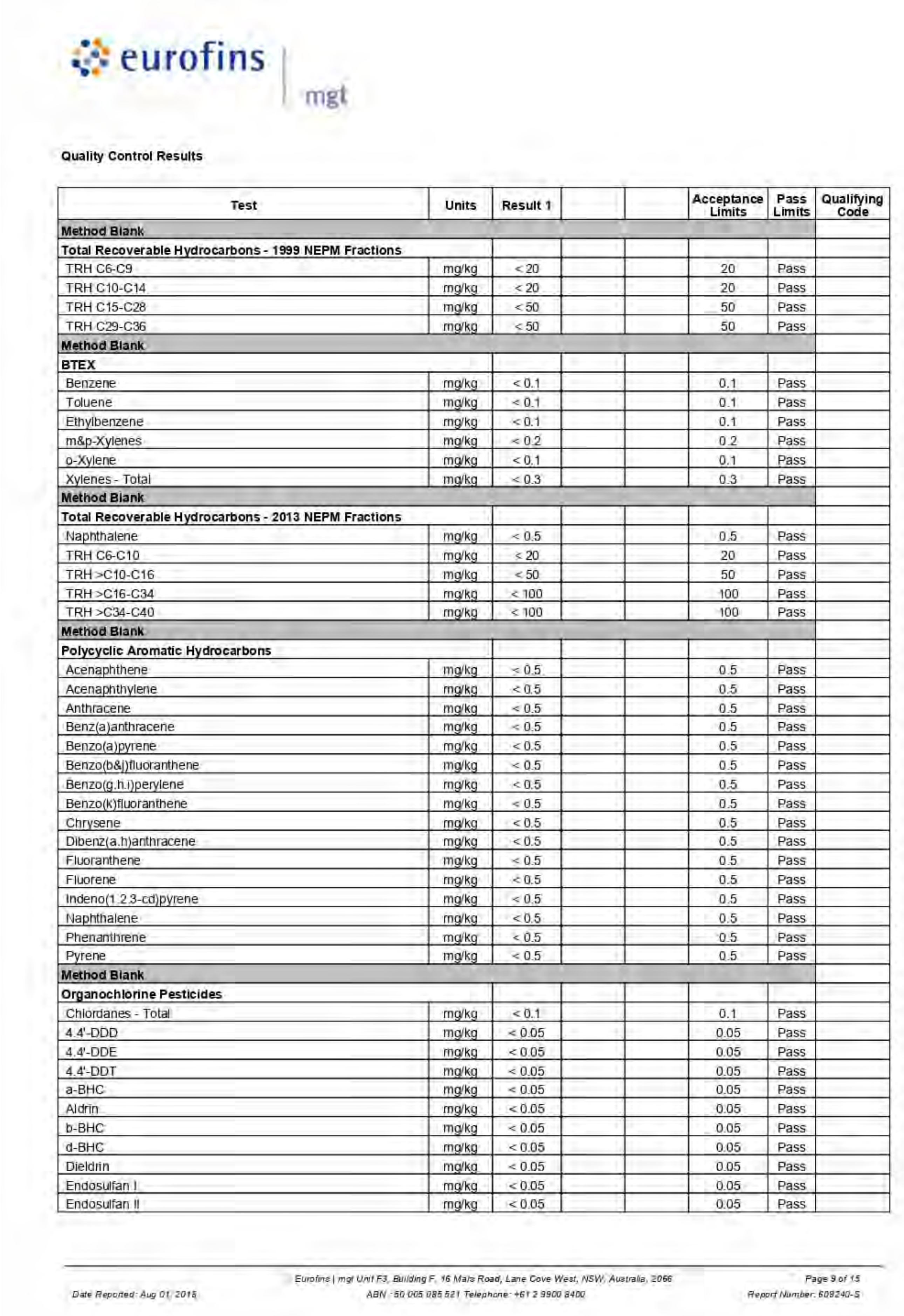
Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



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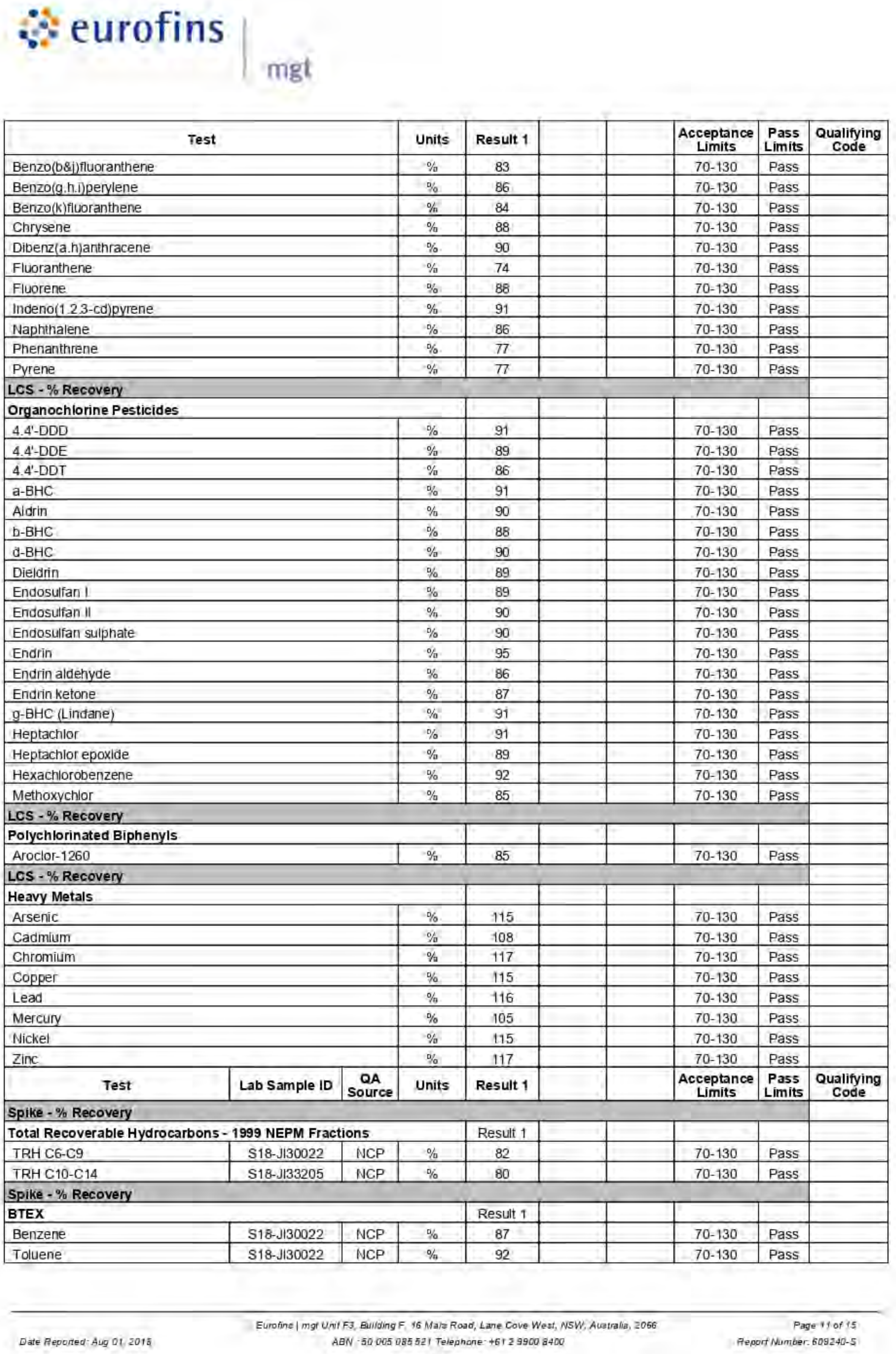
Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	96			70-130	Pass	
TRH C10-C14	%	79			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	96			70-130	Pass	
Toluene	%	103			70-130	Pass	
Ethylbenzene	%	100			70-130	Pass	
m&p-Xylenes	%	104			70-130	Pass	
o-Xylene	%	102			70-130	Pass	
Xylenes - Total	%	103			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	98			70-130	Pass	
TRH C6-C10	%	94			70-130	Pass	
TRH >C10-C16	%	85			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	89			70-130	Pass	
Acenaphthylene	%	88			70-130	Pass	
Anthracene	%	79			70-130	Pass	
Benz(a)anthracene	%	86			70-130	Pass	
Benzo(a)pyrene	%	86			70-130	Pass	



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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	%	83			70-130	Pass	
Benzo(g.h.i)perylene	%	86			70-130	Pass	
Benzo(k)fluoranthene	%	84			70-130	Pass	
Chrysene	%	88			70-130	Pass	
Dibenz(a.h)anthracene	%	90			70-130	Pass	
Fluoranthene	%	74			70-130	Pass	
Fluorene	%	88			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	91			70-130	Pass	
Naphthalene	%	86			70-130	Pass	
Phenanthrene	%	77			70-130	Pass	
Pyrene	%	77			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	91			70-130	Pass	
4.4'-DDE	%	89			70-130	Pass	
4.4'-DDT	%	86			70-130	Pass	
a-BHC	%	91			70-130	Pass	
Aldrin	%	90			70-130	Pass	
b-BHC	%	88			70-130	Pass	
d-BHC	%	90			70-130	Pass	
Dieldrin	%	89			70-130	Pass	
Endosulfan I	%	89			70-130	Pass	
Endosulfan II	%	90			70-130	Pass	
Endosulfan sulphate	%	90			70-130	Pass	
Endrin	%	95			70-130	Pass	
Endrin aldehyde	%	86			70-130	Pass	
Endrin ketone	%	87			70-130	Pass	
g-BHC (Lindane)	%	91			70-130	Pass	
Heptachlor	%	91			70-130	Pass	
Heptachlor epoxide	%	89			70-130	Pass	
Hexachlorobenzene	%	92			70-130	Pass	
Methoxychlor	%	85			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	85			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	115			70-130	Pass	
Cadmium	%	108			70-130	Pass	
Chromium	%	117			70-130	Pass	
Copper	%	115			70-130	Pass	
Lead	%	116			70-130	Pass	
Mercury	%	105			70-130	Pass	
Nickel	%	115			70-130	Pass	
Zinc	%	117			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S18-JI30022	NCP	%	82			70-130	Pass	
TRH C10-C14	S18-JI33205	NCP	%	80			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S18-JI30022	NCP	%	87			70-130	Pass	
Toluene	S18-JI30022	NCP	%	92			70-130	Pass	

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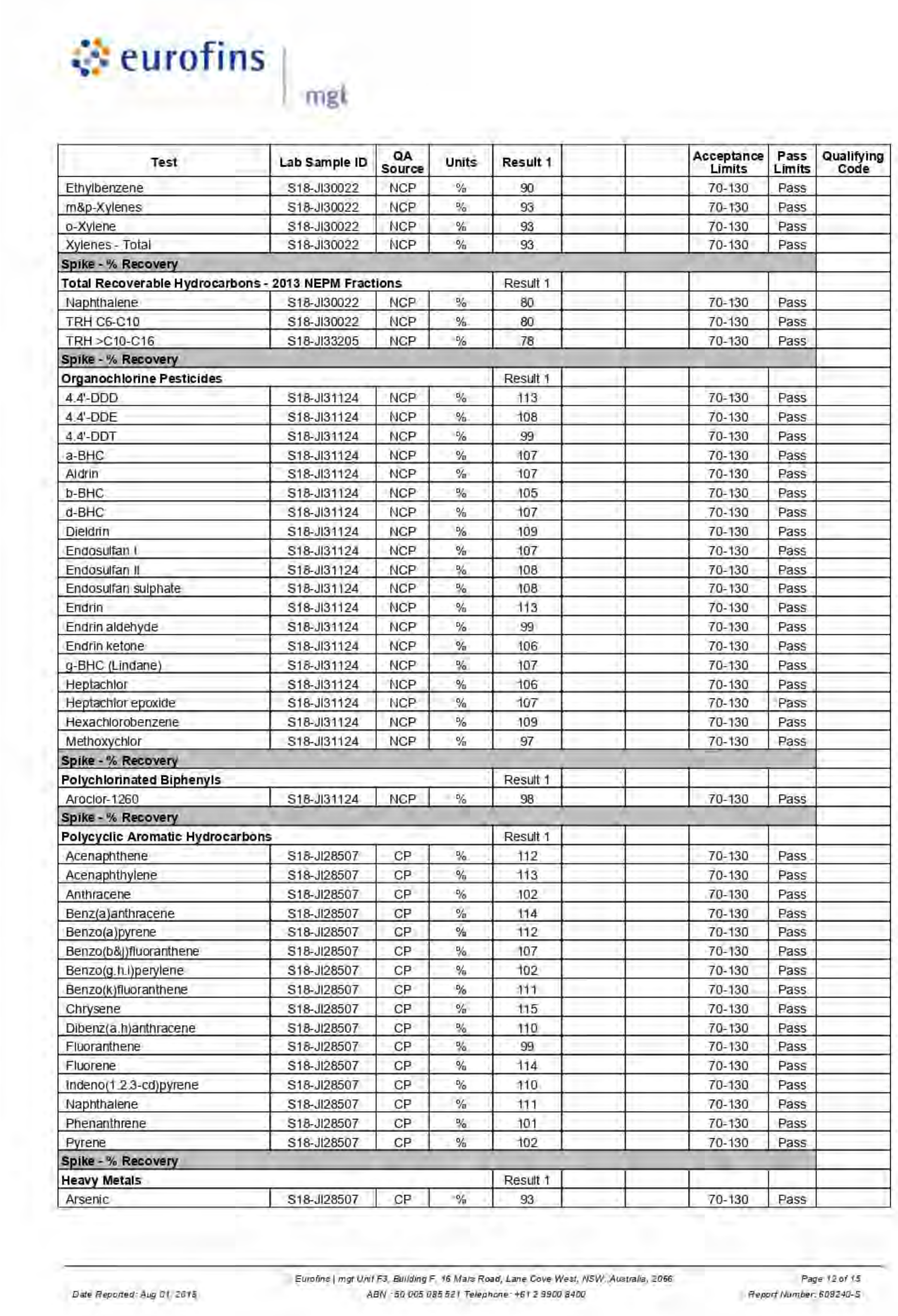

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Ethylbenzene	S18-Jl30022	NCP	%	90			70-130	Pass	
m&p-Xylenes	S18-Jl30022	NCP	%	93			70-130	Pass	
o-Xylene	S18-Jl30022	NCP	%	93			70-130	Pass	
Xylenes - Total	S18-Jl30022	NCP	%	93			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S18-Jl30022	NCP	%	80			70-130	Pass	
TRH C6-C10	S18-Jl30022	NCP	%	80			70-130	Pass	
TRH >C10-C16	S18-Jl33205	NCP	%	78			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S18-Jl31124	NCP	%	113			70-130	Pass	
4.4'-DDE	S18-Jl31124	NCP	%	108			70-130	Pass	
4.4'-DDT	S18-Jl31124	NCP	%	99			70-130	Pass	
a-BHC	S18-Jl31124	NCP	%	107			70-130	Pass	
Aldrin	S18-Jl31124	NCP	%	107			70-130	Pass	
b-BHC	S18-Jl31124	NCP	%	105			70-130	Pass	
d-BHC	S18-Jl31124	NCP	%	107			70-130	Pass	
Dieldrin	S18-Jl31124	NCP	%	109			70-130	Pass	
Endosulfan I	S18-Jl31124	NCP	%	107			70-130	Pass	
Endosulfan II	S18-Jl31124	NCP	%	108			70-130	Pass	
Endosulfan sulphate	S18-Jl31124	NCP	%	108			70-130	Pass	
Endrin	S18-Jl31124	NCP	%	113			70-130	Pass	
Endrin aldehyde	S18-Jl31124	NCP	%	99			70-130	Pass	
Endrin ketone	S18-Jl31124	NCP	%	106			70-130	Pass	
g-BHC (Lindane)	S18-Jl31124	NCP	%	107			70-130	Pass	
Heptachlor	S18-Jl31124	NCP	%	106			70-130	Pass	
Heptachlor epoxide	S18-Jl31124	NCP	%	107			70-130	Pass	
Hexachlorobenzene	S18-Jl31124	NCP	%	109			70-130	Pass	
Methoxychlor	S18-Jl31124	NCP	%	97			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S18-Jl31124	NCP	%	98			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S18-Jl28507	CP	%	112			70-130	Pass	
Acenaphthylene	S18-Jl28507	CP	%	113			70-130	Pass	
Anthracene	S18-Jl28507	CP	%	102			70-130	Pass	
Benz(a)anthracene	S18-Jl28507	CP	%	114			70-130	Pass	
Benzo(a)pyrene	S18-Jl28507	CP	%	112			70-130	Pass	
Benzo(b&j)fluoranthene	S18-Jl28507	CP	%	107			70-130	Pass	
Benzo(g.h.i)perylene	S18-Jl28507	CP	%	102			70-130	Pass	
Benzo(k)fluoranthene	S18-Jl28507	CP	%	111			70-130	Pass	
Chrysene	S18-Jl28507	CP	%	115			70-130	Pass	
Dibenz(a.h)anthracene	S18-Jl28507	CP	%	110			70-130	Pass	
Fluoranthene	S18-Jl28507	CP	%	99			70-130	Pass	
Fluorene	S18-Jl28507	CP	%	114			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S18-Jl28507	CP	%	110			70-130	Pass	
Naphthalene	S18-Jl28507	CP	%	111			70-130	Pass	
Phenanthrene	S18-Jl28507	CP	%	101			70-130	Pass	
Pyrene	S18-Jl28507	CP	%	102			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S18-Jl28507	CP	%	93			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Cadmium	S18-JI28507	CP	%	93			70-130	Pass	
Chromium	S18-JI28507	CP	%	96			70-130	Pass	
Copper	S18-JI28507	CP	%	93			70-130	Pass	
Lead	S18-JI28507	CP	%	94			70-130	Pass	
Mercury	S18-JI28507	CP	%	91			70-130	Pass	
Nickel	S18-JI28507	CP	%	95			70-130	Pass	
Zinc	S18-JI28507	CP	%	93			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-JI28506	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	S18-JI28506	CP	mg/kg	< 20	30	<1	30%	Pass	
TRH C15-C28	S18-JI28506	CP	mg/kg	< 50	70	<1	30%	Pass	
TRH C29-C36	S18-JI28506	CP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S18-JI28506	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S18-JI28506	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S18-JI28506	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S18-JI28506	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S18-JI28506	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S18-JI28506	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S18-JI28506	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	S18-JI33147	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S18-JI28506	CP	mg/kg	< 100	110	<1	30%	Pass	
TRH >C34-C40	S18-JI28506	CP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	S18-JI28506	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-JI31123	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	

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Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Aldrin	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-JI31123	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-JI31123	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-JI31123	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S18-JI31123	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S18-JI31123	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-JI30212	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Cadmium	S18-JI30212	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S18-JI30212	NCP	mg/kg	6.0	6.0	<1	30%	Pass	
Copper	S18-JI30212	NCP	mg/kg	5.5	5.6	2.0	30%	Pass	
Lead	S18-JI30212	NCP	mg/kg	6.8	7.2	6.0	30%	Pass	
Mercury	S18-JI30212	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S18-JI30212	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Zinc	S18-JI30212	NCP	mg/kg	26	28	8.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S18-JI28506	CP	%	13	14	3.0	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S18-JI28511	CP	pH Units	5.1	5.2	pass	30%	Pass	
Reaction Ratings*	S18-JI28511	CP	comment	1.0	1.0	pass	30%	Pass	

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Nibha Vaidya	Analytical Services Manager
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

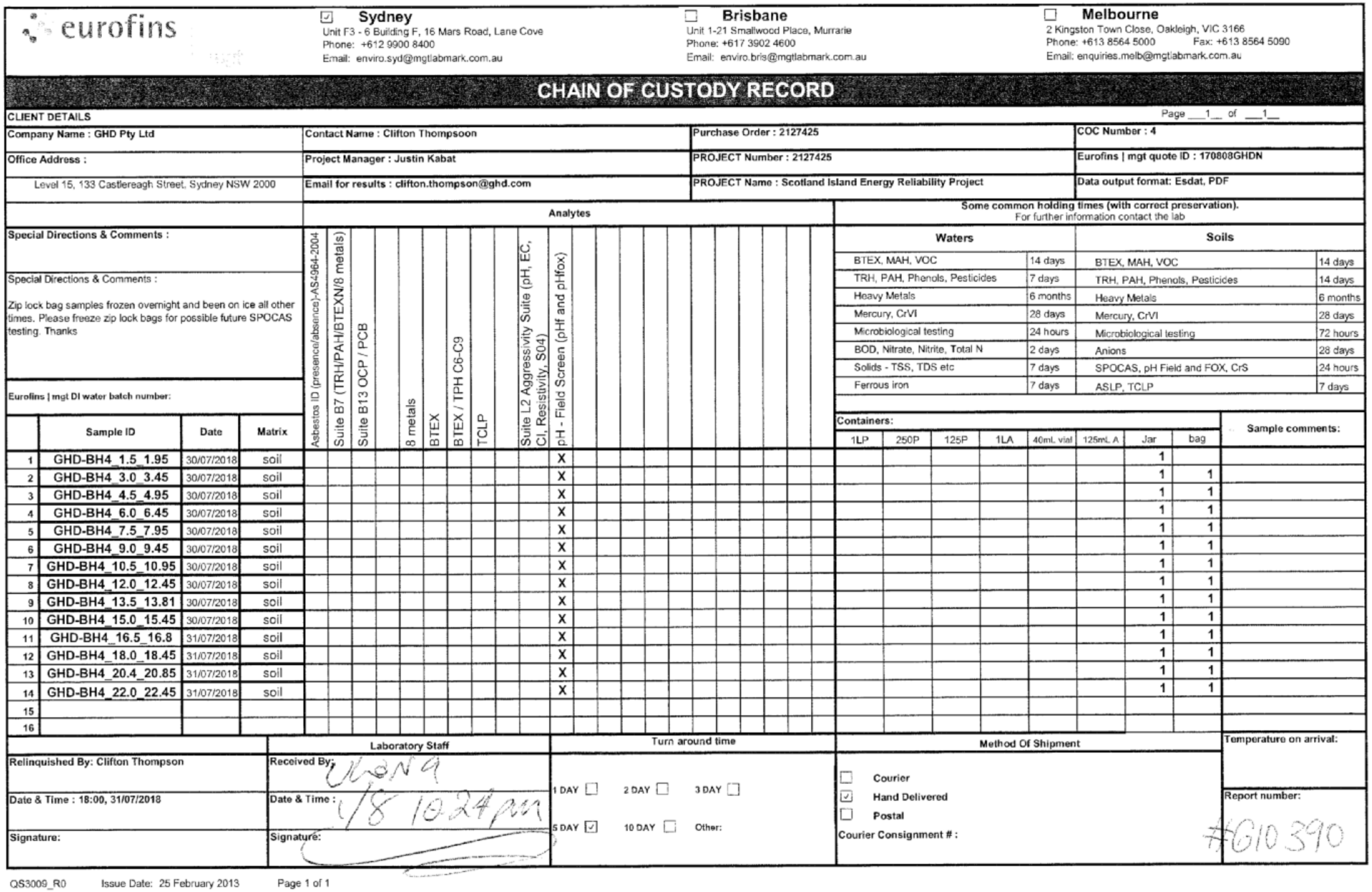
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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Email: enviro.bris@mgtlabmark.com.au

☐ **Melbourne**
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Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd	**Contact Name : Clifton Thompsoon**	**Purchase Order : 2127425**	**COC Number : 4**
Office Address :	**Project Manager : Justin Kabat**	**PROJECT Number : 2127425**	**Eurofins | mgt quote ID : 170808GHDN**
Level 15, 133 Castlereagh Street, Sydney NSW 2000	**Email for results : clifton.thompson@ghd.com**	**PROJECT Name : Scotland Island Energy Reliability Project**	**Data output format: Esdat, PDF**

Special Directions & Comments :

Special Directions & Comments :

Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Analytes

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH4_1.5_1.95	30/07/2018	soil									X							1		
2	GHD-BH4_3.0_3.45	30/07/2018	soil									X							1	1	
3	GHD-BH4_4.5_4.95	30/07/2018	soil									X							1	1	
4	GHD-BH4_6.0_6.45	30/07/2018	soil									X							1	1	
5	GHD-BH4_7.5_7.95	30/07/2018	soil									X							1	1	
6	GHD-BH4_9.0_9.45	30/07/2018	soil									X							1	1	
7	GHD-BH4_10.5_10.95	30/07/2018	soil									X							1	1	
8	GHD-BH4_12.0_12.45	30/07/2018	soil									X							1	1	
9	GHD-BH4_13.5_13.81	30/07/2018	soil									X							1	1	
10	GHD-BH4_15.0_15.45	30/07/2018	soil									X							1	1	
11	GHD-BH4_16.5_16.8	31/07/2018	soil									X							1	1	
12	GHD-BH4_18.0_18.45	31/07/2018	soil									X							1	1	
13	GHD-BH4_20.4_20.85	31/07/2018	soil									X							1	1	
14	GHD-BH4_22.0_22.45	31/07/2018	soil									X							1	1	
15																					
16																					

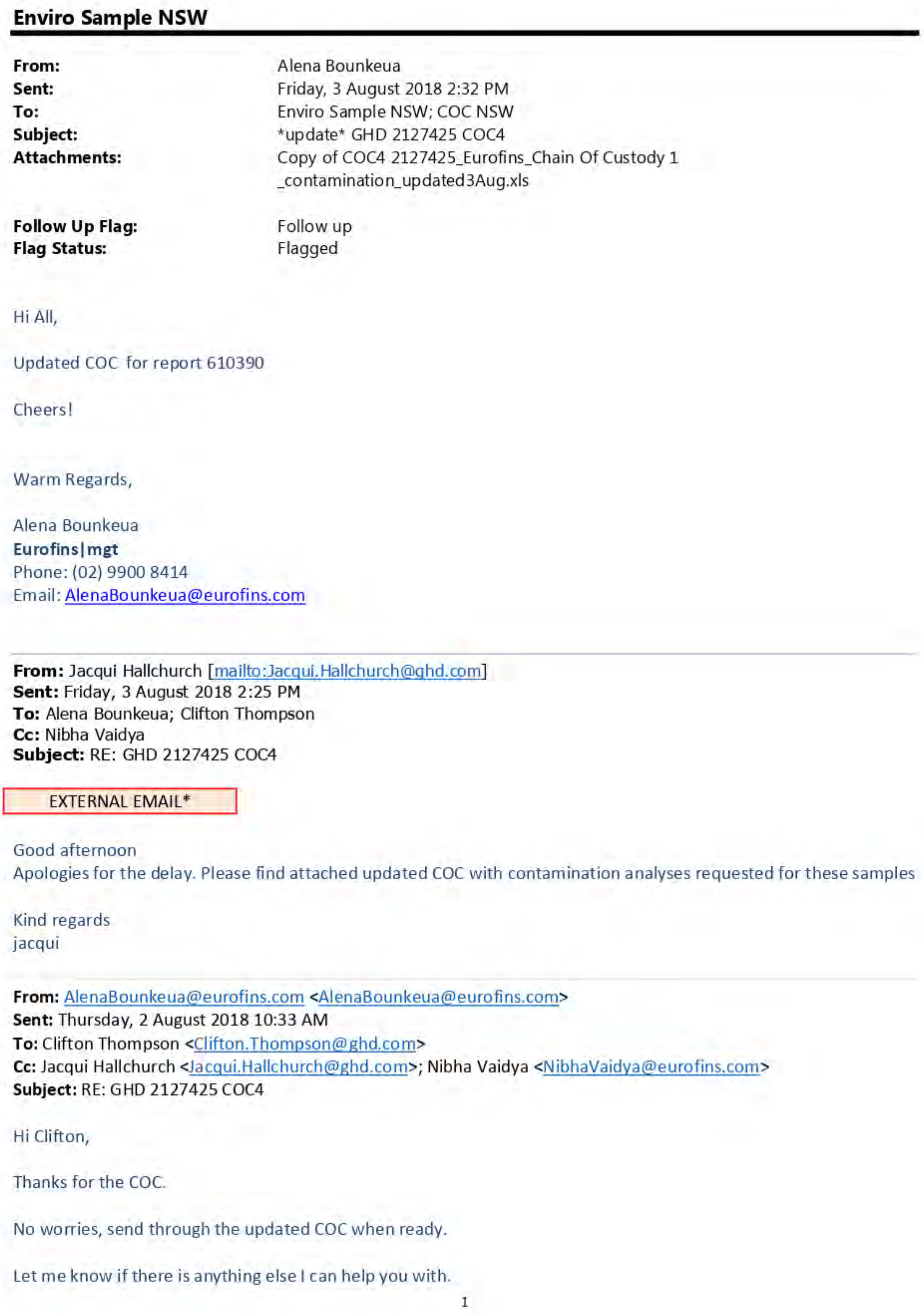
Containers: 1LP, 250P, 125P, 1LA, 40mL vial, 125mL A, Jar, bag

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

	Laboratory Staff	Turn around time	Method Of Shipment	
Relinquished By: Clifton Thompson	**Received By:** Ulena	1 DAY ☐ 2 DAY ☐ 3 DAY ☐	☐ Courier	**Temperature on arrival:**
Date & Time : 18:00, 31/07/2018	**Date & Time :** 1/8 1024pm	5 DAY ☑ 10 DAY ☐ Other:	☑ Hand Delivered ☐ Postal	**Report number:** #610390
Signature:	**Signature:**		**Courier Consignment # :**	

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



Enviro Sample NSW

From:	Alena Bounkeua
Sent:	Friday, 3 August 2018 2:32 PM
To:	Enviro Sample NSW; COC NSW
Subject:	*update* GHD 2127425 COC4
Attachments:	Copy of COC4 2127425_Eurofins_Chain Of Custody 1 _contamination_updated3Aug.xls
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi All,

Updated COC for report 610390

Cheers!

Warm Regards,

Alena Bounkeua
Eurofins|mgt
Phone: (02) 9900 8414
Email: AlenaBounkeua@eurofins.com

From: Jacqui Hallchurch [mailto:Jacqui.Hallchurch@ghd.com]
Sent: Friday, 3 August 2018 2:25 PM
To: Alena Bounkeua; Clifton Thompson
Cc: Nibha Vaidya
Subject: RE: GHD 2127425 COC4

EXTERNAL EMAIL*

Good afternoon
Apologies for the delay. Please find attached updated COC with contamination analyses requested for these samples

Kind regards
jacqui

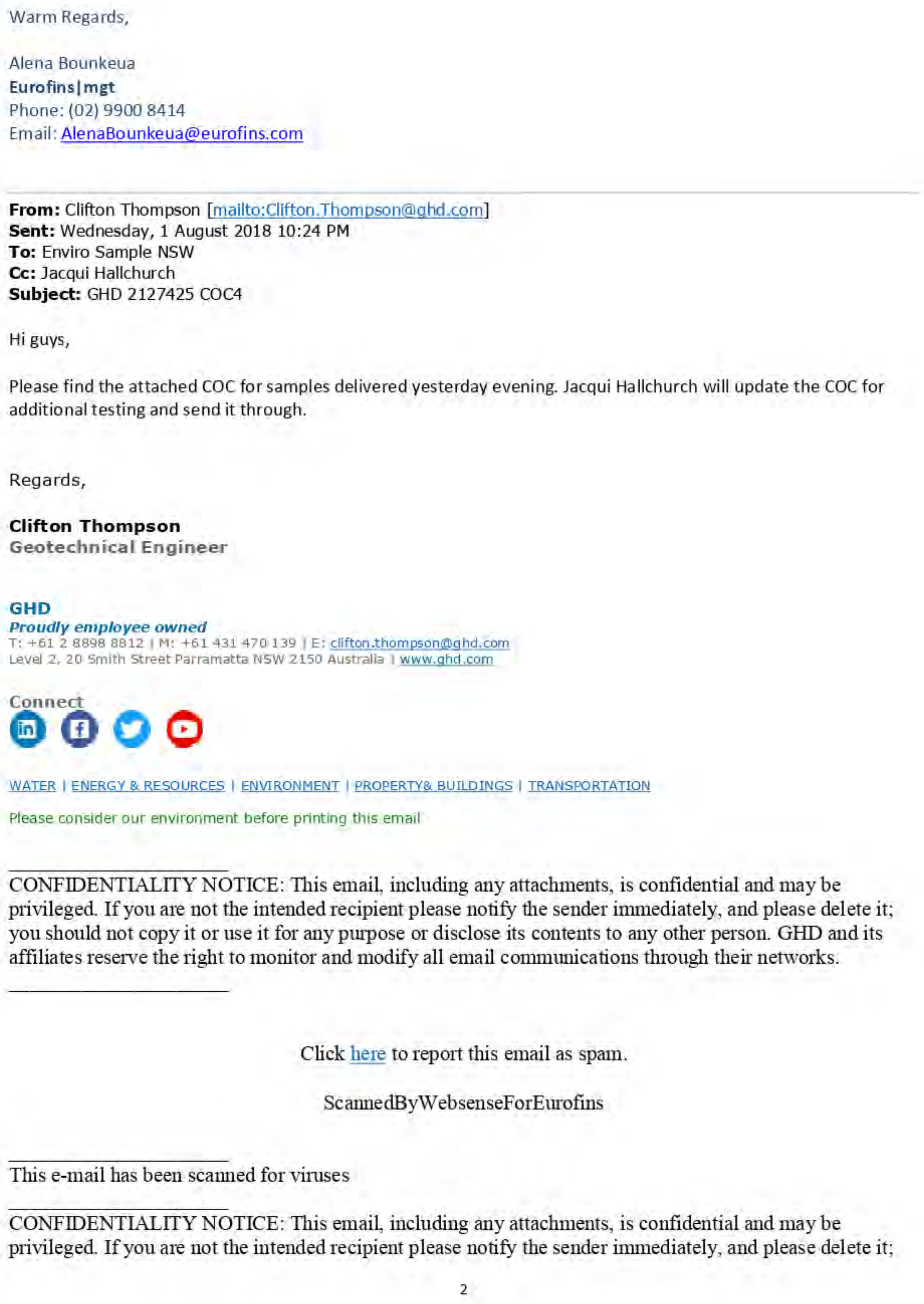
From: AlenaBounkeua@eurofins.com <AlenaBounkeua@eurofins.com>
Sent: Thursday, 2 August 2018 10:33 AM
To: Clifton Thompson <Clifton.Thompson@ghd.com>
Cc: Jacqui Hallchurch <Jacqui.Hallchurch@ghd.com>; Nibha Vaidya <NibhaVaidya@eurofins.com>
Subject: RE: GHD 2127425 COC4

Hi Clifton,

Thanks for the COC.

No worries, send through the updated COC when ready.

Let me know if there is anything else I can help you with.



Warm Regards,

Alena Bounkeua
Eurofins|mgt
Phone: (02) 9900 8414
Email: AlenaBounkeua@eurofins.com

From: Clifton Thompson [mailto:Clifton.Thompson@ghd.com]
Sent: Wednesday, 1 August 2018 10:24 PM
To: Enviro Sample NSW
Cc: Jacqui Hallchurch
Subject: GHD 2127425 COC4

Hi guys,

Please find the attached COC for samples delivered yesterday evening. Jacqui Hallchurch will update the COC for additional testing and send it through.

Regards,

Clifton Thompson
Geotechnical Engineer

GHD
Proudly employee owned
T: +61 2 8898 8812 | M: +61 431 470 139 | E: clifton.thompson@ghd.com
Level 2, 20 Smith Street Parramatta NSW 2150 Australia | www.ghd.com

Connect

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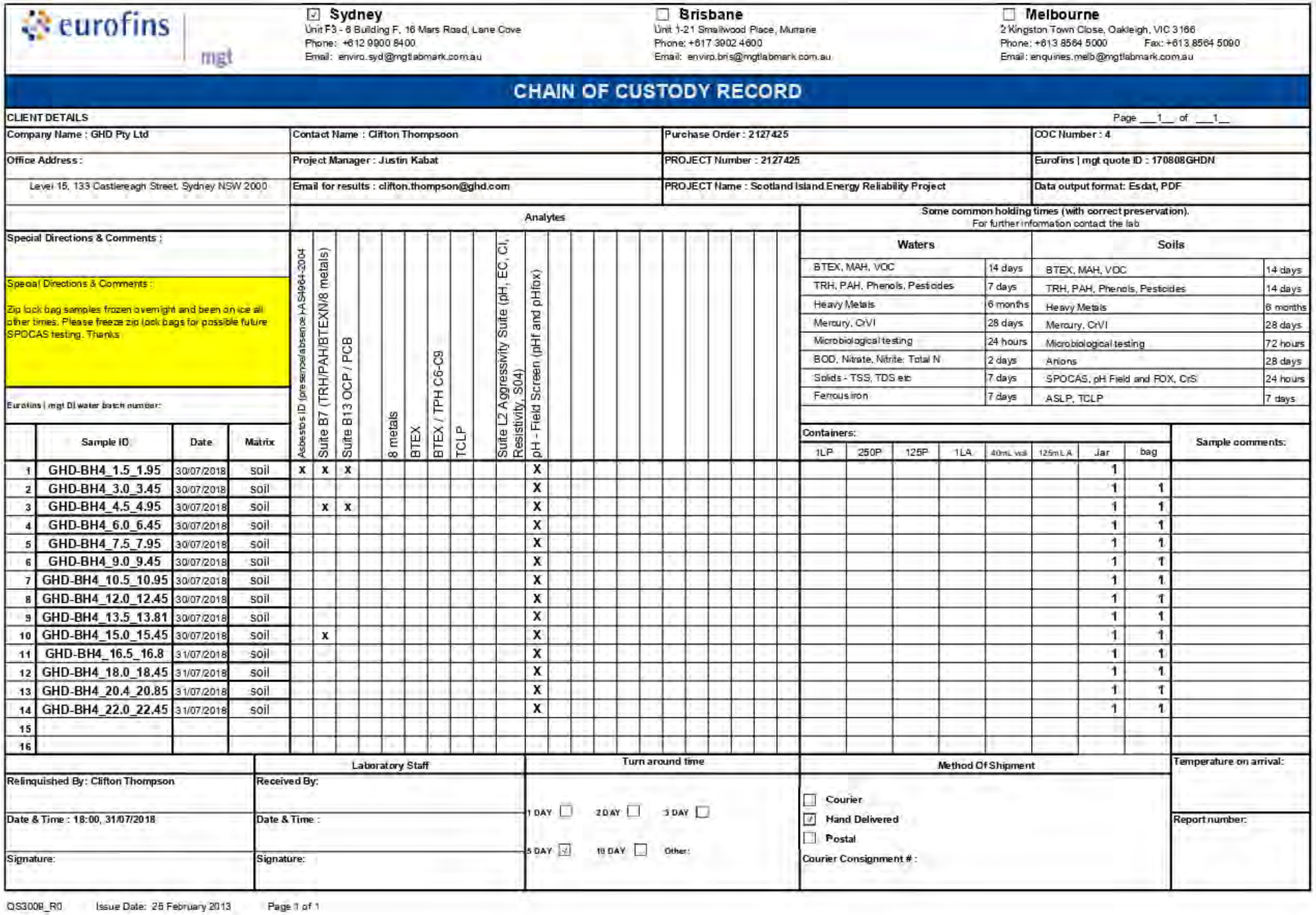
Please consider our environment before printing this email



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Email: enviro.bris@mgtlabmark.com.au

☐ **Melbourne**
2 Kingston Town Close, Oakleigh, VIC 3166
Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page __1__ of __1__

Company Name : GHD Pty Ltd
Contact Name : Clifton Thompsoon
Purchase Order : 2127425
COC Number : 4
Office Address :
Level 15, 133 Castlereagh Street, Sydney NSW 2000
Project Manager : Justin Kabat
PROJECT Number : 2127425
Eurofins | mgt quote ID : 170808GHDN
Email for results : clifton.thompson@ghd.com
PROJECT Name : Scotland Island Energy Reliability Project
Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :
Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

				Analytes										Containers:								
	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB		8 metals	BTEX	BTEX / TPH C6-C9	TCLP		Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH4_1.5_1.95	30/07/2018	soil	x	x	x								X							1		
2	GHD-BH4_3.0_3.45	30/07/2018	soil											X							1	1	
3	GHD-BH4_4.5_4.95	30/07/2018	soil		x	x								X							1	1	
4	GHD-BH4_6.0_6.45	30/07/2018	soil											X							1	1	
5	GHD-BH4_7.5_7.95	30/07/2018	soil											X							1	1	
6	GHD-BH4_9.0_9.45	30/07/2018	soil											X							1	1	
7	GHD-BH4_10.5_10.95	30/07/2018	soil											X							1	1	
8	GHD-BH4_12.0_12.45	30/07/2018	soil											X							1	1	
9	GHD-BH4_13.5_13.81	30/07/2018	soil											X							1	1	
10	GHD-BH4_15.0_15.45	30/07/2018	soil		x									X							1	1	
11	GHD-BH4_16.5_16.8	31/07/2018	soil											X							1	1	
12	GHD-BH4_18.0_18.45	31/07/2018	soil											X							1	1	
13	GHD-BH4_20.4_20.85	31/07/2018	soil											X							1	1	
14	GHD-BH4_22.0_22.45	31/07/2018	soil											X							1	1	
15																							
16																							

Relinquished By: Clifton Thompson
Date & Time : 18:00, 31/07/2018
Signature:

Laboratory Staff
Received By:
Date & Time :
Signature:

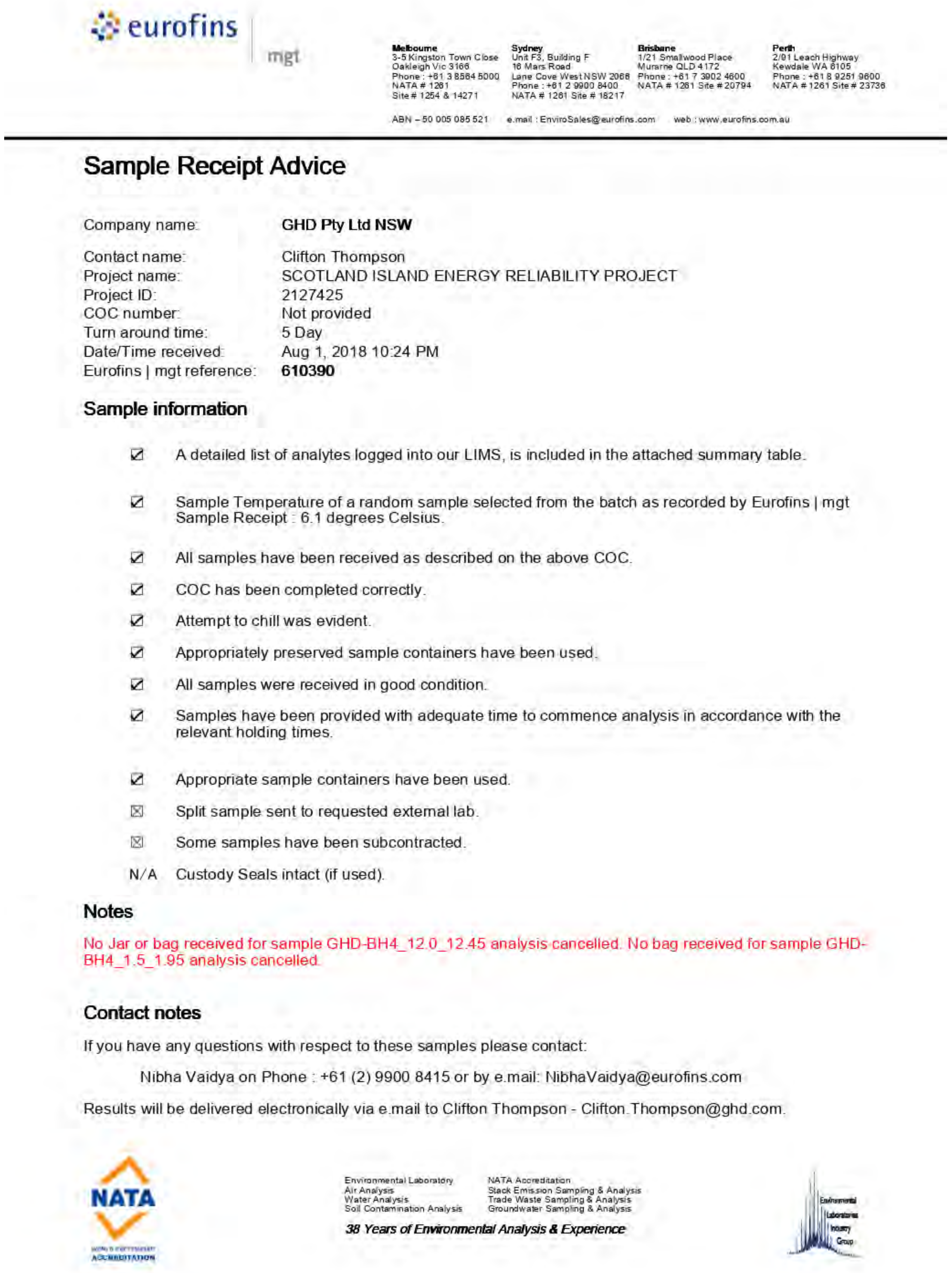
Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☐ Courier
☑ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival:

Report number:

QS3008_R0 Issue Date: 28 February 2013 Page 1 of 1



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NATA # 1261
Site # 1254 & 14271

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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Clifton Thompson
Project name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID:	2127425
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Aug 1, 2018 10:24 PM
Eurofins | mgt reference:	**610390**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 6.1 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

No Jar or bag received for sample GHD-BH4_12.0_12.45 analysis cancelled. No bag received for sample GHD-BH4_1.5_1.95 analysis cancelled.

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	Clifton Thompson
Report	610390-AID
Project Name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Aug 01, 2018
Date Reported	Aug 09, 2018

Methodology:

Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS4964 method for inhomogeneous samples is around 0.1 g/kg (0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis where required, this is considered to be at the nominal reporting limit of 0.01 % (w / w).The examination of large sample sizes(500 mL is recommended) may improve the likelihood of identifying ACM in the > 2mm fraction.The NEPM screening level of 0.001 % (w / w) asbestos in soil for FA(friable asbestos) and AF(asbestos fines) then applies where they are able to be quantified by gravimetric procedures.This quantitative screening is not generally applicable to FF(free fibres) and results of Trace Analysis are referred. *NOTE: NATA News March 2014, p.7, states in relation to AS4964: "This is a qualitative method with a nominal reporting limit of 0.01%" and that currently in Australia "there is no validated method available for the quantification of asbestos". Accordingly, NATA Accreditation does not cover the performance of this service (indicated with an asterisk).* *This report is consistent with the analytical procedures and reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended) and the Western Australia Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, 2009, including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil, June 2011.*

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Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Date Sampled Jul 30, 2018
Report 610390-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
GHD-BH4_1.5_1.95	18-Au02475	Jul 30, 2018	Approximate Sample 22g Sample consisted of: Dark Grey fine grain soil and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Asbestos - LTM-ASB-8020	Sydney	Aug 03, 2018	Indefinite

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 610390
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 1, 2018 10:24 PM
Due: Aug 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	GHD-BH4_1.5_1.95	Jul 30, 2018		Soil	S18-Au02475	X			X	X	X
2	GHD-BH4_3.0_3.45	Jul 30, 2018		Soil	S18-Au02476			X			
3	GHD-BH4_4.5_4.95	Jul 30, 2018		Soil	S18-Au02477			X	X	X	X
4	GHD-BH4_6.0_6.45	Jul 30, 2018		Soil	S18-Au02478			X			
5	GHD-BH4_7.5_7.95	Jul 30, 2018		Soil	S18-Au02479			X			
6	GHD-	Jul 30, 2018		Soil	S18-Au02480			X			

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Sample Detail						Asbestos - AS4964	CANCELLED	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
	BH4_9.0_9.45										
7	GHD-BH4_10.5_10.95	Jul 30, 2018		Soil	S18-Au02481			X			
8	GHD-BH4_12.0_12.45	Jul 30, 2018		Soil	S18-Au02482		X				
9	GHD-BH4_13.5_13.81	Jul 30, 2018		Soil	S18-Au02483			X			
10	GHD-BH4_15.0_15.45	Jul 30, 2018		Soil	S18-Au02484			X		X	X
11	GHD-BH4_16.5_16.	Jul 31, 2018		Soil	S18-Au02485			X			

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Aug 1, 2018 10:24 PM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	610390	**Due:**	Aug 9, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
	8										
12	GHD-BH4_18.0_18.45	Jul 31, 2018		Soil	S18-Au02486			X			
13	GHD-BH4_20.4_20.85	Jul 31, 2018		Soil	S18-Au02487			X			
14	GHD-BH4_22.0_22.45	Jul 31, 2018		Soil	S18-Au02488			X			
Test Counts						1	1	12	2	3	3

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Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

Comments

The sample received was not collected in an approved asbestos bag and was therefore sub-sampled from the 250mL glass jar. Valid sub-sampling procedures were applied so as to ensure that the sub-sample to be analysed accurately represented the sample received.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Sayeed Abu	Senior Analyst-Asbestos (NSW)

Authorised by:

Laxman Dias	Senior Analyst-Asbestos (NSW)

Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested
* Indicates NATA accreditation does not cover the performance of this service
Measurement uncertainty of test data is available on request or please click here.

Date Reported: Aug 09, 2018
Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400
Page 8 of 8
Report Number: 610390-AID

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention: **Clifton Thompson**

Report	**610390-S**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Aug 01, 2018

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	G01 **GHD-BH4_1.5_1.95** **Soil** **S18-Au02475** **Jul 30, 2018**	**GHD-BH4_3.0_3.45** **Soil** **S18-Au02476** **Jul 30, 2018**	**GHD-BH4_4.5_4.95** **Soil** **S18-Au02477** **Jul 30, 2018**	**GHD-BH4_6.0_6.45** **Soil** **S18-Au02478** **Jul 30, 2018**
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 40	-	< 20	-
TRH C10-C14	20	mg/kg	< 40	-	< 20	-
TRH C15-C28	50	mg/kg	< 100	-	< 50	-
TRH C29-C36	50	mg/kg	< 100	-	< 50	-
TRH C10-36 (Total)	50	mg/kg	< 100	-	< 50	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	< 0.1	-
Toluene	0.1	mg/kg	< 0.1	-	< 0.1	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	< 0.1	-
m&p-Xylenes	0.2	mg/kg	< 0.2	-	< 0.2	-
o-Xylene	0.1	mg/kg	< 0.1	-	< 0.1	-
Xylenes - Total	0.3	mg/kg	< 0.3	-	< 0.3	-
4-Bromofluorobenzene (surr.)	1	%	72	-	77	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene N02	0.5	mg/kg	< 1	-	< 0.5	-
TRH C6-C10	20	mg/kg	< 40	-	< 20	-
TRH C6-C10 less BTEX (F1) N04	20	mg/kg	< 40	-	< 20	-
TRH >C10-C16	50	mg/kg	< 100	-	< 50	-
TRH >C10-C16 less Naphthalene (F2) N01	50	mg/kg	< 100	-	< 50	-
TRH >C16-C34	100	mg/kg	< 200	-	< 100	-
TRH >C34-C40	100	mg/kg	< 200	-	< 100	-
TRH >C10-C40 (total)*	100	mg/kg	< 100	-	< 100	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	< 0.5	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	1.2	-	0.6	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	2.4	-	1.2	-
Acenaphthene	0.5	mg/kg	< 1	-	< 0.5	-
Acenaphthylene	0.5	mg/kg	< 1	-	< 0.5	-
Anthracene	0.5	mg/kg	< 1	-	< 0.5	-
Benz(a)anthracene	0.5	mg/kg	< 1	-	< 0.5	-
Benzo(a)pyrene	0.5	mg/kg	< 1	-	< 0.5	-
Benzo(b&j)fluoranthene N07	0.5	mg/kg	< 1	-	< 0.5	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 1	-	< 0.5	-
Benzo(k)fluoranthene	0.5	mg/kg	< 1	-	< 0.5	-
Chrysene	0.5	mg/kg	< 1	-	< 0.5	-

Client Sample ID			[G01]**GHD-BH4_1.5_1.95**	**GHD-BH4_3.0_3.45**	**GHD-BH4_4.5_4.95**	**GHD-BH4_6.0_6.45**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au02475**	**S18-Au02476**	**S18-Au02477**	**S18-Au02478**
Date Sampled			**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 1	-	< 0.5	-
Fluoranthene	0.5	mg/kg	< 1	-	< 0.5	-
Fluorene	0.5	mg/kg	< 1	-	< 0.5	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 1	-	< 0.5	-
Naphthalene	0.5	mg/kg	< 1	-	< 0.5	-
Phenanthrene	0.5	mg/kg	< 1	-	< 0.5	-
Pyrene	0.5	mg/kg	< 1	-	< 0.5	-
Total PAH*	0.5	mg/kg	< 1	-	< 0.5	-
2-Fluorobiphenyl (surr.)	1	%	104	-	105	-
p-Terphenyl-d14 (surr.)	1	%	112	-	111	-
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	< 0.05	-
a-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Aldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
b-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
d-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Dieldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan I	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan II	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin ketone	0.05	mg/kg	< 0.05	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	< 0.05	-
Methoxychlor	0.2	mg/kg	< 0.2	-	< 0.2	-
Toxaphene	1	mg/kg	< 1	-	< 1	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Dibutylchlorendate (surr.)	1	%	99	-	96	-
Tetrachloro-m-xylene (surr.)	1	%	102	-	97	-
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1221	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1232	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1242	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1248	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1254	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1260	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PCB*	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibutylchlorendate (surr.)	1	%	99	-	96	-
Tetrachloro-m-xylene (surr.)	1	%	102	-	97	-

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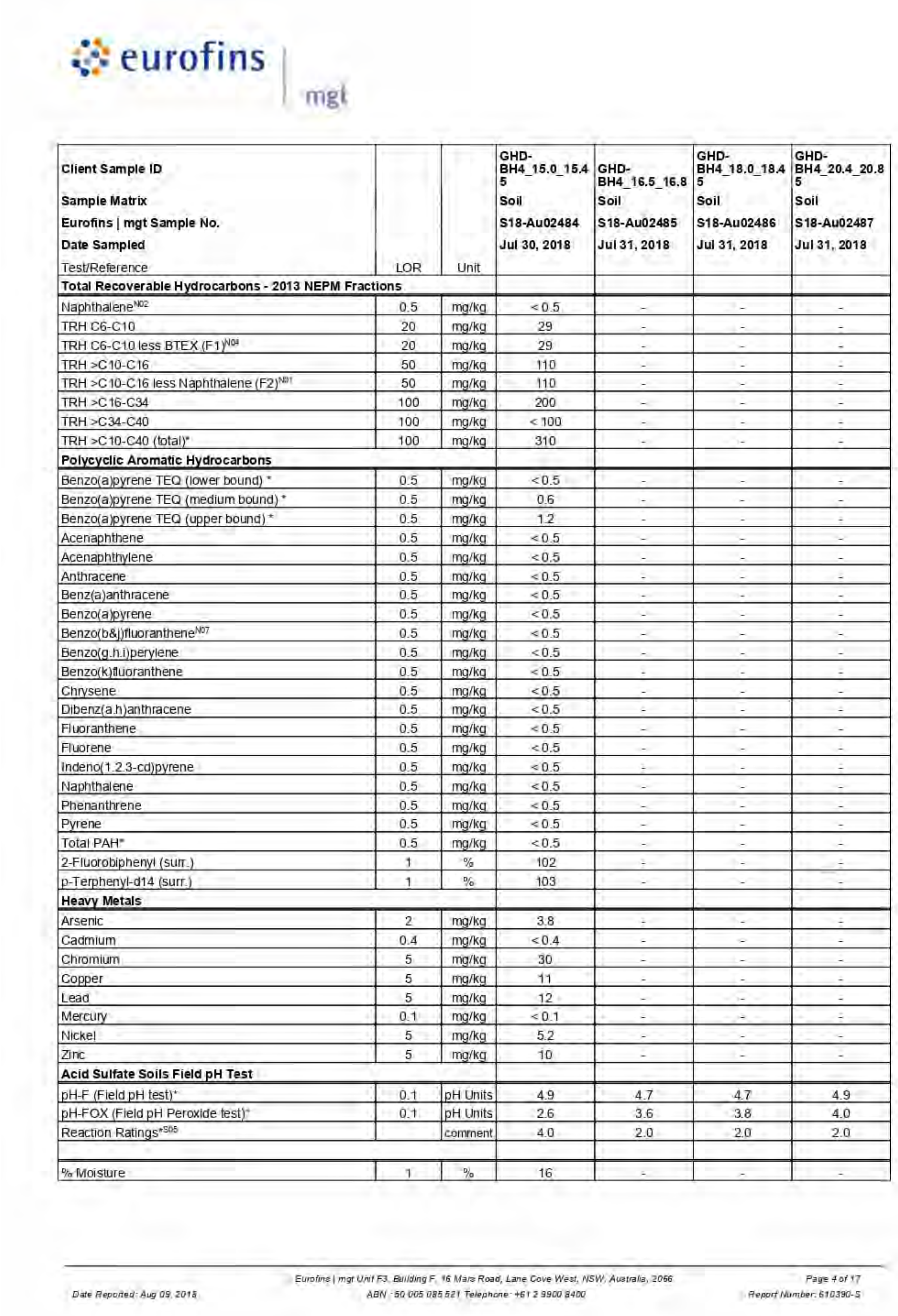
Client Sample ID			[G01]**GHD-BH4_1.5_1.95**	**GHD-BH4_3.0_3.45**	**GHD-BH4_4.5_4.95**	**GHD-BH4_6.0_6.45**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au02475**	**S18-Au02476**	**S18-Au02477**	**S18-Au02478**
Date Sampled			**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	18	-	< 2	-
Cadmium	0.4	mg/kg	< 0.4	-	< 0.4	-
Chromium	5	mg/kg	18	-	6.7	-
Copper	5	mg/kg	< 5	-	< 5	-
Lead	5	mg/kg	5.7	-	< 5	-
Mercury	0.1	mg/kg	< 0.1	-	< 0.1	-
Nickel	5	mg/kg	7.6	-	< 5	-
Zinc	5	mg/kg	16	-	< 5	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	-	5.0	4.7	5.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	3.6	3.9	3.7
Reaction Ratings*[S05]		comment	-	4.0	2.0	2.0
% Moisture	1	%	43	-	10	-

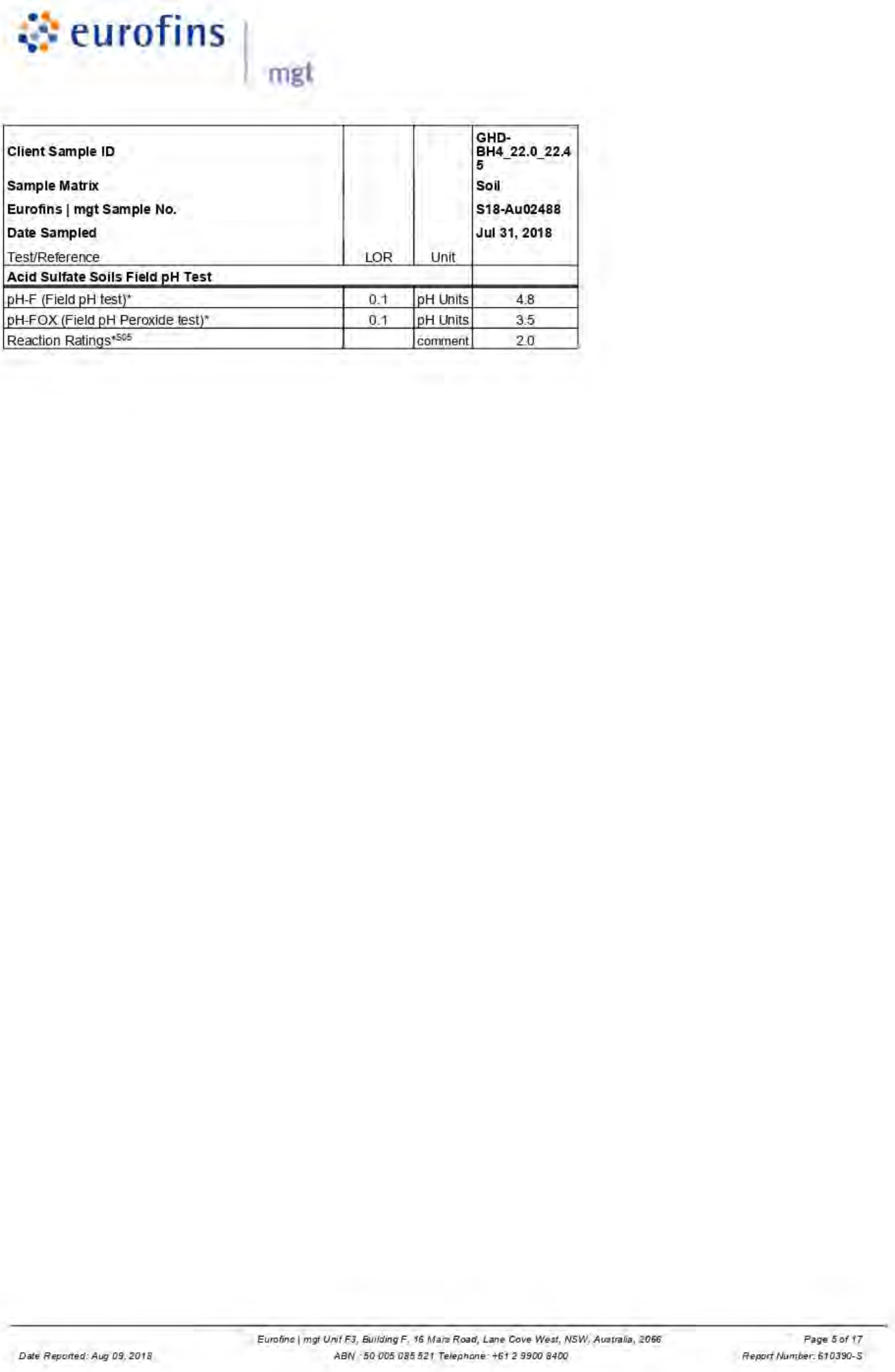
Client Sample ID			**GHD-BH4_7.5_7.95**	**GHD-BH4_9.0_9.45**	**GHD-BH4_10.5_10.95**	**GHD-BH4_13.5_13.81**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au02479**	**S18-Au02480**	**S18-Au02481**	**S18-Au02483**
Date Sampled			**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**	**Jul 30, 2018**
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	4.4	4.4	4.8	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.4	3.5	3.7	4.1
Reaction Ratings*[S05]		comment	2.0	1.0	2.0	2.0

Client Sample ID			**GHD-BH4_15.0_15.45**	**GHD-BH4_16.5_16.8**	**GHD-BH4_18.0_18.45**	**GHD-BH4_20.4_20.85**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au02484**	**S18-Au02485**	**S18-Au02486**	**S18-Au02487**
Date Sampled			**Jul 30, 2018**	**Jul 31, 2018**	**Jul 31, 2018**	**Jul 31, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	-	-	-
TRH C10-C14	20	mg/kg	130	-	-	-
TRH C15-C28	50	mg/kg	120	-	-	-
TRH C29-C36	50	mg/kg	130	-	-	-
TRH C10-36 (Total)	50	mg/kg	380	-	-	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	-	-	-
Toluene	0.1	mg/kg	< 0.1	-	-	-
Ethylbenzene	0.1	mg/kg	< 0.1	-	-	-
m&p-Xylenes	0.2	mg/kg	0.2	-	-	-
o-Xylene	0.1	mg/kg	< 0.1	-	-	-
Xylenes - Total	0.3	mg/kg	< 0.3	-	-	-
4-Bromofluorobenzene (surr.)	1	%	82	-	-	-



eurofins | mgt

Client Sample ID			**GHD-BH4_15.0_15.45**	**GHD-BH4_16.5_16.8**	**GHD-BH4_18.0_18.45**	**GHD-BH4_20.4_20.85**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au02484**	**S18-Au02485**	**S18-Au02486**	**S18-Au02487**
Date Sampled			**Jul 30, 2018**	**Jul 31, 2018**	**Jul 31, 2018**	**Jul 31, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	-	-	-
TRH C6-C10	20	mg/kg	29	-	-	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	29	-	-	-
TRH >C10-C16	50	mg/kg	110	-	-	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	110	-	-	-
TRH >C16-C34	100	mg/kg	200	-	-	-
TRH >C34-C40	100	mg/kg	< 100	-	-	-
TRH >C10-C40 (total)*	100	mg/kg	310	-	-	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	-	-	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	-	-	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	-	-	-
Acenaphthene	0.5	mg/kg	< 0.5	-	-	-
Acenaphthylene	0.5	mg/kg	< 0.5	-	-	-
Anthracene	0.5	mg/kg	< 0.5	-	-	-
Benz(a)anthracene	0.5	mg/kg	< 0.5	-	-	-
Benzo(a)pyrene	0.5	mg/kg	< 0.5	-	-	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	-	-	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	-	-	-
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	-	-	-
Chrysene	0.5	mg/kg	< 0.5	-	-	-
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	-	-	-
Fluoranthene	0.5	mg/kg	< 0.5	-	-	-
Fluorene	0.5	mg/kg	< 0.5	-	-	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	-	-	-
Naphthalene	0.5	mg/kg	< 0.5	-	-	-
Phenanthrene	0.5	mg/kg	< 0.5	-	-	-
Pyrene	0.5	mg/kg	< 0.5	-	-	-
Total PAH*	0.5	mg/kg	< 0.5	-	-	-
2-Fluorobiphenyl (surr.)	1	%	102	-	-	-
p-Terphenyl-d14 (surr.)	1	%	103	-	-	-
Heavy Metals						
Arsenic	2	mg/kg	3.8	-	-	-
Cadmium	0.4	mg/kg	< 0.4	-	-	-
Chromium	5	mg/kg	30	-	-	-
Copper	5	mg/kg	11	-	-	-
Lead	5	mg/kg	12	-	-	-
Mercury	0.1	mg/kg	< 0.1	-	-	-
Nickel	5	mg/kg	5.2	-	-	-
Zinc	5	mg/kg	10	-	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	4.9	4.7	4.7	4.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.6	3.6	3.8	4.0
Reaction Ratings*[S05]		comment	4.0	2.0	2.0	2.0
% Moisture	1	%	16	-	-	-



Client Sample ID			**GHD-BH4_22.0_22.45**
Sample Matrix			**Soil**
Eurofins | mgt Sample No.			**S18-Au02488**
Date Sampled			**Jul 31, 2018**
Test/Reference	LOR	Unit	
Acid Sulfate Soils Field pH Test			
pH-F (Field pH test)*	0.1	pH Units	4.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.5
Reaction Ratings*S05		comment	2.0

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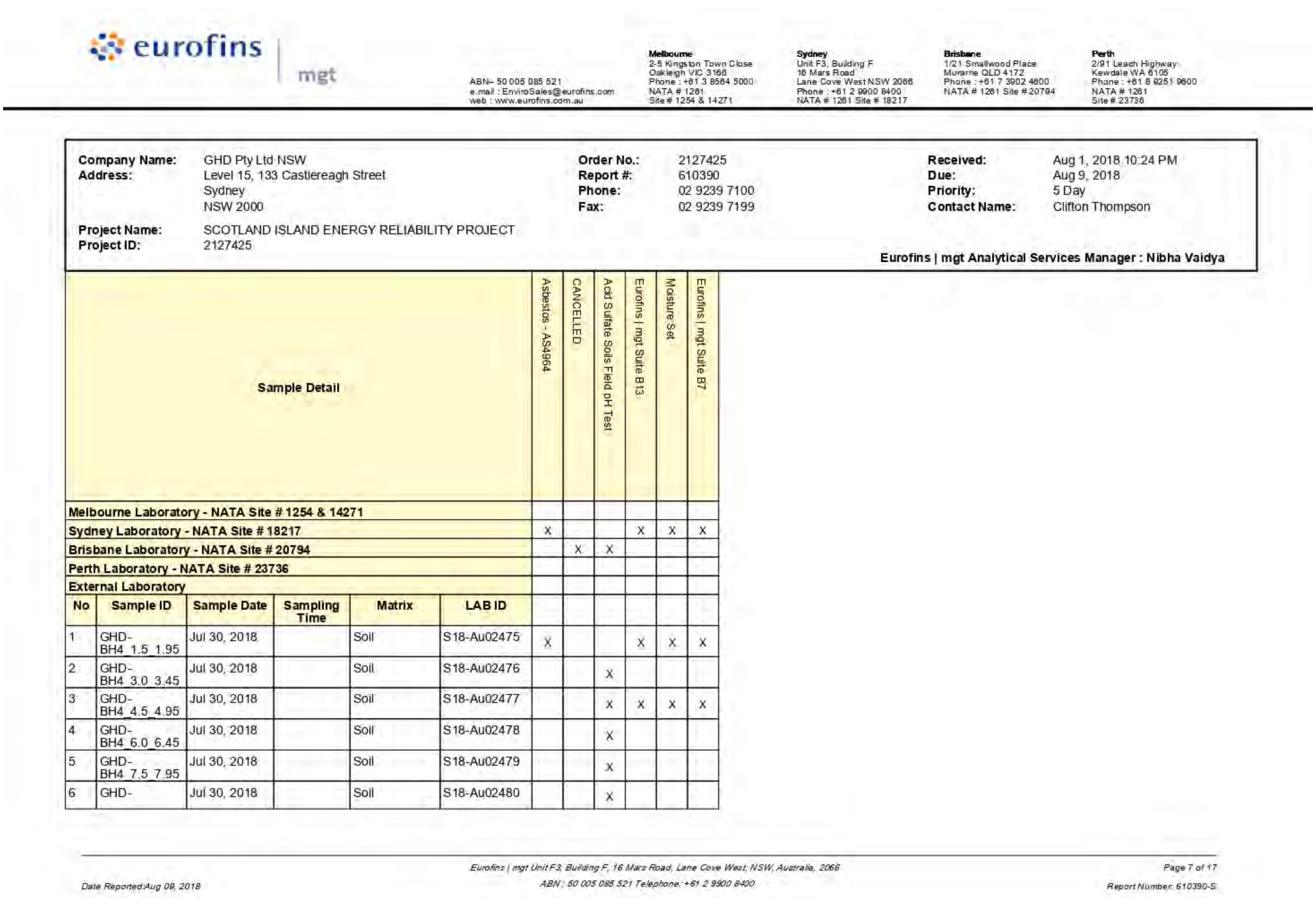
Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: TRH C6-C36 - LTM-ORG-2010	Sydney	Aug 08, 2018	14 Day
BTEX - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 08, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 08, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 08, 2018	14 Day
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Sydney	Aug 08, 2018	14 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Aug 08, 2018	28 Day
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Aug 08, 2018	14 Day
Polychlorinated Biphenyls - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Aug 08, 2018	28 Days
Acid Sulfate Soils Field pH Test - Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests	Brisbane	Aug 06, 2018	7 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Sydney	Aug 08, 2018	14 Day

Date Reported: Aug 09, 2018
Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400
Page 6 of 17
Report Number: 610390-S



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NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

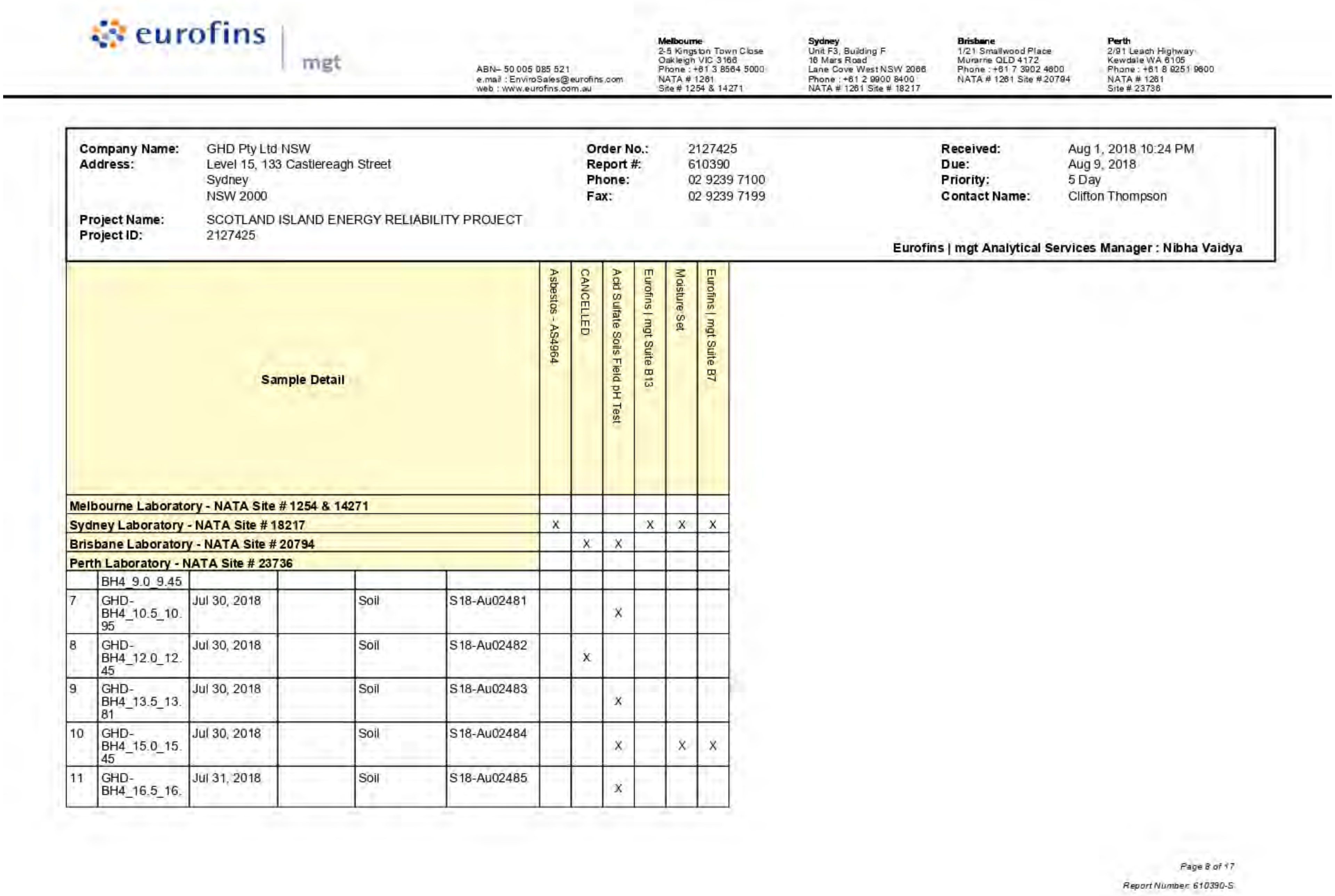
Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 610390
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 1, 2018 10:24 PM
Due: Aug 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	CANCELLED	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	GHD-BH4_1.5_1.95	Jul 30, 2018		Soil	S18-Au02475	X			X	X	X
2	GHD-BH4_3.0_3.45	Jul 30, 2018		Soil	S18-Au02476			X			
3	GHD-BH4_4.5_4.95	Jul 30, 2018		Soil	S18-Au02477			X	X	X	X
4	GHD-BH4_6.0_6.45	Jul 30, 2018		Soil	S18-Au02478			X			
5	GHD-BH4_7.5_7.95	Jul 30, 2018		Soil	S18-Au02479			X			
6	GHD-	Jul 30, 2018		Soil	S18-Au02480			X			



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Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
	BH4_9.0_9.45										
7	GHD-BH4_10.5_10.95	Jul 30, 2018		Soil	S18-Au02481			X			
8	GHD-BH4_12.0_12.45	Jul 30, 2018		Soil	S18-Au02482		X				
9	GHD-BH4_13.5_13.81	Jul 30, 2018		Soil	S18-Au02483			X			
10	GHD-BH4_15.0_15.45	Jul 30, 2018		Soil	S18-Au02484			X		X	X
11	GHD-BH4_16.5_16.	Jul 31, 2018		Soil	S18-Au02485			X			

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Report Number: 610390-S

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Sample Detail						Asbestos - AS4964	CANCELLED	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X			X	X	X
Brisbane Laboratory - NATA Site # 20794							X	X			
Perth Laboratory - NATA Site # 23736											
	8										
12	GHD-BH4_18.0_18.45	Jul 31, 2018		Soil	S18-Au02486			X			
13	GHD-BH4_20.4_20.85	Jul 31, 2018		Soil	S18-Au02487			X			
14	GHD-BH4_22.0_22.45	Jul 31, 2018		Soil	S18-Au02488			X			
Test Counts						1	1	12	2	3	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

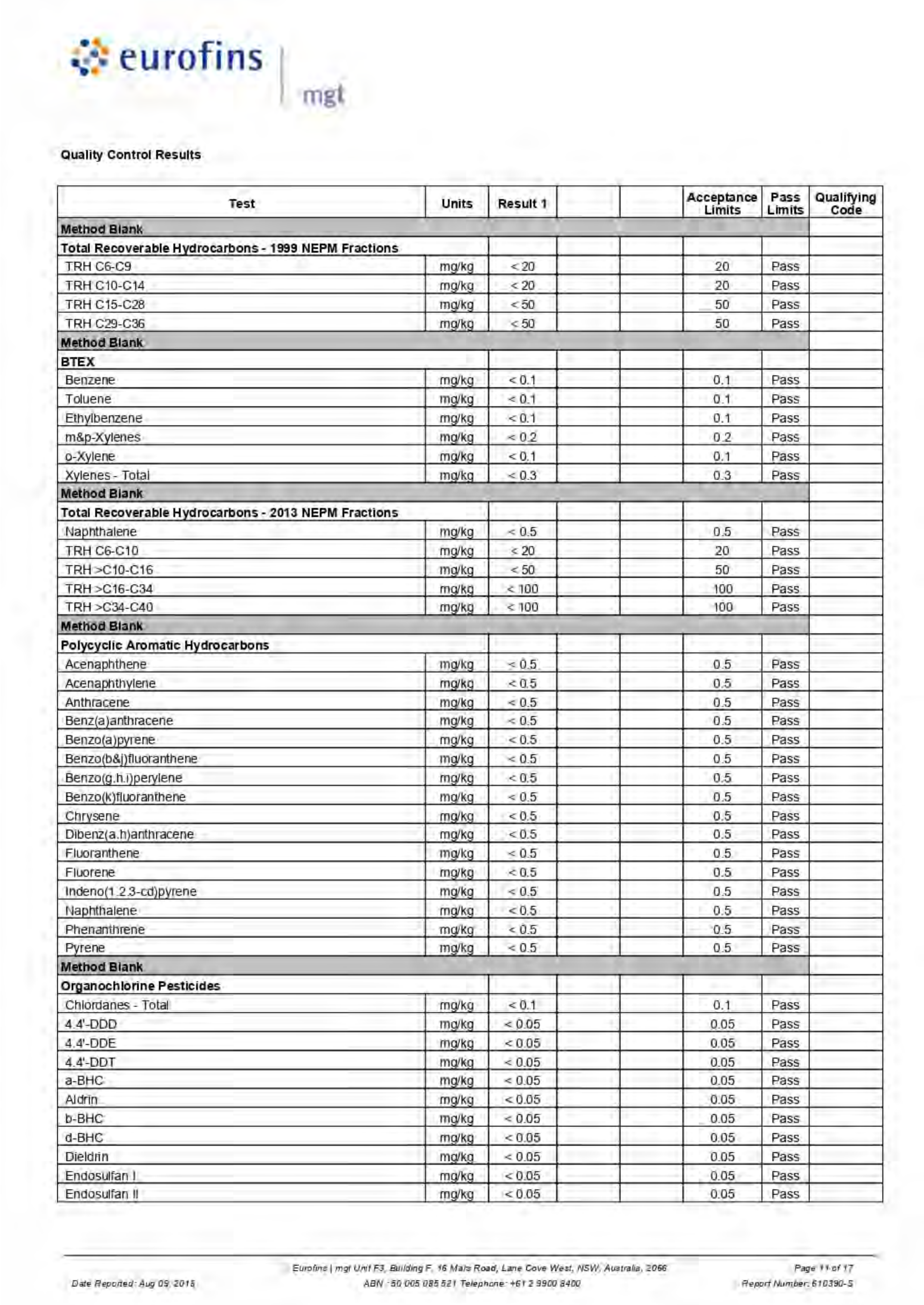
Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

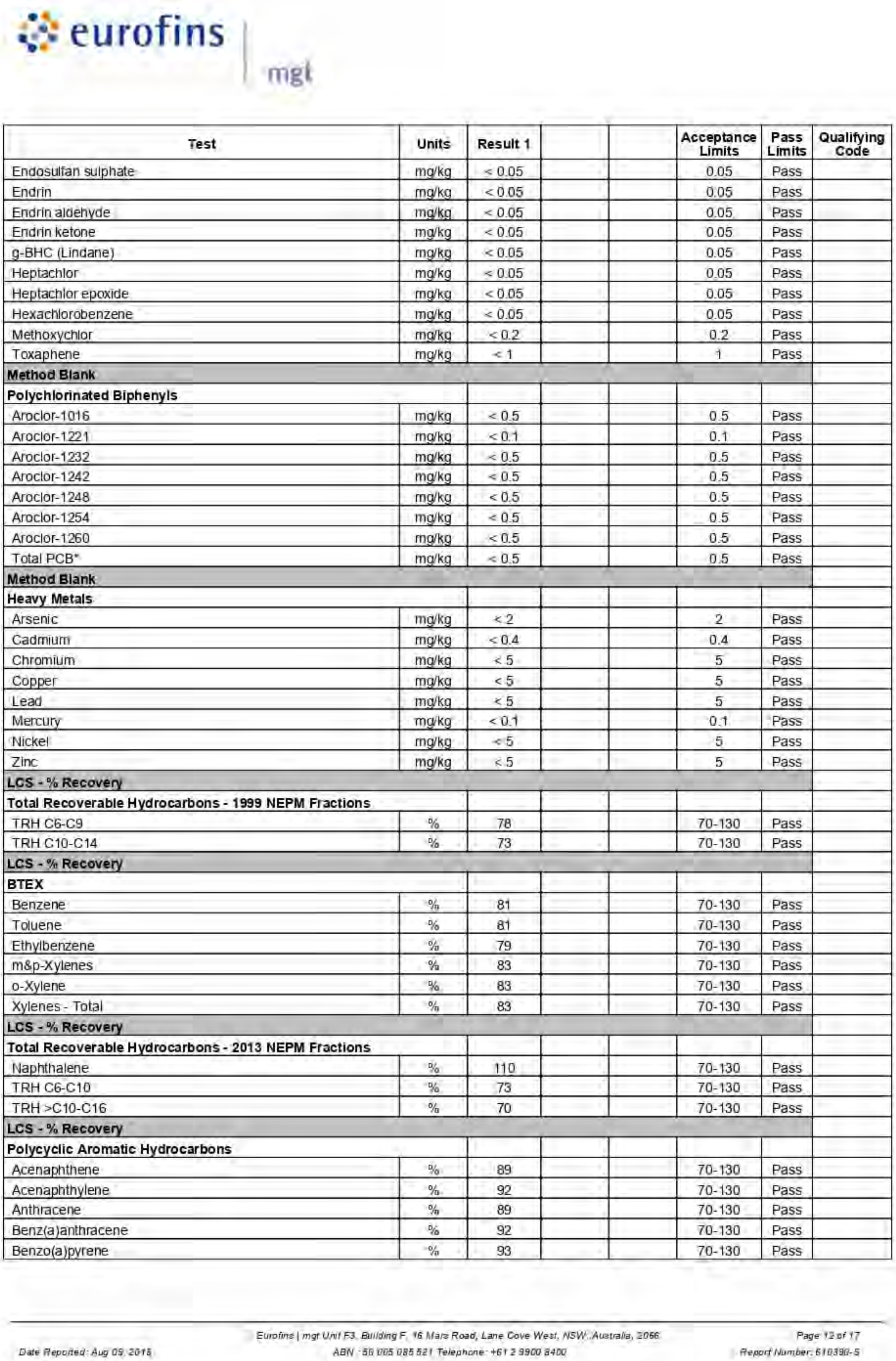
QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	



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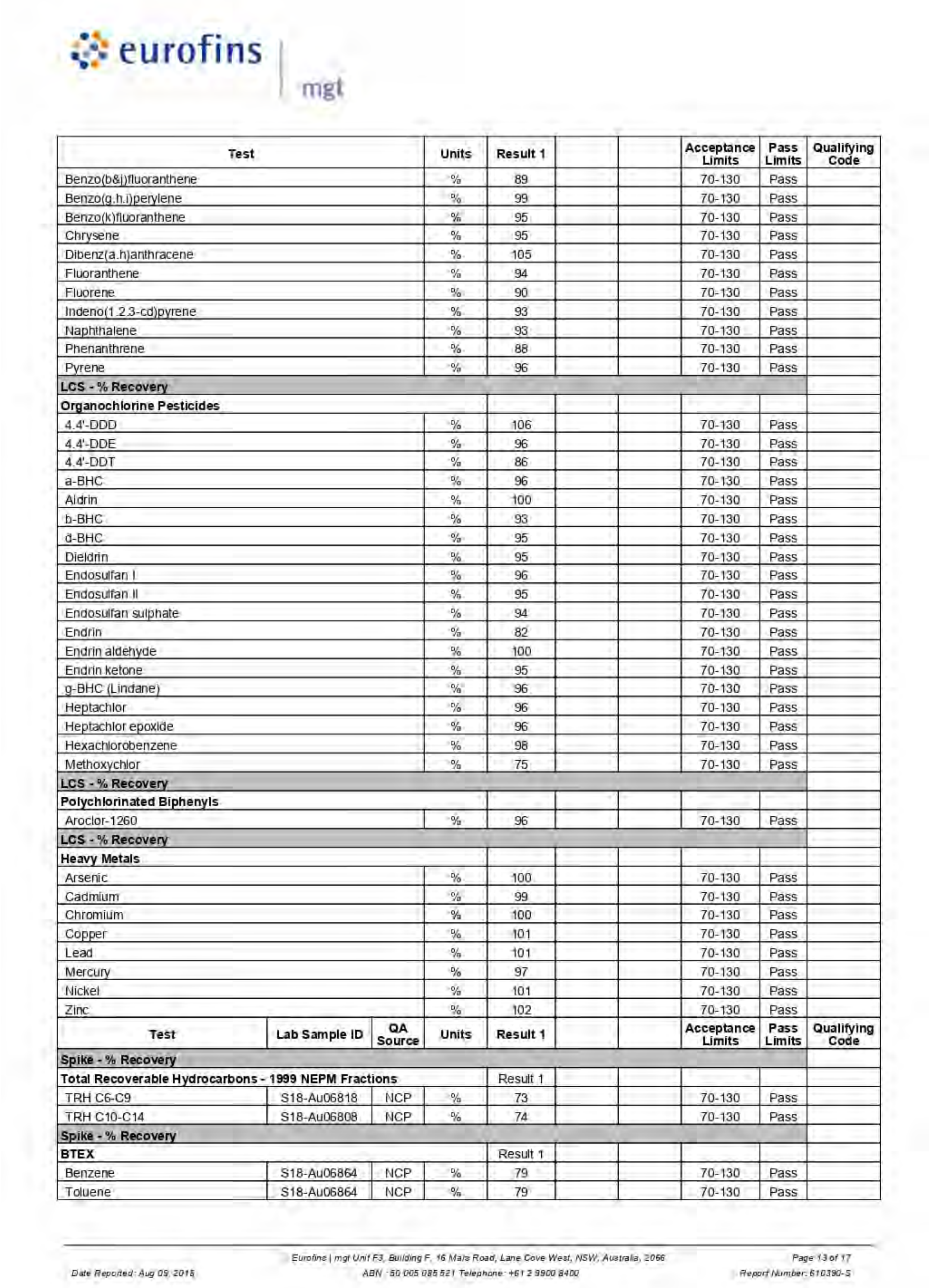
Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	78			70-130	Pass	
TRH C10-C14	%	73			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	81			70-130	Pass	
Toluene	%	81			70-130	Pass	
Ethylbenzene	%	79			70-130	Pass	
m&p-Xylenes	%	83			70-130	Pass	
o-Xylene	%	83			70-130	Pass	
Xylenes - Total	%	83			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	110			70-130	Pass	
TRH C6-C10	%	73			70-130	Pass	
TRH >C10-C16	%	70			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	89			70-130	Pass	
Acenaphthylene	%	92			70-130	Pass	
Anthracene	%	89			70-130	Pass	
Benz(a)anthracene	%	92			70-130	Pass	
Benzo(a)pyrene	%	93			70-130	Pass	



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Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene			%	89			70-130	Pass	
Benzo(g.h.i)perylene			%	99			70-130	Pass	
Benzo(k)fluoranthene			%	95			70-130	Pass	
Chrysene			%	95			70-130	Pass	
Dibenz(a.h)anthracene			%	105			70-130	Pass	
Fluoranthene			%	94			70-130	Pass	
Fluorene			%	90			70-130	Pass	
Indeno(1.2.3-cd)pyrene			%	93			70-130	Pass	
Naphthalene			%	93			70-130	Pass	
Phenanthrene			%	88			70-130	Pass	
Pyrene			%	96			70-130	Pass	
LCS - % Recovery									
Organochlorine Pesticides									
4.4'-DDD			%	106			70-130	Pass	
4.4'-DDE			%	96			70-130	Pass	
4.4'-DDT			%	86			70-130	Pass	
a-BHC			%	96			70-130	Pass	
Aldrin			%	100			70-130	Pass	
b-BHC			%	93			70-130	Pass	
d-BHC			%	95			70-130	Pass	
Dieldrin			%	95			70-130	Pass	
Endosulfan I			%	96			70-130	Pass	
Endosulfan II			%	95			70-130	Pass	
Endosulfan sulphate			%	94			70-130	Pass	
Endrin			%	82			70-130	Pass	
Endrin aldehyde			%	100			70-130	Pass	
Endrin ketone			%	95			70-130	Pass	
g-BHC (Lindane)			%	96			70-130	Pass	
Heptachlor			%	96			70-130	Pass	
Heptachlor epoxide			%	96			70-130	Pass	
Hexachlorobenzene			%	98			70-130	Pass	
Methoxychlor			%	75			70-130	Pass	
LCS - % Recovery									
Polychlorinated Biphenyls									
Aroclor-1260			%	96			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Arsenic			%	100			70-130	Pass	
Cadmium			%	99			70-130	Pass	
Chromium			%	100			70-130	Pass	
Copper			%	101			70-130	Pass	
Lead			%	101			70-130	Pass	
Mercury			%	97			70-130	Pass	
Nickel			%	101			70-130	Pass	
Zinc			%	102			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S18-Au06818	NCP	%	73			70-130	Pass	
TRH C10-C14	S18-Au06808	NCP	%	74			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S18-Au06864	NCP	%	79			70-130	Pass	
Toluene	S18-Au06864	NCP	%	79			70-130	Pass	

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Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Ethylbenzene	S18-Au06864	NCP	%	76			70-130	Pass	
m&p-Xylenes	S18-Au06864	NCP	%	79			70-130	Pass	
o-Xylene	S18-Au06864	NCP	%	81			70-130	Pass	
Xylenes - Total	S18-Au06864	NCP	%	80			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S18-Au06864	NCP	%	95			70-130	Pass	
TRH C6-C10	S18-Au06818	NCP	%	71			70-130	Pass	
TRH >C10-C16	S18-Au06808	NCP	%	70			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S18-Au06159	NCP	%	89			70-130	Pass	
Acenaphthylene	S18-Au06159	NCP	%	94			70-130	Pass	
Anthracene	S18-Au06159	NCP	%	86			70-130	Pass	
Benz(a)anthracene	S18-Au06159	NCP	%	97			70-130	Pass	
Benzo(a)pyrene	S18-Au06159	NCP	%	93			70-130	Pass	
Benzo(b&j)fluoranthene	S18-Au06159	NCP	%	88			70-130	Pass	
Benzo(g.h.i)perylene	S18-Au06159	NCP	%	96			70-130	Pass	
Benzo(k)fluoranthene	S18-Au06159	NCP	%	91			70-130	Pass	
Chrysene	S18-Au06159	NCP	%	95			70-130	Pass	
Dibenz(a.h)anthracene	S18-Au06159	NCP	%	105			70-130	Pass	
Fluoranthene	S18-Au06159	NCP	%	97			70-130	Pass	
Fluorene	S18-Au06159	NCP	%	89			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S18-Au06159	NCP	%	101			70-130	Pass	
Naphthalene	S18-Au06159	NCP	%	95			70-130	Pass	
Phenanthrene	S18-Au06159	NCP	%	83			70-130	Pass	
Pyrene	S18-Au06159	NCP	%	97			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S18-Au08245	NCP	%	127			70-130	Pass	
4.4'-DDE	S18-Au08245	NCP	%	99			70-130	Pass	
4.4'-DDT	S18-Au06773	NCP	%	83			70-130	Pass	
a-BHC	S18-Au08245	NCP	%	97			70-130	Pass	
Aldrin	S18-Au08245	NCP	%	109			70-130	Pass	
b-BHC	S18-Au08245	NCP	%	91			70-130	Pass	
d-BHC	S18-Au08245	NCP	%	101			70-130	Pass	
Dieldrin	S18-Au08245	NCP	%	98			70-130	Pass	
Endosulfan I	S18-Au08245	NCP	%	98			70-130	Pass	
Endosulfan II	S18-Au08245	NCP	%	97			70-130	Pass	
Endosulfan sulphate	S18-Au08245	NCP	%	93			70-130	Pass	
Endrin	S18-Au08245	NCP	%	87			70-130	Pass	
Endrin aldehyde	S18-Au08245	NCP	%	83			70-130	Pass	
Endrin ketone	S18-Au08245	NCP	%	71			70-130	Pass	
g-BHC (Lindane)	S18-Au08245	NCP	%	90			70-130	Pass	
Heptachlor	S18-Au08245	NCP	%	72			70-130	Pass	
Heptachlor epoxide	S18-Au08245	NCP	%	101			70-130	Pass	
Hexachlorobenzene	S18-Au08245	NCP	%	99			70-130	Pass	
Methoxychlor	S18-Au06773	NCP	%	97			70-130	Pass	
Toxaphene	S18-Jl33208	NCP	%	95			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S18-Au08245	NCP	%	93			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					

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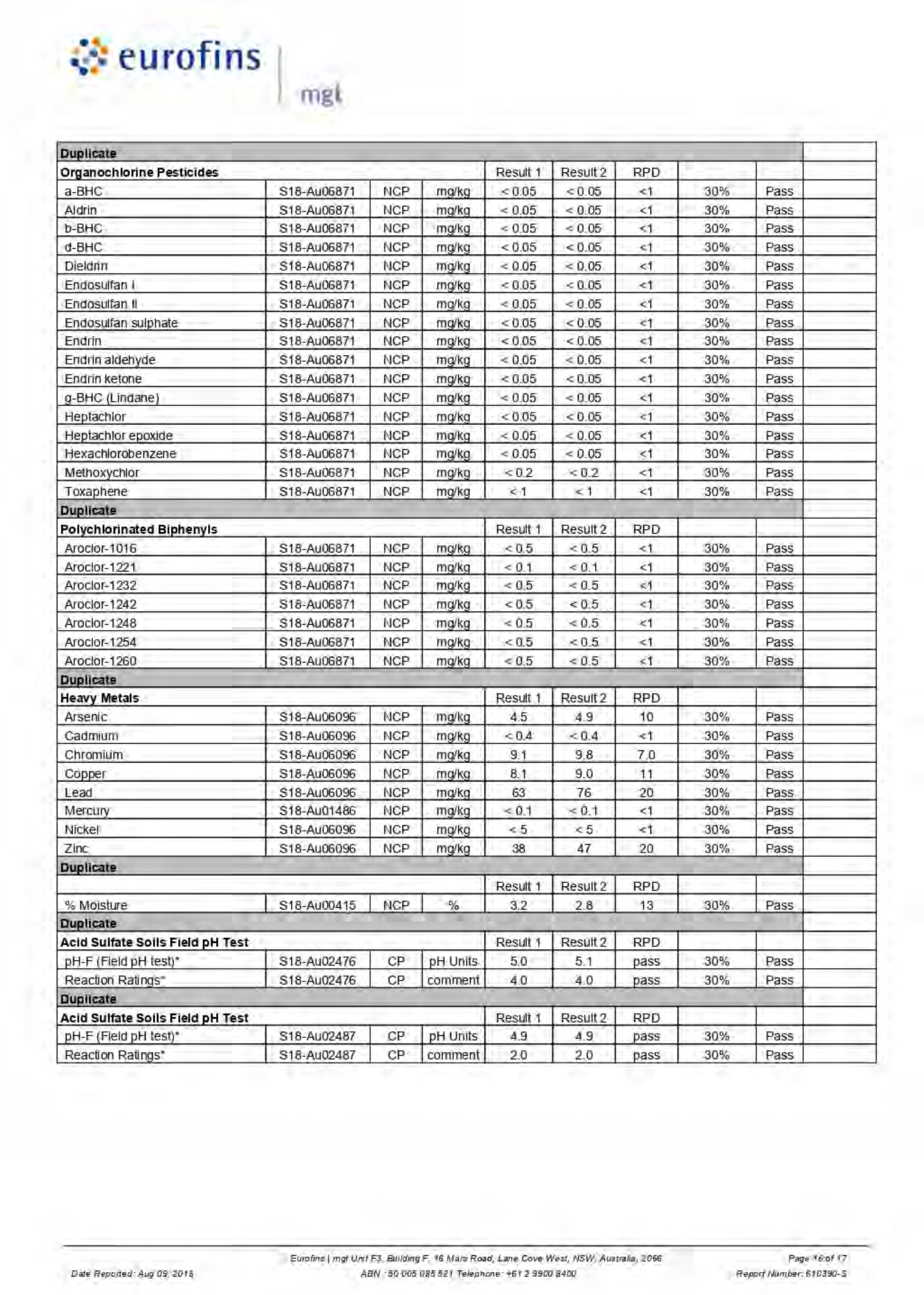
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Arsenic	S18-Au06151	NCP	%	103			70-130	Pass	
Cadmium	S18-Au06151	NCP	%	103			70-130	Pass	
Chromium	S18-Au06151	NCP	%	100			70-130	Pass	
Copper	S18-Au06151	NCP	%	101			70-130	Pass	
Lead	S18-Au08243	NCP	%	81			70-130	Pass	
Mercury	S18-Au06151	NCP	%	100			70-130	Pass	
Nickel	S18-Au06151	NCP	%	103			70-130	Pass	
Zinc	S18-Au06151	NCP	%	111			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-Au06863	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	S18-Au06158	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	S18-Au06158	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	S18-Au06158	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S18-Au06863	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S18-Au06863	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S18-Au06863	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S18-Au06863	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S18-Au06863	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S18-Au06863	NCP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S18-Au06863	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S18-Au06863	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	S18-Au06158	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S18-Au06158	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	S18-Au06158	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	S18-Au07709	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-Au06871	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	



Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
a-BHC	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-Au06871	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-Au06871	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-Au06871	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S18-Au06871	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S18-Au06871	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-Au06096	NCP	mg/kg	4.5	4.9	10	30%	Pass	
Cadmium	S18-Au06096	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S18-Au06096	NCP	mg/kg	9.1	9.8	7.0	30%	Pass	
Copper	S18-Au06096	NCP	mg/kg	8.1	9.0	11	30%	Pass	
Lead	S18-Au06096	NCP	mg/kg	63	76	20	30%	Pass	
Mercury	S18-Au01486	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S18-Au06096	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Zinc	S18-Au06096	NCP	mg/kg	38	47	20	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S18-Au00415	NCP	%	3.2	2.8	13	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S18-Au02476	CP	pH Units	5.0	5.1	pass	30%	Pass	
Reaction Ratings*	S18-Au02476	CP	comment	4.0	4.0	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S18-Au02487	CP	pH Units	4.9	4.9	pass	30%	Pass	
Reaction Ratings*	S18-Au02487	CP	comment	2.0	2.0	pass	30%	Pass	

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
G01	The LORs have been raised due to matrix interference
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Nibha Vaidya	Analytical Services Manager
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Enviro Sample Bris

From:	Enviro Sample NSW
Sent:	Wednesday, 8 August 2018 4:02 PM
To:	Enviro Sample Bris
Subject:	FW: Eurofins | mgt Sample Receipt Advice - Report 609184 : Site SCOTLAND ISLAND ENERGY RELIABILITY PROJECT (2127425)
Attachments:	COC1 2127425_Eurofins_Chain Of Custody 5_SPOCAS.xls
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi Team,

Following additional for samples sent to Brisbane under report No: 609184.

9/8/18

Kind Regards,
Elvis D
Enviro Sample NSW
Sample Receipt NSW

Eurofins | mgt
Unit F3, Parkview Building
16 Mars Road
LANE COVE WEST NSW 2066
AUSTRALIA
Phone : +61 2 9900 8492

Email : EnviroSampleNSW@Eurofins.com
Website: www.eurofins.com.au/environmental-testing

From: Justin Kabat [mailto:Justin.Kabat@ghd.com]
Sent: Wednesday, 8 August 2018 3:40 PM
To: Enviro Sample NSW; Clifton Thompson
Cc: Jacqui Hallchurch
Subject: RE: Eurofins | mgt Sample Receipt Advice - Report 609184 : Site SCOTLAND ISLAND ENERGY RELIABILITY PROJECT (2127425)

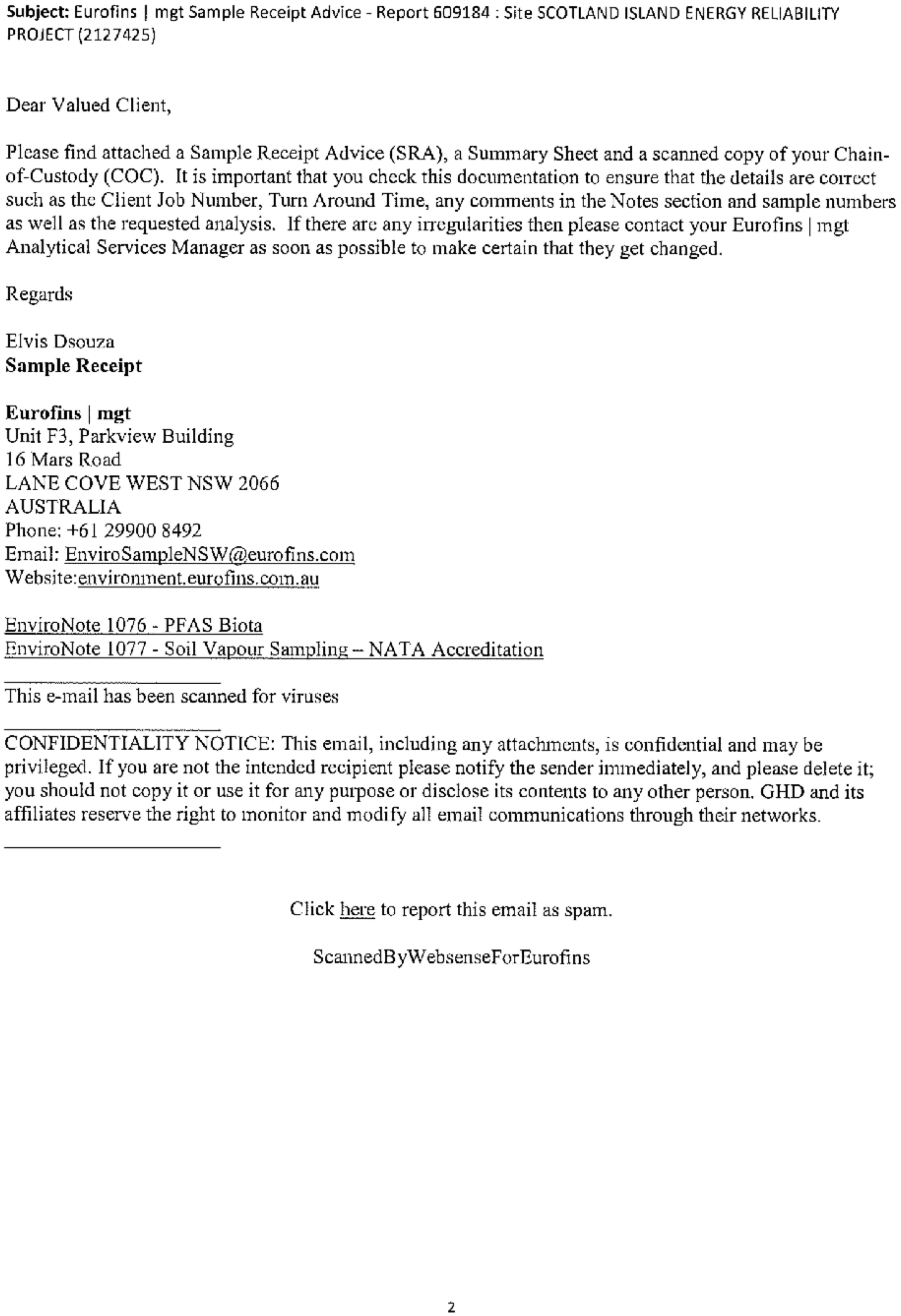
Hi Elvis

Further to the testing undertaken on samples, we wish to schedule the attached additional testing on remaining sample material (sPOCAS and SCr suites).

Cheers,
Justin Kabat MIEAust CPEng NER
Senior Geotechnical Engineer

GHD
T: 61 2 9462 4831 | F: 61 2 8898 8810 | V: 214831 | M: 61 413 244 331 | E: justin.kabat@ghd.com
Level 6, 20 Smith Street Parramatta NSW 2150 Australia | http://www.ghd.com/
Water | Energy & Resources | Environment | Property & Buildings | Transportation

From: EnviroSampleNSW@eurofins.com <EnviroSampleNSW@eurofins.com>
Sent: Wednesday, 25 July 2018 2:39 PM
To: Clifton Thompson <Clifton.Thompson@ghd.com>
Cc: Jacqui Hallchurch <Jacqui.Hallchurch@ghd.com>; Justin Kabat <Justin.Kabat@ghd.com>



Subject: Eurofins | mgt Sample Receipt Advice - Report 609184 : Site SCOTLAND ISLAND ENERGY RELIABILITY PROJECT (2127425)

Dear Valued Client,

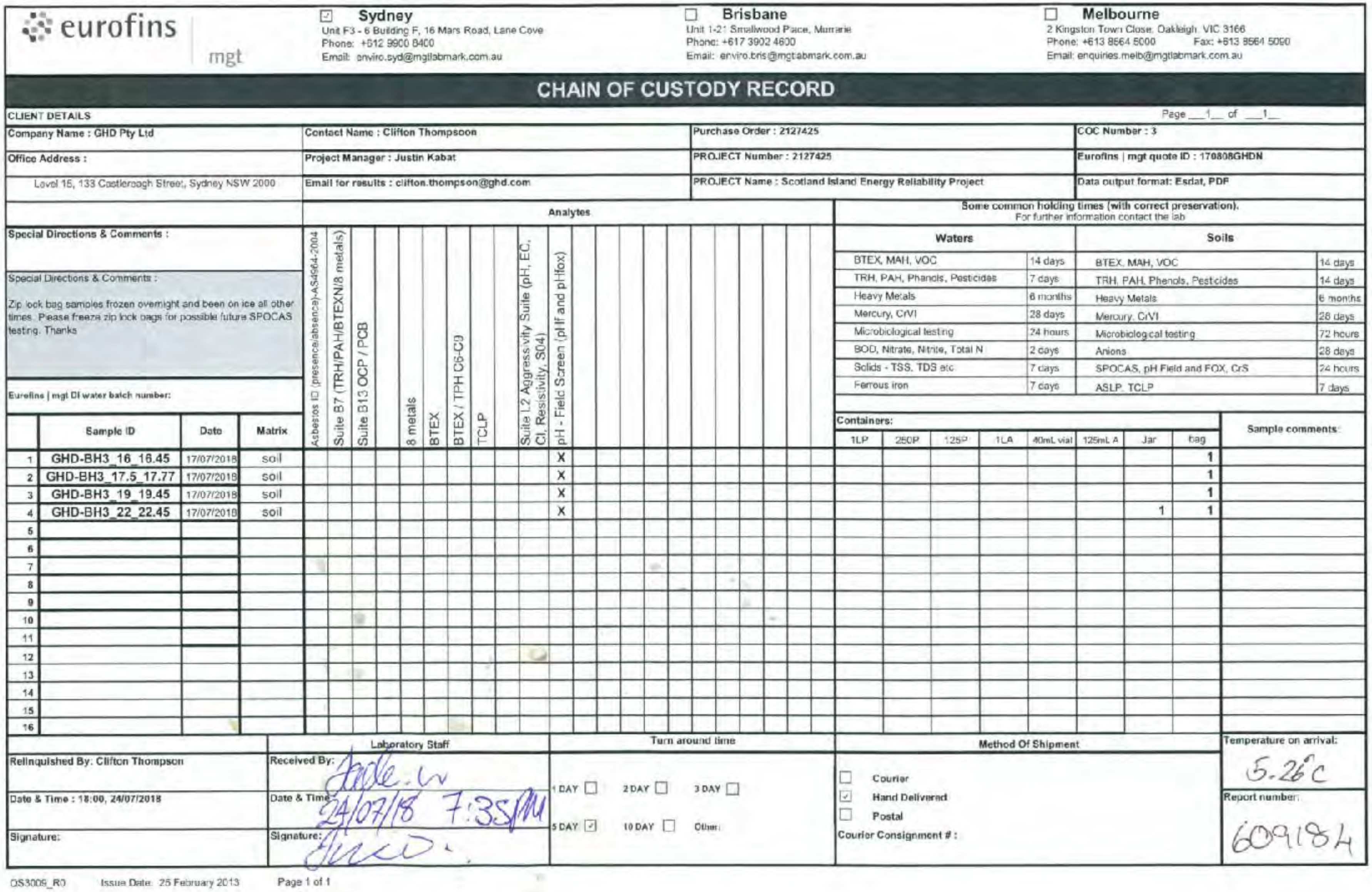
Please find attached a Sample Receipt Advice (SRA), a Summary Sheet and a scanned copy of your Chain-of-Custody (COC). It is important that you check this documentation to ensure that the details are correct such as the Client Job Number, Turn Around Time, any comments in the Notes section and sample numbers as well as the requested analysis. If there are any irregularities then please contact your Eurofins | mgt Analytical Services Manager as soon as possible to make certain that they get changed.

Regards

Elvis Dsouza
Sample Receipt

Eurofins | mgt
Unit F3, Parkview Building
16 Mars Road
LANE COVE WEST NSW 2066
AUSTRALIA
Phone: +61 29900 8492
Email: EnviroSampleNSW@eurofins.com
Website:environment.eurofins.com.au

EnviroNote 1076 - PFAS Biota
EnviroNote 1077 - Soil Vapour Sampling – NATA Accreditation



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☑ **Sydney**
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Phone: +612 9900 8400
Email: enviro.syd@mgtlabmark.com.au

☐ **Brisbane**
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Phone: +617 3902 4600
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☐ **Melbourne**
2 Kingston Town Close, Oakleigh VIC 3166
Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd	Contact Name : Clifton Thompsoon	Purchase Order : 2127425	COC Number : 3
Office Address :	Project Manager : Justin Kabat	PROJECT Number : 2127425	Eurofins | mgt quote ID : 170808GHDN
Level 15, 133 Castlereagh Street, Sydney NSW 2000	Email for results : clifton.thompson@ghd.com	PROJECT Name : Scotland Island Energy Reliability Project	Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :

Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

Analytes

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH3_16_16.45	17/07/2018	soil									X								1	
2	GHD-BH3_17.5_17.77	17/07/2018	soil									X								1	
3	GHD-BH3_19_19.45	17/07/2018	soil									X								1	
4	GHD-BH3_22_22.45	17/07/2018	soil									X							1	1	
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					

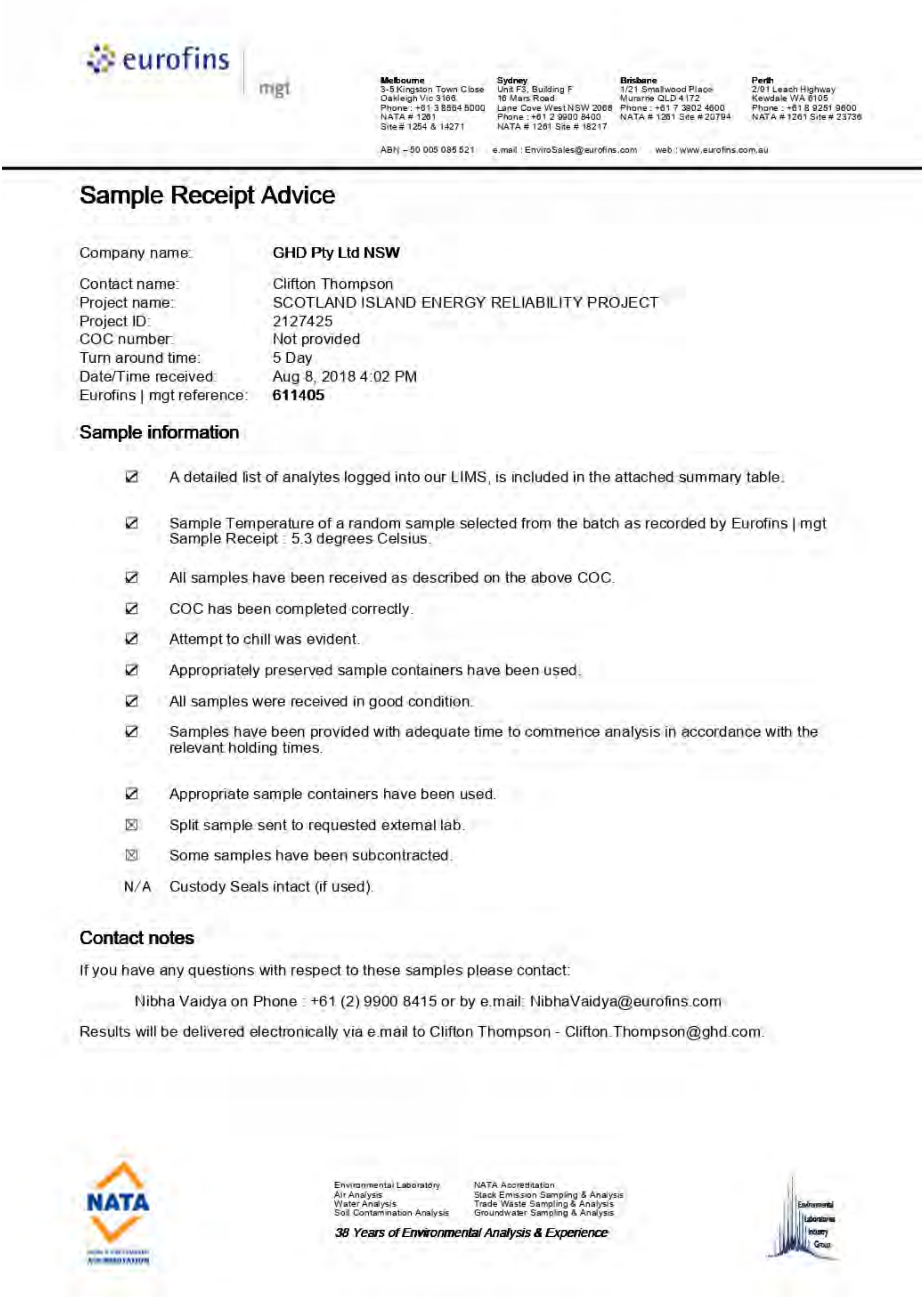
Containers: 1LP, 250P, 125P, 1LA, 40mL vial, 125mL A, Jar, bag

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

	Laboratory Staff	Turn around time	Method Of Shipment	Temperature on arrival:
Relinquished By: Clifton Thompson	Received By: Jade.W	1 DAY ☐ 2 DAY ☐ 3 DAY ☐	☐ Courier	5.26°C
Date & Time : 18:00, 24/07/2018	Date & Time: 24/07/18 7:35PM	5 DAY ☑ 10 DAY ☐ Other:	☑ Hand Delivered ☐ Postal	Report number:
Signature:	Signature:		Courier Consignment # :	609184

DS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



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Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name: **GHD Pty Ltd NSW**

Contact name: Clifton Thompson
Project name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425
COC number: Not provided
Turn around time: 5 Day
Date/Time received: Aug 8, 2018 4:02 PM
Eurofins | mgt reference: **611405**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 5.3 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

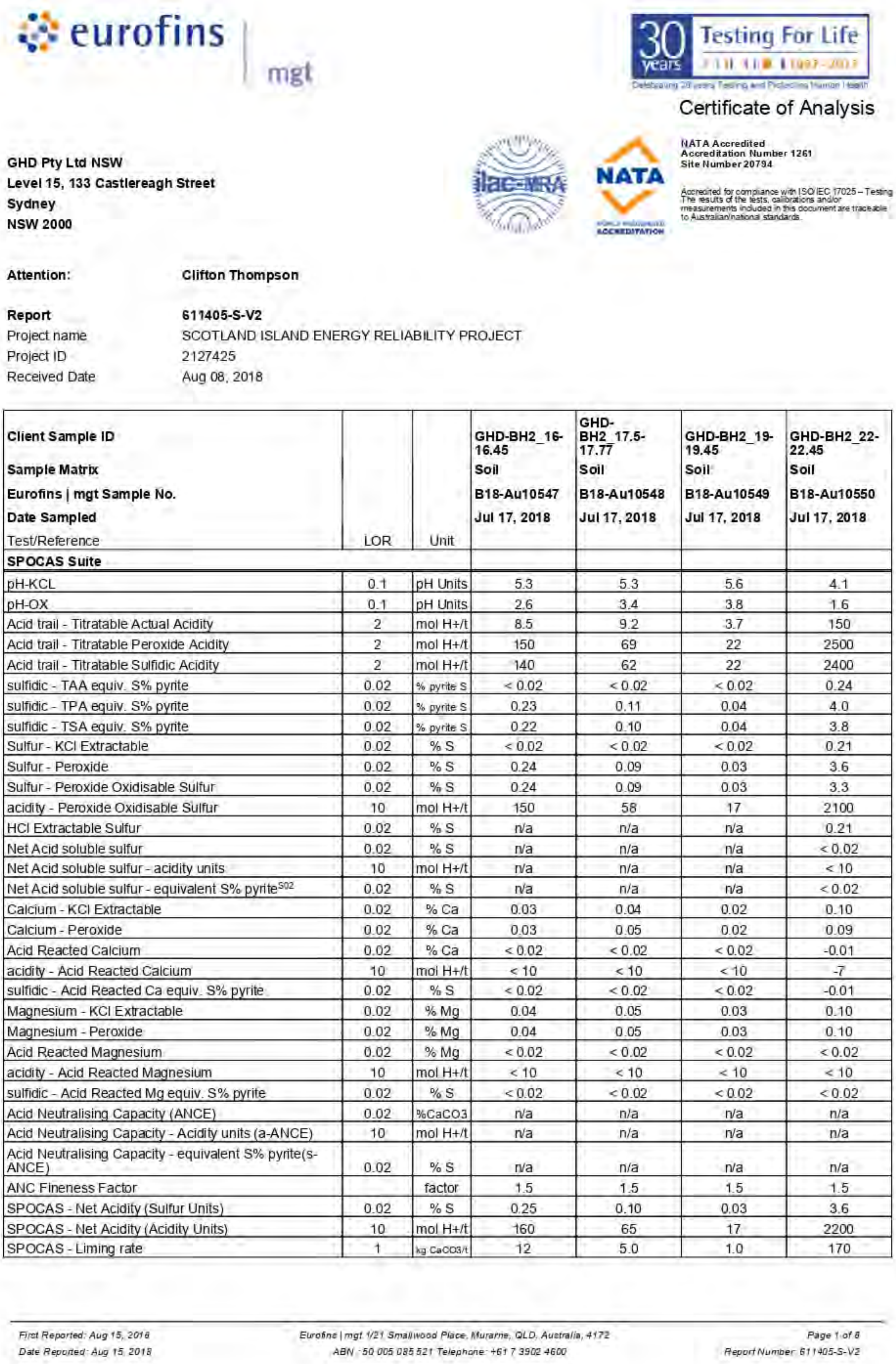
NATA

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

Environmental Laboratories Industry Group



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30 years Testing For Life

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 20794

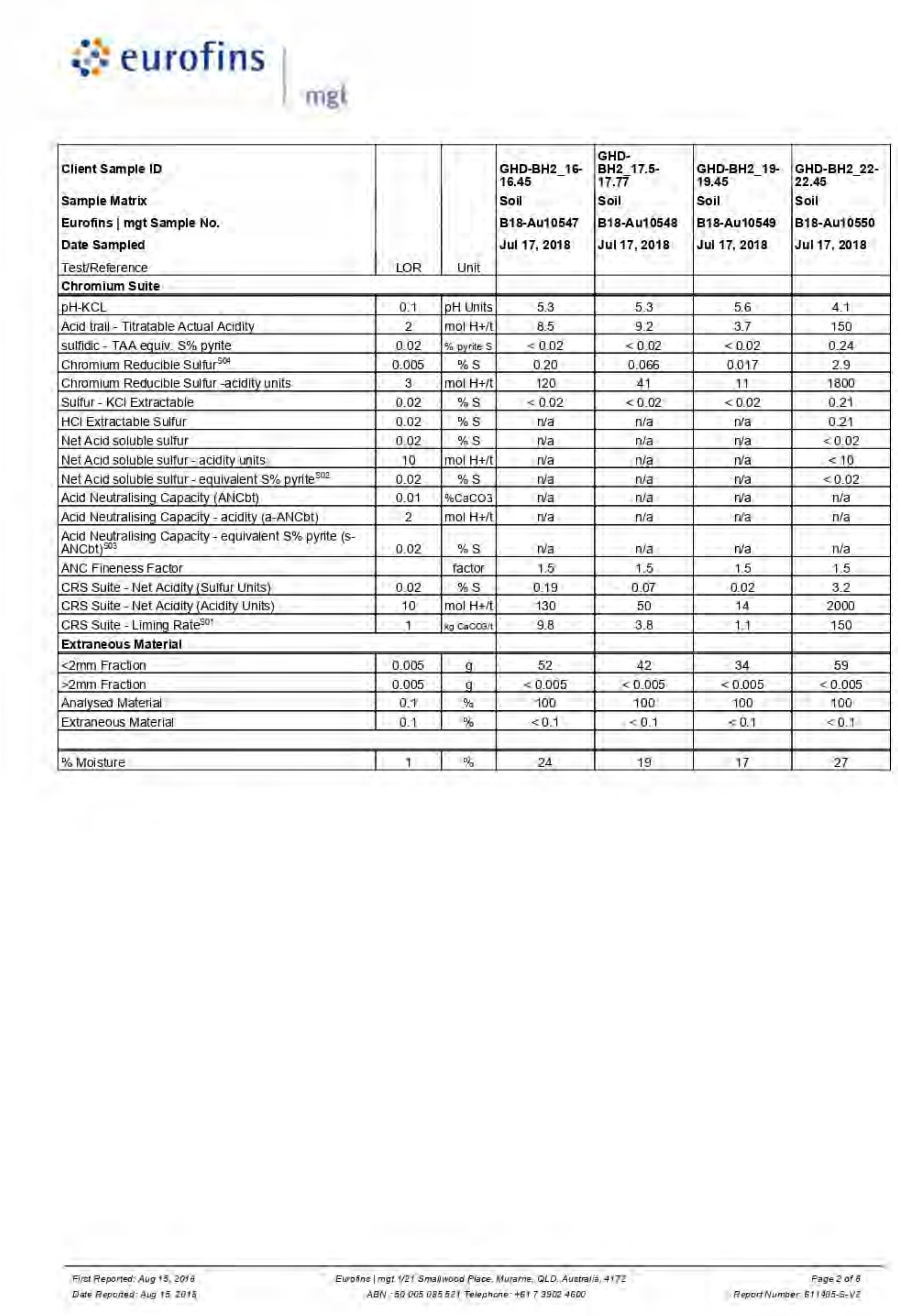
Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention: **Clifton Thompson**

Report **611405-S-V2**
Project name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Received Date Aug 08, 2018

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH2_16-16.45** **Soil** **B18-Au10547** **Jul 17, 2018**	**GHD-BH2_17.5-17.77** **Soil** **B18-Au10548** **Jul 17, 2018**	**GHD-BH2_19-19.45** **Soil** **B18-Au10549** **Jul 17, 2018**	**GHD-BH2_22-22.45** **Soil** **B18-Au10550** **Jul 17, 2018**
SPOCAS Suite						
pH-KCL	0.1	pH Units	5.3	5.3	5.6	4.1
pH-OX	0.1	pH Units	2.6	3.4	3.8	1.6
Acid trail - Titratable Actual Acidity	2	mol H+/t	8.5	9.2	3.7	150
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	150	69	22	2500
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	140	62	22	2400
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	0.24
sulfidic - TPA equiv. S% pyrite	0.02	% pyrite S	0.23	0.11	0.04	4.0
sulfidic - TSA equiv. S% pyrite	0.02	% pyrite S	0.22	0.10	0.04	3.8
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	0.21
Sulfur - Peroxide	0.02	% S	0.24	0.09	0.03	3.6
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	0.24	0.09	0.03	3.3
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	150	58	17	2100
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	0.21
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	< 0.02
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	< 10
Net Acid soluble sulfur - equivalent S% pyrite^{S02}	0.02	% S	n/a	n/a	n/a	< 0.02
Calcium - KCl Extractable	0.02	% Ca	0.03	0.04	0.02	0.10
Calcium - Peroxide	0.02	% Ca	0.03	0.05	0.02	0.09
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	-0.01
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	-7
sulfidic - Acid Reacted Ca equiv. S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	-0.01
Magnesium - KCl Extractable	0.02	% Mg	0.04	0.05	0.03	0.10
Magnesium - Peroxide	0.02	% Mg	0.04	0.05	0.03	0.10
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
sulfidic - Acid Reacted Mg equiv. S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCE)	0.02	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units (a-ANCE)	10	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite(s-ANCE)	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
SPOCAS - Net Acidity (Sulfur Units)	0.02	% S	0.25	0.10	0.03	3.6
SPOCAS - Net Acidity (Acidity Units)	10	mol H+/t	160	65	17	2200
SPOCAS - Liming rate	1	kg CaCO3/t	12	5.0	1.0	170



Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH2_16-16.45** **Soil** **B18-Au10547** **Jul 17, 2018**	**GHD-BH2_17.5-17.77** **Soil** **B18-Au10548** **Jul 17, 2018**	**GHD-BH2_19-19.45** **Soil** **B18-Au10549** **Jul 17, 2018**	**GHD-BH2_22-22.45** **Soil** **B18-Au10550** **Jul 17, 2018**
Chromium Suite						
pH-KCL	0.1	pH Units	5.3	5.3	5.6	4.1
Acid trail - Titratable Actual Acidity	2	mol H+/t	8.5	9.2	3.7	150
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	0.24
Chromium Reducible Sulfur[S04]	0.005	% S	0.20	0.066	0.017	2.9
Chromium Reducible Sulfur -acidity units	3	mol H+/t	120	41	11	1800
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	0.21
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	0.21
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	< 0.02
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	< 10
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	0.19	0.07	0.02	3.2
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	130	50	14	2000
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	9.8	3.8	1.1	150
Extraneous Material						
<2mm Fraction	0.005	g	52	42	34	59
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	24	19	17	27

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
SPOCAS Suite			
SPOCAS Suite	Brisbane	Aug 09, 2018	6 Week
- Method: LTM-GEN-7050			
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Aug 13, 2018	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Aug 09, 2018	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Aug 09, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 611405
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 8, 2018 4:02 PM
Due: Aug 15, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						SPOCAS Suite	Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217								
Brisbane Laboratory - NATA Site # 20794						X	X	X
Perth Laboratory - NATA Site # 23736								
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	GHD-BH2_16-16.45	Jul 17, 2018		Soil	B18-Au10547	X	X	X
2	GHD-BH2_17.5-17.77	Jul 17, 2018		Soil	B18-Au10548	X	X	X
3	GHD-BH2_19-19.45	Jul 17, 2018		Soil	B18-Au10549	X	X	X
4	GHD-BH2_22-22.45	Jul 17, 2018		Soil	B18-Au10550	X	X	X
Test Counts						4	4	4

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

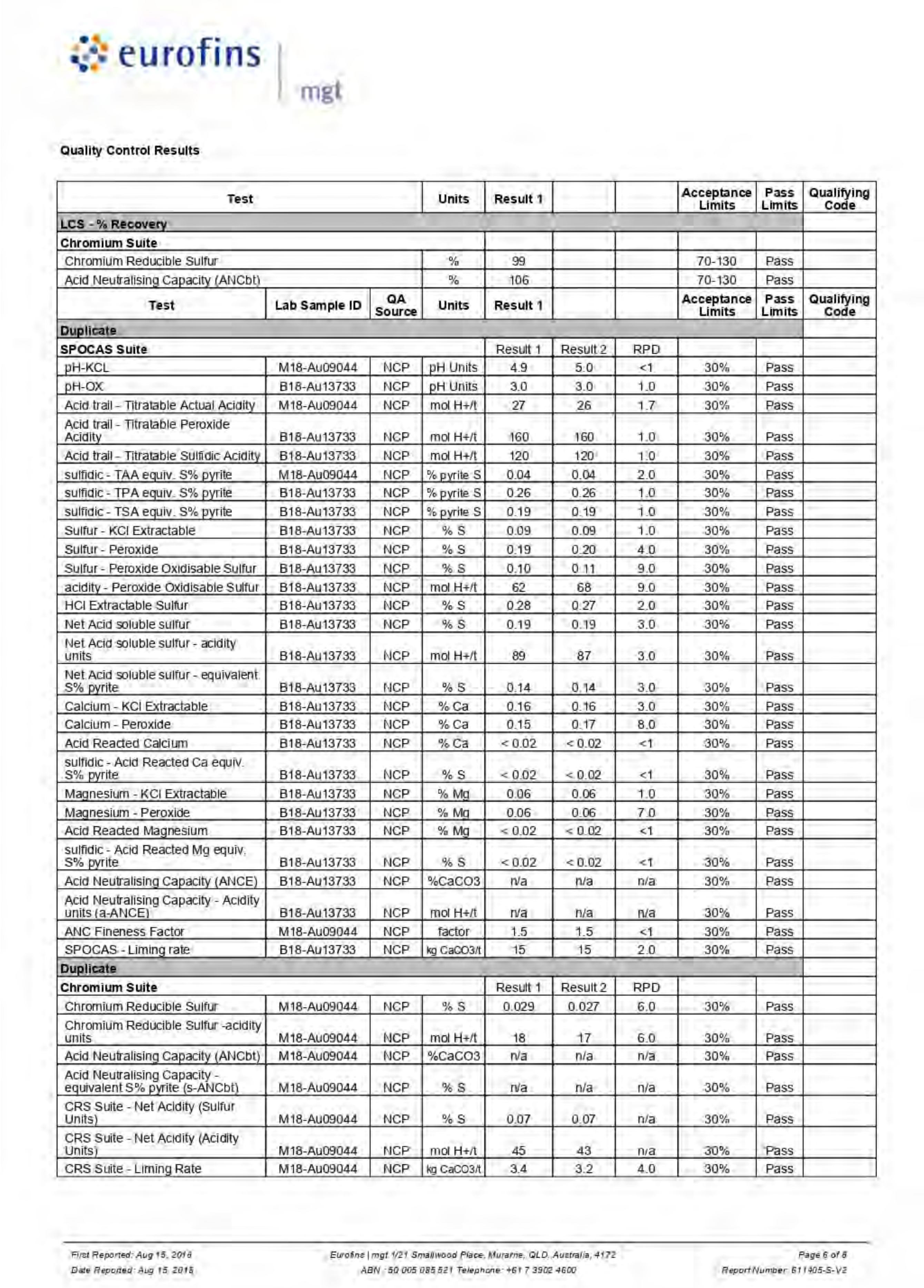
Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Chromium Suite							
Chromium Reducible Sulfur	%	99			70-130	Pass	
Acid Neutralising Capacity (ANCbt)	%	106			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
SPOCAS Suite				Result 1	Result 2	RPD			
pH-KCL	M18-Au09044	NCP	pH Units	4.9	5.0	<1	30%	Pass	
pH-OX	B18-Au13733	NCP	pH Units	3.0	3.0	1.0	30%	Pass	
Acid trail – Titratable Actual Acidity	M18-Au09044	NCP	mol H+/t	27	26	1.7	30%	Pass	
Acid trail - Titratable Peroxide Acidity	B18-Au13733	NCP	mol H+/t	160	160	1.0	30%	Pass	
Acid trail – Titratable Sulfidic Acidity	B18-Au13733	NCP	mol H+/t	120	120	1.0	30%	Pass	
sulfidic - TAA equiv. S% pyrite	M18-Au09044	NCP	% pyrite S	0.04	0.04	2.0	30%	Pass	
sulfidic - TPA equiv. S% pyrite	B18-Au13733	NCP	% pyrite S	0.26	0.26	1.0	30%	Pass	
sulfidic - TSA equiv. S% pyrite	B18-Au13733	NCP	% pyrite S	0.19	0.19	1.0	30%	Pass	
Sulfur - KCl Extractable	B18-Au13733	NCP	% S	0.09	0.09	1.0	30%	Pass	
Sulfur - Peroxide	B18-Au13733	NCP	% S	0.19	0.20	4.0	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	B18-Au13733	NCP	% S	0.10	0.11	9.0	30%	Pass	
acidity - Peroxide Oxidisable Sulfur	B18-Au13733	NCP	mol H+/t	62	68	9.0	30%	Pass	
HCl Extractable Sulfur	B18-Au13733	NCP	% S	0.28	0.27	2.0	30%	Pass	
Net Acid soluble sulfur	B18-Au13733	NCP	% S	0.19	0.19	3.0	30%	Pass	
Net Acid soluble sulfur - acidity units	B18-Au13733	NCP	mol H+/t	89	87	3.0	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B18-Au13733	NCP	% S	0.14	0.14	3.0	30%	Pass	
Calcium - KCl Extractable	B18-Au13733	NCP	% Ca	0.16	0.16	3.0	30%	Pass	
Calcium - Peroxide	B18-Au13733	NCP	% Ca	0.15	0.17	8.0	30%	Pass	
Acid Reacted Calcium	B18-Au13733	NCP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - Acid Reacted Ca equiv. S% pyrite	B18-Au13733	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - KCl Extractable	B18-Au13733	NCP	% Mg	0.06	0.06	1.0	30%	Pass	
Magnesium - Peroxide	B18-Au13733	NCP	% Mg	0.06	0.06	7.0	30%	Pass	
Acid Reacted Magnesium	B18-Au13733	NCP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - Acid Reacted Mg equiv. S% pyrite	B18-Au13733	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Acid Neutralising Capacity (ANCE)	B18-Au13733	NCP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - Acidity units (a-ANCE)	B18-Au13733	NCP	mol H+/t	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	M18-Au09044	NCP	factor	1.5	1.5	<1	30%	Pass	
SPOCAS - Liming rate	B18-Au13733	NCP	kg CaCO3/t	15	15	2.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
Chromium Reducible Sulfur	M18-Au09044	NCP	% S	0.029	0.027	6.0	30%	Pass	
Chromium Reducible Sulfur -acidity units	M18-Au09044	NCP	mol H+/t	18	17	6.0	30%	Pass	
Acid Neutralising Capacity (ANCbt)	M18-Au09044	NCP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	M18-Au09044	NCP	% S	n/a	n/a	n/a	30%	Pass	
CRS Suite - Net Acidity (Sulfur Units)	M18-Au09044	NCP	% S	0.07	0.07	n/a	30%	Pass	
CRS Suite - Net Acidity (Acidity Units)	M18-Au09044	NCP	mol H+/t	45	43	n/a	30%	Pass	
CRS Suite - Liming Rate	M18-Au09044	NCP	kg CaCO3/t	3.4	3.2	4.0	30%	Pass	

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Duplicate									
				Result 1	Result 2	RPD			
% Moisture	P18-JI04806	NCP	%	25	25	1.0	30%	Pass	

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Comments

New version to amend IDs.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Nibha Vaidya	Analytical Services Manager
Steven Trout	Senior Analyst-Metal (QLD)

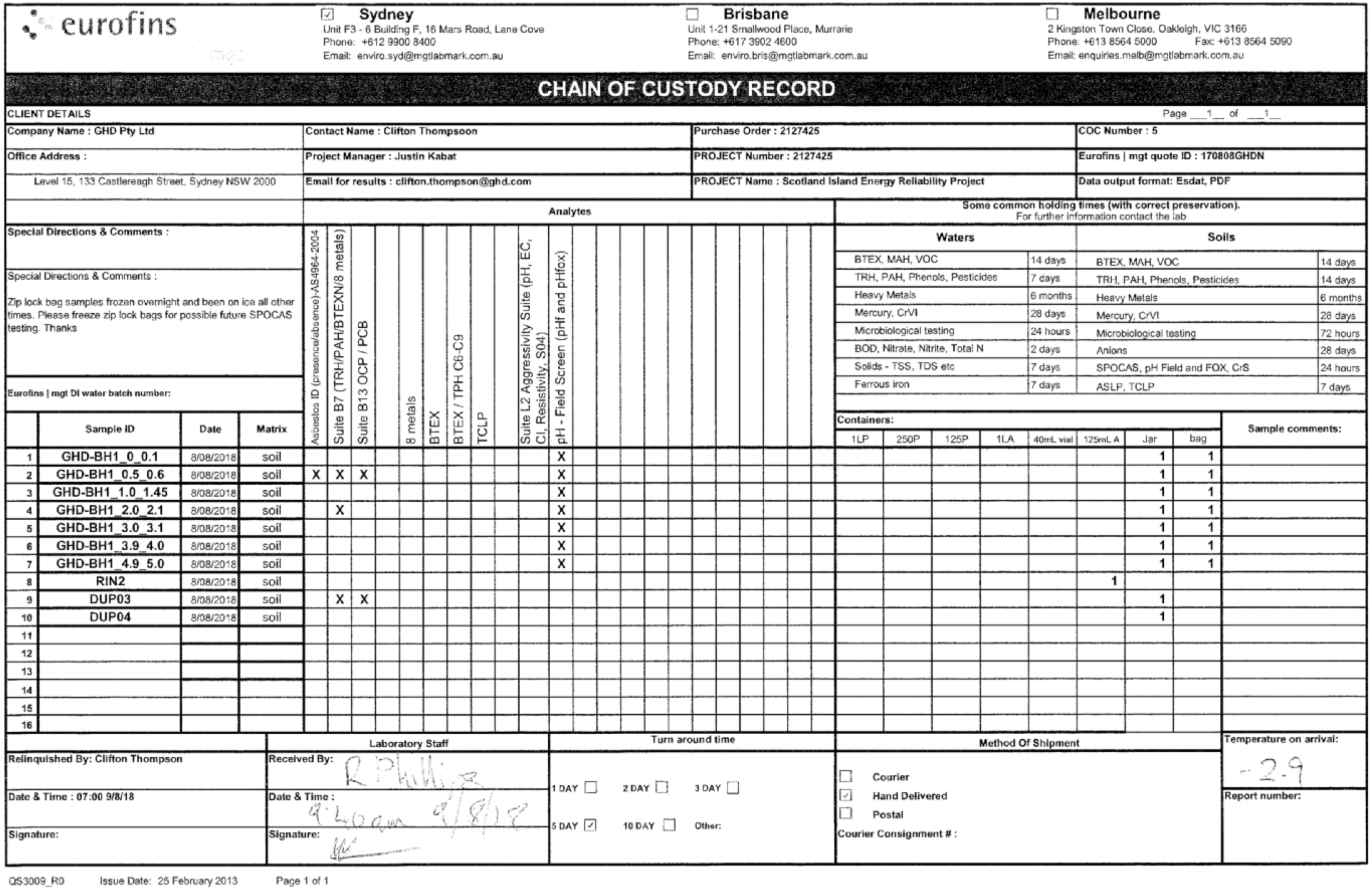
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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☑ **Sydney**
Unit F3 - 6 Building F, 16 Mars Road, Lane Cove
Phone: +612 9900 8400
Email: enviro.syd@mgtlabmark.com.au

☐ **Brisbane**
Unit 1-21 Smallwood Place, Murrarie
Phone: +617 3902 4600
Email: enviro.bris@mgtlabmark.com.au

☐ **Melbourne**
2 Kingston Town Close, Oakleigh, VIC 3166
Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page _1_ of _1_

Company Name : GHD Pty Ltd	**Contact Name : Clifton Thompsoon**	**Purchase Order : 2127425**	**COC Number : 5**
Office Address :	**Project Manager : Justin Kabat**	**PROJECT Number : 2127425**	**Eurofins | mgt quote ID : 170808GHDN**
Level 15, 133 Castlereagh Street, Sydney NSW 2000	**Email for results : clifton.thompson@ghd.com**	**PROJECT Name : Scotland Island Energy Reliability Project**	**Data output format: Esdat, PDF**

Special Directions & Comments :

Special Directions & Comments :

Zip lock bag samples frozen overnight and been on ice all other times. Please freeze zip lock bags for possible future SPOCAS testing. Thanks

Eurofins | mgt DI water batch number:

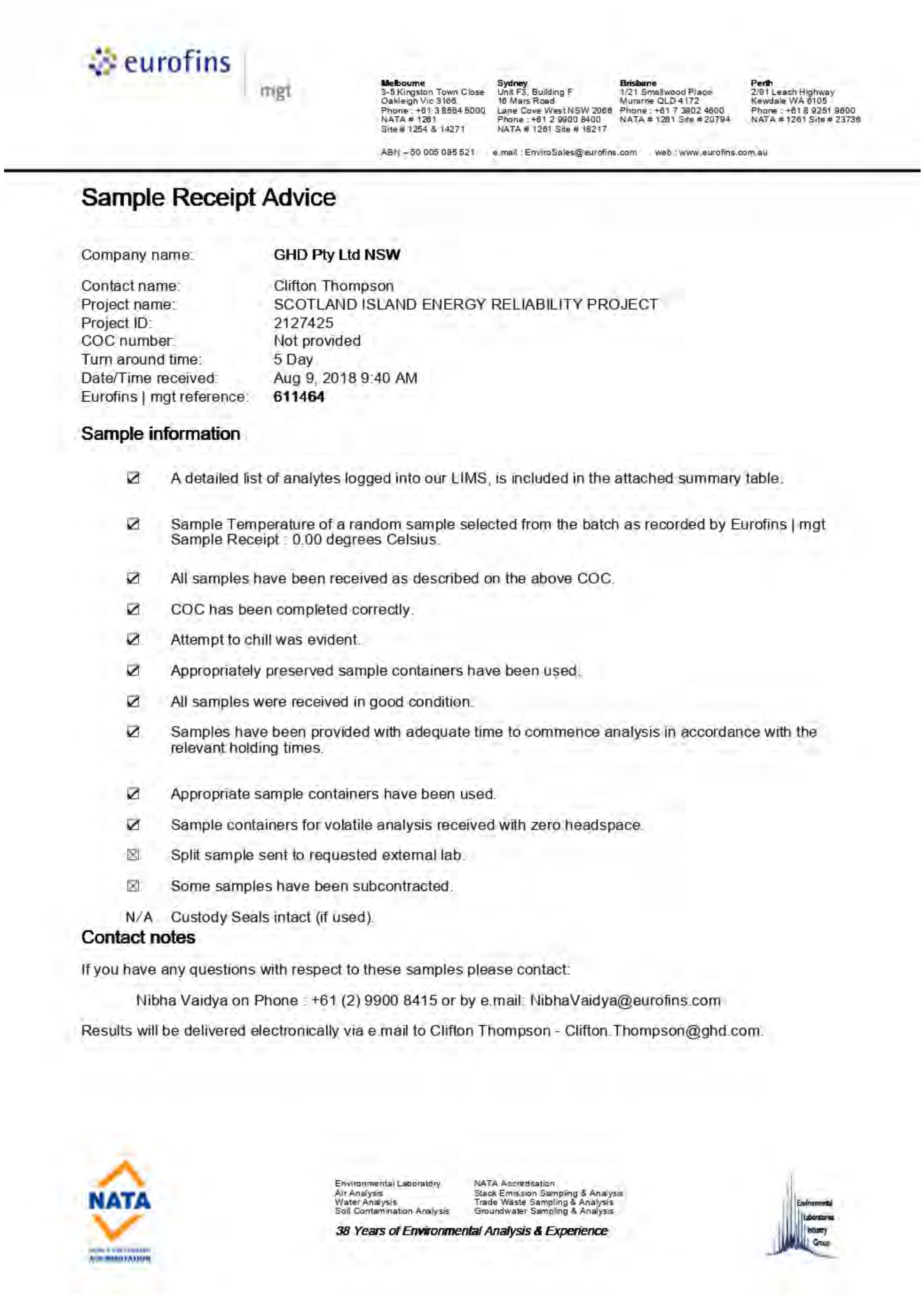
Some common holding times (with correct preservation).
For further information contact the lab

Waters		**Soils**	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

				Analytes											**Containers:**								
	Sample ID	**Date**	**Matrix**	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB		8 metals	BTEX	BTEX / TPH C6-C9	TCLP		Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	**Sample comments:**
1	GHD-BH1_0_0.1	8/08/2018	soil											X							1	1	
2	GHD-BH1_0.5_0.6	8/08/2018	soil	X	X	X								X							1	1	
3	GHD-BH1_1.0_1.45	8/08/2018	soil											X							1	1	
4	GHD-BH1_2.0_2.1	8/08/2018	soil		X									X							1	1	
5	GHD-BH1_3.0_3.1	8/08/2018	soil											X							1	1	
6	GHD-BH1_3.9_4.0	8/08/2018	soil											X							1	1	
7	GHD-BH1_4.9_5.0	8/08/2018	soil											X							1	1	
8	RIN2	8/08/2018	soil																	1			
9	DUP03	8/08/2018	soil		X	X															1		
10	DUP04	8/08/2018	soil																		1		
11																							
12																							
13																							
14																							
15																							
16																							

	Laboratory Staff	**Turn around time**	**Method Of Shipment**	**Temperature on arrival:**
Relinquished By: Clifton Thompson	**Received By:** R Phillips	1 DAY ☐ 2 DAY ☐ 3 DAY ☐	☐ Courier	-2.9
Date & Time : 07:00 9/8/18	**Date & Time :** 9:40am 9/8/18	5 DAY ☑ 10 DAY ☐ Other:	☑ Hand Delivered ☐ Postal	**Report number:**
Signature:	**Signature:**		**Courier Consignment # :**	

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1



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NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Clifton Thompson
Project name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID:	2127425
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Aug 9, 2018 9:40 AM
Eurofins | mgt reference:	**611464**

Sample information

- ☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 0.00 degrees Celsius.
- ☑ All samples have been received as described on the above COC.
- ☑ COC has been completed correctly.
- ☑ Attempt to chill was evident.
- ☑ Appropriately preserved sample containers have been used.
- ☑ All samples were received in good condition.
- ☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ☑ Appropriate sample containers have been used.
- ☑ Sample containers for volatile analysis received with zero headspace.
- ☒ Split sample sent to requested external lab.
- ☒ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

NATA

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

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Site Number 18217

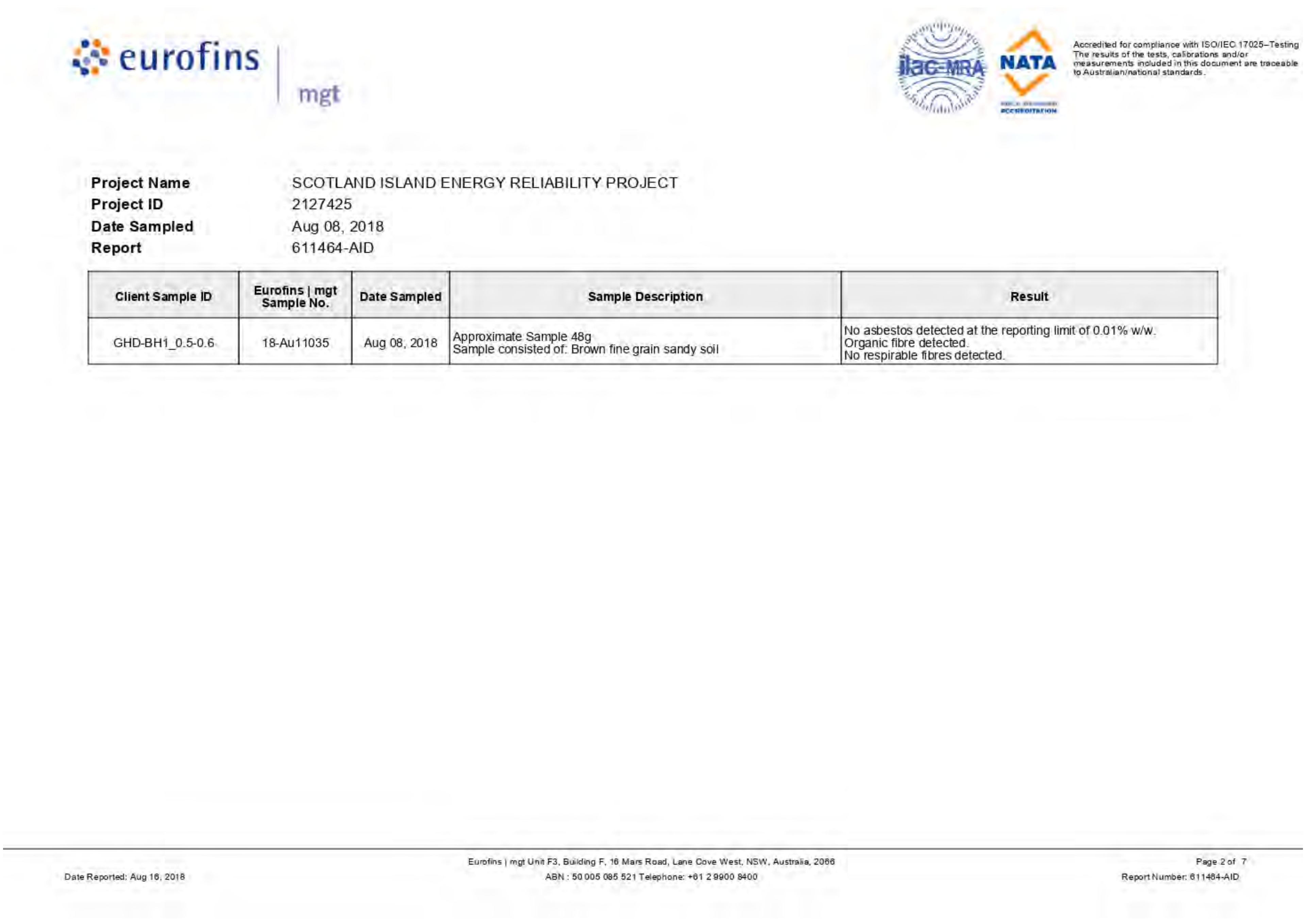
Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	Clifton Thompson
Report	611464-AID
Project Name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Aug 09, 2018
Date Reported	Aug 16, 2018

Methodology:

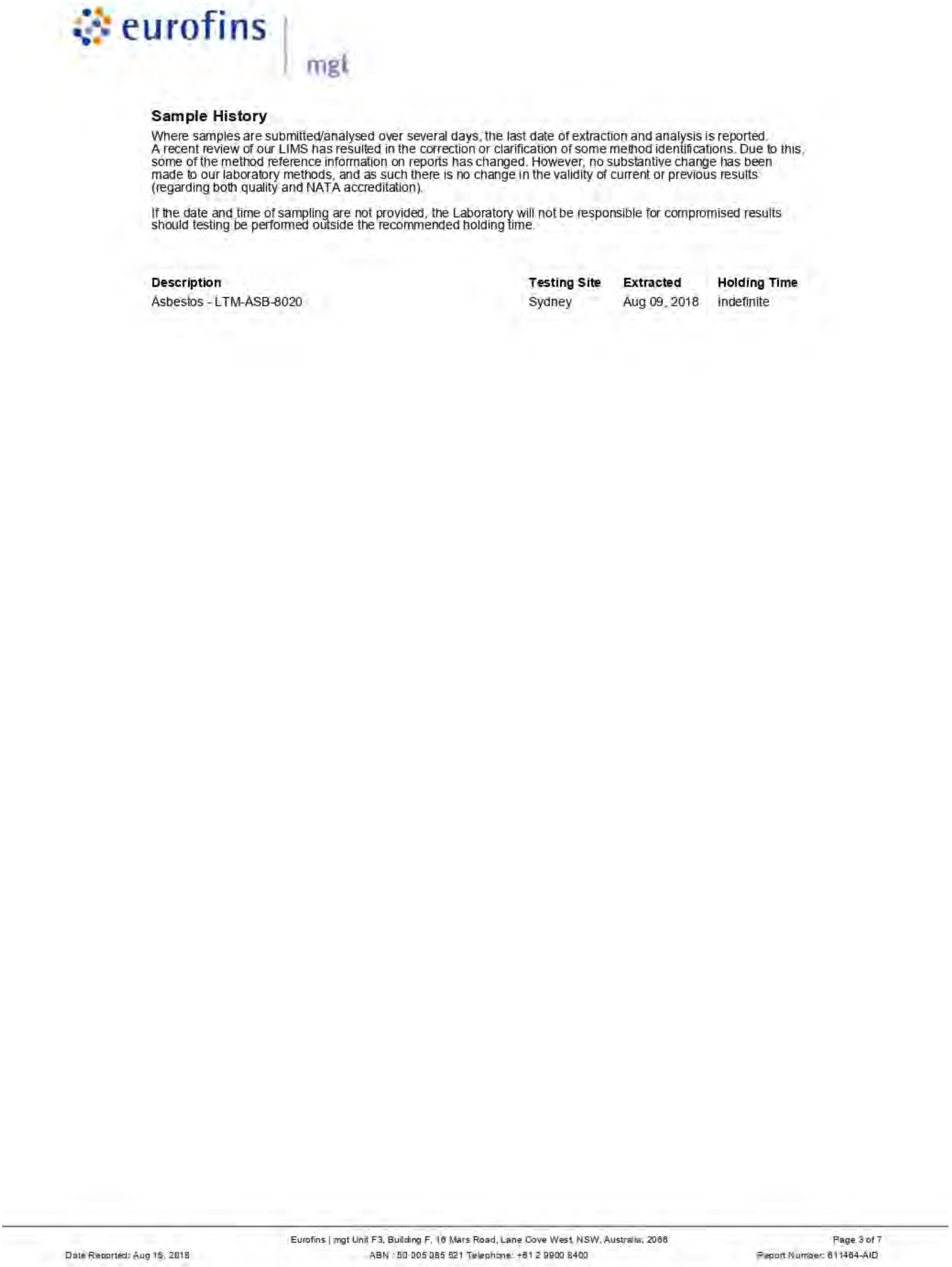
Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS4964 method for inhomogeneous samples is around 0.1 g/kg (0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis where required, this is considered to be at the nominal reporting limit of 0.01 % (w / w).The examination of large sample sizes(500 mL is recommended) may improve the likelihood of identifying ACM in the > 2mm fraction.The NEPM screening level of 0.001 % (w / w) asbestos in soil for FA(friable asbestos) and AF(asbestos fines) then applies where they are able to be quantified by gravimetric procedures.This quantitative screening is not generally applicable to FF(free fibres) and results of Trace Analysis are referred. *NOTE: NATA News March 2014, p.7, states in relation to AS4964: "This is a qualitative method with a nominal reporting limit of 0.01%" and that currently in Australia "there is no validated method available for the quantification of asbestos". Accordingly, NATA Accreditation does not cover the performance of this service (indicated with an asterisk).* *This report is consistent with the analytical procedures and reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended) and the Western Australia Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, 2009, including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil, June 2011.*



Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Date Sampled Aug 08, 2018
Report 611464-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
GHD-BH1_0.5-0.6	18-Au11035	Aug 08, 2018	Approximate Sample 48g Sample consisted of: Brown fine grain sandy soil	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.



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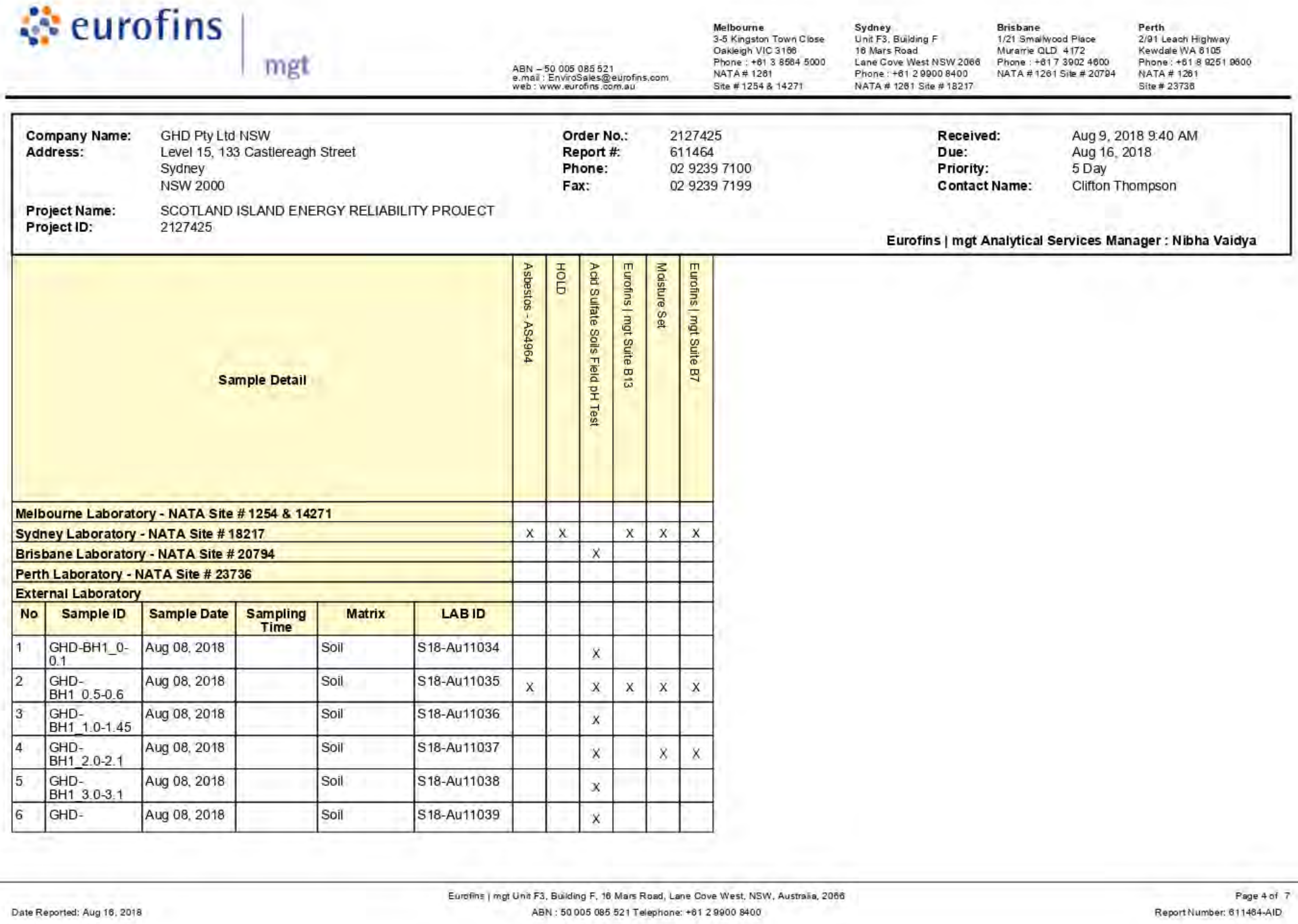
Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Asbestos - LTM-ASB-8020	Sydney	Aug 09, 2018	Indefinite



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NATA # 1261 Site # 20794

Perth
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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 611464
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 9, 2018 9:40 AM
Due: Aug 16, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X		X	X	X
Brisbane Laboratory - NATA Site # 20794								X			
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	GHD-BH1_0-0.1	Aug 08, 2018		Soil	S18-Au11034			X			
2	GHD-BH1_0.5-0.6	Aug 08, 2018		Soil	S18-Au11035	X		X	X	X	X
3	GHD-BH1_1.0-1.45	Aug 08, 2018		Soil	S18-Au11036			X			
4	GHD-BH1_2.0-2.1	Aug 08, 2018		Soil	S18-Au11037			X		X	X
5	GHD-BH1_3.0-3.1	Aug 08, 2018		Soil	S18-Au11038			X			
6	GHD-	Aug 08, 2018		Soil	S18-Au11039			X			

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Aug 9, 2018 9:40 AM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	611464	**Due:**	Aug 16, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X		X	X	X
Brisbane Laboratory - NATA Site # 20794								X			
Perth Laboratory - NATA Site # 23736											
	BH1_3.9-4.0										
7	GHD-BH1_4.9-5.0	Aug 08, 2018		Soil	S18-Au11040			X			
8	DUP03	Aug 08, 2018		Soil	S18-Au11041				X	X	X
9	RIN2	Aug 08, 2018		Water	S18-Au11042		X				
10	DUP04	Aug 08, 2018		Soil	S18-Au11043		X				
Test Counts						1	2	7	2	3	3

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

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Comments

The sample received was not collected in an approved asbestos bag and was therefore sub-sampled from the 250mL glass jar. Valid sub-sampling procedures were applied so as to ensure that the sub-sample to be analysed accurately represented the sample received.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Sayeed Abu	Senior Analyst-Asbestos (NSW)

Authorised by:

Laxman Dias	Senior Analyst-Asbestos (NSW)

Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Certificate of Analysis

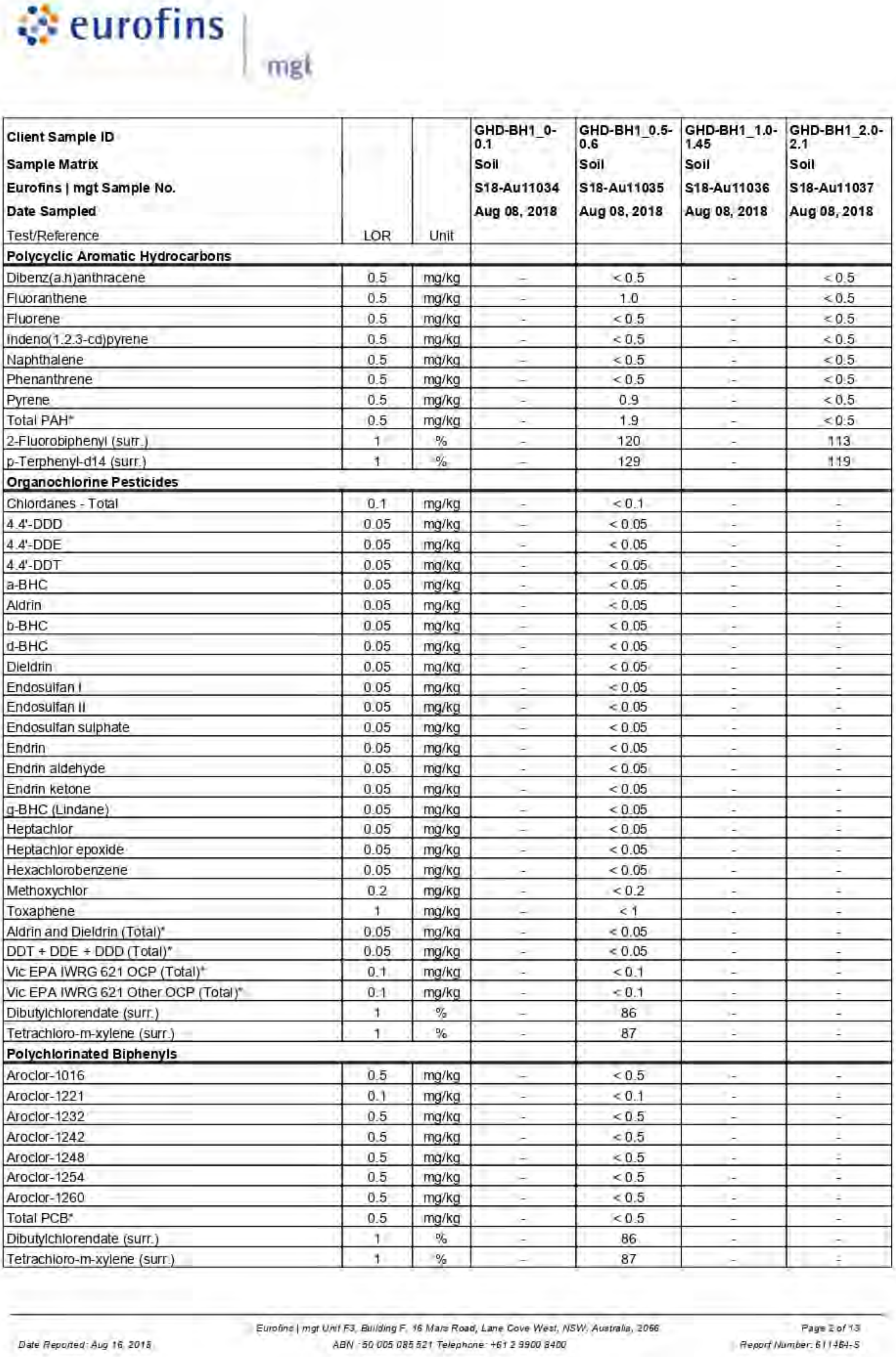
NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	**Clifton Thompson**
Report	**611464-S**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Aug 09, 2018

Client Sample ID			**GHD-BH1_0-0.1**	**GHD-BH1_0.5-0.6**	**GHD-BH1_1.0-1.45**	**GHD-BH1_2.0-2.1**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au11034**	**S18-Au11035**	**S18-Au11036**	**S18-Au11037**
Date Sampled			**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	< 20	-	< 20
TRH C10-C14	20	mg/kg	-	< 20	-	< 20
TRH C15-C28	50	mg/kg	-	< 50	-	< 50
TRH C29-C36	50	mg/kg	-	< 50	-	< 50
TRH C10-36 (Total)	50	mg/kg	-	< 50	-	< 50
BTEX						
Benzene	0.1	mg/kg	-	< 0.1	-	< 0.1
Toluene	0.1	mg/kg	-	< 0.1	-	< 0.1
Ethylbenzene	0.1	mg/kg	-	< 0.1	-	< 0.1
m&p-Xylenes	0.2	mg/kg	-	< 0.2	-	< 0.2
o-Xylene	0.1	mg/kg	-	< 0.1	-	< 0.1
Xylenes - Total	0.3	mg/kg	-	< 0.3	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	66	-	54
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene^{N02}	0.5	mg/kg	-	< 0.5	-	< 0.5
TRH C6-C10	20	mg/kg	-	< 20	-	< 20
TRH C6-C10 less BTEX (F1)^{N04}	20	mg/kg	-	< 20	-	< 20
TRH >C10-C16	50	mg/kg	-	< 50	-	< 50
TRH >C10-C16 less Naphthalene (F2)^{N01}	50	mg/kg	-	< 50	-	< 50
TRH >C16-C34	100	mg/kg	-	< 100	-	< 100
TRH >C34-C40	100	mg/kg	-	< 100	-	< 100
TRH >C10-C40 (total)*	100	mg/kg	-	< 100	-	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	-	1.2
Acenaphthene	0.5	mg/kg	-	< 0.5	-	< 0.5
Acenaphthylene	0.5	mg/kg	-	< 0.5	-	< 0.5
Anthracene	0.5	mg/kg	-	< 0.5	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	-	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	-	< 0.5
Benzo(b&j)fluoranthene^{N07}	0.5	mg/kg	-	< 0.5	-	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	-	< 0.5
Chrysene	0.5	mg/kg	-	< 0.5	-	< 0.5



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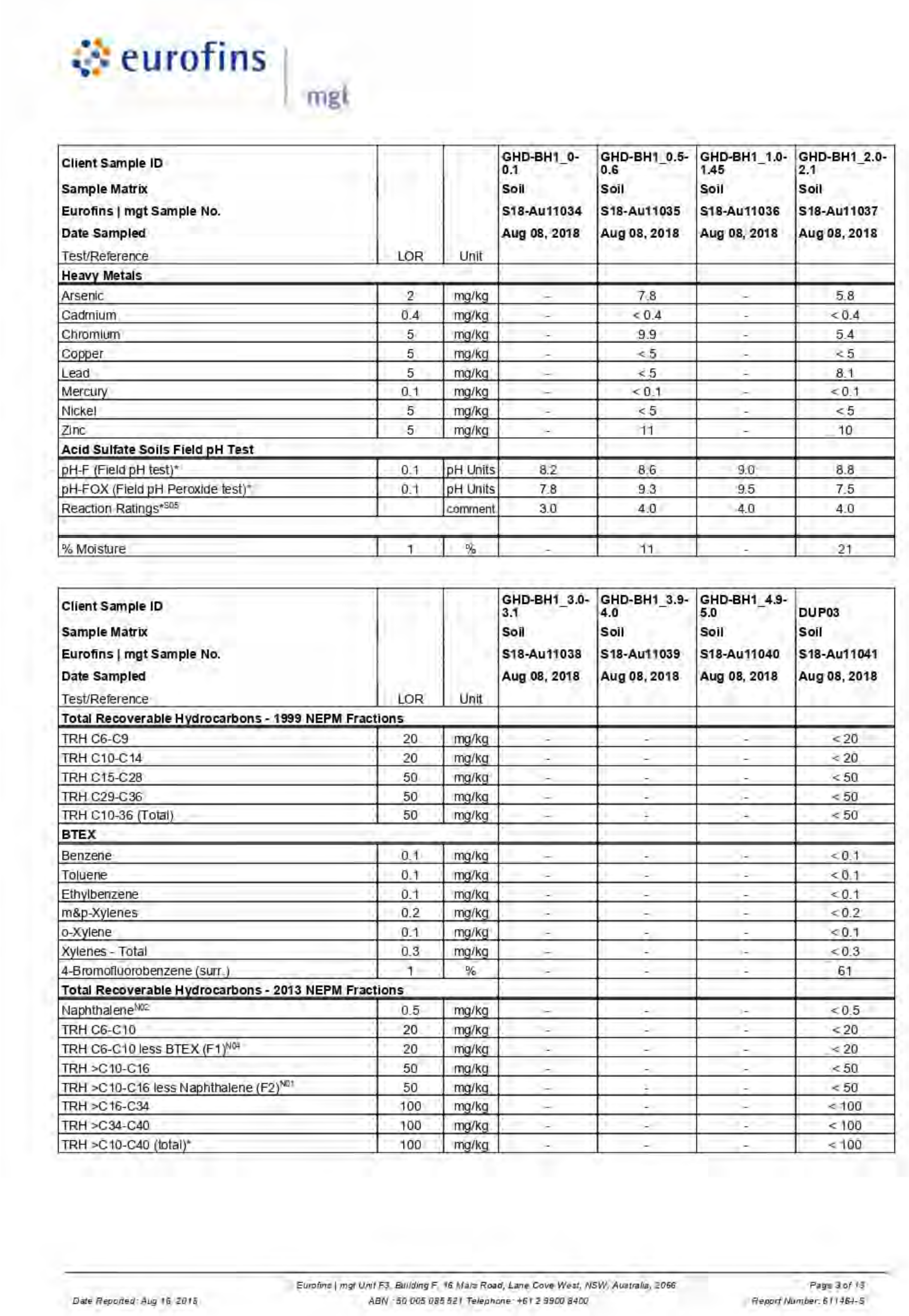
Client Sample ID			**GHD-BH1_0-0.1**	**GHD-BH1_0.5-0.6**	**GHD-BH1_1.0-1.45**	**GHD-BH1_2.0-2.1**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au11034**	**S18-Au11035**	**S18-Au11036**	**S18-Au11037**
Date Sampled			**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	-	< 0.5
Fluoranthene	0.5	mg/kg	-	1.0	-	< 0.5
Fluorene	0.5	mg/kg	-	< 0.5	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	-	< 0.5
Naphthalene	0.5	mg/kg	-	< 0.5	-	< 0.5
Phenanthrene	0.5	mg/kg	-	< 0.5	-	< 0.5
Pyrene	0.5	mg/kg	-	0.9	-	< 0.5
Total PAH*	0.5	mg/kg	-	1.9	-	< 0.5
2-Fluorobiphenyl (surr.)	1	%	-	120	-	113
p-Terphenyl-d14 (surr.)	1	%	-	129	-	119
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	< 0.1	-	-
4.4'-DDD	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDE	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDT	0.05	mg/kg	-	< 0.05	-	-
a-BHC	0.05	mg/kg	-	< 0.05	-	-
Aldrin	0.05	mg/kg	-	< 0.05	-	-
b-BHC	0.05	mg/kg	-	< 0.05	-	-
d-BHC	0.05	mg/kg	-	< 0.05	-	-
Dieldrin	0.05	mg/kg	-	< 0.05	-	-
Endosulfan I	0.05	mg/kg	-	< 0.05	-	-
Endosulfan II	0.05	mg/kg	-	< 0.05	-	-
Endosulfan sulphate	0.05	mg/kg	-	< 0.05	-	-
Endrin	0.05	mg/kg	-	< 0.05	-	-
Endrin aldehyde	0.05	mg/kg	-	< 0.05	-	-
Endrin ketone	0.05	mg/kg	-	< 0.05	-	-
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05	-	-
Heptachlor	0.05	mg/kg	-	< 0.05	-	-
Heptachlor epoxide	0.05	mg/kg	-	< 0.05	-	-
Hexachlorobenzene	0.05	mg/kg	-	< 0.05	-	-
Methoxychlor	0.2	mg/kg	-	< 0.2	-	-
Toxaphene	1	mg/kg	-	< 1	-	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	-	< 0.05	-	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	-	< 0.05	-	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	-	< 0.1	-	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	-	< 0.1	-	-
Dibutylchlorendate (surr.)	1	%	-	86	-	-
Tetrachloro-m-xylene (surr.)	1	%	-	87	-	-
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	-	< 0.5	-	-
Aroclor-1221	0.1	mg/kg	-	< 0.1	-	-
Aroclor-1232	0.5	mg/kg	-	< 0.5	-	-
Aroclor-1242	0.5	mg/kg	-	< 0.5	-	-
Aroclor-1248	0.5	mg/kg	-	< 0.5	-	-
Aroclor-1254	0.5	mg/kg	-	< 0.5	-	-
Aroclor-1260	0.5	mg/kg	-	< 0.5	-	-
Total PCB*	0.5	mg/kg	-	< 0.5	-	-
Dibutylchlorendate (surr.)	1	%	-	86	-	-
Tetrachloro-m-xylene (surr.)	1	%	-	87	-	-



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Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	GHD-BH1_0-0.1 Soil S18-Au11034 Aug 08, 2018	GHD-BH1_0.5-0.6 Soil S18-Au11035 Aug 08, 2018	GHD-BH1_1.0-1.45 Soil S18-Au11036 Aug 08, 2018	GHD-BH1_2.0-2.1 Soil S18-Au11037 Aug 08, 2018
Heavy Metals						
Arsenic	2	mg/kg	-	7.8	-	5.8
Cadmium	0.4	mg/kg	-	< 0.4	-	< 0.4
Chromium	5	mg/kg	-	9.9	-	5.4
Copper	5	mg/kg	-	< 5	-	< 5
Lead	5	mg/kg	-	< 5	-	8.1
Mercury	0.1	mg/kg	-	< 0.1	-	< 0.1
Nickel	5	mg/kg	-	< 5	-	< 5
Zinc	5	mg/kg	-	11	-	10
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	8.2	8.6	9.0	8.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.8	9.3	9.5	7.5
Reaction Ratings*^{S05}		comment	3.0	4.0	4.0	4.0
% Moisture	1	%	-	11	-	21

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	GHD-BH1_3.0-3.1 Soil S18-Au11038 Aug 08, 2018	GHD-BH1_3.9-4.0 Soil S18-Au11039 Aug 08, 2018	GHD-BH1_4.9-5.0 Soil S18-Au11040 Aug 08, 2018	DUP03 Soil S18-Au11041 Aug 08, 2018
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	-	-	< 20
TRH C10-C14	20	mg/kg	-	-	-	< 20
TRH C15-C28	50	mg/kg	-	-	-	< 50
TRH C29-C36	50	mg/kg	-	-	-	< 50
TRH C10-36 (Total)	50	mg/kg	-	-	-	< 50
BTEX						
Benzene	0.1	mg/kg	-	-	-	< 0.1
Toluene	0.1	mg/kg	-	-	-	< 0.1
Ethylbenzene	0.1	mg/kg	-	-	-	< 0.1
m&p-Xylenes	0.2	mg/kg	-	-	-	< 0.2
o-Xylene	0.1	mg/kg	-	-	-	< 0.1
Xylenes - Total	0.3	mg/kg	-	-	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	-	-	61
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene^{N02}	0.5	mg/kg	-	-	-	< 0.5
TRH C6-C10	20	mg/kg	-	-	-	< 20
TRH C6-C10 less BTEX (F1)^{N04}	20	mg/kg	-	-	-	< 20
TRH >C10-C16	50	mg/kg	-	-	-	< 50
TRH >C10-C16 less Naphthalene (F2)^{N01}	50	mg/kg	-	-	-	< 50
TRH >C16-C34	100	mg/kg	-	-	-	< 100
TRH >C34-C40	100	mg/kg	-	-	-	< 100
TRH >C10-C40 (total)*	100	mg/kg	-	-	-	< 100

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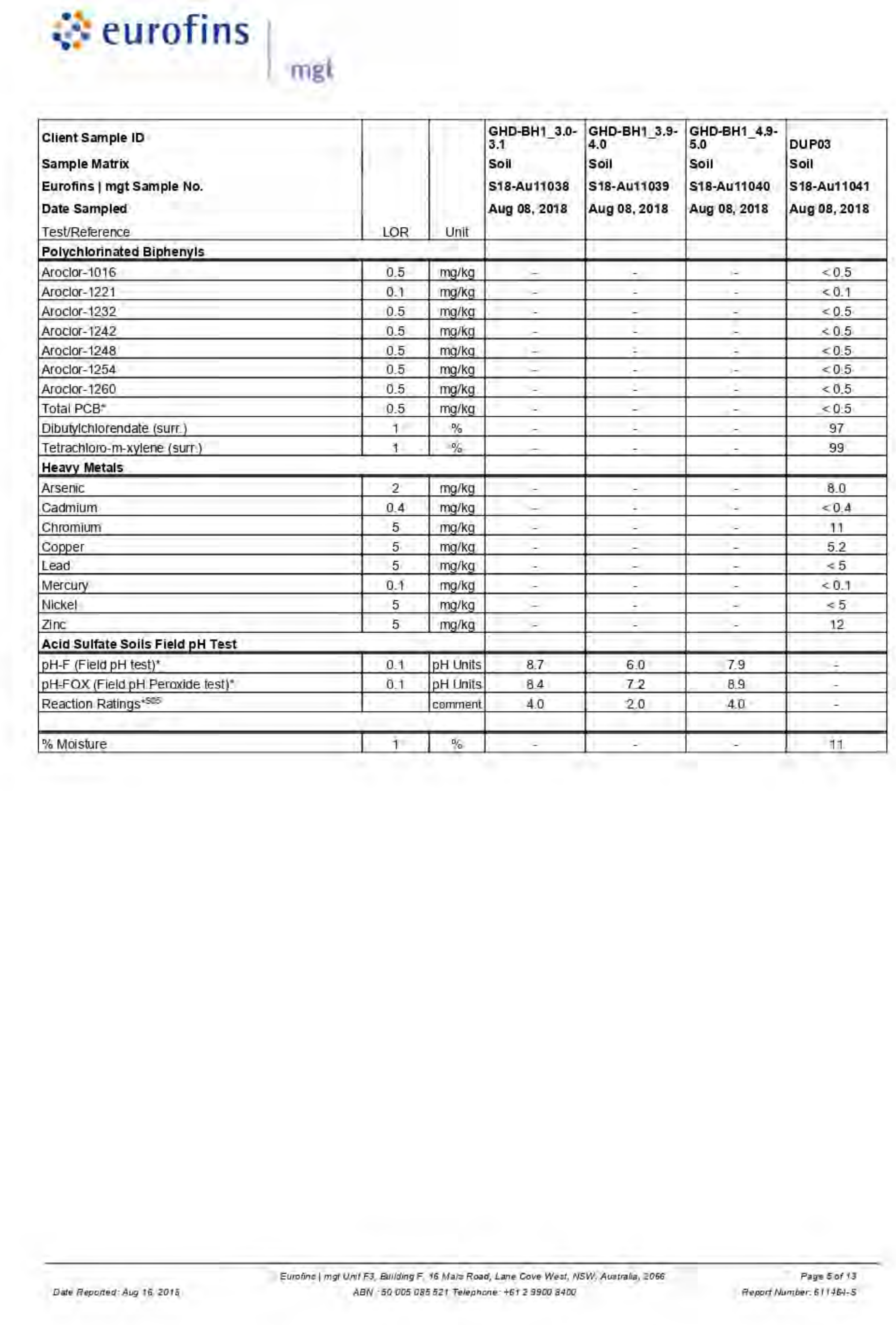
Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH1_3.0-3.1** **Soil** **S18-Au11038** **Aug 08, 2018**	**GHD-BH1_3.9-4.0** **Soil** **S18-Au11039** **Aug 08, 2018**	**GHD-BH1_4.9-5.0** **Soil** **S18-Au11040** **Aug 08, 2018**	**DUP03** **Soil** **S18-Au11041** **Aug 08, 2018**
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	-	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	-	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	-	-	1.2
Acenaphthene	0.5	mg/kg	-	-	-	< 0.5
Acenaphthylene	0.5	mg/kg	-	-	-	< 0.5
Anthracene	0.5	mg/kg	-	-	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	-	-	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	-	-	< 0.5
Benzo(b&j)fluoranthene^{N07}	0.5	mg/kg	-	-	-	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	-	-	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	-	-	< 0.5
Chrysene	0.5	mg/kg	-	-	-	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	-	-	-	< 0.5
Fluoranthene	0.5	mg/kg	-	-	-	0.8
Fluorene	0.5	mg/kg	-	-	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	-	-	< 0.5
Naphthalene	0.5	mg/kg	-	-	-	< 0.5
Phenanthrene	0.5	mg/kg	-	-	-	< 0.5
Pyrene	0.5	mg/kg	-	-	-	0.7
Total PAH*	0.5	mg/kg	-	-	-	1.5
2-Fluorobiphenyl (surr.)	1	%	-	-	-	113
p-Terphenyl-d14 (surr.)	1	%	-	-	-	121
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	-	< 0.1
4.4'-DDD	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDE	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDT	0.05	mg/kg	-	-	-	< 0.05
a-BHC	0.05	mg/kg	-	-	-	< 0.05
Aldrin	0.05	mg/kg	-	-	-	< 0.05
b-BHC	0.05	mg/kg	-	-	-	< 0.05
d-BHC	0.05	mg/kg	-	-	-	< 0.05
Dieldrin	0.05	mg/kg	-	-	-	< 0.05
Endosulfan I	0.05	mg/kg	-	-	-	< 0.05
Endosulfan II	0.05	mg/kg	-	-	-	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	-	-	< 0.05
Endrin	0.05	mg/kg	-	-	-	< 0.05
Endrin aldehyde	0.05	mg/kg	-	-	-	< 0.05
Endrin ketone	0.05	mg/kg	-	-	-	< 0.05
g-BHC (Lindane)	0.05	mg/kg	-	-	-	< 0.05
Heptachlor	0.05	mg/kg	-	-	-	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	-	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	-	< 0.05
Methoxychlor	0.2	mg/kg	-	-	-	< 0.2
Toxaphene	1	mg/kg	-	-	-	< 1
Aldrin and Dieldrin (Total)*	0.05	mg/kg	-	-	-	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	-	-	-	< 0.05
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	-	-	-	< 0.1
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	-	-	-	< 0.1
Dibutylchlorendate (surr.)	1	%	-	-	-	97
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	99



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Client Sample ID			**GHD-BH1_3.0-3.1**	**GHD-BH1_3.9-4.0**	**GHD-BH1_4.9-5.0**	**DUP03**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au11038**	**S18-Au11039**	**S18-Au11040**	**S18-Au11041**
Date Sampled			**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**	**Aug 08, 2018**
Test/Reference	LOR	Unit				
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	-	-	-	< 0.5
Aroclor-1221	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1232	0.5	mg/kg	-	-	-	< 0.5
Aroclor-1242	0.5	mg/kg	-	-	-	< 0.5
Aroclor-1248	0.5	mg/kg	-	-	-	< 0.5
Aroclor-1254	0.5	mg/kg	-	-	-	< 0.5
Aroclor-1260	0.5	mg/kg	-	-	-	< 0.5
Total PCB*	0.5	mg/kg	-	-	-	< 0.5
Dibutylchlorendate (surr.)	1	%	-	-	-	97
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	99
Heavy Metals						
Arsenic	2	mg/kg	-	-	-	8.0
Cadmium	0.4	mg/kg	-	-	-	< 0.4
Chromium	5	mg/kg	-	-	-	11
Copper	5	mg/kg	-	-	-	5.2
Lead	5	mg/kg	-	-	-	< 5
Mercury	0.1	mg/kg	-	-	-	< 0.1
Nickel	5	mg/kg	-	-	-	< 5
Zinc	5	mg/kg	-	-	-	12
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	8.7	6.0	7.9	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	8.4	7.2	8.9	-
Reaction Ratings*S05		comment	4.0	2.0	4.0	-
% Moisture	1	%	-	-	-	11

Date Reported: Aug 16, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
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Page 5 of 13
Report Number: 611464-S

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: TRH C6-C36 - LTM-ORG-2010	Sydney	Aug 13, 2018	14 Day
BTEX - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 13, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 13, 2018	14 Day
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: TRH C6-C40 - LTM-ORG-2010	Sydney	Aug 13, 2018	14 Day
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Sydney	Aug 13, 2018	14 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Aug 13, 2018	28 Day
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Aug 13, 2018	14 Day
Polychlorinated Biphenyls - Method: LTM-ORG-2220 OCP & PCB in Soil and Water	Sydney	Aug 13, 2018	28 Days
Acid Sulfate Soils Field pH Test - Method: LTM-GEN-7080 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests	Brisbane	Aug 10, 2018	7 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Sydney	Aug 09, 2018	14 Day

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NATA # 1261
Site # 23736

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425	**Received:**	Aug 9, 2018 9:40 AM
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	611464	**Due:**	Aug 16, 2018
		Phone:	02 9239 7100	**Priority:**	5 Day
		Fax:	02 9239 7199	**Contact Name:**	Clifton Thompson
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT				
Project ID:	2127425				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X		X	X	X
Brisbane Laboratory - NATA Site # 20794								X			
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	GHD-BH1_0-0.1	Aug 08, 2018		Soil	S18-Au11034			X			
2	GHD-BH1_0.5-0.6	Aug 08, 2018		Soil	S18-Au11035	X		X	X	X	X
3	GHD-BH1_1.0-1.45	Aug 08, 2018		Soil	S18-Au11036			X			
4	GHD-BH1_2.0-2.1	Aug 08, 2018		Soil	S18-Au11037			X		X	X
5	GHD-BH1_3.0-3.1	Aug 08, 2018		Soil	S18-Au11038			X			
6	GHD-	Aug 08, 2018		Soil	S18-Au11039			X			

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Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
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NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 611464
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 9, 2018 9:40 AM
Due: Aug 16, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	HOLD	Acid Sulfate Soils Field pH Test	Eurofins | mgt Suite B13	Moisture Set	Eurofins | mgt Suite B7
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X		X	X	X
Brisbane Laboratory - NATA Site # 20794								X			
Perth Laboratory - NATA Site # 23736											
	BH1_3.9-4.0										
7	GHD-BH1_4.9-5.0	Aug 08, 2018		Soil	S18-Au11040			X			
8	DUP03	Aug 08, 2018		Soil	S18-Au11041				X	X	X
9	RIN2	Aug 08, 2018		Water	S18-Au11042		X				
10	DUP04	Aug 08, 2018		Soil	S18-Au11043		X				
Test Counts						1	2	7	2	3	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

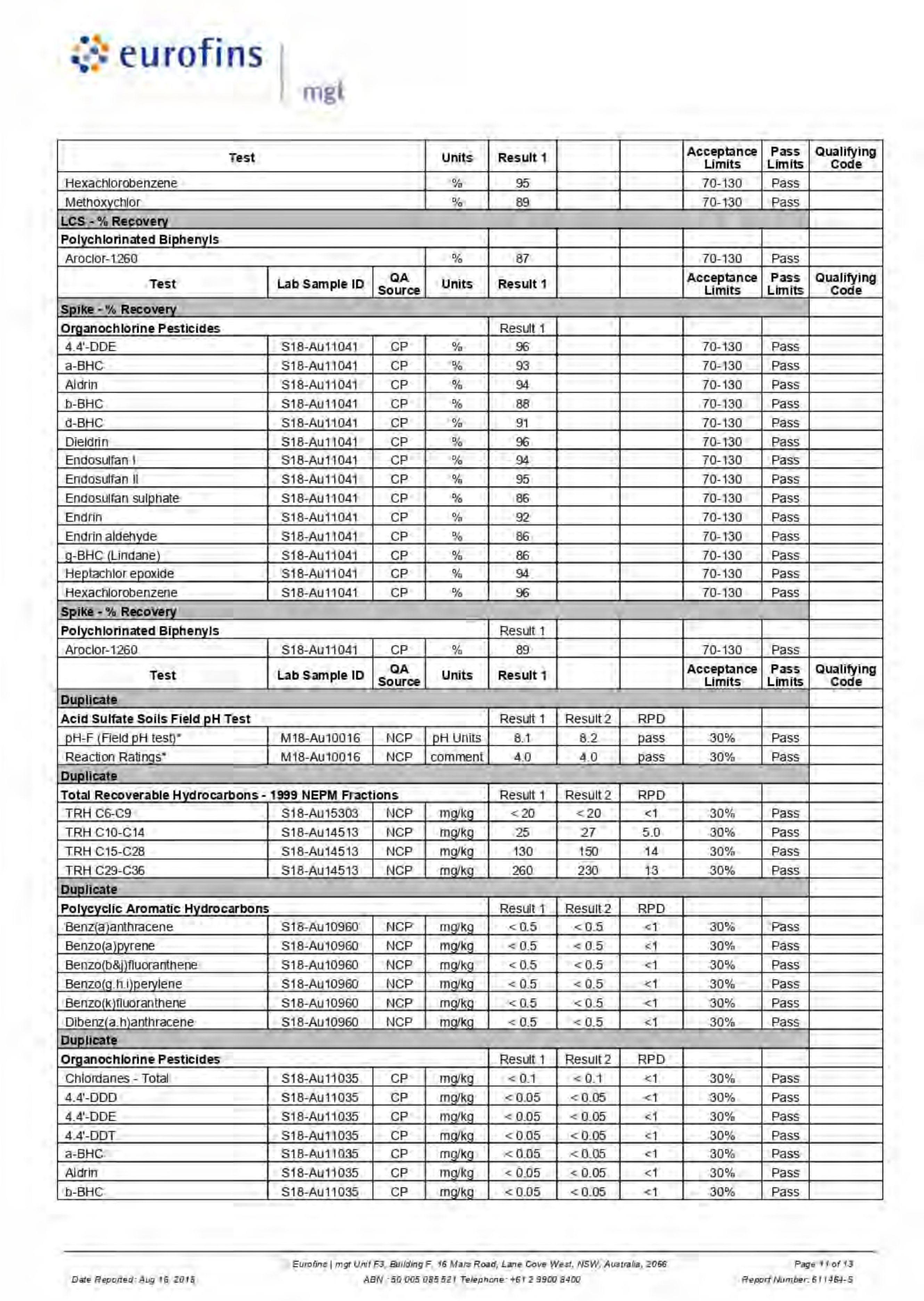
WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	85			70-130	Pass	
4.4'-DDE	%	85			70-130	Pass	
4.4'-DDT	%	85			70-130	Pass	
a-BHC	%	91			70-130	Pass	
Aldrin	%	85			70-130	Pass	
b-BHC	%	85			70-130	Pass	
d-BHC	%	84			70-130	Pass	
Dieldrin	%	86			70-130	Pass	
Endosulfan I	%	85			70-130	Pass	
Endosulfan II	%	83			70-130	Pass	
Endosulfan sulphate	%	84			70-130	Pass	
Endrin	%	89			70-130	Pass	
Endrin aldehyde	%	80			70-130	Pass	
Endrin ketone	%	86			70-130	Pass	
g-BHC (Lindane)	%	90			70-130	Pass	
Heptachlor	%	91			70-130	Pass	
Heptachlor epoxide	%	88			70-130	Pass	



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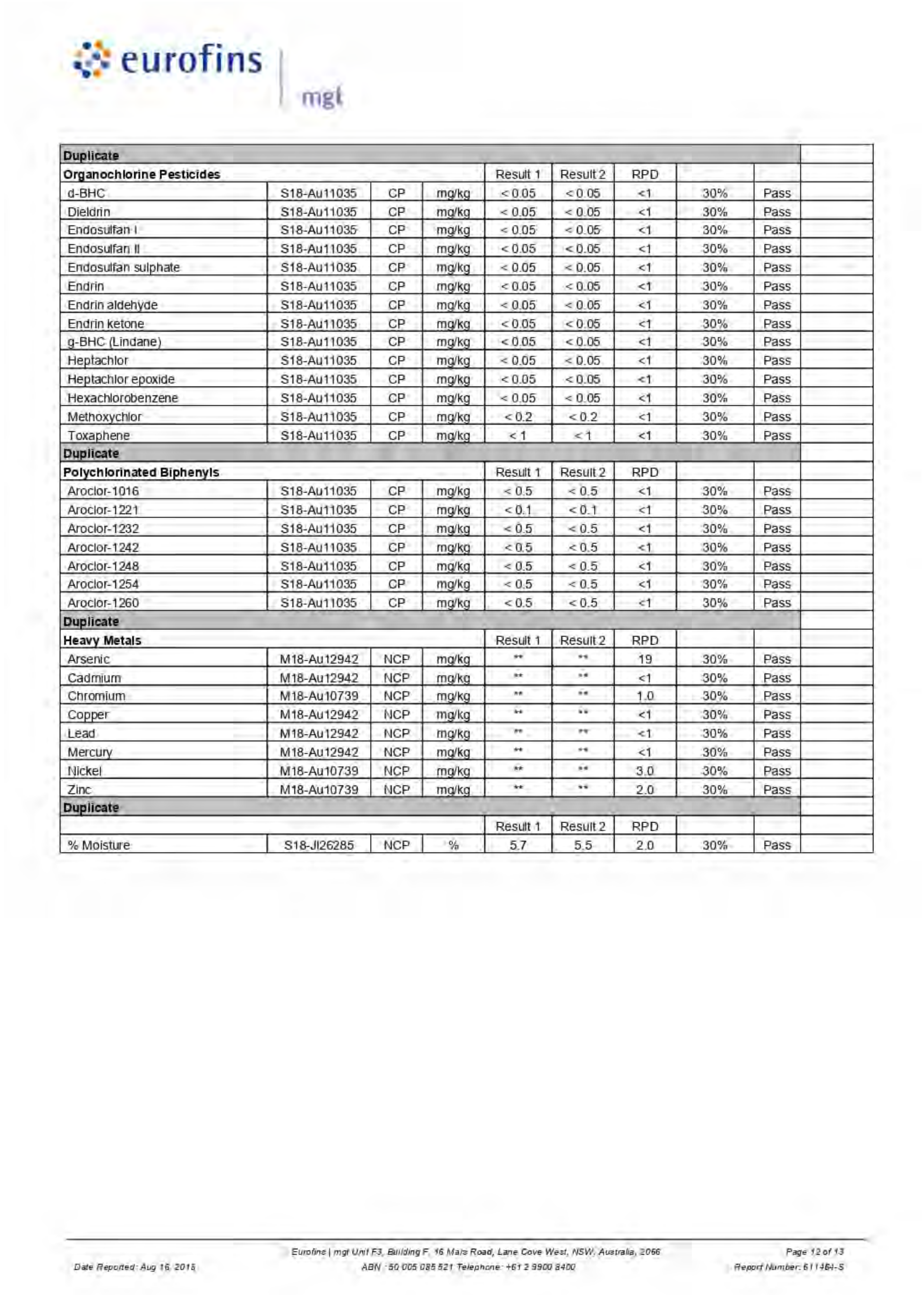
Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Hexachlorobenzene			%	95			70-130	Pass	
Methoxychlor			%	89			70-130	Pass	
LCS - % Recovery									
Polychlorinated Biphenyls									
Aroclor-1260			%	87			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDE	S18-Au11041	CP	%	96			70-130	Pass	
a-BHC	S18-Au11041	CP	%	93			70-130	Pass	
Aldrin	S18-Au11041	CP	%	94			70-130	Pass	
b-BHC	S18-Au11041	CP	%	88			70-130	Pass	
d-BHC	S18-Au11041	CP	%	91			70-130	Pass	
Dieldrin	S18-Au11041	CP	%	96			70-130	Pass	
Endosulfan I	S18-Au11041	CP	%	94			70-130	Pass	
Endosulfan II	S18-Au11041	CP	%	95			70-130	Pass	
Endosulfan sulphate	S18-Au11041	CP	%	86			70-130	Pass	
Endrin	S18-Au11041	CP	%	92			70-130	Pass	
Endrin aldehyde	S18-Au11041	CP	%	86			70-130	Pass	
g-BHC (Lindane)	S18-Au11041	CP	%	86			70-130	Pass	
Heptachlor epoxide	S18-Au11041	CP	%	94			70-130	Pass	
Hexachlorobenzene	S18-Au11041	CP	%	96			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S18-Au11041	CP	%	89			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	M18-Au10016	NCP	pH Units	8.1	8.2	pass	30%	Pass	
Reaction Ratings*	M18-Au10016	NCP	comment	4.0	4.0	pass	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-Au15303	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	S18-Au14513	NCP	mg/kg	25	27	5.0	30%	Pass	
TRH C15-C28	S18-Au14513	NCP	mg/kg	130	150	14	30%	Pass	
TRH C29-C36	S18-Au14513	NCP	mg/kg	260	230	13	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Benz(a)anthracene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S18-Au10960	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-Au11035	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	



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Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
d-BHC	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-Au11035	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-Au11035	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-Au11035	CP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S18-Au11035	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S18-Au11035	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M18-Au12942	NCP	mg/kg	**	**	19	30%	Pass	
Cadmium	M18-Au12942	NCP	mg/kg	**	**	<1	30%	Pass	
Chromium	M18-Au10739	NCP	mg/kg	**	**	1.0	30%	Pass	
Copper	M18-Au12942	NCP	mg/kg	**	**	<1	30%	Pass	
Lead	M18-Au12942	NCP	mg/kg	**	**	<1	30%	Pass	
Mercury	M18-Au12942	NCP	mg/kg	**	**	<1	30%	Pass	
Nickel	M18-Au10739	NCP	mg/kg	**	**	3.0	30%	Pass	
Zinc	M18-Au10739	NCP	mg/kg	**	**	2.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S18-Jl26285	NCP	%	5.7	5.5	2.0	30%	Pass	

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
Page 12 of 13
Date Reported: Aug 16, 2018
ABN : 50 005 085 521 Telephone: +61 2 9900 8400
Report Number: 611464-S

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Nibha Vaidya	Analytical Services Manager
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

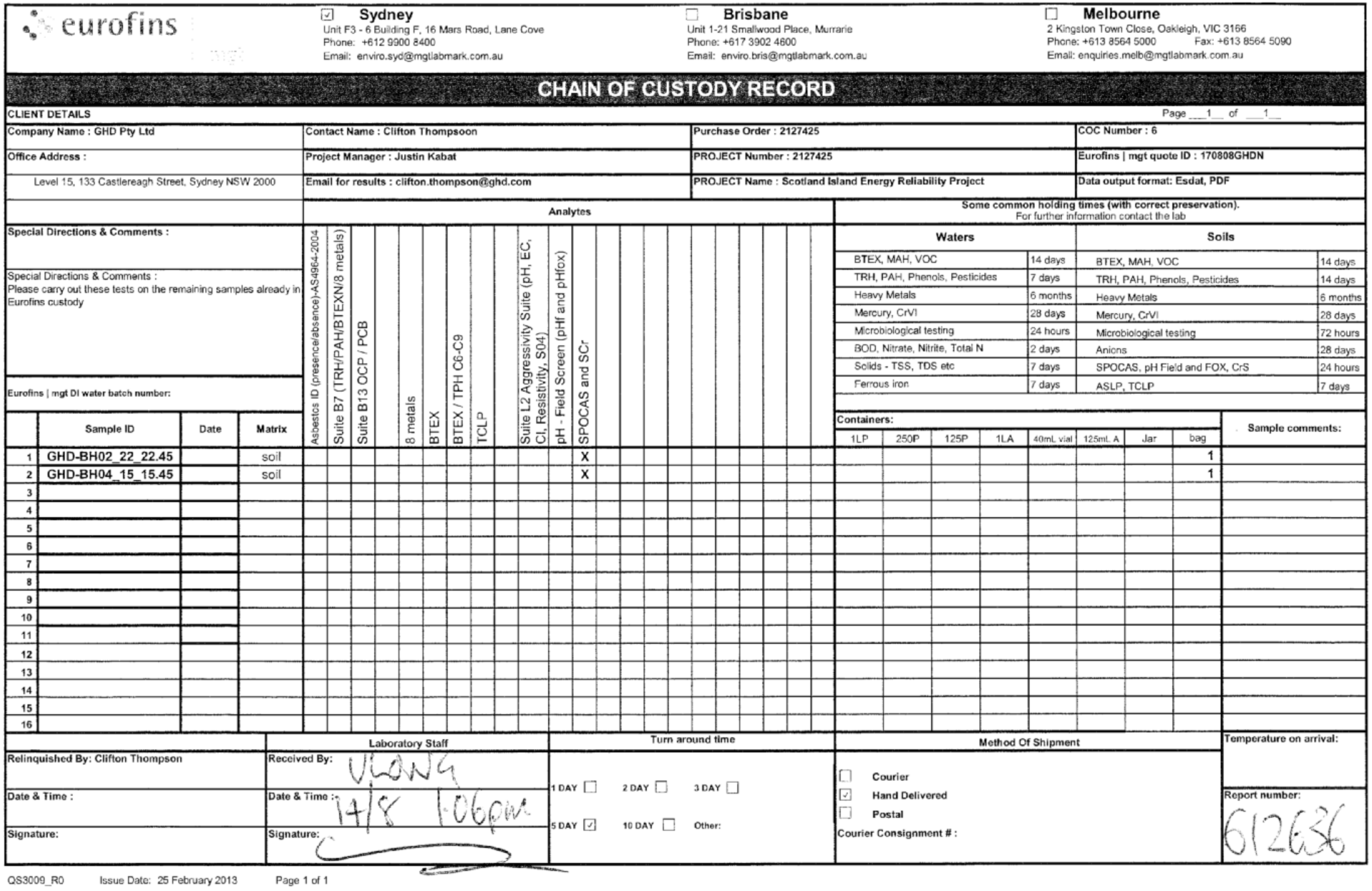
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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CHAIN OF CUSTODY RECORD

CLIENT DETAILS Page 1 of 1

Company Name : GHD Pty Ltd	Contact Name : Clifton Thompsoon	Purchase Order : 2127425	COC Number : 6
Office Address :	Project Manager : Justin Kabat	PROJECT Number : 2127425	Eurofins | mgt quote ID : 170808GHDN
Level 15, 133 Castlereagh Street, Sydney NSW 2000	Email for results : clifton.thompson@ghd.com	PROJECT Name : Scotland Island Energy Reliability Project	Data output format: Esdat, PDF

Special Directions & Comments :

Special Directions & Comments :
Please carry out these tests on the remaining samples already in Eurofins custody

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

Analytes

	Sample ID	Date	Matrix	Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	SPOCAS and SCr	1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH02_22_22.45		soil										X								1	
2	GHD-BH04_15_15.45		soil										X								1	
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						
16																						

Containers:

	Laboratory Staff	Turn around time	Method Of Shipment	Temperature on arrival:
Relinquished By: Clifton Thompson	Received By: VLONG	1 DAY ☐ 2 DAY ☐ 3 DAY ☐	☐ Courier	
Date & Time :	Date & Time : 14/8 1:06pm	5 DAY ☑ 10 DAY ☐ Other:	☑ Hand Delivered	Report number:
Signature:	Signature:		☐ Postal Courier Consignment # :	612636

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1

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NATA # 1261 Site # 20794

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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Clifton Thompson
Project name:	ADDITIONAL - SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID:	2127425
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Aug 14, 2018 1:06 PM
Eurofins | mgt reference:	**612636**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 5.3 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

Testing For Life
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

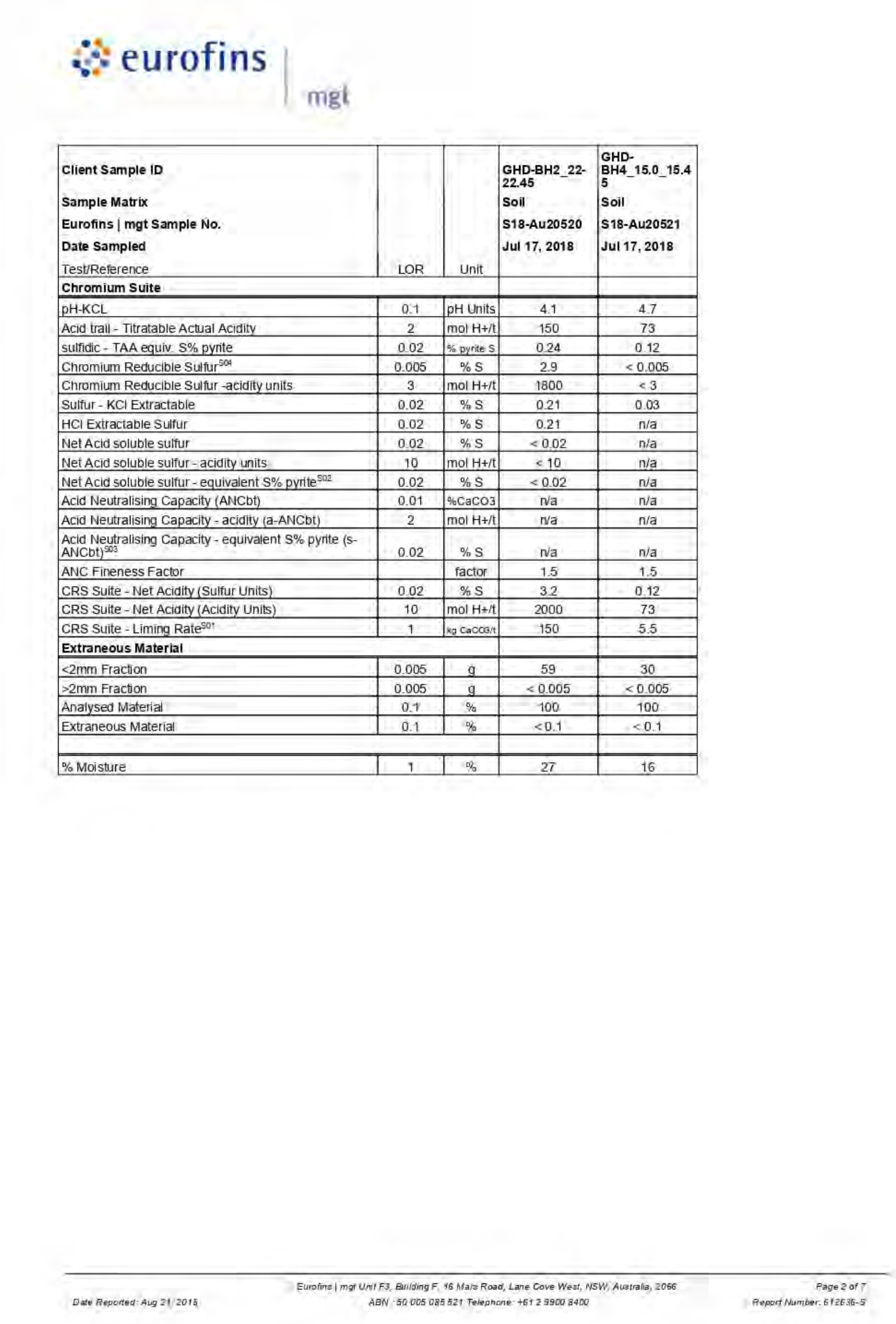
Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention: **Clifton Thompson**

Report **612636-S**
Project name ADDITIONAL - SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Received Date Aug 14, 2018

Client Sample ID			**GHD-BH2_22-22.45**	**GHD-BH4_15.0_15.45**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au20520**	**S18-Au20521**
Date Sampled			**Jul 17, 2018**	**Jul 17, 2018**
Test/Reference	LOR	Unit		
SPOCAS Suite				
pH-KCL	0.1	pH Units	4.1	4.7
pH-OX	0.1	pH Units	1.6	3.6
Acid trail - Titratable Actual Acidity	2	mol H+/t	150	73
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	2500	170
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	2400	92
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.24	0.12
sulfidic - TPA equiv. S% pyrite	0.02	% pyrite S	4.0	0.27
sulfidic - TSA equiv. S% pyrite	0.02	% pyrite S	3.8	0.15
Sulfur - KCl Extractable	0.02	% S	0.21	0.03
Sulfur - Peroxide	0.02	% S	3.6	0.04
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	3.3	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	2100	< 10
HCl Extractable Sulfur	0.02	% S	0.21	n/a
Net Acid soluble sulfur	0.02	% S	< 0.02	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	< 10	n/a
Net Acid soluble sulfur - equivalent S% pyrite^{S02}	0.02	% S	< 0.02	n/a
Calcium - KCl Extractable	0.02	% Ca	0.10	0.04
Calcium - Peroxide	0.02	% Ca	0.09	0.04
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10
sulfidic - Acid Reacted Ca equiv. S% pyrite	0.02	% S	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	0.10	0.08
Magnesium - Peroxide	0.02	% Mg	0.10	0.07
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10
sulfidic - Acid Reacted Mg equiv. S% pyrite	0.02	% S	< 0.02	< 0.02
Acid Neutralising Capacity (ANCE)	0.02	%CaCO3	n/a	n/a
Acid Neutralising Capacity - Acidity units (a-ANCE)	10	mol H+/t	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite(s-ANCE)	0.02	% S	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5
SPOCAS - Net Acidity (Sulfur Units)	0.02	% S	3.6	0.13
SPOCAS - Net Acidity (Acidity Units)	10	mol H+/t	2200	79
SPOCAS - Liming rate	1	kg CaCO3/t	170	6.0



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Client Sample ID			**GHD-BH2_22-22.45**	**GHD-BH4_15.0_15.45**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au20520**	**S18-Au20521**
Date Sampled			**Jul 17, 2018**	**Jul 17, 2018**
Test/Reference	LOR	Unit		
Chromium Suite				
pH-KCL	0.1	pH Units	4.1	4.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	150	73
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.24	0.12
Chromium Reducible Sulfur[S04]	0.005	% S	2.9	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	1800	< 3
Sulfur - KCl Extractable	0.02	% S	0.21	0.03
HCl Extractable Sulfur	0.02	% S	0.21	n/a
Net Acid soluble sulfur	0.02	% S	< 0.02	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	< 10	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	3.2	0.12
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	2000	73
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	150	5.5
Extraneous Material				
<2mm Fraction	0.005	g	59	30
>2mm Fraction	0.005	g	< 0.005	< 0.005
Analysed Material	0.1	%	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1
% Moisture	1	%	27	16

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
SPOCAS Suite			
SPOCAS Suite	Brisbane	Aug 16, 2018	6 Week
- Method: LTM-GEN-7050			
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Aug 16, 2018	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Aug 16, 2018	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Aug 16, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: ADDITIONAL - SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.:
Report #: 612636
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Aug 14, 2018 1:06 PM
Due: Aug 21, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						SPOCAS Suite	Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217								
Brisbane Laboratory - NATA Site # 20794						X	X	X
Perth Laboratory - NATA Site # 23736								
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	GHD-BH2_22-22.45	Jul 17, 2018		Soil	S18-Au20520	X	X	X
2	GHD-BH4_15.0_15.45	Jul 17, 2018		Soil	S18-Au20521	X	X	X
Test Counts						2	2	2

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
ppm: Parts per million
org/100mL: Organisms per 100 millilitres
mg/L: milligrams per litre
ppb: Parts per billion
NTU: Nephelometric Turbidity Units
ug/L: micrograms per litre
%: Percentage
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

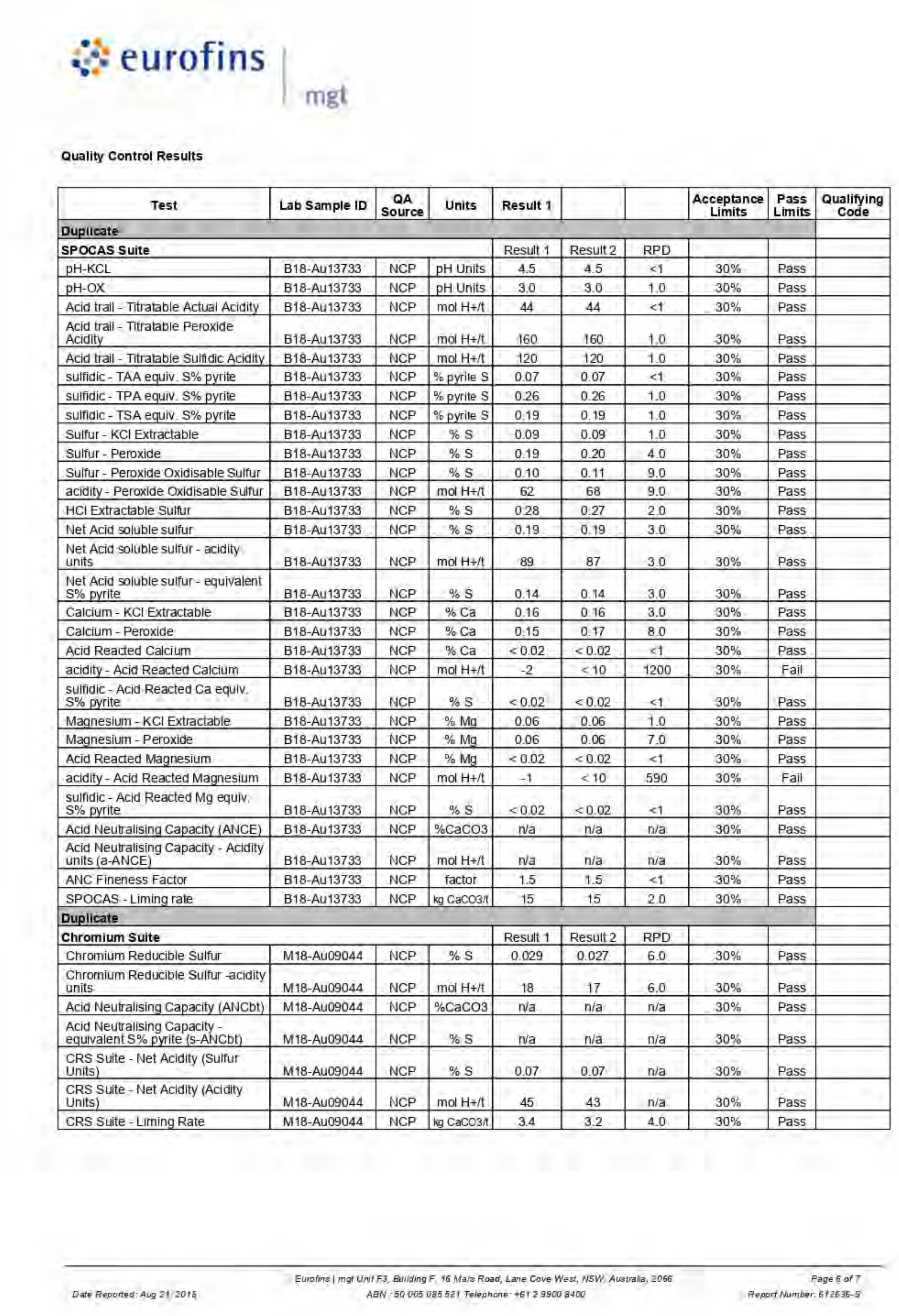
Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



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Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
SPOCAS Suite				Result 1	Result 2	RPD			
pH-KCL	B18-Au13733	NCP	pH Units	4.5	4.5	<1	30%	Pass	
pH-OX	B18-Au13733	NCP	pH Units	3.0	3.0	1.0	30%	Pass	
Acid trail - Titratable Actual Acidity	B18-Au13733	NCP	mol H+/t	44	44	<1	30%	Pass	
Acid trail - Titratable Peroxide Acidity	B18-Au13733	NCP	mol H+/t	160	160	1.0	30%	Pass	
Acid trail - Titratable Sulfidic Acidity	B18-Au13733	NCP	mol H+/t	120	120	1.0	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B18-Au13733	NCP	% pyrite S	0.07	0.07	<1	30%	Pass	
sulfidic - TPA equiv. S% pyrite	B18-Au13733	NCP	% pyrite S	0.26	0.26	1.0	30%	Pass	
sulfidic - TSA equiv. S% pyrite	B18-Au13733	NCP	% pyrite S	0.19	0.19	1.0	30%	Pass	
Sulfur - KCl Extractable	B18-Au13733	NCP	% S	0.09	0.09	1.0	30%	Pass	
Sulfur - Peroxide	B18-Au13733	NCP	% S	0.19	0.20	4.0	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	B18-Au13733	NCP	% S	0.10	0.11	9.0	30%	Pass	
acidity - Peroxide Oxidisable Sulfur	B18-Au13733	NCP	mol H+/t	62	68	9.0	30%	Pass	
HCl Extractable Sulfur	B18-Au13733	NCP	% S	0.28	0.27	2.0	30%	Pass	
Net Acid soluble sulfur	B18-Au13733	NCP	% S	0.19	0.19	3.0	30%	Pass	
Net Acid soluble sulfur - acidity units	B18-Au13733	NCP	mol H+/t	89	87	3.0	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B18-Au13733	NCP	% S	0.14	0.14	3.0	30%	Pass	
Calcium - KCl Extractable	B18-Au13733	NCP	% Ca	0.16	0.16	3.0	30%	Pass	
Calcium - Peroxide	B18-Au13733	NCP	% Ca	0.15	0.17	8.0	30%	Pass	
Acid Reacted Calcium	B18-Au13733	NCP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Calcium	B18-Au13733	NCP	mol H+/t	-2	< 10	1200	30%	Fail	
sulfidic - Acid Reacted Ca equiv. S% pyrite	B18-Au13733	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - KCl Extractable	B18-Au13733	NCP	% Mg	0.06	0.06	1.0	30%	Pass	
Magnesium - Peroxide	B18-Au13733	NCP	% Mg	0.06	0.06	7.0	30%	Pass	
Acid Reacted Magnesium	B18-Au13733	NCP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Magnesium	B18-Au13733	NCP	mol H+/t	-1	< 10	590	30%	Fail	
sulfidic - Acid Reacted Mg equiv. S% pyrite	B18-Au13733	NCP	% S	< 0.02	< 0.02	<1	30%	Pass	
Acid Neutralising Capacity (ANCE)	B18-Au13733	NCP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - Acidity units (a-ANCE)	B18-Au13733	NCP	mol H+/t	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B18-Au13733	NCP	factor	1.5	1.5	<1	30%	Pass	
SPOCAS - Liming rate	B18-Au13733	NCP	kg CaCO3/t	15	15	2.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
Chromium Reducible Sulfur	M18-Au09044	NCP	% S	0.029	0.027	6.0	30%	Pass	
Chromium Reducible Sulfur -acidity units	M18-Au09044	NCP	mol H+/t	18	17	6.0	30%	Pass	
Acid Neutralising Capacity (ANCbt)	M18-Au09044	NCP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	M18-Au09044	NCP	% S	n/a	n/a	n/a	30%	Pass	
CRS Suite - Net Acidity (Sulfur Units)	M18-Au09044	NCP	% S	0.07	0.07	n/a	30%	Pass	
CRS Suite - Net Acidity (Acidity Units)	M18-Au09044	NCP	mol H+/t	45	43	n/a	30%	Pass	
CRS Suite - Liming Rate	M18-Au09044	NCP	kg CaCO3/t	3.4	3.2	4.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Nibha Vaidya	Analytical Services Manager
Steven Trout	Senior Analyst-Metal (QLD)

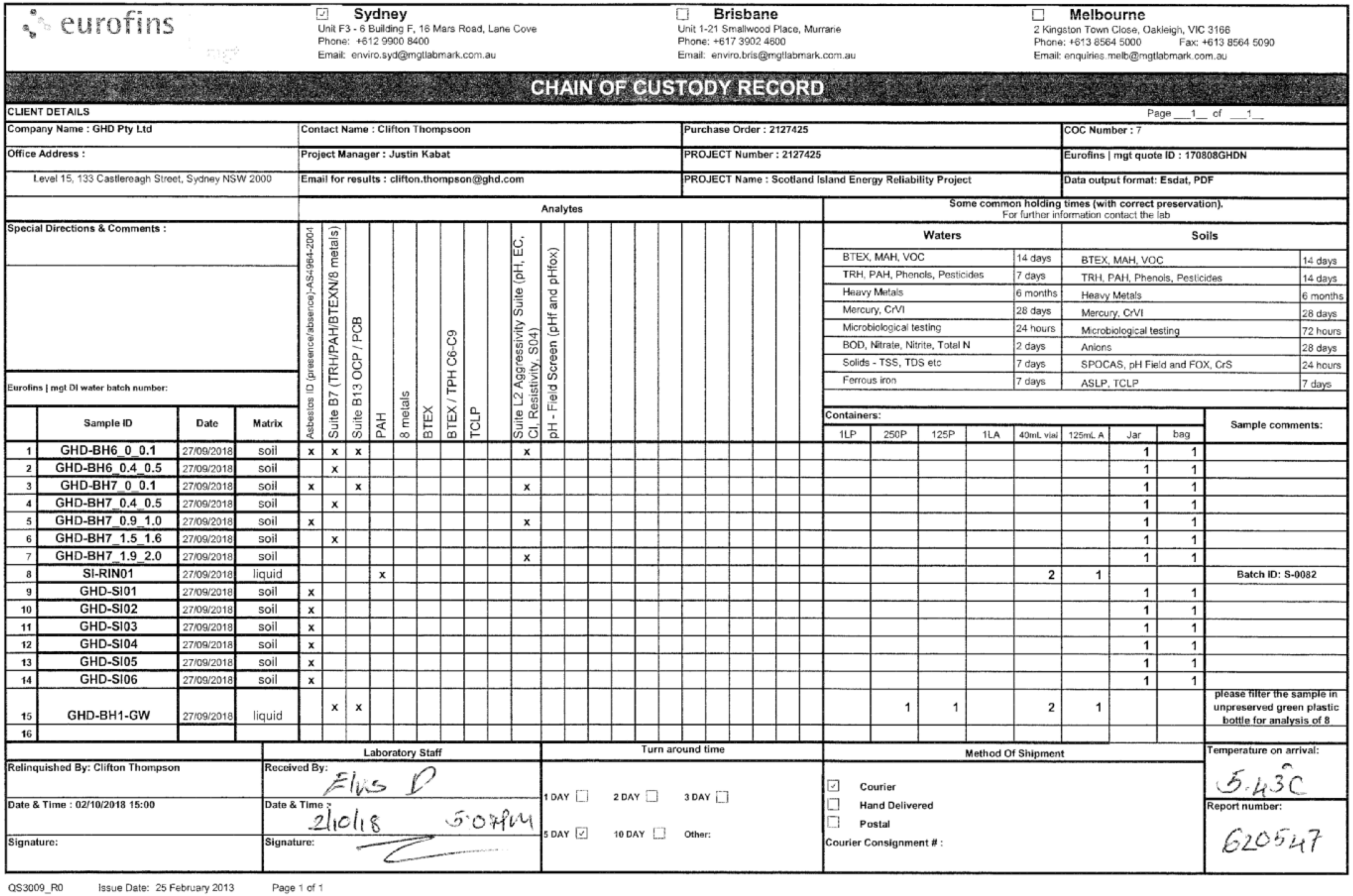
Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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☐ **Melbourne**
2 Kingston Town Close, Oakleigh, VIC 3166
Phone: +613 8564 5000 Fax: +613 8564 5090
Email: enquiries.melb@mgtlabmark.com.au

CHAIN OF CUSTODY RECORD

CLIENT DETAILS

Page 1 of 1

Company Name : GHD Pty Ltd	Contact Name : Clifton Thompsoon	Purchase Order : 2127425	COC Number : 7
Office Address :	Project Manager : Justin Kabat	PROJECT Number : 2127425	Eurofins | mgt quote ID : 170808GHDN
Level 15, 133 Castlereagh Street, Sydney NSW 2000	Email for results : clifton.thompson@ghd.com	PROJECT Name : Scotland Island Energy Reliability Project	Data output format: Esdat, PDF

Special Directions & Comments :

Eurofins | mgt DI water batch number:

Some common holding times (with correct preservation).
For further information contact the lab

Waters		Soils	
BTEX, MAH, VOC	14 days	BTEX, MAH, VOC	14 days
TRH, PAH, Phenols, Pesticides	7 days	TRH, PAH, Phenols, Pesticides	14 days
Heavy Metals	6 months	Heavy Metals	6 months
Mercury, CrVI	28 days	Mercury, CrVI	28 days
Microbiological testing	24 hours	Microbiological testing	72 hours
BOD, Nitrate, Nitrite, Total N	2 days	Anions	28 days
Solids - TSS, TDS etc	7 days	SPOCAS, pH Field and FOX, CrS	24 hours
Ferrous iron	7 days	ASLP, TCLP	7 days

	Sample ID	Date	Matrix	Analytes: Asbestos ID (presence/absence)-AS4964-2004	Suite B7 (TRH/PAH/BTEXN/8 metals)	Suite B13 OCP / PCB	PAH	8 metals	BTEX	BTEX / TPH C6-C9	TCLP	Suite L2 Aggressivity Suite (pH, EC, Cl, Resistivity, S04)	pH - Field Screen (pHf and pHfox)	Containers: 1LP	250P	125P	1LA	40mL vial	125mL A	Jar	bag	Sample comments:
1	GHD-BH6_0_0.1	27/09/2018	soil	x	x	x						x								1	1	
2	GHD-BH6_0.4_0.5	27/09/2018	soil		x															1	1	
3	GHD-BH7_0_0.1	27/09/2018	soil	x		x						x								1	1	
4	GHD-BH7_0.4_0.5	27/09/2018	soil		x															1	1	
5	GHD-BH7_0.9_1.0	27/09/2018	soil	x								x								1	1	
6	GHD-BH7_1.5_1.6	27/09/2018	soil		x															1	1	
7	GHD-BH7_1.9_2.0	27/09/2018	soil									x								1	1	
8	SI-RIN01	27/09/2018	liquid				x											2	1			Batch ID: S-0082
9	GHD-SI01	27/09/2018	soil	x																1	1	
10	GHD-SI02	27/09/2018	soil	x																1	1	
11	GHD-SI03	27/09/2018	soil	x																1	1	
12	GHD-SI04	27/09/2018	soil	x																1	1	
13	GHD-SI05	27/09/2018	soil	x																1	1	
14	GHD-SI06	27/09/2018	soil	x																1	1	
15	GHD-BH1-GW	27/09/2018	liquid		x	x									1	1		2	1			please filter the sample in unpreserved green plastic bottle for analysis of 8
16																						

Relinquished By: Clifton Thompson
Date & Time : 02/10/2018 15:00
Signature:

Laboratory Staff
Received By: Elvis D
Date & Time : 2/10/18 5:07PM
Signature:

Turn around time
1 DAY ☐ 2 DAY ☐ 3 DAY ☐
5 DAY ☑ 10 DAY ☐ Other:

Method Of Shipment
☑ Courier
☐ Hand Delivered
☐ Postal
Courier Consignment # :

Temperature on arrival: 5.4°C
Report number: 620547

QS3009_R0 Issue Date: 25 February 2013 Page 1 of 1

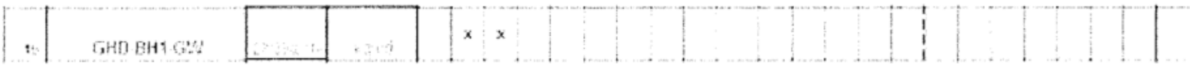
Enviro Sample NSW

From:	Alena Bounkeua
Sent:	Tuesday, 2 October 2018 5:07 PM
To:	Enviro Sample NSW; COC NSW
Subject:	FW: GHD 2127425
Attachments:	COC7 2127425_Eurofins_Chain Of Custody 1_SCOTLAND ISLAND.xls
Follow Up Flag:	Follow up
Flag Status:	Flagged

Hi Guys,

COC for samples arrived on Friday.

Please note that for the last water sample – it is for B7FILT - metals needs to be subbed from the unpreserved and filtered. If sending unlogged to Melbourne – please let Melbourne team know.



15	GHD BH1 GW	[illegible]	[illegible]	x	x

Thanks!

Warm Regards,

Alena Bounkeua
Eurofins | mgt
Phone: (02) 9900 8414
Email: AlenaBounkeua@eurofins.com

From: Clifton Thompson [mailto:Clifton.Thompson@ghd.com]
Sent: Tuesday, 2 October 2018 4:32 PM
To: Alena Bounkeua
Cc: Nibha Vaidya; Henry Luo
Subject: GHD 2127425

EXTERNAL EMAIL*

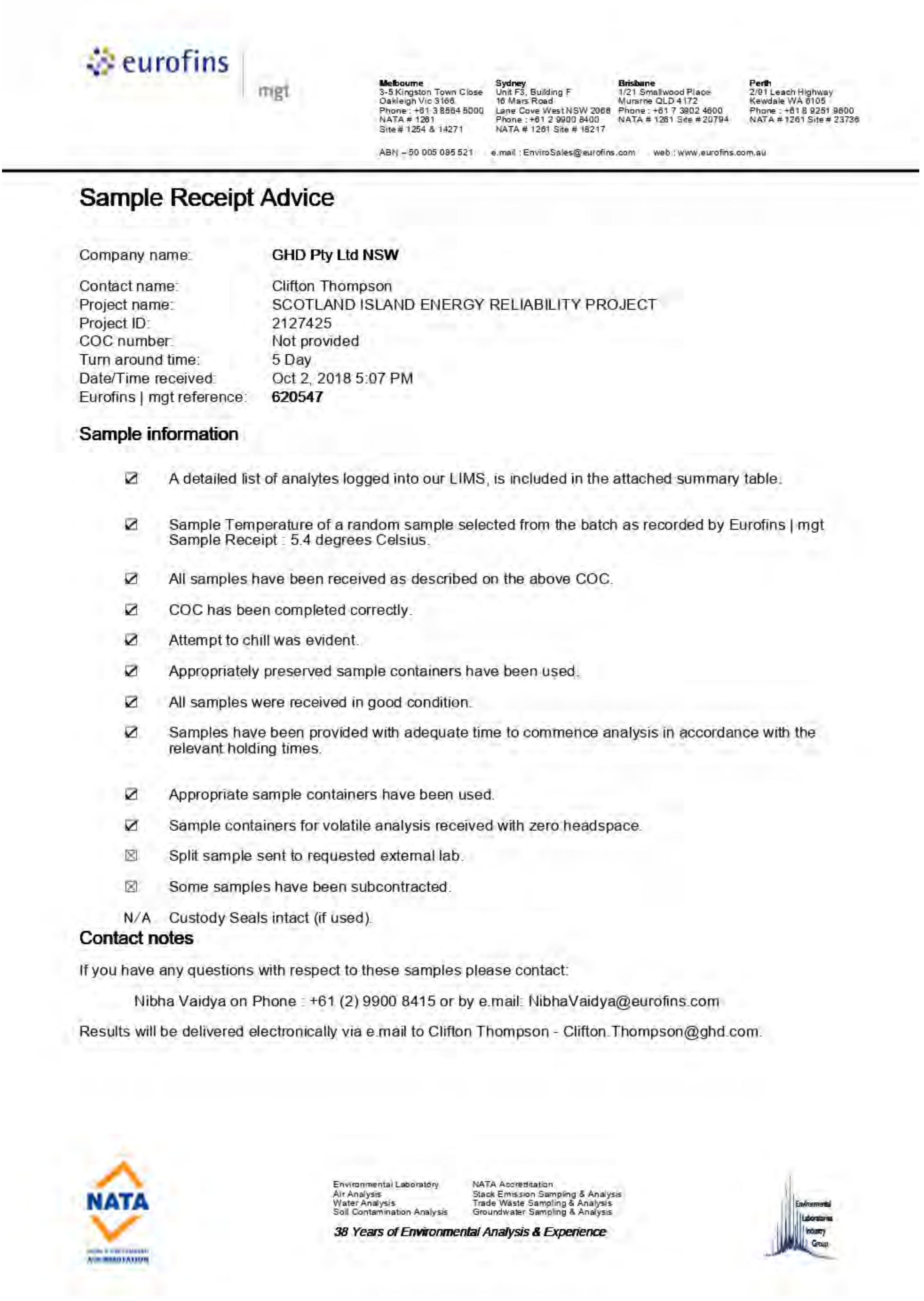
Hi Alena,

Please find the attached COC for the samples received on Friday.

Regards,

Clifton Thompson
Geotechnical Engineer

GHD
Proudly employee owned
T: +61 2 8898 3812 | M: +61 431 470 139 | E: clifton.thompson@ghd.com
Level 2, 20 Smith Street Parramatta NSW 2150 Australia | www.ghd.com



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3-5 Kingston Town Close
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NATA # 1261
Site # 1254 & 14271

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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

---

Sample Receipt Advice

Company name:	**GHD Pty Ltd NSW**
Contact name:	Clifton Thompson
Project name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID:	2127425
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Oct 2, 2018 5:07 PM
Eurofins | mgt reference:	**620547**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ Sample Temperature of a random sample selected from the batch as recorded by Eurofins | mgt Sample Receipt : 5.4 degrees Celsius.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☑ Sample containers for volatile analysis received with zero headspace.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8415 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Clifton Thompson - Clifton.Thompson@ghd.com.

NATA

Environmental Laboratory
Air Analysis
Water Analysis
Soil Contamination Analysis

NATA Accreditation
Stack Emission Sampling & Analysis
Trade Waste Sampling & Analysis
Groundwater Sampling & Analysis

38 Years of Environmental Analysis & Experience

Environmental Laboratories Industry Group

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Testing For Life

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	Clifton Thompson
Report	620547-AID
Project Name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Oct 02, 2018
Date Reported	Oct 09, 2018

Methodology:

Asbestos Fibre Identification	Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques. *NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.*
Unknown Mineral Fibres	Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity. *NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.*
Subsampling Soil Samples	The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed. *NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.*
Bonded asbestos-containing material (ACM)	The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004. *NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.*
Limit of Reporting	The performance limitation of the AS4964 method for inhomogeneous samples is around 0.1 g/kg (0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis where required, this is considered to be at the nominal reporting limit of 0.01 % (w / w).The examination of large sample sizes(500 mL is recommended) may improve the likelihood of identifying ACM in the > 2mm fraction.The NEPM screening level of 0.001 % (w / w) asbestos in soil for FA(friable asbestos) and AF(asbestos fines) then applies where they are able to be quantified by gravimetric procedures.This quantitative screening is not generally applicable to FF(free fibres) and results of Trace Analysis are referred. *NOTE: NATA News March 2014, p.7, states in relation to AS4964: "This is a qualitative method with a nominal reporting limit of 0.01%" and that currently in Australia "there is no validated method available for the quantification of asbestos". Accordingly, NATA Accreditation does not cover the performance of this service (indicated with an asterisk).* *This report is consistent with the analytical procedures and reporting recommendations in the National Environment Protection (Assessment of Site Contamination) Measure, 2013 (as amended) and the Western Australia Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, 2009, including supporting document Recommended Procedures for Laboratory Analysis of Asbestos in Soil, June 2011.*

Accredited for compliance with ISO/IEC 17025–Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Project Name SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID 2127425
Date Sampled Sep 27, 2018
Report 620547-AID

Client Sample ID	Eurofins | mgt Sample No.	Date Sampled	Sample Description	Result
GHD-BH6_0.0-0.1	18-Oc02399	Sep 27, 2018	Approximate Sample 192g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-BH7_0.0-0.1	18-Oc02401	Sep 27, 2018	Approximate Sample 289g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-BH7_0.9-1.0	18-Oc02403	Sep 27, 2018	Approximate Sample 229g Sample consisted of: Light brown fine-grained soil and rocks	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI01	18-Oc02406	Sep 27, 2018	Approximate Sample 420g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI02	18-Oc02407	Sep 27, 2018	Approximate Sample 343g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI03	18-Oc02408	Sep 27, 2018	Approximate Sample 262g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI04	18-Oc02409	Sep 27, 2018	Approximate Sample 267g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI05	18-Oc02410	Sep 27, 2018	Approximate Sample 245g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.
GHD-SI06	18-Oc02411	Sep 27, 2018	Approximate Sample 255g Sample consisted of: Brown fine-grained soil, rocks and organic debris	No asbestos detected at the reporting limit of 0.01% w/w. Organic fibre detected. No respirable fibres detected.

Date Reported: Oct 09, 2018
Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400
Page 2 of 7
Report Number: 620547-AID

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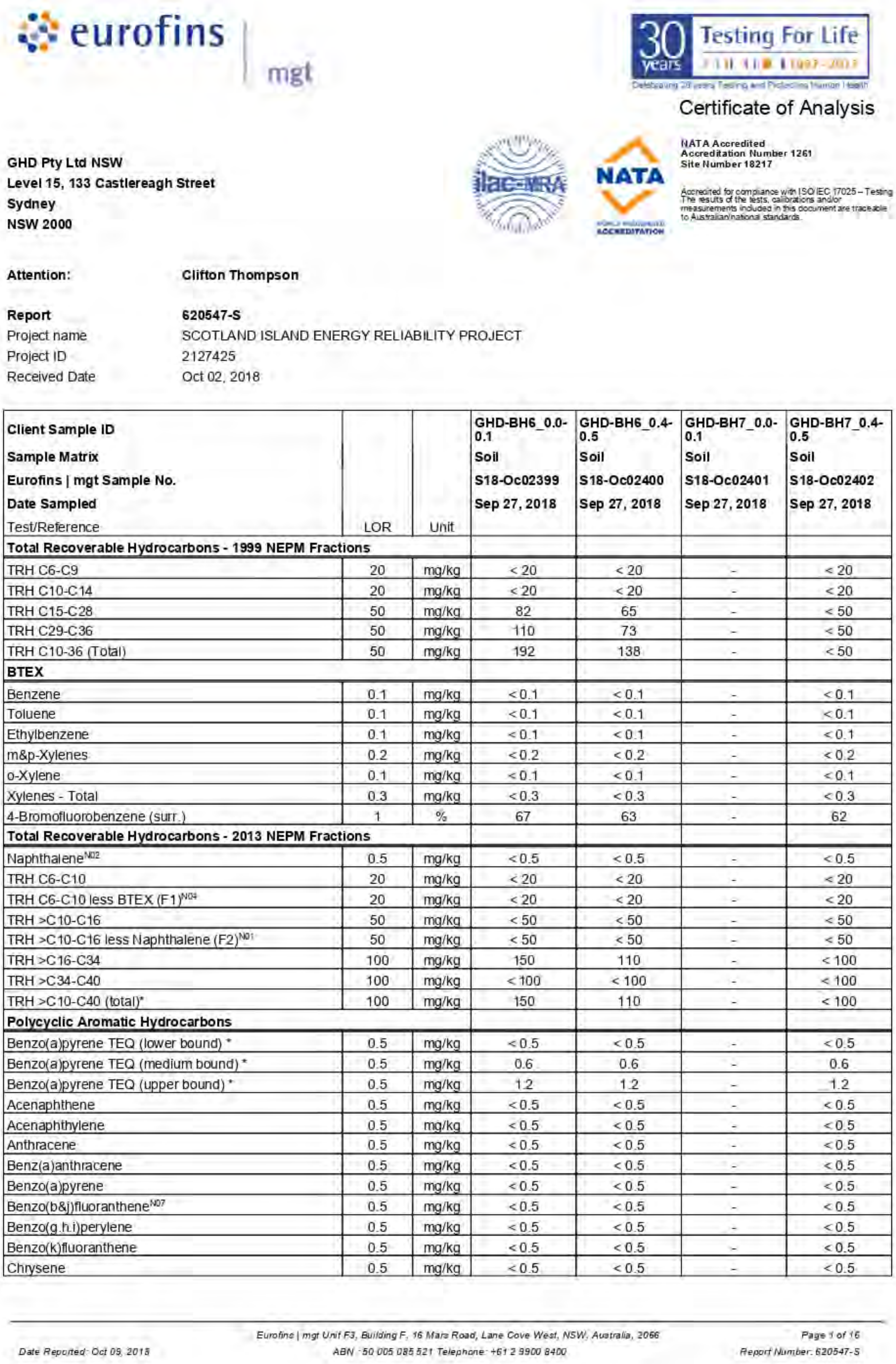
Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	**Testing Site**	**Extracted**	**Holding Time**
Asbestos - LTM-ASB-8020	Sydney	Oct 02, 2018	Indefinite



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30 years Testing For Life
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	**Clifton Thompson**
Report	**620547-S**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Oct 02, 2018

Client Sample ID			**GHD-BH6_0.0-0.1**	**GHD-BH6_0.4-0.5**	**GHD-BH7_0.0-0.1**	**GHD-BH7_0.4-0.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Oc02399**	**S18-Oc02400**	**S18-Oc02401**	**S18-Oc02402**
Date Sampled			**Sep 27, 2018**	**Sep 27, 2018**	**Sep 27, 2018**	**Sep 27, 2018**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	-	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	-	< 20
TRH C15-C28	50	mg/kg	82	65	-	< 50
TRH C29-C36	50	mg/kg	110	73	-	< 50
TRH C10-36 (Total)	50	mg/kg	192	138	-	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	-	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	67	63	-	62
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene^{N02}	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	-	< 20
TRH C6-C10 less BTEX (F1)^{N04}	20	mg/kg	< 20	< 20	-	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	-	< 50
TRH >C10-C16 less Naphthalene (F2)^{N01}	50	mg/kg	< 50	< 50	-	< 50
TRH >C16-C34	100	mg/kg	150	110	-	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	-	< 100
TRH >C10-C40 (total)*	100	mg/kg	150	110	-	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	-	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(b&j)fluoranthene^{N07}	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5

Date Reported: Oct 09, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
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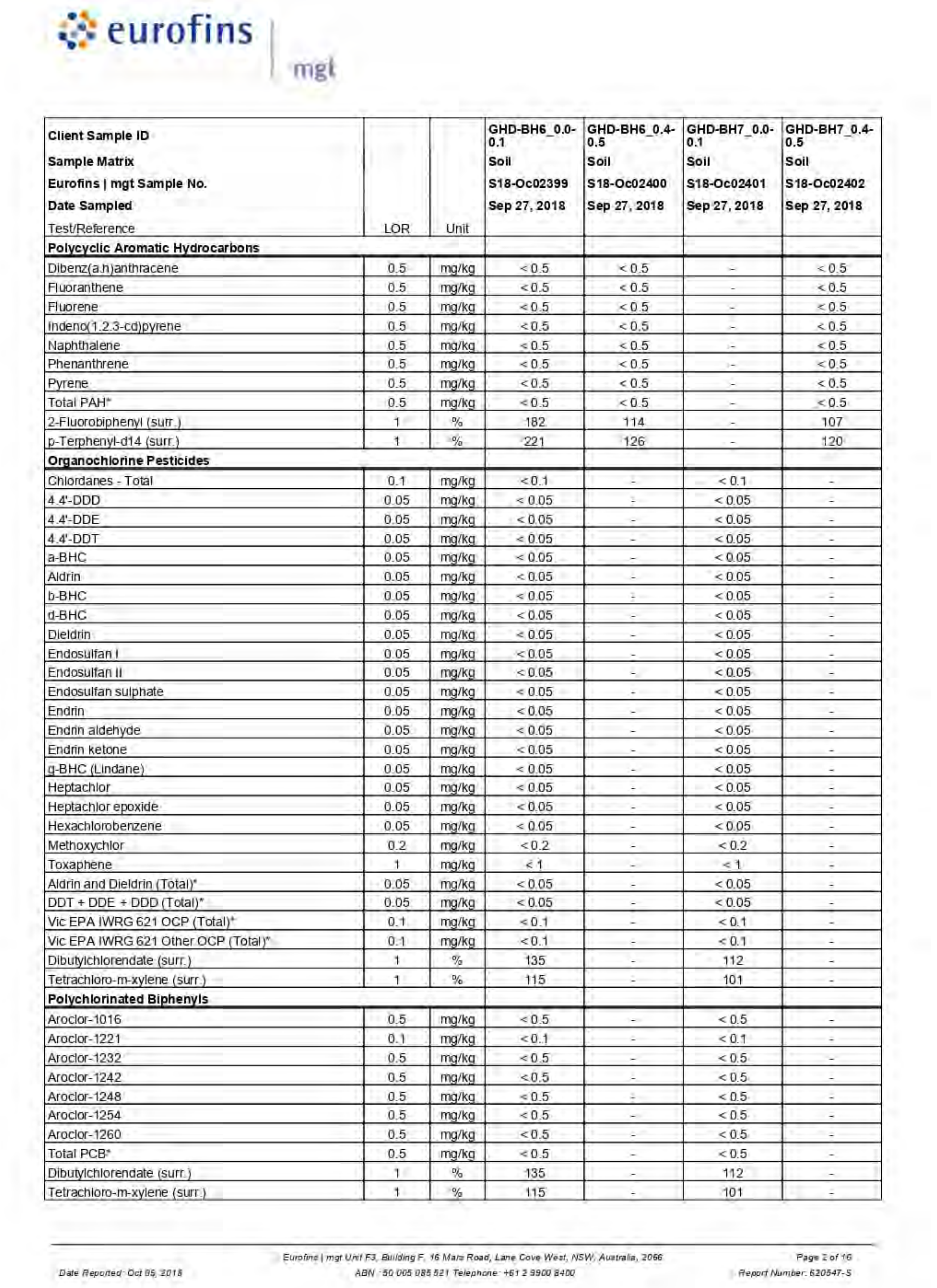
Report Number: 620547-S

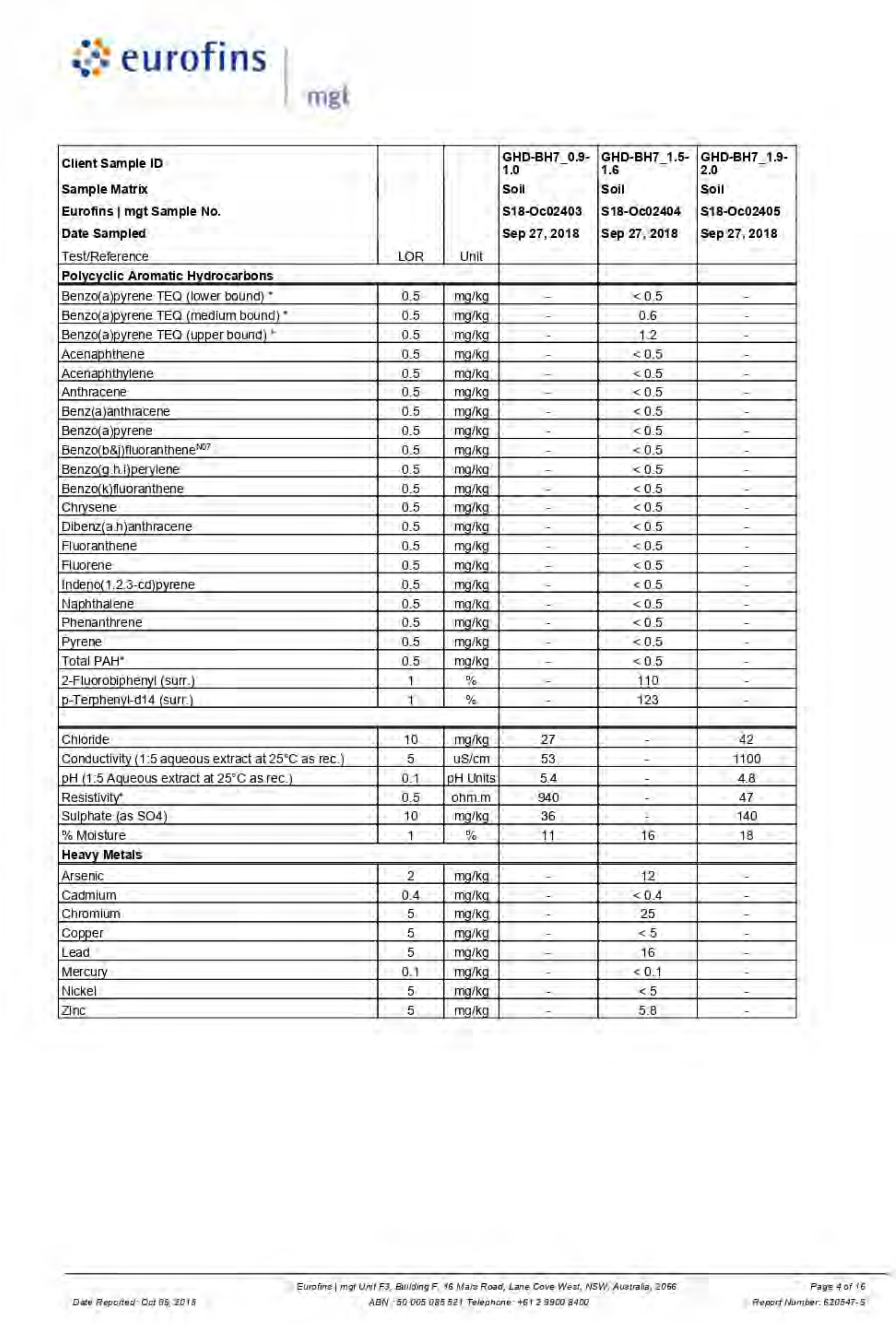


eurofins | mgt

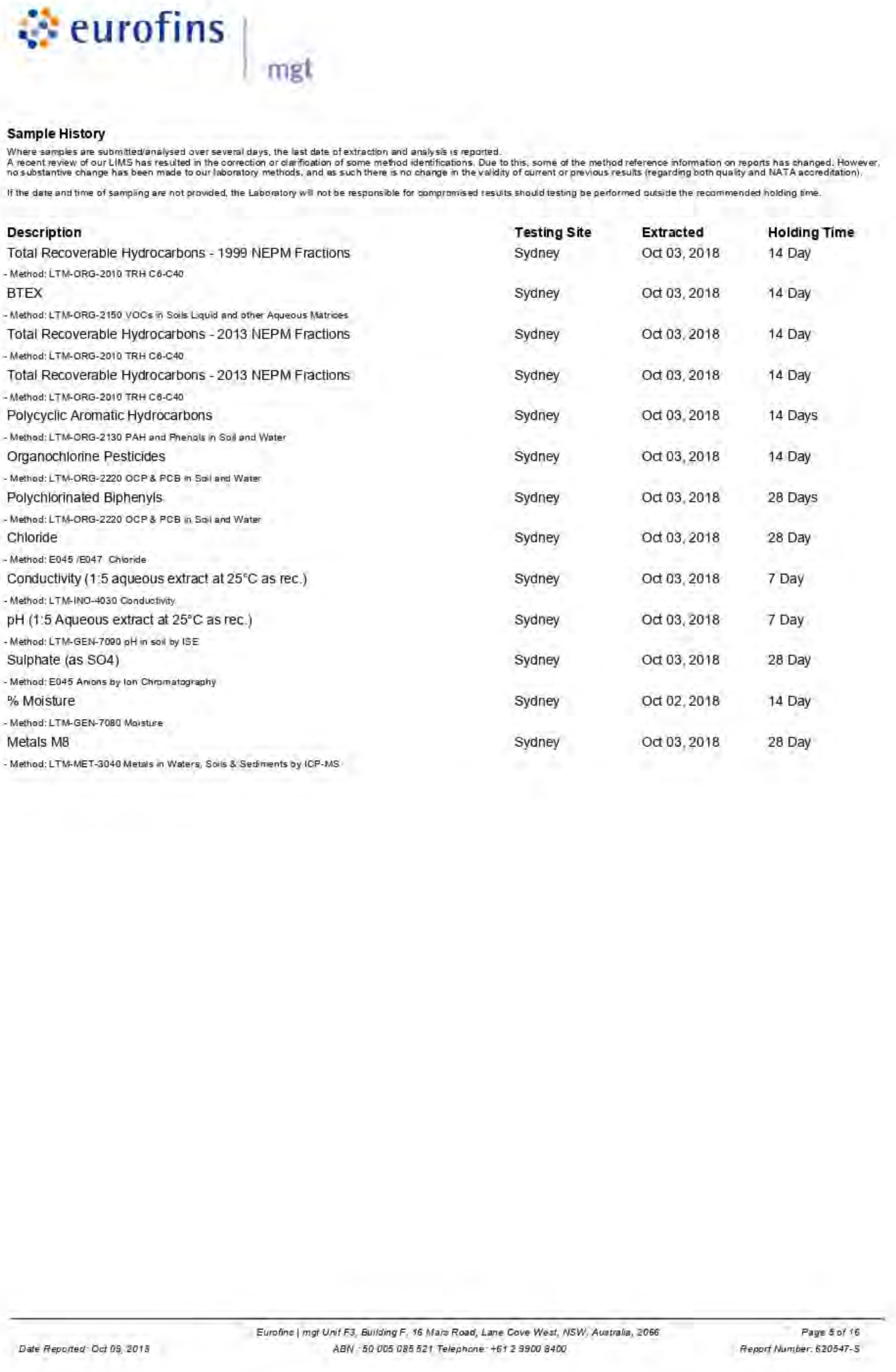
Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH6_0.0-0.1** **Soil** **S18-Oc02399** **Sep 27, 2018**	**GHD-BH6_0.4-0.5** **Soil** **S18-Oc02400** **Sep 27, 2018**	**GHD-BH7_0.0-0.1** **Soil** **S18-Oc02401** **Sep 27, 2018**	**GHD-BH7_0.4-0.5** **Soil** **S18-Oc02402** **Sep 27, 2018**
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	-	< 0.5
2-Fluorobiphenyl (surr.)	1	%	182	114	-	107
p-Terphenyl-d14 (surr.)	1	%	221	126	-	120
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	< 0.05	-
a-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Aldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
b-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
d-BHC	0.05	mg/kg	< 0.05	-	< 0.05	-
Dieldrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan I	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan II	0.05	mg/kg	< 0.05	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	< 0.05	-
Endrin ketone	0.05	mg/kg	< 0.05	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor	0.05	mg/kg	< 0.05	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	< 0.05	-
Methoxychlor	0.2	mg/kg	< 0.2	-	< 0.2	-
Toxaphene	1	mg/kg	< 1	-	< 1	-
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	-	< 0.05	-
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	-	< 0.1	-
Dibutylchlorendate (surr.)	1	%	135	-	112	-
Tetrachloro-m-xylene (surr.)	1	%	115	-	101	-
Polychlorinated Biphenyls						
Aroclor-1016	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1221	0.1	mg/kg	< 0.1	-	< 0.1	-
Aroclor-1232	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1242	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1248	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1254	0.5	mg/kg	< 0.5	-	< 0.5	-
Aroclor-1260	0.5	mg/kg	< 0.5	-	< 0.5	-
Total PCB*	0.5	mg/kg	< 0.5	-	< 0.5	-
Dibutylchlorendate (surr.)	1	%	135	-	112	-
Tetrachloro-m-xylene (surr.)	1	%	115	-	101	-

Client Sample ID			**GHD-BH6_0.0-0.1**	**GHD-BH6_0.4-0.5**	**GHD-BH7_0.0-0.1**	**GHD-BH7_0.4-0.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Oc02399**	**S18-Oc02400**	**S18-Oc02401**	**S18-Oc02402**
Date Sampled			**Sep 27, 2018**	**Sep 27, 2018**	**Sep 27, 2018**	**Sep 27, 2018**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	57	-	77	-
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	77	-	94	-
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.9	-	5.4	-
Resistivity*	0.5	ohm.m	650	-	530	-
Sulphate (as SO4)	10	mg/kg	14	-	13	-
% Moisture	1	%	14	11	11	11
Heavy Metals						
Arsenic	2	mg/kg	4.1	4.7	-	4.0
Cadmium	0.4	mg/kg	< 0.4	< 0.4	-	< 0.4
Chromium	5	mg/kg	8.3	10	-	9.8
Copper	5	mg/kg	< 5	< 5	-	< 5
Lead	5	mg/kg	23	18	-	13
Mercury	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Nickel	5	mg/kg	< 5	< 5	-	< 5
Zinc	5	mg/kg	39	32	-	22

Client Sample ID			**GHD-BH7_0.9-1.0**	**GHD-BH7_1.5-1.6**	**GHD-BH7_1.9-2.0**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Oc02403**	**S18-Oc02404**	**S18-Oc02405**
Date Sampled			**Sep 27, 2018**	**Sep 27, 2018**	**Sep 27, 2018**
Test/Reference	LOR	Unit			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions					
TRH C6-C9	20	mg/kg	-	< 20	-
TRH C10-C14	20	mg/kg	-	< 20	-
TRH C15-C28	50	mg/kg	-	< 50	-
TRH C29-C36	50	mg/kg	-	< 50	-
TRH C10-36 (Total)	50	mg/kg	-	< 50	-
BTEX					
Benzene	0.1	mg/kg	-	< 0.1	-
Toluene	0.1	mg/kg	-	< 0.1	-
Ethylbenzene	0.1	mg/kg	-	< 0.1	-
m&p-Xylenes	0.2	mg/kg	-	< 0.2	-
o-Xylene	0.1	mg/kg	-	< 0.1	-
Xylenes - Total	0.3	mg/kg	-	< 0.3	-
4-Bromofluorobenzene (surr.)	1	%	-	75	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions					
Naphthalene^{N02}	0.5	mg/kg	-	< 0.5	-
TRH C6-C10	20	mg/kg	-	< 20	-
TRH C6-C10 less BTEX (F1)^{N04}	20	mg/kg	-	< 20	-
TRH >C10-C16	50	mg/kg	-	< 50	-
TRH >C10-C16 less Naphthalene (F2)^{N01}	50	mg/kg	-	< 50	-
TRH >C16-C34	100	mg/kg	-	< 100	-
TRH >C34-C40	100	mg/kg	-	< 100	-
TRH >C10-C40 (total)*	100	mg/kg	-	< 100	-



Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH7_0.9-1.0** **Soil** **S18-Oc02403** **Sep 27, 2018**	**GHD-BH7_1.5-1.6** **Soil** **S18-Oc02404** **Sep 27, 2018**	**GHD-BH7_1.9-2.0** **Soil** **S18-Oc02405** **Sep 27, 2018**
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	-
Acenaphthene	0.5	mg/kg	-	< 0.5	-
Acenaphthylene	0.5	mg/kg	-	< 0.5	-
Anthracene	0.5	mg/kg	-	< 0.5	-
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	-
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	-
Benzo(b&j)fluoranthene^{N07}	0.5	mg/kg	-	< 0.5	-
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	-
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	-
Chrysene	0.5	mg/kg	-	< 0.5	-
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	-
Fluoranthene	0.5	mg/kg	-	< 0.5	-
Fluorene	0.5	mg/kg	-	< 0.5	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	-
Naphthalene	0.5	mg/kg	-	< 0.5	-
Phenanthrene	0.5	mg/kg	-	< 0.5	-
Pyrene	0.5	mg/kg	-	< 0.5	-
Total PAH*	0.5	mg/kg	-	< 0.5	-
2-Fluorobiphenyl (surr.)	1	%	-	110	-
p-Terphenyl-d14 (surr.)	1	%	-	123	-
Chloride	10	mg/kg	27	-	42
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	53	-	1100
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.4	-	4.8
Resistivity*	0.5	ohm.m	940	-	47
Sulphate (as SO4)	10	mg/kg	36	-	140
% Moisture	1	%	11	16	18
Heavy Metals					
Arsenic	2	mg/kg	-	12	-
Cadmium	0.4	mg/kg	-	< 0.4	-
Chromium	5	mg/kg	-	25	-
Copper	5	mg/kg	-	< 5	-
Lead	5	mg/kg	-	16	-
Mercury	0.1	mg/kg	-	< 0.1	-
Nickel	5	mg/kg	-	< 5	-
Zinc	5	mg/kg	-	5.8	-



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Sample History

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Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Oct 03, 2018	14 Day
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Sydney	Oct 03, 2018	14 Day
- Method: LTM-ORG-2150 VOCs in Soils Liquid and other Aqueous Matrices			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Oct 03, 2018	14 Day
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Oct 03, 2018	14 Day
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Sydney	Oct 03, 2018	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Organochlorine Pesticides	Sydney	Oct 03, 2018	14 Day
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Polychlorinated Biphenyls	Sydney	Oct 03, 2018	28 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Chloride	Sydney	Oct 03, 2018	28 Day
- Method: E045 /E047 Chloride			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Oct 03, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Oct 03, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	Oct 03, 2018	28 Day
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	Oct 02, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			
Metals M8	Sydney	Oct 03, 2018	28 Day
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

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NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 620547
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Oct 2, 2018 5:07 PM
Due: Oct 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	Polycyclic Aromatic Hydrocarbons	Eurofins | mgt Suite B13	Aggressivity Soil Set	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B7 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD-BH6_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02399	X		X	X	X	X	
2	GHD-BH6_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02400					X	X	
3	GHD-BH7_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02401	X		X	X	X		
4	GHD-BH7_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02402					X	X	
5	GHD-BH7_0.9-1.0	Sep 27, 2018		Soil	S18-Oc02403	X			X	X		
6	GHD-	Sep 27, 2018		Soil	S18-Oc02404					X	X	

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 620547
Phone: 02 9239 7100
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Received: Oct 2, 2018 5:07 PM
Due: Oct 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	Polycyclic Aromatic Hydrocarbons	Eurofins | mgt Suite B13	Aggressivity Soil Set	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B7 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
	BH7_1.5-1.6											
7	GHD-BH7_1.9-2.0	Sep 27, 2018		Soil	S18-Oc02405				X	X		
8	GHD-SI01	Sep 27, 2018		Soil	S18-Oc02406	X						
9	GHD-SI02	Sep 27, 2018		Soil	S18-Oc02407	X						
10	GHD-SI03	Sep 27, 2018		Soil	S18-Oc02408	X						
11	GHD-SI04	Sep 27, 2018		Soil	S18-Oc02409	X						
12	GHD-SI05	Sep 27, 2018		Soil	S18-Oc02410	X						
13	GHD-SI06	Sep 27, 2018		Soil	S18-Oc02411	X						
14	GHD-BH1-GW	Sep 27, 2018		Water	S18-Oc02412			X				X
15	SI-RIN01	Sep 27, 2018		Water	S18-Oc02413		X					
Test Counts						9	1	3	4	7	4	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

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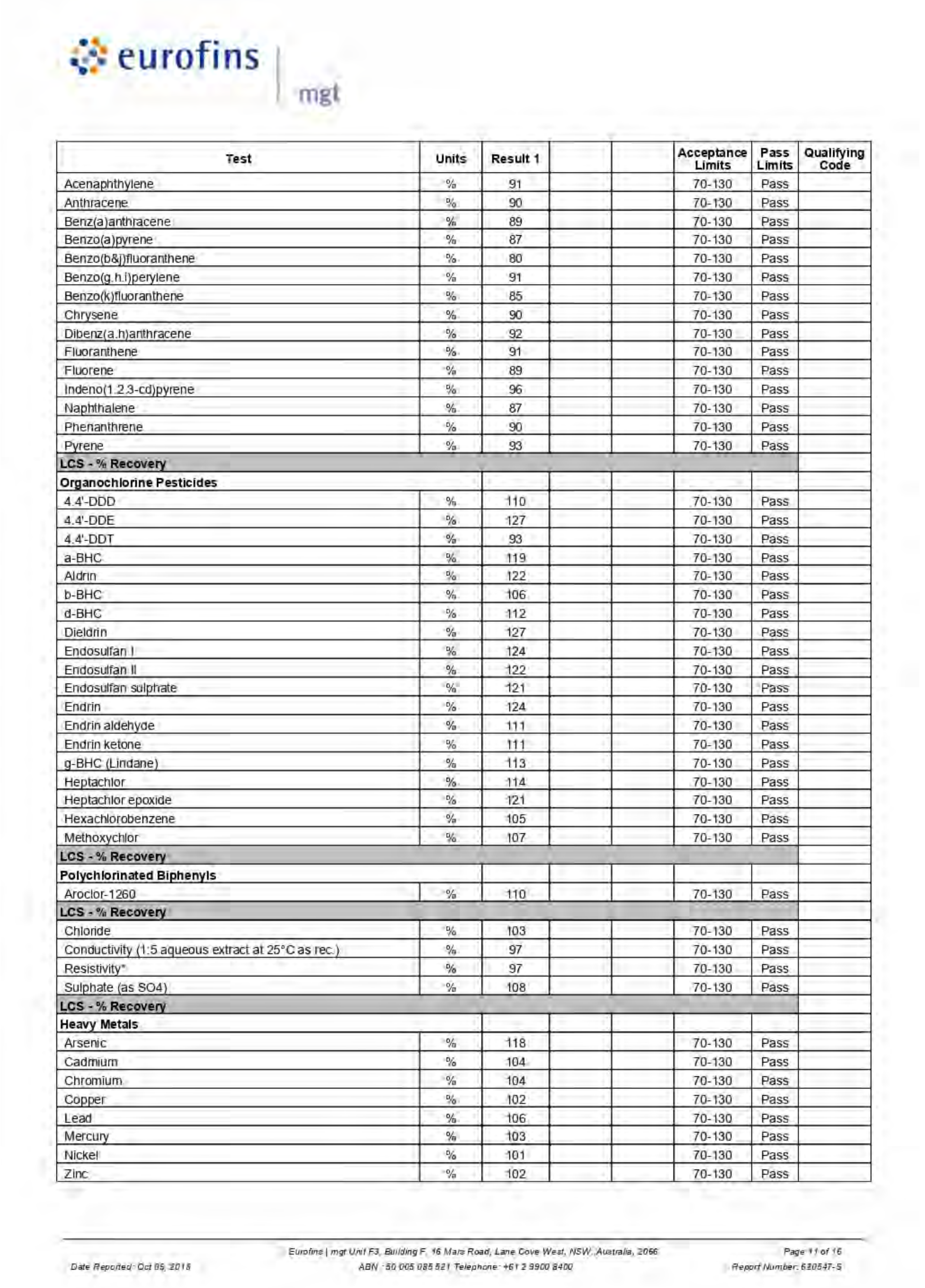
Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.5			0.5	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.5			0.5	Pass	
Aroclor-1242	mg/kg	< 0.5			0.5	Pass	
Aroclor-1248	mg/kg	< 0.5			0.5	Pass	
Aroclor-1254	mg/kg	< 0.5			0.5	Pass	
Aroclor-1260	mg/kg	< 0.5			0.5	Pass	
Total PCB*	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 5			5	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	109			70-130	Pass	
TRH C10-C14	%	114			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	117			70-130	Pass	
Toluene	%	116			70-130	Pass	
Ethylbenzene	%	116			70-130	Pass	
m&p-Xylenes	%	119			70-130	Pass	
o-Xylene	%	118			70-130	Pass	
Xylenes - Total	%	119			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	127			70-130	Pass	
TRH C6-C10	%	105			70-130	Pass	
TRH >C10-C16	%	128			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	82			70-130	Pass	



Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Acenaphthylene	%	91			70-130	Pass	
Anthracene	%	90			70-130	Pass	
Benz(a)anthracene	%	89			70-130	Pass	
Benzo(a)pyrene	%	87			70-130	Pass	
Benzo(b&j)fluoranthene	%	80			70-130	Pass	
Benzo(g.h.i)perylene	%	91			70-130	Pass	
Benzo(k)fluoranthene	%	85			70-130	Pass	
Chrysene	%	90			70-130	Pass	
Dibenz(a.h)anthracene	%	92			70-130	Pass	
Fluoranthene	%	91			70-130	Pass	
Fluorene	%	89			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	96			70-130	Pass	
Naphthalene	%	87			70-130	Pass	
Phenanthrene	%	90			70-130	Pass	
Pyrene	%	93			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	110			70-130	Pass	
4.4'-DDE	%	127			70-130	Pass	
4.4'-DDT	%	93			70-130	Pass	
a-BHC	%	119			70-130	Pass	
Aldrin	%	122			70-130	Pass	
b-BHC	%	106			70-130	Pass	
d-BHC	%	112			70-130	Pass	
Dieldrin	%	127			70-130	Pass	
Endosulfan I	%	124			70-130	Pass	
Endosulfan II	%	122			70-130	Pass	
Endosulfan sulphate	%	121			70-130	Pass	
Endrin	%	124			70-130	Pass	
Endrin aldehyde	%	111			70-130	Pass	
Endrin ketone	%	111			70-130	Pass	
g-BHC (Lindane)	%	113			70-130	Pass	
Heptachlor	%	114			70-130	Pass	
Heptachlor epoxide	%	121			70-130	Pass	
Hexachlorobenzene	%	105			70-130	Pass	
Methoxychlor	%	107			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	110			70-130	Pass	
LCS - % Recovery							
Chloride	%	103			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	97			70-130	Pass	
Resistivity*	%	97			70-130	Pass	
Sulphate (as SO4)	%	108			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	118			70-130	Pass	
Cadmium	%	104			70-130	Pass	
Chromium	%	104			70-130	Pass	
Copper	%	102			70-130	Pass	
Lead	%	106			70-130	Pass	
Mercury	%	103			70-130	Pass	
Nickel	%	101			70-130	Pass	
Zinc	%	102			70-130	Pass	

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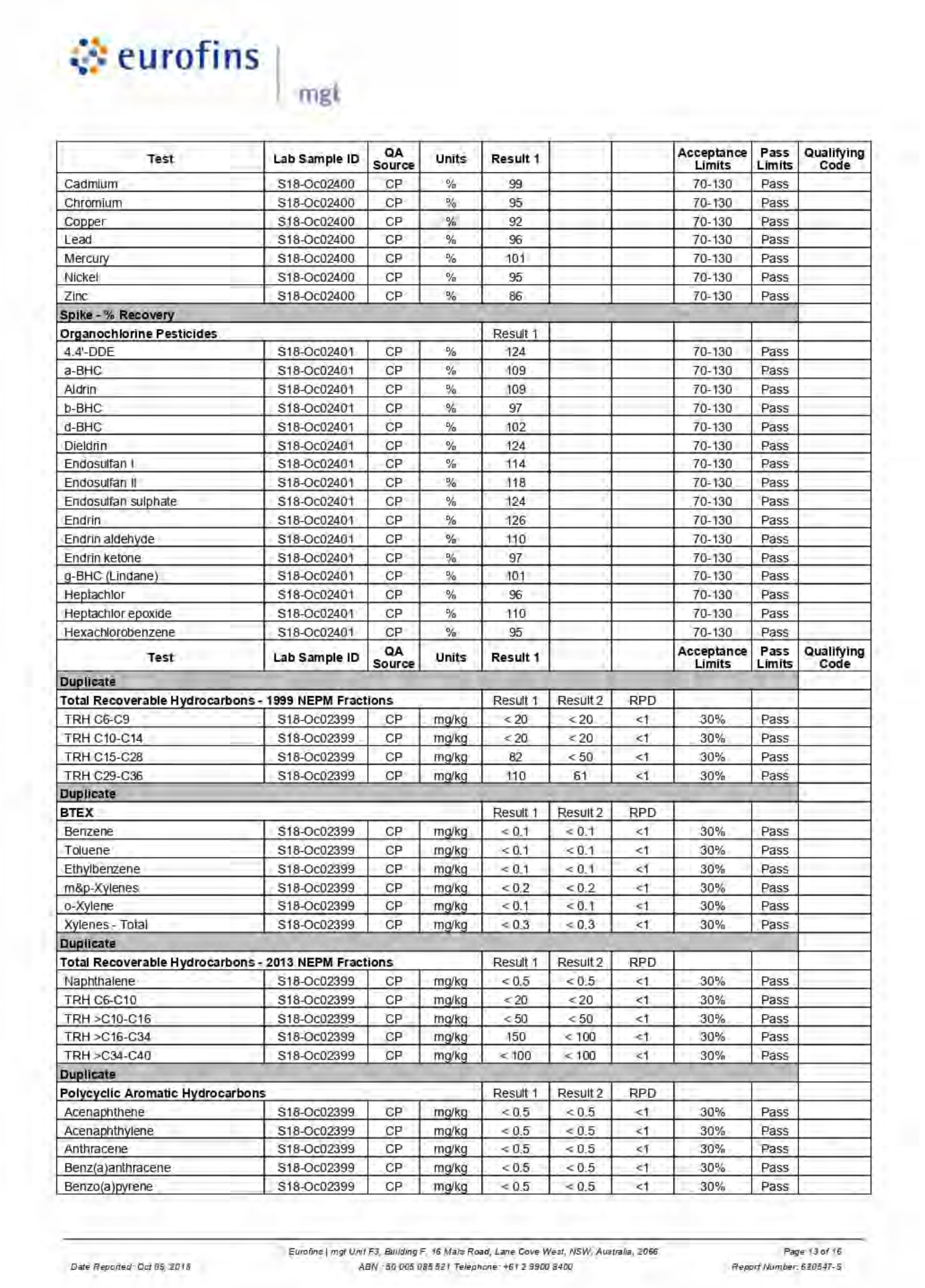
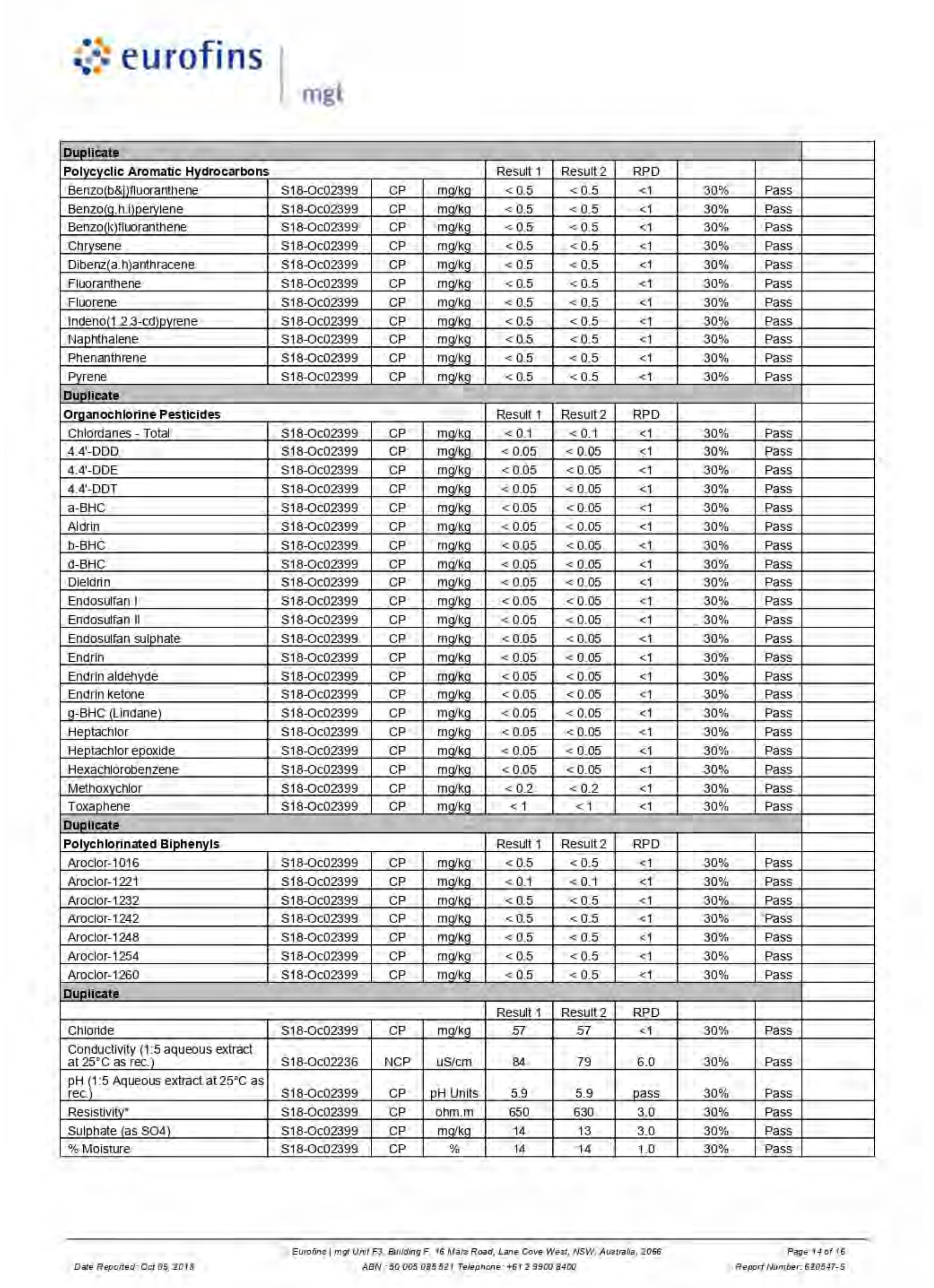
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S18-Oc02040	NCP	%	101			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S18-Oc02040	NCP	%	103			70-130	Pass	
Toluene	S18-Oc02040	NCP	%	102			70-130	Pass	
Ethylbenzene	S18-Oc02040	NCP	%	99			70-130	Pass	
m&p-Xylenes	S18-Oc02040	NCP	%	104			70-130	Pass	
o-Xylene	S18-Oc02040	NCP	%	102			70-130	Pass	
Xylenes - Total	S18-Oc02040	NCP	%	103			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S18-Oc02040	NCP	%	82			70-130	Pass	
TRH C6-C10	S18-Oc02040	NCP	%	99			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S18-Oc03390	NCP	%	123			70-130	Pass	
4.4'-DDT	S18-Oc03390	NCP	%	121			70-130	Pass	
Methoxychlor	S18-Oc03390	NCP	%	117			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1260	S18-Oc03390	NCP	%	97			70-130	Pass	
Spike - % Recovery									
				Result 1					
Chloride	S18-Oc02399	CP	%	96			70-130	Pass	
Sulphate (as SO4)	S18-Oc02399	CP	%	101			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	S18-Oc02400	CP	%	86			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	S18-Oc02400	CP	%	91			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	S18-Oc02400	CP	%	77			70-130	Pass	
Acenaphthylene	S18-Oc02400	CP	%	87			70-130	Pass	
Anthracene	S18-Oc02400	CP	%	86			70-130	Pass	
Benz(a)anthracene	S18-Oc02400	CP	%	83			70-130	Pass	
Benzo(a)pyrene	S18-Oc02400	CP	%	79			70-130	Pass	
Benzo(b&j)fluoranthene	S18-Oc02400	CP	%	75			70-130	Pass	
Benzo(g.h.i)perylene	S18-Oc02400	CP	%	88			70-130	Pass	
Benzo(k)fluoranthene	S18-Oc02400	CP	%	79			70-130	Pass	
Chrysene	S18-Oc02400	CP	%	87			70-130	Pass	
Dibenz(a.h)anthracene	S18-Oc02400	CP	%	90			70-130	Pass	
Fluoranthene	S18-Oc02400	CP	%	89			70-130	Pass	
Fluorene	S18-Oc02400	CP	%	85			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S18-Oc02400	CP	%	92			70-130	Pass	
Naphthalene	S18-Oc02400	CP	%	87			70-130	Pass	
Phenanthrene	S18-Oc02400	CP	%	86			70-130	Pass	
Pyrene	S18-Oc02400	CP	%	89			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S18-Oc02400	CP	%	109			70-130	Pass	



Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Cadmium	S18-Oc02400	CP	%	99			70-130	Pass	
Chromium	S18-Oc02400	CP	%	95			70-130	Pass	
Copper	S18-Oc02400	CP	%	92			70-130	Pass	
Lead	S18-Oc02400	CP	%	96			70-130	Pass	
Mercury	S18-Oc02400	CP	%	101			70-130	Pass	
Nickel	S18-Oc02400	CP	%	95			70-130	Pass	
Zinc	S18-Oc02400	CP	%	86			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDE	S18-Oc02401	CP	%	124			70-130	Pass	
a-BHC	S18-Oc02401	CP	%	109			70-130	Pass	
Aldrin	S18-Oc02401	CP	%	109			70-130	Pass	
b-BHC	S18-Oc02401	CP	%	97			70-130	Pass	
d-BHC	S18-Oc02401	CP	%	102			70-130	Pass	
Dieldrin	S18-Oc02401	CP	%	124			70-130	Pass	
Endosulfan I	S18-Oc02401	CP	%	114			70-130	Pass	
Endosulfan II	S18-Oc02401	CP	%	118			70-130	Pass	
Endosulfan sulphate	S18-Oc02401	CP	%	124			70-130	Pass	
Endrin	S18-Oc02401	CP	%	126			70-130	Pass	
Endrin aldehyde	S18-Oc02401	CP	%	110			70-130	Pass	
Endrin ketone	S18-Oc02401	CP	%	97			70-130	Pass	
g-BHC (Lindane)	S18-Oc02401	CP	%	101			70-130	Pass	
Heptachlor	S18-Oc02401	CP	%	96			70-130	Pass	
Heptachlor epoxide	S18-Oc02401	CP	%	110			70-130	Pass	
Hexachlorobenzene	S18-Oc02401	CP	%	95			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-Oc02399	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	S18-Oc02399	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	S18-Oc02399	CP	mg/kg	82	< 50	<1	30%	Pass	
TRH C29-C36	S18-Oc02399	CP	mg/kg	110	61	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	S18-Oc02399	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	S18-Oc02399	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	S18-Oc02399	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	S18-Oc02399	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	S18-Oc02399	CP	mg/kg	150	< 100	<1	30%	Pass	
TRH >C34-C40	S18-Oc02399	CP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	



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Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Benzo(b&j)fluoranthene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-Oc02399	CP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-Oc02399	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-Oc02399	CP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1221	S18-Oc02399	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1242	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1248	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1254	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Aroclor-1260	S18-Oc02399	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S18-Oc02399	CP	mg/kg	57	57	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	S18-Oc02236	NCP	uS/cm	84	79	6.0	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S18-Oc02399	CP	pH Units	5.9	5.9	pass	30%	Pass	
Resistivity*	S18-Oc02399	CP	ohm.m	650	630	3.0	30%	Pass	
Sulphate (as SO4)	S18-Oc02399	CP	mg/kg	14	13	3.0	30%	Pass	
% Moisture	S18-Oc02399	CP	%	14	14	1.0	30%	Pass	

Date Reported: Oct 05, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
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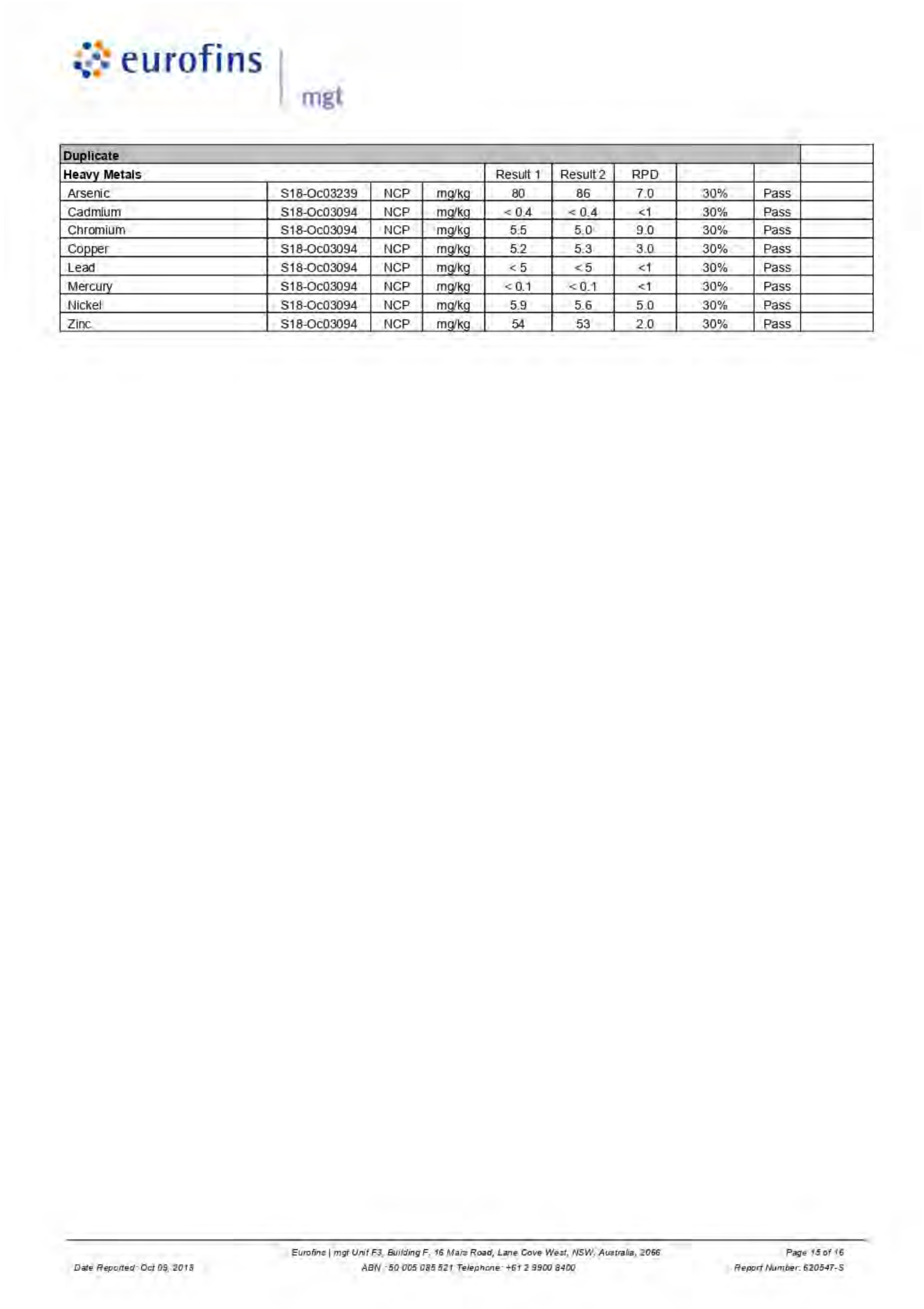
Report Number: 620547-S



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Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-Oc03239	NCP	mg/kg	80	86	7.0	30%	Pass	
Cadmium	S18-Oc03094	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S18-Oc03094	NCP	mg/kg	5.5	5.0	9.0	30%	Pass	
Copper	S18-Oc03094	NCP	mg/kg	5.2	5.3	3.0	30%	Pass	
Lead	S18-Oc03094	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	S18-Oc03094	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S18-Oc03094	NCP	mg/kg	5.9	5.6	5.0	30%	Pass	
Zinc	S18-Oc03094	NCP	mg/kg	54	53	2.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised By

Nibha Vaidya	Analytical Services Manager
Nibha Vaidya	Senior Analyst-Asbestos (NSW)

Glenn Jackson

National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Perth
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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 620547
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Oct 2, 2018 5:07 PM
Due: Oct 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	Polycyclic Aromatic Hydrocarbons	Eurofins | mgt Suite B13	Aggressivity Soil Set	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B7 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD-BH6_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02399	X		X	X	X	X	
2	GHD-BH6_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02400					X	X	
3	GHD-BH7_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02401	X		X	X	X		
4	GHD-BH7_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02402					X	X	
5	GHD-BH7_0.9-1.0	Sep 27, 2018		Soil	S18-Oc02403	X			X	X		
6	GHD-	Sep 27, 2018		Soil	S18-Oc02404					X	X	

Company Name:	GHD Pty Ltd NSW	**Order No.:**	2127425
Address:	Level 15, 133 Castlereagh Street Sydney NSW 2000	**Report #:**	620547
		Phone:	02 9239 7100
		Fax:	02 9239 7199
Project Name:	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT	**Received:**	Oct 2, 2018 5:07 PM
Project ID:	2127425	**Due:**	Oct 9, 2018
		Priority:	5 Day
		Contact Name:	Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	Polycyclic Aromatic Hydrocarbons	Eurofins | mgt Suite B13	Aggressivity Soil Set	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B7 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
	BH7_1.5-1.6											
7	GHD-BH7_1.9-2.0	Sep 27, 2018		Soil	S18-Oc02405				X	X		
8	GHD-SI01	Sep 27, 2018		Soil	S18-Oc02406	X						
9	GHD-SI02	Sep 27, 2018		Soil	S18-Oc02407	X						
10	GHD-SI03	Sep 27, 2018		Soil	S18-Oc02408	X						
11	GHD-SI04	Sep 27, 2018		Soil	S18-Oc02409	X						
12	GHD-SI05	Sep 27, 2018		Soil	S18-Oc02410	X						
13	GHD-SI06	Sep 27, 2018		Soil	S18-Oc02411	X						
14	GHD-BH1-GW	Sep 27, 2018		Water	S18-Oc02412			X				X
15	SI-RIN01	Sep 27, 2018		Water	S18-Oc02413		X					
Test Counts						9	1	3	4	7	4	1

Internal Quality Control Review and Glossary

General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

Units

% w/w: weight for weight basis	grams per kilogram
Filter loading:	fibres/100 graticule areas
Reported Concentration:	fibres/mL
Flowrate:	L/min

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting
COC	Chain of Custody
SRA	Sample Receipt Advice
ISO	International Standards Organisation
AS	Australian Standards
WA DOH	Western Australia Department of Health
NOHSC	National Occupational Health and Safety Commission
ACM	Bonded asbestos-containing material means any material containing more than 1% asbestos and comprises asbestos-containing-material which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin. Common examples of ACM include but are not limited to: pipe and boiler insulation, sprayed-on fireproofing, troweled-on acoustical plaster, floor tile and mastic, floor linoleum, transite shingles, roofing materials, wall and ceiling plaster, ceiling tiles, and gasket materials. This term is restricted to material that cannot pass a 7 mm x 7 mm sieve. This sieve size is selected because it approximates the thickness of common asbestos cement sheeting and for fragments to be smaller than this would imply a high degree of damage and hence potential for fibre release.
FA	FA comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).
PACM	Presumed Asbestos-Containing Material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980 that are assumed to contain greater than one percent asbestos but have not been sampled or analyzed to verify or negate the presence of asbestos.
AF	Asbestos fines (AF) are defined as free fibres, or fibre bundles, smaller than 7mm. It is the free fibres which present the greatest risk to human health, although very small fibres (< 5 microns in length) are not considered to be such a risk. AF also includes small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve. (Note that for bonded ACM fragments to pass through a 7 mm x 7 mm sieve implies a substatntial degree of damage which increases the potential for fibre release.)
AC	Asbestos cement means a mixture of cement and asbestos fibres (typically 90:10 ratios).

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N/A	Not applicable

Asbestos Counter/Identifier:

Sayeed Abu	Senior Analyst-Asbestos (NSW)

Authorised by:

Nibha Vaidya	Senior Analyst-Asbestos (NSW)

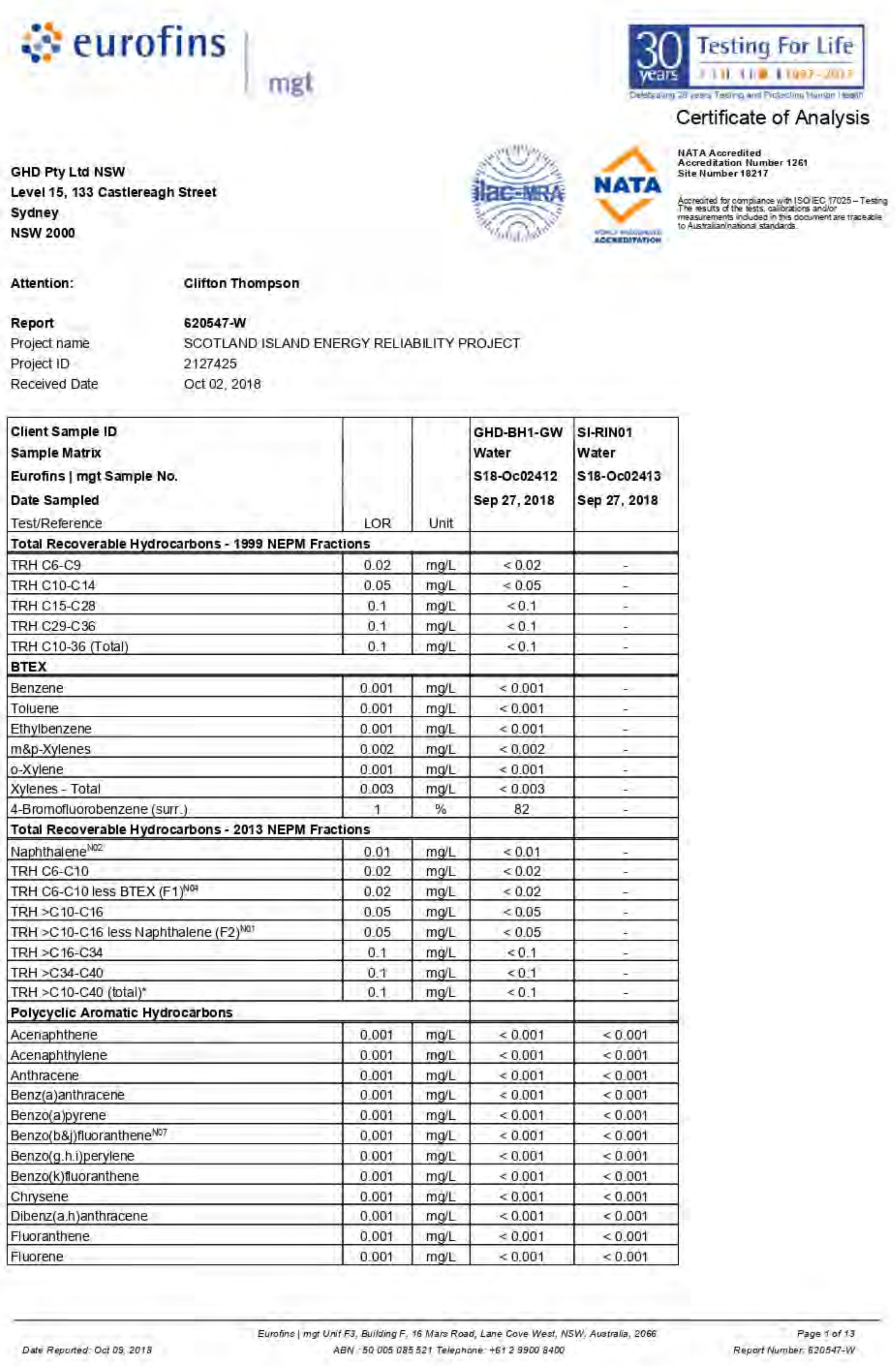
Glenn Jackson
National Operations Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.



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30 years Testing For Life
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Attention:	**Clifton Thompson**
Report	**620547-W**
Project name	SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID	2127425
Received Date	Oct 02, 2018

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH1-GW** **Water** **S18-Oc02412** **Sep 27, 2018**	**SI-RIN01** **Water** **S18-Oc02413** **Sep 27, 2018**
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				
TRH C6-C9	0.02	mg/L	< 0.02	-
TRH C10-C14	0.05	mg/L	< 0.05	-
TRH C15-C28	0.1	mg/L	< 0.1	-
TRH C29-C36	0.1	mg/L	< 0.1	-
TRH C10-36 (Total)	0.1	mg/L	< 0.1	-
BTEX				
Benzene	0.001	mg/L	< 0.001	-
Toluene	0.001	mg/L	< 0.001	-
Ethylbenzene	0.001	mg/L	< 0.001	-
m&p-Xylenes	0.002	mg/L	< 0.002	-
o-Xylene	0.001	mg/L	< 0.001	-
Xylenes - Total	0.003	mg/L	< 0.003	-
4-Bromofluorobenzene (surr.)	1	%	82	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				
Naphthalene[N02]	0.01	mg/L	< 0.01	-
TRH C6-C10	0.02	mg/L	< 0.02	-
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	-
TRH >C10-C16	0.05	mg/L	< 0.05	-
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	-
TRH >C16-C34	0.1	mg/L	< 0.1	-
TRH >C34-C40	0.1	mg/L	< 0.1	-
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1	-
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	0.001	mg/L	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001

Date Reported: Oct 09, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
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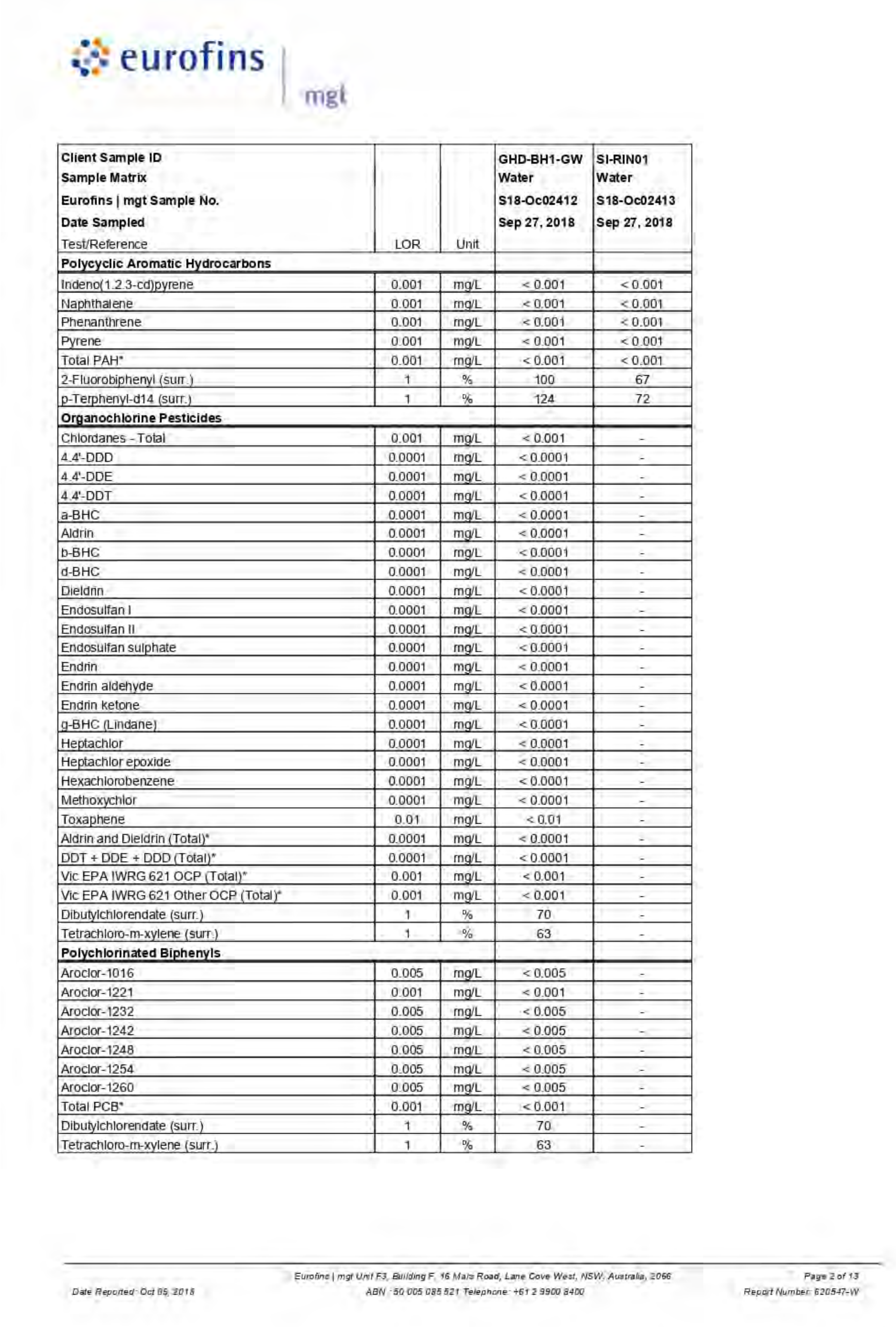
Report Number: 620547-W



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Client Sample ID			**GHD-BH1-GW**	**SI-RIN01**
Sample Matrix			**Water**	**Water**
Eurofins | mgt Sample No.			**S18-Oc02412**	**S18-Oc02413**
Date Sampled			**Sep 27, 2018**	**Sep 27, 2018**
Test/Reference	LOR	Unit		
Polycyclic Aromatic Hydrocarbons				
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	100	67
p-Terphenyl-d14 (surr.)	1	%	124	72
Organochlorine Pesticides				
Chlordanes - Total	0.001	mg/L	< 0.001	-
4.4'-DDD	0.0001	mg/L	< 0.0001	-
4.4'-DDE	0.0001	mg/L	< 0.0001	-
4.4'-DDT	0.0001	mg/L	< 0.0001	-
a-BHC	0.0001	mg/L	< 0.0001	-
Aldrin	0.0001	mg/L	< 0.0001	-
b-BHC	0.0001	mg/L	< 0.0001	-
d-BHC	0.0001	mg/L	< 0.0001	-
Dieldrin	0.0001	mg/L	< 0.0001	-
Endosulfan I	0.0001	mg/L	< 0.0001	-
Endosulfan II	0.0001	mg/L	< 0.0001	-
Endosulfan sulphate	0.0001	mg/L	< 0.0001	-
Endrin	0.0001	mg/L	< 0.0001	-
Endrin aldehyde	0.0001	mg/L	< 0.0001	-
Endrin ketone	0.0001	mg/L	< 0.0001	-
g-BHC (Lindane)	0.0001	mg/L	< 0.0001	-
Heptachlor	0.0001	mg/L	< 0.0001	-
Heptachlor epoxide	0.0001	mg/L	< 0.0001	-
Hexachlorobenzene	0.0001	mg/L	< 0.0001	-
Methoxychlor	0.0001	mg/L	< 0.0001	-
Toxaphene	0.01	mg/L	< 0.01	-
Aldrin and Dieldrin (Total)*	0.0001	mg/L	< 0.0001	-
DDT + DDE + DDD (Total)*	0.0001	mg/L	< 0.0001	-
Vic EPA IWRG 621 OCP (Total)*	0.001	mg/L	< 0.001	-
Vic EPA IWRG 621 Other OCP (Total)*	0.001	mg/L	< 0.001	-
Dibutylchlorendate (surr.)	1	%	70	-
Tetrachloro-m-xylene (surr.)	1	%	63	-
Polychlorinated Biphenyls				
Aroclor-1016	0.005	mg/L	< 0.005	-
Aroclor-1221	0.001	mg/L	< 0.001	-
Aroclor-1232	0.005	mg/L	< 0.005	-
Aroclor-1242	0.005	mg/L	< 0.005	-
Aroclor-1248	0.005	mg/L	< 0.005	-
Aroclor-1254	0.005	mg/L	< 0.005	-
Aroclor-1260	0.005	mg/L	< 0.005	-
Total PCB*	0.001	mg/L	< 0.001	-
Dibutylchlorendate (surr.)	1	%	70	-
Tetrachloro-m-xylene (surr.)	1	%	63	-

Date Reported: Oct 05, 2018

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

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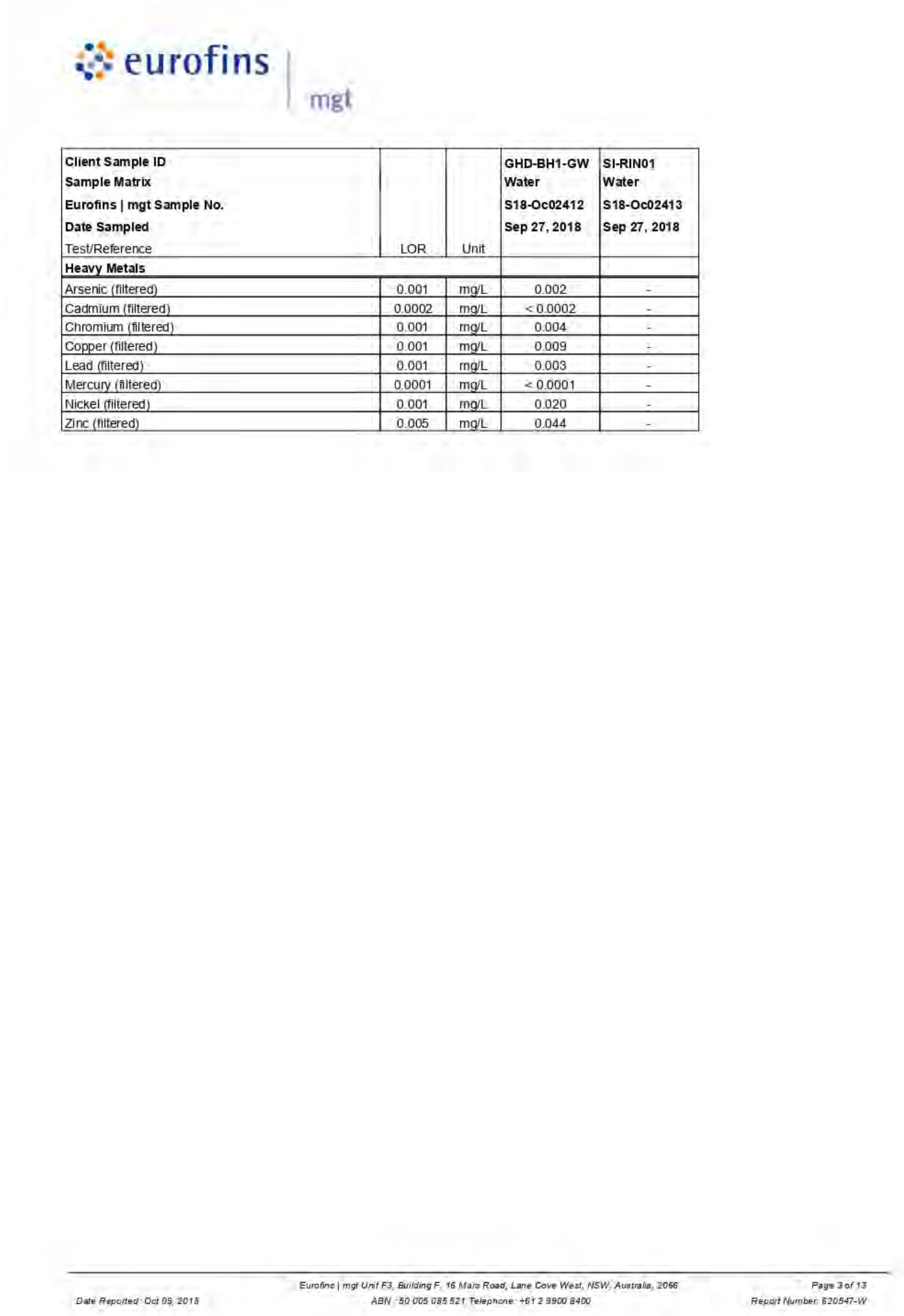
Report Number: 620547-W



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Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**GHD-BH1-GW** **Water** **S18-Oc02412** **Sep 27, 2018**	**SI-RIN01** **Water** **S18-Oc02413** **Sep 27, 2018**
Heavy Metals				
Arsenic (filtered)	0.001	mg/L	0.002	-
Cadmium (filtered)	0.0002	mg/L	< 0.0002	-
Chromium (filtered)	0.001	mg/L	0.004	-
Copper (filtered)	0.001	mg/L	0.009	-
Lead (filtered)	0.001	mg/L	0.003	-
Mercury (filtered)	0.0001	mg/L	< 0.0001	-
Nickel (filtered)	0.001	mg/L	0.020	-
Zinc (filtered)	0.005	mg/L	0.044	-

Eurofins | mgt Unit F3, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 9900 8400

Date Reported: Oct 09, 2018

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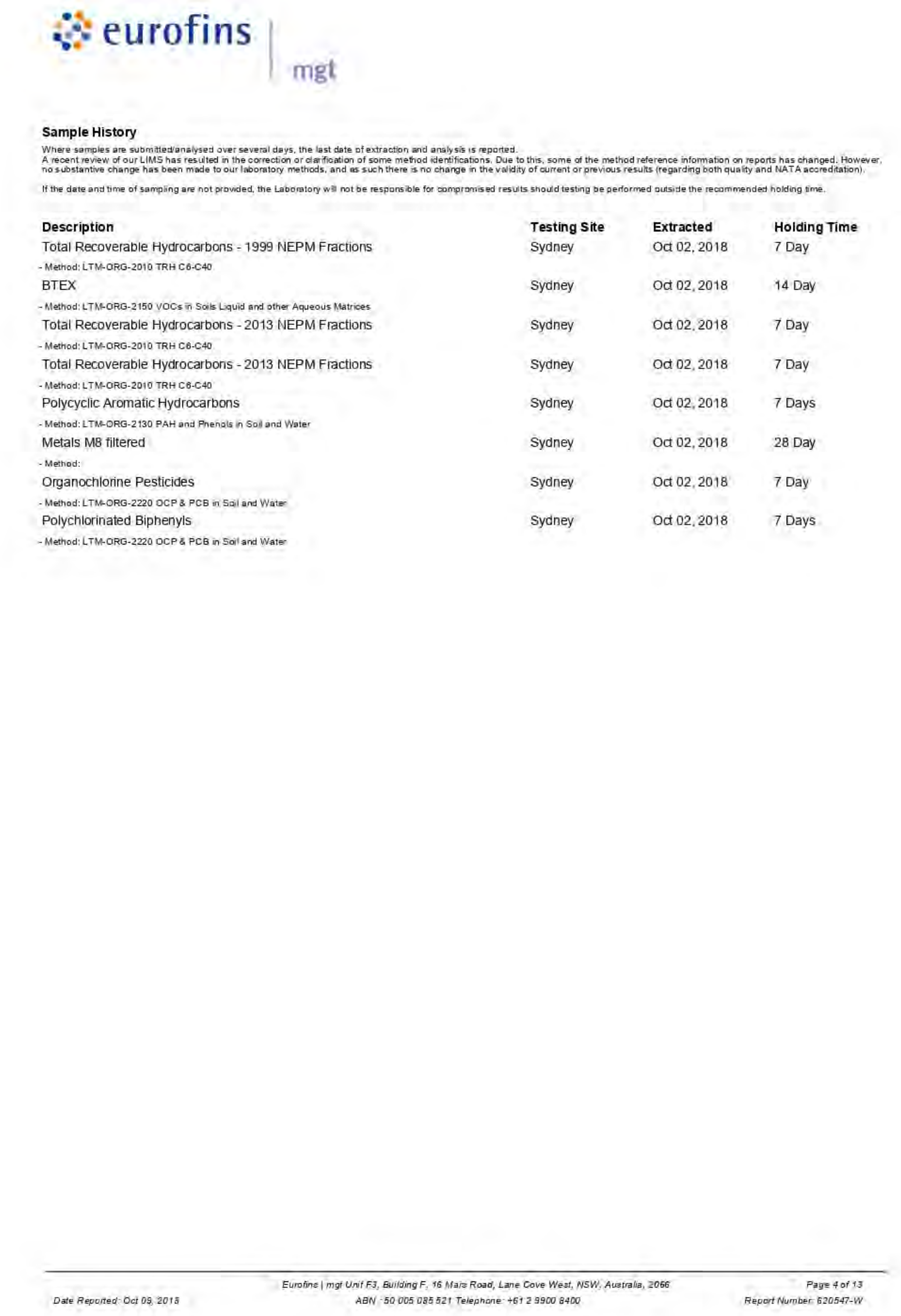
Report Number: 620547-W



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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Oct 02, 2018	7 Day
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Sydney	Oct 02, 2018	14 Day
- Method: LTM-ORG-2150 VOCs in Soils Liquid and other Aqueous Matrices			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Oct 02, 2018	7 Day
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Oct 02, 2018	7 Day
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Sydney	Oct 02, 2018	7 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Metals M8 filtered	Sydney	Oct 02, 2018	28 Day
- Method:			
Organochlorine Pesticides	Sydney	Oct 02, 2018	7 Day
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Polychlorinated Biphenyls	Sydney	Oct 02, 2018	7 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: SCOTLAND ISLAND ENERGY RELIABILITY PROJECT
Project ID: 2127425

Order No.: 2127425
Report #: 620547
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Oct 2, 2018 5:07 PM
Due: Oct 9, 2018
Priority: 5 Day
Contact Name: Clifton Thompson

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos - AS4964	Polycyclic Aromatic Hydrocarbons	Eurofins | mgt Suite B13	Aggressivity Soil Set	Moisture Set	Eurofins | mgt Suite B7	Eurofins | mgt Suite B7 (filtered metals)
Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
External Laboratory												
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**							
1	GHD-BH6_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02399	X		X	X	X	X	
2	GHD-BH6_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02400					X	X	
3	GHD-BH7_0.0-0.1	Sep 27, 2018		Soil	S18-Oc02401	X		X	X	X		
4	GHD-BH7_0.4-0.5	Sep 27, 2018		Soil	S18-Oc02402					X	X	
5	GHD-BH7_0.9-1.0	Sep 27, 2018		Soil	S18-Oc02403	X			X	X		
6	GHD-	Sep 27, 2018		Soil	S18-Oc02404					X	X	

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Melbourne Laboratory - NATA Site # 1254 & 14271												
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794												
Perth Laboratory - NATA Site # 23736												
	BH7_1.5-1.6											
7	GHD-BH7_1.9-2.0	Sep 27, 2018		Soil	S18-Oc02405				X	X		
8	GHD-SI01	Sep 27, 2018		Soil	S18-Oc02406	X						
9	GHD-SI02	Sep 27, 2018		Soil	S18-Oc02407	X						
10	GHD-SI03	Sep 27, 2018		Soil	S18-Oc02408	X						
11	GHD-SI04	Sep 27, 2018		Soil	S18-Oc02409	X						
12	GHD-SI05	Sep 27, 2018		Soil	S18-Oc02410	X						
13	GHD-SI06	Sep 27, 2018		Soil	S18-Oc02411	X						
14	GHD-BH1-GW	Sep 27, 2018		Water	S18-Oc02412			X				X
15	SI-RIN01	Sep 27, 2018		Water	S18-Oc02413		X					
Test Counts						9	1	3	4	7	4	1

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

**NOTE: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

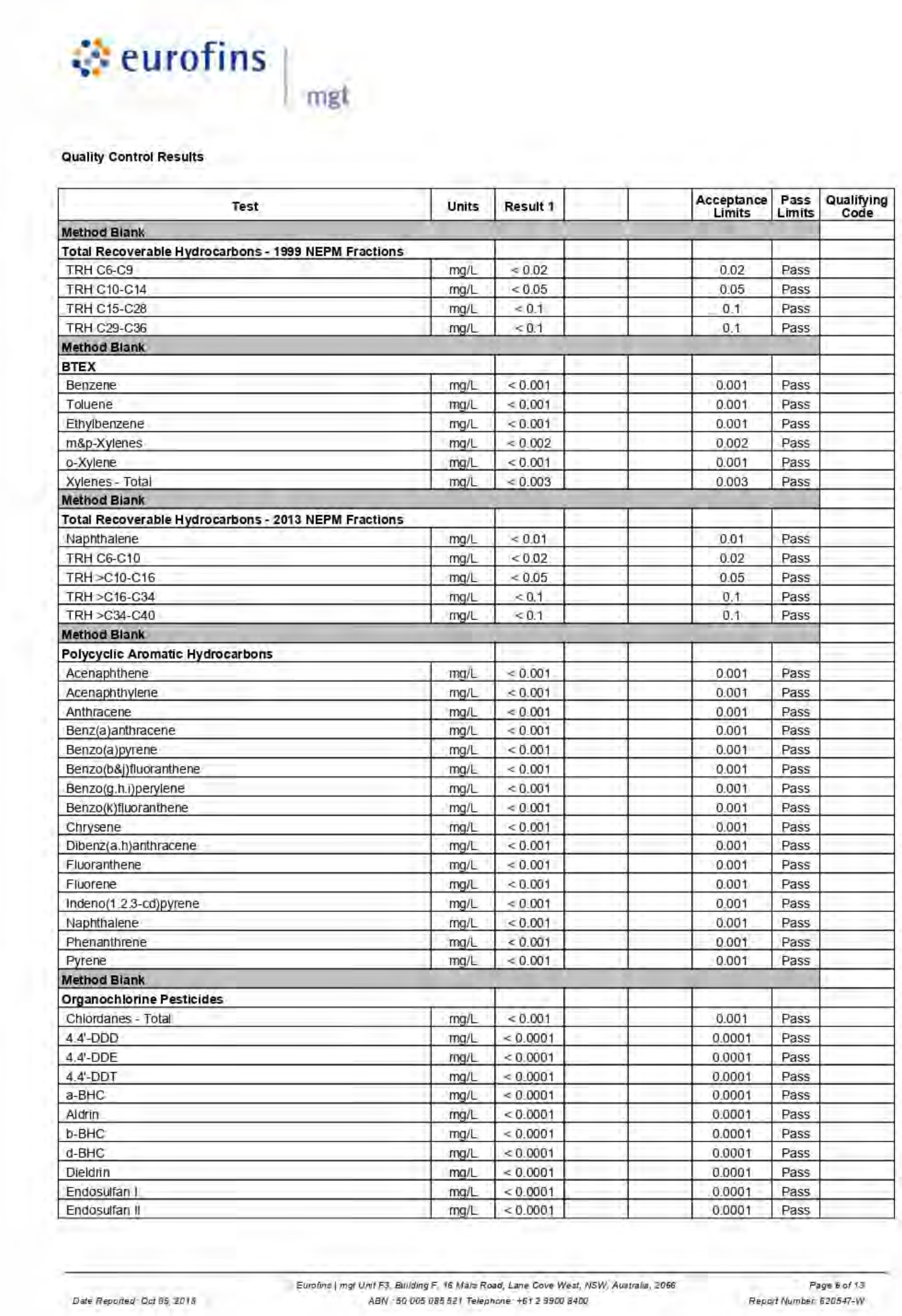
Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.



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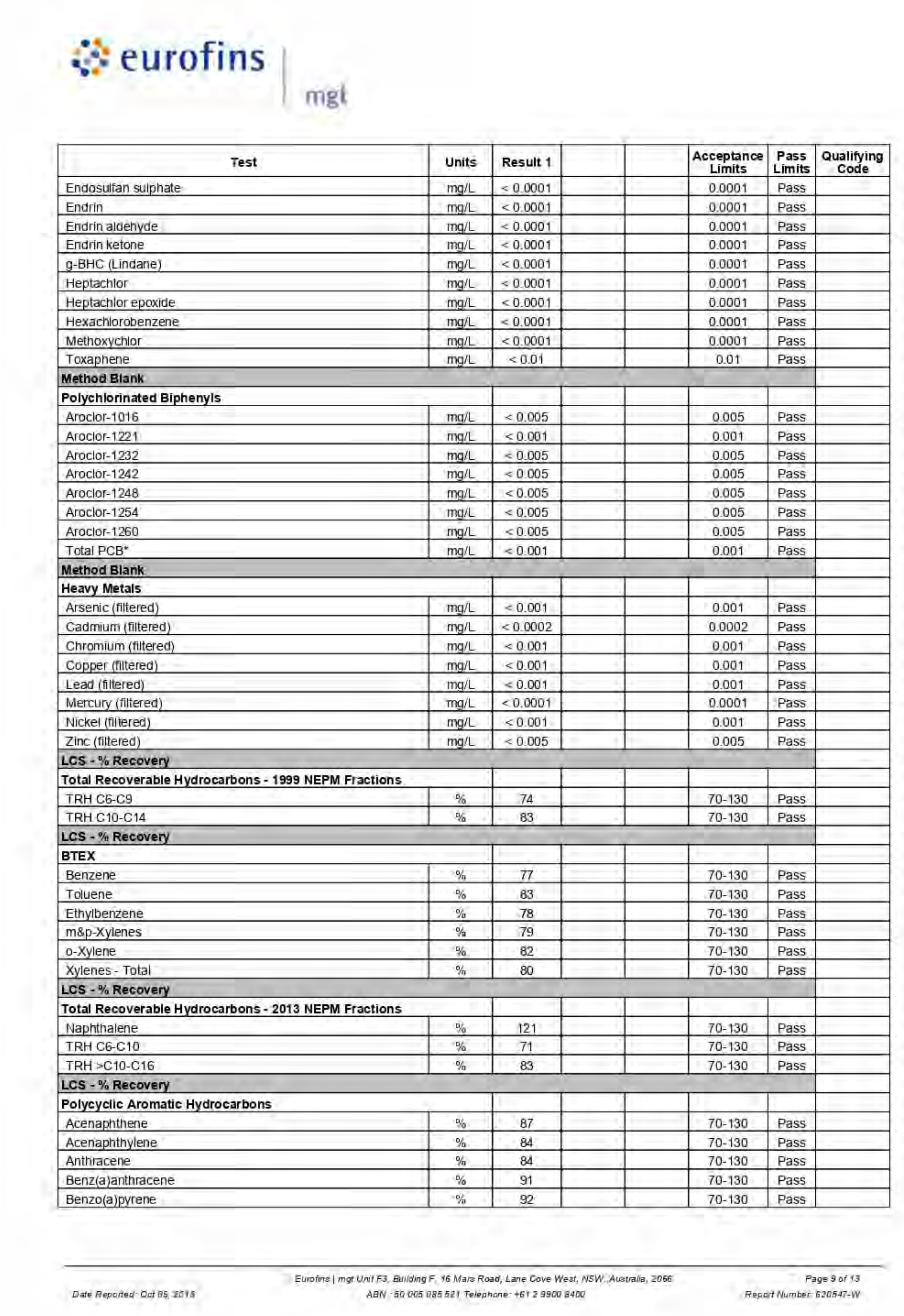
Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g.h.i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a.h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1.2.3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/L	< 0.001			0.001	Pass	
4.4'-DDD	mg/L	< 0.0001			0.0001	Pass	
4.4'-DDE	mg/L	< 0.0001			0.0001	Pass	
4.4'-DDT	mg/L	< 0.0001			0.0001	Pass	
a-BHC	mg/L	< 0.0001			0.0001	Pass	
Aldrin	mg/L	< 0.0001			0.0001	Pass	
b-BHC	mg/L	< 0.0001			0.0001	Pass	
d-BHC	mg/L	< 0.0001			0.0001	Pass	
Dieldrin	mg/L	< 0.0001			0.0001	Pass	
Endosulfan I	mg/L	< 0.0001			0.0001	Pass	
Endosulfan II	mg/L	< 0.0001			0.0001	Pass	



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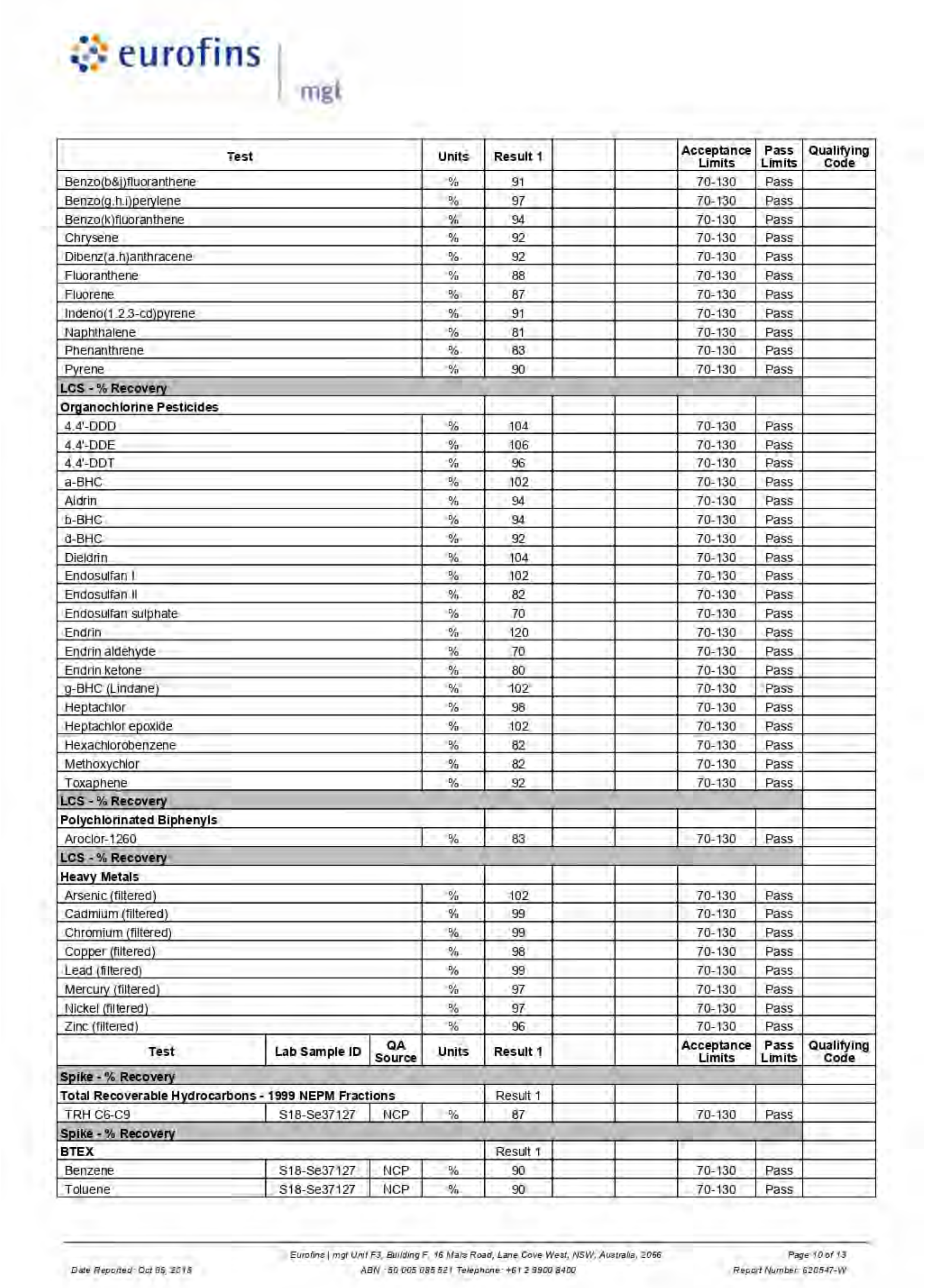
Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	mg/L	< 0.0001			0.0001	Pass	
Endrin	mg/L	< 0.0001			0.0001	Pass	
Endrin aldehyde	mg/L	< 0.0001			0.0001	Pass	
Endrin ketone	mg/L	< 0.0001			0.0001	Pass	
g-BHC (Lindane)	mg/L	< 0.0001			0.0001	Pass	
Heptachlor	mg/L	< 0.0001			0.0001	Pass	
Heptachlor epoxide	mg/L	< 0.0001			0.0001	Pass	
Hexachlorobenzene	mg/L	< 0.0001			0.0001	Pass	
Methoxychlor	mg/L	< 0.0001			0.0001	Pass	
Toxaphene	mg/L	< 0.01			0.01	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/L	< 0.005			0.005	Pass	
Aroclor-1221	mg/L	< 0.001			0.001	Pass	
Aroclor-1232	mg/L	< 0.005			0.005	Pass	
Aroclor-1242	mg/L	< 0.005			0.005	Pass	
Aroclor-1248	mg/L	< 0.005			0.005	Pass	
Aroclor-1254	mg/L	< 0.005			0.005	Pass	
Aroclor-1260	mg/L	< 0.005			0.005	Pass	
Total PCB*	mg/L	< 0.001			0.001	Pass	
Method Blank							
Heavy Metals							
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	74			70-130	Pass	
TRH C10-C14	%	83			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	77			70-130	Pass	
Toluene	%	83			70-130	Pass	
Ethylbenzene	%	78			70-130	Pass	
m&p-Xylenes	%	79			70-130	Pass	
o-Xylene	%	82			70-130	Pass	
Xylenes - Total	%	80			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	121			70-130	Pass	
TRH C6-C10	%	71			70-130	Pass	
TRH >C10-C16	%	83			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	87			70-130	Pass	
Acenaphthylene	%	84			70-130	Pass	
Anthracene	%	84			70-130	Pass	
Benz(a)anthracene	%	91			70-130	Pass	
Benzo(a)pyrene	%	92			70-130	Pass	



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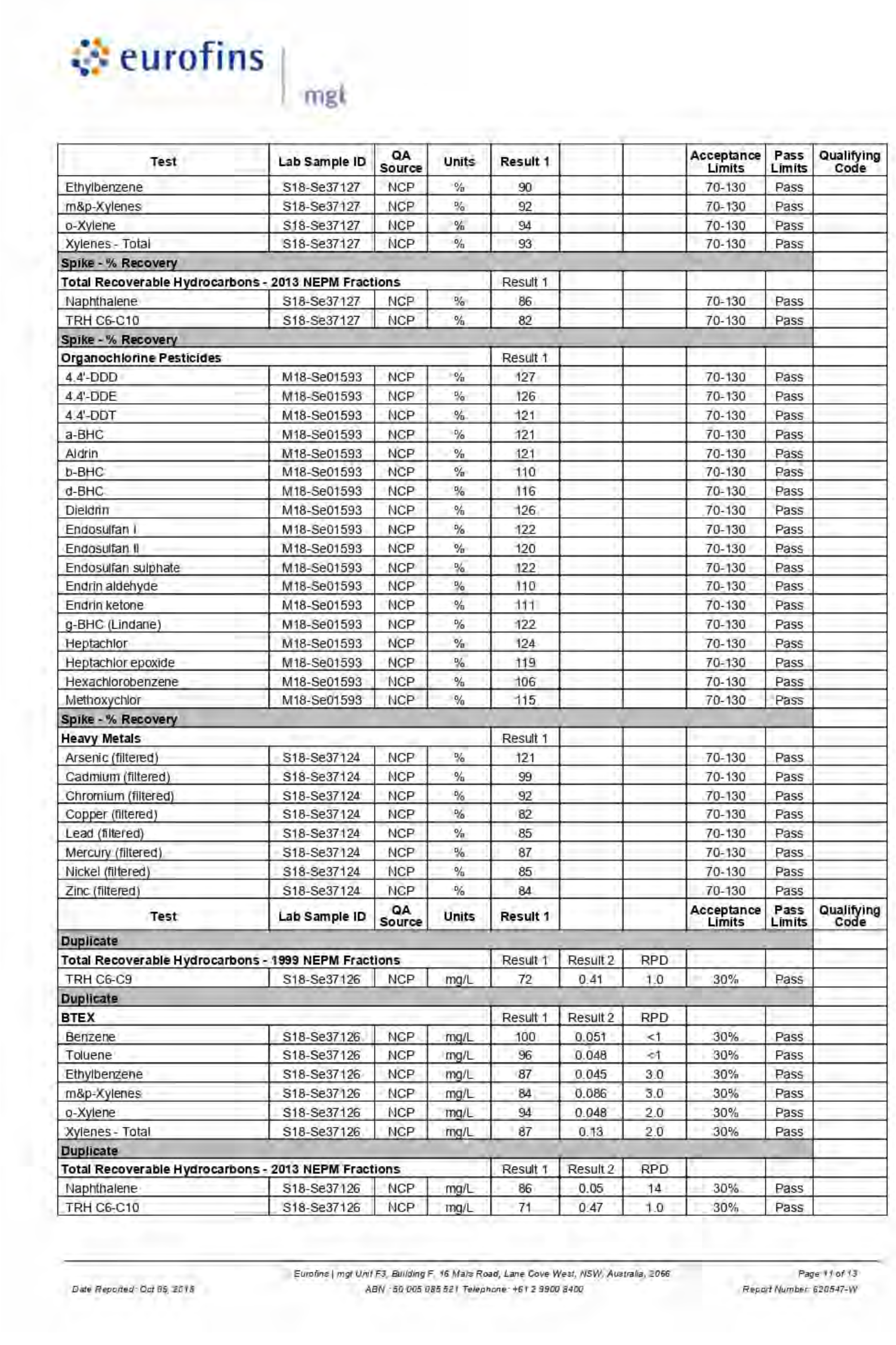
Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	%	91			70-130	Pass	
Benzo(g.h.i)perylene	%	97			70-130	Pass	
Benzo(k)fluoranthene	%	94			70-130	Pass	
Chrysene	%	92			70-130	Pass	
Dibenz(a.h)anthracene	%	92			70-130	Pass	
Fluoranthene	%	88			70-130	Pass	
Fluorene	%	87			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	91			70-130	Pass	
Naphthalene	%	81			70-130	Pass	
Phenanthrene	%	83			70-130	Pass	
Pyrene	%	90			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	104			70-130	Pass	
4.4'-DDE	%	106			70-130	Pass	
4.4'-DDT	%	96			70-130	Pass	
a-BHC	%	102			70-130	Pass	
Aldrin	%	94			70-130	Pass	
b-BHC	%	94			70-130	Pass	
d-BHC	%	92			70-130	Pass	
Dieldrin	%	104			70-130	Pass	
Endosulfan I	%	102			70-130	Pass	
Endosulfan II	%	82			70-130	Pass	
Endosulfan sulphate	%	70			70-130	Pass	
Endrin	%	120			70-130	Pass	
Endrin aldehyde	%	70			70-130	Pass	
Endrin ketone	%	80			70-130	Pass	
g-BHC (Lindane)	%	102			70-130	Pass	
Heptachlor	%	98			70-130	Pass	
Heptachlor epoxide	%	102			70-130	Pass	
Hexachlorobenzene	%	82			70-130	Pass	
Methoxychlor	%	82			70-130	Pass	
Toxaphene	%	92			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	83			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic (filtered)	%	102			70-130	Pass	
Cadmium (filtered)	%	99			70-130	Pass	
Chromium (filtered)	%	99			70-130	Pass	
Copper (filtered)	%	98			70-130	Pass	
Lead (filtered)	%	99			70-130	Pass	
Mercury (filtered)	%	97			70-130	Pass	
Nickel (filtered)	%	97			70-130	Pass	
Zinc (filtered)	%	96			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S18-Se37127	NCP	%	87			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	S18-Se37127	NCP	%	90			70-130	Pass	
Toluene	S18-Se37127	NCP	%	90			70-130	Pass	



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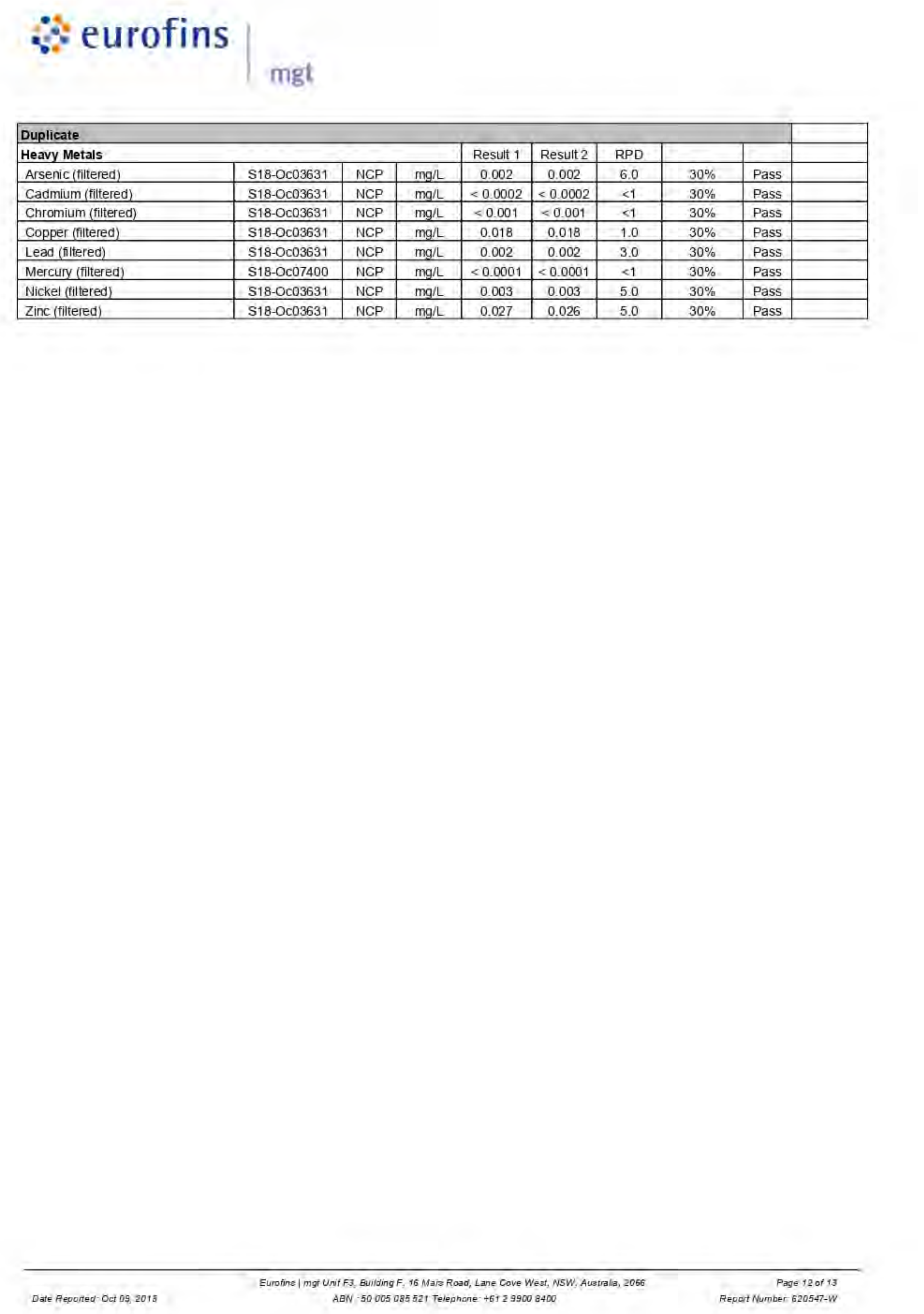
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Ethylbenzene	S18-Se37127	NCP	%	90			70-130	Pass	
m&p-Xylenes	S18-Se37127	NCP	%	92			70-130	Pass	
o-Xylene	S18-Se37127	NCP	%	94			70-130	Pass	
Xylenes - Total	S18-Se37127	NCP	%	93			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S18-Se37127	NCP	%	86			70-130	Pass	
TRH C6-C10	S18-Se37127	NCP	%	82			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	M18-Se01593	NCP	%	127			70-130	Pass	
4.4'-DDE	M18-Se01593	NCP	%	126			70-130	Pass	
4.4'-DDT	M18-Se01593	NCP	%	121			70-130	Pass	
a-BHC	M18-Se01593	NCP	%	121			70-130	Pass	
Aldrin	M18-Se01593	NCP	%	121			70-130	Pass	
b-BHC	M18-Se01593	NCP	%	110			70-130	Pass	
d-BHC	M18-Se01593	NCP	%	116			70-130	Pass	
Dieldrin	M18-Se01593	NCP	%	126			70-130	Pass	
Endosulfan I	M18-Se01593	NCP	%	122			70-130	Pass	
Endosulfan II	M18-Se01593	NCP	%	120			70-130	Pass	
Endosulfan sulphate	M18-Se01593	NCP	%	122			70-130	Pass	
Endrin aldehyde	M18-Se01593	NCP	%	110			70-130	Pass	
Endrin ketone	M18-Se01593	NCP	%	111			70-130	Pass	
g-BHC (Lindane)	M18-Se01593	NCP	%	122			70-130	Pass	
Heptachlor	M18-Se01593	NCP	%	124			70-130	Pass	
Heptachlor epoxide	M18-Se01593	NCP	%	119			70-130	Pass	
Hexachlorobenzene	M18-Se01593	NCP	%	106			70-130	Pass	
Methoxychlor	M18-Se01593	NCP	%	115			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	S18-Se37124	NCP	%	121			70-130	Pass	
Cadmium (filtered)	S18-Se37124	NCP	%	99			70-130	Pass	
Chromium (filtered)	S18-Se37124	NCP	%	92			70-130	Pass	
Copper (filtered)	S18-Se37124	NCP	%	82			70-130	Pass	
Lead (filtered)	S18-Se37124	NCP	%	85			70-130	Pass	
Mercury (filtered)	S18-Se37124	NCP	%	87			70-130	Pass	
Nickel (filtered)	S18-Se37124	NCP	%	85			70-130	Pass	
Zinc (filtered)	S18-Se37124	NCP	%	84			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S18-Se37126	NCP	mg/L	72	0.41	1.0	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	S18-Se37126	NCP	mg/L	100	0.051	<1	30%	Pass	
Toluene	S18-Se37126	NCP	mg/L	96	0.048	<1	30%	Pass	
Ethylbenzene	S18-Se37126	NCP	mg/L	87	0.045	3.0	30%	Pass	
m&p-Xylenes	S18-Se37126	NCP	mg/L	84	0.086	3.0	30%	Pass	
o-Xylene	S18-Se37126	NCP	mg/L	94	0.048	2.0	30%	Pass	
Xylenes - Total	S18-Se37126	NCP	mg/L	87	0.13	2.0	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S18-Se37126	NCP	mg/L	86	0.05	14	30%	Pass	
TRH C6-C10	S18-Se37126	NCP	mg/L	71	0.47	1.0	30%	Pass	



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Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	S18-Oc03631	NCP	mg/L	0.002	0.002	6.0	30%	Pass	
Cadmium (filtered)	S18-Oc03631	NCP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium (filtered)	S18-Oc03631	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S18-Oc03631	NCP	mg/L	0.018	0.018	1.0	30%	Pass	
Lead (filtered)	S18-Oc03631	NCP	mg/L	0.002	0.002	3.0	30%	Pass	
Mercury (filtered)	S18-Oc07400	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	S18-Oc03631	NCP	mg/L	0.003	0.003	5.0	30%	Pass	
Zinc (filtered)	S18-Oc03631	NCP	mg/L	0.027	0.026	5.0	30%	Pass	

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised By

Nibha Vaidya	Analytical Services Manager

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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		Name	Signature	Name	Signature	Date
0	T. Nham	J. Hallchurch		S. Mortimer		26/10/2018

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FEASIBILITY STUDY

July 2019

SCOTLAND ISLAND
WATER AND WASTEWATER FEASIBILITY STUDY
STAGE 1b OPTIONS REPORT

PS Solutions

PRESSURE SYSTEM SOLUTIONS PTY LTD
www.pssolutions.net.au

DRAFT FINAL REPORT

PS Solutions

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Approval

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Title:	Director	Date 25/08/20

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1 EXECUTIVE SUMMARY

Scotland Island is one of the largest villages in greater Sydney without a reticulated potable water supply or wastewater service. Scotland Island Residents' Association (SIRA) has been lobbying the NSW State Government for improved water and sewerage services for over 30 years, and the issue has been raised in Parliament several times in a period from 2000 to 2010. Recently SIRA have engaged with Sydney Water to investigate servicing Scotland Island under the Priority Sewerage Program. There have been several studies undertaken, including an option assessment in 1997.

Scotland Island is located in the southern end of Pittwater, north of Sydney. Scotland Island has 377 lots and sits well within urban Sydney. The island is within close proximity to urban areas, being approximately 2.5km north of Mona Vale. Lot sizes are typical of urbanised areas. Figure 1-1 displays the regional context and proximity to urbanised areas which are serviced by reticulated water and wastewater systems. Scotland Island is less than 390m from Church Point, mainland Sydney, which is serviced by both reticulated water and sewerage systems.

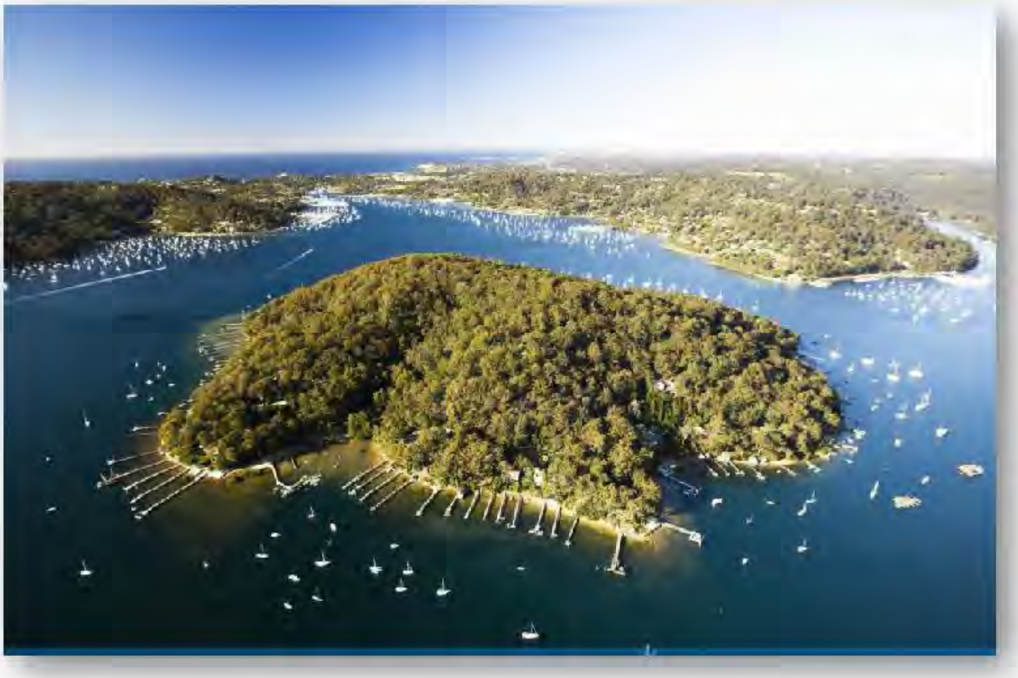


Figure 1-1– Scotland Island – close proximity to urban Sydney

The 2016 Australian Bureau of Statistics (ABS) census recorded that 358 of the 377 lots have been developed with residential dwellings, with Scotland Island having a permanent population of 579 people. A proportion of the dwellings are holiday homes, resulting in the population on the Island increasing to approximately 1000 people during holiday periods.

2019 Feasibility study

To identify a pathway for provision of acceptable water supply and sewerage services on Scotland Island, the State Government's Stronger Communities Fund has funded a feasibility study. This report is Stage 1b of a three-stage process:

- Stage 1a - identification of environmental and social factors associated with water infrastructure servicing (Completed March 2019);
- Stage 1b - review of previous reports and identification of servicing options, shortlisting two in each category, and
- Stage 2 is the commercial assessment and identification of the pathway to delivering services on Scotland Island.

The objective of this Stage 1b report is to identify and assess options for water and sewerage servicing of Scotland Island, and shortlist two options for the next stage of the project which is the commercial viability assessment. This report supplements the Environmental and Social report that was developed and submitted to Council in March 2019.

Existing Water Infrastructure Systems

The existing water supply consists of household rainwater tanks and an emergency pipeline, originally intended for firefighting purposes and emergency drinking water.

This current arrangement carries risk to public health. The water supply is non-potable, provided to residents without monitoring and used after being stored within rainwater tanks. As a result, there is potentially low to zero levels of disinfection. The filling process provides avenues for contamination of the supply though physical contact, exposure to soil (potentially containing septic runoff) and as a result of having no compliant backflow protection.

Wastewater systems consist of on-site management systems that are generally unsuitable for the topography and geology of the Island. Scotland Island is steep-sided bedrock with shallow soils of sandy loam (highly permeable) with sandy clay loam subsoils (highly impermeable). Evidence of overflow of septic systems was observed during the site inspection and audit conducted as part of this investigation. Septic odours and high numbers of mosquitos were also observed, supporting anecdotal reports of these issues.

Water Balance

From the Water Balance analysis, the following design criteria has been used to establish the scheme's inputs which in turn helped to establish the options for assessment.

Table 1-1 Preliminary water balance assessment for Scotland Island

Item	Criteria
Number of Lots	377
Ultimate Holiday Population	1,413 EP
TOTAL Water	75 kL/person per year OR 226 kL/home/y Estimated maximum flow rate 30 L/s
Peak Sewage Daily Total	300 kL/day

The only option for further development on Scotland Island is redevelopment of existing lots. This takes the form of knock-down-rebuilds or upgrading existing holiday house. Redevelopment has been occurring for several years, however the Island's population has seen a decrease since the 2011 Census suggesting development has been focussed on improvements to accommodation and not an increase in capacity. The size of housing is somewhat restricted by a requirement to maintain 80 percent of the property as landscaped area. Associated with an increase in the size and value of dwellings has been an expectation to have upgraded facilities such as dishwashers.

This report identifies the potential options for the Sewerage Collection System, Effluent Disposal, and Water Supply, assesses the options and shortlists two options in each category for commercial analysis in Stage 2.

The potential options for servicing Scotland Island identified in this report are:

Table 1-2: Potential Services Options

	A. SEWAGE COLLECTION SYSTEMS *Required for* B. Sewage Treatment / Disposal *options not utilising on-property disposal*
A.1	Gravity Sewer
A.2	Pressure Sewer
A.3	Vacuum System
A.4	Hybrid System
A.5	Variable Grade Sewer
	B. SEWAGE TREATMENT / DISPOSAL
B.1	Do Nothing
B.2	Upgrade of existing Domestic Systems (Managed System)
B.3	On Site Grey Water Reuse using existing Septic Tank, with on-site reduced disposal
B.4	Tanker Truck Disposal from each lot
B.5	Tanker Truck disposal from common collection storage tank
B.6 *	Upgrade existing on lot systems with disposal redirected to Pittwater;
B.7 *	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal
B.8 *	Septic Tank Pump Out System discharging to Sydney Water
B.9 *	Installation of a sewer collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater
B.10 *	Installation of a sewer collection system discharging to a treatment system on Scotland Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater
B.11 *	Collect Sewage and Pump to Sydney Water sewerage system
B.12	Non-potable Reuse
*	*Sewage Disposal Strategy requiring an* A. Common Sewage Collection *system option to be constructed*
	C. WATER SUPPLY
C.1	Disconnect existing non potable supply
C.2	Do Nothing
C.3	Upgrade of rainwater storage tanks and water usage management

C.4	Replace Small Bore Supply and provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks
C.5	Provide supply from Sydney Water System to reservoir on Island
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required
C.7	Desal with new water reticulation
C.8	Reuse non potable
C.9	Reuse potable

Assessment of Options

Option assessment was undertaken by a multi-disciplined team including Water Infrastructure Strategic Planners, water services engineers, and Environmental Consultants, with input as required from Cost Planners and Construction Managers. With additional contributions from Northern Beaches Council and the Scotland Island Community, and peer review by Institute of Sustainable Futures.

The options were technically evaluated using a multi-criteria assessment matrix. The assessment categories included Environmental Performance, Community Acceptance, Stakeholder Acceptance, Technical Risk and Work Health and Safety. Each category was weighted for performance, with sensitivity analysis for alternate weighting profiles.

Shortlisted Options

The options shortlisted from the selection process for detailed costing and commercial funding modelling analysis are:

Sewage Collection System options

A.2 Pressure Sewerage System

A.4 Hybrid System, combination of gravity and pressure sewerage systems

Sewage Treatment and Disposal options

B.9 Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

B.11 Collect Sewage to central pumping station and pump to Sydney Water sewerage system at Church point

Water Supply options

C.4 Replace Small Bore Supply and provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks

C.6 Direct mains pressure supply from Sydney Water mains / pressure boost if required

Pathway to provision of services

The historical barriers to providing water and sewerage services have been commercial, with budget costing analysis showing negative return on investment. Scotland Islands has steep rocky topography and unsealed carriageways with informal road boundaries that add significant costs to construction, exacerbated by the remoteness of the Island requiring materials and labour to be transported by boat.

There have been cost estimates produced in previous studies, undertaken by Sydney Water and other stakeholders, but the costing and planning has been at a high level only. The key success factor for implementation of Water and Sewerage Infrastructure to Scotland Island is to develop a detailed cost plan and delivery strategy to provide certainty for the project delivery. With a robust delivery plan and cost structure a funding model can be developed with consultation between Sydney Water, NSW Government, Constructors and service providers, and the Scotland Island community.

Summary of indicative costings

Preliminary capital cost estimates were prepared to assist in assessment of options. All costs including operation and maintenance will be refined and developed further in the next Stage 2 of the feasibility assessment.

Table 1-3: Indicative Capital Cost

Table 1: Indicative capital cost for two combinations of shortlisted options

System	Option/Item *	Indicative cost ($)
Project	Project management	6,240,000
Project	Preliminaries and site establishment	12,137,034
Water	C4: Low flow from Sydney Water	16,029,637
	C6: Full reticulated system from Sydney Water	16,730,267
Wastewater collection and delivery	A2: Pressure system	28,504,189
	A4: Hybrid system	31,265,520
Wastewater treatment and disposal	B9: On-island treatment system	30,153,240
	B11: Discharge to Sydney Water	7,361,263
Total cost systems combined	C6 + A2 + B11	70,972,753
Total cost per lot#	C6 + A2 + B11	188,257
Total cost systems combined	C6 + A2 + B9	93,764,730
Total cost per lot#	C6 + A2 + B9	248,713

Scotland Island Lots = 377

* Water Supply options

C.4 Replace Small Bore Supply and provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks

C.6 Direct mains pressure supply from Sydney Water mains / pressure boost if required

* Sewage Collection and Transport options

A.2 Pressure Sewerage System

A.4 Hybrid System, combination of gravity and pressure sewerage systems

* Sewage Treatment and Disposal options

B.9 Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

B.11 Collect Sewage to central pumping station and pump to Sydney Water sewerage system at Church point

To provide certainty in the commercial delivery and operational aspects of the project a concept design is recommended to be prepared for each preferred option, and a delivery plan and construction strategy developed in conjunction with a detailed cost plan. The detailed planning is recommended to include a multidiscipline team of water services engineers, utility providers, council planners, project managers, cost planners, and contractors experienced in delivering this type of project.

2 INTRODUCTION

The State Government's Stronger Communities Fund has funded a feasibility study for the provision of water and wastewater infrastructure to Scotland Island. Northern Beaches Council are managing the study and have commissioned Pressure System Solutions to undertake the initial scopes of work to identify options and make recommendations for water and sewerage servicing.

Scotland Island is about 55 ha and located at the southern end of the Pittwater estuary. In the 2016 Census there were 579 people living in 359 private dwellings on Scotland Island. Only 209 of those dwellings were occupied at the time of the census. Over half the population is employed. These figures are down from 715 residents in 344 dwellings in the 2011 Census, with 252 dwellings occupied at the time of the census. The proportion of permanent residents has gradually increased over time, although it has historically fluctuated.

Table 2-1: Scotland Island Population 2001 - 2016

Census Data	
Year	**Population**
2016	579
2011	715
2006	642
2001	734

Source: Australian Bureau of Statistics

Figure 2-1: Scotland Island Location Plan

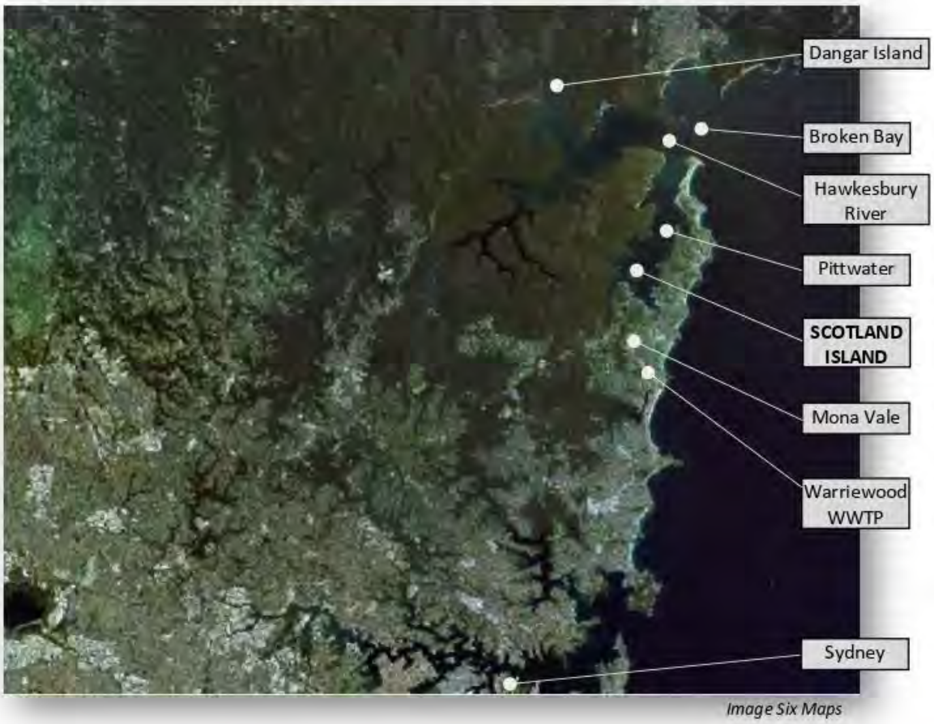


Image Six Maps

2.1 Existing Water and Sewage Services

Scotland Island is one of the larger villages in greater Sydney without a reticulated potable water supply or sewerage services. There are approximately 358 dwellings on Scotland Island with suburban development density.

Figure 2-2: Scotland Island Urban Context

Image Google Earth

Potential health risks have been identified in substandard water supply systems and from poorly performing on site disposal systems.(1,10)

Water supply is from rainwater tanks. A small-bore pipeline was initially an emergency water supply pipeline set up for firefighting and then later used as an emergency drinking water supply. This supply is officially non-potable.

The small-bore supply pipework extends under Pittwater from a connection to Sydney Water supply at Church Point. Sydney Water ownership of the service ends at the Church Point connection. The council originally owned and maintained the service, but when council were going to disconnect the service SIRA accepted responsibility. The actual ownership of the pipeline in not clearly defined.

The reticulated non-potable water supply is not installed to AS3500, without the provision of mandatory back flow prevention devices required for protection of ingress of contaminated water into the pipeline. The small-bore service is not sufficient to fill the rainwater tanks on Scotland Island on demand, only a small number of rainwater tanks can be filled simultaneously. Residents are required to book for a fill period to fill their tanks. (SIRA)

Photo 2-3: Small Bore Water Supply fixed to trees

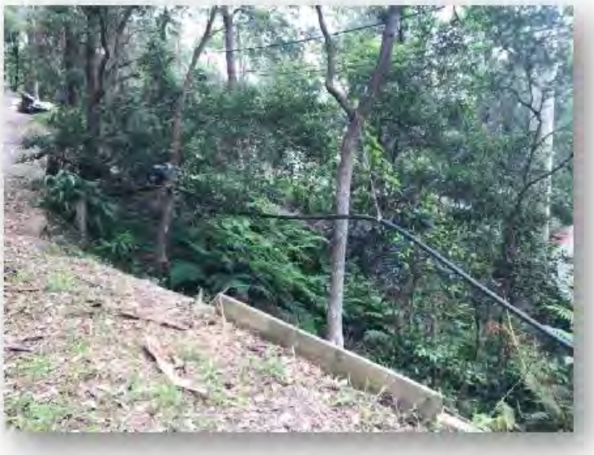


Photo 2-4: Tank Filling from Small Bore Pipeline

Environmental impacts from sewage surface run-off have been identified on Scotland Island (1,5). The sewage disposal is on site systems with high variance in performance (11). The on-site wastewater systems on Scotland Island are generally not performing to required standards, which has contributed to water quality impacts on the Pittwater Estuary, particularly following rain events. (1,5)

Figure 2-5: Scotland Island Contiguity

Image Google Earth

Scotland Island topography is generally not suitable for on-site sewage treatment and disposal systems (14). Sewage systems with on-site disposal are best suited to level sites having deep soils with high absorption rates. Scotland Island is generally steeply sloping with shallow soils. In some locations surface rock is visible. The issue is exacerbated during rainy periods. Although the standard advice from the Office of Environment and Heritage (OEH) is to not use waterways in Sydney after wet weather, there is further anecdotal evidence of an informal agreement amongst the community not to use the waterways surrounding Scotland Island after wet weather periods due to pollution from contaminated stormwater run-off; indicating a heightened awareness of this issue on the Island. The on-site treatment systems are generally of insufficient capacity to cope with reticulated supply.

Photo 2-6: Evidence of surcharge from poorly performing on-site disposal

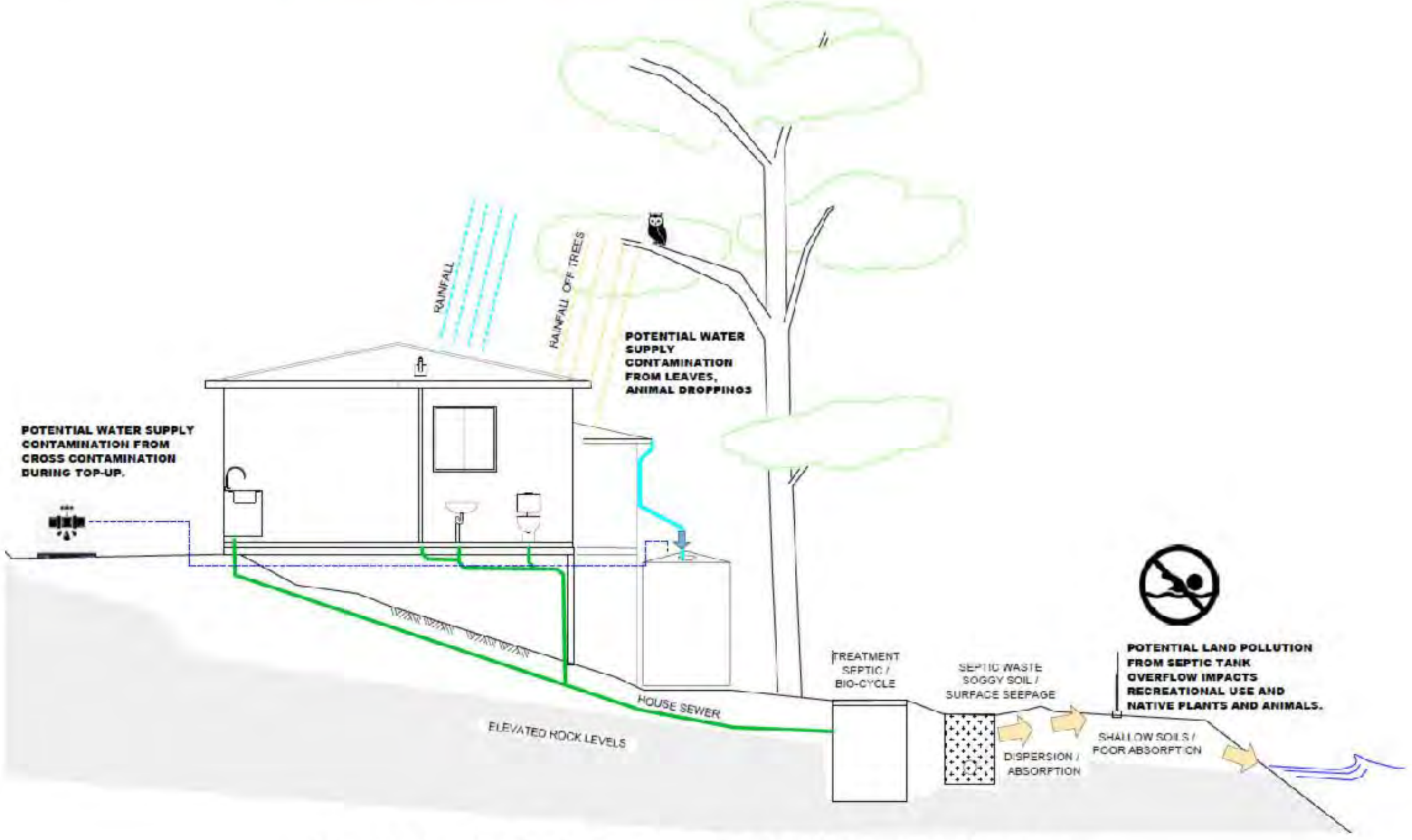


Figure 2-7: Small Lot On-Site Sewage Treatment and Rainwater Collection Risks

2.2 Lobbying Background

The Scotland Island Residents Association (SIRA) has taken an active role in lobbying for improved services to Scotland Island for over 30 years (5). The water and sewage servicing of Scotland Island has been the subject of discussion and various investigations for over 25 years (5).

A report 'SCOTLAND ISLAND WATER AND SEWAGE OPTIONS STUDY' was prepared by Marten and Associates in 1997 investigating the options for water and sewage servicing of Scotland Island.

The project was recorded in NSW Legislative Assembly Parliament Hansard(5,8) in May 2000, March 2005, June 2007 and in March 2010. In 2000 Scotland Island Sewerage Servicing was identified as undergoing an assessment process, and in March 2005 was nominated in the Sydney Water Priority Sewerage Program Stage 2. In 2007 Hansard records state the project was expected to commence in 2010/11 and reconfirmed in 2010 to be expected to commence in 2011, subject to funding and upgrade of existing on island water supply.

In December 2012 NSW Government committed in the Northern Beaches Regional Action Plan (under NSW 2021) to better manage wastewater and upgrade wastewater treatment facilities to Scotland Island as a matter of priority. SIRA have met with NSW Government Ministers and Sydney Water on various occasions from 2014 to 2016 lobbying for action.

A Sewage Survey(9) was undertaken in 2015 asking residents of Scotland Island if they supported a sewerage system for Scotland Island, with over 95% of the respondents voting yes.

Sydney Water recently met with SIRA to investigate servicing of Scotland Island under the Priority Sewerage Program.

Below is an overview of SIRA's history in advocating for improved infrastructure for Scotland Island:

1997	Scotland Island Landcare Group won a grant, administered by SIRA to investigate the environmental and public health impacts of current on-site wastewater disposal on Scotland Island, and consider water and wastewater options for Scotland Island.
2001	Scotland Island announced as one of 20 villages to receive improved wastewater infrastructure as part of Stage 2 of the Priority Sewerage Program (PSP).
Jun 2005	SIRA held a workshop with key stakeholders to discuss future water and wastewater infrastructure for Scotland Island.
Mar 2010	Pittwater Council raised concerns directly with Sydney Water that Scotland Island appeared to have been removed from the program for PSP.
Apr 2010	The Hon. Rob Stokes (Member for Pittwater) raised in Parliament the question of when PSP work would begin on Scotland Island. The response was that planning would begin in 2011, subject to funding and a resolution by residents to upgrade local water infrastructure.
Jan 2011	Soon to be Premier Barry O'Farrell committed to the fast-tracking of wastewater connections to a number of PSP identified villages in Wollondilly and Hornsby Shires, and said the remaining villages including Scotland Island were a priority.

Dec 2012	NSW Government commitment in Northern Beaches Regional Action Plan (under NSW 2021) to better manage wastewater and upgrade wastewater treatment facilities to Scotland Island as a matter of priority.
Aug 2014	SIRA submission to review of Sydney Water's Operating Licence review in support of Sydney Water retaining responsibility for delivery of the Priority Sewage Program as part of their next operating license.
Jan 2015	PR and letter campaign by SIRA and residents to Minister Humphries, IPART and EPA in response to a concern that Sydney Water was going to be released from the PSP as part of their Operating Licence conditions.
Jun 2015	Sydney Water's new Operating Licence has no firm commitment to deliver the PSP to Scotland Island.
Aug 2015	SIRA met with The Hon. Rob Stokes, Member for Pittwater.
Nov 2015	SIRA met with The Hon. Niall Blair, Minister for Lands and Water regarding installation of wastewater infrastructure plus subsequent correspondence.
Apr 2016	SIRA met with The Hon. Rob Stokes and decentralised service providers regarding options for water and wastewater provision on Scotland Island.
2016	Draft Pittwater Waterways Review Discussion Paper notes key issues raised in stakeholder engagement were sewage runoff from Scotland Island.

Despite being listed on the State Government's Priority Sewerage Program, there is currently no requirement on Sydney Water to service villages, and as such, the State Government has encouraged SIRA to consider alternative servicing options.

2.3 Report Objective

The objective of this report is to identify potential technical and commercial options for water and sewerage servicing of Scotland Island, and shortlist two options for commercial viability assessment.

Potential servicing options are identified, and a technical assessment process utilised to identify preferred solutions. High level cost planning is undertaken for solutions considered technically and commercially feasible.

The servicing options are to be capable of servicing all lots on Scotland Island, existing and potential ultimate loading including development on lots that are currently vacant.

A Hydraulic water consumption model was developed for Scotland Island, estimating a typical dwelling existing water usage and sewage discharge profile, and potential future usage profiles if reticulated towns water was available on Scotland Island and existing vacant lots were developed.

The hydraulic loading and servicing strategies did not assess any changes to zoning, excluding any commercial developments or high-density developments.

2.4 Feasibility Study Process Overview

The feasibility study is being prepared in stages.

Stage 1a of the process is a high-level review of Social and Environmental factors. (Completed)

Stage 1b (this report) is assessment of servicing options, including development of a Hydraulic Demand model, identification of potential water and sewerage servicing options, and an initial technical assessment, and shortlist of two options for further detailed commercial analysis. Two options are shortlisted for each water infrastructure category:

A. Sewerage Collection System
B. Sewage Treatment and/or Disposal
C. Water Supply

Stage 2 is the preparation of a Commercial feasibility report examining the two short listed options from Stage 1b.

The feasibility study is being undertaken by a multi-disciplined team including Water Infrastructure Strategic Planners, water services engineers, and Environmental Consultants, with input as required from Cost Planners and Construction Managers. Northern Beaches Council provided an overview management role, including engaging UTS Institute for Sustainable Futures to undertake independent external peer review of the option identification and evaluation methodology. The Scotland Island Community was consulted and contributed at key milestones during the Stage 1b stakeholder workshops.

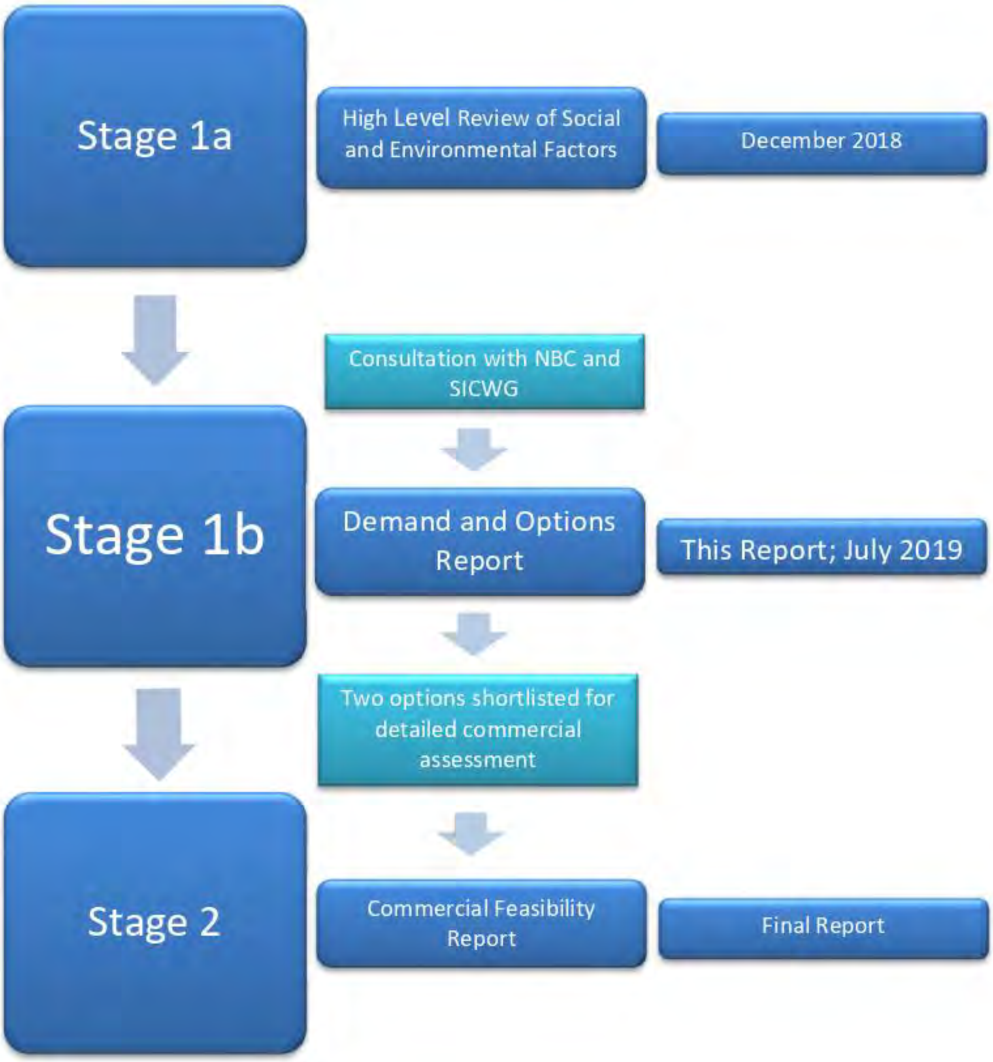


Figure 2-8: Feasibility Process Overview

2.5 Scope

This feasibility study is for the water supply and sewerage servicing of all the residential lots on Scotland Island. The scope of the study includes:

- Water Supply servicing from Sydney Water services on the mainland, Church Point
- Decentralised Sewage solutions
- Innovative solutions treatment and reuse and hybrid systems
- Centralised treatment and disposal system
- Pumped discharge to Sydney Water Sewerage System on the mainland

Key Areas

- Safety
- Environment
- Community / Key Stakeholder engagement
- Engineering / Technical
- Commercial / Legal / Financial
- Delivery / Operating Models

Figure 2-9: Plan of Scotland Island showing lots included in scope

2.6 Identification of Stakeholders

Key stakeholders include Northern Beaches Council, Scotland Island Residents Association, Sydney Water, NSW Department of Planning and Environment, NSW Office Environment and Heritage (including NSW National Parks and Wildlife Service), NSW Health, residents of Scotland Island, recreational users of the Pittwater waterway, and environmental and community groups associated with Pittwater and its environs.

NORTHERN BEACHES COUNCIL

Business units	NECC and TCI
Key Subject Matter Experts	Ruby Ardren, Project Leader - Water Management
Executive Leadership Team	Yianni Mentis, Executive Manager - Natural Environment and Climate Change Todd Dickinson, Director of Environment and Sustainability
Councillors	Kylie Ferguson - Pittwater Ward Alex McTaggart - Pittwater Ward Ian White – Pittwater Ward

Council and Government Stakeholders

Government Depts	The Hon. Rob Stokes, Member for Pittwater Dept Local Government Rural Fire Service Dept Health Office Environment and Heritage
Service providers	Northern Beaches Council
Utilities	Sydney Water

External Stakeholders and Community

Local residents and property owners	Scotland Island	Tenants	
Local businesses	Operating from Scotland Island	Accommodation providers	Scotland Island Off-shore Children's Services (Scotland Island Kindy)
Users of facility/ area	Island Visitors	Recreational Pittwater Waterway users	

Community groups	Scotland Island Residents Association (SIRA)	Scotland Island Pipeline Company (SIPCO) - private consortium
Environment groups	Bushcare Groups	

Others

- Beach Watch
- EPA
- Health Department
- Fisheries
- National Parks

3 IDENTIFICATION OF OPTIONS

3.1 Water and Sewerage Servicing options

The identification of options for water and sewerage services to Scotland Island was undertaken by a panel including Water Infrastructure Strategic Planners, water services engineers, and Environmental Consultants, with input as required installation contractors. The water and sewerage Servicing options identified include;-

	A. SEWAGE COLLECTION SYSTEMS *Required for* B. Sewage Treatment / Disposal *options not utilising on-property disposal*
A.1	Gravity Sewer
A.2	Pressure Sewer
A.3	Vacuum System
A.4	Hybrid System
A.5	Variable Grade Sewer
	B. SEWAGE TREATMENT / DISPOSAL
B.1	Do Nothing
B.2	Upgrade of existing Domestic Systems (Managed System)
B.3	On Site Grey Water Reuse using existing Septic Tank, with on-site reduced disposal
B.4	Tanker Truck Disposal from each lot
B.5	Tanker Truck disposal from common collection storage tank
B.6 *	Upgrade existing on lot systems with disposal redirected to Pittwater;
B.7 *	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal
B.8 *	Septic Tank Pump Out System discharging to Sydney Water
B.9 *	Installation of a sewer collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater
B.10 *	Installation of a sewer collection system discharging to a treatment system on Scotland Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater
B.11 *	Collect Sewage and Pump to Sydney Water sewerage system
B.12	Non-potable Reuse
*	*Sewage Disposal Strategy requiring an* A. Common Sewage Collection *system option to be constructed*
	C. WATER SUPPLY
C.1	Disconnect existing non potable supply
C.2	Do Nothing
C.3	Upgrade of rainwater storage tanks and water usage management
C.4	Replace Small Bore Supply and provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks
C.5	Provide supply from Sydney Water System to reservoir on Island
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required
C.7	Desal with new water reticulation
C.8	Reuse non potable
C.9	Reuse potable

3.2 Research and Investigation

The first stage of the option assessment process was identifying potential methods of providing water and sewage to Scotland Island. To ensure a comprehensive assessment no options were excluded from the initial discussion and appraisal.

Selection of the candidate options was an integrated process involving

- Discussions with Stakeholders NBC and Community Groups
- Site inspections
- Review of Geotechnical Conditions
- Identification of new emerging technologies
- Review of Previous reports prepared in 1997
- Workshops with industry leaders in Sustainable Urban Water
- Review of previously prepared reports (SCOTLAND ISLAND WATER AND SEWAGE OPTIONS STUDY Marten and associates 1997 (1))
- Review with Northern Beaches Council
- Discussion with Scotland Island community group SIRA
- Peer Review with UTS Institute for Sustainable Futures
- Several workshops were held with the community and council during the option identification and assessment process.

Two site activities were undertaken to inform the option selection and assessment process.

1. Audit of selected properties; 21 properties were audited to determine construction and compliance issues on site to inform project scope, standard of existing services and cost planning.
2. Soil sampling was undertaking in strategic locations to confirm levels of contamination from on-site sewage treatment and disposal systems. (10)

4 OPTION ASSESSMENT METHODOLOGY

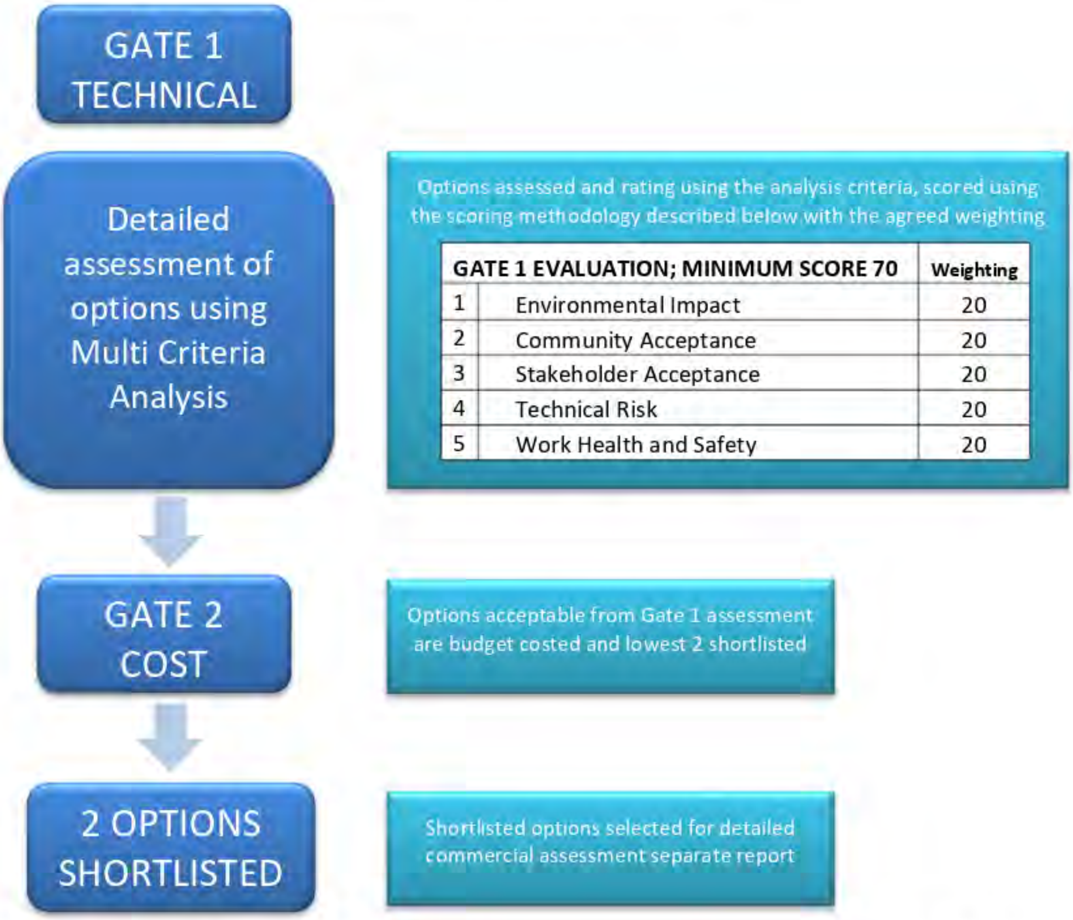
4.1 Option Assessment Methodology

The options assessment rating was undertaken in a two-part process.

The first part (Gate 1 - Technical) of the process assesses the options with a Multi-Criteria Analysis matrix. This assessment phase focusses on the technical aspects and rates the options without a cost assessment. A minimum scoring benchmark was determined and any options not reaching the benchmark were eliminated from further assessment. Options that scored a rating higher than 70 were taken forward to Gate 2 assessment. However, if there were not two options scoring 70 or higher, the two highest rating options were taken forward to gate 2.

The second part (Gate 2 – Estimated Cost) of the assessment applied an estimate cost to the remaining acceptable options. From this assessment two options were shortlisted for detailed commercial analysis and viability assessment undertaken within a separate report.

Figure 4-1: ASSESSMENT PROCESS MODEL



GATE 1 EVALUATION; MINIMUM SCORE 70		Weighting
1	Environmental Impact	20
2	Community Acceptance	20
3	Stakeholder Acceptance	20
4	Technical Risk	20
5	Work Health and Safety	20

The assessment technical criteria were developed and weighted by collaboration with the project panel, including Water Infrastructure Planners and engineers, environmental consultants and contractors. Assessment Criteria were grouped into five categories

Figure 4-2: Option Analysis Process

GATE 1 EVALUATION;		Weighting
1	Environmental Impact	20
	Construction Disturbance	
	Operational Impact on Island	
	Operational Impact off Island	
	Sustainability: Water, Energy, Material, Life Cycle Performance	
2	Community Acceptance	20
	Equity: Sydney Water area of operation / Local Community	
	Cost to Community	
	Land Use Impact	
3	Stakeholder Acceptance	20
	Management complexity (Governance)	
	Regulatory / Compliance	
	Legal Risk	
4	Technical Risk	20
	Design	
	Construction	
	Likelihood of failure	
	Operations	
5	Work Health and Safety	20
	Construction Risk	
	Operational Risk	
	Public Health	
	Fire Fighting	
GATE 2 EVALUATION		
	Indicative Cost NPV = Capex, Opex, IRR 7%, 30 years	Lowest 2

GATE 2 - ESTIMATED COST EVALUATION

Lowest two options to be shortlisted

4.2 Criteria Weighting

The initial option assessment weighting criteria placed all categories equal at 20. During the assessment process it was acknowledged the weighting may vary when appraised by different stakeholders.

Alternate weighting scenarios were evaluated to ensure the selected shortlisted options were not disproportionally biased.

The assessment team agreed on the following alternate weighting profiles for sensitivity analysis:

	Base	**Increased focus on Environment and Community**	**Increase focus on Stakeholders and WHS**
		Weightings	
ENVIRONMENTAL	20	30	10
COMMUNITY ACCEPTANCE	20	30	20
STAKEHOLDER ACCEPTANCE	20	10	30
TECHNCIAL RISK	20	10	10
WORK HEALTH AND SAFETY	20	20	30

The outcomes of the sensitivity alternate weightings are provided in Attachment B. The alternate weightings did not change the highest scoring options.

5 OPTION ASSESSMENT

A workshop was undertaken with the panel to evaluate each option and apply the rating tool to identify the preferred solutions.

The full notes from the workshop are included in Attachment F, Stage 1b Option Evaluation Workshop Notes, to this report.

A summary of the evaluation for each option is provided within this section.

5.1 Sewage Collection System Options

Sewage collection systems are required for servicing options proposing central sewage treatment on Scotland Island or disposal of Island and are an integral part of the selection of the sewage treatment and disposal strategy.

Figure 5-1: COLLECTION SYSTEM OPTION SELECTION MODEL

SEWAGE COLLECTION

PUMP SYSTEM

GRAVITY SYSTEM

Hybrid

Table 5-1: Sewage Collection System Options

A.1	Gravity Sewerage
A.2	Pressure Sewerage
A.3	Vacuum System
A.4	Hybrid System, Gravity and Pressure Sewerage
A.5	Variable Grade Sewerage

5.1.1 Option A.1: Gravity Sewerage

Description

A gravity sewerage option is the provision of traditional gravity drainage system collecting sewage from each property. The topography of Scotland Island would constrain the reticulation requiring multiple sewage pumping stations servicing many small catchments. The location of properties around the foreshore at Scotland Island would also constrain the spacing of the pump stations at water's edge. Many pump stations would be required around Scotland Island to cater for the minimal runs before the gravity sewer became too deep below sea level adjacent to the foreshore.

The multiple sewage pumping stations will transfer to a central sewage pumping station pumping to the Sydney Water gravity sewerage at Church Point, or to the on-island treatment plant. Each lot provided with a gravity sewerage drainage connection point. Common collection pipework will be located in public areas where feasible. Gravity fall constrained lots will require creating of easements for common pipework located within private lots.

The environmental impact of gravity sewerage would be significant, requiring deep trenching in some locations, and trenching within private property.

Technology

Typical sewerage solution widely accepted as a sound servicing strategy.

Environmental Impact

Higher negative impact, deep extensive excavation, potential for infiltration and ingress of stormwater, extensive tree removal and root damage.

Community Acceptance

Community acceptance is likely to be high initially, based on an intuitive response. Then once educated on the damage that a gravity system would cause Scotland Island and the associated effect of amenity in the area, acceptance would become lower.

Stakeholder Acceptance

- High risk for any stakeholder to want to deliver, operate, maintain and manage impact
- High risk of inflow and infiltration (I&I) and overflows to the environment.

Technical Risk

- risk is high with deep excavation, unstable soils,
- costs could easily escalate, due to unmanageable delivery risk
- chance of system failure is high, and
- operation will be problematic with I&I.

Work, Health and Safety

- Construction works high risk in all aspects (e.g. procedures, property damage, environmental damage)
- Operational risk high – system will consistently be problematic, labour intensive, and require high expenditure.
- Public health risk high – overflows, odour

5.1.2 Option A.2: Pressure Sewerage

Description

A pressure sewerage system consists of a dedicated pressure sewage pumping unit located on each lot discharging to a common collection main. The common main discharges to a sewage pumping station for transfer to the Sydney Water sewerage on the mainland, or to on-island Treatment Plant. Common pipework is generally located in public spaces, roadways etc.

A limited amount of pipework may be required located across two or three private lots to facilitate system performance, to be resolved in detailed design.

This option was a preferred option outcome from the assessment matrix. A concept design for a pressure sewerage collection system was developed and this option was costed.

Technology

A proven technology, accepted and operating in Australia for over 20 years, and internationally for more than 50 years.

- Small diameter pipes, predominantly directionally drilled,
- Not constrained by pipe grades
- One sewage pumping station may be required, to boost flows across Pittwater

Environmental Impact

Negative impact, but less than gravity

- Most of the retrofitted sewerage reticulation could be directionally drilled,
- Sewage no longer leaching into soils and ground water – positive impact

Community Acceptance

Positive community acceptance anticipated:

- Provides an equitable servicing solution for Scotland Island;
- Residents will be required to supply and pay for the electricity – negative;
- Provides equity with other comparable Sydney Water customers, such as Dangar Island

Stakeholder Acceptance

Positive acceptance,

- Fully equitable solution;
- SWC currently have many systems of this type operating in their area of operations and previously produced a pressure sewerage system concept design for Scotland Island;
- Comparable to Dangar Island.

Technical Risk

Positive balance of risk,

- As before, any retrofit solution has its difficulties and complications, however
- Site investigations and audits has identified that there is nothing that has not been delivered previously, therefore risks are manageable,
- The gravity sewerage option has greater risk compared to a pressure sewerage option.

Work, Health and Safety

Positive balance of risk,

- Less odour,
- Less chance of overflow,
- Manageable risks

5.1.3 Option A.3: Vacuum System

Description

A Vacuum system consists of a central collection vacuum chamber connecting to a pipework system reticulated to each property. Each property has a vacuum control valve that opens on high level in the collection well and allows the vacuum to draw the waste through the pipe to the vacuum collection chamber. Each chamber includes a sewage pumping unit discharging to a common central sewage pumping station to discharge to the Sydney Water sewerage system at Church Point or to the on-island treatment plant.

Pipework is generally located in public areas roadways etc. Because of the topography constraints on Scotland Island a very high number of systems would be required. The topographical constraints and technical challenges for vacuum collection resulted in a low score for this option in the assessment evaluation matrix.

Technology

A vacuum sewerage servicing strategy does not technically work with the constraints identified at Scotland Island. A vacuum sewerage system requires installation of a saw-tooth profile in the collection pipeline. A vacuum station and pumping station would be required on Scotland Island. Vacuum pots, with valves, would need to be located for property gravity sewer connection. The major difference, and failure point, of the system is that the system must be kept under constant vacuum, one valve failure and the whole system can be affected, and effects service to all connected properties.

Environmental Impact

Negative impact, comparable to gravity or pressure sewerage

- Likelihood is high that excavation in Pittwater will be required
- High likelihood of I&I into the system
- Deep trenches required to achieve saw-tooth profile along contours, disregarding property boundaries.
- Extensive tree removal and root damage will occur,

Community Acceptance

Negative acceptance, as less is known about vacuum sewerage, with the community already having a familiarity with pressure sewer from Dangar Island, therefore community perception will be cautious from the onset.

Stakeholder Acceptance

Negative impact,

- Too high risk for any stakeholder to want to operate, maintain and manage impact of I&I and overflows to the environment.

Technical Risk

Difficult to the implement with any certainty - risk is too high. Based on experience, ongoing operation will be problematic.

Work, Health and Safety

Extremely negative high-risk solution,

- Construction works high risk in all aspects (e.g. procedures, property damage, environmental damage)
- Operational risk high – system will consistently be problematic, labour intensive, and require high expenditure.
- Public health risk high – overflows, odour

5.1.4 Option A.4: Hybrid System

Description
A hybrid system is Combination of gravity sewerage and pressure sewerage. Gravity sewerage is provided where the topography is conducive to pipelines installed at grade, and in constrained areas lots are serviced by pressure sewerage. Refer to concept drawing.

Technology
The hybrid system in this analysis consist of a combination of gravity sewer, where feasible, and pressure sewer.

Environmental Impact
The environmental impact will be negative, between scoring higher than gravity alone, but lower than a complete pressure sewerage system.

Community Acceptance
One of the key issues associated with a hybrid system is that it does not provide and equitable service across the community, such as differing;

- connection costs depending on whether the property is serviced by gravity or pressure;
- on-property asset requirements, such as a pressure sewer unit, or direct connection;
- electricity costs supplied by the property to run the pump in a PSU;
- servicing arrangements on the property,
- I&I entry points into the system, can be monitored with a pressure sewer connection, very difficult to manage with a gravity connection.

Evaluation team deemed: Negative community acceptance anticipated.

Stakeholder Acceptance
Neutral acceptance,

- Operationally and logistically the system can be difficult
- Non equity will cause issues,
- Technical solution can be achieved

Technical Risk
Positive balance of risk.

- This system has the benefits of pressure sewerage and only utilises gravity sewerage where there are benefits. However, rated lower than pressure sewerage.
- Bigger pump stations would be required than for the full pressure sewerage system, due to I&I

Work, Health and Safety
Positive balance of risk, utilising the benefits of both gravity sewerage and pressure sewerage systems, however there is rated slightly lower than for pressure sewer, as the risks are higher.

5.1.5 Option A.5: Variable Grade Sewer

Description

Conveyance of treated sewage through collection system utilising variable grading acting under gravity and under pressure. This system is not considered a feasible solution for a wastewater collection system at Scotland Island.

Technology

Sealed gravity sewer carrier pipes, with intermediate lift stations. Unlikely to be technically feasible.

Environmental Impact

Negative impact,

- High likelihood of I&I into the system
- Trenching to provide variable grade sewer potentially more manageable than that gravity sewer
- Tree removal and root damage will occur.

Community Acceptance

Negative acceptance

- Trenching required
- Treatment plant at the bottom of the hill
- Multiple lift stations across Island,
- Odour and I&I will still be issues
- Accessibility required to across network to all lift stations

Stakeholder Acceptance

Negative acceptance,

- risk is high,
- costs could easily escalate,
- chance of system failure is high, and
- operation will be problematic.

Technical Risk

- Unlikely to be technical feasible
- Velocity in the pipes needs to be sufficient to carry solids, without them dropping out of the flow, increasing risks of blockages.

Work, Health and Safety

Negative high-risk solution,

- Construction works high risk
- Location of lift stations needs careful consideration for access and maintenance,
- Operational risk high – system will likely be problematic, labour intensive
- Public health risk high – overflows, odour

5.2 Wastewater Disposal Options

Sewage disposal options generally were in three categories,

- On site treatment and disposal
- On Island local treatment plant with disposal to Pittwater
- Off Island disposal, discharge to Sydney Water System
- Plus some combinations of the above solutions

Figure 5-2: SEWAGE DISPOSAL OPTION SELECTION MODEL

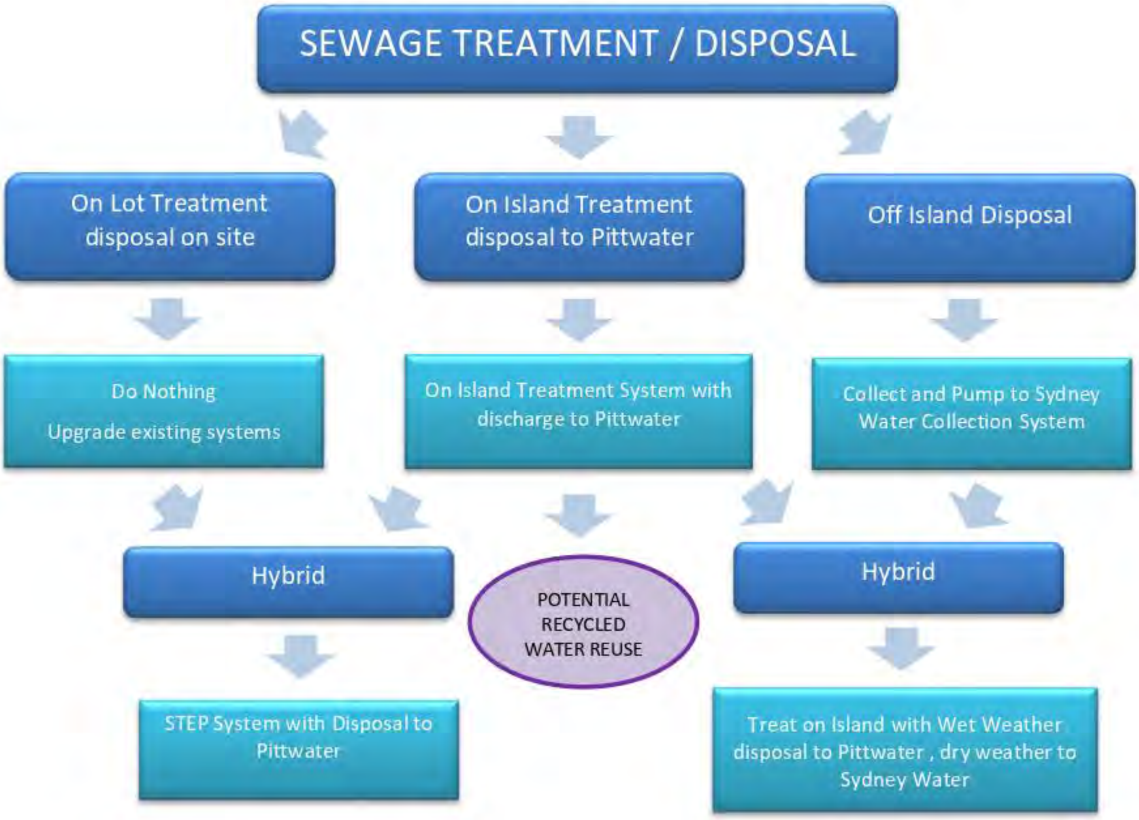


Table 5-2: Summary of Sewage Disposal Options

B.1	Do Nothing
B.2	Upgrade of existing Domestic Systems
B.3	On Site Grey Water Reuse using existing Septic Tank, with on-site reduced disposal
B.4	Tanker Truck Disposal from each lot
B.5	Tanker Truck disposal from common collection storage tank
B.6	Upgrade existing on lot systems with disposal redirected to Pittwater
B.7	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal
B.8	Septic Tank Pump Out System discharging to Sydney Water
B.9	Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater
B.10	Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater
B.11	Collect Sewage and Pump to Sydney Water sewerage system
B.12	Non-potable Reuse
B.13	Potable Reuse

5.2.1 Option B.1: Do Nothing

Description

The Do Nothing option is to leave the existing on-site disposal systems operating without any changes or upgrades. The existing water treatment and disposal systems are currently servicing Scotland Island without measured severe negative impact on the residents. There is anecdotal evidence of odours and minor health events attributed to the poorly performing systems, and a visual and negative impact on the surrounding waters.

However, investigations have shown the poor performing systems are surcharging, and discharging contaminants into the environment and waterways. Soil testing undertaken in Feb 2019 indicated high levels of Faecal Coliforms in the soil in several locations.(10) There is sufficient evidence of high health risk from the poorly performing on-site systems to confirm the 'do nothing' option is not acceptable, and scored low in the assessment matrix rating tool.

Environmental Impact

Negative,

- The majority of on-site systems are non-compliant to minimum standards and are causing environmental damage, ground water contamination and public health concerns. (1,10)

Community Acceptance

Negative,

- The majority (>95%) of residents want upgrade of sewerage services.
- If enforcement occurred to get each lot up to code and compliance, the lots would become uninhabitable – which is not an option – as Scotland Island was historically declared as having developable lots.

Stakeholder Acceptance

Negative,

- Stakeholders recognise that Scotland Island water and sewerage services require resolution

Technical Risk

Negative,

- Technically, it is impossible to make the 'Do Nothing' option plausible even with enforcement,
- Not technically possible to get on-site systems to meet Australian Standards compliance, primarily due to lot size and slope, and soil conditions.

Work, Health and Safety

Negative and high risk for public health on Scotland Island.

5.2.2 Option B.2: Upgrade of Existing On-Site System

Description

This option is the upgrade the underperforming onsite systems, supported by an operating strategy with ownership and management plan. Upgrade of the existing on-site treatment systems may include:

- Improvement of existing septic tanks to aerated sewage treatment systems
- Enlargement of septic tanks
- Sand Filter or Media Filter post treatment
- Extending existing absorption trench systems and transpiration beds
- Constructed mound systems to increase absorption / transpiration capacities
- Removal of all effluent by collection system for centralised disposal

The upgrade of the existing treatment systems through provision of larger septic tanks, and higher performing aerated systems, will improve primary treatment of the sewage, but will only provide marginal improvement on the overall performance of the on-site disposal systems. Implementation of these improved primary treatment devices however do not reduce the hydraulic load on the on-site disposal.

Assumptions

- Effluent disposal strategy is in place.
- Common body to make the system work

Environmental Impact

Negative impact,

- Sustainability of the option a concern – centrally managed system is required for there to be potential for improvement.
- Construction disturbance on property will be high, removing existing system, installing with a larger replacement system.
- Soil does not have capacity for effluent disposal volumes

Community Acceptance

Negative acceptance,

- If there is not enough land area on the property to irrigate, then system must be pumped-out.
- Solids require regular removal.

Stakeholder Acceptance

Negative acceptance,

- Compliance cannot be achieved
- Implications on environment and health,
- Servicing strategy for Scotland Island would lead to equity issues with other customers

Technical Risk

Negative impact / high risk,

- Likelihood of ongoing failure is high,
- Option may not even be technically achievable for some properties, insufficient land space
    - Clear distinction required for who owns the asset, and maintains the asset,

Work, Health and Safety

Negative impact / high risk,

- Despite implementation of a managed system and effluent disposal strategy, water logged ground will still exist; Effect on public health still a risk factor

5.2.3 Option B.3: On-Site Grey Water Reuse reusing existing Septic Tank

Description

This option focusses on reducing the volume of treated sewage site disposal by treating grey water for reuse as a non-potable supply. Grey water is the discharge from showers, basins, laundries and possibly kitchen sinks. Treatment of grey water is less complex than treating blackwater and has a less stringent approval process. This option is constrained by the limitations in grey water reuse volume, and complicated by the requirement to retrofit/diversion of drainage on most properties, and the retrofit of a second non-potable water supply. Many properties already have some form of water recycling.

The opportunities offered with this technology is not envisaged to significantly reduce the impact of the on-site treatment, with only a portion of the sewage removed from the requirement for site soil / transpiration disposal.

Environmental Impact

Negative impact, non-compliance unless approved grey water treatment is installed

Community Acceptance

Negative impact,

- More for the community to maintain

Stakeholder Acceptance

Negative impact,

- Does not achieve much improvement to the current situation

Technical Risk

Negative impact,

- Requires separate plumbing on the property,
- Quality of grey water at high risk

Work, Health and Safety

Negative impact,

- Does not improve on the current situation,
- Grey water reuse quality risk is high

5.2.4 Option B.4: Tanker Truck Disposal from each lot

Description

This option utilises the existing primary treatment system on each lot, with a storage tank being provided for collection of the treated sewage for pump out by a tanker. This eliminates disposal of sewage into the environment.

There a several obstacles to providing an effective tanker collection system to each property on Scotland Island. The roads are low standard, with only minimal sealed carriageways. There are only a small number of vehicles on Scotland Island utilised by tradesman and for firefighting. The roads are not considered suitable for heavy sewage pump out vehicle constant use. Transporting the trucks to Scotland Island by barge is weather dependant, and a conservative estimate is up to 20 truck movements per work day on Scotland Island. There would be high risk to pedestrians within a community with minimal car usage and family orientated outdoor activities.

Environmental Impact

Negative impact,

- Ongoing operational impact extremely high
- Upgrade to most Island roads would be required to transport tanker trucks
- Calculated that 20 tanker trucks per day would be required to service the 370 properties
    - High disturbance on Scotland Island
    - Low sustainability measure

Community Acceptance

Negative impact,

- Amenity on Scotland Island would be greatly affected,
- Holding tank may be required
- Costs for ongoing disposal
- Costs and implications of ordering a tanker truck for emergency pump-out,
- Odour

Stakeholder Acceptance

Negative impact,

- Not a sustainable ongoing strategy
- Disposal / discharge arrangement for 20 tanker trucks per day
- Council required to upgrade road network on Island to accommodate 20 tanker trucks per day.
- Public health and environment – ongoing concerns
- Not equitable

Technical Risk

Negative impact,

- Not a sustainable option for an Island

Work, Health and Safety

Negative impact, vehicle movement, odour, servicing difficulty in wet weather

5.2.5 Option B.5: Tanker Truck Disposal from common collection storage tank

Description

This option is the provision of a sewage system collecting the treated sewage from each property discharging to a common collection storage tank, or several tanks, for removal by tanker, possibly by a water barge. It may be necessary to upgrade some roads to provide suitable truck access if collection by a water borne vessel is not feasible. Collection will be at regular intervals carried of site to an approved Sydney Water dump point.

However, this option has the cost of an on-Island collection system plus the cost of removal by tanker. The only saving is the cost of the underbore below Pittwater for direct discharge to the Sydney Water sewerage system. The option of the underbore is more cost effective, and this option scored low in the assessment matrix rating tool.

Environmental Impact

Neutral impact,

- Reduces the risk of illegal discharges into the Pittwater
- Takes sewage off the property, reducing seepage into groundwater
- There will be issues with odour around the common collection tank on the foreshore

Community Acceptance

Negative acceptance,

- Takes sewage off the property, shifts responsibility
- There will be issues with odour around the common collection tank on the foreshore
    - Location of tank would be on the western foreshore, where the ferry's land at Church Point
- Not equitable

Stakeholder Acceptance

Negative acceptance,

- Sydney Water may be resistant to 2 day old, highly septic, sewage being discharged into Sydney Water's network.

Technical Risk

Neutral risk,

- Technical assessment would be required to determine a suitable location in the Sydney Water network to discharge the septic sewage
    - Required flow rate
    - Capacity within network
    - Adequate dilution
    - Odour

Work, Health and Safety

Neutral risk

5.2.6 Option B.6: Upgrade existing on Lot Systems with disposal redirected to Pittwater

Description

The intent of this option is to provide an economical modification to the on-site disposal systems and eliminate the problems with on-site disposal by direct discharge to Pittwater. The sewage will be collected in a piped system utilising the existing Island topography, generally following the existing surface stormwater paths and easements, and directing the sewage directly to the surrounding waters. In practice the sewage is currently discharged into Pittwater indirectly through ground water. However, the quality of the existing flow is improved through further treatment in the soil, so to improve the quality of the direct discharge the existing active on-site pre-treatment devices will be upgraded.

However, there are already problems identified with the quality of the surround waters during and following rain events. This option does not have high Environmental performance and would not be favoured by the community, and therefore scored low in the assessment matrix rating tool.

Environmental Impact

Negative impact,

- Scotland Island is already absorbing effluent
- Reduces the on-property works risks

Community Acceptance

Negative acceptance,

- Already a perception of pollution, disposing from the septic into Pittwater will add to this concern
- Kids playing in the creeks and along the waterways

Stakeholder Acceptance

Negative acceptance,

- This option cannot meet ANZECC (1992) guidelines
- NSW Public Health would have major concerns

Technical Risk

Negative impact / high risk

- This option cannot meet ANZECC (1992) guidelines
- NSW Public Health would have major concerns
- Increased monitoring would be required

Work, Health and Safety

Negative impact / high risk

- Concentration of risk
- Inground treatment is not adequate

5.2.7 Option B.7: Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal

Description
This option takes advantage of the existing sewage pre-treatment facilities on each lot, but instead on on-site disposal, the primary treated sewage is collected and discharged to a central treatment plant, treated, and disposed to Pittwater. The central sewage treatment plant would be designed for final polishing and sanitisation before disposal. The intent is the partial treatment in the on-site treatment devices would reduce the size of the on-Island treatment plant.

Environmental Impact
Neutral balance of impact,

- Site required for treatment plant
- Reduces the risk of illegal discharges into the Pittwater
- Takes sewage off the property, reducing seepage into groundwater, and therefore vegetation deterioration.

Community Acceptance
Negative acceptance anticipated,

- The inclusion of a treatment plant into this option, improves the acceptance from the previous option 6 (discharge to Pittwater)
- Not all septic tanks would suitable for the STEP system
    - Many will need upgrading to larger tanks

Stakeholder Acceptance
Negative acceptance,

- Responsibility, ownership and operation of a satellite plant and system

Technical Risk
Negative impact / very high risk

- Unknown number of sewage treatment systems requiring upgrade or replacement
- Implications on the treatment plant will be high as the septic tank will have left all the elements that are hardest to treat in the system e.g. nitrogen
    - Likely will need to add carbons back into the wastewater

Work, Health and Safety
Negative impact / high risk,

- Water tightness (extent of external water entering or exiting the system, such as I&I) of the independent property systems will now become a component of the entire system as this needs to be contemplated in the sizing and design of the treatment plant.
- Operational risk associated with a satellite plant.

5.2.8 Option B.8: Septic Tank Pump Out System discharging to Sydney Water

Description
Septic Tank Pump Out System discharging to Sydney Water

Environmental Impact
Slightly positive impact,

- Better than previous option 7 (pump out to treatment plant) from an environmental perspective.
- However, there's not positive reason to keep the septic tank as part of the solutions for this option, as Sydney Water will treat the wastewater regardless of treatment in septic.

Community Acceptance
Slightly positive acceptance,

- Removal off property and removal off Island into Sydney Water's network.

Stakeholder Acceptance
Slightly positive acceptance,

- Sydney Water would prefer non-treated wastewater into their network, rather than wastewater higher in nitrogens and more difficult to treat.
- Difficult utility ownership model is assets on private property not replaced; I.e. non-performing assets dedicated to utility is a high unacceptable risk structure

Technical Risk
Negative impact / high risk,

- Collection system required to transport septic effluent to a sewage pumping station
    - Various property connection configurations and arrangements required to collect waste.
- Underbore required across Pittwater
- Pump sewage across Pittwater for discharge into Sydney Water system
- Effluent pumps required at each property (different type of pumps but same principle as pressure sewerage system)
- Same construction works as pressure sewerage system

Work, Health and Safety
Negative impact / high risk,

- Construction risk and potential cost escalations associated with on-property works
- Residual risks from utilising onsite septics,

5.2.9 Option B.9: Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

Description

Provision of a Sewage treatment Plant located on the Island, treating sewage to a tertiary level, suitable quality for discharge to Pittwater

Assumption: Pressure sewerage system was evaluated as the collection system for this option.

Environmental Impact

Slightly positive impact,

- Consent for disposing of effluent into Pittwater is the questions associated with option
- Brooklyn, Dangar Island and Hawkesbury River systems discharge effluent into these waterways, however, and are not good examples of precedence for their disposal is into waterways better flushed than Pittwater.

Community Acceptance

Neutral acceptance,

- Community perception regarding treatment then discharge into Pittwater

Stakeholder Acceptance

Neutral acceptance,

- Council will no longer be looking after the septic tanks
- Effluent disposal consent is the key issue

Technical Risk

Slightly positive impact,

- Sewage will be easier to treat than the effluent from the septics

Work, Health and Safety

Positive impact

- Removal of on-site treatment and disposal will eliminate the risk from contamination of soils, and waterways during wet weather events

5.2.10 Option B.10: Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater

Description

The EPA would rather discharge treated effluent into waterways, than untreated wastewater with wet weather component.

- EPA review of nutrients into the Hawkesbury River

This option was removed from the evaluation process, due to the assumption at the beginning of the workshop that Sydney Water has adequate capacity in their network for servicing of Scotland Island.

5.2.11 Option B.11: Collect Sewage and Pump to Sydney Water sewerage system

Description
Collection of sewage and pump to Sydney Water Sewerage System at Church Point.

Environmental Impact
Positive impact,

- Most of the retrofitted sewerage reticulation could be directionally drilled,
- Sewage no longer leaching into soils and ground water – positive impact

Community Acceptance
Positive acceptance,

- Equity of service, reliability, health benefits comparative to customers on mainland Sydney
- Comparable to Dangar Island

Stakeholder Acceptance
Positive acceptance,

- Risk is transferred to the organisation best placed to manage the risks.
- Fully equitable solution;
- Comparable to Dangar Island, which was implemented and now operated by SWC;
- At some point, the viability measure needs to be determined,
  - Environment
  - Public health
  - System capacity

Technical Risk
Positive balance of risk,

- Any retrofit solution has its difficulties and complications, however
- Site investigations and audits has identified that there is nothing that has not been done before, therefore risks are manageable,
- Sewage pumping station may be required,
- Underbore across Pittwater

Work, Health and Safety
Positive balance of risk,

- Less odour,
- Less chance of overflow,

5.2.12 Option B.12: Non-potable Reuse

Description
Soil absorption capabilities and irrigation opportunities are limited on Scotland Island, and no other users on the Island have been identified that may be interested in non-potable reuse water. A typical customer for non-potable reuse water in other servicing areas is a Golf Course for irrigation purposes.

Environmental Impact
Slightly negative impact

Community Acceptance
Anticipated positive acceptance

Stakeholder Acceptance
Negative due to risk and commercial viability,

Technical Risk
Negative impact; Approved non potable water quality is technically difficult to achieve

Work, Health and Safety
Negative impact; Risk of technical failure and low quality non potable water

5.2.13 Option B.13: Potable Reuse

Description

REFER TO WATER SUPPLY OPTION C.9

5.3 Water Supply

Potential servicing options were identified during the first stage of the assessment process. To ensure a thorough analysis of available technologies a broad selection of options were included for assessment, even though some options were considered unlikely to be selected. Inclusion of the less favoured options facilitated the evaluation process by providing a comparative benchmark performance base. (E.g., The options 'Disconnect Existing Small-Bore Supply' and 'Do Nothing' options were included in the assessment evaluation to baseline performance).

Figure 5-3: WATER SUPPLY OPTION SELECTION MODEL

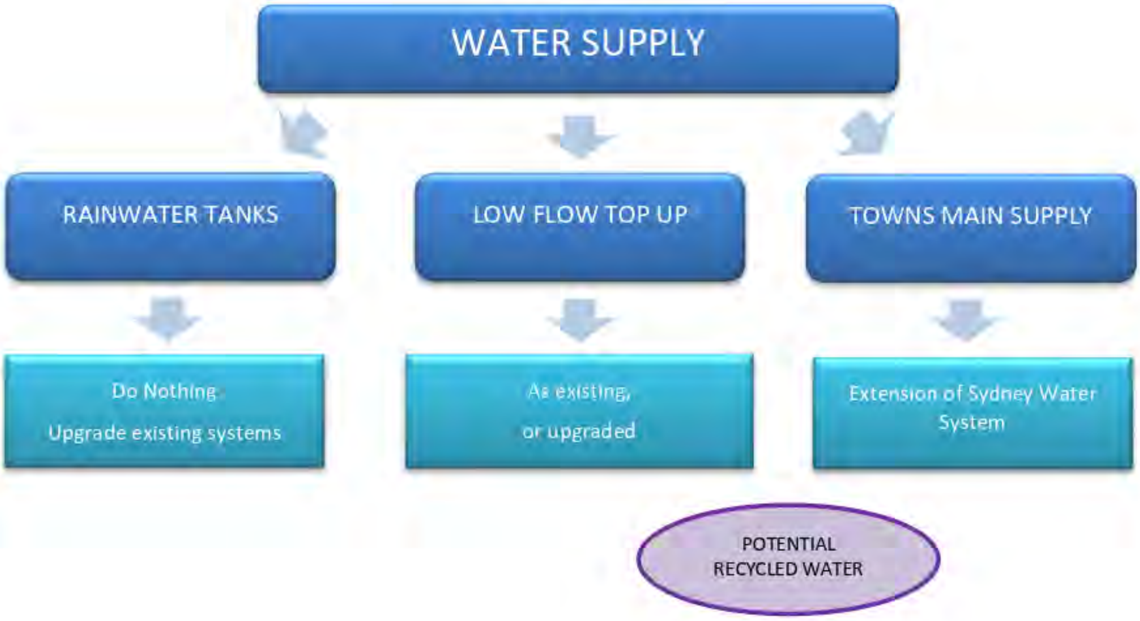


Table 5-3: Water supply options

C.1	Disconnect existing non-potable supply
C.2	Do Nothing
C.3	Upgrade of rainwater storage tanks and water usage management
C.4	Replace Small Bore Supply for drinking water with top up to rainwater tanks
C.5	Provide supply from Sydney Water System to reservoir on Island
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required
C.7	Desal with new water reticulation
C.8	Reuse non-potable
C.9	Reuse potable
C.10	Fire Fighting Sea Water

5.3.1 Option C.1: Disconnect existing non-potable supply

Description

Disconnect existing non-potable water supply. There are non-compliance issues with the existing reticulation with regard to back flow protection and pipework condition and location. Quality of the non-potable water supply and up-keep of aging infrastructure is of concern, therefore this option is to disconnect this supply and rely solely on potable water supply brought over by barge from the mainland.

Environmental Impact

Neutral impact:

- neutral construction disturbance and
- sustainability rated highly, as infrastructure no longer requires maintenance, however additional services will be required to transport water across to Scotland Island and distribute to the properties.

Community Acceptance

Disconnecting existing non-potable water likely to be unacceptable to the community.

- Increased costs to the community with all non rainwater systems water required to be supplied by alternate means;
- Many residents currently rely on the non-potable supply therefore they would be greatly affected.
- Deemed unacceptable to the Community

Stakeholder Acceptance

Marginally positive:

- Community perceive the non-potable supply as Council's responsibility, with a current system in place and a lot of upgrades required.
- Eliminates risk to Council, however,
    - Council will receive more complaints from residents if the current non-potable supply is disconnected
- Quality and quantity performance to be considered;
    - Need to maintain a service to conduct essential services in the interest of public health and safety, such as toilet flushing and washing.
- Risk must outweigh opportunity,
    - Event of disease outbreak; fire-fighting capabilities

Technical Risk

Not an alternative solution.

- Cutting source of supply to properties
- Removal of tanks and pipes

Work, Health and Safety

Scored Neutral (10) impact in evaluation matrix, however score could be 15 or 5 depending on quality or quantity assessment perspective:

- **Score 15**. Broadly, from a whole community, health benefit. Current water quality is poor.
- **Score 5**. Individual property perspective, water source drastically impacted including ability to flush toilets and wash clothes.

5.3.2 Option C.2: Do Nothing

Description

Assumption: The 'Do Nothing' option was assessed as no changes to the existing water supply, but the assessment process did consider the ongoing maintenance and repair costs of the existing service. In order to maintain a service that has already served 30 years, it would be prudent to investigate the initial design life of the existing system, including the materials pipe material and rating, to ascertain technical viability of the system and anticipated time until replacement of system components, such as pipework, is required. The base assumption for the 'Do Nothing' option has implications in the comparable assessment of the subsequent options. In terms of if the evaluation is based on the solution providing –

- A design life of 5-10 years,
    - e.g. may get away with basic maintenance and repairs to keep the existing system operational; or
- A design with a 30–50 year horizon, which is consistent with industry solutions
    - Involves high likelihood of Pittwater crossing replacement.
    - In this respect other servicing options become comparatively viable.

Consideration -

- In the event of a failure/breakage of the existing Pittwater crossing pipeline supplying the non-potable water source for Scotland Island,
    - What are the failure response strategies?
    - Who are responsible for implementing and paying for these; Ownership etc?

Environmental Impact

Neutral impact: maintaining status quo.

- However it has been identified that the current system is impacting the environment.

Community Acceptance

Negative impact:

- Another feasibility study that has resulted in no action.
- Top-up of rainwater, is cheaper than supply from a tanker on a barge.
- Therefore assessed more positively than the disconnection option.

Stakeholder Acceptance

Negative impact:

- Investigations and soil sampling consistently flag serious public health and environmental concerns.

Technical Risk

Negative impact:

- Although this option requires no immediate action, the system is failing and is inadequate.
- Likelihood of failure increases daily, including the pipe across the Pittwater., and cross contamination of supply

Work, Health and Safety

Identified as a significant health issue.

5.3.3 Option C.3: Upgrade of rainwater storage tanks and water usage management

Description

This option involves the upgrade of on-site rainwater tanks, that are appropriately sized and managed according to roof size and occupancy. The second component of this option is a program to and assist community with water management strategies. The larger storage tanks would increase the reliability of the supply to the households, and with usage management through low flow fixtures etc the intent is to maximise rainwater collection and use. Emergency top ups would be required from tanker supply to Scotland Island. Roads on Scotland Island would need to be upgraded to accommodate the trucks.

- No top-up water, just rainwater - Less reliant or no reliance on non-potable water source
- Community to pay for upgrades
- Assumes community has operational responsibility - Residents to monitor and responsible for own water quality

Environmental Impact

Positive impact:

- Sustainability of this option is high
  - Water efficiency
  - Self-regulating and self-limiting.
- Issues with tannins may be a problem, this can be addressed in the technical solution options provided by Council such as utilising activated carbon filtration.

Community Acceptance

Neutral outcome / marginally negative:

- Community less / not reliant on poor quality non-potable water supply;
- Individually responsible for own water quality - not impacted on by others;
- There's equity among community; But not across Sydney Metropolitan Area
- Costs for upgrades and top-up
- Implications during peak occupancy periods and increased demand requirements,

Stakeholder Acceptance

Positive impact:

- Stakeholders will be comfortable that a solution has been provided and the properties are capable of holding adequate water.

Technical Risk

Negative impact:

- Complexities with this option - cannot be certain the solution will work,
  - Storage volume can be based on roof collection area, or based on usage requirements and emergency supply
  - Site constraints
    - Storage tank size restrictions,
    - Pump up arrangements e.g. from gutter into rainwater tank
- System maintenance is critical.

Work, Health and Safety

Better than neutral impact:

- There are risks associated with this option however they are better than neutral,
- Supply is less likely to run-out

5.3.4 Option C.4: Replace existing non-potable supply with small bore supply for drinking water with top-up to rainwater tanks

Description

The existing small-bore water supply system is upsized to provide a permanent drinking water supply within each household at the kitchen sink, and a timed permanent top up supply to the rainwater storage tanks. The pipework required would be smaller than a full water supply service. The supply system would extend for the Sydney Water water supply system at Church Point. Refer to concept drawing. Existing pipe sizes and state of repair will result in the requirement to replace the current emergency water supply, however take away the manual interface.

Install one small bore tube into the house with one connection point into the kitchen, providing potable water to each house. Automated daily trickle top-up into rainwater tanks, at this point the source will no longer be potable supply.

This option does not try to provide a full potable water supply, but gives a balance between quality and quantity of water supply, and minimise interference with existing reliance on the non-potable supply arrangements at each property.

- Its estimated that 50-60% of the properties on Scotland Island use the non-potable supply source regularly, with the remainder a couple of times a year.
- Meter readings required at each property.

Environmental Impact

Positive Impact,

- Score is variable (within the positive range) depending on the base assumption of the 'Do Nothing' option, whether the Pittwater crossing requires replacement.

Community Acceptance

Positive Impact,

- Provides a reliable clean water supply to the Community
- Reduces health risks and provides top-up system to rainwater tanks
- Does not provide equity with Sydney Benchmark Water Services

Stakeholder Acceptance

Positive Impact,

- Can achieve regulatory compliance
- Reduces risks for stakeholders

Technical Risk

Positive Impact,

- Any retrofit is difficult, however option has minimised on property works
- Low likelihood of failures, however the more moving parts, such as the automation component of the system, the higher likelihood of failures.

Work, Health and Safety

Better than the previous option 3 (upgrade rainwater tanks):

- Doesn't provide fire-fighting resource – too high velocity in 50mm pipe across Pittwater
- A 125PE pipe would provide larger diameter, remain a small bore and be supplied in coils.
    - All rainwater top-up could be turned off, during fire-fighting event.
- Potable water reservoir, if required, would likely be low level with VSD pumps.

5.3.5 Option C.5: Provide supply from Sydney Water System to reservoir on Island

Description

A new full potable water supply system extending from the Sydney Water water supply at Church point. The incoming supply would extend to a new reservoir at the top of Scotland Island, with a full-sized reticulated water supply reticulated around Scotland Island in the roadways with a supply point to each of the lots on Scotland Island. Each lot would be fitted with a Sydney Water meter.

Assumption

The reservoir would be approximately 1ML in size at the highest elevation on Scotland Island.

Environmental Impact

Negative impact:

- Major construction impact, road construction required for truck access to top of Island
- Major land use impact,
- Reservoir size would require clearing of land at site of reservoir,
- Additional clearing of land would be required by Sydney Water for all-weather road access up to the reservoir
- Some loss of open space

Community Acceptance

Slightly positive:

- Perceived as the equitable, gold-plated option, however impact of the reservoir will be major;
- Provide good equity;
- Residents generally like that they do not have a water bill and they may feel that it would destroy the place they are living in and impact on amenity of Scotland Island
- Only source of water to Scotland Island
    - Residents may want to keep rainwater tanks,
- Many trees will be cleared
- Reservoir would provide emergency water supply in the event of power failure, or main crossing break

Stakeholder Acceptance

Positive from majority of stakeholders, as it addresses many of the risks, except Sydney Water, who will be heavily opposed to this option.

- Sydney Water will not be in favour of a reservoir on an Island and the associated impact on resourcing for up-keep of roads and infrastructure for operations and maintenance.

Technical Risk

Slightly positive,

- Retrofitting a complete reticulated system will be hard, however
    - It is constructible, and
    - It is a typical solution.

Work, Health and Safety

Positive impact,

- Good for most aspects, operational risk, public health and firefighting.

5.3.6 Option C.6: Direct mains pressure supply from Sydney Water mains / pressure boosted if required

Description

A new full potable water supply system extending from the Sydney Water water supply at Church point. Similar to option 5, full reticulated potable water supply to Scotland Island, without the reservoir. The incoming supply would extend to a full sized reticulated water supply reticulated around Scotland Island located in the roadways with a supply point to each of the lots on Scotland Island. The higher lots on Scotland Island would be provided with a pressure boosted supply to ensure adequate water supply pressure. Each lot would be fitted with a Sydney Water meter. Refer to concept drawing.

Environmental Impact

Negative impact, however not an extreme impact like the previous reservoir option.

- Most of the retrofitted reticulation could be directionally drilled,
- Accessibility and road access may need to be upgraded by Council, for Sydney Water operations and maintenance of the system.
    - Council are planning for the upgrade of the stormwater system and overland flow paths – so potential for concurrent upgrades.
- Environmental risks increase if this option is not combined with reticulated sewage disposal, as a reticulated water supply results in increased wastewater disposal from properties.

Community Acceptance

Positive impact / high acceptance:

- Perceived as the gold-plated solution;
- Land use impact will be minimal
- Provides good equity;
- Scheme cost may be limiting factor.
- Equitable solution

Stakeholder Acceptance

Positive impact / high acceptance:

- Covers risks and responsibilities

Technical Risk

Technically better solution than the other options:

Work, Health and Safety

Addresses the WH&S risks better than the other options, with the difference being the fire-fighting resource of the reservoir on Scotland Island.

5.3.7 Option C.7: Desal plant with new water reticulation

Description
Extraction from Pittwater with local desalination plant supplying potable water to lots on Scotland Island.

Environmental Impact
Negative impact,

- Requires high energy consumption to produce the potable water
- Discharge of concentrated salt would be required –
    - There are uncertainties where this would be possible to discharge and what consent requirements would be imposed where this would be possible to discharge.

Community Acceptance
Very low community acceptance anticipated,

- Very expensive to construct and operate.
- May enable sense of independence from the mainland

Stakeholder Acceptance
Neutral acceptance,

- Guaranteed supply of water
- Not drought related,
- Sydney water or private sector could deliver and operate system,
    - Similar systems operate on Hayman Island and Rottnest Island.
- State government not likely to endorse a plant for only 370 properties.
    - Costs to provide the plant, undertake upgrades and maintain are massive on the mainland, therefore are going to be significantly more on an Island.
    - Potentially something to consider if the plant became a local issue/responsibility

Technical Risk
Not insignificant / negative,

- The water supplying the desalination plant needs to be of good quality, and
- The outlet, the location for the discharge of the brine, is likely to be difficult to determine.
- Accommodations of the system will factor into the final score for this option
    - E.g. who will own, operate, maintain system?

Work, Health and Safety
Positive impact,

- Provides a reliable source of potable water source for Scotland Island
- Operational risks are higher than for the two previous servicing options with supply from Sydney Water's network.

5.3.8 Option C.8: Reuse non-potable

Description

Reticulated recycled water system for external use, and toilet and washing use if necessitated. Not a stand-alone solution, integrated with the sewerage system solution, and would require a third pipe (purple), such as Rouse Hill.

Less reliance on the potable water supply source.

Environmental Impact

This option is implemented in conjunction with sewage options utilising an on-island sewage treatment plant. The sewage is treated to a level suitable for reticulation as a non-potable water supply to each lot on Scotland Island. A dual pipe reticulation would be required.

Deemed to be a higher environmental impact than option 6 (reticulated water supply),two services installation now required, - 1. Potable Water and 2 – Recycled Water

Community Acceptance

Slightly positive acceptance,

- More overall reliability of service on Scotland Island,
- Not a lot of evidence of irrigation on Scotland Island, therefore need is questionable.

Stakeholder Acceptance

Negative,

- Implementation costs would outweigh any benefit, particularly for a scheme of this size.

Technical Risk

Main risk associated with this option is with end-user failure,

- E.g. cross-connections and contamination

Work, Health and Safety

Slightly negative,

- Not an essential service, therefore additional risks factors exist

5.3.9 Option C.9: Reuse potable

Description
Treatment plant on Island to provide reuse potable water.

Environmental Impact
Extremely negative,

- Plant would be small but complicated, with a brine stream that has to be disposed of, requiring approval for discharge into Pittwater.

Community Acceptance
Negative perception,

- Studies show that it requires on average 7 years of education to gain acceptance within a community, considering
    - Potable reuse on Scotland Island
    - Large fresh water dilution is typical in other schemes

Stakeholder Acceptance
Negative perception, requires a long journey of education to gather acceptance.

Technical Risk
Negative impact,

- Scheme is doable, however there are very few existing schemes of this scale to compare.

Work, Health and Safety
Deemed high risk in all areas associated with construction, operation, public health and fire fighting.

5.4 Location Options for Boring under Pittwater

The water servicing shortlisted options, and the option to discharge to sewage to Sydney Water sewerage at Church Point, all require a direction drill under Pittwater.

The initial concept drawings and cost planning are based on the direction bore to be from Church Point to Harold Reserve, the closest public land on the Island. However, there may be advantages in locating the bore in an alternate location. Infrastructure plant is required at the termination of the bore at Scotland Island, and there is limited open space at Harold Reserve. Harold Reserve may also be used by another utility for a under Pittwater bore termination, further reducing the land available, and increasing risk of a bore clashing with an existing service.

To minimise risk, and for potential planning benefits, two alternate bore locations have been identified. One location from Church Point to Leahvera Reserve on the west coast of the Island, and the second is from Church Point to Catherine Park on the North of the Island.

Selection of the bore location will be part of the detailed design. The highest cost option was included in the cost estimates for this study.

Figure 5-4: HDD Bore Locations for Boring Under Pittwater

6 GATE 1 MULTI CRITERIA ANALYSIS SUMMARY AND OUTCOMES

Refer to Attachment for detailed assessment matrix scoring.

6.1 Sewage Collection Systems Gate 1 Ratings and selected options

	A. SEWAGE COLLECTION SYSTEMS	
A.1	Gravity Sewerage	22
A.2	Pressure Sewerage	70
A.3	Vacuum System	11
A.4	Hybrid System	54
A.5	Variable Grade Sewerage	21

Gate 1 Selected Sewage Collection System options

A.2 Pressure Sewerage

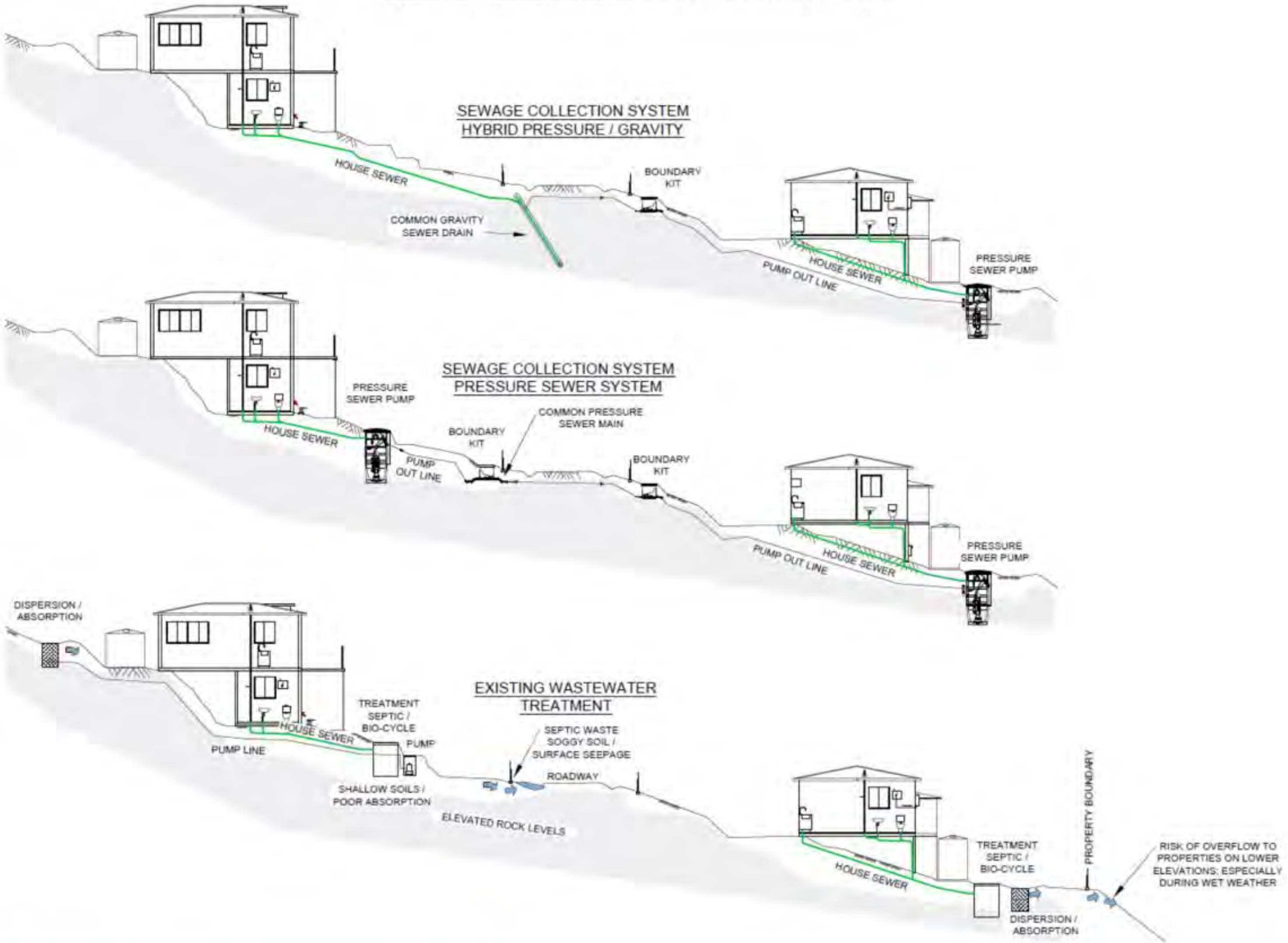
A pressure sewerage system consists of a dedicated pressure sewage pumping unit located on each lot discharging to a common collection main. The common main discharges to a sewage pumping station on site for transfer to the Sydney Water sewerage on the mainland, or to on-island Treatment Plant. Common pipework is generally located in public spaces, roadways etc.

A.4 Hybrid System Gravity Sewerage and Pressure Sewerage System

A hybrid system is Combination of gravity sewerage and pressure sewerage. Gravity sewerage is provided where the topography is conducive to pipelines installed at grade, and in constrained areas lots are serviced by pressure sewerage.

Refer to attachments for concept drawings of options.

Figure 6-1: Collection System Gate 1 Selected Options Functional Comparison



6.2 Sewage Treatment and Disposal Gate 1 Ratings and selected options

	B. SEWAGE TREATMENT / DISPOAL	
B.1	Do Nothing	5
B.2	Upgrade of existing Domestic Systems (Managed System)	26
B.3	On Site Grey Water Reuse using existing Septic Tank, with on site reduced disposal	21
B.4	Tanker Truck Disposal from each lot	8
B.5	Tanker Truck disposal from common collection storage tank	42
B.6	Upgrade existing on lot systems with disposal redirected to Pittwater	25
B.7	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal	36
B.8	Septic Tank Pump Out System discharging to Sydney Water	52
B.9	Installation of a sewerage collection system discharging to a treatment system on the Island, with disposal to Pittwater	58
~~B.10~~	~~Installation of a sewerage collection system discharging to a treatment system on the Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater~~	~~67~~
B.11	Collect Sewage and Pump to Sydney Water sewerage system	79
B.12	Non potable Reuse	40

Note: B.10 option was removed from the evaluation process, due to the assumption at the beginning of the workshop that Sydney Water has adequate capacity in their network for servicing of Scotland Island.

Gate 1 Selected Sewage Treatment and Disposal options

B.9 Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

Provision of a Sewage treatment Plant located on the Island, treating sewage to a tertiary level, suitable quality for discharge to Pittwater

B.11 Collect Sewage and pump to Sydney Water sewerage system

Collection of sewage and pump to Sydney Water Sewerage System at Church Point.

Refer to attachments for concept drawings of options.

6.3 Water Supply Gate 1 Ratings and selected options

	C. WATER SUPPLY	
C.1	Disconnect existing non potable supply	42
C.2	Do Nothing	34
C.3	Upgrade of rainwater storage tanks and water usage management	58
C.4	Replace Small Bore Supply for drinking water with top up to rainwater tanks	70
C.5	Provide supply from Sydney Water System to reservoir on Island	58
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required	75
C.7	Desal with new water reticulation	40
C.8	Reuse non potable	40
C.9	Reuse potable	20

Gate 1 Selected Water Supply options

C.4 Replace Small Bore Supply for drinking water with top up to rainwater tanks

The existing small-bore water supply system is upsized to provide a permanent drinking water supply within each household at the kitchen sink, and a timed permanent top up supply to the rainwater storage tanks. The pipework required would be smaller than a full water supply service. The supply system would extend for the Sydney Water water supply system at Church Point. Refer to concept drawing. Existing pipe sizes and state of repair will result in the requirement to replace the current reticulated on-island supply, however take away the manual interface.

Install one small bore tube into the house with one connection point into the kitchen, providing potable water to each house. Automated daily trickle top-up into rainwater tanks, at this point the source will no longer be potable supply.

C.6 Direct mains pressure supply from Sydney Water mains / pressure boost if required

A new full potable water supply system extending from the Sydney Water water supply at Church point. Similar to option 5, full reticulated potable water supply to Scotland Island, without the reservoir. The incoming supply would extend to a full-sized reticulated water supply reticulated around Scotland Island located in the roadways with a supply point to each of the lots on Scotland Island. The higher lots on Scotland Island would be provided with a pressure boosted supply to ensure adequate water supply pressure. Each lot would be fitted with a Sydney Water meter.

Refer to attachments for concept drawings of options.

7 DETAILED MULTI-CRITERIA TECHNICAL ASSESSMENT

	Option	ADJUSTED TOTAL rated out of 100	Weighted Total Score	ENVIRONMENTAL		COMMUNITY ACCEPTANCE		STAKEHOLDER ACCEPTANCE		TECHNCIAL RISK		WORK HEALTH AND SAFETY	
		100	2000	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
	A. SEWAGE COLLECTION SYSTEMS	ADJUSTED TOTAL rated out of 100	Weighted Total Score										
A.1	Gravity Sewerage	**22**	440	3	60	8	160	5	100	3	60	3	60
A.2	Pressure Sewerage	**70**	1400	9	180	12	240	18	360	15	300	16	320
A.3	Vacuum System	**11**	220	3	60	3	60	1	20	1	20	3	60
A.4	Hybrid System	**54**	1080	8	160	8	160	10	200	13	260	15	300
A.5	Variable Grade Sewerage	**21**	420	5	100	5	100	5	100	1	20	5	100
	B. SEWAGE	ADJUSTED TOTAL rated out of 100	Weighted Total Score										
B.1	Do Nothing	**5**	100	2	40	2	40	1	20	0	0	0	0
B.2	Upgrade of existing Domestic Systems (Managed System)	**26**	520	8	160	5	100	5	100	3	60	5	100
B.3	On Site Grey Water Reuse using existing Septic Tank, with on-site reduced disposal	**21**	420	7	140	3	60	6	120	1	20	4	80
B.4	Tanker Truck Disposal from each lot	**8**	160	1	20	1	20	1	20	2	40	3	60
B.5	Tanker Truck disposal from common collection storage tank	**42**	840	10	200	8	160	4	80	10	200	10	200
B.6	Upgrade existing on lot systems with disposal redirected to Pittwater	**25**	500	5	100	8	160	3	60	5	100	4	80

	Option	ADJUSTED TOTAL rated out of 100	Weighted Total Score	ENVIRONMENTAL		COMMUNITY ACCEPTANCE		STAKEHOLDER ACCEPTANCE		TECHNCIAL RISK		WORK HEALTH AND SAFETY	
		100	2000	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
B.7	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal	**36**	720	10	200	9	180	5	100	4	80	8	160
B.8	Septic Tank Pump Out System discharging to Sydney Water	**52**	1040	12	240	12	240	12	240	8	160	8	160
B.9	Installation of a sewerage collection system discharging to a treatment system on the Island, with disposal to Pittwater	**58**	1160	11	220	10	200	10	200	12	240	15	300
B.10	~~Installation of a sewerage collection system discharging to a treatment system on the Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater~~	~~**67**~~	~~1340~~	~~12~~	~~240~~	~~15~~	~~300~~	~~10~~	~~200~~	~~15~~	~~300~~	~~15~~	~~300~~
B.11	Collect Sewage and Pump to Sydney Water sewerage system	**79**	1580	13	260	18	360	15	300	15	300	18	360
B.12	Non potable Reuse	**40**	800	9	180	12	240	3	60	8	160	8	160

	Option	ADJUSTED TOTAL rated out of 100	Weighted Total Score	ENVIRONMENTAL		COMMUNITY ACCEPTANCE		STAKEHOLDER ACCEPTANCE		TECHNCIAL RISK		WORK HEALTH AND SAFETY	
		100	2000	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
	C. WATER SUPPLY	ADJUSTED TOTAL rated out of 100	Weighted Total Score										
C.1	Disconnect existing non-potable supply	**42**	840	10	200	0	0	12	240	10	200	10	200
C.2	Do Nothing	**34**	680	10	200	8	160	5	100	8	160	3	60
C.3	Upgrade of rainwater storage tanks and water usage management	**58**	1160	15	300	9	180	15	300	7	140	12	240
C.4	Replace Small Bore Supply for drinking water with top up to rainwater tanks	**70**	1400	13	260	15	300	16	320	13	260	13	260
C.5	Provide supply from Sydney Water System to reservoir on Island	**58**	1160	5	100	12	240	16	320	11	220	14	280
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required	**75**	1500	9	180	18	360	18	360	15	300	15	300
C.7	Desal with new water reticulation	**40**	800	5	100	5	100	10	200	7	140	13	260
C.8	Reuse non-potable	**40**	800	9	180	12	240	3	60	8	160	8	160
C.9	Reuse potable	**20**	400	3	60	2	40	2	40	8	160	5	100

8 CONCLUSION / RECOMMENDATIONS

Existing Water and Sewage Servicing to the Island is low standard
Scotland Island currently has a low standard of water supply and sewage disposal when benchmarked to similar density urban residential lots in Sydney. The low standard of servicing has been acknowledged by service providers and government authorities for several decades, but constraints have prevented the implementation of water infrastructure upgrades.

The servicing difficulties originate from the history of development on Scotland Island, combined with a topography and location that impacts on construction costs.

When Scotland Island was initially subdivided and developed it was primarily a holiday destination. Scotland Island is only accessible by boat. When first developed the dwellings were predominately intended for temporary occupation.

The existing geotechnical conditions were not ideal for on-site disposal, but when used for holiday accommodation the soil absorption/dispersal areas only received intermittent sewage discharges. With increasing permanent residents, the disposal areas became stressed through a higher constant hydraulic load.

The rainwater tanks generally were sufficient for the low usages for the non-permanent holiday occupant requirements, complimented with carry-on drinking water. The increased demands from permanents residents, especially families with children, has increased the reliance on the small bore top up supply. The top up supply pipework is non-compliant, and with limited flow capacity in the delivery system residents are required to book for a fill period to fill their tanks.

Changing demographic
The proportion of permanent residents has gradually increased over time, although it has historically fluctuated.

Table 8-1: Scotland Island Population 2001 - 2016

Census Data	
Year	**Population**
2016	579
2011	715
2006	642
2001	734

Source: Australian Bureau of Statistics

The permanent population has increased without a corresponding upgrade to infrastructure. Many residents moved to Scotland Island to enjoy a less urbanised lifestyle, willing to offset some convenience for the benefits of a community based village lifestyle, or to enjoy isolation from the traffic and urbanisation. Historically there was some community reluctance to change the amenity on Scotland Island by development of urban infrastructure services.

The changing demographic and increase in families living on Scotland Island has increased the desire for upgrade of services. In 2016, the proportion of children under 14 years of age was 20.4%. For more than 20 years residents have been lobbying for provision of reticulated water supply and connection to Sydney Water sewerage services. The sewerage servicing of Scotland Island has been listed in the Sydney Water priority sewerage program for nearly a decade.

Need for improvement of services to Scotland Island

Audit of Scotland Island water reticulation has identified a health risk in the existing drinking water supply. Scotland Island is densely vegetated and many of the rainwater collection roofs are under tree canopies, with high debris and organic matter impacting on the harvested rainwater quality, and some of the rainwater tanks have been contaminated by island fauna. The existing small-bore water supply is not installed to Australian standards and is classified as non-potable.

The on-site sewage treatment and disposal systems are underperforming, with evidence of environmental damage, and water and soil contamination.

Scotland Island is not connected to the mainland by road bridge, but it is located within the Sydney suburban/urban boundaries and is situated in an ecologically sensitive area with high human engagement and activity in the environs and surrounding waterways.

The upgrade of the existing water supply and sewage services are a critical requirement to negate the health risk for residents and recreational visitors.

Key drivers for the recommended technical solution

The brief for this report was to investigate opportunities for alternate technologies and potential commercial delivery models to provide Scotland Island with water infrastructure. The opportunities for alternate delivery models are limited by the topography and urban context of Scotland Island.

The size of island population and urban density is not conducive to the implementation of domestic type complex water treatment technology with high user dependant management of on-site sewage treatment systems. The density of development on Scotland Island and the shallow soils are not sufficient to manage the sewage hydraulic loading. Construction of mounds by importing granular material to increase the soil absorption capacity has significant negative environmental impact.

There are key servicing factors that influence the outcome of the options assessment process and recommendations in this report:

- Preliminary discussions with Sydney Water indicate there is sufficient capacity in the water and sewerage infrastructure located at Church Point required to service Scotland Island.
- Scotland Island is approximately 6 kms from Warriewood Sewage Treatment Plant. Sydney Water have indicated there is capacity in the treatment plant to accept the sewage from Scotland Island.

Recommendations

Both recommended shortlisted options for upgrade of water supply to Scotland Island include connection to the Sydney Water mains at Church Point.

No recommended option for sewage disposal considers on-site treatment and disposal. A common sewerage collection system is recommended, discharging to either the Sydney Water sewerage system at Church Point, or to an on island central sewage treatment plant with disposal to Pittwater. Disposal to the Sydney Water sewerage system is the preferred option as determined by the option assessment process.

Discussions with Sydney Water revealed they undertook some investigation for servicing of Scotland Island in recent years but were not able to overcome the commercial requirements for implementation of the program. The cost of servicing Scotland Island was estimated to be extremely high, and not viable within Sydney Water commercial operational responsibilities.

The next phase of this feasibility study is a detailed commercial appraisal of the shortlisted options. The commercial appraisal study objectives will be to:

- Identify the most economical solution that is technically robust and develop certainty in the project delivery costs. Previous studies have been high level costing only. A detailed costing plan will facilitate definition of the potential funding models. It is recommended the costing is informed by contractors' input.
- Assess the construction and operational costs against a commercial model to identify shortfalls in funding, and potential sources of top up finance to implement the services upgrade.

Recommended Water Supply shortlisted options

There are no potable water sources on Scotland Island, the only alternate potable water source is desalination or Black Water treatment and reuse. These options do not compare favourably to the option of connecting to the Sydney Water water source available from Church Point. There are no alternate technologies that are commercially sustainable on Scotland Island.

The recommended option is the removal of the existing non-compliant small-bore water reticulation, and installation of new water supply reticulation connecting to the Sydney Water mains at Church Point. A more detailed analysis is required to determine the preferred option, either:

OPTION C.4	Replace Small Bore Supply for drinking water an optimised size supply capable of constant trickle top up to rainwater tanks with a potable water supply point at the kitchen sink in each dwelling
OR	
OPTION C.6	Typical direct mains pressure supply from Sydney Water mains / pressure boost if required

Recommended Sewage Treatment and Disposal shortlisted options

The topography and urban density on Scotland Island are not suited to an on-site treatment and disposal system. To satisfactorily reduce health risks on Scotland Island it is recommended the sewage is collected to a central point for either:

OPTION B.9	Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater
OR	
OPTION B.11	Collect Sewage and pump to Sydney Water sewerage system at Church Point

Recommended Sewage Collection System shortlisted options

Both recommended options for Sewage Treatment and Disposal requires the provision of a sewage collection system. The two systems are recommended to be considered for further commercial assessment are:

OPTION A.2 Pressure Sewerage Collection System

OR

OPTION A.4 A hybrid system combining pressure sewerage and gravity sewerage where feasible.

9 REFERENCED DOCUMENTS

No	Title	Date	Prepared By	Purpose
1	SCOTLAND ISLAND WATER AND SEWAGE OPTIONS STUDY	1997	Marten & Associates	Second Report of Two Stage Study funded by a Landcare grant administered by SIRA; Report examines options for water and wastewater services. Recommendations: - Health risks identified - Upgrade of on-site treatment - Full reticulated Water Supply - On-going review of sewage systems performance.
2	Lotsearch Enviro Pro Report Sample: Scotland island, Pittwater, NSW 2105	28.11.18	LOTSEARCH	Database environmental risk and planning information: EPA assessed contamination significant enough to warrant regulation
3	Scotland Island Community Engagement Plan: Issue 0.5	1.2.19	RPS / PSS	2019 Scotland Island feasibility study Community and stakeholder engagement
4	Scotland Island Review of Environmental Factors; Issue 0.5	13.2.19	RPS / PSS	2019 Scotland Island feasibility study: Review of previous environmental and social studies and identify knowledge gaps
5	SCOTLAND ISLAND COMMUNITY CALL TO ACTION	Undated	SIRA (Scotland Island Resident's Association)	Community Information document regarding
6	Sydney Water Operating Licence	2015-2020	IPART	Scotland Island included in PSP
7	Sydney Water information Sheet; Bargo and Buxton Wastewater Scheme	06.14	Sydney Water	

No	Title	Date	Prepared By	Purpose
8	NSW Parliament Legislative Assembly Hansard House Papers	Various	Hansard	
	0644 SEWERAGE SCOTLAND ISLAND May 2000			Assessment process
	3820 SEWERAGE UPGRADE March 2005			Prelim Assessment Stage 2 PSP
	0322 SCOTLAND ISLAND WATER SUPPLY June 2007			Under Review
	0324 SEWERAGE CONNECTION June 2007			Expected to commence 2010/11
	9797 CONNECTION TO SEWERAGE March 2010			Expected to commence 2011, subject to upgrade water supply
9	Sewage Survey Paper	2015	SIRA (Attributed)	
10	Soil Testing ES1905204_0_COA ES1905204_COC_1 ES1905204_0_CCI ES1905204_0_QC Scotland Island SK05 Soil Test Location Summary Results	Feb 2019	ALS	Soil Testing. For summary refer to Attachment B
11	On Site System Scotland Island Email	Nov 18	NBC	
12	Northern Beaches Council RFT 2018/221 Consultancy Services for Scotland Island Water and Wastewater	Sep 18	NBC	
13	Scotland Island Feasibility Study; Stage 1b Option Evaluation Workshop Notes	18/5/19	PSS	
14	Scotland Island Review of Environmental Factors	13/2/19	PSS / RPS	

ATTACHMENT A: WATER BALANCE MODEL

Hydraulic Loading Criteria

The Hydraulic Modelling was based on the following criteria

Hydraulic Modelling Population Criteria

Item	Criteria	Comments
Number of Lots	377	
EP / Lot	3	
Holiday Loading	25%	Based on anecdotal discussions with SIRA
Existing Population	550 to 750 EP	
Existing Holiday Loading Population	Approximately 1,000	
Ultimate Fully Developed Population	1,131 EP	
Ultimate Holiday Population	1,413 EP	

Potable Water Consumption Criteria

Item	Criteria
Drinking and Cooking	10 L/person/day OR 3,650 L/person/y Or Approx 11 kL/dw/y
Showering	80 L/person/day
Washing Machine	40 L/person/day
Toilet Flushing	25 L/person/day
General Use	25 L/person/day
Leakage	15% OR 27 L/person/day
TOTAL	207 L/person/day Or 234 kL/day for whole Island Equating to approximately 75 kL/person per year OR 226 kL/home/y

Sewage Production

Item	Criteria
Sewage Loading	200 L/person/day
Average Day Total	226 kL/day
Peak Day Total	282 kL/day
Trade Waste	None allowed

ATTACHMENT B: OPTION SELECTION ALTERNATE WIEGHTING SENSITVITY CHECK

The assessment team agreed on the following alternate weighting profiles for sensitivity analysis:

	Base	Increased focus on Environment and Community	Increase focus on Stakeholders and WHS
		Weightings	
ENVIRONMENTAL	20	30	10
COMMUNITY ACCEPTANCE	20	30	20
STAKEHOLDER ACCEPTANCE	20	10	30
TECHNCIAL RISK	20	10	10
WORK HEALTH AND SAFETY	20	20	30

Weighting Sensitivity Scenario 1: Increased focus on Environment and Community

No	Option	ADJUSTED TOTAL rated out of 100
		100
	A. WASTE WATER COLLECTION SYSTEMS	
A.1	Gravity Sewer	**24**
A.2	Pressure Sewer	**64**
A.3	Vacuum System	**13**
A.4	Hybrid System	**51**
A.5	Variable Grade Sewer	**23**
	B. WASTE WATER	
B.1	Do Nothing	**7**
B.2	Upgrade of existing Domestic Systems (Managed System)	**29**
B.3	On Site Grey Water Reuse using existing Septic Tank, with on site reduced disposal	**23**
B.4	Tanker Truck Disposal from each lot	**8**
B.5	Tanker Truck disposal from common collection storage tank	**44**
B.6	Upgrade existing on lot systems with disposal redirected to Pittwater	**28**
B.7	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal	**41**
B.8	Septic Tank Pump Out System discharging to Sydney Water	**54**
B.9	Installation of a sewer collection system discharging to a treatment system on the Island, with disposal to Pittwater	**58**
~~B.10~~	~~Installation of a sewer collection system discharging to a treatment system on the Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater~~	~~**68**~~
B.11	Collect Waste Water and Pump to Sydney Water sewerage system	**80**
B.12	Non potable Reuse	**45**
	C. WATER SUPPLY	
C.1	Disconnect existing non potable supply	**36**
C.2	Do Nothing	**37**
C.3	Upgrade of rainwater storage tanks and water usage management	**59**
C.4	Replace Small Bore Supply for drinking water with top up to rainwater tanks	**70**
C.5	Provide supply from Sydney Water System to reservoir on Island	**53**
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required	**72**
C.7	Desal with new water reticulation	**37**
C.8	Reuse non potable	**45**
C.9	Reuse potable	**18**

Weighting Sensitivity Scenario 2: Increased focus on Stakeholders and WHS

No	Option	ADJUSTED TOTAL rated out of 100 100
	A. WASTE WATER COLLECTION SYSTEMS	
A.1	Gravity Sewer	**23**
A.2	Pressure Sewer	**75**
A.3	Vacuum System	**11**
A.4	Hybrid System	**56**
A.5	Variable Grade Sewer	**23**
	B. WASTE WATER	
B.1	Do Nothing	**5**
B.2	Upgrade of existing Domestic Systems (Managed System)	**26**
B.3	On Site Grey Water Reuse using existing Septic Tank, with on site reduced disposal	**22**
B.4	Tanker Truck Disposal from each lot	**9**
B.5	Tanker Truck disposal from common collection storage tank	**39**
B.6	Upgrade existing on lot systems with disposal redirected to Pittwater	**24**
B.7	Septic Tank Pump Out System discharging to on Island Treatment with Pittwater Disposal	**36**
B.8	Septic Tank Pump Out System discharging to Sydney Water	**52**
B.9	Installation of a sewer collection system discharging to a treatment system on the Island, with disposal to Pittwater	**59**
~~B.10~~	~~Installation of a sewer collection system discharging to a treatment system on the Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater~~	~~**66**~~
B.11	Collect Waste Water and Pump to Sydney Water sewerage system	**82**
B.12	Non potable Reuse	**37**
	C. WATER SUPPLY	
C.1	Disconnect existing non potable supply	**43**
C.2	Do Nothing	**29**
C.3	Upgrade of rainwater storage tanks and water usage management	**61**
C.4	Replace Small Bore Supply for drinking water with top up to rainwater tanks	**72**
C.5	Provide supply from Sydney Water System to reservoir on Island	**65**
C.6	Direct mains pressure supply from Sydney Water mains / pressure boosted if required	**80**
C.7	Desal with new water reticulation	**46**
C.8	Reuse non potable	**37**
C.9	Reuse potable	**18**

ATTACHMENT C: SOIL TESTING

ATTACHMENT D: COST PLANS

HIGH LEVEL DELIVERY STRATEGY : FOR COST PLANNNING PURPOSES

RESPONSIBILITES	COST CENTRE
Project Delivery; Funding	
Project Management • Head Contract Management • Head Contract Tender • Project Approvals • Cost Control • Community Consultation • Cadastral and Road Survey • Geotechnical Studies • EIS	A: Project Management
Design and Construction Management • Construction Strategy and Planning • Design Management • Sub Contract Tendering • Sub-Contractor Management • Site Office • Site induction • Construction Program • Environmental Controls Waste Management • Line Survey • Road Stabilisation Strengthening • Materials Transport Church Point to Island • Supervision • Quality Control • Cost Control	B: Construction Management
Engineering Design Consultants • Infrastructure Services Design • HDD Design Trade Contractors • Water Infrastructure • Sewerage Infrastructure • Sewage Treatment Plant • HDD	C: Construction

ATTACHMENT E: CONCEPT DRAWINGS

Sewerage Collection System

Pressure Sewer
Dwg SK01 Pressure Sewer Collection System

Hybrid
Dwg SK02 Hybrid Gravity and Pressure Collection System

Pressure and Hybrid
Dwg SK07 Functional Sketches of Collection System arrangement

Sewage Disposal System

On Island Treatment System
Dwg SK06: Concept Plan
J1901105-GA-001-Rev.A (25Jun19): Plant General Arrangement
J1901105-L-001-Rev.A (25Jun19): location Plan

Discharge to Sydney Water
Dwg SK01 Pressure Sewer Collection System

Water Supply System

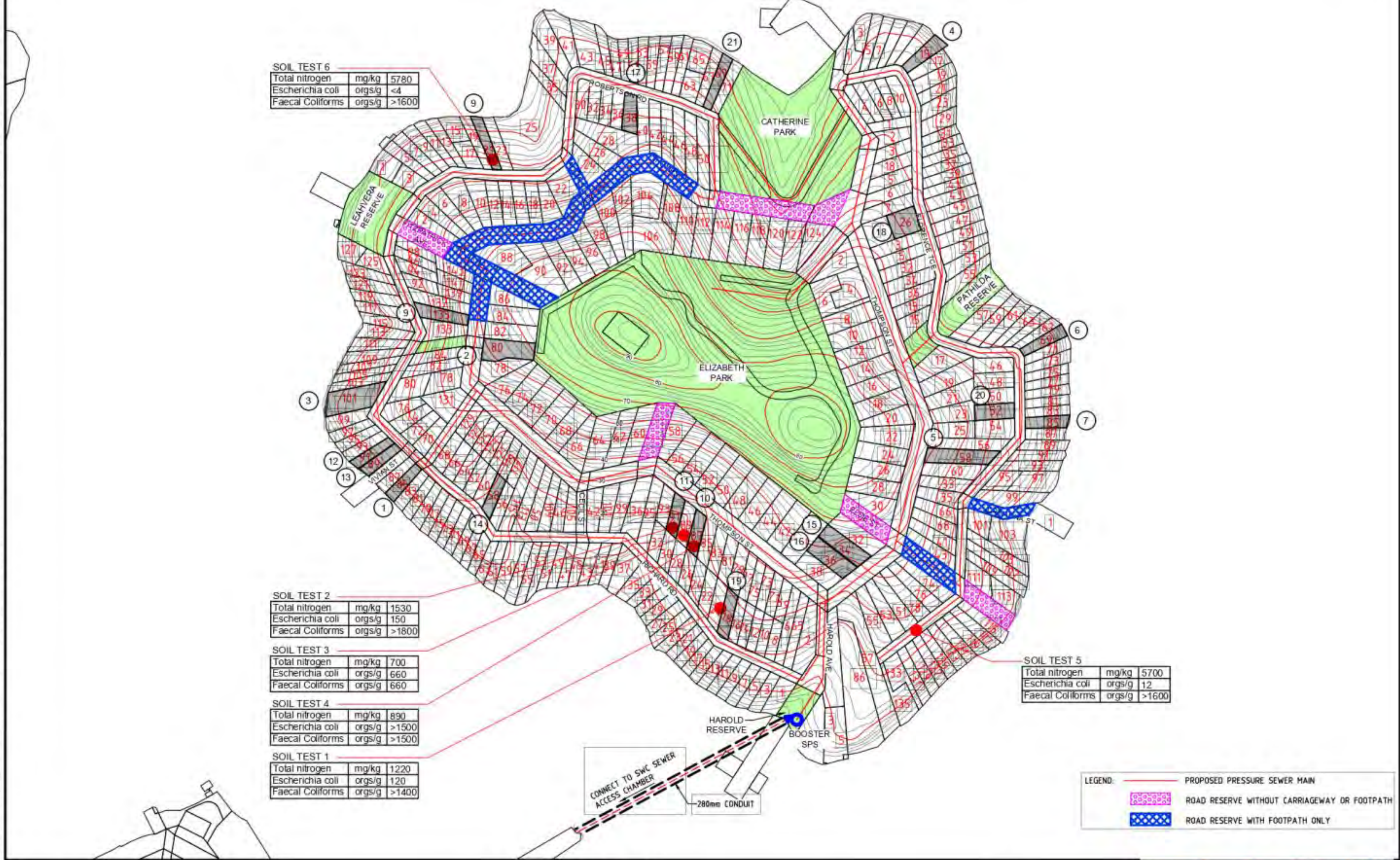
Low Flow
Dwg SK04 Low flow Water Supply from Sydney Water with single drinking water point and rainwater tank top up.

Full Reticulation
Dwg SK03 Full mains pressure supply .

ATTACHMENTS F: OPTION ASSESSMENT WORKSHOP NOTES

Detail workshop notes from Option Assessment Workshop May 2019. The options assessment from this workshop has been summarised in Section '5 OPTION ASSESSMENT'.

ATTACHMENTS G: DETAIL DESCRIPTION OF SCOTLAND ISLAND (12)



SOIL TEST 6

Total nitrogen	mg/kg	5780
Escherichia coli	orgs/g	<4
Faecal Coliforms	orgs/g	>1600

SOIL TEST 2

Total nitrogen	mg/kg	1530
Escherichia coli	orgs/g	150
Faecal Coliforms	orgs/g	>1800

SOIL TEST 3

Total nitrogen	mg/kg	700
Escherichia coli	orgs/g	660
Faecal Coliforms	orgs/g	660

SOIL TEST 4

Total nitrogen	mg/kg	890
Escherichia coli	orgs/g	>1500
Faecal Coliforms	orgs/g	>1500

SOIL TEST 1

Total nitrogen	mg/kg	1220
Escherichia coli	orgs/g	120
Faecal Coliforms	orgs/g	>1400

SOIL TEST 5

Total nitrogen	mg/kg	5700
Escherichia coli	orgs/g	12
Faecal Coliforms	orgs/g	>1600

LEGEND:

—	PROPOSED PRESSURE SEWER MAIN
▨	ROAD RESERVE WITHOUT CARRIAGEWAY OR FOOTPATH
▦	ROAD RESERVE WITH FOOTPATH ONLY

Date: 12/02/2019
Rev: A

Drawing No: SK05
Scale:

SCOTLAND ISLAND
SOIL TEST LOCATIONS AND RESULTS

Pressure System Solutions Pty Ltd
PLANNING, DESIGN & IMPLEMENTATION OF WATER & WASTEWATER SYSTEMS
Our Understanding and Experience Provides Certainty
PS Solutions

Saved: 07.03.2019, By: valued customer
J:\700-Projects\702-Current projects\181031 Scotland Island 8-5-01 sw\181031 Scotland Island\720-Design\721-Drawings\730-Street mains\Scotland Island_SK05 Soil Test locations and summary results.dwg

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES1905204**
Client : **Pressure System Solutions P/L**
Contact : Steve Wallace
Address : Unit 1 / 47 - 51 Lorraine Street
Peakhurst 2210
Telephone : ----
Project : Scotland Island
Order number :
C-O-C number : ----
Sampler : Steve Wallace
Site : ----
Quote number : ----
No. of samples received : 6
No. of samples analysed : 6

Page : 1 of 4
Laboratory : Environmental Division Sydney
Contact : Customer Services ES
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 19-Feb-2019 16:40
Date Analysis Commenced : 20-Feb-2019
Issue Date : 28-Feb-2019 14:18

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Tony DeSouza	Senior Microbiologist	WRG Subcontracting, Smithfield, NSW

RIGHT SOLUTIONS | RIGHT PARTNER

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK061G: Matrix spike failed recovery for TKN due to sample heterogeneity. Confirmed by re-digestion and re-analysis.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Page	: 3 of 4
Work Order	: ES1905204
Client	: Pressure System Solutions P/L
Project	: Scotland Island

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Soil Sample 1 - 18 Richard Received as 1	Soil Sample 2 - 91 Thompson Received as 2	Soil Sample 3 - 89 Thompson Received as 3	Soil Sample 4 - 87 Thompson Received as 4	Soil Sample 5 - Florence Terrace Street Received as 5
			Client sampling date / time	18-Feb-2019 14:30	18-Feb-2019 14:30	18-Feb-2019 14:30	18-Feb-2019 14:30	18-Feb-2019 14:30
Compound	CAS Number	LOR	Unit	ES1905204-001	ES1905204-002	ES1905204-003	ES1905204-004	ES1905204-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.8	7.0	6.4	6.1	4.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	83	83	92	54	641
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	19.4	37.6	34.3	26.6	33.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	2.7	4.2	2.4	2.5	----
Exchangeable Magnesium	----	0.1	meq/100g	1.4	1.4	1.0	1.2	----
Exchangeable Potassium	----	0.1	meq/100g	0.3	0.2	0.3	0.3	----
Exchangeable Sodium	----	0.1	meq/100g	0.3	0.3	0.4	0.5	----
Cation Exchange Capacity	----	0.1	meq/100g	4.7	6.2	4.1	4.5	----
Exchangeable Sodium Percent	----	0.1	%	7.0	5.6	9.8	10.2	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	5.5
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	2.0
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.6
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.2
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	8.2
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	2.0
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	3.7	12.2	2.7	2.1	435
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1220	1520	700	890	5700
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	1220	1530	700	890	6140
EK074: Fluoride Extractable Phosphorus (Bray)								
Fluoride Extractable P (Bray)	----	1.0	mg/kg	1.3	70.5	70.4	115	33.3
MM804: E.coli and Thermotolerant Coliforms by MPN								
Escherichia coli	----	2	orgs/g	120	150	660	>1500	13
Faecal Coliforms	----	2	orgs/g	>1400	>1800	660	>1500	>1600

Page : 4 of 4
Work Order : ES1905204
Client : Pressure System Solutions P/L
Project : Scotland Island

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Soil Sample 6 - 21 Robertson Received as 6	----	---	----	---
			Client sampling date / time	18-Feb-2019 14:30	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1905204-006	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.0	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	200	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	38.8	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	7.1	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	2.3	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.5	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.6	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	10.5	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	6.2	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	126	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	5650	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	5780	----	----	----	----
EK074: Fluoride Extractable Phosphorus (Bray)								
Fluoride Extractable P (Bray)	----	1.0	mg/kg	44.2	----	----	----	----
MM804: E.coli and Thermotolerant Coliforms by MPN								
Escherichia coli	----	2	orgs/g	<4	----	----	----	----
Faecal Coliforms	----	2	orgs/g	>1600	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1905204**	Page	: 1 of 5
Client	: **Pressure System Solutions P/L**	Laboratory	: Environmental Division Sydney
Contact	: Steve Wallace	Contact	: Customer Services ES
Address	: Unit 1 / 47 - 51 Lorraine Street Peakhurst 2210	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: Scotland Island	Date Samples Received	: 19-Feb-2019
Order number	:	Date Analysis Commenced	: 20-Feb-2019
C-O-C number	: ----	Issue Date	: 28-Feb-2019
Sampler	: Steve Wallace		
Site	: ----		
Quote number	: ----		
No. of samples received	: 6		
No. of samples analysed	: 6		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
Tony DeSouza	Senior Microbiologist	WRG Subcontracting, Smithfield, NSW

RIGHT SOLUTIONS | RIGHT PARTNER

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA002: pH 1:5 (Soils) (QC Lot: 2196408)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EA002: pH Value	----	0.1	pH Unit	6.8	6.8	0.00	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 2196407)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	83	84	1.56	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2196590)									
ES1905204-004	Soil Sample 4 - 87 Thompson Received as 4	EA055: Moisture Content	----	0.1	%	26.6	28.5	7.10	0% - 20%
ES1905241-001	Anonymous	EA055: Moisture Content	----	0.1	%	12.1	13.8	13.5	0% - 20%
ED007: Exchangeable Cations (QC Lot: 2200636)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	ED007: Exchangeable Sodium Percent	----	0.1	%	7.0	7.1	1.90	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	2.7	2.5	4.80	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	1.4	1.4	0.00	0% - 50%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.3	0.3	0.00	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.3	0.3	0.00	No Limit
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	4.7	4.5	4.31	0% - 20%
ED008: Exchangeable Cations (QC Lot: 2200639)									
ES1905204-005	Soil Sample 5 - Florence Terrace Street Received as 5	ED008: Exchangeable Sodium Percent	----	0.1	%	2.0	2.0	0.00	0% - 20%
		ED008: Exchangeable Calcium	----	0.1	meq/100g	5.5	5.5	0.00	0% - 20%
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	2.0	2.0	0.00	0% - 20%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	0.6	0.6	0.00	0% - 20%

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Work Order : ES1905204
Client : Pressure System Solutions P/L
Project : Scotland Island

Sub-Matrix: **SOIL**

Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
				Laboratory Duplicate (DUP) Report					
ED008: Exchangeable Cations (QC Lot: 2200639) - continued									
ES1905204-005	Soil Sample 5 - Florence Terrace Street Received as 5	ED008: Exchangeable Sodium	----	0.1	meq/100g	0.2	0.2	0.00	0% - 20%
		ED008: Cation Exchange Capacity	----	0.1	meq/100g	8.2	8.2	0.00	0% - 20%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2196409)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	3.7	3.6	4.59	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2202148)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	1220	1030	16.4	0% - 20%
ES1905252-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	2420	2260	6.84	0% - 20%
EK074: Fluoride Extractable Phosphorus (Bray) (QC Lot: 2197486)									
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EK074: Fluoride Extractable P (Bray)	----	1	mg/kg	1.3	1.1	14.4	No Limit

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Work Order : ES1905204
Client : Pressure System Solutions P/L
Project : Scotland Island

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EA010: Conductivity (1:5) (QCLot: 2196407)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	96.1	92	108
ED007: Exchangeable Cations (QCLot: 2200636)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	1 meq/100g	100	76	120
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.67 meq/100g	97.0	75	115
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.51 meq/100g	104	80	120
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.87 meq/100g	102	80	120
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED007: Exchangeable Sodium Percent	----	0.1	%	<0.1	----	----	----	----
ED008: Exchangeable Cations (QCLot: 2200639)								
ED008: Exchangeable Calcium	----	0.1	meq/100g	<0.1	1 meq/100g	99.0	82	128
ED008: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.67 meq/100g	94.0	82	120
ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.51 meq/100g	108	70	140
ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.87 meq/100g	98.8	78	136
ED008: Exchangeable Sodium Percent	----	0.1	%	<0.1	----	----	----	----
ED008: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2196409)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	97.6	88	118
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2202148)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	85.1	72	106
				<20	100 mg/kg	98.7	70	122
				<20	500 mg/kg	107	74	118
EK074: Fluoride Extractable Phosphorus (Bray) (QCLot: 2197486)								
EK074: Fluoride Extractable P (Bray)	----	1	mg/kg	<1.0	3.5 mg/kg	105	88	118

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2196409)							
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	89.2	70	130

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Work Order : ES1905204
Client : Pressure System Solutions P/L
Project : Scotland Island

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2202148)							
ES1905204-001	Soil Sample 1 - 18 Richard Received as 1	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	# 145	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order : **ES1905204**

Client : **Pressure System Solutions P/L**
Contact : Steve Wallace
Project : Scotland Island
Site : ----
Sampler : Steve Wallace
Order number :

Page : 1 of 5

Laboratory : Environmental Division Sydney
Telephone : +61-2-8784 8555
Date Samples Received : 19-Feb-2019
Issue Date : 28-Feb-2019
No. of samples received : 6
No. of samples analysed : 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	ES1905204--001	Soil Sample 1 - 18 Richard Re	**Total Kjeldahl Nitrogen as N**	----	145 %	70-130%	**Recovery greater than upper data quality objective**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method *Container / Client Sample ID(s)*	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA002: pH 1:5 (Soils)							
Soil Glass Jar - Unpreserved (EA002) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**21-Feb-2019**	25-Feb-2019	✓	**21-Feb-2019**	21-Feb-2019	✓
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved (EA010) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**21-Feb-2019**	25-Feb-2019	✓	**21-Feb-2019**	21-Mar-2019	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	----	----	----	**20-Feb-2019**	04-Mar-2019	✓
ED007: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED007) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**22-Feb-2019**	18-Mar-2019	✓	**22-Feb-2019**	18-Mar-2019	✓
ED008: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED008) Soil Sample 5 - Florence Terrace Street - Received as 5	**18-Feb-2019**	**22-Feb-2019**	18-Mar-2019	✓	**22-Feb-2019**	18-Mar-2019	✓

Page : 3 of 5
Work Order : ES1905204
Client : Pressure System Solutions P/L
Project : Scotland Island

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**21-Feb-2019**	17-Aug-2019	✓	**21-Feb-2019**	17-Aug-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**24-Feb-2019**	17-Aug-2019	✓	**25-Feb-2019**	17-Aug-2019	✓
EK074: Fluoride Extractable Phosphorus (Bray)							
Soil Glass Jar - Unpreserved (EK074) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	**27-Feb-2019**	17-Aug-2019	✓	**27-Feb-2019**	17-Aug-2019	✓
MM804: E.coli and Thermotolerant Coliforms by MPN							
Sterile Plastic Bottle - Sodium Thiosulfate (MM804) Soil Sample 1 - 18 Richard - Received as 1, Soil Sample 2 - 91 Thompson - Received as 2, Soil Sample 3 - 89 Thompson - Received as 3, Soil Sample 4 - 87 Thompson - Received as 4, Soil Sample 5 - Florence Terrace Street - Received as 5, Soil Sample 6 - 21 Robertson - Received as 6	**18-Feb-2019**	----	----	----	**21-Feb-2019**	22-Feb-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5)	EA010	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	1	100.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride extractable Phosphorus (Bray)	EK074	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	18	11.11	9.52	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride extractable Phosphorus (Bray)	EK074	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	3	18	16.67	14.29	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride extractable Phosphorus (Bray)	EK074	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	18	5.56	4.76	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	18	5.56	4.76	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons (2011) Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (2013) Schedule B(3) (Method 301)
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Higginson (2011) Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (2013) Schedule B(3) (Method 301)
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrogen, each determined seperately as N.
Fluoride extractable Phosphorus (Bray)	EK074	SOIL	In house: Referenced to Rayment & Higginson (2011) Method 9E1. Phosphorus is extracted from the soil using NH4F and determined by discrete analyzer.
E.coli and Thermotolerant Coliforms by MPN	MM804	SOIL	Microbiological analysis subcontracted to ALS Scoresby (NATA Accredited Laboratory No. 992).

Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Fluoride extractible Phosphorus (Bray)	EK074PR	SOIL	In house: Referenced to Rayment et al 9E1. Phosphorus is extracted from the soil using NH4F at a ratio of 7.14g: 50 ml for 1 minute. Phosphorus in the extract is determined by FIA.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ **Sydney**: 277 Woodpark Rd, Smithfield NSW 2176
Ph: 02 8784 8555 E:samples.sydney@alsenviro.com
☐ **Newcastle:** 5 Rosegum Rd, Warabrook NSW 2304
Ph:02 4968 9433 E:samples.newcastle@alsenviro.com

☐ **Brisbane**: 32 Shand St, Stafford
Ph:07 3243 7222 E:samples.brisban
☐ **Townsville:** 14-15 Desma Ct, Bo
Ph:07 4796 0600 E: townsville.environ

CLIENT: Pressure System Solutions P/L
OFFICE: Unit 1 / 47 - 51 Lorraine Street, Peakhurst
PROJECT: Scotland Island
ORDER NUMBER:
PROJECT MANAGER: Steve Wallace **CONTACT PH:** 0403 823 013
SAMPLER: Steve Wallace **SAMPLER MOBILE:**
COC emailed to ALS? (YES / NO) **EDD FORMAT (or default):**
Email Reports to (will default to PM if no other addresses are listed): swallace@pssolutions.net.au
Email Invoice to (will default to PM if no other addresses are listed):
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT (List due date): Results required by
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.:

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

RELINQUISHED BY:	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
Steve Wallace	Soggy ... 04-5		
DATE/TIME: 18/02/19 2:30pm	DATE/TIME: 19/2/19 1640	DATE/TIME:	DATE/TIME:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	**SAMPLE ID**	**DATE / TIME**	**MATRIX**	**TYPE & PRESERVATIVE** (refer to codes below) received as HT	**TOTAL BOTTLES**	**MM804**	**pH and EC (1997 soil tests indicate soils are very acidic)**	**Sodicity (sodic soils aren't suitable for application of effluent)**	**Nitrogen (NO3-N)**	**Phosporus (Bray-P)**				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	Soil Sample 1 - 18 Richard	18/02/19 2:30pm		"1"	1	x	x	x	x	x				
2	Soil Sample 2 - 91 Thompson	18/02/19 2:30pm		"2"	1	x	x	x	x	x				
3	Soil Sample 3 - 89 Thompson	18/02/19 2:30pm		"3"	1	x	x	x	x	x				
4	Soil Sample 4 - 87 Thompson	18/02/19 2:30pm		"4"	1	x	x	x	x	x				
5	Soil Sample 5 - Florence Terrace Street	18/02/19 2:30pm		"5"	1	x	x	x	x	x				
6	Soil Sample 6 - 21 Robertson	18/02/19 2:30pm		"6"	1	x	x	x	x	x				
				TOTAL										

Environmental Division
Sydney
Work Order Reference
ES1905204
Telephone : + 61-2-8784 8555

Total N as per Steve. 20.2.19

Sodicity = CEC

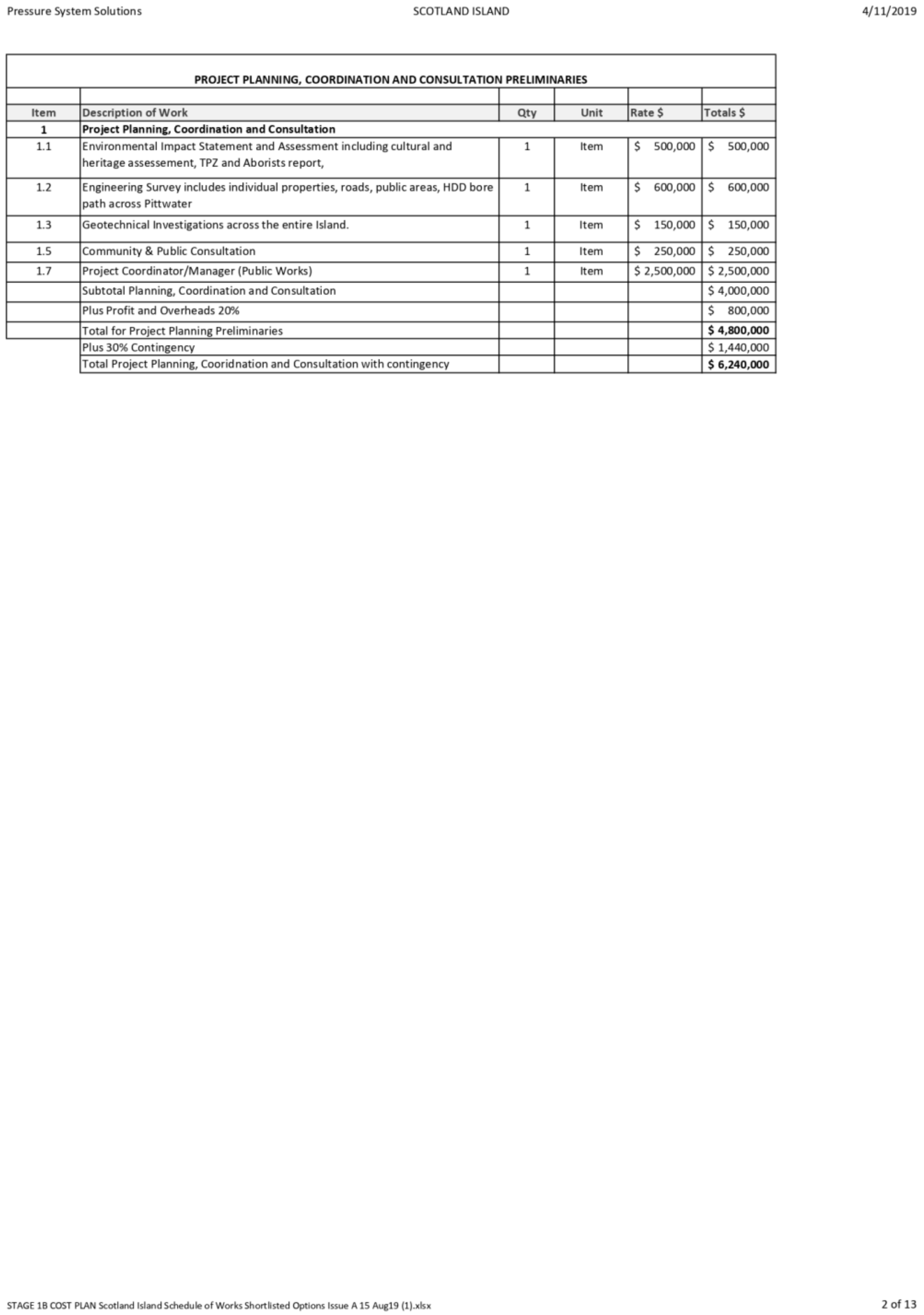
MM804 = both Faecal + Ecoil

Subcon / Forward Lab / Split WO
Lab / Analysis: [redacted], Scoresby (MM804)
Organised By / Date:
Relinquished By / Date:
Connote / Courier:
WO No: ES1905204
Attached By PO / Internal Sheet:

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

COSTING SUMMARY

COMPARITIVE COSTINGS FOR OPTION COMBINATIONS				COMBINATION 1		COMBINATION 2		COMBINATION 3		COMBINATION 4	
COST CENTRE	**ITEM**		**$ (Excl GST)**	**$ (Excl GST)**	**Cost per Lot 377 serviced**	**$ (Excl GST)**	**Cost per Lot 377 serviced**	**$ (Excl GST)**	**Cost per Lot 377 serviced**	**$ (Excl GST)**	**Cost per Lot 377 serviced**
1: PROJECT MANAGEMENT	1.1	***Project Management***	***$6,240,000***	*$ 6,240,000*	*$ 16,552*	*$ 6,240,000*	*$ 16,552*	*$ 6,240,000*	*$ 16,552*	*$ 6,240,000*	*$ 16,552*
2: DESIGN AND CONSTRUCTION MANAGEMENT	2.1	***Project Construction: Preliminaries and Site Establishment***	***$12,137,034***	*$ 12,137,034*	*$ 32,194*	*$ 12,137,034*	*$ 32,194*	*$ 12,137,034*	*$ 32,194*	*$ 12,137,034*	*$ 32,194*
3: DESIGN AND CONSTRCTION		**Sewer Collection System Options**									
	3.1	A.2 Pressure Sewer System (377 LOTS)	$ 28,504,189	$ 28,504,189	$ 75,608						
		A.4 Hybrid System	$ 31,265,520			$ 31,265,520	$ 82,932	$ 31,265,520	$ 82,932	$ 31,265,520	$ 82,932
		Sewage Treatment Disposal									
	3.2	B.9 On Island Treatment System	$ 30,153,240							$ 30,153,240	$ 79,982
		B.11 Discharge to Sydney Water	$ 7,361,263	$ 7,361,263	$ 19,526	$ 7,361,263	$ 19,526	$ 7,361,263	$ 19,526		
		Water Supply									
	3.3	C.4 Low Flow from Sydney Water	$ 16,029,637			$ 16,029,637	$ 42,519				
		C.6 Full Retic from Sydney Water	$ 16,730,267	$ 16,730,267	$ 44,377			$ 16,730,267	$ 44,377	$ 16,730,267	$ 44,377
TOTAL				**$70,972,753**	**$ 188,257**	**$73,033,455**	**$ 193,723**	**$73,734,084**	**$195,581**	**$96,526,061**	**$256,037**



Pressure System Solutions SCOTLAND ISLAND 4/11/2019

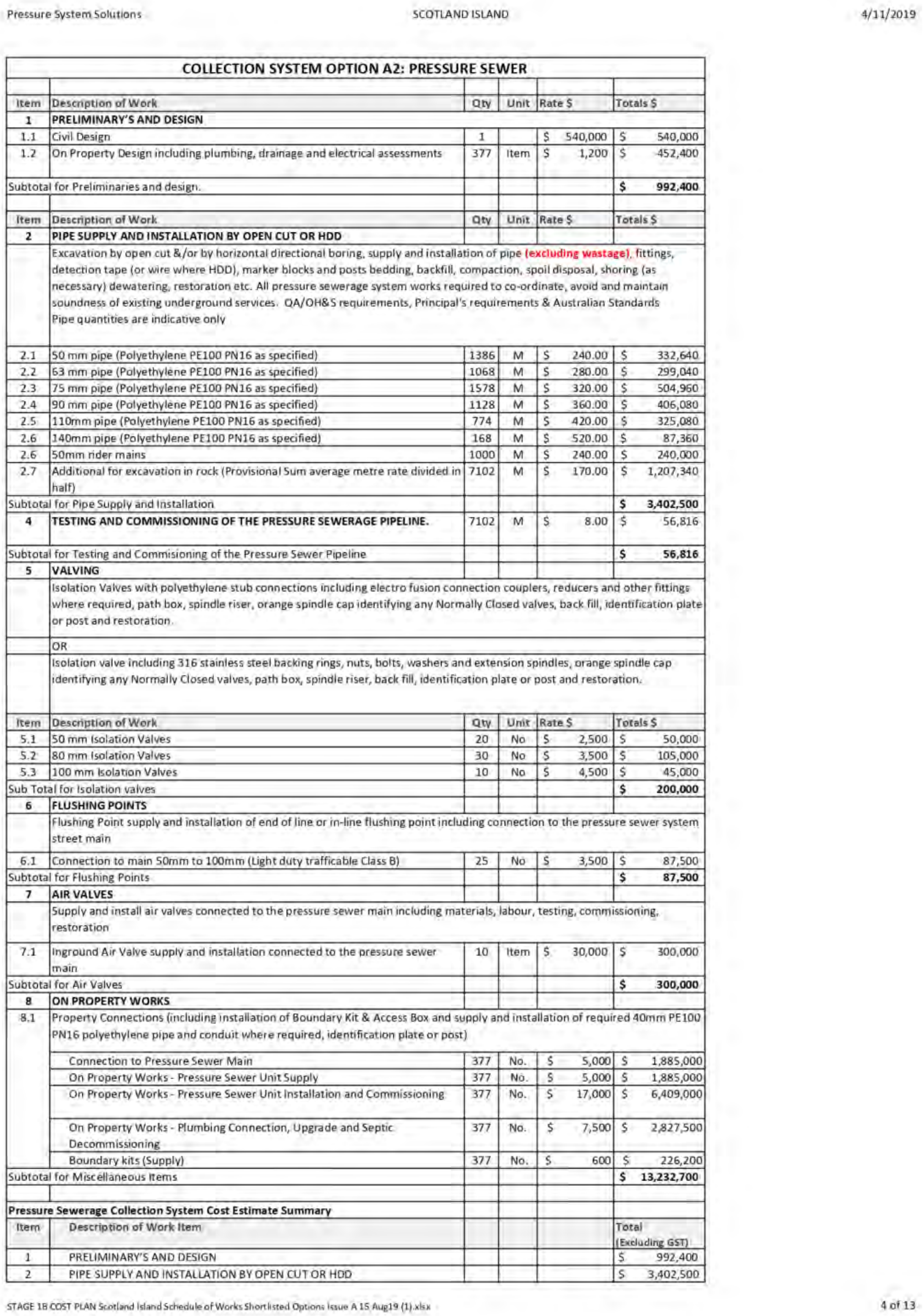
PROJECT PLANNING, COORDINATION AND CONSULTATION PRELIMINARIES

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	**Project Planning, Coordination and Consultation**				
1.1	Environmental Impact Statement and Assessment including cultural and heritage assesement, TPZ and Aborists report,	1	Item	$ 500,000	$ 500,000
1.2	Engineering Survey includes individual properties, roads, public areas, HDD bore path across Pittwater	1	Item	$ 600,000	$ 600,000
1.3	Geotechnical Investigations across the entire Island.	1	Item	$ 150,000	$ 150,000
1.5	Community & Public Consultation	1	Item	$ 250,000	$ 250,000
1.7	Project Coordinator/Manager (Public Works)	1	Item	$ 2,500,000	$ 2,500,000
	Subtotal Planning, Coordination and Consultation				$ 4,000,000
	Plus Profit and Overheads 20%				$ 800,000
	Total for Project Planning Preliminaries				**$ 4,800,000**
	Plus 30% Contingency				$ 1,440,000
	Total Project Planning, Cooridnation and Consultation with contingency				**$ 6,240,000**

STAGE 1B COST PLAN Scotland Island Schedule of Works Shortlisted Options Issue A 15 Aug19 (1).xlsx 2 of 13

PROJECT CONSTRUCTION PRELIMINARIES

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	**PRELIMINARY'S AND SITE ESTABLISHMENT**				
1.1	Mobilisation / Demobilisation including site amenities. Includes the following: 2 x portable site offices, 1 x Unisex Toilet block with showers and waste tank, 1 x Lunchroom, Poly rain water tank, connection of power to the existing Community Hall, wireless NBN, installation and freight costs	1	Item	$ 267,500	$ 267,500
1.11	Barge hire (55ton 17m barge) and materials management including crane hire, loader hire and ancillary equipment to load and unload equipment at Church Point and the Island.	470	Days	$ 5,750	$ 2,702,500
1.2	Inductions for contractor, sub-contractors, visitors (Estimated 100 visitors/staff to site)	1	Item	$ 80,000	$ 80,000
1.3	Prepare and Manage Construction Program (2hrs per week x $120 per hour x 90 week construction period)	1	Item	$ 21,600	$ 21,600
1.4	Prepare & maintain Construction, Traffic & Environmental Management Plans. (40hrs initially to prepare plans plus 8 hrs per week to manage @ $120 per hour)	1	Item	$ 91,200	$ 91,200
1.5	Prepare & maintain Environmental Controls and Waste Management Controls (8hrs per week x 2 guys plus materials)	1	Item	$ 170,000	$ 170,000
1.6	Prepare & maintain, Quality Assurance, Occupational Health & Safety Plans, including ITP's. (8hrs per week x $120 per hour x 90 week construction period)	1	Item	$ 86,400	$ 86,400
1.7	Preparation of all permits, plans, community consultation and approvals required from statutory authorities and pay all required fees and charges. (Provisional Sum)	1	Item	$ 100,000	$ 100,000
1.8	'Dial Before You Dig' services locating including liaison with all relevant authorities for water/sewerage, power, communications etc	1	Item	$ 9,600	$ 9,600
1.9	Site setout and survey as per design documentation	1	Item	$ 157,000	$ 157,000
1.10	Prepare photographic record and Dilapidation Reports of existing site conditions prior to construction. (Includes Individual property photo's and street main alignments)	1	Item	$ 52,000	$ 52,000
1.11	Traffic control including personnel, barriers, control signals etc. 80 wk program - 63 wks of TM	63	Week	$ 7,500	$ 472,500
1.12	Prepare and submit operations and maintenance manuals. (Provisional Sum)	1	Item	$ 20,000	$ 20,000
1.13	Work as Executed Documentation	377	Item	$ 450	$ 169,650
1.14	Construction Management/Engineering/Administration, Site Supervision, Community Consultation per week - includes, 1 x Senior Project Manager/Engineer, 2 x Mid Level Site Engineers, 2 x Site Supervisors, 1 x Community Liaison Officer 2 x admin support staff.	90	Item	$ 24,780	$ 2,230,200
1.15	Design, supply and install Scheme operations and maintenance depot/shed - includes power, water connection, lunch room, workshop, internet, air conditioning, storage, all weather access, security, fencing, architechture design, DA approval.	1	Item	$ 350,000	$ 350,000
1.16	Tree Removal, Aborist Report and Management, Removal off Island of wood and mulch as required.	1	Item	$ 300,000	$ 300,000
1.17	Existing storm water system upgrades/augmentation to prevent soil erosion from the construction activities.	20	Item	$ 25,000	$ 500,000
	Subtotal for Construction Preliminaries and Site Establishment				**$ 7,780,150**
	Plus Head Contractor Profit and Overheads 20%				$ 1,556,030
	Construction Preliminaries Total				**$ 9,336,180**
	Plus 30% Contingency				$ 2,800,854
	Construction Preliminaries Total with Contingency				**$ 12,137,034**



COLLECTION SYSTEM OPTION A2: PRESSURE SEWER

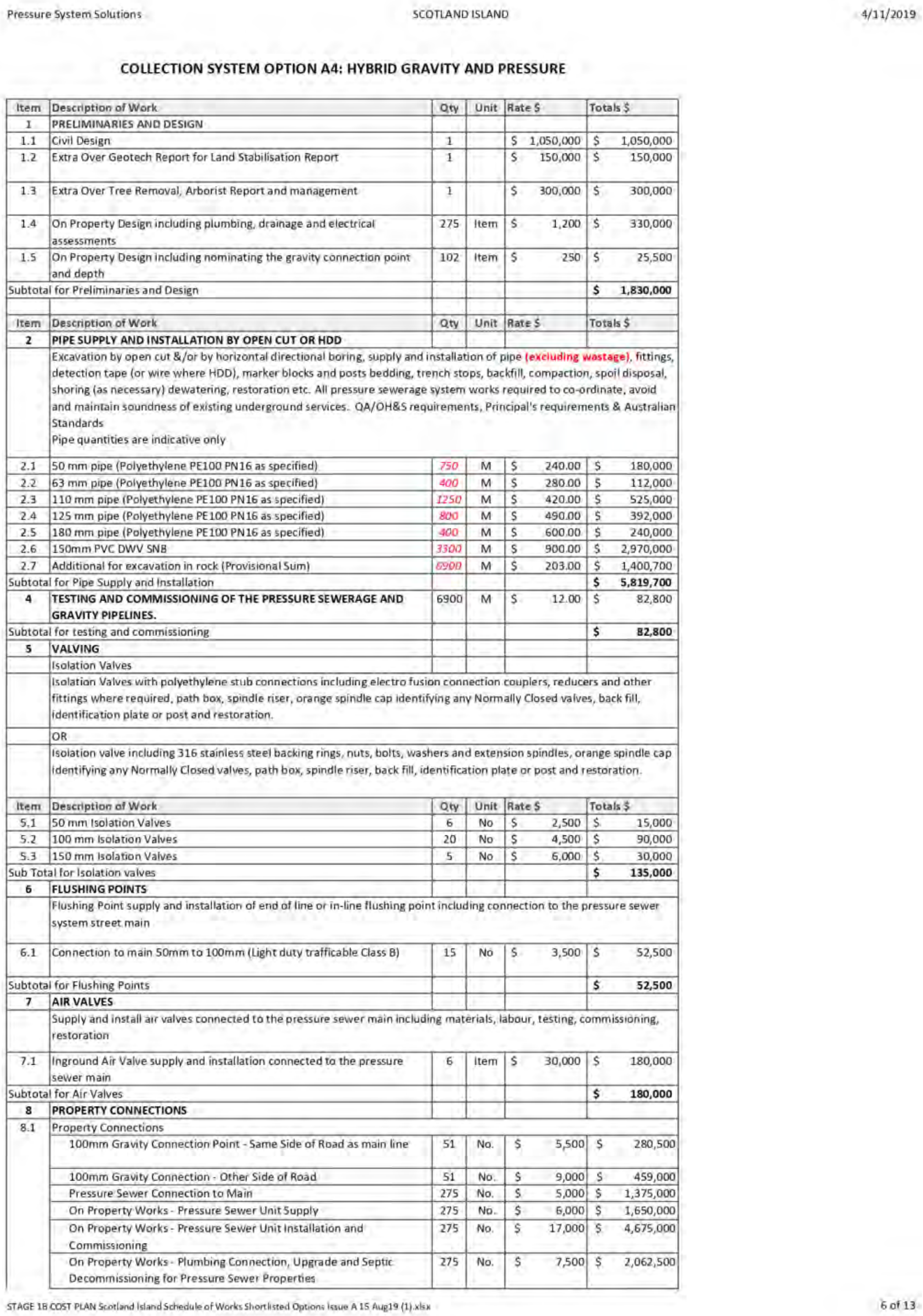
Item	Description of Work	Qty	Unit	Rate $	Totals $
1	**PRELIMINARY'S AND DESIGN**				
1.1	Civil Design	1		$ 540,000	$ 540,000
1.2	On Property Design including plumbing, drainage and electrical assessments	377	Item	$ 1,200	$ 452,400
Subtotal for Preliminaries and design.					**$ 992,400**
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	**PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD**				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe **(excluding wastage)**, fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pressure sewerage system works required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards Pipe quantities are indicative only				
2.1	50 mm pipe (Polyethylene PE100 PN16 as specified)	1386	M	$ 240.00	$ 332,640
2.2	63 mm pipe (Polyethylene PE100 PN16 as specified)	1068	M	$ 280.00	$ 299,040
2.3	75 mm pipe (Polyethylene PE100 PN16 as specified)	1578	M	$ 320.00	$ 504,960
2.4	90 mm pipe (Polyethylene PE100 PN16 as specified)	1128	M	$ 360.00	$ 406,080
2.5	110mm pipe (Polyethylene PE100 PN16 as specified)	774	M	$ 420.00	$ 325,080
2.6	140mm pipe (Polyethylene PE100 PN16 as specified)	168	M	$ 520.00	$ 87,360
2.6	50mm rider mains	1000	M	$ 240.00	$ 240,000
2.7	Additional for excavation in rock (Provisional Sum average metre rate divided in half)	7102	M	$ 170.00	$ 1,207,340
Subtotal for Pipe Supply and Installation					**$ 3,402,500**
4	**TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE PIPELINE.**	7102	M	$ 8.00	$ 56,816
Subtotal for Testing and Commisioning of the Pressure Sewer Pipeline					**$ 56,816**
5	**VALVING**				
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	50 mm Isolation Valves	20	No	$ 2,500	$ 50,000
5.2	80 mm Isolation Valves	30	No	$ 3,500	$ 105,000
5.3	100 mm Isolation Valves	10	No	$ 4,500	$ 45,000
Sub Total for Isolation valves					**$ 200,000**
6	**FLUSHING POINTS**				
	Flushing Point supply and installation of end of line or in-line flushing point including connection to the pressure sewer system street main				
6.1	Connection to main 50mm to 100mm (Light duty trafficable Class B)	25	No	$ 3,500	$ 87,500
Subtotal for Flushing Points					**$ 87,500**
7	**AIR VALVES**				
	Supply and install air valves connected to the pressure sewer main including materials, labour, testing, commissioning, restoration				
7.1	Inground Air Valve supply and installation connected to the pressure sewer main	10	Item	$ 30,000	$ 300,000
Subtotal for Air Valves					**$ 300,000**
8	**ON PROPERTY WORKS**				
8.1	Property Connections (including installation of Boundary Kit & Access Box and supply and installation of required 40mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection to Pressure Sewer Main	377	No.	$ 5,000	$ 1,885,000
	On Property Works - Pressure Sewer Unit Supply	377	No.	$ 5,000	$ 1,885,000
	On Property Works - Pressure Sewer Unit Installation and Commissioning	377	No.	$ 17,000	$ 6,409,000
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning	377	No.	$ 7,500	$ 2,827,500
	Boundary kits (Supply)	377	No.	$ 600	$ 226,200
Subtotal for Miscellaneous Items					**$ 13,232,700**

Pressure Sewerage Collection System Cost Estimate Summary

Item	Description of Work Item	Total (Excluding GST)
1	PRELIMINARY'S AND DESIGN	$ 992,400
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD	$ 3,402,500

COLLECTION SYSTEM OPTION A2: PRESSURE SEWER

4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE PIPELINE.				$	56,816
5	VALVING				$	200,000
6	FLUSHING POINTS				$	87,500
7	AIR VALVES				$	300,000
8	ON PROPERTY WORKS				$	13,232,700
				TOTAL	**$**	**18,271,916**
	PLUS LEAD CONTRACTOR OVERHEADS AND PROFIT 20%				**$**	**3,654,383**
TOTAL COST ESTIMATE						
A	COLLECTION SYSTEM COST ESTIMATE				$	21,926,299
C	CONTINGENCY			30%	$	6,577,890
				TOTAL	**$**	**28,504,189**



COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	PRELIMINARIES AND DESIGN				
1.1	Civil Design	1		$ 1,050,000	$ 1,050,000
1.2	Extra Over Geotech Report for Land Stabilisation Report	1		$ 150,000	$ 150,000
1.3	Extra Over Tree Removal, Arborist Report and management	1		$ 300,000	$ 300,000
1.4	On Property Design including plumbing, drainage and electrical assessments	275	Item	$ 1,200	$ 330,000
1.5	On Property Design including nominating the gravity connection point and depth	102	Item	$ 250	$ 25,500
Subtotal for Preliminaries and Design					**$ 1,830,000**
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	**PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD**				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe **(excluding wastage)**, fittings, detection tape (or wire where HDD), marker blocks and posts bedding, trench stops, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pressure sewerage system works required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards Pipe quantities are indicative only				
2.1	50 mm pipe (Polyethylene PE100 PN16 as specified)	*750*	M	$ 240.00	$ 180,000
2.2	63 mm pipe (Polyethylene PE100 PN16 as specified)	*400*	M	$ 280.00	$ 112,000
2.3	110 mm pipe (Polyethylene PE100 PN16 as specified)	*1250*	M	$ 420.00	$ 525,000
2.4	125 mm pipe (Polyethylene PE100 PN16 as specified)	*800*	M	$ 490.00	$ 392,000
2.5	180 mm pipe (Polyethylene PE100 PN16 as specified)	*400*	M	$ 600.00	$ 240,000
2.6	150mm PVC DWV SN8	*3300*	M	$ 900.00	$ 2,970,000
2.7	Additional for excavation in rock (Provisional Sum)	*6900*	M	$ 203.00	$ 1,400,700
Subtotal for Pipe Supply and Installation					**$ 5,819,700**
4	**TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE AND GRAVITY PIPELINES.**	6900	M	$ 12.00	$ 82,800
Subtotal for testing and commissioning					**$ 82,800**
5	**VALVING**				
	Isolation Valves				
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	50 mm Isolation Valves	6	No	$ 2,500	$ 15,000
5.2	100 mm Isolation Valves	20	No	$ 4,500	$ 90,000
5.3	150 mm Isolation Valves	5	No	$ 6,000	$ 30,000
Sub Total for Isolation valves					**$ 135,000**
6	**FLUSHING POINTS**				
	Flushing Point supply and installation of end of line or in-line flushing point including connection to the pressure sewer system street main				
6.1	Connection to main 50mm to 100mm (Light duty trafficable Class B)	15	No	$ 3,500	$ 52,500
Subtotal for Flushing Points					**$ 52,500**
7	**AIR VALVES**				
	Supply and install air valves connected to the pressure sewer main including materials, labour, testing, commissioning, restoration				
7.1	Inground Air Valve supply and installation connected to the pressure sewer main	6	Item	$ 30,000	$ 180,000
Subtotal for Air Valves					**$ 180,000**
8	**PROPERTY CONNECTIONS**				
8.1	Property Connections				
	100mm Gravity Connection Point - Same Side of Road as main line	51	No.	$ 5,500	$ 280,500
	100mm Gravity Connection - Other Side of Road	51	No.	$ 9,000	$ 459,000
	Pressure Sewer Connection to Main	275	No.	$ 5,000	$ 1,375,000
	On Property Works - Pressure Sewer Unit Supply	275	No.	$ 6,000	$ 1,650,000
	On Property Works - Pressure Sewer Unit Installation and Commissioning	275	No.	$ 17,000	$ 4,675,000
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning for Pressure Sewer Properties	275	No.	$ 7,500	$ 2,062,500

COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE

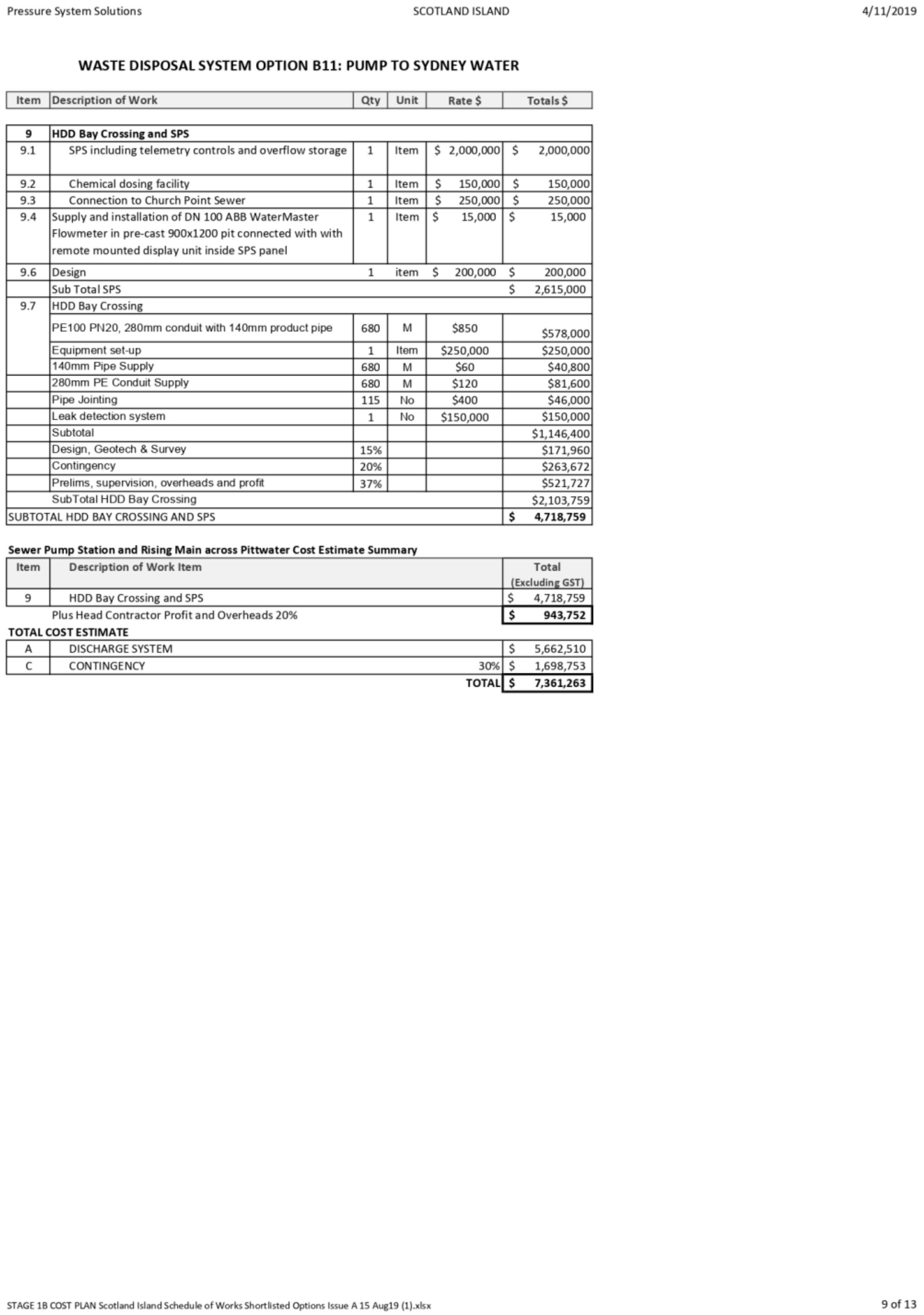
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning for Gravity Sewer Properties	102	No.	$ 12,500	$ 1,275,000
	Boundary kits (Supply)	275	No.	$ 600	$ 165,000
Subtotal for Miscellaneous Items					**$ 11,942,000**
9	**GRAVITY SEWER WORKS**				
9.1	Supply and install concrete Manholes/Access Chambers/Maintenance Shafts	65	No	$13,000	$845,000
8.2	Satellite SPS including telemetry controls and overflow storage. Includes hard stand areas for maintenance, servicing, retaining walls, fencing, safety rails, lighting and earthworks if required.	4	Item	$ 500,000	$ 2,000,000
Subtotal for Gravity Sewer					**$ 2,845,000**
Pressure Sewerage Collection System Cost Estimate Summary					
Item	**Description of Work Item**				**Total (Excluding GST)**
1	PRELIMINARIES AND DESIGN				$ 1,830,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 5,819,700
4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE AND GRAVITY PIPELINES.				$ 82,800
5	VALVING				$ 135,000
6	FLUSHING POINTS				$ 52,500
7	AIR VALVES				$ 180,000
8	PROPERTY CONNECTIONS				$ 11,942,000
9	GRAVITY SEWER WORKS				$ -
				TOTAL	**$ 20,042,000**
	PLUS LEAD CONTRACTOR PROFIT AND OVERHEAD			20%	**$ 4,008,400**
TOTAL COST ESTIMATE					
A	COLLECTION SYSTEM COST ESTIMATE				$ 24,050,400
C	CONTINGENCY			30%	$ 7,215,120
				TOTAL	**$ 31,265,520**

WASTE DISPOSAL SYSTEM OPTION B9: ON ISLAND TREATMENT DISPOSAL TO PITTWATER

Treatment Plant On Island

Permeate Partners			
		Capacity	150 kL/day
Insatlled capacity (kL/day)			
Area /			**$k**
Preliminaries			
Inlet works			**$ 705**
Odour treatment			**$ 262**
Bioreactor			**$ 2,730**
Membrane filtration			**$ 630**
UV Disinfection			**$ 165**
Treated water storage and distribution			**$ 202**
Sludge handling			**$ 315**
Chemical systems/storage			**$ 412**
Plant sump			**$ 156**
Buildings			**$ 1500**
Roadways, earthworks, siteworks, landscaping and fencing			**$ 1600**
Electrical, control, and instrumentation			**$ 1042**
Commissioning, validation and training			**$ 300**
Services			**$ 130**
	SUB-TOTAL CAPEX		**$ 10,149**

Treatment Plant On Island Cost			$ 10,149,000
Extra Over Environmental Impact Statement			$ 500,000
Specific Site Engineer for Treatment Plant Construction			$ 180,000
Land Acquisition			$ 1,500,000
Access Roads			$ 1,000,000
Waste Water Outfall To Pittwater			$ 6,000,000
Sub Total			$ 19,329,000
Plus Head Contractor Profit and Overheads 20%			$ 3,865,800
Sub Total for On Island Treatment Plant			$ 23,194,800
Plus 30% Contingency			$ 6,958,440
Total for Island Treatment Plant			**$ 30,153,240**



Pressure System Solutions SCOTLAND ISLAND 4/11/2019

WASTE DISPOSAL SYSTEM OPTION B11: PUMP TO SYDNEY WATER

Item	Description of Work	Qty	Unit	Rate $	Totals $
9	**HDD Bay Crossing and SPS**				
9.1	SPS including telemetry controls and overflow storage	1	Item	$ 2,000,000	$ 2,000,000
9.2	Chemical dosing facility	1	Item	$ 150,000	$ 150,000
9.3	Connection to Church Point Sewer	1	Item	$ 250,000	$ 250,000
9.4	Supply and installation of DN 100 ABB WaterMaster Flowmeter in pre-cast 900x1200 pit connected with with remote mounted display unit inside SPS panel	1	Item	$ 15,000	$ 15,000
9.6	Design	1	item	$ 200,000	$ 200,000
	Sub Total SPS				$ 2,615,000
9.7	HDD Bay Crossing				
	PE100 PN20, 280mm conduit with 140mm product pipe	680	M	$850	$578,000
	Equipment set-up	1	Item	$250,000	$250,000
	140mm Pipe Supply	680	M	$60	$40,800
	280mm PE Conduit Supply	680	M	$120	$81,600
	Pipe Jointing	115	No	$400	$46,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,146,400
	Design, Geotech & Survey	15%			$171,960
	Contingency	20%			$263,672
	Prelims, supervision, overheads and profit	37%			$521,727
	SubTotal HDD Bay Crossing				$2,103,759
SUBTOTAL HDD BAY CROSSING AND SPS					**$ 4,718,759**

Sewer Pump Station and Rising Main across Pittwater Cost Estimate Summary

Item	Description of Work Item		Total (Excluding GST)
9	HDD Bay Crossing and SPS		$ 4,718,759
	Plus Head Contractor Profit and Overheads 20%		**$ 943,752**
TOTAL COST ESTIMATE			
A	DISCHARGE SYSTEM		$ 5,662,510
C	CONTINGENCY	30%	$ 1,698,753
		TOTAL	**$ 7,361,263**

STAGE 1B COST PLAN Scotland Island Schedule of Works Shortlisted Options Issue A 15 Aug19 (1).xlsx 9 of 13

WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	**PRELIMINARY'S AND DESIGN**				
1.14	Civil Design	1	Item	$ 300,000	$ 300,000
1.16	Wate Booster Pumping Station Design	1	Item	$ 120,000	$ 120,000
1.3	On Property Design - water assessment to verify RWT connection and potable supply to kitchen.	377	Item	$ 450	$ 169,650
Subtotal for Preliminaries and Design					**$ 420,000**

Item	Description of Work	Qty	Unit	Rate $	Totals $
2	**PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD** Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe **(excluding wastage)**, fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pipework required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards				
2.1	110 mm pipe (Polyethylene PE100 PN16 as specified)	5000	M	$ 420.00	$ 2,100,000
2.6	140mm pipe (Polyethylene PE100 PN16 as specified)	400	M	$ 520.00	$ 208,000
2.7	Additional for excavation in rock	5400	M	$ 470.00	$ 2,538,000
Subtotal for Pipe Supply and Installation					**$ 4,846,000**
4	**TESTING AND COMMISSIONING**	5400	M	$ 15.00	$ 81,000
5	**VALVING** Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, OR Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	100 mm Isolation Valves	35	No	$ 4,500	$ 157,500
Sub Total for Isolation valves					**$ 157,500**
6	**Hydrant POINTS** Supply and Install Hydrants as per Sydney Water specification				
6.1	Hydrants	55	No	$ 3,500	$ 192,500
Subtotal for hydrant Points					**$ 192,500**
7	**AIR VALVES** Supply and install air valves connected to the water main including materials, labour, testing, commissioning, restoration				
7.1	In ground Air Valve supply and installation	6	Item	$ 7,500	$ 45,000
Subtotal for Air Valves					**$ 45,000**
8	**PROPERTY CONNECTIONS**				
8.1	Property Connections (including installation of Water Meter and supply and installation of required 25mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection of Property to Water Main	377	No.	$ 5,000	$ 1,885,000
	Water Meters including copper upstand and isolation valve (Supply and install)	377	No.	$ 450	$ 169,650
Subtotal for Property Connections					**$ 2,054,650**
9	**MISCELLANEOUS ITEMS**				
9.1	Supply and install WPS including telemetry controls	1	Item	$ 250,000	$ 250,000
9.3	Connection to Church Point Water Main	1	Item	$ 100,000	$ 100,000
9.4	Supply and installation of DN 100 flow meter at the WPS	1	Item	$ 25,000	$ 25,000
Subtotal for Miscellaneous Items					**$ 375,000**
10	**HDD Bay Crossing**				
10.1	HDD Bay Crossing				
	PE100 PN20, 280mm conduit with 140mm product pipe	680	M	$850	$578,000
	Equipment set-up	1	Item	$250,000	$250,000
	140mm PE Pipe Supply	680	M	$60	$40,800
	280mm PE Conduit Supply	680	M	$120	$81,600
	Pipe Jointing	115	No	$400	$46,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,146,400
	Design, Geotech & Survey	15%			$171,960

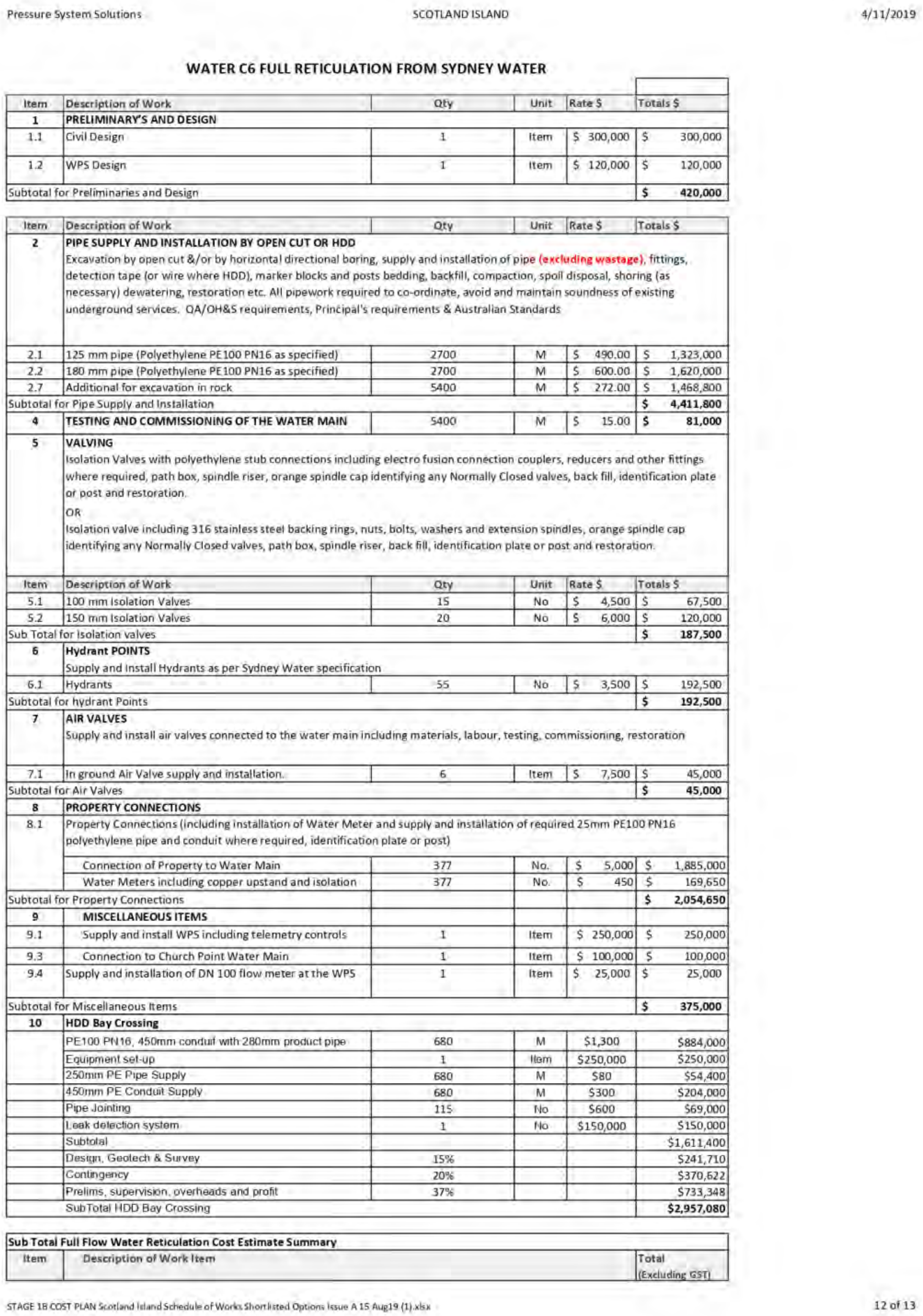
WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER

	Contingency	20%			$263,672
	Prelims, supervision, overheads and profit	37%			$521,727
	SubTotal HDD Bay Crossing				**$2,103,759**

Sub Total Low Flow Water Reticulation Cost Estimate Summary

Item	Description of Work Item				Total (Excluding GST)
1	PRELIMINARY'S AND DESIGN				$ 420,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 4,846,000
4	TESTING AND COMMISSIONING				$ 81,000
5	VALVING				$ 157,500
6	HYDRANT POINTS				$ 192,500
7	AIR VALVES				$ 45,000
8	PROPERTY CONNECTIONS				$ 2,054,650
9	MISCELLANEOUS				$ 375,000
10	HDD Bay Crossing				$ 2,103,759
Sub Total Low Flow Water Reticulation Cost Estimate Summary					**$ 10,275,409**
	Plus Head Contractor Profit and Overheads 20%				$ 2,055,082
					$ 12,330,490
	Plus Contingency 30%				$ 3,699,147
	Total Low Flow Water Reticulation Cost Estimate Summary				**$ 16,029,637**

ON PROPERTY WORKS FOR WATER CONNECTION TO A LOW FLOW SYSTEM					
	Connect a 25mm PE water supply pipe from the water meter to the properties existing RWT with float valve and flow restrictor.	377	No.	$ 3,500	$ 1,319,500
	Connect a 25mm PE water supply pipeline from the water meter connection to the kitchen area of the house providing a potable water supply for drinking/cooking etc	377	No.	$ 2,500	$ 942,500
TOTAL CONNECTION COST FOR COMMUNITY TO CONNECT TO THE LOW FLOW WATER SYSTEM					**$ 2,262,000**
Cost per lot		377			$ 6,000



Pressure System Solutions SCOTLAND ISLAND 4/11/2019

WATER C6 FULL RETICULATION FROM SYDNEY WATER

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	**PRELIMINARY'S AND DESIGN**				
1.1	Civil Design	1	Item	$ 300,000	$ 300,000
1.2	WPS Design	1	Item	$ 120,000	$ 120,000
Subtotal for Preliminaries and Design					**$ 420,000**

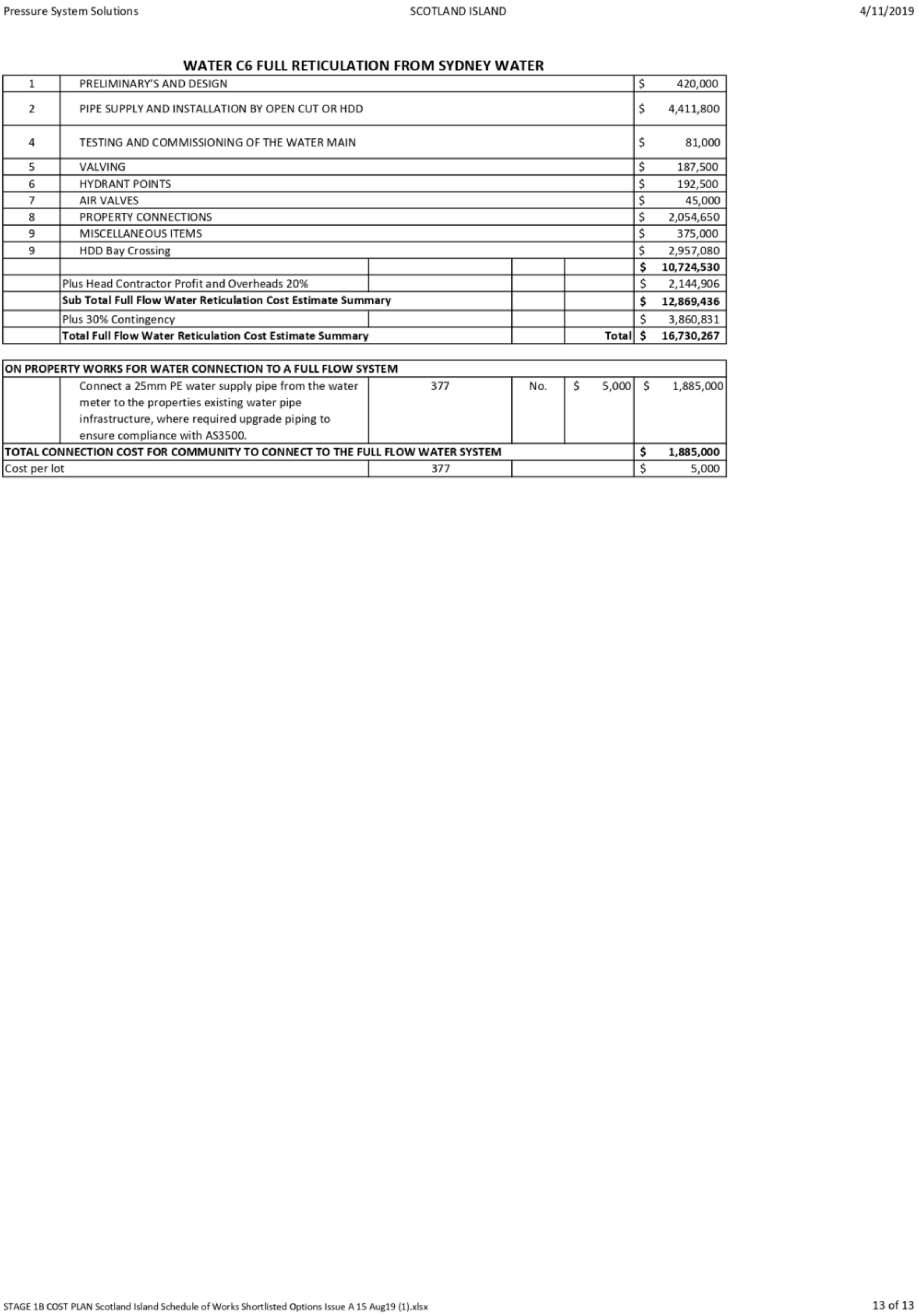
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	**PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD** Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe **(excluding wastage)**, fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pipework required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards				
2.1	125 mm pipe (Polyethylene PE100 PN16 as specified)	2700	M	$ 490.00	$ 1,323,000
2.2	180 mm pipe (Polyethylene PE100 PN16 as specified)	2700	M	$ 600.00	$ 1,620,000
2.7	Additional for excavation in rock	5400	M	$ 272.00	$ 1,468,800
Subtotal for Pipe Supply and Installation					**$ 4,411,800**
4	**TESTING AND COMMISSIONING OF THE WATER MAIN**	5400	M	$ 15.00	**$ 81,000**
5	**VALVING** Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration. OR Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				

Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	100 mm Isolation Valves	15	No	$ 4,500	$ 67,500
5.2	150 mm Isolation Valves	20	No	$ 6,000	$ 120,000
Sub Total for Isolation valves					**$ 187,500**
6	**Hydrant POINTS** Supply and Install Hydrants as per Sydney Water specification				
6.1	Hydrants	55	No	$ 3,500	$ 192,500
Subtotal for hydrant Points					**$ 192,500**
7	**AIR VALVES** Supply and install air valves connected to the water main including materials, labour, testing, commissioning, restoration				
7.1	In ground Air Valve supply and installation.	6	Item	$ 7,500	$ 45,000
Subtotal for Air Valves					**$ 45,000**
8	**PROPERTY CONNECTIONS**				
8.1	Property Connections (including installation of Water Meter and supply and installation of required 25mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection of Property to Water Main	377	No.	$ 5,000	$ 1,885,000
	Water Meters including copper upstand and isolation	377	No.	$ 450	$ 169,650
Subtotal for Property Connections					**$ 2,054,650**
9	**MISCELLANEOUS ITEMS**				
9.1	Supply and install WPS including telemetry controls	1	Item	$ 250,000	$ 250,000
9.3	Connection to Church Point Water Main	1	Item	$ 100,000	$ 100,000
9.4	Supply and installation of DN 100 flow meter at the WPS	1	Item	$ 25,000	$ 25,000
Subtotal for Miscellaneous Items					**$ 375,000**
10	**HDD Bay Crossing**				
	PE100 PN16, 450mm conduit with 280mm product pipe	680	M	$1,300	$884,000
	Equipment set-up	1	Item	$250,000	$250,000
	250mm PE Pipe Supply	680	M	$80	$54,400
	450mm PE Conduit Supply	680	M	$300	$204,000
	Pipe Jointing	115	No	$600	$69,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,611,400
	Design, Geotech & Survey	15%			$241,710
	Contingency	20%			$370,622
	Prelims, supervision, overheads and profit	37%			$733,348
	SubTotal HDD Bay Crossing				**$2,957,080**

Sub Total Full Flow Water Reticulation Cost Estimate Summary

Item	Description of Work Item	Total (Excluding GST)

STAGE 1B COST PLAN Scotland Island Schedule of Works Shortlisted Options Issue A 15 Aug19 (1).xlsx 12 of 13



WATER C6 FULL RETICULATION FROM SYDNEY WATER

1	PRELIMINARY'S AND DESIGN				$ 420,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 4,411,800
4	TESTING AND COMMISSIONING OF THE WATER MAIN				$ 81,000
5	VALVING				$ 187,500
6	HYDRANT POINTS				$ 192,500
7	AIR VALVES				$ 45,000
8	PROPERTY CONNECTIONS				$ 2,054,650
9	MISCELLANEOUS ITEMS				$ 375,000
9	HDD Bay Crossing				$ 2,957,080
					$ 10,724,530
	Plus Head Contractor Profit and Overheads 20%				$ 2,144,906
	Sub Total Full Flow Water Reticulation Cost Estimate Summary				**$ 12,869,436**
	Plus 30% Contingency				$ 3,860,831
	Total Full Flow Water Reticulation Cost Estimate Summary			Total	**$ 16,730,267**

ON PROPERTY WORKS FOR WATER CONNECTION TO A FULL FLOW SYSTEM					
	Connect a 25mm PE water supply pipe from the water meter to the properties existing water pipe infrastructure, where required upgrade piping to ensure compliance with AS3500.	377	No.	$ 5,000	$ 1,885,000
TOTAL CONNECTION COST FOR COMMUNITY TO CONNECT TO THE FULL FLOW WATER SYSTEM					**$ 1,885,000**
Cost per lot		377			$ 5,000

ATTACHMENT E: CONCEPT DRAWINGS

Sewerage Collection System

Pressure Sewer
Dwg SK01 Pressure Sewer Collection System

Hybrid
Dwg SK02 Hybrid Gravity and Pressure Collection System

Pressure and Hybrid
Dwg SK07 Functional Sketches of Collection System arrangement

Waste Water Disposal System

On Island Treatment System
Dwg SK06: Concept Plan
J1901105-GA-001-Rev.A (25Jun19): Plant General Arrangement
J1901105-L-001-Rev.A (25Jun19): location Plan

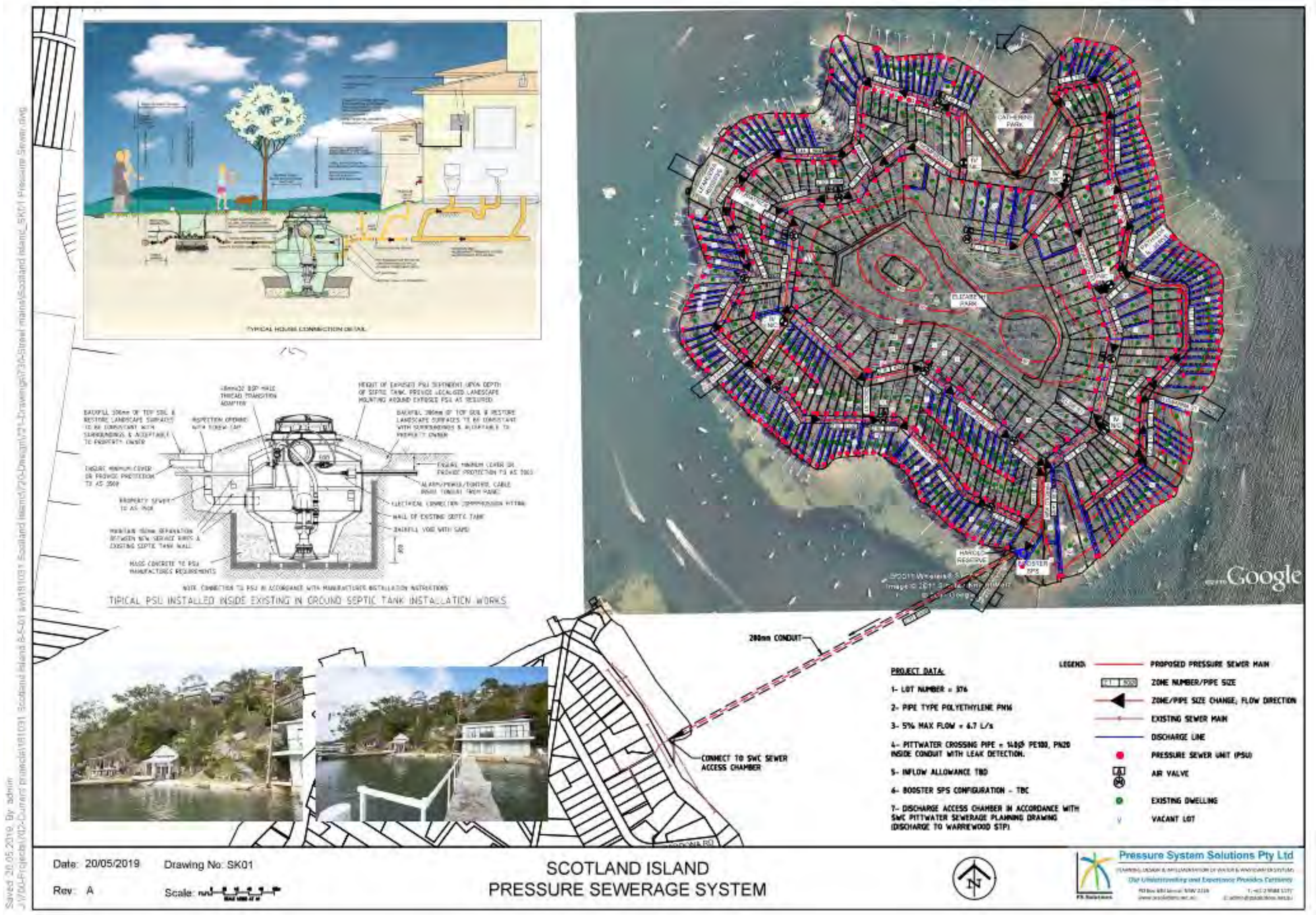
Discharge to Sydney Water
Dwg SK01 Pressure Sewer Collection System

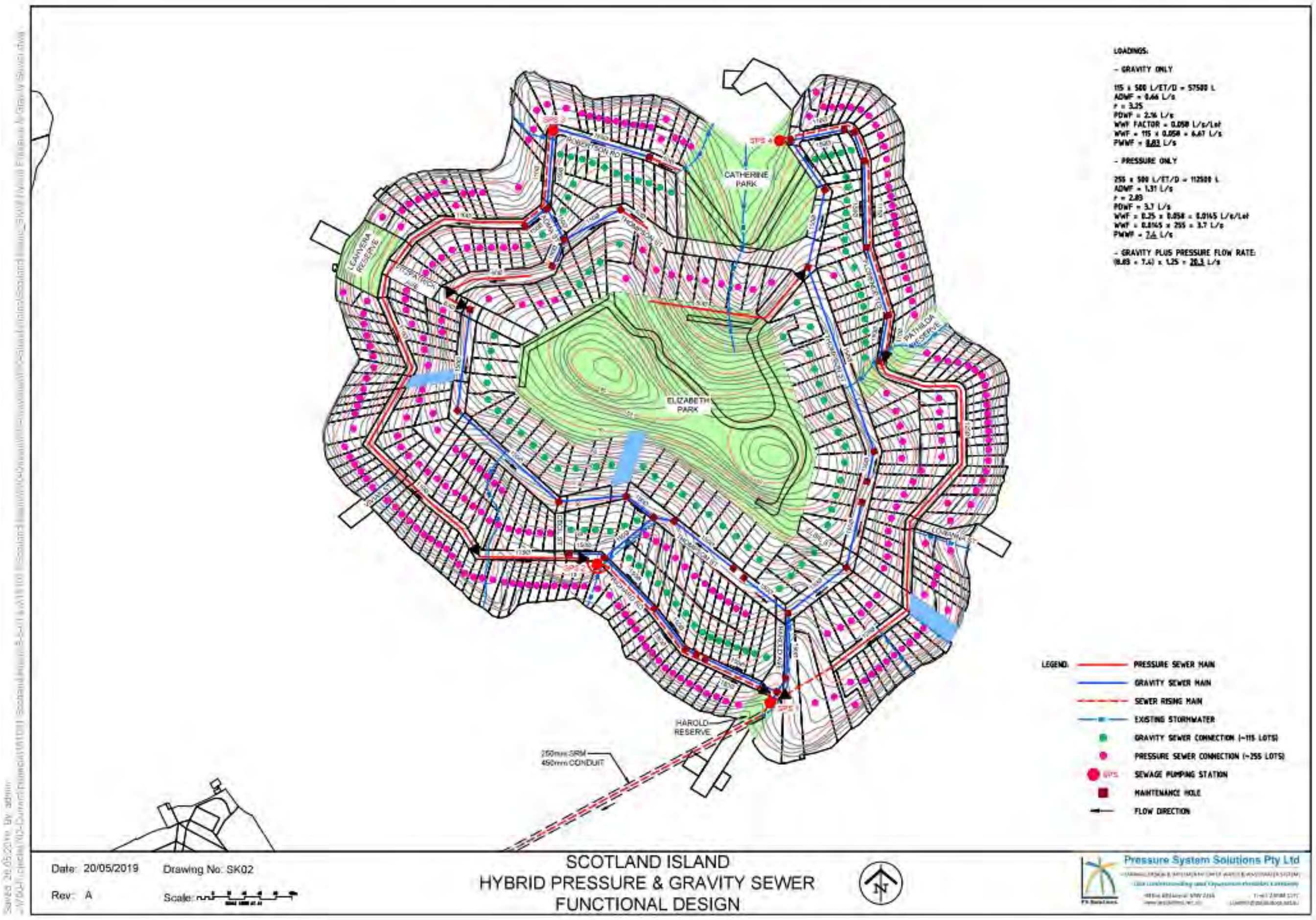
Water Supply System

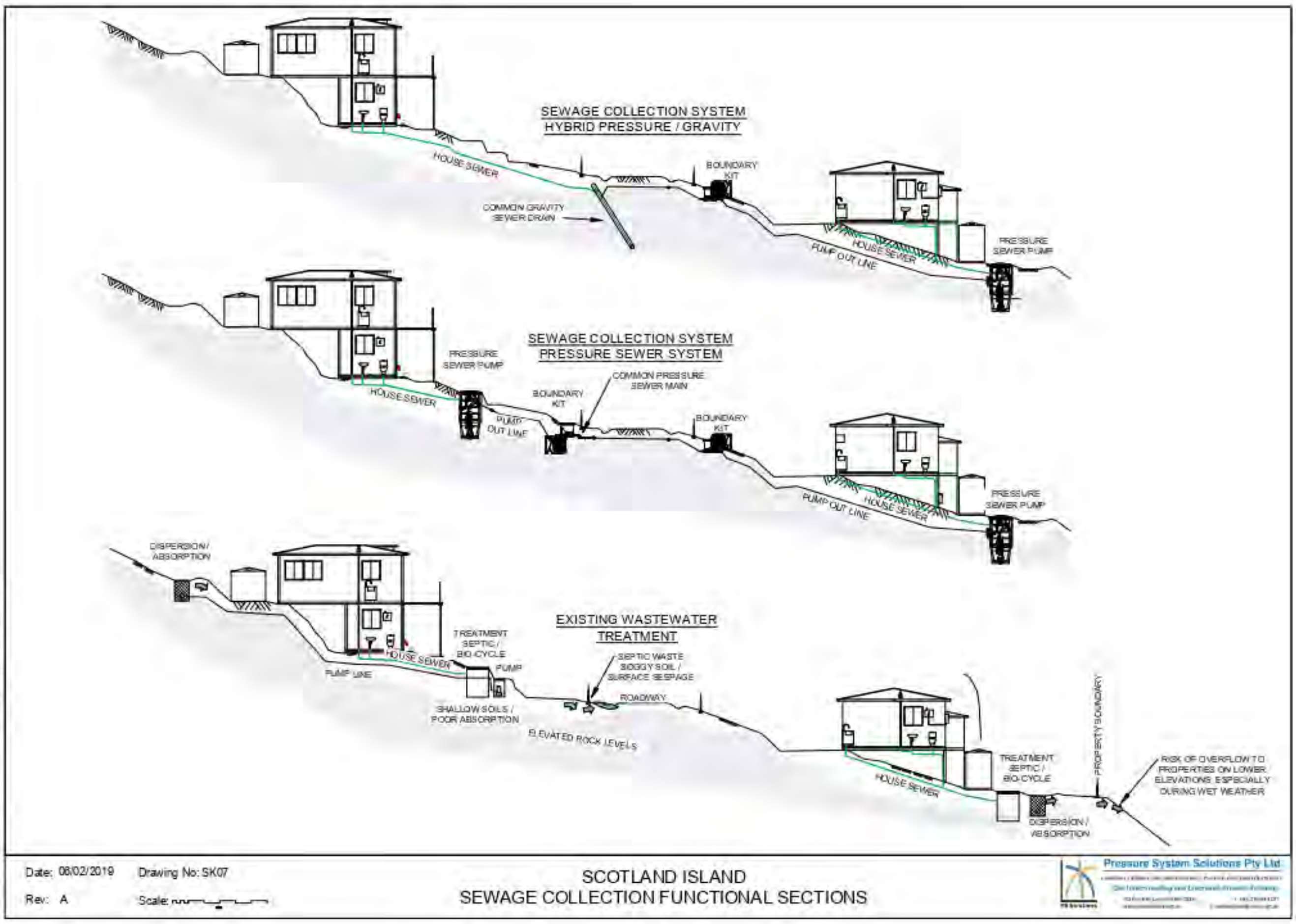
Low Flow
Dwg SK04 Low flow Water Supply from Sydney Water with single drinking water point and rainwater tank top up.

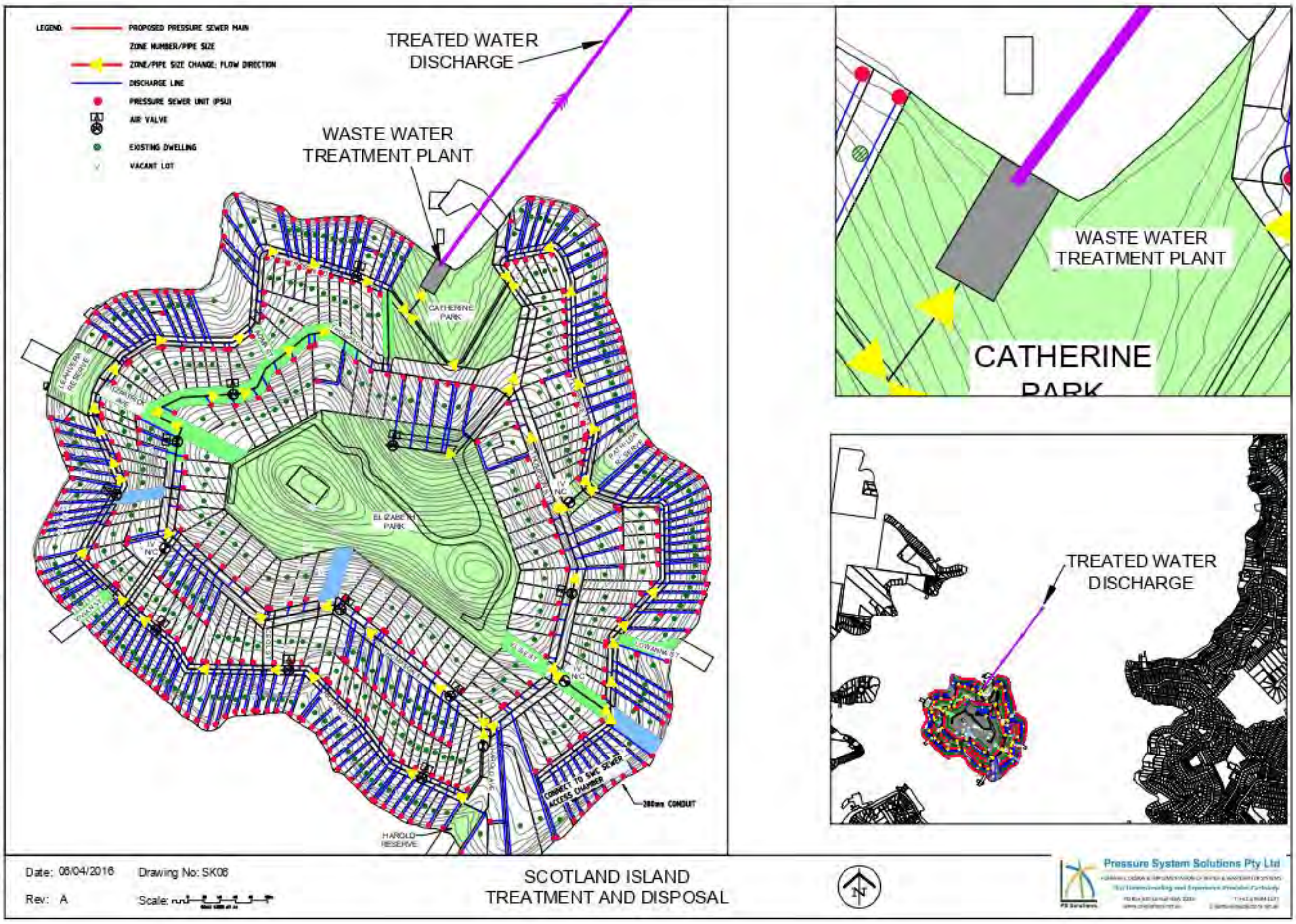
Full Reticulation
Dwg SK03 Full mains pressure supply .

Functional Section
Dwg SK07A Functional Sketches of Water System arrangements

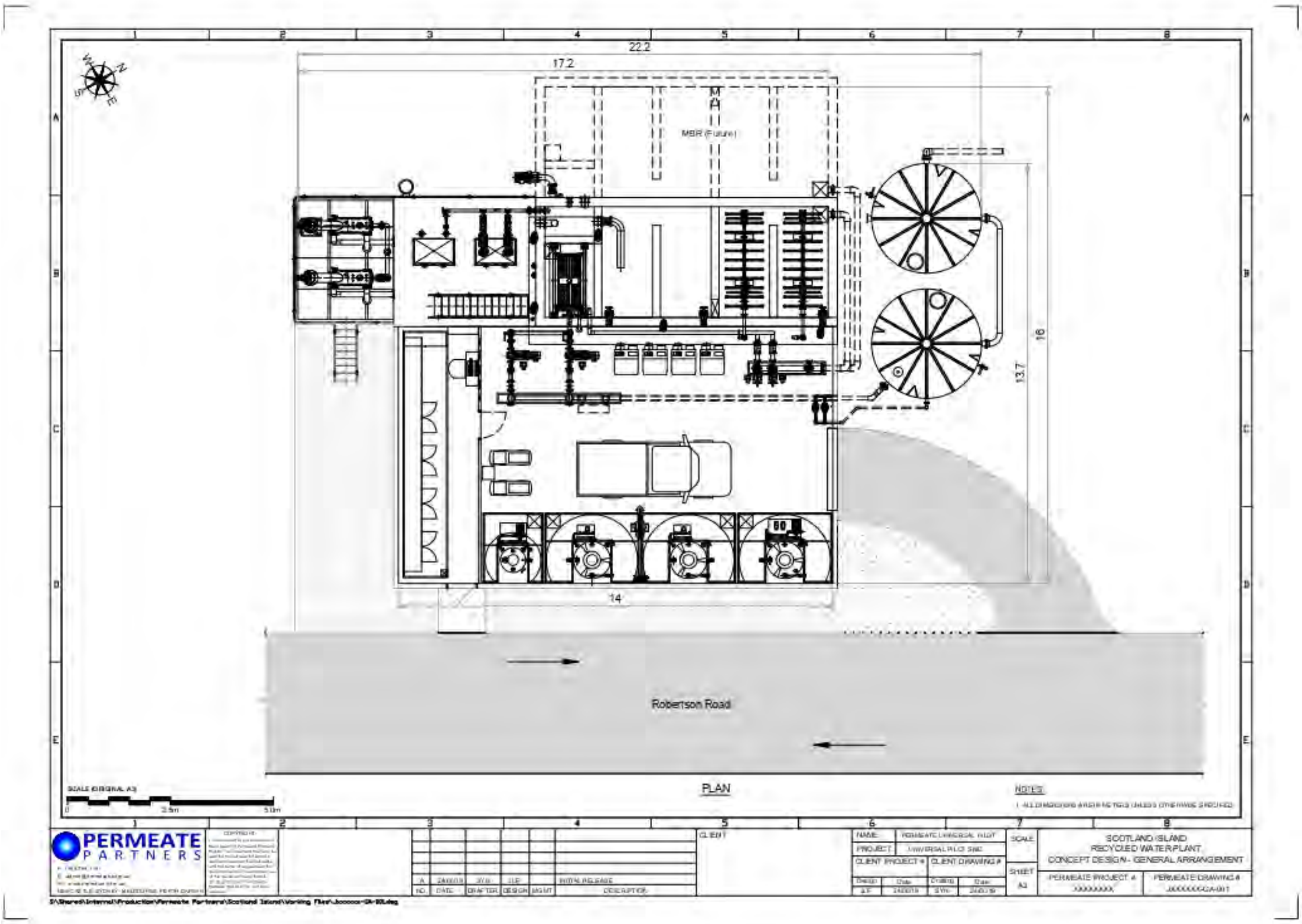

TYPICAL HOUSE CONNECTION DETAIL
TYPICAL PSU INSTALLED INSIDE EXISTING IN GROUND SEPTIC TANK INSTALLATION WORKS
CATHERINE PARK
ELIZABETH PARK
HAROLD RESERVE
BOOSTER SPS
Google
200mm CONDUIT
CONNECT TO SWC SEWER ACCESS CHAMBER
PROJECT DATA:
1- LOT NUMBER = 376
2- PIPE TYPE POLYETHYLENE PN16
3- 5% MAX FLOW = 6.7 L/s
4- PITTWATER CROSSING PIPE = 140Ø PE100, PN20 INSIDE CONDUIT WITH LEAK DETECTION.
5- INFLOW ALLOWANCE TBD
6- BOOSTER SPS CONFIGURATION - TBC
7- DISCHARGE ACCESS CHAMBER IN ACCORDANCE WITH SWC PITTWATER SEWERAGE PLANNING DRAWING (DISCHARGE TO WARRIEWOOD STP)
LEGEND:
PROPOSED PRESSURE SEWER MAIN
ZONE NUMBER/PIPE SIZE
ZONE/PIPE SIZE CHANGE; FLOW DIRECTION
EXISTING SEWER MAIN
DISCHARGE LINE
PRESSURE SEWER UNIT (PSU)
AIR VALVE
EXISTING DWELLING
VACANT LOT
Date: 20/05/2019
Drawing No: SK01
Rev: A
Scale:
SCOTLAND ISLAND
PRESSURE SEWERAGE SYSTEM
N
Pressure System Solutions Pty Ltd
PS Solutions

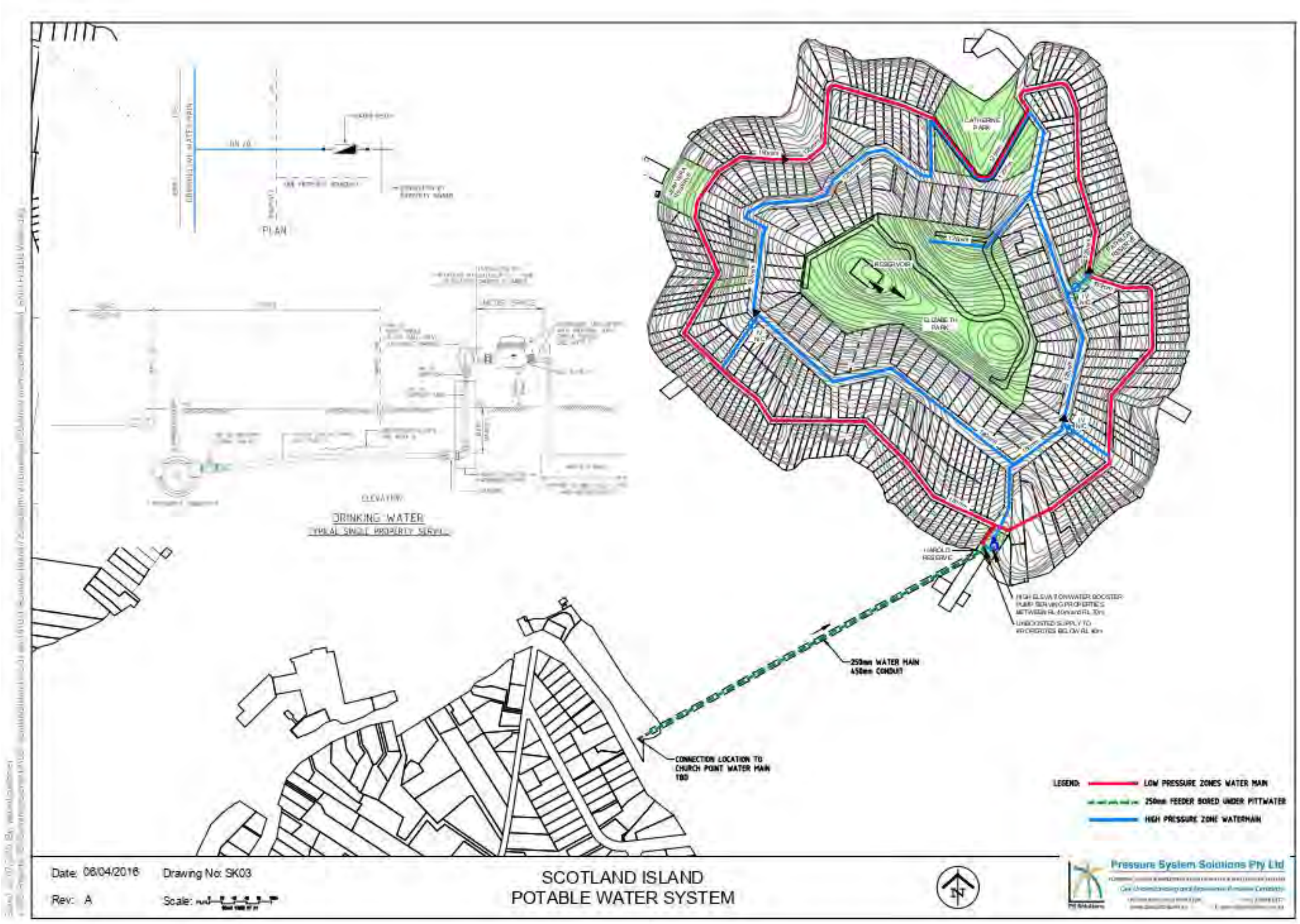

LOADINGS:
- GRAVITY ONLY
115 x 500 L/ET/D = 57500 L
ADWF = 0.66 L/s
r = 3.25
PDWF = 2.16 L/s
WWF FACTOR = 0.058 L/s/Lot
WWF = 115 x 0.058 = 6.67 L/s
PWWF = 8.83 L/s
- PRESSURE ONLY
255 x 500 L/ET/D = 112500 L
ADWF = 1.31 L/s
r = 2.83
PDWF = 3.7 L/s
WWF = 0.25 x 0.058 = 0.0145 L/s/Lot
WWF = 0.0145 x 255 = 3.7 L/s
PWWF = 7.4 L/s
- GRAVITY PLUS PRESSURE FLOW RATE:
(8.83 + 7.4) x 1.25 = 20.3 L/s
CATHERINE PARK
ELIZABETH PARK
HAROLD RESERVE
SPS
250mm SRM
450mm CONDUIT
LEGEND:
PRESSURE SEWER MAIN
GRAVITY SEWER MAIN
SEWER RISING MAIN
EXISTING STORMWATER
GRAVITY SEWER CONNECTION (~115 LOTS)
PRESSURE SEWER CONNECTION (~255 LOTS)
SPS SEWAGE PUMPING STATION
MAINTENANCE HOLE
FLOW DIRECTION
Date: 20/05/2019
Drawing No: SK02
Rev: A
Scale:
SCOTLAND ISLAND
HYBRID PRESSURE & GRAVITY SEWER
FUNCTIONAL DESIGN
N
Pressure System Solutions Pty Ltd

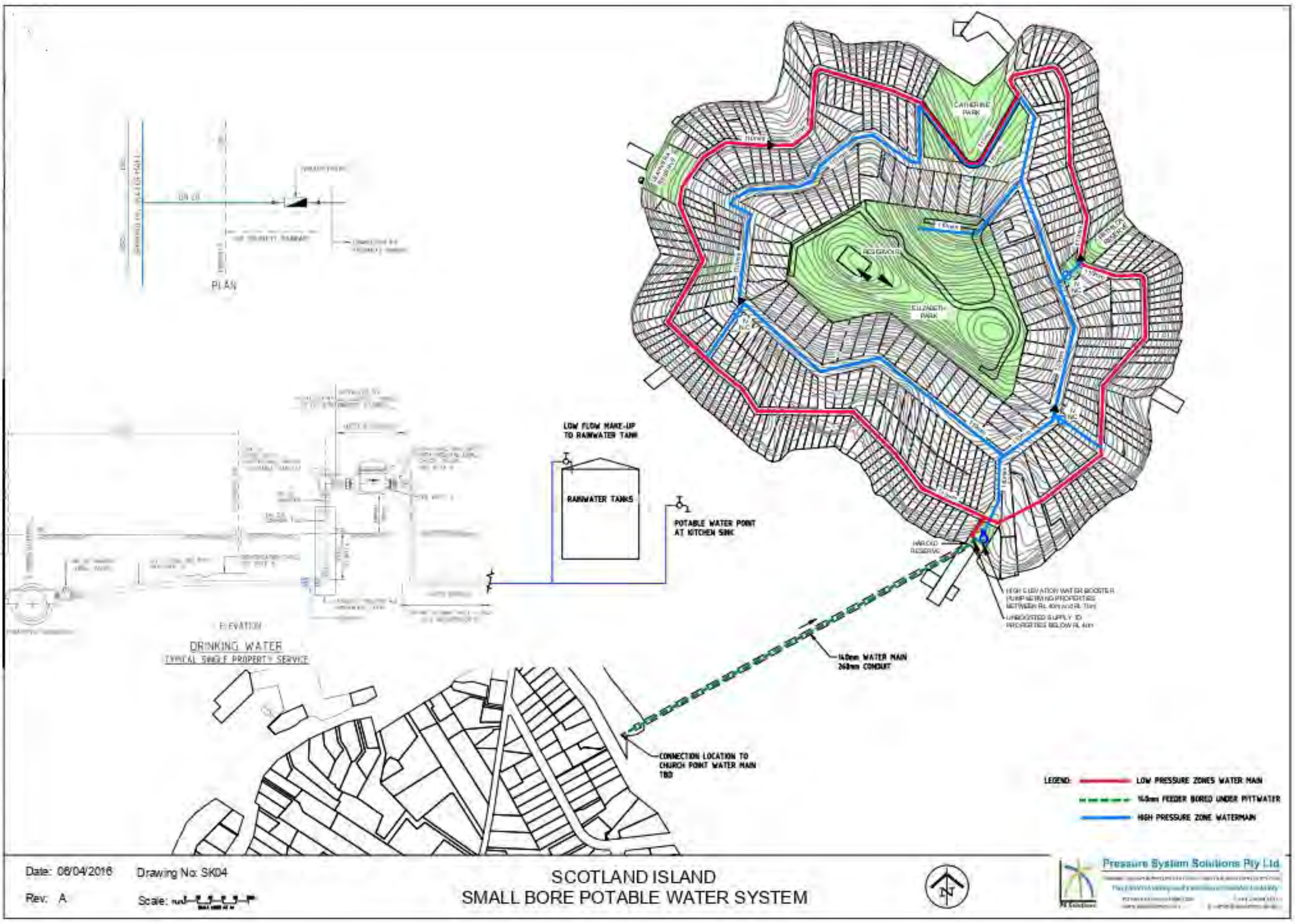

SEWAGE COLLECTION SYSTEM
HYBRID PRESSURE / GRAVITY
HOUSE SEWER
COMMON GRAVITY SEWER DRAIN
BOUNDARY KIT
HOUSE SEWER
PUMP OUT LINE
PRESSURE SEWER PUMP
SEWAGE COLLECTION SYSTEM
PRESSURE SEWER SYSTEM
PRESSURE SEWER PUMP
HOUSE SEWER
PUMP OUT LINE
BOUNDARY KIT
COMMON PRESSURE SEWER MAIN
BOUNDARY KIT
PUMP OUT LINE
HOUSE SEWER
PRESSURE SEWER PUMP
DISPERSION / ABSORPTION
EXISTING WASTEWATER TREATMENT
TREATMENT SEPTIC / BIO-CYCLE
HOUSE SEWER
PUMP LINE
PUMP
SHALLOW SOILS / POOR ABSORPTION
SEPTIC WASTE SOGGY SOIL / SURFACE SEEPAGE
ROADWAY
ELEVATED ROCK LEVELS
HOUSE SEWER
TREATMENT SEPTIC / BIO-CYCLE
PROPERTY BOUNDARY
DISPERSION / ABSORPTION
RISK OF OVERFLOW TO PROPERTIES ON LOWER ELEVATIONS ESPECIALLY DURING WET WEATHER
Date: 08/02/2019
Drawing No: SK07
Rev: A
Scale:
SCOTLAND ISLAND
SEWAGE COLLECTION FUNCTIONAL SECTIONS
Pressure System Solutions Pty Ltd


LEGEND:
PROPOSED PRESSURE SEWER MAIN
ZONE NUMBER/PIPE SIZE
ZONE/PIPE SIZE CHANGE; FLOW DIRECTION
DISCHARGE LINE
PRESSURE SEWER UNIT (PSU)
AIR VALVE
EXISTING DWELLING
VACANT LOT
TREATED WATER DISCHARGE
WASTE WATER TREATMENT PLANT
CATHERINE PARK
ELIZABETH PARK
HAROLD RESERVE
CONNECT TO SWC SEWER ACCESS CHAMBER
200mm CONDUIT
WASTE WATER TREATMENT PLANT
CATHERINE PARK
TREATED WATER DISCHARGE
Date: 08/04/2016
Drawing No: SK08
Rev: A
Scale:
SCOTLAND ISLAND
TREATMENT AND DISPOSAL
N
Pressure System Solutions Pty Ltd


N
W
E
S
73
4
1
3
18
Scotland Island Lodge
Kerin Ave
Robertson Road
Catherine Park
22.3
16
LOCATION - PLAN
SCALE (ORIGINAL A3)
0
15m
30m
PERMEATE PARTNERS
COPYRIGHT
NEWCASTLE, SYDNEY, MELBOURNE, PERTH, DARWIN
A
24/06/19
SYN
JLF
INITIAL RELEASE
NO.
DATE
DRAFTER
DESIGN
MGMT
DESCRIPTION
CLIENT
NAME : PERMEATE UNIVERSAL PILOT
PROJECT: UNIVERSAL PILOT SKID
CLIENT PROJECT #
CLIENT DRAWING #
Design JLF
Date 24/06/19
Drafting SYN
Date 26/06/19
SCALE
SHEET A3
SCOTLAND ISLAND
RECYCLED WATER PLANT
CONCEPT DESIGN - LOCATION MAP
PERMEATE PROJECT # XXXXXXXX
PERMEATE DRAWING # JXXXXXX-L-001
S:\Shared\Internal\Production\Permeate Partners\Scotland Island\Working Files\Jxxxxxx-L-001.dwg


22.2
17.2
MBR (Future)
16
13.7
14
Robertson Road
PLAN
SCALE ORIGINAL A3
0
2.5m
5.0m
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED
PERMEATE PARTNERS
CLIENT
NAME
PERMEATE UNIVERSAL PILOT
PROJECT
UNIVERSAL PILOT SMC
CLIENT PROJECT #
CLIENT DRAWING #
SCALE
SHEET
A3
SCOTLAND ISLAND
RECYCLED WATER PLANT
CONCEPT DESIGN - GENERAL ARRANGEMENT
PERMEATE PROJECT #
XXXXXXXX
PERMEATE DRAWING #
XXXXXXXGA-001
INITIAL RELEASE
DESCRIPTION


PLAN
ELEVATION
DRINKING WATER
TYPICAL SINGLE PROPERTY SERVICE
CATHERINE PARK
RESERVOIR
ELIZABETH PARK
HAROLD RESERVE
HIGH ELEVATION WATER BOOSTER PUMP SERVING PROPERTIES BETWEEN RL 40m and RL 70m
UNBOOSTED SUPPLY TO PROPERTIES BELOW RL 40m
250mm WATER MAIN 450mm CONDUIT
CONNECTION LOCATION TO CHURCH POINT WATER MAIN TBD
LEGEND:
LOW PRESSURE ZONES WATER MAIN
250mm FEEDER BORED UNDER PITTWATER
HIGH PRESSURE ZONE WATERMAIN
Date: 08/04/2016
Drawing No: SK03
Rev: A
Scale:
SCOTLAND ISLAND
POTABLE WATER SYSTEM
N
Pressure System Solutions Pty Ltd
PS Solutions


PLAN
ELEVATION
DRINKING WATER
TYPICAL SINGLE PROPERTY SERVICE
LOW FLOW MAKE-UP TO RAINWATER TANK
RAINWATER TANKS
POTABLE WATER POINT AT KITCHEN SINK
CATHERINE PARK
RESERVOIR
ELIZABETH PARK
HARWOOD RESERVE
HIGH ELEVATION WATER BOOSTER PUMP SERVING PROPERTIES BETWEEN RL 40m and RL 71m
UNBOOSTED SUPPLY TO PROPERTIES BELOW RL 4m
140mm WATER MAIN 260mm CONDUIT
CONNECTION LOCATION TO CHURCH POINT WATER MAIN TBD
LEGEND:
LOW PRESSURE ZONES WATER MAIN
140mm FEEDER BORED UNDER PITTWATER
HIGH PRESSURE ZONE WATERMAIN
Date: 06/04/2016
Drawing No: SK04
Rev: A
Scale:
SCOTLAND ISLAND
SMALL BORE POTABLE WATER SYSTEM
N
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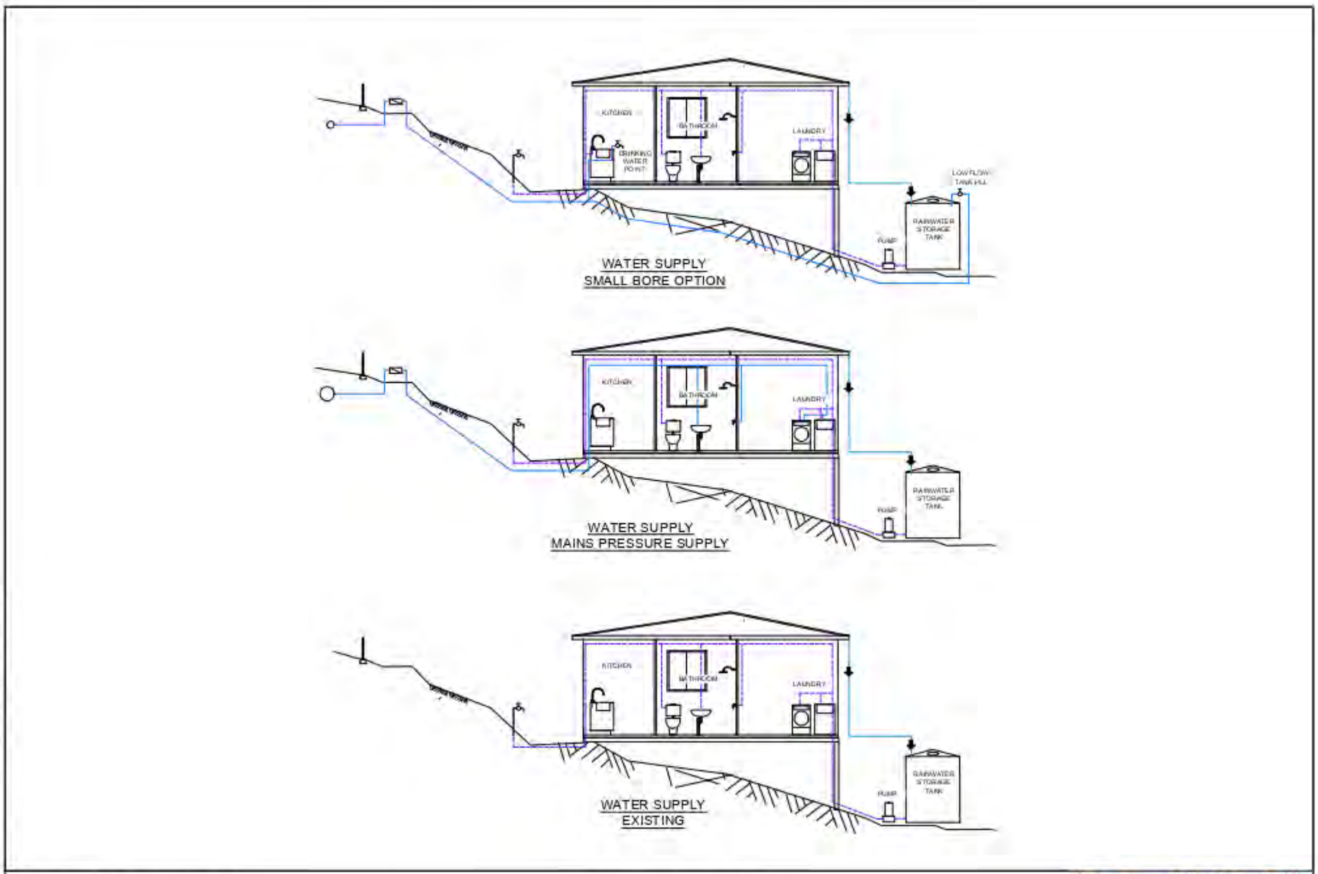

Date: 08/02/2019 Drawing No: SK07A
Rev: A Scale:

SCOTLAND ISLAND
WATER SUPPLY OPTIONS

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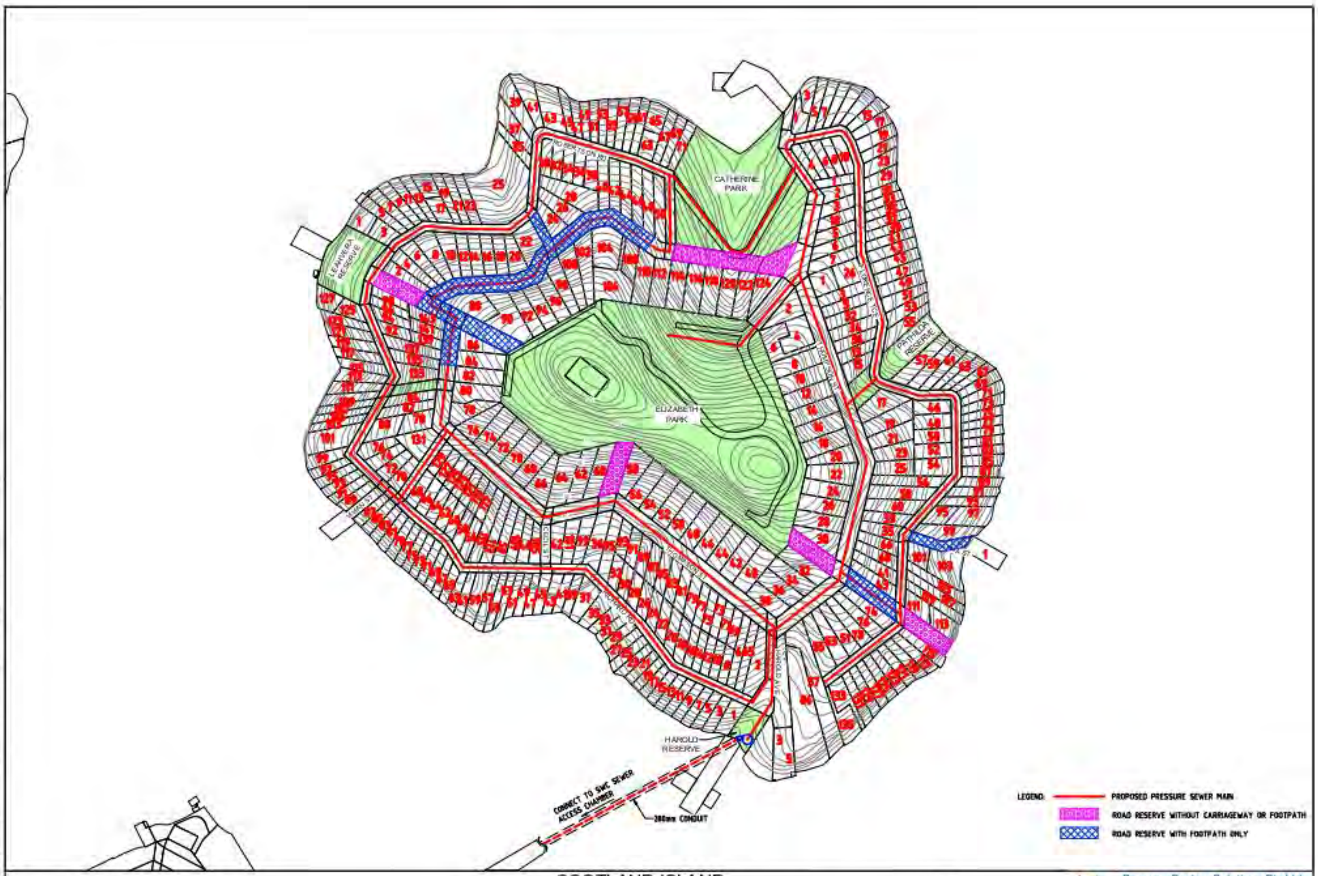

Date: 12/02/2019
Rev: A

Drawing No: SK08
Scale:

SCOTLAND ISLAND
PRESSURE SEWERAGE SYSTEM, ROAD
RESERVES AND HOUSE NUMBERS

Pressure System Solutions Pty Ltd

Scotland Island Feasibility Study

Stage 1b Option Evaluation Workshop Notes

Prepared For:

northern beaches council

Issue F

PS Solutions

PRESSURE SYSTEM SOLUTIONS PTY LTD

Document Information

Project Name	Scotland Island Feasibility Study
File Reference	Stage 1b Options Evaluation Workshop
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D	19.09.19	For Review	EP		
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F	26/08/20	Final Issue	EP	CR	SW

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CONTENTS

1 INTRODUCTION

Disclaimer:
These workshop notes document the informal discussions undertaken during the review of the options for Water and Sewer servicing of Scotland Island. The notes record the opinions and views of the expert evaluation team for the purposes of informing the options shortlisting process. Any legal references are opinion only and are not based on legal advice.

1.1 Workshop Context

This Workshop is a component of the Stage 1b Demand and Options Stage of the **Scotland Island Water and Sewerage Feasibility Study**.

Prior works within this Feasibility Study, have included:

- Stage 1a, High Level Review of Social and Environmental Factors;
- Consultation with Northern Beaches Council (NBC) and peer review with Simon Fane;
- Consultation with Scotland Island Community Working Group (SICWG);
- Water Balance Assessment;
- Options development; and
- External peer review by Simon Fane, Project Expert Advisor to Northern Beaches Council

Identification of Key Considerations and Risks associated with this evaluation process, include:

- Inequity compared to other parts of the Sydney region;
    - Poor access to potable water, esp. during drought and bushfires
    - Impact of poorly performing on-site systems.
- Environmental Impacts;
    - Soil testing during study confirmed high faecal coliforms, effecting environment and health
- Confusion about who is responsible;
- Process and consultation fatigue;
    - Classified as 'a priority' since 1997,
- Site audits and resident's questionnaire (cross-section of 19 properties);
    - Lot size, topography, soil absorption capability
    - Australian Standards compliance achievability
    - Constructability
    - Community expectations and concerns
- Northern Beaches Council are currently planning upgrades to stormwater and overland flow paths, so there is likely to be changes on the Island.
- Fire-fighting capabilities was a key driver for getting a reservoir and water onto the Island.

1.1.1 Workshop Purpose

The purpose of this Assessment Workshop was to undertake a technical evaluation of the Water and Sewerage servicing options identified from the **Stage 1b Options Workshop** for the **Scotland Island Water and Sewerage Feasibility Study,** held 22 January 2019, at the RPS Sydney Office.

The identification, and subsequent assessment, of options for water and sewerage services to Scotland Island was undertaken by a panel of qualified and experienced industry specific professionals, that included Water Infrastructure Strategic Planners, water services engineers, environmental consultants and construction and installation contractors.

A summary of the water and sewerage servicing options that progressed through to this evaluation workshop were;

- 9 water supply options, from disconnection to reticulated potable water,
- 5 sewerage collection system options, and
- 13 sewerage servicing strategies, ranging from Do Nothing to retrofitting full sewerage systems.

Each option was assessed under a pre-determined multi-criteria analysis, each with an equal weighting;

- Environmental Impact,
- Community Acceptance,
- Stakeholder Acceptance,
- Technical Risk,
- Work Health and Safety.

Guidelines and context for the structure and assessment for Stage 1b was documented in *'Scotland Island Stage 1b Report Structure Rev F'* and externally reviewed by Simon Fane, Project Expert Advisor to Northern Beaches Council.

1.1.2 Workshop Aim

The aim of the workshop was for the Evaluation Team to determine at-least two (2) preferred options for water and sewerage, and for these to be documented, costed and articulated back to through to the Community Group.

1.2 Location, Date and Attendees

Location: RPS Office, Level 13, 255 Pitt Street, Sydney

Time and Date: 29 April 2019, 9:30am – 3pm

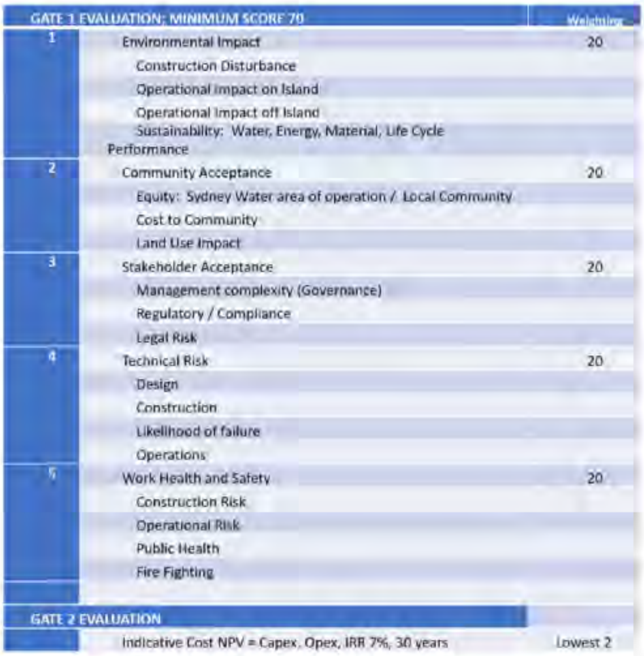
Evaluation Team:

Ruby Arden – *Project Leader* - Northern Beaches Council
Steve Wallace – *Technical Director* – PS Solutions
Gavin Ovens – *Senior Planner and Workshop Facilitator* – PS Solutions
Chris Rust – *Senior Technical Engineer* – PS Solutions
Robert Slade – *On-Property Feasibility and Constructability Advisor* – PS Solutions
Gareth Thomas – *Environmental Planning and Assessment* – RPS
Kurt Dahl – *Process Engineering and Treatment* – Permeate Partners
Elisabeth Paget – *Project Designer* – PS Solutions (recorded Workshop notes)

1.3 Workshop Structure

Prior to commencing the evaluation process the team reviewed and discussed each component of the evaluation criteria, as outlined in Gate 1 MCA table, to ensure a consistent application of the criteria was maintained during the assessment process.

The analysis was conducted utilising the expertise of each member of the Evaluation Team, assessing each option individually, with a majority consensus score agreed progressively for each criterion.



GATE 1 EVALUATION: MINIMUM SCORE 70		Weighting
1	Environmental Impact	20
	Construction Disturbance	
	Operational Impact on Island	
	Operational Impact off Island	
	Sustainability: Water, Energy, Material, Life Cycle Performance	
2	Community Acceptance	20
	Equity: Sydney Water area of operation / Local Community	
	Cost to Community	
	Land Use Impact	
3	Stakeholder Acceptance	20
	Management complexity (Governance)	
	Regulatory / Compliance	
	Legal Risk	
4	Technical Risk	20
	Design	
	Construction	
	Likelihood of failure	
	Operations	
5	Work Health and Safety	20
	Construction Risk	
	Operational Risk	
	Public Health	
	Fire Fighting	
GATE 2 EVALUATION		
	Indicative Cost NPV = Capex, Opex, IRR 7%, 30 years	Lowest 2

1.1.3 Mechanisms for Assessment

It was identified that the 'majority score' applied to the Evaluation Matrix, may not be a stand-alone score and may have variability depending on the assumptions applied to that score.

Therefore, Evaluation Matrix is not a stand-alone document and forms a component of the Technical Evaluation document.

The mechanisms for assessment included:

- Assumptions and scenarios (servicing and operational) associated with each Option;
- Considerations regarding each option, including potential interpretations of physical application and installation procedures, e.g. how would the option be constructed?
    - Including property works to sanitary and electrical connections;
- Risks, challenges and opportunities;
- Project specific technical constraints;

- General community concerns, as understood from previous studies, the community body's interest in pursuing the servicing investigations to recommence, and PS Solutions investigative works on Scotland Island during the study.
- Likelihood of stakeholder acceptance based on consultations and previous experience.

Each criterion was allocated equal weighting for the purpose of the evaluation workshop. A sensitivity analysis utilising alternate criteria weighting scenarios was undertaken post-assessment workshop to determine whether differently weighted assessment would impact on the final recommendations.

1.4 Purpose of this Document

The purpose of this document is to provide a record the Stage 1b Options Evaluation Workshop, and provide documentation of;

- Discussions and relevant commentary;
- Considerations, interpretations, and assumptions;
- Capture score variability through comments, where required; and
- Remove perception and provide an informed rational for short-listed options.

This document is by no-means exhaustive of all the issues and considerations associated with each option, however highlights consideration of differing perspectives based on the evaluations team's experience in delivering water and sewerage infrastructure to communities across Australia.

It is recognised that the assumptions and interpretations of each option would lead to variability in the assessment scoring, therefore the process was a subjective comparative assessment, and tended to be relative to each option rather than an absolute.

Refer to Attachment 1: Scotland Island Option Matrix

Moving forward, the preferred water and sewerage options will require further detailing in which the associated parameters are clearly defined and assumptions are clarified. Addressing items such as:

- Community survey;
- Cost to the community;
- Delivery mechanisms & servicing arrangements;
- Life expectancy of the services.

2 EVALUATION PROCESS

2.1 Overview of Options – Commencement of Discussion

From the five days the PS Solutions team were on Scotland Island undertaking detailed property audits, discussions with members of the community suggested there is an underlying priority for sewerage services over improved water supply services.

At present, Scotland Island property owners are able to be supplied with an emergency non-potable water top-up into their rainwater tanks through membership of the Scotland Island Residents Association (SIRA). On-site systems, such as septic tanks and aerated wastewater treatment systems (AWTS), is the current sewage service strategy for the property's on Scotland Island.

In 1997 faecal coliforms were identified within the non-potable water supply on the island, potentially as a result of cross-contamination or leakage. This was documented in the 1997 Summary Report on Options (*Scotland Island Water and Sewage Options Study, Martens & Associates, 1997).* Soil sampling undertaken as part of PS Solutions investigation works confirmed that faecal coliforms were also present in the soil on Scotland Island.

Faecal coliforms in the islands non-potable water supply present real risks associated with the 'Do Nothing' option for both water and sewerage. Risks identified by the evaluation panel included but are not limited to;

- Die back in the vegetation,
- Public Health,
- Soil samples,
- Effecting usability of property,
- Compliance with minimum Australian Standard requirements; and
- Duty of care – legal implications of stakeholders.

Active enforcement of system requirements and upgrades to existing on-site services will not be adequate, as the detailed property audits undertaken by PS Solutions identified that for all 19 properties audited, the on-site systems could not be upgraded sufficiently to meet Australian Standards compliance, primarily due to lot size and slope constraints.

Scotland Island is within Sydney Water's area of operations, situated in the Pittwater estuary, 35km north of Sydney, one of only two residential islands in the Sydney area, the other being Dangar Island situated 62km from Sydney located in the Hawkesbury River.

2.1.1 Assumption

Sydney Water has provided verbal confirmation that there is capacity in their sewerage and water supply networks for the Scotland Island loadings.

Therefore, based on this information and for the purpose of options assessment, the Evaluation Team assumed adequate capacity within the Sydney Water sewerage and water supply networks, without requirement for augmentation works or upgrades.

Written confirmation of capacity in Sydney Water's water and sewerage networks for Scotland Island has been requested by Northern Beaches Council.

3 WATER SUPPLY OPTIONS EVALUATION

3.1 Disconnect existing non-potable water supply

3.1.1 Description of Option

Scotland Island is currently supplied with an emergency non-potable water top-up supply to rainwater tanks located on individual properties.

This water is supplied via a 40Ø polyethylene pipe, laid under the Pittwater. Northern Beaches Council have advised that pipe failure and repair has occurred on this main, and that there are concerns that further failures may occur.

In addition, water quality of the current supply is of ongoing concern as observed from 1997 report which identified faecal coliforms present in the non-potable water supply ring-mains supply.

Disconnection of the existing non-potable water supply to the island would mitigate the risks associated with failure of the 40Ø main and water quality. The residents would rely solely on potable water being transported across the Pittwater estuary from the mainland, either privately or as a collective group.

3.1.2 Environmental impact considerations

The environmental impact associated with disconnecting the existing non-potable service from a construction disturbance perspective was deemed negligible.

Sustainability rated highly, as the infrastructure, such as the transfer main under the Pittwater estuary, the distribution ring mains on the Island, water meters and valving would no longer require servicing and maintenance.

However, this rating was moderated in consideration of additional services that would be required to transport potable water across to the island and the mechanism to distribute to the properties.

Evaluation team deemed: Neutral impact

3.1.3 Community Acceptance

Disconnecting the emergency non-potable water supply, would be removing an essential service to the island, including top-up source for the fire-fighting storage tanks.

As at April 2019, the SIRA water charge is $5.00 per 1,000 Litres, with an online booking fee of $5.00 per booking, as per the Scotland Island Emergency Water Supply Information & Guidelines.

In the scenario that the non-potable water supply service was removed, all non-rainwater systems would need to be supplied with potable water transported across the Pittwater estuary from the mainland, then transported accordingly to the individual properties.

The logistics associated with the manual transportation of water is heavy and expensive, resulting in increased water supply costs to the community. For example, ferrying a tank of water across Pittwater on a barge, offloading onto a truck for transportation to individual properties where it is de-cantered into the rainwater tank.

During the five days PS Solutions undertook property audits and site investigations on Scotland Island it was identified that many residents currently rely on the non-potable water supply therefore it appeared that many residents would be greatly affected if this service was to be permanently disconnected.

Therefore, based on the removal of an essential service, the increased costs and the current reliance on the existing service provided to the island, the evaluation team determined that it would be unlikely the Community would be accepting of this solution.

Evaluation team assessment: Disconnecting existing non-potable water likely to be **unacceptable** to the community.

3.1.4 Stakeholder Acceptance

The Northern Beaches Council have an operational and maintenance responsibility for the transfer main from the mainland to Scotland Island, with the current system in place, upgrades are required to maintain service. Disconnecting the main eliminates Council's continuity and quality of service risks.

However, based on feedback from Council, the community perceive the non-potable supply as Council's responsibility, therefore Council are likely to receive more complaints from residents if the current non potable supply is disconnected.

Despite the immediate perceived benefits of disconnecting the non-potable water supply to the Island, such as elimination of ongoing maintenance costs and responsibilities, Scotland Island is an established residential area in Sydney with water quality and quantity performance expectations which need to be considered.

In the interest of public health and safety, there is a need to maintain a water supply service to conduct essential services such as toilet flushing and washing.

Although the evaluation team assessed stakeholder acceptance to be marginally positive. The risks associated with disconnecting the water supply, such as disease outbreak and fire-fighting capabilities, must outweigh this opportunity.

Evaluation team deemed: Stakeholder acceptance likely to be **marginally positive**, however warned that risks must outweigh the opportunity.

3.1.5 Technical Risk

Disconnecting the existing water supply is an option, however it is not an alternative technical solution. This option would involve cutting the source of water supply to the properties on Scotland Island, and may involve the removal of existing tanks and pipes.

Evaluation team deemed: Neutral impact

3.1.6 Work, Health and Safety

The evaluation team scored the work, health and safety (WHS) aspect of this option to be neutral (10) impact for the purpose of scoring in the evaluation matrix. However, depending on a quality or quantity assessment perspective, this criterion could be scored positively (15) or negatively (5).

The positive WHS aspect of this option (**score 15**), is derived broadly, from a whole community, health benefit perspective. The previous study in 1997 identified that faecal coliforms were already present within the non-potable water supply on the island. In addition, other sources of water contamination can occur from sources such as a roof with animal droppings in gutter. From this perspective, the current water quality on the Island has been identified as poor, therefore disconnection of the existing service may result in a positive broader health outcome.

Minimal operational changes are likely to occur on the individual properties, as council inspection of water tanks only currently occurs at the development application stage.

From an individual property perspective, the WHS aspect was deemed to be negative (**score 5**), with the water source being drastically impacted including the security to flush toilets and wash clothes.

The investigation works PS Solutions conducted on the Island, identified that there are residents on the island that are heavily reliant on the non-potable water supply service, and would be greatly affected if the supply was to be disconnected.

Construction implications of this option would include removing the existing system and cutting the pipes.

Reliance on only tank water is a risk, in particular in the event of drought and running out of water, and public health requirements such as flushing toilets.

The physical constraints associated with being on an Island impact on WHS, such as:

- on land, a water tank can be ordered to deliver water; in contrast,
- on an Island, a barge would bring tank water across then pump up through a fire-fighting hose – NEGATIVE.

In addition, the roads on Scotland Island are not suitable to regularly transport large volumes of trucked water. Therefore, future road upgrades, and associated environmental impacts, would likely be required.

Evaluation team deemed: WHS impact to be positive (score 15) and negative (score 5) depending on broader community or individual property perspective. Therefore, for the purpose of the evaluation matrix a score of neutral (10) was applied.

3.2 Do Nothing

What does this option mean in application, and subsequently, how should it be assessed?

3.2.1 Description of Option

The evaluation team identified through discussions that the base assumption for the 'Do Nothing' option has implications in the comparable assessment of the subsequent solutions.

In a practical application, the 'Do Nothing' option involves ongoing maintenance and repair costs of the existing service.

In order to maintain a service that has already served 30 years, it would be prudent to investigate the initial design life of the existing infrastructure, including the pipe material and rating, to ascertain technical viability of the system and anticipated time until replacement of system components, such as pipework, is required.

Therefore, forecast replacement/upgrade works of the existing service could be a consideration in the evaluation of the 'Do Nothing' option, such as:

- In the event of a failure/breakage of the existing Pittwater crossing pipeline supplying the non-potable water source for Scotland Island,
    - What are the failure response strategies?
    - Who are responsible for implementing and paying for these?
    - And for how long does the repair/replacement need to continue to provide service?

Are the proposed solutions being evaluated in this workshop expected to have a design life of 5-10 years before replacement/upgrade is required? Or is a 30-50 year design horizon expected, which is consistent with industry solutions?

This fundamental parameter for the proposed solutions/options being evaluated, impacts on the comparable assessment of the 'Do Nothing' option. As such,

- A solution expected to have a design life of 5-10 years,
    - may assume that basic maintenance and repairs could keep the existing system operational; or
- A solution with a 30–50 year design horizon, which is consistent with industry solutions,
    - weighed against a high likelihood of Pittwater crossing replacement.

If assessments are based upon providing a 30-50 year design horizon, in this respect other servicing options become comparatively viable against the 'Do Nothing' option.

For the purpose of this evaluation workshop and to minimise potential scenarios, the following assumption for the 'Do Nothing' option was applied.

- **Assumption:** The 'Do Nothing' option was assessed as exactly that 'do nothing', with no forecast operational scenario applied and the status quo being maintained.

3.2.2 Environmental Impact

This option maintains status quo, therefore assessed as have a neutral impact on the environment.

It was noted that the current system may be impacting the environment, however this had not been clarified or confirmed at the workshop, therefore this could not influence the assessment.

Evaluation team deemed: **Neutral impact**

3.2.3 Community Acceptance

The Scotland Island Community Association has been actively lobbying government representatives and Northern Beaches Council for water and sewerage services to Scotland Island.

A number of feasibility studies have been undertaken over the years, including the study conducted in 1997 which identified a number of risks associated with the current system. It is understood that from a community perspective, these studies resulted in no action or improvement of service.

Therefore, it is likely that a 'Do Nothing' approach would be perceived by the community as another feasibility study that has resulted in no action.

Rainwater top-up into existing on-property tanks, is cheaper than sourcing water supply from a tanker on a barge, based this cost impact, this option was assessed more positively than the disconnection option.

Evaluation team assessment: Do nothing likely to be seen as **unacceptable** to the broader Scotland Island community, however, was seen as potentially more palatable than the disconnection option.

3.2.4 Stakeholder Acceptance

Historically, the servicing responsibilities for Scotland Island have been forwarded to relevant bodies, such as Sydney Water, Northern Beaches Council, Scotland Island Community Association, with associated handovers of risk. As evidenced by the ownership model and supply responsibilities of the existing infrastructure.

This criterion was scored more negatively by the evaluation team compared to how it may have been scored 10 years ago, primarily due to legal liabilities. Legally, if an entity has an expertise in an area, the risk cannot easily be transferred or ignored.

Business as usual presents a significant public health risk and therefore legal risk the range of parties facilitating the service (SWC, Council, State Government, Community Association).

As such, investigations and soil sampling consistently flag serious health and environmental concerns on Scotland Island.

Stakeholders need to accept that this is a collective problem that requires a solution, therefore 'Do Nothing' is no longer a viable option therefore was assessed this way.

Evaluation team deemed: **Negative stakeholder acceptance**

3.2.5 Technical Risk

Although the 'Do Nothing' option requires no immediate action, the system is failing as indicated by the repair requirements and is inadequate for sustainable continuity of service.

Due to the age of the current infrastructure, the likelihood of failure increases daily, including the pipe across the Pittwater and chance of cross contamination of water supply.

Evaluation team deemed: **Negative impact**

3.2.6 Work, Health and Safety

On-property audits, water and soil sampling that have been undertaken as part of this feasibility assessment as well as the previous feasibility studies, have consistently flagged serious health and environmental concerns on Scotland Island.

Evaluation team deemed: Identified as a significant health issue, therefore **negative impact.**

3.3 Upgrade of rainwater storage tanks and water usage management

3.3.1 Description of Option

This option involves the upgrade of on-site rainwater tanks, that are appropriately sized and managed according to roof size and occupancy. The assessment of this option was based upon the following parameters:

- No top-up water in to tanks, just rainwater supply
    - Less reliant or no reliance on non-potable water source.
- Community to pay for upgrades
- Council to assist with the property audit and determining an on-property technical solution, and to,
    - Provide education to the property owners and residents,
    - Tank storage to include emergency storage allowance.
- Assumes community buying power, e.g. bulk deal on tanks. With possible assistance from Council.
- Critically, this option assumes that the community will have operational responsibility -
    - Residents to monitor and responsible for own water quality.

3.3.2 Environmental Impact

The sustainability of this option was ranked highly, due to water efficiency, and the self-regulating and self-limiting nature of the solution.

Tannins in the water will be an on-going problem, however this can be addressed in the technical solution provided by Council such as utilising activated carbon filtration.

Intuitively this option assumes no tree removal will be required, however without the availability of the non-potable water supply source, storage tanks will require an emergency storage allowance, therefore;

- Tree clearing for larger storage tanks potentially will be required on many properties.

Evaluation team deemed: Overall **Positive impact**

3.3.3 Community Acceptance

The evaluation team discussed the following impacts on the community:

- Community less / not reliant on poor quality non-potable water supply;
- Individually responsible for own water quality - not impacted on by others;
- Equity amongst community;
- Inequality compared to the remainder of Sydney Metropolitan Area;
- Cost implications for upgrades and sourcing emergency top-up requirements;
- Implications during peak occupancy periods and increased demand requirements,

  - E.g. family and friends staying over Christmas – 20,000L for 1 week is not unrealistic, and is based on a discussion with a property owner on Scotland Island during PS Solutions Investigative works on the island in 2019.

Evaluation team assessment: Assumed a **neutral outcome** / **marginally negative** acceptance:

3.3.4 Stakeholder Acceptance

Upgrading rainwater storage tanks and enabling sound water usage management processes on Scotland Island mitigates much of the stakeholder's legal responsibilities of supplying poor quality water to the community.

Stakeholders are likely to be comfortable that a solution has been provided and that the properties are capable of storing adequate quality and quantity of water.

Evaluation team deemed: Positive acceptance

3.3.5 Technical Risk

There are complexities with this option, as outlined by the summary of parameter assumptions listed under section 3.3.

Therefore, despite the apparent simplicity of this option the Evaluation Team cannot be certain that the solution will work on each property.

- Calculate storage volume based on property usage and emergency supply requirements.
  - Based on roof area, a property requires X amount of storage.
  - Compare storage volume requirements.
- Assess specific site constraints, such as,
  - Storage tank size restrictions, (e.g. clearing, accessibility, location),
  - Pump up arrangements e.g. from gutter into rainwater tank
- Level indicator would be required on tank to provide warning of low levels.
- Will the system be maintained to adequate standards? E.g. Activated carbon filtration maintenance, level indicator operation.

Evaluation team deemed: The technical risks of this solution are high as the evaluation team cannot be certain that it would work, therefore **Negative impact.**

3.3.6 Work, Health and Safety

There are WHS risks associated with this option however with adequate provisions and mitigation strategies, these risks were assessed as being better than neutral.

Based on the assumed parameters of this option, the water supply at each property would be less likely to run-out than that of the first option assessed, than the option to disconnect the non-potable water supply.

Evaluation team deemed: **Better than neutral WHS impact.**

3.4 Replace existing non-potable supply with small bore supply for drinking water with top-up to rainwater tanks

3.4.1 Description of Option

This option involves the replacement of the river crossing pipeline across Pittwater with a potable water supply (size to be confirmed). Replacement of current reticulated on-island supply system due to pipe sizes and state of repair of the existing system. The benefit of this option is to take away the manual interface, between reticulated system and rainwater tank top-up.

One small bore tube to be installed directly into the house with one connection point into the kitchen, providing potable water to each house. Automated daily trickle top-up into rainwater tanks, at this point the source will no longer be potable supply.

This option does not include enhancing or replacing existing rainwater tanks.

This option may not require a reservoir on the Island, however it will require a buffer tank with a re-chlorination loop.

This option does not try to provide a full potable water supply but aims to give a balance between quality and quantity of water supply, whilst minimising the interference with the Islands existing reliance on the non-potable supply arrangements at each property.

- Based on investigations and property owner discussions in 2019, PS Solutions estimates that 50-60% of the properties on Scotland Island use the non-potable supply source regularly, with the remainder of properties utilising the source a couple of times a year.
- The solution will require meter readings at each property.

3.4.2 Environmental Impact

The environmental impact and sustainability assessment are variable, within the positive range as determined by the evaluation team, the median score within this range was applied to the assessment matrix. The variability was dependent on the base assumption of the 'Do Nothing' option, whether the Pittwater crossing will require no action, maintenance or replacement.

Evaluation team deemed: Positive impact.

3.4.3 Community Acceptance

This solution provides the Scotland Island community with a reliable clean water supply, which an improvement on the current water quality of the non-potable water supply to the Island. Therefore, this option reduces health risks whilst continuing to provide the top-up system to rainwater tanks.

Unlike the option to upgrade the rainwater tanks, this solution can achieve regulatory compliance. However, this option still does not provide equity to Scotland Island customers comparatively with benchmark of services within Sydney Water area of operation.

Evaluation team deemed: Likelihood of a positive community acceptance

3.4.4 Stakeholder Acceptance

This option has two clear benefits for stakeholders;

- The solution can achieve regulatory compliance, and it
- Reduces risks for all stakeholders.

Evaluation team deemed: Likelihood of a positive stakeholder acceptance

3.4.5 Technical Risk

Any retrofit solution is difficult; however, this option has attempted to minimise on-property works. The option only commits to one potable water supply point into a dedicated tap, likely to be located in the kitchen.

There is a low likelihood of failures, however the more moving parts in the system, such as the automation component of the rainwater top-up system, the higher likelihood of failures.

Evaluation team deemed: Positive impact, noting associated technical difficulties

3.4.6 Work, Health and Safety

The WHS element was assessed more positively than the previous option to upgrade rainwater tanks, due predominantly to then reliability and quality of the water service and minimisation of on-property works.

However, critically this option does not provide for a fire-fighting water resource supply, as the velocity in the proposed small diameter pipe across Pittwater would be too high. These losses in the pipe, and subsequent flow restrictions would prevent effectiveness of a fire fighting resource direct from the supply pipe.

A 125PE pipe would provide a larger diameter which can be supplied in coils.

If required, a potable water reservoir, would likely be low level with variable speed drive (VSD) pumps.

Evaluation team deemed: Positive WHS impact

3.5 Provide supply from Sydney Water system to reservoir on Scotland Island

3.5.1 Description of Option

This option provides a full reticulated potable water service, with a reservoir, on Scotland Island.

The key assumption being that the reservoir would be approximately 1ML in size and would be located at the highest elevation on Scotland Island.

3.5.2 Environmental Impact

Although this option may initially be perceived as the ultimate ideal solution, the environmental impact on the Island would be extreme, key impact identified by the evaluation team included;

- Major construction impact,
- Major land use impact,
- Reservoir size would require clearing of land at site of reservoir,
- Additional clearing of land would be required by Sydney Water for an all-weather road access up to the reservoir; and some
- Some loss of open space

Evaluation team deemed: Negative environmental impact

3.5.3 Community Acceptance

The evaluation team discussed many facets of the solution and how they would likely be accepted, or not, by the community. These included:

- The solution being perceived as the equitable Sydney Water service, 'gold-plated' option;
- Reservoir would provide emergency water supply in the event of power failure, or main crossing break.

However,

- The impact of the reservoir (e.g. ambience, environmental) would be major;
- Residents may feel that the reservoir would destroy the place they are living in and impact the amenity of the Island, as many trees would need to be cleared.
- The reticulated potable water supply would be the only source of water on the Island, it was thought that this may be a negative for some residents, as some may want to keep the rainwater tanks;
- It was thought that residents on the Island generally like that they do not received a water bill.

On balance, the evaluation team assessed that the community's preference would likely be towards the previous option 4 (small bore water supply) therefore this option needed to be rated this way in the evaluation matrix.

Evaluation team deemed: Likelihood of community acceptance being slightly positive, primarily due to the perceived benefits of the solution.

The option was assessed in the absence of specific detailed community consultation, therefore the could equally have a negative acceptance. Regardless, based PS Solutions limited investigative works and discussions with member of the community in 2019, it was thought that between the small bore water supply option (option 4) and this full reticulated system option (options 5), the communities preference would be towards the previous option 4, therefore it was rated this way in the matrix.

3.5.4 Stakeholder Acceptance

The full reticulated water supply with an on-island reservoir addresses many of the risks currently affecting the majority of stakeholders.

However, based on previous experience, Sydney Water will not be in favour of a reservoir on an Island and the associated impact on resourcing for up-keep of roads and infrastructure for operations and maintenance, and as such are likely to be opposed to this option.

Evaluation team deemed: Likelihood of marginally positive stakeholder acceptance.

3.5.5 Technical Risk

Retrofitting a complete reticulated system on Scotland Island will be hard, particularly with the site constraints, such as rock, slope, vegetation. Despite this;

- It is a typical solution, and
- It is constructible.

Evaluation team deemed: Sightly positive, noting associated technical difficulties of installing a complete reticulated system into an area with such site constraints.

3.5.6 Work, Health and Safety

The solution was assessed as satisfactory for most WHS aspects, including construction risk, operational risk, public health and fire-fighting.

Evaluation team deemed: Positive WHS impact.

3.6 Direct mains pressure supply from Sydney Water mains / pressure boosted if required

3.6.1 Description of Option

This option is similar to the previous (option 5) full reticulated potable water supply to the Island, the difference being without the reservoir, and supply being pressurised/pressure boosted from direct from the Sydney Water network.

3.6.2 Environmental Impact

The evaluation team concluded that there would be a negative environmental impact with this option, however the impact would not be as extreme as the previous option 5 that included the reservoir on the Island.

Discussion points included that;

- Most of the retrofitted reticulation could be directionally drilled,
- Accessibility and road access may need to be upgraded by Council, for operations and maintenance of the system.
    - It was noted that Council are currently in the planning stage for upgrade of the stormwater system and overland flow paths on Scotland Island – therefore there is potential for concurrent upgrades to occur.
- Environmental risks increase if this option is not combined with reticulated sewage disposal, as a reticulated water supply results in increased wastewater disposal from properties.

Evaluation team deemed: Negative environmental impact

3.6.3 Community Acceptance

Comparable to option 5, this option would also be perceived as the 'gold-plated' solution and provides good equality across the Sydney Water customer base.

Unlike option 5 which proposed the reservoir located at the highest elevation on the Island, this option without the reservoir minimises the associated land use impact, such as clearing of land and upgrades of access roads.

Akin to option 5,

- The reticulated potable water supply would be the only source of water on the Island, it was thought that this may be a negative for some residents, as some may want to keep the rainwater tanks; in addition;
- It was thought that residents on the Island generally like that they do not received a water bill.

Scheme cost to the property owner may be limiting factor, therefore quantum of cost would need to be determined before the level of community acceptance can truly be determined.

Evaluation team deemed: Likelihood of community acceptance being positive, with generally an anticipated high acceptance of the solution, with scheme cost potentially being a limiting factor in level of acceptance.

3.6.4 Stakeholder Acceptance

The full reticulated, pressurised, water supply addresses many of the risks and responsibilities currently affecting the key stakeholders. Therefore, it was identified by the evaluation team as likely to have a high stakeholder acceptance.

Evaluation team deemed: Likelihood of positive impact / high stakeholder acceptance.

3.6.5 Technical Risk

Retrofitting a reticulated system on Scotland Island will be hard, particularly with the site constraints, such as rock, slope, vegetation. Despite this;

- It is a typical solution,
- It is constructible, and
- Most of the reticulation could be directionally drilled.

From a technical perspective this option offers the best solution, compared to all the other options identified.

Evaluation team deemed: Positive, best solution from a technical perspective, noting associated technical difficulties of installing a complete reticulated system into an area with such site constraints.

3.6.6 Work, Health and Safety

The key difference between this option and option 5, being the fire-fighting resource of the reservoir located on the Island, which was offset by WHS issues associated with the reservoir.

Upon discussion, the evaluation team determined that this solution addresses the WH&S risks better than all the other options, therefore was ranked in the matrix accordingly.

Evaluation team deemed: Positive WHS impact.

3.7 Desalination plant with new water reticulation

3.7.1 Description of Option

Desalination plant located on the Island providing water supply through a new reticulated system. For context, the desalination plant on the Island would be of relatively small size with the purpose to only service 370 lots.

3.7.2 Environmental Impact

A desalination plant requires high energy to produce potable water. However, this trait should not necessarily discount the option for consideration. In contrast, Palm Beach also has high energy requirements to transport water supply through the current Sydney Water network.

A product of the desalination process is concentrated salt which would need to be discharged. It is not clear where it would be possible to discharge this concentrated salt, and what consent requirements would be imposed on this discharge.

Evaluation team deemed: **Negative environmental impact**

3.7.3 Community Acceptance

A desalination plant on the Island to service 370 lots would be very expensive to construct and operate, based on this and the environmental impacts, the evaluation team anticipated that community acceptance for this option would be very low.

In contrast, the desalination plant may provide Scotland Island residents with a sense of independence from the mainland.

Evaluation team deemed: **Very low** community acceptance anticipated.

3.7.4 Stakeholder Acceptance

The desalination plant would provide Scotland Island with a Guaranteed supply of water that was not drought related.

The solution could be delivered and operated by either Sydney Water or the private sector, with similar systems already operating on Hayman Island and Rottnest Island.

Based on previous experience, the evaluation team forecast that the state government would be unlikely to endorse a desalination plant for only 370 properties on an Island, based on the known costs to provide the plant, undertake upgrades and maintain a plant on the mainland.

- Therefore, costs are going to be significantly more on an Island.
- Potentially something to consider if the plant became a local issue/responsibility.

Evaluation team deemed: Likelihood of a **neutral** stakeholder acceptance.

3.7.5 Technical Risk

Key technical factors associated with the desalination plant option are that:

- It is imperative that the water supplying the desalination plant is of good quality;
- The outlet, the location for the discharge of the brine, is likely to be difficult to determine; and
- Accommodations of the system will factor into the final score for this option
    - E.g. who will own, operate, maintain system?

Evaluation team deemed: Technical risk to be a **negative risk** but not significant enough to not be able to be managed. The final score for this option can only be determined once specifics such as who will own, operate and maintain the system is determined.

3.7.6 Work, Health and Safety

This solution provides a reliable source of potable water source for the Island, however it was noted that operational risks would be higher than for the two previous servicing options (option 5 and 6) with reticulated supply from Sydney Water's network.

Evaluation team deemed: **Positive WHS impact**, however evaluated as less than that of options 5 and 6.

3.8 Reuse non-potable

3.8.1 Description of Option

Reticulated recycled water system for external use, and toilet and washing use if necessitated. This would not be a stand-alone solution and would be integrated with the sewerage system solution. A third reticulated pipe (purple) network, such as Rouse Hill, would be required on the Island.

The benefit of this solution would be less reliance on the potable water supply source.

3.8.2 Environmental Impact

Deemed to have a high environmental impact when compared with option 6 (reticulated water supply). The solution involves two reticulated services to be installed, - 1. Potable Water and 2 – Recycled Water.

Evaluation team deemed: Negative environmental impact

3.8.3 Community Acceptance

The recycled water system would offer greater overall reliability of service on the Island. However, PS Solutions did not observe much evidence of irrigation on the Island during the investigation works conducted for this feasibility study. Therefore, the need for a recycled water service on Scotland is questionable.

Evaluation team deemed: Slightly positive community acceptance anticipated.

3.8.4 Stakeholder Acceptance

Based on the evaluation team previous experience with recycled water systems, the amount of effort required to get the reuse non-potable water service up and running would far out-weigh any benefit, particularly for a scheme of this size.

Evaluation team deemed: Likelihood of stakeholder acceptance to be **negative**.

3.8.5 Technical Risk

From a technical perspective the solution can be delivered, with the main risk associated with this option is with end-user failure, e.g. cross-connections and contamination of water supply.

Evaluation team deemed: Technical risk to be a **negative risk**

3.8.6 Work, Health and Safety

This solution provides a non-essential service, therefore additional risks factors are being introduced where they would otherwise not be required.

Evaluation team deemed: **Negative** WHS impact, as service is non-essential.

3.9 Reuse potable water

3.9.1 Description of Option

Sewage treatment plant on Island to provide reuse potable water. This would not be a stand-alone solution and would be integrated with the sewerage system solution

3.9.2 Environmental Impact

The sewage treatment plant located on the Island would be small but complicated to provide a reuse potable water supply source. The plant would produce a brine stream that would need to be disposed of, consequently requiring approval for discharge into Pittwater. It was discussed that other schemes of this type tend to have scope for a larger fresh water dilution.

Evaluation team deemed: Negative environmental impact

3.9.3 Community Acceptance

Reuse potable water tends to broadly have a negative perception across the wider community. Studies have indicated that it requires on average seven years of education for a technology of this type to gain acceptance within a community.

Evaluation team deemed: Negative community acceptance anticipated, based on perception of process and service, and resulting environmental impact.

3.9.4 Stakeholder Acceptance

As above, reuse potable water generally has an extremely negative perception amongst the broader community, and is likely to require a long journey of education to gather acceptance amongst stakeholders and the community.

Evaluation team deemed: Negative stakeholder acceptance anticipated, based on perception of process and service, and resulting environmental impact.

3.9.5 Technical Risk

Technically the scheme is possible, however there are very few existing schemes of this scale to compare and evaluate from based on their learnings.

Evaluation team deemed: Technical risk to be **negative,** risks are higher as there a very few existing schemes of this scale to gather learnings from.

3.9.6 Work, Health and Safety

This option presents with high WHS risks in all areas associated with construction, operation, public health and fire-fighting.

Evaluation team deemed: **High risk** WHS impact, risks are higher as there a very few existing schemes of this scale to gather learnings from.

4 SEWERAGE COLLECTION SYSTEM OPTIONS EVALUATION

4.1 Gravity Sewerage System

4.1.1 Description of Option

A gravity sewerage system is a typical sewerage solution, widely accepted as a sound servicing strategy. The basic requirements of a system of this type include:

- Pipes that maintain constant downward sloping grades to allow adequate flows and velocities to carry solids;
- Access chambers (a.k.a. manholes);
- Where adequate pipe grade cannot be maintained, sewage pumping stations (SPS) are required.
- Pipes are installed via digging trenches, with limited trenchless technology application.
- High risk of ingress and infiltration (I&I) into the system, with associated risk of sewage overflows from the network.
- Trenching will be required in private properties
- Ductile iron cement lined (DICL) pipe would be required to be exposed across private properties on Scotland Island.
- A sewer junction is provided for each property connection.

4.1.2 Environmental Impact

The construction techniques required to install a gravity sewerage system are generally environmentally invasive. These environmental impacts are increased due to the specific constraints and characteristics on Scotland Island, such as:

- High likelihood that excavation into Pittwater will be required;
- High likelihood of I&I into the system
- To maintain constant downward sloping pipe grades, trenches will be required across properties;
- High number of SPSs will be required at various locations around Scotland Island;
- Road accessibility required to all pump stations in network;
- Extensive tree removal and root damage will occur.

Evaluation team deemed: Negative environmental impact

4.1.3 Community Acceptance

Intuitively, community acceptance of a gravity sewerage system solution is initially likely to be high. However, the impact will be different for Scotland Island, than for typical areas suited to gravity sewerage – this will need to be clearly articulated in order to educate the community.

Once the impacts are articulated, educating the residents on the damage that a gravity sewerage system would cause not only the Island, but also their property, and the associated effect of amenity in the area, it is anticipated that acceptance would become much lower.

Impact on the Island including:

- Trenches required across properties;
- Tree and tree roots will be damaged – resulting in extensive tree removal in many locations across the Island;
- Waterfront properties would likely have a visible pipe along the water's edge;
    - The gravity sewer pipes would likely need to be above the ground along the water front, leaving the main collector pipe for the Island exposed.
- Vibrations from construction works may affect house structures;
- Removal / decommissioning of existing septic systems will be required;
- Sewage pumping stations across island with a number below water level;
- Road accessibility required to all pump stations in network.

Property connection costs for this scheme will be extremely high for this solution on Scotland Island, based on known connection costs from other schemes;

Evaluation team deemed: **Negative** community acceptance anticipated, once impacts of solution are clearly articulated to the community and residents are educated on the effect on the Island.

4.1.4 Stakeholder Acceptance

The risks associated with retrofitting a gravity sewerage system into Scotland Island are high in terms of all aspects, including; delivery, operation, maintenance and managing the impact on the Island. The evaluation team deemed that these would be too high risk for any stakeholder to want to be responsible for.

In addition, there would be an ever-present high risk of inflow and infiltration (I&I) and overflows to the environment.

Evaluation team deemed: **Too high risk**, therefore **negative** stakeholder acceptance anticipated,

4.1.5 Technical Risk

Technically Scotland Island is very different to typical areas suited to a gravity sewerage system solution. The risks associated with this option are very high.

Despite mitigation strategies the chance of system failure will remain high, and operation will be problematic, particularly in relation to I&I.

The scheme costs could easily escalate, due to unmanageable delivery risks.

Evaluation team deemed: Technically **too high risk** for successful implementation, therefore **negative** assessment.

4.1.6 Work, Health and Safety

Construction works will be high risk in all aspects (e.g. procedures, property damage, costs, environmental damage).

Operational risks will remain high and ongoing – the system will consistently be problematic, labour intensive, and require high expenditure.

Public health risks are high – with chances for sewage overflows and odour.

Evaluation team deemed: WHS **too high risk** for successful implementation, therefore **negative** assessment.

4.2 Pressure Sewerage System

4.2.1 Description of Option

Pressure sewer is a proven technology, accepted in Australia for over 20 years and currently operating in more than 250 systems, and internationally for more than 50 years. The basic characteristics of a system of this type include:

- Pressure sewer units (PSU), with grinding pump, located on each property;
- Small diameter pipes, predominantly directionally drilled;
- Not constrained by pipe grades;
- Fully sealed pressurised pipe network;
- Power to be supplied by the property;
- Sewage pumping station may be required, to boost flows across Pittwater.

4.2.2 Environmental Impact

Retrofitting a new reticulated service will have an environmental impact, however the characteristics of pressure sewer, such as small diameter pipes which are not constrained by maintaining a constant grade, can be installed using less invasive construction techniques. Therefore, the environmental impacts can be minimised with a pressure sewerage system in comparison to other system types as follows:

- Most of the retrofitted sewerage reticulation could be directionally drilled;
  - Minimising trenching requirements,
  - Reducing impact to trees and tree roots.
- Pressure sewer units (PSU) to be installed in each property;
  - Reducing the requirement for many SPS's around Scotland Island,
  - May require a pumping station to boost flows across Pittwater.

Sewage no would no longer leaching into soils and ground water – positive impact. As indicated by the soil sampling undertaken by PS Solutions.

The nature of the pressurised system minimises I&I within the system.

Evaluation team deemed: **Negative** environmental impact

4.2.3 Community Acceptance

- Reliability of the technology has been proven in Australia;
- Provides and equitable servicing solution for Scotland Island;
- Residents will be required to supply and pay for the electricity to operate the PSU – negative;
- Provides equity with other comparable Sydney Water customers, such as Dangar Island.

Evaluation team deemed: **Positive** community acceptance anticipated, as it provides a sewerage service to the community, whilst causing less environmental impact that the gravity sewerage solution.

4.2.4 Stakeholder Acceptance

Pressure sewerage is a fully equitable and widely accepted servicing solution that has gained stakeholder acceptance, within the Sydney Water operating region, and more widely across Australia. The solution is comparable to the servicing solution provided at Dangar Island.

- SWC currently have many systems of this type operating in their area of operations and previously produced a pressure sewerage system concept design for Scotland Island.

Evaluation team deemed: **Positive** stakeholder acceptance anticipated.

4.2.5 Technical Risk

As before, any retrofit solution has its difficulties and complications, however site investigations and audits conducted by PS Solutions as part of this study, identified that there is nothing on Scotland Island that has not been delivered previously, therefore based on experience the risks have been deemed to be manageable.

At many properties, it is likely that pressure sewer units could be retrofitted into the existing septic tanks.

In every measure, the gravity sewerage option has greater risk compared to a pressure sewerage option. Therefore, from a technical perspective then evaluation team determined that there was a positive balance of risk, comparatively to a gravity sewerage solution.

Evaluation team deemed: The technical aspect to have a **positive balance of risk.**

4.2.6 Work, Health and Safety

Due the pressurised nature of the reticulated network, there is less risk of odour, I&I and chance of overflow occurring throughout the network. Through experience and commencing at design, these risks are manageable.

Evaluation team deemed: WHS impact assessed as a positive balance of risk.

4.3 Vacuum Sewerage System

4.3.1 Description of Option

A vacuum sewerage system requires installation of a saw-tooth profile for the sewer network. Vacuum pots, with valves, are located on each property connecting to the sanitary drainage connection point. A vacuum station transfers sewage through the pipe network and, in this case a pumping station would be required on the Island to pump flows across Pittwater.

The major difference, and known failure point, of a vacuum system is that in order to maintain service the system must be kept under a constant vacuum. A failure of one valve has the potential to affect the service of the whole system.

A design maximum of 8m lift.

4.3.2 Environmental Impact

The environmental impact of a vacuum sewerage system being constructed on Scotland Island would be comparable to the impact of the gravity sewerage system.

- Likelihood is high that excavation in Pittwater will be required;
- High likelihood of I&I into the system;
- Trenches required across properties to achieve saw-tooth profile along contours, disregarding property boundaries; and
- Extensive tree removal and root damage will occur.

Evaluation team deemed: The environmental impact of a vacuum system would be comparable to that of the gravity sewerage system, therefore **negative** impact.

4.3.3 Community Acceptance

Generally, there is less is known about vacuum sewerage systems, with the community already having a familiarity with pressure sewer from Dangar Island, therefore community acceptance is likely to be cautious of this solution initially. The community may be offered further understanding of the system and its implications for the Island and each property, however in summary the impact would not be dissimilar to the impacts associated with a gravity sewerage system.

- Trenches dug across properties, to achieve saw-tooth profile along contours, disregarding property boundaries,
- Tree and tree roots will be damaged – resulting in tree removal in locations,

Evaluation team deemed: **Negative** community acceptance anticipated.

4.3.4 Stakeholder Acceptance

The risks associated with retrofitting a vacuum sewerage system into Scotland Island are very high in terms of all aspects, including; delivery, operation, maintenance and managing the impact on the Island. The evaluation team deemed that these risks would be too high for any stakeholder to want to be responsible for.

In addition, there would be an ever-present high risk of I&I and overflows to the environment.

Based on other known operating vacuum systems, maintaining consistent service to the properties on Scotland Island, would be labour intensive and costly.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

4.3.5 Technical Risk

PS Solutions assessed the technical feasibility of the vacuum sewerage system solution. Theoretically it found that it may be possible to design a vacuum system on Scotland Island as multiple smaller systems, with short strips of saw-tooth profile pipework tracking along the contours of the Island, to multiple vacuum stations and pump stations.

- Virtually impossible to the implement with any certainty of success – risk is too high;
- Costs would easily escalate;
- Chance of system failure is high, and
- Based on experience, ongoing operation will be problematic.

Evaluation team deemed: Technical risk **too high**, to achieve successful implementation and operation.

4.3.6 Work, Health and Safety

Extremely negative high-risk solution,

- Construction works high risk in all aspects (e.g. procedures, property damage, environmental damage)
- Operational risk high – system will consistently be problematic, labour intensive, and require high expenditure.
- Public health risk high – overflows, odour

Evaluation team deemed: Technical risk **too high**, to achieve successful implementation and operation.

4.4 Hybrid Sewerage System

4.4.1 Description of Option

The hybrid system is a combination of different system types that best suit the area being serviced. For Scotland Island the proposed hybrid system consists of a combination of gravity sewer, where feasible, and the remainder pressure sewer.

4.4.2 Environmental Impact

Retrofitting a new reticulated service will have an environmental impact, utilising the combination of gravity and pressure system types where suited, will improve the environmental impact than of gravity system alone.

Even where the system is suited, the construction techniques required to install a gravity sewerage system remain generally environmentally invasive. Utilising pressure sewer in the more difficult areas will reduce the environmental impact.

Comparatively against the gravity sewerage solution, the hybrid system is likely to:

- reduce excavation requirements into Pittwater;
- Still be affected by I&I into the system, but not to the degree of a full gravity system;
- Fewer trenches likely to be required across properties;
- Reduced number of SPSs will be required (compared to a full gravity sewerage system) at various locations around Scotland Island;
- Accessibility required to across network to all pump stations;
- Reduced tree removal and root damage will occur.

The environmental impact of the hybrid system will be negative. The impact is an improvement on the complete gravity sewerage system, however the construction impact of trenching and multiple pumping stations will still exist, therefore the hybrid system will have more of an impact than a complete pressure sewerage system.

Evaluation team deemed: **Negative** environmental impact

4.4.3 Community Acceptance

One of the key issues associated with a hybrid system is that it does not provide and equitable service across the community, such as differing;

- connection costs depending on whether the property is serviced by gravity or pressure;
- on-property asset requirements, such as a pressure sewer unit, or direct connection;
- electricity costs supplied by the property to run the pump in a PSU;
- servicing arrangements on the property,
- I&I entry points into the system, can be monitored with a pressure sewer connection, very difficult to manage with a gravity connection.

Evaluation team deemed: **Negative** community acceptance anticipated.

4.4.4 Stakeholder Acceptance

Technically a hybrid solution at Scotland Island can be achieved. However past experience has shown that the non-equity (different system requirements serving properties) will cause issues across a range of project delivery elements, such as connection costs, servicing arrangements, asset ownership. Operationally and logistically a hybrid system can be difficult to manage.

Evaluation team deemed: Neutral stakeholder acceptance anticipated.

4.4.5 Technical Risk

The hybrid system, from a technical perspective can be achieved. The system utilises the benefits of pressure sewer where advantageous and only utilises gravity sewer where there are benefits to do so – hybrid of convenience.

However, the site constraints and associated difficulties on the Island to install sections of gravity sewer, resulted in the evaluation team assessing the options as having a positive balance of risk but slightly higher risk than a complete pressure sewer technical solution.

Larger pump stations would be required in the hybrid system than that of the full pressure sewerage system, due to I&I entering the system from the sections of gravity sewer.

Evaluation team deemed: Positive balance of risk.

4.4.6 Work, Health and Safety

Evaluation team assessed the hybrid system to have a positive balance of risk, as the design would be driven by being a hybrid of convenience and benefits.

However, the WHS risks are higher, particularly in construction and on-going operation, than for pressure sewer alone.

Evaluation team deemed: Positive balance of risk.

4.5 Variable Grade Sewer

4.5.1 Description of Option

Variable grade sewer system consists of sealed gravity sewer carrier pipes, with intermediate lift stations. The intended benefit of this type of system is to keep the gravity sewers relatively shallow compared to the traditional gravity system.

4.5.2 Environmental Impact

The trenching to provide variable grade sewer potentially would be more manageable than that of a gravity sewerage system. However there maintains a high likelihood of I&I into the system. Trenching and intermediate lift station requirements will be environmentally invasive, and tree removal and root damage will occur.

Evaluation team deemed: **Negative** environmental impact

4.5.3 Community Acceptance

As with the gravity sewerage solution, trenching will be required across properties. With multiple lift stations required across the Island, locations of would likely be controlled by site constraints and system requirements rather than property boundaries. Further issues associated with this option include:

- Treatment plant or SPS at the bottom of the hill;
- Odour and I&I will still be an issue
- Accessibility will be required to across network to all lift stations

Evaluation team deemed: **Negative** community acceptance anticipated.

4.5.4 Stakeholder Acceptance

The risks associated with this option are high, therefore it is unlikely to gather stakeholder acceptance. The chance of system failure is high with this type of solution on Scotland Island and operationally will always be problematic and difficult.

Costs could easily escalate, during construction and into operations and maintenance.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

4.5.5 Technical Risk

From a technical perspective, variable grade sewers require adequate velocity in the pipes sufficient enough to carry solids, without them dropping out of the flow, increasing risk of blockages within the network.

Preliminary assessment conducted by PS Solutions identified that this option was unlikely to be technical feasible on Scotland Island.

Evaluation team deemed: Technically high risk, **negative**.

4.5.6 Work, Health and Safety

If a technical design solution providing variable grade sewer for Scotland Island was possible, the construction works would be high risk to achieve a successful system.

The locations of lift stations need careful consideration for access and maintenance, whilst maintaining the requirements of the system such as pipe velocity.

Operational risk high – system will likely be problematic, labour intensive

Public health risk high – overflows, odour

Evaluation team deemed: Negative impact, high WHS risk.

5 SEWERAGE SERVICING OPTIONS EVALUATION

5.1 Do Nothing

5.1.1 Description of Option

Scotland Island properties are currently serviced by on-site systems, many of which are non-compliant to minimum standards. The study in 1997 identified that faecal coliforms are present in the non-potable water supply. Soil sampling conducted as part of this study also identified faecal coliforms in the soil.

5.1.2 Environmental Impact

PS Solutions conducted desk-top assessment and on-site investigations on Scotland Island, including a number of detailed property audits as a component of this feasibility study. It was identified that the majority of on-site systems are non-compliant to minimum standards and therefore are likely to be causing environmental damage, ground water contamination and public health concerns.

This environmental impact has been reaffirmed by the data collected from this and previous studies.

Evaluation team deemed: **Negative** environmental impact

5.1.3 Community Acceptance

The Scotland Island Community Association has been actively lobbying government representatives and Northern Beaches Council for water and sewerage services to Scotland Island. It is understood from these communications that the vocal members of the community that want sewerage services on the Island.

A number of feasibility studies have been undertaken over the years, including the study conducted in 1997 which identified a number of risks associated with the current system. It is understood that from a community perspective, these studies resulted in no action or improvement of service. Therefore, it is likely that a ‘Do Nothing’ approach would be perceived by the community as another feasibility study that has resulted in no action.

Based on the investigation works conducted by PS Solutions, and talking with many residents on the Island, it is estimated that approximately 10% of the community would like to keep their existing onsite system. However, costs are a key determining factor in the community’s level of acceptance.

Water and soil sampling on the Island has identified that there are real health and environmental risks associated with doing nothing.

If enforcement occurred to get each lot up to minimum code and compliance requirements, many of the lots would become uninhabitable – which is not an option for Council – as the Island was historically declared by Council as having developable lots.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.1.4 Stakeholder Acceptance

Historically, the servicing responsibilities for Scotland Island and associated risks have shifted to other stakeholders, such as Northern Beaches Council, NSW Environmental Protection Authority (EPA), Scotland Island Community Association (SICA), Sydney Water.

This criteria was scored more negatively by the evaluation team compared to how it may have been scored 10 years ago, primarily due to a change in acceptance of legal liabilities. Legally, if an entity has an expertise in an area, the risk cannot easily be transferred or ignored.

As such, investigations and soil sampling consistently flag serious health and environmental concerns on Scotland Island.

Stakeholders need to accept that this is a collective problem that requires a solution, therefore 'Do Nothing' is no longer a viable option therefore was assessed this way.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.1.5 Technical Risk

Technically, it is impossible to make the 'Do Nothing' option plausible even with enforcement, as it is not technically possible to get many of the on-site systems on Scotland Island to meet Australian Standards compliance, this is primarily due to lot sizes and slope.

Evaluation team deemed: **Negative** technical risk

5.1.6 Work, Health and Safety

On-site systems have been installed on Scotland Island which do not satisfy minimum code requirements, therefore providing a public health and environmental risk.

This risk has been reinforced by the findings from the water and soil sampling conducted as part of this study, and previous studies. There is high risk to public health on Scotland Island.

Evaluation team deemed: **Negative, high-risk** to WHS on Scotland Island

5.2 Upgrade of Existing Domestic Systems (Managed System)

5.2.1 Description of Option

This option proposes the upgrade of all the physical on-site systems and the engagement of a functioning operating strategy with an ownership and management plan.

Assumptions of this option include:

- That there is an effluent disposal strategy is in place; and
- That there will be a common body to make the system work.

5.2.2 Environmental Impact

Construction disturbance on property will be high, in many cases needing to remove the existing system and install a larger replacement system.

A centrally managed system implementing the operational strategy and management plan is required for there to be potential of an environmental improvement, however sustainability of this strategy will be an ongoing concern.

However, it was identified during PS Solutions detailed property audits, that there are examples where new existing onsite systems, approved within the last 4-5 years, are already failing, due to:

- limited irrigation area,
  - mechanically overflowing and
  - trenches are overflowing
- Soil does not have capacity for effluent disposal volumes
- Land disposal areas are largely insufficient
- Non-compliance to Australian Standards

Therefore, even by upgrading existing on-site systems and implementing a managed system strategy it is likely that the on-site systems will continue to fail.

Evaluation team deemed: **Negative** environmental impact

5.2.3 Community Acceptance

One of the aspects of achieving compliance with the on-site system, is having adequate irrigation area. Many properties are likely to be limited with area available for irrigation. In these cases, if there is not enough land area on the property to irrigate, then the system effluent must be pumped-out and remotely disposed.

It is understood that few properties would currently pump their systems out, unless out of necessity. Therefore, this option will generally require a change in behaviour across broader community, and the systems will become more labour intensive than current processes.

Regardless of the pump-out requirements, solids within the on-site systems require regular removal.

Accessibility for the pump-out truck to access the on-site systems will be required, potentially resulting in road upgrades and clearing requirements.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.2.4 Stakeholder Acceptance

Minimum compliance requirements for on-site systems will be difficult to achieve on Scotland Island, even if the systems are upgraded and the operation of the systems are centrally managed, resulting in continuing implications on environment and health.

Product manufacturers generally specify that on-site systems are required to be serviced once a quarter, therefore with 370 properties on the Island, an agent would be required to service 5 properties per day in order to meet the regular servicing requirements.

How do Stakeholders get comfort that these servicing requirements are being maintained?

Part-privatisation option?

The servicing strategy for the Island would likely lead to equity issues with other customers of the stakeholder, particularly where these customers have on-site systems but do not have a managed servicing strategy being provided. The difference in strategy/policy for providing the service may be place because it is an island.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.2.5 Technical Risk

It is likely that installing an upgraded system may not be technically achievable for some properties. For example, assuming the site was upgraded with an AWTS with approximate dimensions around 2.4m diameter by 2.4m deep, some properties will not have this land space to install unit of this size.

For the properties that do have the land space to install an upgraded unit, minimum compliance requirements on many properties will be difficult to achieve. Therefore, likelihood of ongoing failure of the system as a collective is high.

A clear distinction will be required defining:

- who will own the asset; and,
- who will be responsible for the onsite systems working and being maintained.

Evaluation team deemed: Technically **high risk / negative impact** option, with limited chance of ongoing success and improvements in public health and environmental concerns.

5.2.6 Work, Health and Safety

Despite implementation of an upgraded, managed system and effluent disposal strategy, water logged ground will still exist, due to the composition and type of soils on Scotland Island that have limited capacity, therefore the effect on public health and the environment is likely to continue.

Evaluation team deemed: **Negative, high-risk** to WHS on Scotland Island

5.3 On-Site Grey Water Reuse using existing septic tank, with on-site reduced disposal

5.3.1 Description of Option

It was identified previously that success of the on-system options, in many cases, would be limited by the size of the property's irrigation area and soil capacity, in which land disposal areas have been identified as largely insufficient on Scotland Island.

This option to reuse the on-site grey water indoors aims to reduce the onsite disposal requirements by utilising the grey water from the existing septic tanks.

The grey water reuse would require separate plumbing to be installed on the property.

5.3.2 Environmental Impact

This option is non-compliant to standards, unless an approved grey water treatment is also installed on each property. The greywater must be treated and disinfected before storage and general reuse, and be suited for intermittent use, if required (such as for a holiday home).

The following is an extract from http://www.yourhome.gov.au/water/wastewater-reuse.

> *Any greywater reused indoors must be disinfected. All disinfection systems require frequent maintenance. Chlorine, although the most common disinfectant, has been found to have adverse environmental impacts. Alternatives such as UV or ozone disinfection should be used where possible, but they do require electric power to operate. UV sterilisers disinfect the water as it passes through them and use about 20–40W of electric power depending on the water flow rate they can treat. Ozone systems use about 50W of power and operate for about 30 minutes six to eight times a day depending on water usage.*

Evaluation team deemed: **Negative** environmental impact, whether greywater treatment was, or as not installed on the property.

5.3.3 Community Acceptance

On-site greywater treatment system would need to be installed as well as the addition plumbing on the property. This treatment and disinfectant system would be additional infrastructure located on the property, requiring additional regular maintenance.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.3.4 Stakeholder Acceptance

This option does not achieve much improvement to the current situation, therefore current stakeholder risks and responsibilities remain.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.3.5 Technical Risk

Technically this option will not achieve much improvement on the current situation.

- Requires separate plumbing on the property, and the
- Quality of grey water is high risk, therefore public health and environmental concerns remain.

Evaluation team deemed: **Negative** technical risk

5.3.6 Work, Health and Safety

This option does not improve on the current WHS situation on Scotland Island, and introduces an additional risk of greywater reuse quality affecting public health and the environment

Evaluation team deemed: **Negative, increased risk** to WHS on Scotland Island

5.4 Tanker Truck Disposal from each lot

5.4.1 Description of Option

It has been identified that compliance will be difficult to achieve with on-site sewage systems sewage systems. This option investigates the possibility of tanker trucks disposing of sewage collected directly from each property.

Theoretically removing the health and environment risks associated with inadequate on-site treatment and disposal.

5.4.2 Environmental Impact

The ongoing operational impact of the tanker trucks tasked with collecting and disposing of effluent from each lot is extremely high.

An upgrade to most Island roads would be required to transport tanker trucks. The evaluation team calculated that 20 tanker trucks per day would be required to service the 370 properties on Scotland Island, resulting in:

- High disturbance on the Island; and
- Low sustainability measure

Evaluation team deemed: **Negative** environmental impact

5.4.3 Community Acceptance

It was estimated that in order to service the 370 properties, 20 tanker trucks on Scotland Island would be required each day, resulting in most of the roads on the Island needing to be upgraded to accommodate this volume of traffic.

The amenity of the island would be greatly affected. Barging and a holding tank may need to be constructed on the Island and odour would be an issue.

The costs to maintain ongoing disposal would need to be considered, as well as the costs and implications of ordering a tanker truck for emergency pump-out.

Evaluation team deemed: Negative community acceptance anticipated.

5.4.4 Stakeholder Acceptance

The logistics of providing a disposal / discharge arrangement for 20 tanker trucks and barging per day would be problematic, and not a sustainable ongoing strategy.

Council would be required to upgrade the road network on Island to accommodate the estimated 20 tanker trucks per day.

Public health and environmental risks would remain an ongoing concern for stakeholders and the option is not equitable amongst stakeholder customers.

Evaluation team deemed: Negative stakeholder acceptance anticipated.

5.4.5 Technical Risk

Technically managing the logistics of the 20 tanker trucks required per day to collect and dispose of sewage from every property, on and off an Island, is not a sustainable solution.

Evaluation team deemed: Negative technical risk

5.4.6 Work, Health and Safety

The daily transportation of 20 tanker trucks, operating on an off the barges and around the Scotland Island road network, on and off every property, introduces many WHS risks.

Evaluation team deemed: Negative, high-risk to WHS on Scotland Island

5.5 Tanker Truck Disposal from Common Collection Storage Tank

5.5.1 Description of Option

Installation of a collection system on Scotland Island, collecting and transporting septic tank effluent or live sewage to a central common collection tank.

Tanker truck could remain on the barge, therefore upgrades of the roads not required.

No bore under Pittwater would be required.

5.5.2 Environmental Impact

The collection system reduces the risk of illegal discharges into the Pittwater, and takes sewage off the property, reducing seepage into groundwater, improving public health and environment risks.

There will be issues with odour around the common collection tank on the foreshore.

The type of collection system selected will affect the environmental impact, however the various system types were assessed in the previous section.

Evaluation team deemed: **Neutral balance** of environmental impact

5.5.3 Community Acceptance

This option removes sewage off each property, shifting responsibility away from the property owners, which is likely to be viewed positively by the community.

However, there will be issues with odour around the common collection tank, which will need to be situated on the foreshore. Location of tank would be on the western foreshore, where the ferry's land at Church Point, Bay View or Rowland Reserve affecting the amenity of the area.

This option is not equitable compared to the services provided elsewhere, therefore it is unlikely the community will be accepting of this solution.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.5.4 Stakeholder Acceptance

The retention time of the sewage could easily be two days old by the time it is discharged into Sydney Water's network;

- from the point of discharge at the property,
- transportation through the network,
- into the common collection tank for storage, until
- the tanker truck collects the sewage, and
- discharges it into Sydney Water's network.

Sydney Water may be resistant to receiving 2 day old, highly septic and odourous, sewage into its network which has potential to effect issues such as;

- asset condition;
- treatment processes;
- customer complaints, etc.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.5.5 Technical Risk

Technical assessment would be required to determine a suitable location in the Sydney Water network to discharge the septic sewage, assessing details such as;

- Required flow rate;
- Capacity within network;
- Adequate dilution; and
- Odour

Evaluation team deemed: **Neutral** technical risk

5.5.6 Work, Health and Safety

WHS risks can be managed with this option, in particular situating the common collection tank on the waterfront to eliminate the requirement for the tanker truck to disembark from the barge.

Sewage collection into the tanker truck can be achieved efficiently, reducing the WHS impact on the island itself.

Evaluation team deemed: **Neutral risk** to WHS on Scotland Island

5.6 Upgrade existing on lot systems with disposal redirected to Pittwater

5.6.1 Description of Option

Upgrade the existing on-site systems, to redirect effluent disposal off the property, for direct discharge into Pittwater.

5.6.2 Environmental Impact

Minimises many of the on-property works requirements comparatively to other on-property upgrade options.

Redirecting effluent to Pittwater may reduce the effluent currently being absorbed into the soils, however detailed property audits have identified that the inground treatment on many properties is not currently adequate.

Evaluation team deemed: **Negative** environmental impact

5.6.3 Community Acceptance

There is already a perception of pollution around Scotland Island based on discussions with community members, therefore disposing effluent from the septic into Pittwater will add to this concern.

Knowing that effluent directly from individual properties into Pittwater is likely to raise further public health and environmental concerns, for example impact on children playing in the creeks and along the waterways.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.6.4 Stakeholder Acceptance

This option to directly discharge effluent into Pittwater cannot meet ANZECC (1992) guidelines, and it is anticipated that NSW Public Health would have major concerns.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.6.5 Technical Risk

This option to directly discharge effluent into Pittwater cannot meet ANZECC (1992) guidelines, and it is anticipated that NSW Public Health would have major concerns.

Increased, and regular, water sampling and monitoring would be required to ensure that the solution was not increasing/contributing to pollution in the area.

Evaluation team deemed: Technically **negative impact / high risk** option, with limited chance of success.

5.6.6 Work, Health and Safety

The effluent concentration discharged into Pittwater is an introduced risk of this option, as detailed property audits identified that inground treatment is not currently adequate on many properties.

Evaluation team deemed: **Negative impact, high-risk** to WHS on Scotland Island

5.7 Septic tank effluent pump-out (STEP) system, discharging to an island treatment facility with Pittwater disposal

5.7.1 Description of Option

This option investigates a pump-out system directly from the septic system, transporting effluent through a collection system, discharging to a treatment facility located on Scotland Island, with treated effluent disposal into Pittwater.

5.7.2 Environmental Impact

Removes effluent off the property, reducing seepage into groundwater, and therefore vegetation deterioration. This option reduces the risk of illegal discharges into the Pittwater.

Sewage treatment to occur on the Island, with a suitable site required for the treatment plant.

Evaluation team deemed: Neutral environmental impact

5.7.3 Community Acceptance

The inclusion of a treatment plant into this option, improves the acceptance from the previous option 6 (effluent discharge directly from properties into Pittwater).

The affected amenity of a treatment plant being located on the Island is anticipated to be viewed upon negatively by the community.

In addition, not all existing septic tanks would suitable for the STEP system, therefore many are likely to need upgrading to larger tanks, and subsequent on-property works.

Evaluation team deemed: **Negative** community acceptance anticipated.

5.7.4 Stakeholder Acceptance

Responsibility, ownership and operation of a satellite sewage treatment plant and system located on Scotland Island is unlikely to be accepted by any stakeholders as similar systems tend to be labour intensive and are unviable without subsidy.

Evaluation team deemed: **Negative** stakeholder acceptance anticipated.

5.7.5 Technical Risk

Not all existing septic tanks would suitable for the STEP system, therefore it is likely that many would need upgrading to larger tanks, and subsequent on-property works.

Technical implications of receiving sewage from the septic tank on the treatment plant will be high. This is because the septic tank will have left all the elements in the sewage that are hardest to treat in the system e.g. nitrogen.

In all likelihood, carbon will need to be added back into the sewage at the plant in order run the treatment processes.

Evaluation team deemed: Technically negative impact / high risk option, predominantly associated with the treatment complications of receiving high volumes of effluent from septic tanks.

5.7.6 Work, Health and Safety

The water tightness (extent of external water entering or exiting the system, such as I&I) of the independent on-property systems will become a component of the entire system, as this component needs to be contemplated in the sizing and design of the treatment plant.

Increased operational risks associated with a satellite treatment plant.

Evaluation team deemed: Negative, high-risk to WHS on Scotland Island

5.8 Septic Tank Pump-Out System discharging to Sydney Water

5.8.1 Description of Option

This option investigates a pump-out system directly from the septic system, transporting effluent through a collection system crossing the Pittwater, for discharge into Sydney Water's network.

5.8.2 Environmental Impact

Removes effluent off the property, reducing seepage into groundwater, and therefore vegetation deterioration. This option reduces the risk of illegal discharges into the Pittwater.

It was considered a better option than previous option 7 (pump out to treatment plant located on Scotland Island) from an environmental perspective.

However, there's not positive reason to keep the on-property septic tank as part of the solution for this option, as Sydney Water will treat the sewage regardless of treatment in septic.

Evaluation team deemed: Slightly positive environmental impact

5.8.3 Community Acceptance

This solution provides a servicing solution that removes sewage off the property and removes it off the Island into Sydney Water's network.

However, not all existing septic tanks would suitable for the STEP system, therefore many are likely to need upgrading to larger tanks, and subsequent on-property works.

Evaluation team deemed: Slightly positive community acceptance anticipated.

5.8.4 Stakeholder Acceptance

In the evaluation team's experience, Sydney Water would likely prefer non-treated sewage into their network, rather than effluent higher in nitrogens and more difficult to treat.

The configuration of this option presents a difficult utility ownership model for stakeholders, because there are assets on private properties that are not being replaced; i.e. dedicating non-performing assets to a utility, would usually flag as a high unacceptable risk structure.

Evaluation team deemed: **Slightly positive** stakeholder acceptance anticipated.

5.8.5 Technical Risk

The Collection system would be required to transport septic effluent to a sewage pumping station, for pumping across Pittwater to the mainland.

Technical complexities would arise with the various property connection configurations and arrangements required to collect effluent from existing septic tanks.

The under bore required across Pittwater, also has complexities associated with this option, such as:

- Pumping (septic, treated) effluent across Pittwater for discharge into suitable location within the Sydney Water network;
- Effluent pumps required at each property (same principle as pressure sewer system, but different type of pumps).

Evaluation team deemed: Technically **negative impact / high risk** option,

5.8.6 Work, Health and Safety

Construction risks and high potential for cost escalations associated with on-property works

- Residual risks from utilising onsite septics,
- More trouble than benefits.

Evaluation team deemed: **Negative impact, high-risk** to WHS on Scotland Island

5.9 Installation of a Sewerage Collection System Discharging to a Treatment System on the Island, with Disposal to Pittwater

5.9.1 Description of Option

Installation of a new sewerage collection system, discharging to a treatment facility located on Scotland Island, with treated effluent disposal into Pittwater. Decommissioning/removal of on-site septic systems.

Assumption: Pressure sewerage system was evaluated as the collection system for this option.

5.9.2 Environmental Impact

Removes sewage off the property, reducing seepage into groundwater, and therefore vegetation deterioration. Reducing the risk of illegal discharges into the Pittwater.

Clarification on consent requirements for disposing of effluent into Pittwater would be required.

Brooklyn, Dangar Island and Hawkesbury River systems discharge effluent into these waterways, however these are not good examples of precedence for their disposal is into waterways better flushed than Pittwater.

Evaluation team deemed: **Slightly positive** environmental impact

5.9.3 Community Acceptance

It is anticipated the community acceptance for this option on balance to be neutral.

Community perception regarding treatment then discharge into Pittwater, is likely to be negative, along with the affected amenity of a treatment plant being located on the Island.

However, this option does provide a solid sewerage servicing solution for the residents on Scotland Island, with the ability to improve upon their public health and environment concerns.

Evaluation team deemed: **Neutral** community acceptance anticipated.

5.9.4 Stakeholder Acceptance

Council would no longer be responsible for the septic tanks on properties, as these would have been decommissioned/removed. Compliance with codes and standards can be achieved, reduces associated risks for stakeholders.

However, responsibility, ownership and operation of a satellite sewage treatment plant located on Scotland Island is unlikely to be accepted by any stakeholders as similar systems tend to be labour intensive and are unviable without cross-subsidy.

Effluent disposal consent remains the key consideration for resolution, in terms of assessment moving forward.

Evaluation team deemed: **Neutral** stakeholder acceptance anticipated.

5.9.5 Technical Risk

From a collection system perspective, retrofitting a new system into an existing area is always difficult but risks the can managed.

Sewage received at the treatment plant will be easier to manage and treat than the effluent from the septic tanks (option 7).

Evaluation team deemed: **Slightly positive** technical risk

5.9.6 Work, Health and Safety

Construction risks are more typical to the types of risks on other similar projects, and therefore can be managed accordingly.

Evaluation team deemed: **Positive balance** of risk and impact to WHS on Scotland Island.

5.10 Installation of a sewerage collection system discharging to a treatment system on the Island, with dry weather disposal to Sydney Water, wet weather disposal to Pittwater

5.10.1 Description of Option

From previous experience, the NSW EPA would rather discharge treated effluent into waterways, than untreated sewage with a wet weather component.

It is understood that the NSW EPA has expressed that no nutrients are to be discharged into the Hawkesbury River.

This option was removed from the evaluation process, due to the assumption at the beginning of the workshop that Sydney Water has adequate capacity in their network for servicing of Scotland Island.

5.11 Collect Sewage and Pump to Sydney Water sewerage system

5.11.1 Description of Option

Installation of a new sewerage collection system, with pumped flow via an under bore across Pittwater, discharging into Sydney Water's sewerage system.

Decommissioning/removal of on-site septic systems.

5.11.2 Environmental Impact

Most of the retrofitted sewerage reticulation could be directionally drilled. Sewage no longer leaching into soils and ground water – resulting in a positive environmental impact.

Pumping station required to pump flows across Pittwater.

Evaluation team deemed: Positive environmental impact

5.11.3 Community Acceptance

Provides equity of service, reliability, health benefits comparative to customers on mainland Sydney, whilst minimising operational responsibilities on the Island. Comparable to Dangar Island.

Evaluation team deemed: On the balance of all the options it is anticipated community acceptance positive in comparison.

5.11.4 Stakeholder Acceptance

Risk is transferred to the organisation best placed to manage the risks. Provides a fully equitable solution that's comparable to Dangar Island, which was implemented and now operated by SWC;

Viability of the solution still requires needs to be determination and measurement, in terms of,

- Environment
- Public health
- System capacity

Evaluation team deemed: Positive stakeholder acceptance anticipated.

5.11.5 Technical Risk

Any retrofit solution has its difficulties and complications, however site investigations and audits identified no complications that have not been addressed before, therefore risks are manageable. Such as,

- Sewage pumping station may be required,
- Under bore across Pittwater.

Evaluation team deemed: Positive balance of technical risk

5.11.6 Work, Health and Safety

Public health and environmental risks are addressed with this option, resulting in

- Less odour,
- Less chance of overflow,
- All risks are manageable

Evaluation team deemed: Positive balance of technical risk

5.12 Non-potable Reuse

5.12.1 Description of Option

Soil absorption capabilities and irrigation opportunities are limited on Scotland Island, and no other users on the Island have been identified that may be interested in non-potable reuse water. A typical customer for non-potable reuse water in other servicing areas is a Golf Course for irrigation purposes.

5.12.2 Environmental Impact

The additional infrastructure required to be installed to facilitate non-potable reuse on the island, on balance is likely to have a negative impact based on limited users for the service/product.

Evaluation team deemed: **Slightly negative** environmental impact

5.12.3 Community Acceptance

The perceived sustainability of a non-potable reuse system on the Island may be viewed positively by the community.

Evaluation team deemed: Positive community acceptance anticipated.

5.12.4 Stakeholder Acceptance

The costs, risks and responsibilities associated with providing non-potable reuse would significantly out-weigh any benefits.

Evaluation team deemed: Negative stakeholder acceptance anticipated.

5.12.5 Technical Risk

Providing suitable quality of non-potable reuse would involve many technical risks, that would out-weigh the benefits of the system on Scotland Island.

Evaluation team deemed: Technically **negative impact / high risk** option,

5.12.6 Work, Health and Safety

Maintain suitable water quality, chance of cross-connections, would introduce risks within the system.

Evaluation team deemed: **Negative** impact to WHS on Scotland Island

GLOSSARY / ABBREVIATIONS

AWTS	Aerated wastewater treatment system
DICL	Ductile iron cement lined
EPA	Environmental Protection Authority
ET	Equivalent Tenement = Number of Equivalent Dwellings
GSS	Gravity sewerage system
HDB	Horizontal Directional Boring
HDD	Horizontal Directional Drilling
I&I	Ingress and Infiltration
MCA	Multi-criteria analysis
ML	Mega Litre
NBC	Northern Beaches Council
PE	Polyethylene
PSS	Pressure sewerage system
PSU	Pressure sewer unit
PW	Potable water
RW	Recycled water
SICWG	Scotland Island Community Working Group
SIRA	Scotland Island Residents Association
SPS	Sewage Pumping Station
SRM	Sewer Rising Main
STEP	Septic tank effluent pump-out
STP	Sewage Treatment Plant
SWC	Sydney Water Corporation
VSD	Variable speed drive
VSS	Vacuum sewerage system
WHS	Work, health and safety
WWPS	Wastewater pump station

ATTACHMENT 1 – SCOTLAND ISLAND OPTION MATRIX

ATTACHMENT G:

SCOTLAND ISLAND STAGE 1b WATER SERVICING OPTION REPORT

DETAILED DESCRIPTION OF SCOTLAND ISLAND

PS Solutions

SCOTLAND ISLAND DESCRIPTION (12)

The Pittwater Estuary is a drowned river valley located near the mouth of the Hawkesbury-Nepean River system. The estuary is about 10 km in length and 1 km in width, with a maximum depth of 20 metres. Water quality issues in Pittwater are mostly confined to shoreline areas and are more pronounced in the southern part of the waterway. Flushing is restricted in the bay areas, with wind driven currents more dominant than tidal currents in mixing and flushing processes. Dredged areas (common in the southern embayments) also have poorer water quality as flushing is reduced in deeper water.

Water quality in the tributaries, embayments and the main estuary body of Pittwater is poor to extremely poor following rainfall, and otherwise reasonable. Poor water quality following rainfall is mostly due to runoff from developed land areas.(12)

Pittwater is highly valued as an ecological and recreational resource. Numerous primary and secondary contact recreational activities take place, including swimming, sailing, kayaking, fishing, sailboarding, kite-surfing, water skiing and boat and shore fishing.

1 Scotland Island

Scotland Island is about 55 ha and located at the southern end of the Pittwater estuary. In the 2016 Census there were 579 people living in 359 private dwellings on Scotland Island. Only 209 of those dwellings were occupied at the time of the census. Over half the population is employed. These figures are down from 715 residents in 344 dwellings in the 2011 Census, with 252 dwellings occupied at the time of the census.

The proportion of permanent residents has gradually increased over time, although it has historically fluctuated.

Table 1-1: Scotland Island Population 2001 - 2016

Census Data	
Year	**Population**
2016	579
2011	715
2006	642
2001	734

Source: Australian Bureau of Statistics

The only option for further development on Scotland Island is redevelopment of existing lots. This takes the form of knock-down-rebuilds or upgrading existing holiday house and beach shack accommodation to permanent residences. Redevelopment has been occurring for a number of years, seeing increases in the size of houses and the population. The size of housing is somewhat restricted by a requirement to maintain 80 percent of the property as landscaped area. Associated with an increase in the size and value of dwellings has been an expectation to have upgraded facilities such as dishwashers.

2 Existing water and wastewater services

2.1 Water supply

There is no true centralised water supply on Scotland Island. Residents rely on rainwater tanks, supplemented by purchases of water from an emergency supply line.

Around 1977, an emergency supply pipeline was built by Warringah Council to supply water for firefighting. The pipe was damaged by boats and replaced one metre below the estuary floor in 1988, at which time Council agreed that the supply could be used as an emergency top-up supply for rainwater tanks in the event of low rainfall.

Sydney Water ownership of the system ends at the connection at Church Point. Northern Beaches Council is responsible for the 37mm ID polyethylene submarine pipeline to the reservoir located at the top of Scotland Island.

When Pittwater Council attempted to disconnect the line due to safety concerns, SIRA accepted legal responsibility for the lines in 2002 and upgraded the system across Scotland Island. SIRA, acting on behalf of the residents, pays Council for the water, and then distributes it from the reservoir to residents for a fee. There are three polyethylene pipelines around Scotland Island, maintained by a trust fund derived from SIRA through a user pays arrangement. The pipeline distributes the water to standpipes, where residents can attach a hose to top-up their tanks.

A proportion of households use the emergency supply as their primary supply, as indicated by the average demand for Scotland Island of 13 kL per year over the last five years. There is high demand for the emergency supply during drought, when residents have to book in weeks in advance to fill their tanks.

When it was last assessed, the pipe was in poor condition and exposed in many locations, meaning it is susceptible to puncture, burning and melting and at risk of wastewater infiltration. Limited testing of water supplies on Scotland Island in a 1996 study found faecal coliforms present in private rainwater tanks (most likely due to animal droppings) with some exceeding recommended levels for potable water, and in the emergency water supply line (possibly due to wastewater infiltration).

Pittwater Council Policy No. 76 notes that it is a non-potable supply that should be clearly sign-posted for that purpose, to only be used in the manner and for the specific purposes specified under the (unsigned) agreement with Sydney Water. SIRA's agreement for sale also clearly notes that the water is non-potable. While Sydney Water is required to deliver water that meets Australian Drinking Water Guidelines to the connection point, there is no similar requirement on SIRA for the water they deliver to island residents.

A small number of properties on Florence Terrace have a private water supply connection to Taylor's Point on the mainland. They operate as the Scotland Island Pipeline Company (SIPCO). SIPCO investigated expanding their scheme in 2013, but abandoned the process due to the cost of submitting a development application.

The emergency water supply has insufficient pressure to use for fire-fighting purposes (despite being originally provided for this). In a study in the 1990's, the Warringah Pittwater Bush Fire Service concluded that there was a high potential for loss of life and property.

2.2 Wastewater

There is no centralised wastewater system on Scotland Island. Septic systems with soil absorption trenches account for the majority of wastewater disposal. A small number of properties have aerobic wastewater treatment units (AWTS) and composting toilets. It is likely that a percentage of the septic systems have never been pumped out and many could be of a significant age. Most new developments on Scotland Island are now required to install an AWTS, so it might be assumed that wastewater management has improved to some degree in recent years.

Disposal areas are generally smaller than recommended in the Australian Standard. Some of the waterfront properties dispose of wastewater directly into estuarine sands, and for some, tidal sea water accesses and 'flushes' their disposal area. In these cases, little post-disposal treatment occurs before the water enters Pittwater.

If a reticulated town water supply were brought to Scotland Island without an accompanying reticulated wastewater network, it is likely that the current septic systems would become hydraulically overloaded and fail. It should be noted that this may already occurring with those properties relying on the emergency water supply as their primary supply.

3 Land capability for wastewater disposal

Scotland Island is steep-sided bedrock with shallow soils of sandy loam (highly permeable) with sandy clay loam sub-soils (highly impermeable). Both layers are highly acidic and encourage nutrients and contaminants to leach away from wastewater disposal areas. Previous mapping has indicated that up to 44 percent of Scotland Island is unsuitable for existing wastewater disposal systems.

The ephemeral streams in 15 water catchments on Scotland Island have been found in previous monitoring studies to have elevated nutrient, sediment and bacterial concentrations exceeding the ANZECC (1992) guidelines for surface water and saltwater estuaries. More recent data is not available. Streams require rainfall of 2-5mm/hr to generate runoff, after which water flows rapidly to Pittwater. Due to the soil's low capacity to accept and treat wastewater, it is dispersed from land application areas via sub-surface flow and surface runoff.

An additional source of dispersal is sediments, which absorb pollutants at the source and then migrate them to waterways. A study in 1997 suggested that up to 80 percent of the daily inflow to septic tanks may be transported from the adjoining absorption trenches to surrounding soil.

The steep slopes of Scotland Island contribute to an extreme erosion hazard for both non-concentrated and concentrated flows. Continuing redevelopment is contributing to sources of erodible sediment, with many building sites lacking erosion control measures. The isolation of Scotland Island has meant ensuring compliance has been difficult with the limited resources available at Council. It is possible that Scotland Island contributes in excess of 14 tonnes per hectare per year of suspended sediment to Pittwater, much of which is likely to be contaminated from exposure to on-site wastewater disposal.

Native vegetation responds poorly to elevated nutrient supplies and some dieback in Eucalypt species has been observed.

When considering soils, drainage lines, slope, proximity to waterways etc, approximately 40 percent of Scotland Island is unsuitable or marginal for on-site wastewater disposal.

4 Existing On Site Systems (11)

There are 343 On-Site Sewerage Management Systems listed on Scotland Island all are listed as Domestic systems

Treatment type

a) 118 are listed as AWTS,
b) 225 are listed as Septic Tanks
c) Land Application Area
    a. 234 have Absorption trenches
    b. 77 have surface spray
    c. 25 for sub surface irrigation
    d. 1 drip line
    e. 1 mound
    f. 5 unknown

Table 4-1 : Existing Waste Water Systems Condition/Performance

Risk rating	Number systems	Current Approval to Operate an On-Site Sewerage Management System	No current Approval to Operate an On-Site Sewerage Management System	Never received an Approval to Operate an On-Site Sewerage Management System	History of Failure requiring action this calendar year	Did not pass initial Approval to Operate an On-Site Sewerage Management System inspection	Local Government Act Notices since keeping of electronic records
Low	43	36	2	5			
Medium	143	126	10	7			
High	157	93	62	2			
Total	**343**	**255**	**74**	**14**	**34**	**104**	**115**

Typical Issues include but not limited to:

- Due to Scotland Island's shallow clay soil the land application areas often fail due to too much load
- Few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distances to a permanent water source
- few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distance to boundaries
- few properties meet the AS1547 for wet weather storage
- few properties meet the AS1547 for reserve land application areas
- the entire Island is shaded by tall trees that hinder evapotranspiration
- Majority of properties have been overdeveloped in regards to Design Load Rates

- Pump out of systems is incredibly hard due to needing a pump out barge or a barge to transport over a pump out truck, which is hard to access all sites due to poor roads
- The topography of Scotland Island is a major limiting factor in regards to installing tanks and Land Application Areas
- Scotland Island does not have much vegetation that is in accordance schedule 7 of the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households

5 Community expectations and lobbying history

The Scotland Island Residents' Association is a representative body of the residents of Scotland Island and has been lobbying the Government, Pittwater Council and Sydney Water on behalf of the residents for improved water and wastewater services for over 30 years. A 2015 survey of residents indicated that 96 percent of the 383 respondents wanted a wastewater connection on the condition that the only cost to households was the connection to the mains system.

SIRA has had an active history in advocating for improved infrastructure for Scotland Island:

1997	Scotland Island Landcare Group won a grant, administered by SIRA to investigate the environmental and public health impacts of current on-site wastewater disposal on Scotland Island, and consider water and wastewater options for Scotland Island.
2001	Scotland Island announced as one of 20 villages to receive improved wastewater infrastructure as part of Stage 2 of the Priority Sewerage Program (PSP).
Jun 2005	SIRA held a workshop with key stakeholders to discuss future water and wastewater infrastructure for Scotland Island.
Mar 2010	Pittwater Council raised concerns directly with Sydney Water that Scotland Island appeared to have been removed from the program for PSP.
Apr 2010	The Hon. Rob Stokes (Member for Pittwater) raised in Parliament the question of when PSP work would begin on Scotland Island. The response was that planning would begin in 2011, subject to funding *and a resolution by residents to upgrade* local water infrastructure.
Jan 2011	Soon to be Premier Barry O'Farrell committed to the fast-tracking of wastewater connections to a number of PSP identified villages in Wollondilly and Hornsby Shires, and said the remaining villages including Scotland Island were a priority.
Dec 2012	NSW Government commitment in Northern Beaches Regional Action Plan (under NSW 2021) to better manage wastewater and upgrade wastewater treatment facilities to Scotland Island as a matter of priority.
Aug 2014	SIRA submission to review of Sydney Water's Operating Licence review in support of Sydney Water retaining responsibility for delivery of the Priority Sewage Program as part of their next operating license.
Jan 2015	PR and letter campaign by SIRA and residents to Minister Humphries, IPART and EPA in response to a concern that Sydney Water was going to be released from the PSP as part of their Operating Licence conditions.
Jun 2015	Sydney Water's new Operating Licence has no firm commitment to deliver the PSP to Scotland Island.

Aug 2015 SIRA met with The Hon. Rob Stokes, Member for Pittwater.

Nov 2015 SIRA met with The Hon. Niall Blair, Minister for Lands and Water regarding installation of wastewater infrastructure plus subsequent correspondence.

Apr 2016 SIRA met with The Hon. Rob Stokes and decentralised service providers regarding options for water and wastewater provision on Scotland Island.

2016 Draft Pittwater Waterways Review Discussion Paper notes key issues raised in stakeholder engagement were sewage runoff from Scotland Island.

6 Stakeholders

Key stakeholders include Northern Beaches Council, Scotland Island Residents Association, Sydney Water, NSW Department of Planning and Environment, NSW Office Environment and Heritage (including NSW National Parks and Wildlife Service), NSW Health, residents of Scotland Island, recreational users of the Pittwater waterway, and environmental and community groups associated with Pittwater and its environs.

NORTHERN BEACHES COUNCIL

Business units	NECC and TCI
Key Subject Matter Experts	Ruby Ardren, Project Leader - Water Management
Executive Leadership Team	Todd Dickinson
Councillors	Kvlie Ferguson - Pittwater Ward Alex McTannart - Pittwater Ward Ian White – Pittwater Ward

Council and Government Stakeholders

Government Depts	The Hon. Rob Stokes, Member for Pittwater Dept Local Government Rural Fire Service Office Environment and Heritage
Service providers	Northern Beaches Council
Utilities	Sydney Water

External Stakeholders and Community

Local residents and property owners	All Scotland Island	Tenants

Local businesses	Operating from Scotland Island	Accommodation providers	Scotland Island Off-shore Children's Services (Scotland Island Kindy)
Users of facility/ area	Island Visitors	Recreational Pittwater Waterway users	
Community groups	Scotland Island Residents Association (SIRA)	Scotland Island Pipeline Company (SIPCO) - private consortium	
Environment groups	Bushcare Groups		

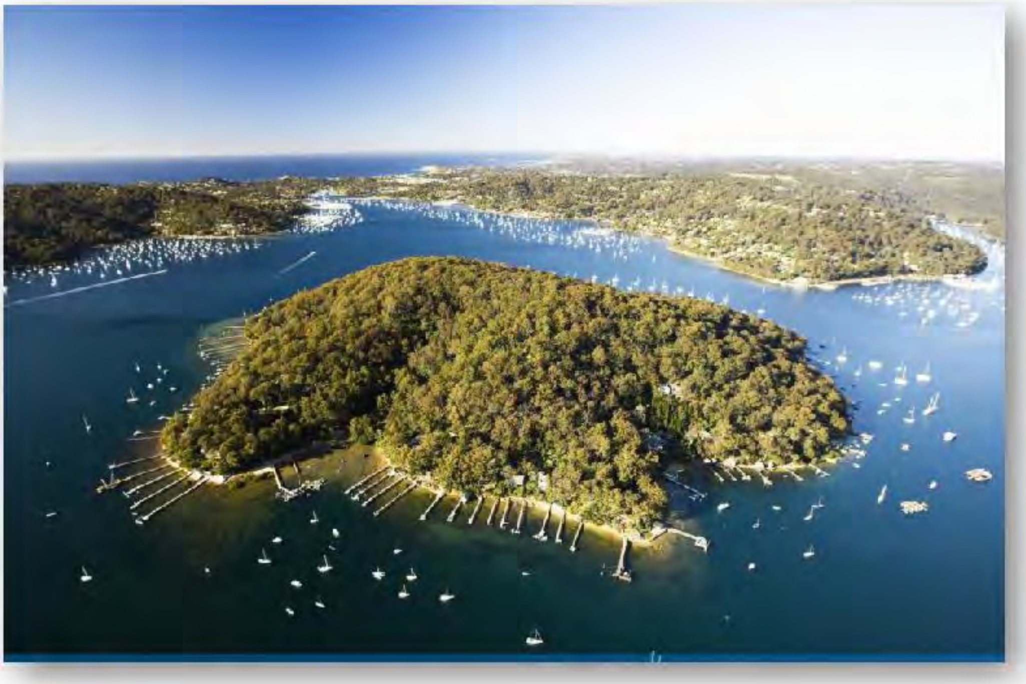
Others

- Beach Watch
- EPA
- Health Department
- Fisheries
- National Parks

FEASIBILITY STUDY

November 2019

SCOTLAND ISLAND
WATER AND WASTEWATER FEASIBILITY STUDY
STAGE 2 COMMERCIAL ASSESSMENT REPORT



PS Solutions

PRESSURE SYSTEM SOLUTIONS PTY LTD
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DRAFT FINAL REPORT

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Approval

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DRAFT FINAL REPORT

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1 EXECUTIVE SUMMARY

Northern Beaches Council engaged Pressure System Solutions to undertake a feasibility study for provision of water and wastewater services to Scotland Island. RPS were engaged by Pressure System Solutions to undertake the Cost Benefit Analysis part of the feasibility study.

This Stage 2 report is the final report of the overall feasibility study, a commercial feasibility assessment. The Stage 2 report also includes a separate report 'SCOTLAND ISLAND WATER INFRASTRUCTURE, Case for Investment; RPS 2020'.

Previous Reports:

Stage 1a report provided a high-level review of Social and Environmental factors.

Stage 1b report provided a technical assessment of water and wastewater servicing to Scotland Island, and analysed feasible servicing options, shortlisting two options in each area as follows:

SHORTLISTED OPTIONS FROM STAGE 1B REPORT
WATER SUPPLY OPTIONS
Low flow from Sydney Water
Full reticulated system from Sydney Water
WASTEWATER SERVICING OPTIONS
Pressure system
Hybrid system
WASTEWATER DISPOSAL OPTIONS
On-island treatment system
Discharge to Sydney Water

For commercial assessment preferred servicing options were selected from the Stage 1b report shortlisted options. The preferred servicing options are:

- Water Supply: Full reticulated water supply system from Sydney Water.
- Wastewater Servicing: Pressure Sewer System
- Wastewater Disposal: Disposal to Sydney Water sewage system.

This stage 2 report provides the commercial feasibility assessment including

- Case for Investment: assessing the economic, environmental, and indirect benefits of providing reticulated water and wastewater to the island, including
- a definition of the problem and the project need.
- a presentation of four infrastructure options that address these problems.
- a qualitative assessment of the benefits of supply infrastructure (Benefits Assessment); and
- an analysis of the potential funding models (Funding Analysis).
- Costs analysis: compilation of costs for construction and operation, and present value (PV) costs.

- Risk analysis of the water and wastewater servicing options.

The key outcomes of the feasibility study are that providing Scotland Island with potable reticulated water supply and wastewater collection system will:

- significantly reduce health risks,
- alleviate existing liability risks of Government stakeholders associated with the facilitation and acceptance of current solutions not complying to Australian Standards.
- Provide equity by addressing a long-standing community need for the services, which have been provided to similar communities in the past, and at a cost that is comparable to similar schemes.
- improve the quality of service for island residents; and
- significantly improve the local environment, both on and off the island.

These benefits accrue to a broad range of stakeholders including island residents and visitors, the Council, the local environment, and recreational users of the Pittwater bay.

Costing Summary:

- The preliminary estimate for the construction cost for the preferred water and wastewater servicing option is $68,428,764; equating to approximately $181,509 per lot.

Scotland Island

Scotland Island is located at the southern end of the Pittwater estuary. There are 377 lots (358 dwellings) on Scotland Island, and it is one of the largest villages in greater Sydney without a reticulated potable water supply or wastewater service. The Island is in close proximity to the northern beaches and urban areas of Church Point, Bayview and Bigola Plateau. The Pittwater Estuary has substantial recreational usage and high community and cultural significance.

The drinking water supply consists of household rainwater tanks and an emergency pipeline intended for firefighting purposes. The pipeline is non-compliant to Australian drinking water supply standards, and is classified as non-potable, but is now servicing the majority of residents on an ongoing basis. The use of the emergency pipeline for drinking water is a health risk to the community.

There is no centralised wastewater system on the island. The topography of the Island is not conducive to on-lot treatment and disposal, resulting in poorly treated wastewater being discharged into Pittwater.

Septic systems with soil absorption trenches account for the majority of wastewater disposal. Approximately a third of properties have aerobic wastewater treatment systems (AWTS). Most new developments on the island are now required to install an AWTS. Disposal areas are generally smaller than recommended in the Australian Standard AS/NZS1547. Some of the waterfront properties dispose of wastewater directly into estuarine sands, and for some, tidal sea water accesses and 'flushes' their disposal area. In these cases, little post-disposal treatment occurs before the water enters Pittwater.

Northern Beaches Council has identified the following compliance issues with Wastewater systems on the island:

- few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distances to a permanent water source.
- few properties meet the NSW Environmental & Health Protection Guidelines On-site Sewage Management for Single Households buffer distance to boundaries.
- few properties meet the AS/NZS1547 for wet weather storage; and

- few properties meet the AS/NZS1547 for reserve land application areas.

The issues with the sewerage infrastructure that led to these challenges included the unsuitability of the local geology with shallow soils and high rock levels, land reservation requirements, lack of compliance with Australian Standards and island generally steeply sloping topography. Poorly performing systems pose a potential health risk through:

- direct or indirect exposure to pathogens in effluent or effluent contaminated soil. Direct exposure includes contact with pooled effluent while indirect exposure includes recreation in an affected waterway; or
- exposure to pathogens by recreational users of local waterways.

They can also impact local residential amenity through increased mosquito numbers, the generation of odours, dieback of native vegetation and proliferation of noxious weeds. There is evidence of each of these impacts on the Island.

Provision of potable reticulated water and centralised wastewater services to Scotland Island will significantly reduce the above mentioned environmental and health risks to the community.

1.1 Funding Analysis Summary

The Capital Funding Analysis investigated how the cost of the scheme could be recovered through funding from either SWC / the NSW Government (Funding Option 1), or by SWC / the NSW Government through co-contributions from island residents (Funding Option 2).

Funding the infrastructure through SWC (Funding Option 1) is assessed as the most favourable option, as it leverages SWC's strong balance sheet and is much more likely to be accepted by the various stakeholders (i.e. SWC and island residents).

- Note: Attachment C: Report: 'RPS- Scotland Island Water Infrastructure – Case for Investment' provides additional commentary on Funding Options

1.2 Project Context

In February 1997, the NSW Government announced the Priority Sewerage Program (PSP), which nominated 16 unsewered villages, with high environmental sensitivity, for improved sewerage services. All schemes listed in the first stage of the scheme have been completed, including Brooklyn and Dangar Island. Scotland Island was included among another 20 villages identified in Stage 2 of the program, announced in 2001.

Sydney Water funded previous PSP schemes through the Sewer Service Charge that is levied on all existing Sydney Water wastewater customers. Sydney Water's Operating Licences between 2005 and 2015 obligated Sydney Water to implement the PSP in a number of nominated villages.

Sydney Water made submissions to IPART in 2014 arguing that an obligation to implement the PSP should not be included in their Operating Licence, as the Operating Licence was meant to ensure a minimum standard of service to existing customers (which residents of Scotland Island are not). However, Scotland Island is mentioned in the Sydney Water Operating Licence 2019-2023, requiring Sydney Water to participate cooperatively with NSW Government review of the PSP and implement and comply with any outcomes from a review of the PSP.

In light of IPART's considerations and noting that they did not discount the need for delivery of improved services to Scotland Island, it is considered that that changes in delivery efficiency, occupancy patterns on the island and impacts from existing systems warrant reconsideration of delivery of these essential services to Scotland Island.

As discussed above, there is an economic benefit in providing these services. Investigations suggest that it could be done at a cost lower than identified in Sydney Water's IPART submission. If so, the wastewater services could also be delivered at a lower indexed cost than those provided to Dangar Island, which was similar to Scotland Island in terms of servicing scope, environmental impact and need.

2 INTRODUCTION

This report is to be read in conjunction with the reports ' Stage 1a Report: High Level Review of Environmental Factors', and 'Stage 1b Report: Scotland Island Feasibility Options' November 2019.

2019 Feasibility study

To identify a pathway for provision of acceptable water supply and sewerage services on Scotland Island, the State Government's Stronger Communities Fund has funded a feasibility study. Northern Beaches Council are managing the study and have commissioned Pressure System Solutions to undertake the initial scopes of work to identify options and make recommendations for water and sewerage servicing. RPS were engaged by Pressure System Solutions to undertake the Economic and Funding analysis component of the study.

This report is Stage 2 of a three-stage process:

- Stage 1a - identification of environmental and social factors associated with water infrastructure servicing (Completed March 2019).
- Stage 1b - review of previous reports and identification of servicing options, shortlisting two in each category, and
- Stage 2 is the commercial assessment and identification of the pathway to delivering services on Scotland Island.

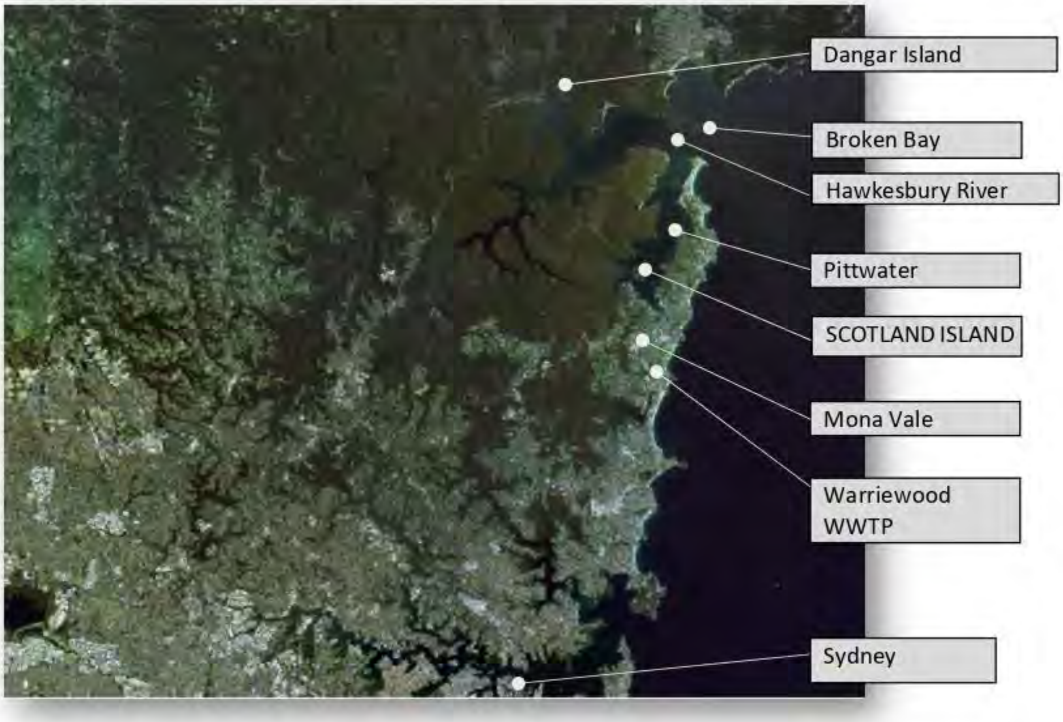
The objective of this Stage 2 report is to undertake a commercial assessment of the options shortlisted in Stage 1b.

Stage 2 Commercial Assessment

The stage 2 commercial assessment includes.

- Economic Assessment
- Risk Assessment for
- Planning
- Technical
- Environmental
- Stakeholder and Community Acceptance
- Construction
- Commercial Assessment

Figure 2-1: Scotland Island Location Plan



2.1 Report Objective

The objective of this report is to present the Commercial Assessment of the Wastewater and Water Servicing Options for Scotland Island, and present information on potential funding and financing models, and project delivery options.

2.2 Scotland Island

Scotland Island is one of the larger villages in greater Sydney without a reticulated potable water supply or sewerage services. Scotland Island is about 55 ha and located at the southern end of the Pittwater estuary. There are approximately 358 dwellings on Scotland Island with suburban development density. The Island is in close proximity to the northern beaches and urban areas of Church Point, Bayview and Bigola Plateau. In the 2016 Census there were 579 people living in 359 private dwellings on Scotland Island. Only 209 of those dwellings were occupied at the time of the census. Over half the population is employed. These figures are down from 715 residents in 344 dwellings in the 2011 Census, with 252 dwellings occupied at the time of the census. The proportion of permanent residents historically fluctuated.

Table 2-1: Scotland Island Population 2001 – 2016: Census Data

Year	Population
2016	579
2011	715
2006	642
2001	734

Source: Australian Bureau of Statistics

Figure 2-2: Scotland Island Urban Context

2.3 Feasibility Study Process Overview

The feasibility study is being prepared in stages.

Stage 1a of the process was a high-level review of Social and Environmental factors.

Stage 1b was an assessment of servicing options, including development of a Hydraulic Demand model, identification of potential water and sewerage servicing options, an initial technical assessment, and shortlist of two options for further detailed commercial analysis. (Completed). Two options were shortlisted for each water infrastructure category:

A. Wastewater Collection System Collection System

B. Wastewater Treatment and/or Disposal

C. Water Supply

SHORTLISTED OPTIONS FROM STAGE 1B REPORT
WASTEWATER SERVICING OPTIONS
Pressure system
Hybrid system
WASTEWATER DISPOSAL OPTIONS
On-island treatment system
Discharge to Sydney Water
WATER SUPPLY OPTIONS
Low flow from Sydney Water
Full reticulated system from Sydney Water

Stage 2 (this report) is the preparation of a commercial feasibility report examining the two short listed options for each category as determined in the Stage 1b report.

Preferred servicing options were selected from the Stage 1b report shortlisted options to facilitate some aspects of the commercial assessment. The preferred servicing options are:

A. WASTEWATER SERVICING: Pressure Sewer System
A pressure Sewer system is the preferred option because of the lower PV costs, and environmental benefits from less impact during construction.

B. WASTEWATER DISPOSAL: Disposal to Sydney Water sewage system.
Disposal of the wastewater to Sydney Water sewage system is preferred because of the lower PV costs, and reduced environmental impact to Pittwater.

C. WATER SUPPLY: Full reticulated water supply system from Sydney Water.
A fully reticulated water supply is preferred because it provides a level of eservice equitable to other customers within the Sydney Water area of operations.

The feasibility study is being undertaken by a multi-disciplined team including water infrastructure strategic planners, water services engineers, and environmental consultants, with input as required from cost planners and construction managers. Northern Beaches Council provided an overview management role, including engaging UTS Institute for Sustainable Futures to undertake independent external peer review of the option identification and evaluation methodology. The Scotland Island Community was consulted with a community working group contributing at key milestones.

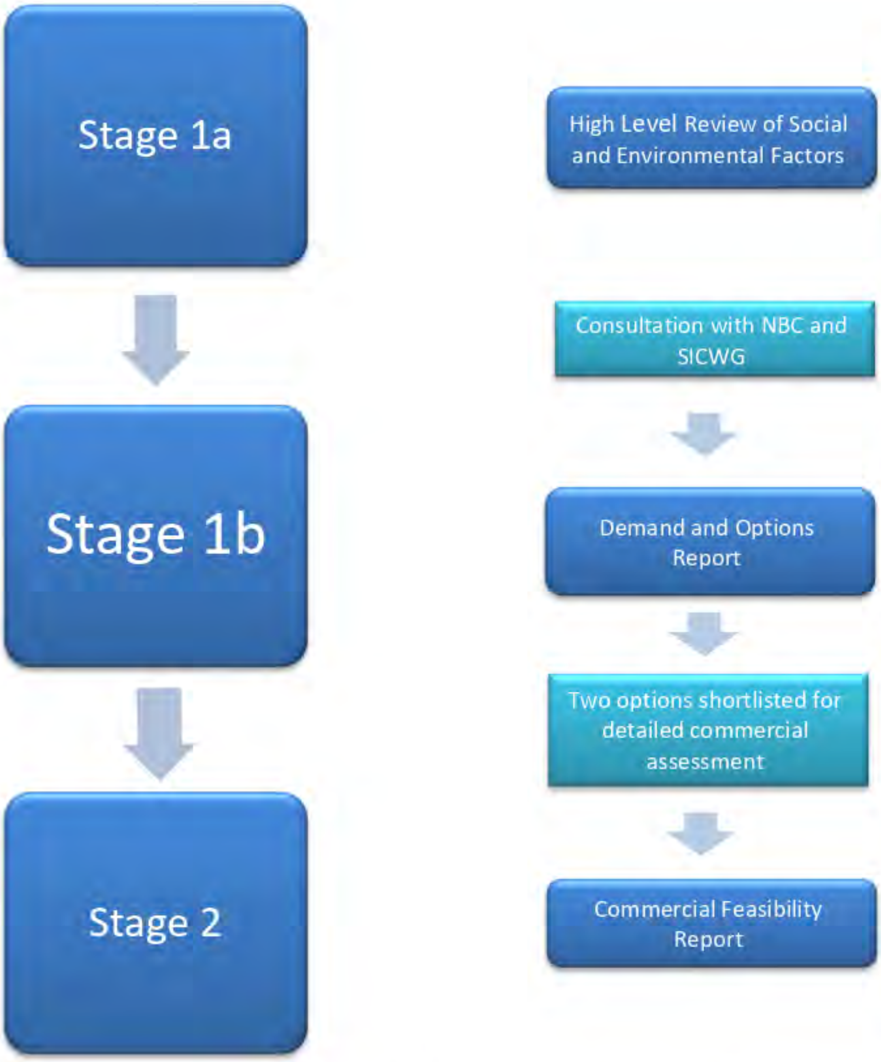


Figure 2-3: Feasibility Process Overview

2.4 Preferred Options

Refer to the Pressure System Solutions Stage 1b Report November 2019 for the determination of the Shortlisted Options.

The options shortlisted from the Stage 1b selection process for detailed costing and commercial funding modelling analysis are:

Wastewater Collection System options

A.2 Pressure Sewerage System

A.4 Hybrid System, combination of gravity and pressure sewerage systems

Wastewater Treatment and Disposal options

B.9 Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

B.11 Transport wastewater to a central pumping station and pump to Sydney Water sewerage system at Church point

Water Supply options

C.4 Replace existing small bore supply, provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks

C.6 Direct mains pressure supply from Sydney Water mains / pressure boost if required

3 RISK

A risk assessment was undertaken for the options. The risk assessment workshop was attended by

NAME	COMPANY	ROLE
Ruby Ardren	Northern beaches Council	Project Leader Water
Craig Kennedy	PS Solutions	Senior Civil Engineer
Steve Wallace	PS Solutions	Project Director
Gavin Ovens	GOH / PSS	Water Infrastructure Advisor
Chris Rust	PS Solutions	Design Manager
Kurt Dahl	Permeate Partners	Wastewater Treatment Consultant
Gareth Thomas	RPS	Environmental
Kapil Kulkarni	RPS	Investment Analysis

Refer to ATTACHMENT B: RISK ASSESSMENT for full risk analysis matrix including risk costing allowances.

3.1 Indicative Costings from Risk Assessment

Each option was evaluated for risk and risk mitigation strategies and assessed as low, medium, high or extreme risk level.

Indicative costs were allocated to Risks rated as medium or higher after identification of mitigation strategies. These costs are not including in the project costing budgets.

Table 3-1: Risk Item Costings

RISK ITEMS CARRIED FORWARD FROM RISK ASSESSMENT		
Risk Item	Description	$ (Excl GST)
P.1	Delays - Planning approvals	$ 324,000
P.21	Coordination risk in underbore	$ 100,000
E.2	Option B9 only, stringent operational conditions	$ 1,500,000
C.4	Land slip, unstable ground	$ 500,000
C.8	Excavations near structures requiring additional structural engineers assessment / support	$ 40,000
C.25	Construction equipment / machinery access & movement around the Island	$ 250,000
TOTAL		**$ 2,714,000**

4 COMMERCIAL ANALYSIS METHODOLOGY

4.1 Methodology

Commercial Analysis of the Scotland Island water servicing feasibility study included:

COST ANALYSIS

Indicative cost analysis for construction and operation, including capital costs, maintenance and operational costs, and present value estimates.

CASE FOR INVESTMENT

Case for Investment: assessing the economic, environmental, and indirect benefits of providing reticulated water and wastewater to the island, including

- a definition of the problem and the project need.
- a presentation of four infrastructure options that address these problems.
- a qualitative assessment of the benefits of supply infrastructure (Benefits Assessment); and
- an analysis of the potential funding models (Funding Analysis).

DELIVERY MODELS

Discussion on alternative delivery models, linked to financing model strategies.

5 CONSTRUCTION AND OPERATIONAL COSTS

Schedules of rates were prepared based on concept designs for all options. Costings for pipework infrastructure was developed with input from four contractors experienced in the construction of water and wastewater infrastructure.

- Abergeldie Complex Infrastructure
- Ledonne Constructions Pty Ltd
- Hills to Harbour Plumbing Pty Ltd
- Trenchless UEA

Costings for on property pressure sewer installations and water supply were prepared with input from two contractors experienced in retrofitting pressure sewer pump out systems into existing properties.

- Ledonne Constructions Pty Ltd
- Hills to Harbour Plumbing Pty Ltd

Costings for the Pittwater underbores were benchmarked from similar projects and consultation with HDD Contractors.

Costings for the On-site wastewater treatment plant was developed with input from Permeate Partners, Wastewater Treatment consultants.

PRESENT VALUE ANALYSIS

Present Value analysis was undertaken on operational data obtained for existing similar wastewater collection systems, and similar scale local wastewater treatment plants.

Table 5-1: Cost Plan Structure

COST PLAN STRUCTURE
SUMMARIES
CAPITAL COSTS SUMMARIES FOR ALL OPTIONS
NPV FOR ALL OPTIONS
SUMMARY OF CAPITAL COST COMBINATIONS OF OPTIONS
SUMMARY OF NPV COST COMBINATIONS OF OPTIONS
NPV DETAIL ASSESSMENTS
WASTEWATER NPV OPTION A2 and B11
WASTEWATER NPV OPTIONS A2 and B9

COST PLAN STRUCTURE
WASTEWATER NPV OPTIONS A4 and B11
WASTEWATER NPV OPTIONS A4 and B9
WATER SUPPLY NPV OPTIONS C4
WATER SUPPLY NPV OPTIONS C6
CAPITAL COST DETAIL SHEETS
Wastewater Collection System Options
A.2 Pressure Sewer System (377 LOTS)
A.4 Hybrid System
Wastewater Treatment and Disposal
B.9 'On Island' Treatment System
B.11 Discharge to Sydney Water
Water Supply
C.4 Low Flow from Sydney Water
C.6 Full Retic from Sydney Water

5.1 Costing Summaries

Refer to Attachment A for Capital Cost Detail Sheets

5.1.1 Summary Capital Costs by Cost Centre

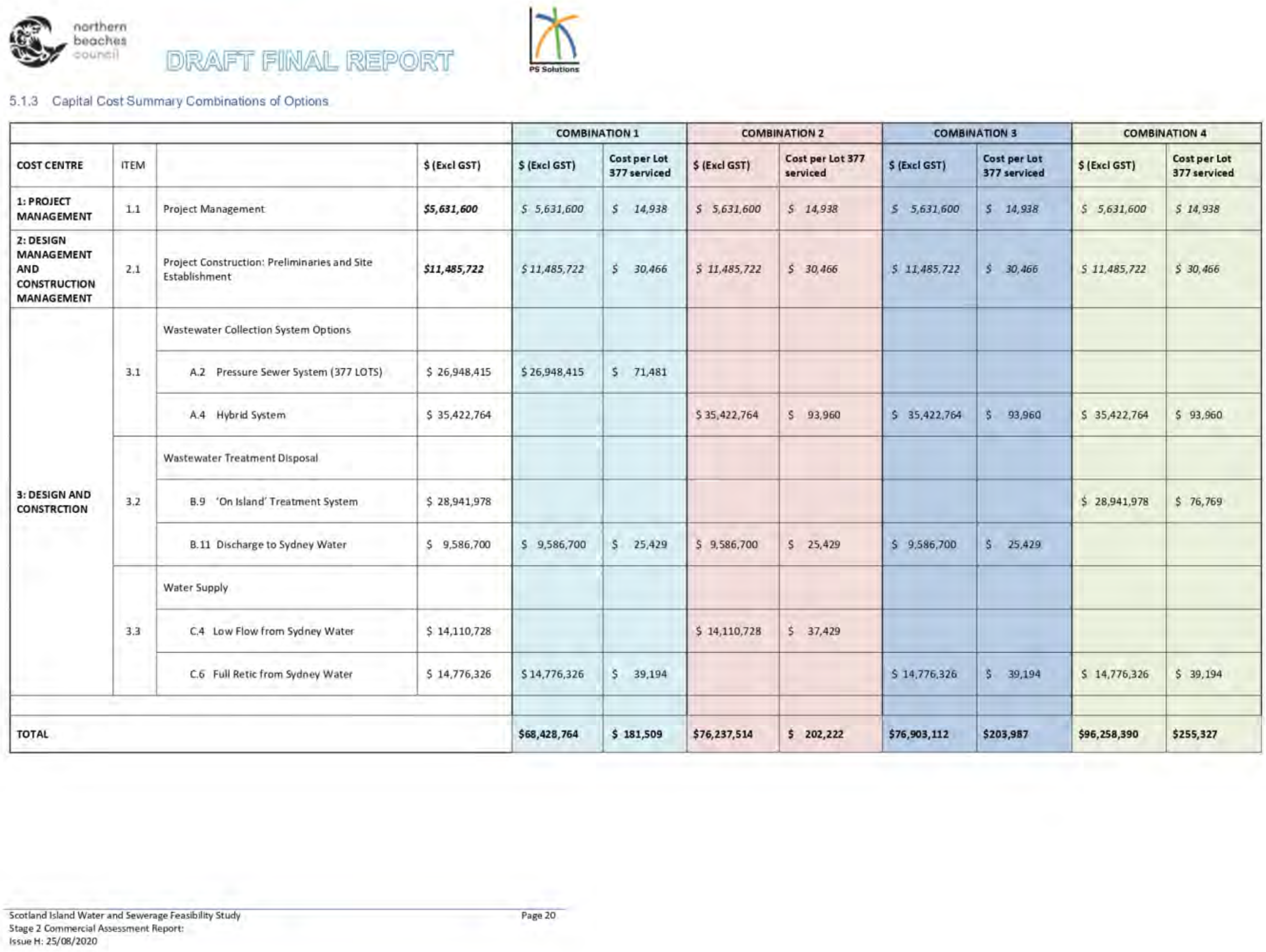
Table 5-2: Summary Capital Costs by Cost Centre

COST CENTRE	ITEM		$ (Excl GST)
1: PROJECT MANAGEMENT	1.1	Project Management	$ 5,631,600
2: DESIGN MANAGEMENT AND CONSTRUCTION MANAGEMENT	2.1	Project Construction: Preliminaries and Site Establishment	$ 11,485,722
3: DESIGN AND CONSTRUCTION	3.1	Wastewater Collection System Options	
		A.2 Pressure Sewer System (377 LOTS)	$ 26,948,415
		A.4 Hybrid System	$ 35,422,764
	3.2	Wastewater Treatment Disposal	
		B.9 'On Island' Treatment System	$ 28,941,978
		B.11 Discharge to Sydney Water	$ 9,586,700
	3.3	Water Supply	
		C.4 Low Flow from Sydney Water	$ 14,110,728
		C.6 Full Retic from Sydney Water	$ 14,776,326

5.1.2 Summary Capital Costs with Project and Construction Management attributed pro-rata to each option:-

Table 5-3: Summary Costs by Option

Option	$ (Excl GST)
Wastewater Collection System Options	
A.2 Pressure Sewer System (377 LOTS)	$ 35,174,419
A.4 Hybrid System	$ 43,648,767
Wastewater Treatment Disposal	
B.9 'On Island' Treatment System	$ 34,023,444
B.11 Discharge to Sydney Water	$ 14,668,167
Water Supply	
C.4 Low Flow from Sydney Water	$ 17,920,580
C.6 Full Retic from Sydney Water	$ 18,586,178



5.1.3 Capital Cost Summary Combinations of Options

				COMBINATION 1		COMBINATION 2		COMBINATION 3		COMBINATION 4	
COST CENTRE	ITEM		$ (Excl GST)	$ (Excl GST)	Cost per Lot 377 serviced	$ (Excl GST)	Cost per Lot 377 serviced	$ (Excl GST)	Cost per Lot 377 serviced	$ (Excl GST)	Cost per Lot 377 serviced
1: PROJECT MANAGEMENT	1.1	Project Management	*$5,631,600*	*$ 5,631,600*	*$ 14,938*	*$ 5,631,600*	*$ 14,938*	*$ 5,631,600*	*$ 14,938*	*$ 5,631,600*	*$ 14,938*
2: DESIGN MANAGEMENT AND CONSTRUCTION MANAGEMENT	2.1	Project Construction: Preliminaries and Site Establishment	*$11,485,722*	*$ 11,485,722*	*$ 30,466*	*$ 11,485,722*	*$ 30,466*	*$ 11,485,722*	*$ 30,466*	*$ 11,485,722*	*$ 30,466*
3: DESIGN AND CONSTRCTION	3.1	Wastewater Collection System Options									
		A.2 Pressure Sewer System (377 LOTS)	$ 26,948,415	$ 26,948,415	$ 71,481						
		A.4 Hybrid System	$ 35,422,764			$ 35,422,764	$ 93,960	$ 35,422,764	$ 93,960	$ 35,422,764	$ 93,960
	3.2	Wastewater Treatment Disposal									
		B.9 'On Island' Treatment System	$ 28,941,978							$ 28,941,978	$ 76,769
		B.11 Discharge to Sydney Water	$ 9,586,700	$ 9,586,700	$ 25,429	$ 9,586,700	$ 25,429	$ 9,586,700	$ 25,429		
	3.3	Water Supply									
		C.4 Low Flow from Sydney Water	$ 14,110,728			$ 14,110,728	$ 37,429				
		C.6 Full Retic from Sydney Water	$ 14,776,326	$ 14,776,326	$ 39,194			$ 14,776,326	$ 39,194	$ 14,776,326	$ 39,194
TOTAL				**$68,428,764**	**$ 181,509**	**$76,237,514**	**$ 202,222**	**$76,903,112**	**$203,987**	**$96,258,390**	**$255,327**

5.1.4 Summary NPV Costs

Table 5-4: Summary NPV Costs

NPV Assessment		$ (Excl GST)
Wastewater Option Combination	OPTION A2/B11: Pressure Sewerage System - Discharge to SWC Network	$ 52,197,652.90
Wastewater Option Combination	OPTION A2/B9: Pressure Sewerage System - "On Island" STP	$ 79,103,323.29
Wastewater Option Combination	OPTION A4/B11: Hybrid Sewerage System - Discharge to SWC Network	$ 54,908,118.54
Wastewater Option Combination	OPTION A4/B9: Hybrid Sewerage System - "On Island" STP	$ 82,229,397.19
Water Supply Option	OPTION C4: Low Flow Supply	$ 18,261,285.62
Water Supply Option	OPTION C6: Full Flow Supply	$ 18,912,047.93

6 CASE FOR INVESTMENT AND FUNDING ANALYSIS

For detailed report refer to Attachment C: Report 'RPS: Scotland Island Water Infrastructure – Case for Investment: RPS May 2020'

6.1 Case for Investment

The 'case for Investment' assessment includes:

- a definition of the problem and the project need.
- a presentation of four infrastructure options that address these problems.
- a qualitative assessment of the benefits of supply infrastructure (Benefits Assessment); and
- an analysis of the potential funding models (Funding Analysis).

It should be noted that water and wastewater services are considered essential services. Moreover, these services are very rarely priced for full cost recovery (i.e. they are not financially self-sufficient), and cost benefit analyses (CBA) often do not always show a favourable economic benefit-cost ratio. However, such services are still provided to communities and considered to be in the public interest. In this case, the investigation of reticulated water and wastewater services responds to three main problems:

- **Problem 1:** Existing infrastructure not fit-for-purpose and failing / non-compliant.
- **Problem 2:** Perception of high cost without sufficient investigation.
- **Problem 3:** Inequity due to comparable services having been provided to similar communities.

The Case for Investment considered the following four potential infrastructure options:

- **Infrastructure Option 1:** Fully reticulated water supply with a pressure sewerage system that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 2:** Low flow reticulated water supply with a hybrid sewer system (pressure and gravity sewerage systems) that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 3:** Fully reticulated water supply with a hybrid sewer system that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 4:** Fully reticulated water supply with on island treatment for sewage and effluent discharging to Pittwater.

The Benefits Assessment shows that the options for water and sewerage servicing for the residents of Scotland Island:

- will significantly reduce health risks,
- provide equity by addressing a long-standing community need for the services, which have been provided to similar communities in the past, and at a cost that is comparable to similar schemes,
- improve the quality of service for island residents, and
- significantly improve the local environment, both on and off the island.

These benefits accrue to a broad range of stakeholders including island residents and visitors, the Council, the local environment, and recreational users of the Pittwater Bay.

Importantly, all infrastructure options were found to address problems 1-3, by providing water and wastewater services that are reliable and compliant with the required standards (addressing Problem 1), providing these at a cost comparable to previous schemes (addressing Problem 2), and resolving the inequity currently felt by the residents of Scotland Island (addressing Problem 3).

Among the four options, Infrastructure Option 1 is the most cost effective and is therefore the recommended option.

6.2 Summary Funding Analysis

The Funding Analysis investigated how the cost of the scheme could be recovered through funding from either SWC / the NSW Government (Funding Option 1), or by SWC / the NSW Government through co-contributions from island residents (Funding Option 2).

Funding the infrastructure through SWC (Funding Option 1) is the preferred option, as it leverages SWC's strong balance sheet and is much more likely to be accepted by the various stakeholders (i.e. SWC and island residents).

7 DELIVERY AND FUNDING STRATEGY

This section of the report gives an overview of the potential delivery strategies for the Scotland Island water supply and wastewater schemes. Future refinement of the project planning will determine the strategy that will achieve the delivery of the services in the most effective way.

To consider the most effective delivery strategy requires the following key elements of the delivery process to be understood and considered. These key elements are as follows.

- Planning
- Ownership
- Funding *
- Design
- Construction.
- O&M
- Revenue collection and customer management

* Note: Attachment C: Report: 'RPS- Scotland Island Water Infrastructure – Case for Investment' provides additional commentary on Funding Options

The following table provides an initial review of these elements. These elements have been evaluated using the following criteria.

- cost of financing and
- delivery effectiveness for the scheme (in terms magnitude, complexity, and sensitivity).

The delivery elements were rated on a scale of 1 to 10 for likelihood of success, with 10 representing the highest likelihood of success.

7.1 Delivery Elements and the Key Providers

This opinion is provided for discussion purposes only, and is based on the industry and project experience of our team within the context of a feasibility study level of detail.

Table 7-1: Delivery Strategy key Elements and Providers

Delivery Element	Assessment Category	Key Provider and commentary				Preferred Provider Opportunity & Comment
Asset Ownership (Administration to generate and manage the asset)		Sydney Water	Investor / Superannuation fund	Private Water Utility		Sydney Water
	Cost of Financing	10	5	7		
	Delivery	7	3	8		
Funding		NSW Govt / TCorp	Sydney Water	Investor / Superannuation fund	Private Water Utility	NSW Govt / Sydney Water
	Cost of Financing	10	8	3	3	
	Delivery	10	9	3	3	

Delivery Element	Assessment Category	Key Provider and commentary				Preferred Provider Opportunity & Comment
Design		Sydney Water	Tier 1 Consultants	Industry Specialist Design Expert		Industry Specialist Design Expert
	Cost of Financing (Expensive to inexpensive)	6	7	9		
	Delivery	6	7	9		
Construction.		Tier 1 – e.g. John Holland Constructions, Acciona, Lend Lease, Downer EDI, Ventia	Tier 2 – e.g., Abergeldie, Comdain, Fulton Hogan,	Tier 3 – e.g. Ledonne Constructions, Ford Civil, Diona,		Tier 3 Contractor
	Cost of Financing (1 = High Cost: 10 = Low Cost)	6	7	8		
	Delivery	5	8	9		

Delivery Element	Assessment Category	Key Provider and commentary				Preferred Provider Opportunity & Comment
Operation and Maintenance		Sydney Water / Ventia	Tier 1 – e.g. Veolia, Tenix, Suez, Ventia	Private Water Utility		Sydney Water
	Cost of Financing (1 = High Cost 10 = Low Cost)	7	8	7		
	Delivery	7	6	6		
Revenue collection and customer management		Sydney Water	Veolia, Suez, Trility	Private Water Utility		Sydney Water
	Cost of Financing	9	7	8		
	Delivery	9	7	8		

7.2 Delivery model opportunity assessment

An additional assessment has been undertaken on the various forms of delivery and is presented in the table below. The traditional delivery models presented below include a high-level description of each option. The delivery model would be developed during the next phase of the project to allocate the construction risk and identify the most effective structure to deliver the assets for both the Scotland Island residents and the asset owner.

Table 7-2: Delivery Model Options

Delivery Model Options	Description
Construct only:	The proponent retains full responsibility for design and documentation (via engaging a design consultant) and tenders for construction contractors.
Early tenderer involvement (ETI):	As a subset of the Construct Only delivery model, this model involves selecting shortlisted competing contractors to participate in value engineering and refinement of a client's preliminary designs.
Design and construct (D&C):	The proponent contracts with a single entity that is responsible for both design and construction of the project
Early contractor involvement (ECI):	As a subset of the D&C delivery model, this model involves engaging a construction contractor prior to commencing a project to work in collaboration with the project sponsor
Design, construct, maintain and operate (DCMO):	The proponent contracts with a single entity that is responsible for both design and construction of the project, as well as the operations and maintenance components
Alliance:	The proponent enters into a transparent 'open book' co-operative contracting arrangement with the private sector wherein unforeseen risks and benefits are essentially shared
Availability payment public private partnership (PPP):-	A Special Purpose Vehicle (SPV) receives a guaranteed fixed payment from the proponent in return for delivering a project on behalf of the public sector (i.e. an availability payment)
Build, own, operate, transfer (BOO/T)	A SPV builds, owns and operates an asset for a specified period during which time the SPV is entitled to collect user charges

NOTE: This report is a technical and commercial assessment of water and wastewater servicing for Scotland Island. Determination and finalisation of funding and delivery models will need to be further assessed during the next planning phase of the project.

7.3 Recommendation form of project delivery

The complexities and planning constraints for the delivery of services on Scotland Island require a high level of environmental and community engagement capabilities. The level of integration required for planning and design are not considered to favour a Design and Construct delivery model. A Project Manager with suitable capabilities in planning and design management is considered essential for successful management of social, environmental, technical, commercial and delivery risk.

Figure 7-1: Recommended Construction Strategy

7.4 Risk management

Within the contracting plan, a key success factor is to ensure each risk is allocated to the party best able to manage that risk.

A risk management plan will be developed and updated by the proponent if the project proceeds to tendering.

To minimise the risk of contract price escalation and construction risks, it is essential that the project scope and approval conditions are clearly defined, including the provision of pretender investigative information, such as geotechnical surveys etc.

8 CONCLUSION

Scotland Island is a significant suburb within the greater metropolitan area of Sydney that is currently without a reticulated potable water service, or a wastewater collection system. The existing on-site wastewater systems are not operating efficiently, and the topography of Scotland Island, combined with the average lot size, present challenges to achieving compliant on-site disposal.

The existing water supply to Scotland Island is from rainwater tanks that are insufficiently sized to continuously supply a standard household without supplementary filling. Some supplementary filling takes place from a non-potable water supply that poses health risks to the community. The existing water supply pipework is unreliable, a small pipeline installed for emergency fire fighting purposes. The provision of reticulated water supply to Scotland Island is considered to be an essential health obligation.

There are health risks on the Island from poorly treated septic effluent discharge. Scotland Island is located in Pittwater, an area with significant recreational use, and there is a high risk of contaminants being discharged into the surrounding waterways, especially during wet weather events.

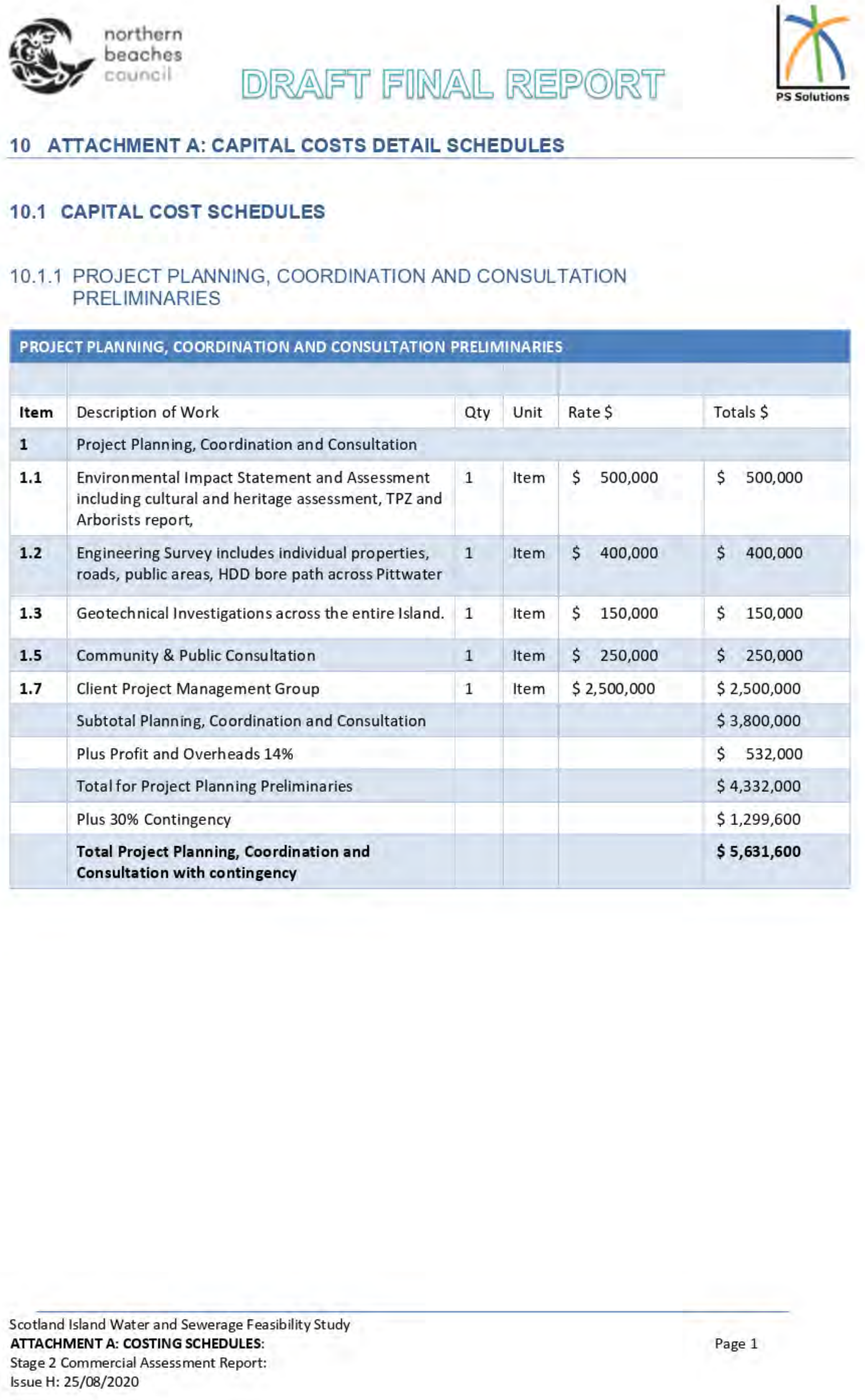
There is a history of lobbying by the community for provision of services, and several investigations have been undertaken regarding provision of services, including a preliminary project assessment by Sydney Water. There are challenges in providing the water and wastewater services to Scotland Island, such as limited sealed roadways, and steep topography with shallow soils. The high cost per lot of the project has, to date, prevented implementation of any works.

Servicing Scotland Island with a reticulated water supply and wastewater collection and disposal system will provide benefits to the residents of Scotland Island and the broader community.

It is considered there is sufficient local market capability and interest to enable a competitive tendering process.

9 GLOSSARY

AS	Australian Standard
AWTS	Aerated Wastewater treatment System
BOO	Build Own Operate
BOOT	Build Own Operate Transfer
CBA	Commercial Benefit Analysis
CBR	Cost Benefit Ratio
D&C	Design and Construct
DBO	Design build Operate
DCMO	Design Construct Maintain and Operate
ECI	Early Contractor involvement
ETI	Early Tenderer Involvement
Ha	Hectare
HDD	Horizontal Direction Drill
IPART	Independent Pricing and regulatory Tribunal of NSW
M	meter
mm	millimetre
NBC	Northern Beaches Council
NPV	Nett Present Value
NZS	New Zealand Standard
O&M	Operation and Maintenance
PPP	Public Private Partnership
PSP	Priority Sewer Program
PV	Present Value
SPV	Special Purpose Vehicle
SWC	Sydney Water Corporation
TCorp	NSW Treasury Corporation
UTS	University of Technology Sydney



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10 ATTACHMENT A: CAPITAL COSTS DETAIL SCHEDULES

10.1 CAPITAL COST SCHEDULES

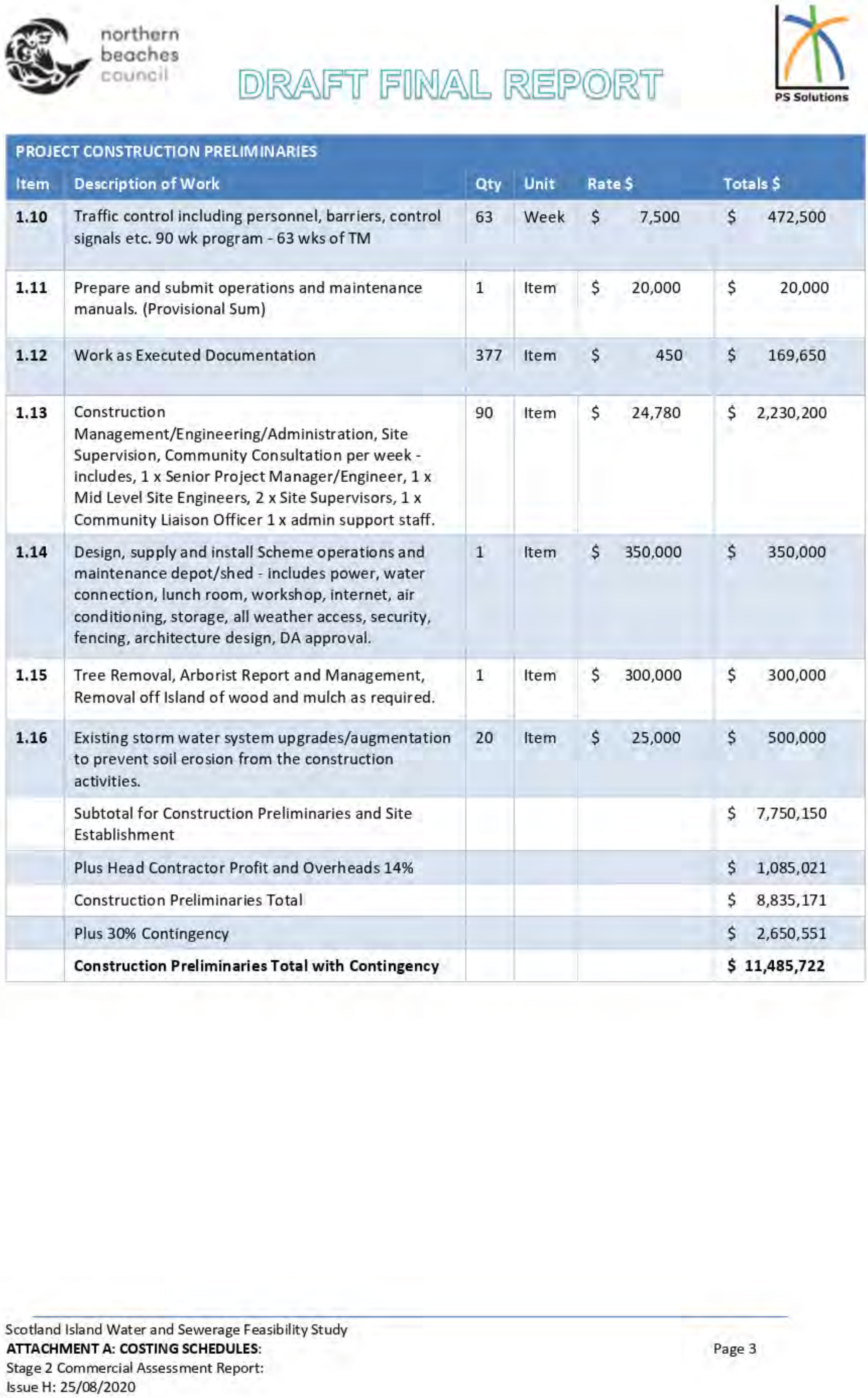
10.1.1 PROJECT PLANNING, COORDINATION AND CONSULTATION PRELIMINARIES

PROJECT PLANNING, COORDINATION AND CONSULTATION PRELIMINARIES

Item	Description of Work	Qty	Unit	Rate $	Totals $
1	Project Planning, Coordination and Consultation				
1.1	Environmental Impact Statement and Assessment including cultural and heritage assessment, TPZ and Arborists report,	1	Item	$ 500,000	$ 500,000
1.2	Engineering Survey includes individual properties, roads, public areas, HDD bore path across Pittwater	1	Item	$ 400,000	$ 400,000
1.3	Geotechnical Investigations across the entire Island.	1	Item	$ 150,000	$ 150,000
1.5	Community & Public Consultation	1	Item	$ 250,000	$ 250,000
1.7	Client Project Management Group	1	Item	$ 2,500,000	$ 2,500,000
	Subtotal Planning, Coordination and Consultation				$ 3,800,000
	Plus Profit and Overheads 14%				$ 532,000
	Total for Project Planning Preliminaries				$ 4,332,000
	Plus 30% Contingency				$ 1,299,600
	Total Project Planning, Coordination and Consultation with contingency				**$ 5,631,600**

10.1.2 PROJECT CONSTRUCTION PRELIMINARIES

PROJECT CONSTRUCTION PRELIMINARIES					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1	PRELIMINARY'S AND SITE ESTABLISHMENT				
1.1	Mobilisation / Demobilisation including site amenities. Includes the following: 2 x portable site offices, 1 x Unisex Toilet block with showers and waste tank, 1 x Lunchroom, Poly rainwater tank, connection of power to the existing Community Hall, wireless NBN, installation and freight costs	1	Item	$ 267,500	$ 267,500
1.1.1	Barge hire (55ton 17m barge) and materials management including crane hire, loader hire and ancillary equipment to load and unload equipment at Church Point and the Island.	470	Days	$ 5,750	$ 2,702,500
1.1.2	Extra over ferry costs for transporting workers	1	Item	$ 50,000	$ 50,000
1.2	Prepare and Manage Construction Program (2hrs per week x $120 per hour x 90 week construction period)	1	Item	$ 21,600	$ 21,600
1.3	Prepare & maintain Construction, Traffic & Environmental Management Plans. (40hrs initially to prepare plans plus 8 hrs per week to manage @ $120 per hour)	1	Item	$ 91,200	$ 91,200
1.4	Prepare & maintain Environmental Controls and Waste Management Controls (8hrs per week x 2 guys plus materials)	1	Item	$ 170,000	$ 170,000
1.5	Prepare & maintain, Quality Assurance, Occupational Health & Safety Plans, including ITP's. (8hrs per week x $120 per hour x 90 week construction period)	1	Item	$ 86,400	$ 86,400
1.6	Preparation of all permits, plans, community consultation and approvals required from statutory authorities and pay all required fees and charges. (Provisional Sum)	1	Item	$ 100,000	$ 100,000
1.7	'Dial Before You Dig' services locating including liaison with all relevant authorities for water/sewerage, power, communications etc	1	Item	$ 9,600	$ 9,600
1.8	Site setout and survey as per design documentation	1	Item	$ 157,000	$ 157,000
1.9	Prepare photographic record and Dilapidation Reports of existing site conditions prior to construction. (Includes Individual property photos and street main alignments)	1	Item	$ 52,000	$ 52,000



PROJECT CONSTRUCTION PRELIMINARIES					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1.10	Traffic control including personnel, barriers, control signals etc. 90 wk program - 63 wks of TM	63	Week	$ 7,500	$ 472,500
1.11	Prepare and submit operations and maintenance manuals. (Provisional Sum)	1	Item	$ 20,000	$ 20,000
1.12	Work as Executed Documentation	377	Item	$ 450	$ 169,650
1.13	Construction Management/Engineering/Administration, Site Supervision, Community Consultation per week - includes, 1 x Senior Project Manager/Engineer, 1 x Mid Level Site Engineers, 2 x Site Supervisors, 1 x Community Liaison Officer 1 x admin support staff.	90	Item	$ 24,780	$ 2,230,200
1.14	Design, supply and install Scheme operations and maintenance depot/shed - includes power, water connection, lunch room, workshop, internet, air conditioning, storage, all weather access, security, fencing, architecture design, DA approval.	1	Item	$ 350,000	$ 350,000
1.15	Tree Removal, Arborist Report and Management, Removal off Island of wood and mulch as required.	1	Item	$ 300,000	$ 300,000
1.16	Existing storm water system upgrades/augmentation to prevent soil erosion from the construction activities.	20	Item	$ 25,000	$ 500,000
	Subtotal for Construction Preliminaries and Site Establishment				$ 7,750,150
	Plus Head Contractor Profit and Overheads 14%				$ 1,085,021
	Construction Preliminaries Total				$ 8,835,171
	Plus 30% Contingency				$ 2,650,551
	Construction Preliminaries Total with Contingency				**$ 11,485,722**

10.1.3 COLLECTION SYSTEM OPTION A2: PRESSURE SEWER

COLLECTION SYSTEM OPTION A2: PRESSURE SEWER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1	PRELIMINARY'S AND DESIGN				
1.1	Civil Design	1		$ 540,000	$ 540,000
1.2	On Property Design including plumbing, drainage and electrical assessments	377	Item	$ 1,200	$ 452,400
Subtotal for Preliminaries and design.					$ 992,400
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe **(excluding wastage)**, fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pressure sewerage system works required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards Pipe quantities are indicative only				
2.1	50 mm pipe (Polyethylene PE100 PN16 as specified)	1386	M	$ 240.00	$ 332,640
2.2	63 mm pipe (Polyethylene PE100 PN16 as specified)	1068	M	$ 280.00	$ 299,040
2.3	75 mm pipe (Polyethylene PE100 PN16 as specified)	1578	M	$ 320.00	$ 504,960
2.4	90 mm pipe (Polyethylene PE100 PN16 as specified)	1128	M	$ 360.00	$ 406,080
2.5	110mm pipe (Polyethylene PE100 PN16 as specified)	774	M	$ 420.00	$ 325,080
2.6	140mm pipe (Polyethylene PE100 PN16 as specified)	168	M	$ 520.00	$ 87,360
2.6	50mm rider mains	1000	M	$ 240.00	$ 240,000
2.7	Additional for excavation in rock (Provisional Sum average metre rate divided in half)	7102	M	$ 170.00	$ 1,207,340
Subtotal for Pipe Supply and Installation					$ 3,402,500
4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE PIPELINE.	7102	M	$ 8.00	$ 56,816
Subtotal for Testing and Commissioning of the Pressure Sewer Pipeline					$ 56,816
5	VALVING				

COLLECTION SYSTEM OPTION A2: PRESSURE SEWER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	50 mm Isolation Valves	20	No	$ 2,500	$ 50,000
5.2	80 mm Isolation Valves	30	No	$ 3,500	$ 105,000
5.3	100 mm Isolation Valves	10	No	$ 4,500	$ 45,000
Sub Total for Isolation valves					$ 200,000
6	FLUSHING POINTS				
	Flushing Point supply and installation of end of line or in-line flushing point including connection to the pressure sewer system street main				
6.1	Connection to main 50mm to 100mm (Light duty trafficable Class B)	25	No	$ 4,500	$ 112,500
Subtotal for Flushing Points					$ 112,500
7	AIR VALVES				
	Supply and install air valves connected to the pressure sewer main including materials, labour, testing, commissioning, restoration				
7.1	Inground Air Valve supply and installation connected to the pressure sewer main	10	Item	$ 30,000	$ 300,000
Subtotal for Air Valves					$ 300,000
8	ON PROPERTY WORKS				
8.1	Property Connections (including installation of Boundary Kit & Access Box and supply and installation of required 40mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection to Pressure Sewer Main	377	No.	$ 3,000	$ 1,131,000
	On Property Works - Pressure Sewer Unit Supply incl telemetry	377	No.	$ 6,700	$ 2,525,900
	On Property Works - Pressure Sewer Unit Installation and Commissioning	377	No.	$ 17,000	$ 6,409,000

COLLECTION SYSTEM OPTION A2: PRESSURE SEWER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning	377	No.	$ 7,500	$ 2,827,500
	Boundary kits (Supply)	377	No.	$ 600	$ 226,200
Subtotal for Miscellaneous Items					$ 13,119,600
Pressure Sewerage Collection System Cost Estimate Summary					
Item	Description of Work Item				Total (Excluding GST)
1	PRELIMINARY'S AND DESIGN				$ 992,400
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 3,402,500
4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE PIPELINE.				$ 56,816
5	VALVING				$ 200,000
6	FLUSHING POINTS				$ 112,500
7	AIR VALVES				$ 300,000
8	ON PROPERTY WORKS				$ 13,119,600
				TOTAL	$ 18,183,816
	PLUS LEAD CONTRACTOR OVERHEADS AND PROFIT 14%				$ 2,545,734
TOTAL COST ESTIMATE					
A	COLLECTION SYSTEM COST ESTIMATE				$ 20,729,550
C	CONTINGENCY			30%	$ 6,218,865
				TOTAL	**$ 26,948,415**

10.1.4 COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE

COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1	PRELIMINARIES AND DESIGN				
1.1	Civil Design	1		$ 1,050,000	$ 1,050,000
1.2	Extra Over Geotech Report for Land Stabilisation Report	1		$ 150,000	$ 150,000
1.3	Extra Over Tree Removal, Arborist Report and management	1		$ 300,000	$ 300,000
1.4	On Property Design including plumbing, drainage and electrical assessments	275	Item	$ 1,200	$ 330,000
1.5	On Property Design including nominating the gravity connection point and depth	102	Item	$ 250	$ 25,500
Subtotal for Preliminaries and Design					$ 1,830,000
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe (excluding wastage), fittings, detection tape (or wire where HDD), marker blocks and posts bedding, trench stops, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pressure sewerage system works required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards Pipe quantities are indicative only				
2.1	50 mm pipe (Polyethylene PE100 PN16 as specified)	*750*	M	$ 240.00	$ 180,000
2.2	63 mm pipe (Polyethylene PE100 PN16 as specified)	*400*	M	$ 280.00	$ 112,000
2.3	110 mm pipe (Polyethylene PE100 PN16 as specified)	*1250*	M	$ 420.00	$ 525,000
2.4	125 mm pipe (Polyethylene PE100 PN16 as specified)	*800*	M	$ 490.00	$ 392,000
2.5	180 mm pipe (Polyethylene PE100 PN16 as specified)	*400*	M	$ 600.00	$ 240,000
2.6	150mm PVC DWV SN8	*3300*	M	$ 900.00	$ 2,970,000
2.7	Additional for excavation in rock (Provisional Sum)	*6900*	M	$ 203.00	$ 1,400,700
Subtotal for Pipe Supply and Installation					$ 5,819,700
4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE AND GRAVITY PIPELINES.	6900	M	$ 12.00	$ 82,800
Subtotal for testing and commissioning					$ 82,800
5	VALVING				
	Isolation Valves				
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				

COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE

Item	Description of Work	Qty	Unit	Rate $	Totals $
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	50 mm Isolation Valves	6	No	$ 2,500	$ 15,000
5.2	100 mm Isolation Valves	20	No	$ 4,500	$ 90,000
5.3	150 mm Isolation Valves	5	No	$ 6,000	$ 30,000
Sub Total for Isolation valves					$ 135,000
6	FLUSHING POINTS				
	Flushing Point supply and installation of end of line or in-line flushing point including connection to the pressure sewer system street main				
6.1	Connection to main 50mm to 100mm (Light duty trafficable Class B)	15	No	$ 4,500	$ 67,500
Subtotal for Flushing Points					$ 67,500
7	AIR VALVES				
	Supply and install air valves connected to the pressure sewer main including materials, labour, testing, commissioning, restoration				
7.1	Inground Air Valve supply and installation connected to the pressure sewer main	6	Item	$ 30,000	$ 180,000
Subtotal for Air Valves					$ 180,000
8	PROPERTY CONNECTIONS				
8.1	Property Connections				
	100mm Gravity Connection Point - Same Side of Road as main line	51	No.	$ 5,500	$ 280,500
	100mm Gravity Connection - Other Side of Road	51	No.	$ 9,000	$ 459,000
	Pressure Sewer Connection to Main	275	No.	$ 5,000	$ 1,375,000
	On Property Works - Pressure Sewer Unit Supply	275	No.	$ 6,000	$ 1,650,000
	On Property Works - Pressure Sewer Unit Installation and Commissioning	275	No.	$ 17,000	$ 4,675,000
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning for Pressure Sewer Properties	275	No.	$ 7,500	$ 2,062,500
	On Property Works - Plumbing Connection, Upgrade and Septic Decommissioning for Gravity Sewer Properties	102	No.	$ 12,500	$ 1,275,000
	Boundary kits (Supply)	275	No.	$ 600	$ 165,000
Subtotal for Miscellaneous Items					$ 11,942,000
9	GRAVITY SEWER WORKS				
9.1	Supply and install concrete Manholes/Access Chambers/Maintenance Shafts	65	No	$13,000	$845,000

COLLECTION SYSTEM OPTION A4: HYBRID GRAVITY AND PRESSURE

Item	Description of Work	Qty	Unit	Rate $	Totals $
8.2	Satellite SPS including telemetry controls and overflow storage. Includes hard stand areas for maintenance, servicing, retaining walls, fencing, safety rails, lighting and earthworks if required.	4	Item	$ 750,000	$ 3,000,000
Subtotal for Gravity Sewer					$ 3,845,000
Pressure Sewerage Collection System Cost Estimate Summary					
Item	Description of Work Item				Total (Excluding GST)
1	PRELIMINARIES AND DESIGN				$ 1,830,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 5,819,700
4	TESTING AND COMMISSIONING OF THE PRESSURE SEWERAGE AND GRAVITY PIPELINES.				$ 82,800
5	VALVING				$ 135,000
6	FLUSHING POINTS				$ 67,500
7	AIR VALVES				$ 180,000
8	PROPERTY CONNECTIONS				$ 11,942,000
9	GRAVITY SEWER WORKS				$ 3,845,000
				TOTAL	$ 23,902,000
	PLUS LEAD CONTRACTOR PROFIT AND OVERHEAD			14%	$ 3,346,280
TOTAL COST ESTIMATE					
A	COLLECTION SYSTEM COST ESTIMATE				$ 27,248,280
C	CONTINGENCY			30%	$ 8,174,484
				TOTAL	$ 35,422,764

10.1.5 WASTE DISPOSAL SYSTEM OPTION B9: ON ISLAND TREATMENT DISPOSAL TO PITTWATER

WASTE DISPOSAL SYSTEM OPTION B9: ON ISLAND TREATMENT DISPOSAL TO PITTWATER			
WASTEWATER TREATMENT PLANT			
Installed capacity (kL/day)		Capacity	150 kL/day
Preliminaries			
Inlet works			$ 705,000
Odour treatment			$ 262,000
Bioreactor			$ 2730,000
Membrane filtration			$ 630,000
UV Disinfection			$ 165,000
Treated water storage and distribution			$ 202,000
Sludge handling			$ 315,000
Chemical systems/storage			$ 412,000
Plant sump			$ 156,000
Buildings			$ 1500,000
Roadways, earthworks, siteworks, landscaping and fencing			$ 1,600,000
Electrical, control, and instrumentation			$ 1,042,000
Commissioning, validation and training			$ 300,000
Services			$ 130,000
WASTEWATER TREATMENT PLANT SUB TOTAL	**SUB-TOTAL CAPEX**		**$ 10,149,000**
ASSOCIATED WORKS			
Extra Over Environmental Impact Statement			$ 500,000
Specific Site Engineer for Treatment Plant Construction			$ 180,000
Land Acquisition			$ 1,500,000
Access Roads			$ 1,000,000
Wastewater Outfall to Pittwater			$ 6,200,000
Sub Total			$ 19,529,000
Plus Head Contractor Profit and Overheads 14%			$ 2,734,060
Sub Total for 'On Island' Treatment Plant and associated works			**$ 22,263,060**
Plus 30% Contingency			$ 6,678,918
Total for Island Treatment Plant			$ 28,941,978

10.1.6 WASTE DISPOSAL SYSTEM OPTION B11: PUMP TO SYDNEY WATER

WASTE DISPOSAL SYSTEM OPTION B11: PUMP TO SYDNEY WATER					
Item	Description of Work	Qty	Unit	Rate $	Totals $
9	HDD Bay Crossing and SPS				
9.1	SPS including telemetry controls and overflow storage	1	Item	$ 3,500,000	$ 3,500,000
9.2	Chemical dosing facility	1	Item	$ 400,000	$ 400,000
9.3	Connection to Church Point Sewer	1	Item	$ 250,000	$ 250,000
9.4	Supply and installation of DN 100 ABB WaterMaster Flowmeter in pre-cast 900x1200 pit connected with remote mounted display unit inside SPS panel	1	Item	$ 15,000	$ 15,000
9.6	Design	1	item	$ 200,000	$ 200,000
	Sub Total SPS				$ 4,365,000
9.7	HDD Bay Crossing				
	PE100 PN20, 280mm conduit with 140mm product pipe	680	M	$850	$578,000
	Equipment set-up	1	Item	$250,000	$250,000
	140mm Pipe Supply	680	M	$60	$40,800
	280mm PE Conduit Supply	680	M	$120	$81,600
	Pipe Jointing	115	No	$400	$46,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,146,400
	Design, Geotech & Survey	15%			$171,960
	Contingency	20%			$263,672
	Prelims, supervision, overheads and profit	37%			$521,727
	Subtotal HDD Bay Crossing				$2,103,759
SUBTOTAL HDD BAY CROSSING AND SPS					$ 6,468,759
Sewer Pump Station and Rising Main across Pittwater Cost Estimate Summary					
Item	Description of Work Item				Total (Excl GST)
9	HDD Bay Crossing and SPS				$ 6,468,759
	Plus Head Contractor Profit and Overheads 14%				$ 905,626
TOTAL COST ESTIMATE					
A	DISCHARGE SYSTEM				$ 7,374,385
C	CONTINGENCY			30%	$ 2,212,315
				TOTAL	$ 9,586,700

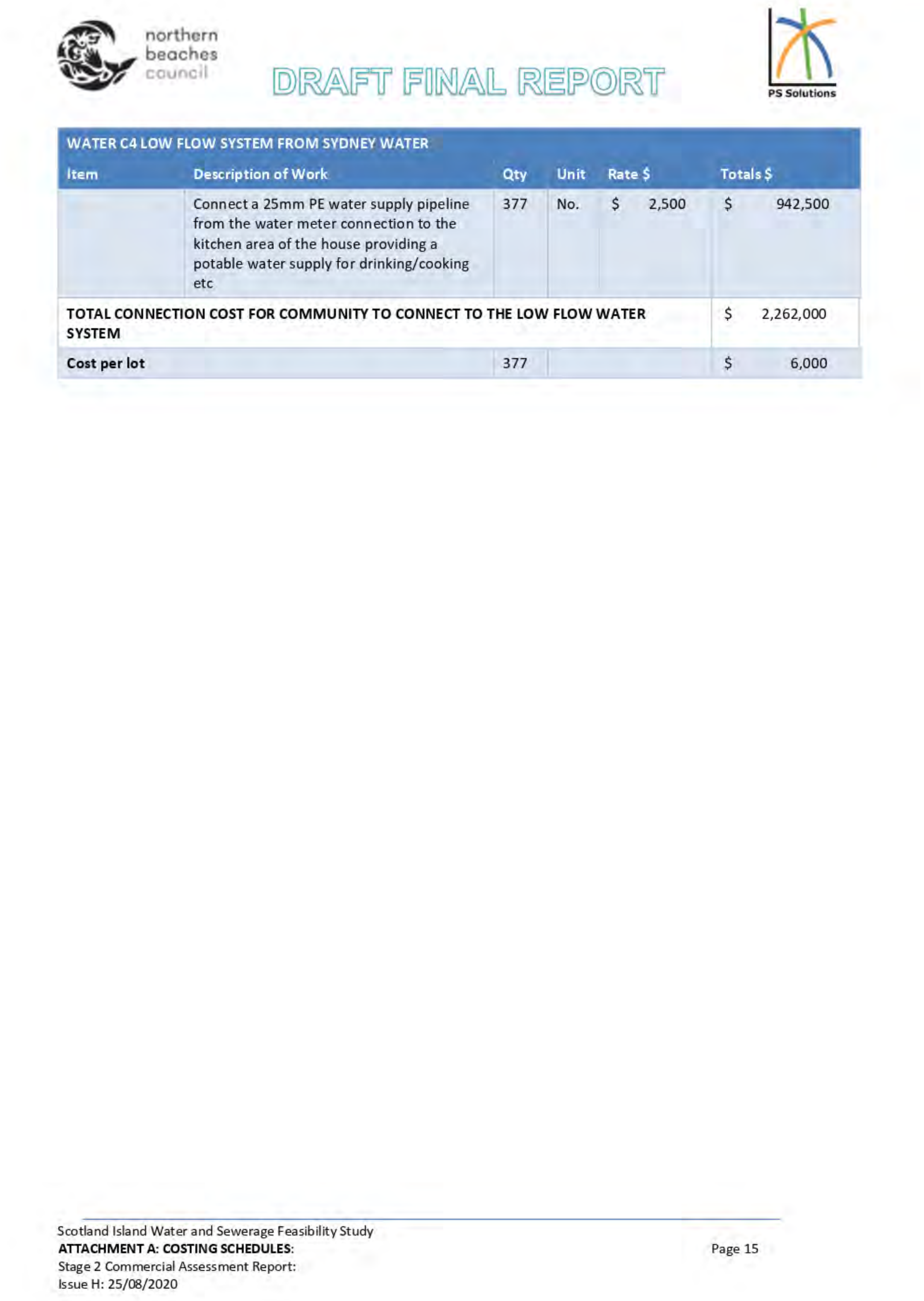
10.1.7 WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER

WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1	PRELIMINARY'S AND DESIGN				
1.14	Civil Design	1	Item	$ 300,000	$ 300,000
1.16	Wate Booster Pumping Station Design	1	Item	$ 120,000	$ 120,000
1.3	On Property Design - water assessment to verify RWT connection and potable supply to kitchen.	377	Item	$ 450	$ 169,650
Subtotal for Preliminaries and Design					$ 420,000
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe (excluding wastage), fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pipework required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards				
2.1	110 mm pipe (Polyethylene PE100 PN16 as specified)	5000	M	$ 420.00	$ 2,100,000
2.6	140mm pipe (Polyethylene PE100 PN16 as specified)	400	M	$ 520.00	$ 208,000
2.7	Additional for excavation in rock	5400	M	$ 470.00	$ 2,538,000
Subtotal for Pipe Supply and Installation					$ 4,846,000
4	TESTING AND COMMISSIONING	5400	M	$ 15.00	$ 81,000
5	VALVING				
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				

WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER

Item	Description of Work	Qty	Unit	Rate $	Totals $
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	100 mm Isolation Valves	35	No	$ 4,500	$ 157,500
Sub Total for Isolation valves					$ 157,500
6	Hydrant POINTS				
	Supply and Install Hydrants as per Sydney Water specification				
6.1	Hydrants	55	No	$ 3,500	$ 192,500
Subtotal for hydrant Points					$ 192,500
7	AIR VALVES				
	Supply and install air valves connected to the water main including materials, labour, testing, commissioning, restoration				
7.1	In ground Air Valve supply and installation	6	Item	$ 7,500	$ 45,000
Subtotal for Air Valves					$ 45,000
8	PROPERTY CONNECTIONS				
8.1	Property Connections (including installation of Water Meter and supply and installation of required 25mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection of Property to Water Main	377	No.	$ 3,000	$ 1,131,000
	Water Meters including copper upstand and isolation valve (Supply and install)	377	No.	$ 450	$ 169,650
Subtotal for Property Connections					$ 1,300,650
9	MISCELLANEOUS ITEMS				
9.1	Supply and install WPS including telemetry controls	1	Item	$ 250,000	$ 250,000
9.3	Connection to Church Point Water Main	1	Item	$ 100,000	$ 100,000
9.4	Supply and installation of DN 100 flow meter at the WPS	1	Item	$ 25,000	$ 25,000
Subtotal for Miscellaneous Items					$ 375,000
10	HDD Bay Crossing				
10.1	HDD Bay Crossing				
	PE100 PN20, 280mm conduit with 140mm product pipe	680	M	$850	$578,000
	Equipment set-up	1	Item	$250,000	$250,000
	140mm PE Pipe Supply	680	M	$60	$40,800

WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
	280mm PE Conduit Supply	680	M	$120	$81,600
	Pipe Jointing	115	No	$400	$46,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,146,400
	Design, Geotech & Survey	15%			$171,960
	Contingency	20%			$263,672
	Prelims, supervision, overheads and profit	37%			$521,727
	Subtotal HDD Bay Crossing				$2,103,759
Sub Total Low Flow Water Reticulation Cost Estimate Summary					
Item	Description of Work Item				Total (Excluding GST)
1	PRELIMINARY'S AND DESIGN				$ 420,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 4,846,000
4	TESTING AND COMMISSIONING				$ 81,000
5	VALVING				$ 157,500
6	HYDRANT POINTS				$ 192,500
7	AIR VALVES				$ 45,000
8	PROPERTY CONNECTIONS				$ 1,300,650
9	MISCELLANEOUS				$ 375,000
10	HDD Bay Crossing				$ 2,103,759
Sub Total Low Flow Water Reticulation Cost Estimate Summary					$ 9,521,409
	Plus Head Contractor Profit and Overheads 14%				$ 1,332,997
					$ 10,854,406
	Plus Contingency 30%				$ 3,256,322
	Total Low Flow Water Reticulation Cost Estimate Summary				$ 14,110,728
ON PROPERTY WORKS FOR WATER CONNECTION TO A LOW FLOW SYSTEM					
	Connect a 25mm PE water supply pipe from the water meter to the properties existing RWT with float valve and flow restrictor.	377	No.	$ 3,500	$ 1,319,500



WATER C4 LOW FLOW SYSTEM FROM SYDNEY WATER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
	Connect a 25mm PE water supply pipeline from the water meter connection to the kitchen area of the house providing a potable water supply for drinking/cooking etc	377	No.	$ 2,500	$ 942,500
TOTAL CONNECTION COST FOR COMMUNITY TO CONNECT TO THE LOW FLOW WATER SYSTEM					$ 2,262,000
Cost per lot		377			$ 6,000

10.1.8 WATER C6 FULL RETICULATION FROM SYDNEY WATER

WATER C6 FULL RETICULATION FROM SYDNEY WATER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
1	PRELIMINARY'S AND DESIGN				
1.1	Civil Design	1	Item	$300,000	$ 300,000
1.2	WPS Design	1	Item	$120,000	$ 120,000
Subtotal for Preliminaries and Design					$ 420,000
Item	Description of Work	Qty	Unit	Rate $	Totals $
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				
	Excavation by open cut &/or by horizontal directional boring, supply and installation of pipe (excluding wastage), fittings, detection tape (or wire where HDD), marker blocks and posts bedding, backfill, compaction, spoil disposal, shoring (as necessary) dewatering, restoration etc. All pipework required to co-ordinate, avoid and maintain soundness of existing underground services. QA/OH&S requirements, Principal's requirements & Australian Standards				
2.1	125 mm pipe (Polyethylene PE100 PN16 as specified)	2700	M	$ 490.00	$ 1,323,000
2.2	180 mm pipe (Polyethylene PE100 PN16 as specified)	2700	M	$ 600.00	$ 1,620,000
2.7	Additional for excavation in rock	5400	M	$ 272.00	$ 1,468,800
Subtotal for Pipe Supply and Installation					$ 4,411,800
4	TESTING AND COMMISSIONING OF THE WATER MAIN	5400	M	$ 15.00	$ 81,000
5	VALVING				
	Isolation Valves with polyethylene stub connections including electro fusion connection couplers, reducers and other fittings where required, path box, spindle riser, orange spindle cap identifying any Normally Closed valves, back fill, identification plate or post and restoration.				
	OR				
	Isolation valve including 316 stainless steel backing rings, nuts, bolts, washers and extension spindles, orange spindle cap identifying any Normally Closed valves, path box, spindle riser, back fill, identification plate or post and restoration.				
Item	Description of Work	Qty	Unit	Rate $	Totals $
5.1	100 mm Isolation Valves	15	No	$ 4,500	$ 67,500
5.2	150 mm Isolation Valves	20	No	$ 6,000	$ 120,000

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PS Solutions

WATER C6 FULL RETICULATION FROM SYDNEY WATER

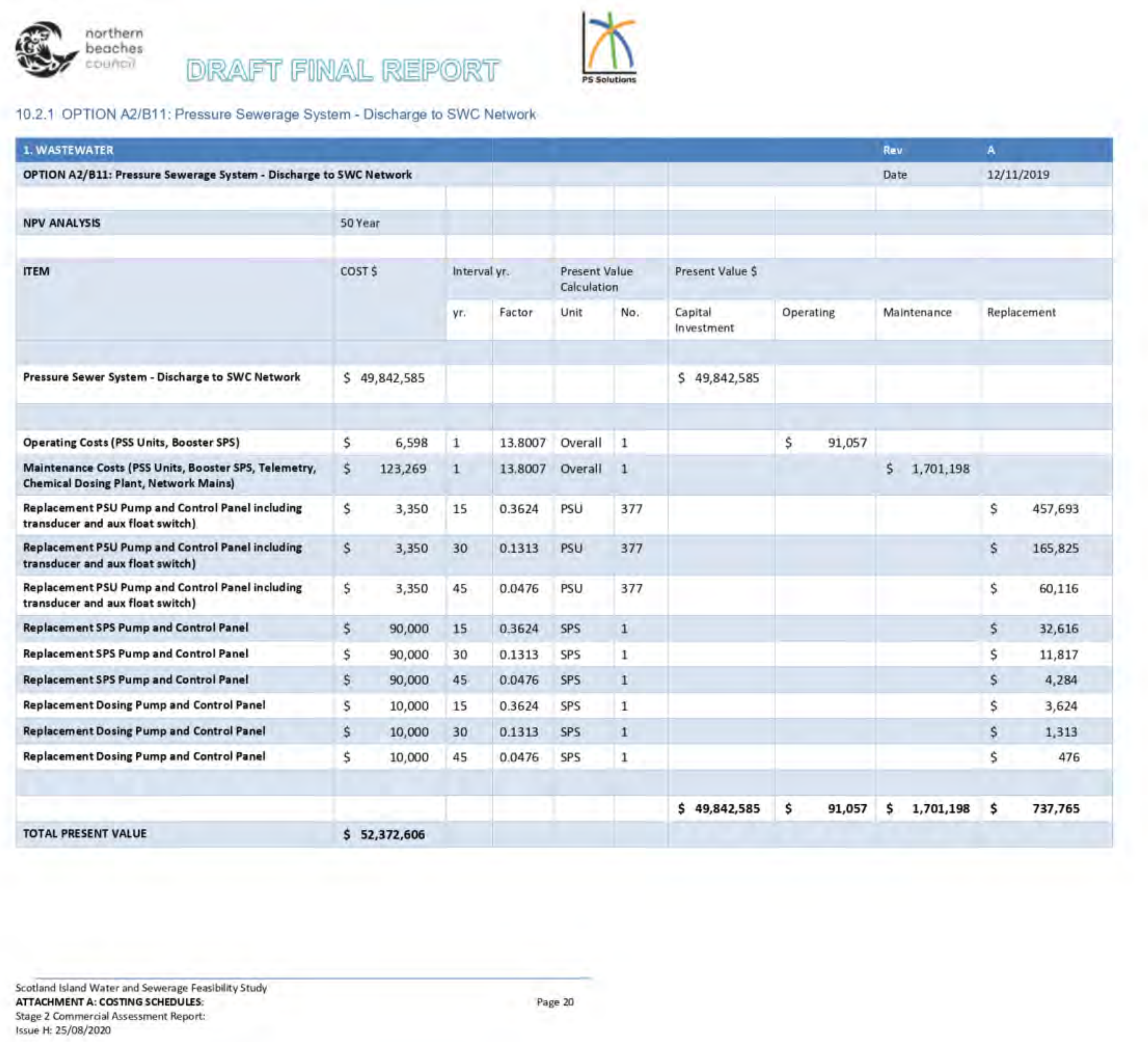
Item	Description of Work	Qty	Unit	Rate $	Totals $
Sub Total for Isolation valves					$ 187,500
6	Hydrant POINTS				
	Supply and Install Hydrants as per Sydney Water specification				
6.1	Hydrants	55	No	$ 3,500	$ 192,500
Subtotal for hydrant Points					$ 192,500
7	AIR VALVES				
	Supply and install air valves connected to the water main including materials, labour, testing, commissioning, restoration				
7.1	In ground Air Valve supply and installation.	6	Item	$ 7,500	$ 45,000
Subtotal for Air Valves					$ 45,000
8	PROPERTY CONNECTIONS				
8.1	Property Connections (including installation of Water Meter and supply and installation of required 25mm PE100 PN16 polyethylene pipe and conduit where required, identification plate or post)				
	Connection of Property to Water Main	377	No.	$ 3,000	$ 1,131,000
	Water Meters including copper upstand and isolation valve (Supply and install)	377	No.	$ 450	$ 169,650
Subtotal for Property Connections					$ 1,300,650
9	MISCELLANEOUS ITEMS				
9.1	Supply and install WPS including telemetry controls	1	Item	$ 250,000	$ 250,000
9.3	Connection to Church Point Water Main	1	Item	$100,000	$ 100,000
9.4	Supply and installation of DN 100 flow meter at the WPS	1	Item	$ 25,000	$ 25,000
Subtotal for Miscellaneous Items					$ 375,000
10	HDD Bay Crossing				
	PE100 PN16, 450mm conduit with 280mm product pipe	680	M	$1,300	$884,000
	Equipment set-up	1	Item	$250,000	$250,000
	250mm PE Pipe Supply	680	M	$80	$54,400
	450mm PE Conduit Supply	680	M	$300	$204,000
	Pipe Jointing	115	No	$600	$69,000
	Leak detection system	1	No	$150,000	$150,000
	Subtotal				$1,611,400
	Design, Geotech & Survey	15%			$241,710
	Contingency	20%			$370,622

WATER C6 FULL RETICULATION FROM SYDNEY WATER					
Item	**Description of Work**	**Qty**	**Unit**	**Rate $**	**Totals $**
	Prelims, supervision, overheads and profit	37%			$733,348
	Subtotal HDD Bay Crossing				$2,957,080
Sub Total Full Flow Water Reticulation Cost Estimate Summary					
Item	Description of Work Item				Total (Excluding GST)
1	PRELIMINARY'S AND DESIGN				$ 420,000
2	PIPE SUPPLY AND INSTALLATION BY OPEN CUT OR HDD				$ 4,411,800
4	TESTING AND COMMISSIONING OF THE WATER MAIN				$ 81,000
5	VALVING				$ 187,500
6	HYDRANT POINTS				$ 192,500
7	AIR VALVES				$ 45,000
8	PROPERTY CONNECTIONS				$ 1,300,650
9	MISCELLANEOUS ITEMS				$ 375,000
9	HDD Bay Crossing				$ 2,957,080
					$ 9,970,530
	Plus Head Contractor Profit and Overheads 14%				$ 1,395,874
	Sub Total Full Flow Water Reticulation Cost Estimate Summary				$ 11,366,404
	Plus 30% Contingency				$ 3,409,921
	Total Full Flow Water Reticulation Cost Estimate Summary			Total	$ 14,776,326
ON PROPERTY WORKS FOR WATER CONNECTION TO A FULL FLOW SYSTEM					
	Connect a 25mm PE water supply pipe from the water meter to the properties existing water pipe infrastructure, where required upgrade piping to ensure compliance with AS/NZS3500.	377	No.	$ 5,000	$ 1,885,000
TOTAL CONNECTION COST FOR COMMUNITY TO CONNECT TO THE FULL FLOW WATER SYSTEM					$ 1,885,000
Cost per lot		377			$ 5,000

10.2 PV DETAILED SCHEDULES

PV Criteria and Factors

CRITERIA	
PV	50 yr.
Interval Factors	
yr.	NPV Factor
1	13.8007
5	0.713
10	0.5083
15	0.3624
20	0.2584
25	0.1842
30	0.1313
35	0.0936
40	0.0668
45	0.0476
50	0.0339



10.2.1 OPTION A2/B11: Pressure Sewerage System - Discharge to SWC Network

1. WASTEWATER								Rev	A
OPTION A2/B11: Pressure Sewerage System - Discharge to SWC Network								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr.		Present Value Calculation		Present Value $			
		yr.	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Pressure Sewer System - Discharge to SWC Network	$ 49,842,585					$ 49,842,585			
Operating Costs (PSS Units, Booster SPS)	$ 6,598	1	13.8007	Overall	1		$ 91,057		
Maintenance Costs (PSS Units, Booster SPS, Telemetry, Chemical Dosing Plant, Network Mains)	$ 123,269	1	13.8007	Overall	1			$ 1,701,198	
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	15	0.3624	PSU	377				$ 457,693
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	30	0.1313	PSU	377				$ 165,825
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	45	0.0476	PSU	377				$ 60,116
Replacement SPS Pump and Control Panel	$ 90,000	15	0.3624	SPS	1				$ 32,616
Replacement SPS Pump and Control Panel	$ 90,000	30	0.1313	SPS	1				$ 11,817
Replacement SPS Pump and Control Panel	$ 90,000	45	0.0476	SPS	1				$ 4,284
Replacement Dosing Pump and Control Panel	$ 10,000	15	0.3624	SPS	1				$ 3,624
Replacement Dosing Pump and Control Panel	$ 10,000	30	0.1313	SPS	1				$ 1,313
Replacement Dosing Pump and Control Panel	$ 10,000	45	0.0476	SPS	1				$ 476
						$ 49,842,585	**$ 91,057**	**$ 1,701,198**	**$ 737,765**
TOTAL PRESENT VALUE	**$ 52,372,606**								

10.2.2 OPTION A2/B9: Pressure Sewerage System - "On Island" STP

WASTEWATER								Rev	A
OPTION A2/B9: Pressure Sewerage System - "On Island" STP								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Pressure Sewer System - Discharge to "On Island" STP	$ 69,197,863					$ 69,197,863			
Operating Costs (PSS Units, TE Pump Station)	$ 5,624	1	13.8007	Overall	1		$ 77,615		
Maintenance Costs (PSS Units, TE Pump Station, MBR STP, Telemetry, Network Mains, Ebb Tide Release Structure including electricity and chemical costs)	$ 643,236	1	13.8007	Overall	1			$ 8,877,107	
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	15	0.3624	PSU	377				$ 457,693
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	30	0.1313	PSU	377				$ 165,825
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	45	0.0476	PSU	377				$ 60,116
Replacement TE Pump and Control Panel	$ 85,000	15	0.3624	WWTP	1				$ 30,804
Replacement TE Pump and Control Panel	$ 85,000	30	0.1313	WWTP	1				$ 11,161
Replacement TE Pump and Control Panel	$ 85,000	45	0.0476	WWTP	1				$ 4,046
Replacement key MBR equipment									
Aeration Diffusers	$ 15,000	5	0.713	WWTP	1				$ 10,695
Aeration diffusers, membranes, pumps, blowers	$ 275,000	10	0.5083	WWTP	1				$ 139,783
Aeration Diffusers, Inlet Screens	$ 115,000	15	0.3624	WWTP	1				$ 41,676
Aeration diffusers, membranes, pumps, blowers	$ 275,000	20	0.2584	WWTP	1				$ 71,060
Aeration Diffusers	$ 15,000	25	0.1842	WWTP	1				$ 2,763
Aeration diffusers, membranes, pumps, blowers and inlet screens	$ 375,000	30	0.1313	WWTP	1				$ 49,238
Aeration Diffusers	$ 15,000	35	0.0936	WWTP	1				$ 1,404
Aeration diffusers, membranes, pumps, blowers	$ 275,000	40	0.0668	WWTP	1				$ 18,370
Aeration Diffusers, Inlet Screens	$ 115,000	45	0.0476	WWTP	1				$ 5,474
Aeration diffusers, membranes, pumps, blowers	$ 275,000	50	0.0339	WWTP	1				$ 9,323
Replacement Ebb Tide Release Equipment									
Duckbill Valve	$ 8,000	5	0.713	WWTP	1				$ 5,704

WASTEWATER
OPTION A2/B9: Pressure Sewerage System - ''On Island'' STP
NPV ANALYSIS 50 Year
Rev A
Date 12/11/2019

ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Duckbill Valve	$ 8,000	10	0.5083	WWTP	1				$ 4,066
Duckbill Valve, Anodes	$ 58,000	15	0.3624	WWTP	1				$ 21,019
Duckbill Valve	$ 8,000	20	0.2584	WWTP	1				$ 2,067
Duckbill Valve	$ 8,000	25	0.1842	WWTP	1				$ 1,474
Duckbill Valve, Anodes	$ 58,000	30	0.1313	WWTP	1				$ 7,615
Duckbill Valve	$ 8,000	35	0.0936	WWTP	1				$ 749
Duckbill Valve	$ 8,000	40	0.0668	WWTP	1				$ 534
Duckbill Valve, Anodes	$ 58,000	45	0.0476	WWTP	1				$ 2,761
Duckbill Valve	$ 8,000	50	0.0339	WWTP	1				$ 271
						$ 69,197,863	**$ 77,615**	**$ 8,877,107**	**$ 1,125,691**
TOTAL PRESENT VALUE	**$ 79,278,276**								

10.2.3 OPTION A4/B11: Hybrid Sewerage System - Discharge to SWC Network

1. WASTEWATER								**Rev**	**A**
OPTION A4/B11: Hybrid Sewerage System - Discharge to SWC Network								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Hybrid Sewer System - Discharge to SWC Network	$ 58,316,934					$ 58,316,934			
Operating Costs (PSS Units, Booster SPS)	$ 5,960	1	13.8007	Overall	1		$ 82,252		
Maintenance Costs (PSS Units, Booster SPS, Telemetry, Chemical Dosing Plant, Network Mains)	$ 123,994	1	13.8007	Overall	1			$ 1,711,204	
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	15	0.3624	PSU	275				$ 333,861
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	30	0.1313	PSU	275				$ 120,960
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	45	0.0476	PSU	275				$ 43,852
Replacement SPS Pump and Control Panel	$ 315,000	15	0.3624	SPS	1				$ 114,156
Replacement SPS Pump and Control Panel	$ 315,000	30	0.1313	SPS	1				$ 41,360
Replacement SPS Pump and Control Panel	$ 315,000	45	0.0476	SPS	1				$ 14,994
Replacement Dosing Pump and Control Panel for 4 pump stations	$ 10,000	15	0.3624	SPS	1				
Replacement Dosing Pump and Control Panel for 4 pump stations	$ 10,000	30	0.1313	SPS	1				$ 1,313
Replacement Dosing Pump and Control Panel for 4 pump stations	$ 10,000	45	0.0476	SPS	1				$ 476
						$ 58,316,934	**$ 82,252**	**$ 1,711,204**	**$ 670,971**
TOTAL PRESENT VALUE	**$ 60,781,361**								

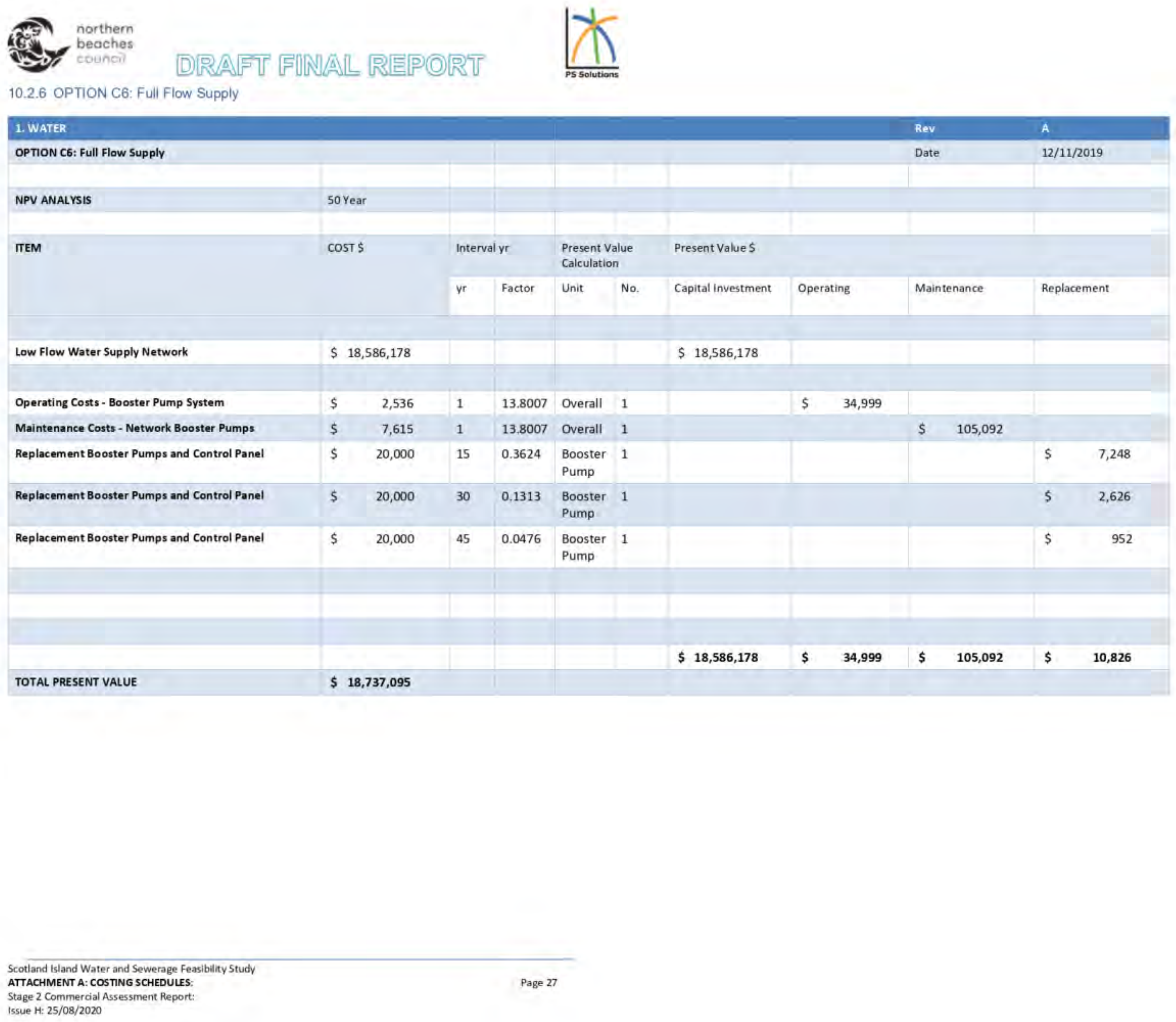
10.2.4 OPTION A4/B9: Hybrid Sewerage System - "On Island" STP

1. WASTEWATER								Rev	A
OPTION A4/B9: Hybrid Sewerage System - "On Island" STP								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Pressure Sewer System - Discharge to "On Island" STP	$ 77,672,212					$ 77,672,212			
Operating Costs (PSS Units, TE Pump Station, Intermediate SPS)	$ 7,420	1	13.8007	Overall	1		$ 102,401		
Maintenance Costs (PSS Units, TE Pump Station, MBR STP, Telemetry, Network Mains, Ebb Tide Release Structure including electricity and chemical costs)	$ 654,447	1	13.8007	Overall	1			$ 9,031,827	
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	15	0.3624	PSU	377				$ 457,693
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	30	0.1313	PSU	377				$ 165,825
Replacement PSU Pump and Control Panel including transducer and aux float switch)	$ 3,350	45	0.0476	PSU	377				$ 60,116
Replacement TE Pump and Control Panel	$ 85,000	15	0.3624	WWTP	1				$ 30,804
Replacement TE Pump and Control Panel	$ 85,000	30	0.1313	WWTP	1				$ 11,161
Replacement TE Pump and Control Panel	$ 85,000	45	0.0476	WWTP	1				$ 4,046
Replacement key MBR equipment									
Aeration Diffusers	$ 15,000	5	0.713	WWTP	1				$ 10,695
Aeration diffusers, membranes, pumps, blowers	$ 275,000	10	0.5083	WWTP	1				$ 139,783
Aeration Diffusers, Inlet Screens	$ 115,000	15	0.3624	WWTP	1				$ 41,676
Aeration diffusers, membranes, pumps, blowers	$ 275,000	20	0.2584	WWTP	1				$ 71,060
Aeration Diffusers	$ 15,000	25	0.1842	WWTP	1				$ 2,763
Aeration diffusers, membranes, pumps, blowers and inlet screens	$ 375,000	30	0.1313	WWTP	1				$ 49,238
Aeration Diffusers	$ 15,000	35	0.0936	WWTP	1				$ 1,404
Aeration diffusers, membranes, pumps, blowers	$ 275,000	40	0.0668	WWTP	1				$ 18,370
Aeration Diffusers, Inlet Screens	$ 115,000	45	0.0476	WWTP	1				$ 5,474
Aeration diffusers, membranes, pumps, blowers	$ 275,000	50	0.0339	WWTP	1				$ 9,323

1. WASTEWATER								Rev	A
OPTION A4/B9: Hybrid Sewerage System - "On Island" STP								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Replacement Ebb Tide Release Equipment									
Duckbill Valve	$ 8,000	5	0.713	WWTP	1				$ 5,704
Duckbill Valve	$ 8,000	10	0.5083	WWTP	1				$ 4,066
Duckbill Valve, Anodes	$ 58,000	15	0.3624	WWTP	1				$ 21,019
Duckbill Valve	$ 8,000	20	0.2584	WWTP	1				$ 2,067
Duckbill Valve	$ 8,000	25	0.1842	WWTP	1				$ 1,474
Duckbill Valve, Anodes	$ 58,000	30	0.1313	WWTP	1				$ 7,615
Duckbill Valve	$ 8,000	35	0.0936	WWTP	1				$ 749
Duckbill Valve	$ 8,000	40	0.0668	WWTP	1				$ 534
Duckbill Valve, Anodes	$ 58,000	45	0.0476	WWTP	1				$ 2,761
Duckbill Valve	$ 8,000	50	0.0339	WWTP	1				$ 271
Replacement SPS and Control Panels	$ 315,000	15	0.3624	WWTP	1				$ 114,156
Replacement SPS and Control Panels	$ 315,000	30	0.1313	WWTP	1				$ 41,360
Replacement SPS and Control Panels	$ 315,000	45	0.0476	WWTP	1				$ 14,994
						$ 77,672,212	**$ 102,401**	**$ 9,031,827**	**$ 1,296,200**
TOTAL PRESENT VALUE	**$ 88,102,640**								

10.2.5 OPTION C4: Low Flow Supply

1. WATER								Rev	A
OPTION C4: Low Flow Supply								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Low Flow Water Supply Network	$ 17,920,580					$ 17,920,580			
Operating Costs - Booster Pump System	$ 2,598	1	13.8007	Overall	1		$ 35,854		
Maintenance Costs - Network Booster Pumps	$ 8,628	1	13.8007	Overall	1			$ 119,072	
Replacement Booster Pumps and Control Panel	$ 20,000	15	0.3624	Booster Pump	1				$ 7,248
Replacement Booster Pumps and Control Panel	$ 20,000	30	0.1313	Booster Pump	1				$ 2,626
Replacement Booster Pumps and Control Panel	$ 20,000	45	0.0476	Booster Pump	1				$ 952
						$ 17,920,580	**$ 35,854**	**$ 119,072**	**$ 10,826**
TOTAL PRESENT VALUE	**$ 18,086,333**								



10.2.6 OPTION C6: Full Flow Supply

1. WATER								Rev	A
OPTION C6: Full Flow Supply								Date	12/11/2019
NPV ANALYSIS	50 Year								
ITEM	COST $	Interval yr		Present Value Calculation		Present Value $			
		yr	Factor	Unit	No.	Capital Investment	Operating	Maintenance	Replacement
Low Flow Water Supply Network	$ 18,586,178					$ 18,586,178			
Operating Costs - Booster Pump System	$ 2,536	1	13.8007	Overall	1		$ 34,999		
Maintenance Costs - Network Booster Pumps	$ 7,615	1	13.8007	Overall	1			$ 105,092	
Replacement Booster Pumps and Control Panel	$ 20,000	15	0.3624	Booster Pump	1				$ 7,248
Replacement Booster Pumps and Control Panel	$ 20,000	30	0.1313	Booster Pump	1				$ 2,626
Replacement Booster Pumps and Control Panel	$ 20,000	45	0.0476	Booster Pump	1				$ 952
						$ 18,586,178	**$ 34,999**	**$ 105,092**	**$ 10,826**
TOTAL PRESENT VALUE	**$ 18,737,095**								

11 ATTACHMENT B: RISK ASSESSMENT

11.1 Risk Assessment Process

A risk assessment workshop was undertaken to identify and analyse potential risks and opportunities. The analysis included the identification of strategies to mitigate the level of risk or implement the opportunity.

Risk Process:

- Identification of risks and opportunities
- Evaluation each risk / opportunity for likelihood and consequence
- A level of risk was derived from the likelihood / consequence levels, Low – Medium – High or Extreme.
- Mitigation / implementation strategies were identified for items with risks levels greater than medium.
- An indicative costing was compiled for risks greater than medium that were not mitigated

Risks were assessed under five categories

- Planning
- Technical
- Environmental
- Stakeholder and Community Assessment
- Construction

Risk Workshop Attendees

NAME	COMPANY	ROLE
Ruby Ardren	Northern beaches Council	Project Leader Water
Craig Kennedy	PS Solutions	Senior Civil Engineer
Steve Wallace	PS Solutions	Project Director
Gavin Ovens	GOH / PSS	Water Infrastructure Advisor
Kurt Dahl	Permeate Partners	Wastewater Treatment Consultant
Gareth Thomas	RPS	Environmental
Kapil Kulkarni	RPS	Investment Analysis

11.2 Risk Assessment Evaluation Criteria

Risk Matrix						
Likelihood		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
5	Almost Certain	Medium	High	High	Extreme	Extreme
4	Likely	Medium	Medium	High	High	Extreme
3	Possible	Low	Medium	Medium	High	High
2	Unlikely	Low	Low	Medium	Medium	High
1	Rare	Low	Low	Low	Medium	Medium

Likelihood

Rating	Description	Frequency	Description
1	Rare	< 100 years	No evidence of it occurring.
2	Unlikely	< 20 years	Never known to occur, but considered a possibility
3	Possible	< 5 years	Has been known to occur
4	Likely	< 1 year	Known to occur
5	Almost Certain	<6 months	Expected to occur more than once per year

Consequence							
		1	2	3	4	5	6
Rating	Description	Commercial Impact Guide	Planning	Technical	Environmental	Stakeholder and Community Assessment	Construction
1	Insignificant	< $5,000	Oversight with no Process Delays	Technical compliance breach No legal significance.	Minimal environmental impact.	Of interest to individuals only. No media interest.	Negligible impact on cost and time;
2	Minor	< $20,000	Approval Resubmissions.	Compliance or legal breach resulting in minor corrective action.	Noticeable environmental impact.	Interest to local community only.	Minor alternate methods required .
3	Moderate	< $50,000	Additional planning constraints identified	Moderate compliance or legal breach	Significant environmental impact. Release effecting moderate area.	Stakeholder actively expressing dissatisfaction.	System functional changes, redesign required
4	Major	< $500,000	Delays in planning approval	Serious compliance or legal breach resulting in court imposed penalties	Extensive environmental impact. Large release requiring long term remediation.	Stakeholder alarm or grave concern.	Major obstacle or delay greater than 3 months
5	Catastrophic	> $500,000	Prevents planning approval	Extensive breach with fines & litigation with possible class action. Loss of charter to operate.	Massive impact on the environment. Massive clean up and rehabilitation.	Irreparable loss of community and stakeholder confidence in the organisation.	Significant component of construction not buildable or failure in installation

11.3 Risk Assessment Matrix

Project: SCOTLAND ISLAND WATER/WASTEWATER FEASIBILTY	Phase	Feasibility Risk Analysis	Date: 12-11-2019	
Documents:			Rev D	

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
Planning & Approval														
P.1	R	EIS required to be expanded to include Pittwater			B.9				Program Delays, expansion in EIS Scope.	Possible	Moderate	Medium	Early engagement in planning & design phases	Allowance for all Delay Items compiled into one item: Allowance 6 months PM x 2 = $324,000
P.2	R	REF Scope	A.1	A.4		B.11	C.4	C.6	Program Delays, expansion in REF Scope. May preclude option B.9	Rare	Minor	Low	Early engagement in planning & design phases	
P.3	R	Not getting approval from DPIE & DPI	A.1	A.4	B.9	B.11	C.4	C.6	Delays and Resubmission of Planning documents	Rare	Moderate	Low	Early engagement in planning & design phases	
P.4	R	Delay in approval from DPIE, DPI, RMS, EPA, NBC, Energy Aust.	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Early engagement in planning & design phases	Included in item P1; More likely for B9
P.5	R	Change of State Govt	A.1	A.4	B.9	B.11	C.4	C.6	Delays in Construction	Possible	Insignificant	Low		
P.6	R	Change of Council	A.1	A.4	B.9	B.11	C.4	C.6	Delays in Construction	Possible	Insignificant	Low		
P.7	R	Modifications to approvals	A.1	A.4	B.9	B.11	C.4	C.6	Delays in Construction	Rare	Moderate	Low		
P.8	R	Stop work delays due to non compliance with conditions	A.1	A.4	B.9	B.11	C.4	C.6	Delays in Construction	Rare	Moderate	Low	Project QA	
P.9	R	Design not consistent with what is approved	A.1	A.4	B.9	B.11	C.4	C.6	Possible Fines, delays	Rare	Moderate	Low	Multiple QA sign offs	
P.10	R	Not getting heritage item approvals	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Rare	Moderate	Low		
P.11	R	Onerous conditions of approval - Heritage & Environmental	A.1	A.4	B.9	B.11	C.4	C.6		Possible	Moderate	Medium		Included in P1; May impact significantly on B.9

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
P.12	R	Not getting authority to enter private property	A.1	A.4			C.4	C.6	Delays	Likely	Minor	Medium	Include in provisional allowance; Council authority to facilitate community engagement	Nil, mitigation
P.13	R	Failure to adhere to correct procedure re: entry of properties	A.1	A.4			C.4	C.6	Delays	Unlikely	Minor	Low	n/a	
P.14	R	Changes to scheme parameters, number of lots, zoning changes etc.	A.1	A.4	B.9		C.4	C.6	Redesign, delays	Unlikely	Minor	Low	Detailed survey & consultation with NBC	
P.15	R	Failure to gather information for future development, prior to construction start	A.1	A.4	B.9		C.4	C.6	Redesign, delays	Unlikely	Minor	Low	Detailed survey & consultation with NBC	
P.16	R	Delays due to land acquisition/resumption for pump stns, STP, Operations workshop/storage			B.9	B.11			Project Delays	Possible	Moderate	Medium	Early engagement in planning & design phases	Delays included in item P1
P.17	R	Property boundaries may need to be surveyed to ensure infrastructure is accurately located	A.1	A.4			C.4	C.6	Relocation of installed services	Almost Certain	Moderate	High	Survey included in Scope	nil
P.18	R	Insurance gaps	A.1	A.4	B.9	B.11	C.4	C.6	Litigation, cost implications	Unlikely	Minor	Low	Workshop risks & allocate to the party that has main control over the risk	Nil
P.19	R	Maritime incident	A.1	A.4	B.9	B.11	C.4	C.6	Project Delays	Unlikely	Minor	Low		
P.20	R	Rates charges and structure;	A.1	A.4	B.9	B.11	C.4	C.6	Resistance from community to increase rates through property value increase	Unlikely	Minor	Low	Early engagement	
P.21	R	Finalising location of underbore				B.11	C.4	C.6	Project Delays	Possible	Major	High	Detailed design and coordination	Allowance for increase in difficulty; $100,000
P.22	R	Sydney Water technical & procedural requirements	A.1	A.4	B.9	B.11	C.4	C.6	Project Delays	Likely	Major	High	Collaborative design; Full engagement with Sydney Water; Review of Sydney Water similar projects for costings. Alternate delivery models	Included in item P.1 Delay Costs

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
P.23	R	Sydney Water augmentation requirements				B.11	C.4	C.6	Project Delays	Unlikely	Major	Medium	Sydney Water have confirmed capacity is available at Church Point	Nil
P.24	R	Procurement model not fit for purpose / does not meet long term project objectives	A.1	A.4	B.9	B.11	C.4	C.6	Cost increases, delays	Likely	Major	High	Due diligence in planning, and greater assessment of options with the potential delivery agents	Nil
P.25	O	Fast Track Planning Approvals	A.1	A.4	B.9	B.11	C.4	C.6	Accelerated delivery	Possible	Moderate	Medium	Agency alignment	Percent of approval process, included in item P.1
Design / Technical														
D.1	R	Services locations (power, water, comms, effluent mains)	A.1	A.4			C.4	C.6	Damage to existing services and service interruptions	Possible	Moderate	Medium	Scope to include services locating and potholing, policies etc	Nil
D.2	R	Survey errors	A.1	A.4	B.9	B.11	C.4	C.6		Unlikely	Minor	Low		
D.3	R	Insufficient allowance for prolonged consultation with customers in siting tanks, manholes, SPS's	A.1	A.4		B.11			Delays, design changes	Possible	Minor	Medium	Community planning sessions, early engagement, established policies and procedures	Nil
D.4	R	Inflow & Infiltration to sewer system	A.1	A.4	B.9					likely	Moderate	High	Project QA audits due diligence	Nil
D.5	R	Water demand higher than expected					C.4	C.6	Operational issues, low pressures	likely	Moderate	High	Community education	Nil
D.6	R	Water pipe burst in underbore					C.4	C.6	Operational issues	Unlikely	Major	Medium	Locate product pipe in sleeve pipe. Higher pressure rated pipe to be employed. Leak detection.	Nil

			Relevant Option											
			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
D.8	R	SPS additional odour control design changes	A.1			B.11				Possible	Minor	Medium	Collaborative design	Nil
D.9	R	STP additional odour control design changes			B.9					Possible	Minor	Medium	Collaborative design	Nil
D.10	R	Additional telemetry / comms infrastructure due to location	A.1	A.4	B.9	B.11	C.4	C.6	Unable to commission. Unable to operate remotely.	Possible	Moderate	Medium	Test telemetry/coverage on site during design phase	Nil
D.11	R	Potential for requirement to upgrade power to sites &/or delay	A.1	A.4					Delays, additional costs for upgrade of electrical panels	Likely	Moderate	High	Property audits	Community homeowner costs. Benchmark to similar projects
D.13	R	Adequacy of electrical supply	A.1	A.4	B.9	B.11	C.4	C.6	Additional construction costs	Unlikely	Major	Medium	Early engagement in planning & design phases	Telemetry to manage peak power demand
D.14	O	Eliminate pumping stations				B.11			Reduced scope	Possible	Moderate	Medium	Opportunity to be reviewed in detailed design, replaced with flushing system	Eliminate Pumping Station for Pressure Sewer Option
D.15	O	Recycled Water			B.9				Income stream, maintaining rainwater tanks	Possible	Minor	Medium	Not considered commercially viable	Nil
D.16	R	Integrity of existing house drainage	A.1	A.4	B.9	B.11			Wet weather flow disrupting service	Possible	Minor	Medium	Due diligence in audit of existing house drainage	Nil
Environmental														
E.1	R	threatened species - flora / fauna	A.1	A.4	B.9		C.4	C.6	Damage to existing flora and fauna	Unlikely	Minor	Low	EIS, REF	
E.2	R	Precautionary water monitoring treated water discharge, not comply with EPA requirements, stringent EPA licence conditions			B.9				Operational risk, quality going out of spec.	Almost Certain	Moderate	High	Design to include monitoring and controls, flexible allowance negotiation	$1.5m, plus $100k operating

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
E.3	R	Discharge of wastewater into environment	A.1	A.4	B.9	B.11			Fines. Pollution.	possible	Moderate	Medium	Design modelling. Emergency storage. Containment controls in work method statements	Nil
E.4	R	Discharge of wastewater into Pittwater	A.1	A.4	B.9	B.11			Fines. Pollution.	possible	Moderate	Medium	Design modelling. Emergency storage. Containment controls in work method statements	Nil
E.7	R	Acid sulphate soil	A.1	A.4	B.9	B.11	C.4	C.6	Additional costs for ASS management. Pollution.	Almost Certain	Moderate	High	Early Geotech survey. ASS Management Plan.	Nil mitigated
E.8	R	Septic effluent/sludge removal & disposal	A.1	A.4					Pollution, customer complaints	Possible	Minor	Medium	Community Cost	Nil
E.9	R	Drilling slurry disposal / management	A.1	A.4	B.9	B.11	C.4	C.6	Contamination	Unlikely	Major	Medium	Specification to include suitable controls	Nil
E.10	R	Flooding - during construction	A.1	A.4	B.9	B.11	C.4	C.6	Delays. Remediation costs. Pollution.	Unlikely	Minor	Low		
E.12	R	Construction erosion – water pollution	A.1	A.4	B.9	B.11	C.4	C.6	Contamination	Possible	Moderate	Medium	Work site erosion control to be appropriately specified	Nil
E.13	R	Inadequate restoration	A.1	A.4	B.9	B.11	C.4	C.6	Customer complaints. Erosion. Pollution.	Unlikely	Moderate	Medium	Project QA, dilapidation surveys	Nil
E.14	R	Underbore construction				B.11	C.4	C.6	Delays. Remediation costs. Pollution.	Possible	Major	High	Pre-qualified, experienced contractors	Nil
E.15	R	Tree roots encountered / cut. Re-route &/or stoppage &/or fines	A.1	A.4			C.4	C.6	Delays, increased excavation costs. Environmental damage.	Possible	Minor	Medium	Detailed mains layout survey during design phase. HDB where possible	Nil
E.16	R	Odour – from air release points	A.1	A.4		B.11			Customer complaints. Pollution. Operational issues.	Possible	Minor	Medium	Odour management to be implemented at all air release points in pressure sewer system	Mitigated

			Relevant Option Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
E.17	R	Visual issues re: air release points	A.1	A.4					Customer complaints	Possible	Minor	Medium	Early community engagement in Planning & design phases	Nil
E.18	R	Damage to heritage items	A.1	A.4	B.9	B.11	C.4	C.6		Unlikely	Minor	Low		
E.19	R	Visual impacts adjacent to heritage items	A.1	A.4	B.9	B.11	C.4	C.6		Unlikely	Minor	Low		
E.20	R	Bush fire	A.1	A.4	B.9	B.11	C.4	C.6	Risk to life and injury, Delays, loss of materials	Unlikely	Major	Medium	Bushfire emergency plan, evacuation plan	Nil
E.21	R	Encountering heritage site & subsequent scope change	A.1	A.4	B.9	B.11	C.4	C.6	Delays, design changes	Unlikely	Moderate	Medium		Including planning delay item P.1
E.22	R	Climate change and sea level rises	A.1	A.4	B.9	B.11	C.4	C.6	Planning implications	Unlikely	Moderate	Medium	Allowance for NBC climate policy	Nil
E.23	O	Improved environment on the Island	A.1	A.4	B.9	B.11			Improved health	Almost Certain	Moderate	High	Intangible benefit to be include in overall commercial assessment	
E.24	O	Improved water quality in Pittwater	A.1	A.4	B.9	B.11			Improved amenity	Almost Certain	Moderate	High	Intangible benefit to be include in overall commercial assessment	
E.25	R/O	Environmental support of business case	A.1	A.4	B.9	B.11	C.4	C.6	Advantages / disadvantages not able to be measured as capital cost	Almost Certain	Moderate	High	Intangible benefit to be include in overall commercial assessment	Nil
Stakeholder & Community														
S.1	R	Infrastructure ownership / demarcation	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, reputation damage	Possible	Insignificant	Low	Early stakeholder engagement	
S.2	R	Setting customer expectations too high	A.1	A.4	B.9	B.11	C.4	C.6	Reputation damage	Unlikely	Moderate	Medium	Implementation of detailed community consultation plan	Nil
S.3	R	Acceptance at handover stage	A.1	A.4	B.9	B.11	C.4	C.6		Unlikely	Minor	Low	Project QA	

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
5.4	R	Not managing customer expectations	A.1	A.4	B.9	B.11	C.4	C.6	Reputation damage	Unlikely	Minor	Low	Implementation of detailed community consultation plan	
5.5	R	Not managing events to meet expectations	A.1	A.4	B.9	B.11	C.4	C.6	Reputation damage	Unlikely	Minor	Low	Implementation of detailed community consultation plan	
5.6	R	Delays in being able to connect – Delay to Project - Willingness to connect - Service availability charges	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Council to implement connection policies	Mitigated
5.7	R	Changes to local / cultural amenity	A.1	A.4	B.9	B.11	C.4	C.6	Delays, redesign	Unlikely	Minor	Low	Early community engagement in Planning & design phases	
5.8	R	Poorly performing contractors	A.1	A.4	B.9	B.11	C.4	C.6	Cost overruns, reputation damage	Possible	Major	High	Pre-qualified, experienced contractors, due diligence in tender and procurement process	Mitigated
5.9	R	Land owners causing delays &/or scope changes &/or additional restoration	A.1	A.4			C.4	C.6	Extension of time delays	Possible	Minor	Medium	Early engagement in planning & design phases Council policies	
5.10	R	Extra over costs for additional dilapidation surveys	A.1	A.4			C.4	C.6		Unlikely	Minor	Low		
5.11	R	Community protests - e.g. service availability charges	A.1	A.4	B.9	B.11	C.4	C.6	Reputational damage	Likely	Moderate	High	Implementation of detailed community consultation plan	
5.12	R	Additional consultation / workshops due to scope change	A.1	A.4	B.9	B.11	C.4	C.6		Possible	Minor	Medium	Contingency	
5.13	R	Customers not "trusting" technology	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Implementation of detailed community consultation plan	Mitigated
5.14	R	Customers along the rising main cannot connect	A.1	A.4					Commercial viability	Possible	Moderate	Medium	Financial commercial plan for compulsory connection	DELETE

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
S.15	R	Customer not agreeing with facility location			B.9				Reputational damage, project delays	Likely	Moderate	High	Implementation of detailed community consultation plan	Mitigated
S.16	R	Restoration disputes	A.1	A.4	B.9	B.11	C.4	C.6		Possible	Minor	Medium	Project QA and dilapidation reports	Mitigated
S.17	R	"Poor" restoration perception	A.1	A.4	B.9	B.11	C.4	C.6		Possible	Minor	Medium	Project QA and dilapidation reports	Mitigated
S.18	R	Pump electricity disputes	A.1	A.4						Unlikely	Minor	Low		
S.19	R	Disagreements re meter box upgrades	A.1	A.4						Unlikely	Minor	Low		
S.20	R	Poor customer education – ongoing/commitment	A.1	A.4	B.9	B.11	C.4	C.6		Unlikely	Minor	Low		
S.21	R	Education – Homeowner perceives too complex	A.1	A.4	B.9	B.11				Unlikely	Minor	Low		
S.22	R	Equity issues for on island customers (hybrid scheme)		A.4					Reputational issues, project objections and delays	Likely	Minor	Medium	Eliminate Hybrid System?	Additional allowance; $1000 per lot 115
S.23	O	Reduced public health risks	A.1	A.4	B.9	B.11				Almost Certain	Major	Extreme	Intangible Benefit	
S.24	O	Reduced risk to on island operators of water supply system					C.4	C.6		Almost Certain	Moderate	High		
S.25	O	Reduced supply costs for water supply					C.4	C.6		Almost Certain	Moderate	High		
S.26	O	Improved property value	A.1	A.4	B.9	B.11	C.4	C.6		Almost Certain	Moderate	High		
S.27	O	Improved convenience	A.1	A.4	B.9	B.11	C.4	C.6		Almost Certain	Moderate	High		
S.28	O	Improved amenity on island	A.1	A.4	B.9	B.11	C.4	C.6		Almost Certain	Moderate	High		
S.29	R/O	Increased development								Almost Certain	Moderate	High		
S.30	O	Reduced Bushfire risk								Possible	Moderate	Medium		
S.31	R	Funding not forthcoming	A.1	A.4	B.9	B.11	C.4	C.6	Project does not proceed	Possible	Major	High	Confidence in development of delivery model and cost structure	

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
Construction / Commissioning														
C.1	R	Inclement weather beyond estimate allowances	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Appropriate cost plan allowance	Mitigated
C.2	R	Restoration after heavy rain	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Appropriate cost plan allowance	Mitigated
C.3	R	Stormwater upgrades	A.1	A.4		B.11	C.4	C.6		Possible	Minor	Medium	Included in design	Mitigated
C.4	R	Potential land slip affecting residences, infrastructure etc &/or revised scope	A.1	A.4			C.4	C.6	Land slip, contamination	Possible	Major	High	Detailed geophysical & geotechnical surveys.	CR to review. Allowance 500m retaining wall @ $1000 / m
C.5	R	Escalation of material supply over contract period	A.1	A.4	B.9	B.11	C.4	C.6	Cost overruns, reputation damage	Possible	Moderate	Medium	Tender clauses to exclude escalation,	nil
C.6	R	Boulders encountered during boring	A.1	A.4	B.9	B.11	C.4	C.6	See C.7				Detailed geophysical & geotechnical surveys	
C.7	R	Unexpected rock	A.1	A.4	B.9	B.11	C.4	C.6	Cost overruns	Likely	Moderate	High	Allowance included in cost plan	Mitigated
C.8	R	Structural damage to residences	A.1	A.4			C.4	C.6	Damage to dwellings	Rare	Major	Medium	Structural Engineers certification included in tender documentation	$ 37,700.00
C.9	R	Lack of available resources - labour &/or materials	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, cost overruns	Unlikely	Moderate	Medium	Pre-qualified contractor workshop at tender stage	Nil
C.10	R	Vandalism	A.1	A.4	B.9	B.11	C.4	C.6	Loss, additional costs	Unlikely	Minor	Low		
C.11	R	Theft	A.1	A.4	B.9	B.11	C.4	C.6	Loss, additional costs	Unlikely	Minor	Low		
C.12	R	Additional PM/ management costs due to scope changes	A.1	A.4	B.9	B.11	C.4	C.6	Additional design and construction costs	Possible	Moderate	Medium	Detailed design completed prior to construction tender stage	Nil; GENERIC DELAYS

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
C.13	R	New conditions of approval due to scope changes	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, cost overruns	Possible	Moderate	Medium	Detailed design completed prior to construction tender stage	Nil
C.14	R	Requirement for alternative pipe materials/piers required due to unstable ground	A.1	A.4			C.4	C.6	Refer C.8	Unlikely	Minor	Low	Detailed design completed prior to construction tender stage	Mitigated
C.15	R	Damage to existing services	A.1	A.4	B.9	B.11	C.4	C.6	Refer D.1	Unlikely	Minor	Low		
C.16	R	Unknown heritage items – delays / management	A.1	A.4	B.9	B.11	C.4	C.6	Project delays	Unlikely	Minor	Low	Detailed survey	
C.17	R	Managing pipeline testing - water availability	A.1	A.4			C.4	C.6	Project delays	Unlikely	Minor	Low	Contractors risk	
C.18	R	Contractor default	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, cost overruns	Unlikely	Major	Medium	Due diligence in tender process	Nil
C.19	R	Industrial disputes	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, cost overruns	Unlikely	Moderate	Medium	Contractors risk	Nil
C.20	R	Commissioning delays due to Authorities not happy with work	A.1	A.4	B.9	B.11	C.4	C.6	Project delays, cost overruns	Unlikely	Moderate	Medium	Quality Management Plan monitoring and auditing	Nil
C.21	R	Quality of house plumbing inspections	A.1	A.4			C.4		Project delays, cost variations	Unlikely	Moderate	Medium	Due diligence in selection of auditor, scope of work, specifications and inspections	Nil
C.22	R	Pressure test failure	A.1	A.4		B.11	C.4	C.6	Project delays	Unlikely	Minor	Low	Quality management during construction, contractors' risk	
C.23	R	Programme risk due to re-design works	A.1	A.4	B.9	B.11	C.4	C.6	Project delays	Possible	Moderate	Medium		Included in delay items P.1
C.24	R	Early commissioning/start-up – odours etc	A.1	A.4	B.9	B.11	C.4	C.6	Project delays	Unlikely	Minor	Low		
C.25	R	Foreign exchange risk	A.1	A.4	B.9	B.11	C.4	C.6	Additional costs	Unlikely	Minor	Low	Tender clauses to exclude escalation	
C.26	R	Delayed equipment delivery	A.1	A.4	B.9	B.11	C.4	C.6	Delays	Unlikely	Moderate	Medium	Contractors risk, lump sum tender	Nil

			Relevant Option Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
C.27	R	Loss of warranty time on pumps	A.1	A.4	B.9	B.11	C.4	C.6	Additional costs	Possible	Minor	Medium	Consider pumps not to be installed until placed in service, procurement structure	Mitigated
C.28	R	Sabotage from community	A.1	A.4	B.9	B.11	C.4	C.6	Refer C.11 and C.10					
C.29	R	Handover documentation not complete	A.1	A.4	B.9	B.11	C.4	C.6	Project delays	Unlikely	Minor	Low	Management of QA Process	
C.30	R	Decommissioning of septics	A.1	A.4					Incorrect decommission leaving health risk and/or non compliances	Unlikely	Minor	Low		
C.31	R	Disposal of materials (waste)	A.1	A.4	B.9	B.11	C.4	C.6		Possible	Moderate	Medium	Waste management to be appropriately addressed in project management plan	Community cost
C.32	R	Weather dependent transport - barges, boats	A.1	A.4	B.9	B.11	C.4	C.6	Refer to C.2; Delays and cost overruns					
C.33	R	Availability / location of 'laydown' areas	A.1	A.4		B.11	C.4	C.6	Cost overruns, redesign and cost increases	Unlikely	Moderate	Medium	Suitable project planning and consultation with trenchless consultants during design	Mitigated early project planning
C.34	R	Construction equipment / machinery access & movement around the Island	A.1	A.4	B.9	B.11	C.4	C.6	Injury to residents / visitors	Possible	Major	High	Contractors risk; Traffic management and work site management; suitable project insurances	Nil
C.35	R	Construction equipment / machinery access & movement around the Island	A.1	A.4	B.9	B.11	C.4	C.6	Damage to roadways, residents' access, laydown areas.	Possible	Major	High	Contractors risk; Traffic management and work site management; suitable project insurances. Moved into cost plan	Allowance included; Construction staging, laydown areas, temporary access; 142 work areas, 8 hrs x 2 p, plus 160 per hour plant x 4 hrs, plus materials = $250,000

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			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
C.36	R	Logistics, temporary access provision	A.1	A.4			C.4	C.6	Delays, access to residents	Possible	Major	High	Included C.35	Nil
C.37	R	Maintaining supply / damage to existing water	A.1	A.4			C.4	C.6	Delays	Unlikely	Minor	Low	Easy to repair. Contractor to have materials and equipment on island for immediate repair.	
C.38	R	Latent conditions	A.1	A.4	B.9	B.11	C.4	C.6	Delays, additional costs	Likely	Moderate	High	Detailed geophysical & geotechnical surveys	Included in Contingency:
Operational														
O.1	R	Poor location air valves	A.1	A.4			C.4	C.6	Operational issues	Unlikely	Minor	Low	Design modelling	Nil: Operational
O.2	R	Odour from "air valves " generation / control	A.1	A.4					Pollution, customer complaints	Unlikely	Minor	Low	Odour scrubbing	Nil: Operational
O.3	R	Failure to get air management correct	A.1	A.4			C.4	C.6	Operational issues	Unlikely	Minor	Low	Design modelling	Nil: Operational
O.4	R	Blockage potential in sewer mains (low points, drain down, low velocity sections)	A.1	A.4					Operational issues	Unlikely	Minor	Low	Design modelling	Nil: Operational
O.5	R	Poor location of tanks	A.1	A.4					Operational issues	Unlikely	Minor	Low		Nil: Operational
O.6	R	Cannot use full emergency capacity of tanks							Operational issues	Unlikely	Minor	Low		Nil: Operational
O.7	R	High 'after power outage' discharges	A.1	A.4		B.11			Operational issues	Unlikely	Minor	Low	Design modelling	Nil: Operational
O.8	R	Loss of service during extended power outages	A.1	A.4					Operational issues	Unlikely	Minor	Low	Option for genset backup	Nil: Operational
O.9	R	Equipment not fit for purpose	A.1	A.4	B.9		C.4	C.6	Operational issues, increased O&M Costs	Unlikely	Minor	Low	Use only approved products. Engage suppliers in design process	Nil: Operational
O.10	R	Unable to access equipment for service/maintenance	A.1	A.4	B.9	B.11	C.4	C.6	Operational issues, increased O&M Costs	Unlikely	Minor	Low		Nil: Operational

			Pressure Sewer	Hybrid System	Treated / Pittwater	To SW Church Pt	Water Low Flow	Water Full Supply						
			Relevant Option											
No	R/O	Risk / Opportunity	A.1	A.4	B.9	B.11	C.4	C.6	Consequences	Likelihood	Consequence	Level of Risk	Risk Mitigation / Opportunity Realisation	Quantitative (Per Relevant Option)
O.11	R	Sewer pipe burst in underbore	A.1	A.4		B.11			Operational issues	Unlikely	Major	Medium	Locate product pipe in sleeve pipe. Higher pressure rated pipe to be employed. Leak detection. Specify design life	Nil: Operational
O.12	R	Inadequate emergency storage	A.1	A.4	B.9	B.11			Operational issues				Design modelling	Nil: Operational
O.13	R	Illegal discharges into the sewer system	A.1	A.4	B.9	B.11			Operational issues. Pollution.	Unlikely	Moderate	Medium	Community education	Nil: Operational
O.14	R	Chemical spills at SPS's, STP; Risk in chemical transport	A.1		B.9	B.11			Operational issues. Fines. Pollution.	possible	Moderate	Medium	Compliant design for chemical containment	Nil: Operational
O.15	R	Flooding - during operation	A.1	A.4	B.9	B.11			Operational issues. Pollution.	Unlikely	Moderate	Medium	Design modelling	Nil: Operational

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12 ATTACHMENT C: RPS REPORT: SCOTLAND ISLAND CASE FOR INVESTMENT

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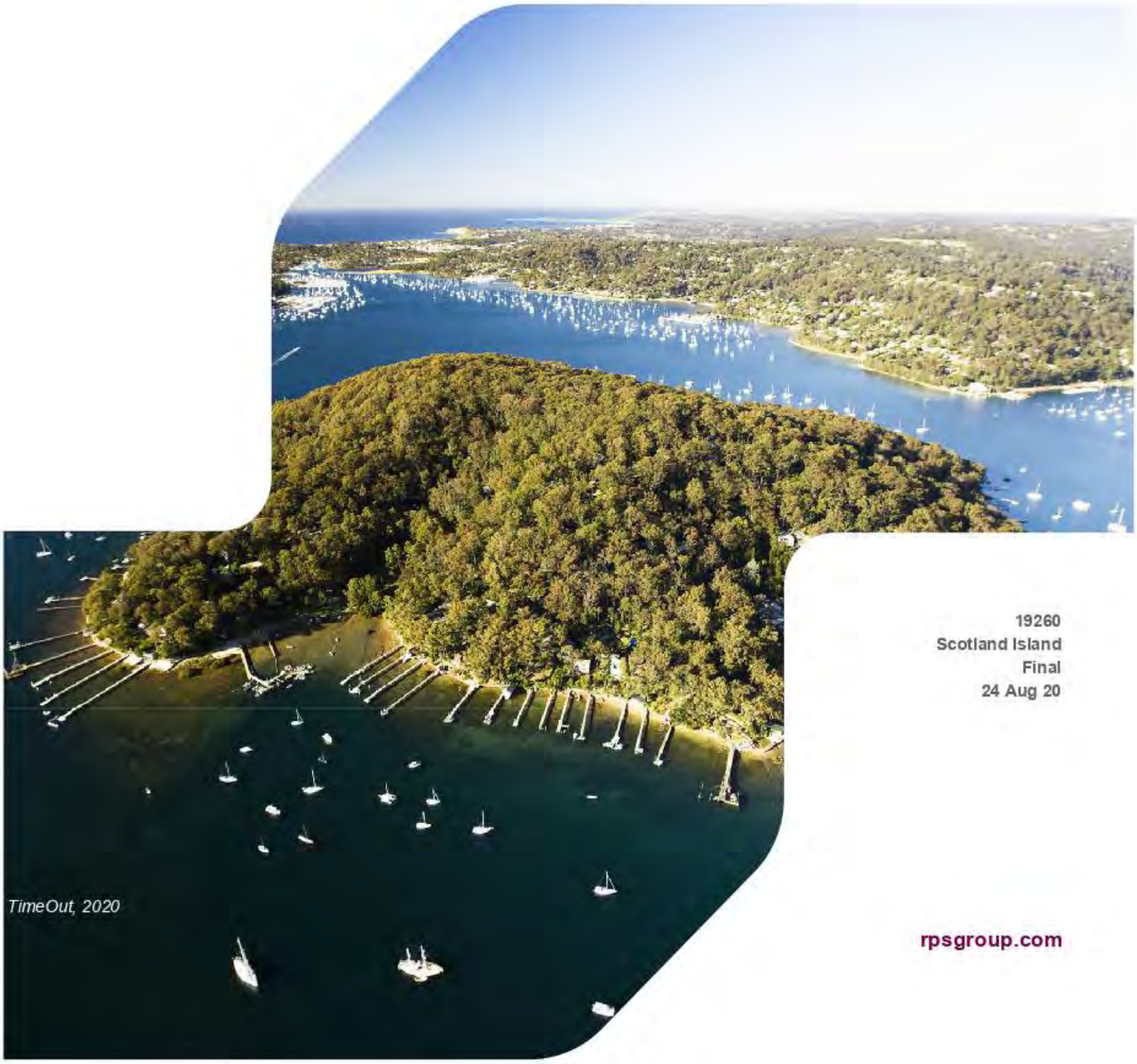
PS Solutions

SCOTLAND ISLAND WATER INFRASTRUCTURE

Case for Investment


TimeOut, 2020

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Scotland Island
Final
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REPORT

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Version	Purpose of document	Authored by	Reviewed by
0.1	Outline for comment	Angelo Rouggos	Kapil Kulkarni
1.0	Working draft report	Angelo Rouggos, Kapil Kulkarni	PS Solutions
2.0	Full draft report	Angelo Rouggos, Kapil Kulkarni, Luke Brennan	Northern Beaches Council
3.0	Draft2 – Updated after Council Review	Angelo Rouggos, Kapil Kulkarni, Luke Brennan	PS Solutions
3.1	Minor updates after PS Solutions review	Angelo Rouggos, Kapil Kulkarni, Luke Brennan	Ruby Arden
3.2	Minor updates after NBC review	Angelo Rouggos, Kapil Kulkarni, Luke Brennan	NBC
Draft Final Report	NBC review	Angelo Rouggos, Kapil Kulkarni, Luke Brennan	NBC

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EXECUTIVE SUMMARY

Scotland Island is a large island / village in Pittwater in the Northern Beaches Council located approximately 30 km north of the Sydney Central Business District (CBD). The island has no reticulated potable water supply nor centralised wastewater system connection.

The existing drinking water supply is fed from rainwater tanks. However, the rainwater tanks are not able to supply residents with a constant source of drinking water. A small diameter emergency water supply pipe servicing Scotland Island was constructed extending from Sydney Water towns water supply at Church Point as an emergency water service supplying firefighting water storage tanks. The small diameter pipeline is not a compliant drinking water supply and is clearly distributed as non-potable water. The water is supplied as a non-potable supply by Northern Beaches Council, as detailed in their Scotland Island - Emergency Water Pipeline and Non-Potable Water Supply (2017) Policy. To access the water supply, residents must be a member of the Scotland Island Residents Association (SIRA) and sign an Agreement for Sale of Non-Potable Water from SIRA. When the rainwater tanks do run out of water, the small diameter non potable service is being used as a top up supply. The flow rate from the emergency pipeline is limited, so residents must book with the Scotland Island residents Association for use of the water supply on a rotational basis. The pipeline is in poor condition, with risk of contamination from contact with contaminated ground water. The practice of filling rainwater tanks provides avenues for contamination of the supply because the fill points generally do not have compliant backflow protection, and the fill hoses can have direct contact with contaminated ground water. The non-potable water supply is provided as firefighting water and is therefore without monitoring, and as a result, there is potentially low to zero levels of disinfection. This current practice on the island carries a risk to public health.

Current wastewater systems consist of on-site management systems (i.e. septic tanks and aerated treatment with local on-lot effluent disposal). This solution is generally unsuitable for the topography and geology of the island (PS Solutions, 2019b). In previous monitoring studies, streams have been found to have elevated nutrient, sediment and bacterial concentrations exceeding the ANZECC (1992) guidelines. Moreover, exposure to septic overflow carries public health risks, which in combination with the water supply arrangements are issues of concern to island residents and surrounding communities.

Soil testing in February 2019 indicated high levels of faecal coliforms in the soil in several locations (PS Solutions, 2019b). Other amenity issues that were anecdotally reported included odour and pests (mosquitoes).

A review of environmental factors found a large extent of noxious weeds and poor health of vegetation, which may be explained by excessive nutrient loads, albeit testing data were not available to confirm this conclusion (PS Solutions, 2019a). These impacts are likely due to contaminants accumulating in the soil, with the potential for these contaminants to run-off into the bay.

The community has been actively pursuing water and wastewater services for over 30 years. There have been previous investigations into the potential cost of servicing the island with grid-connected infrastructure (e.g. Sydney Water, 2018), however, these investigations have largely concluded that the cost of such solutions are likely to be prohibitive, and much higher than solutions provided to similar communities. The scope and inclusions in the Sydney Water assessment are not known in detail, but the submitted costs were high compared to other PSP projects.

Northern Beaches Council under a funding arrangement with NSW Government commissioned Pressure System Solutions (PS Solutions) to identify and assess the feasibility of options for water and sewerage servicing. RPS supported PS Solutions in preparing a Commercial Assessment Report, by investigating the investment case for supplying Scotland Island with water and sewerage services (Case for Investment).

This assessment includes:

- a definition of the problem and the project need;
- a presentation of four infrastructure options that address these problems;
- a qualitative assessment of the benefits of supply infrastructure (Benefits Assessment); and
- an analysis of the potential funding models (Funding Analysis).

It should be noted that water and wastewater services are considered essential services. Moreover, these services are very rarely priced for full cost recovery (i.e. they are not financially self-sufficient), and cost benefit analyses (CBA) often do not always show a favourable economic benefit-cost ratio. However, such services are still provided to communities and considered to be in the public interest. In this case, the investigation of reticulated water and wastewater services responds to three main problems:

- **Problem 1:** Existing infrastructure not fit-for-purpose and failing / non-compliant.
- **Problem 2:** Perception of high cost without sufficient investigation.
- **Problem 3:** Inequity due to comparable services having been provided to similar communities.

The Case for Investment considered the following four potential infrastructure options:

- **Infrastructure Option 1:** Fully reticulated water supply with a pressure sewerage system that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 2:** Low flow reticulated water supply with a hybrid sewer system (pressure and gravity sewerage systems) that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 3:** Fully reticulated water supply with a hybrid sewer system that discharges to Sydney Water sewerage infrastructure located at Church Point.
- **Infrastructure Option 4:** Fully reticulated water supply with on island treatment for sewage and effluent discharging to Pittwater.

The Benefits Assessment shows that the options for water and sewerage servicing for the residents of Scotland Island:

- will significantly reduce health risks,
- Provide equity by addressing a long-standing community need for the services, which have been provided to similar communities in the past, and at a cost that is comparable to similar schemes;
- improve the quality of service for island residents; and
- significantly improve the local environment, both on and off the island.

These benefits accrue to a broad range of stakeholders including island residents and visitors, the Council, the local environment and recreational users of the Pittwater Bay.

Importantly, all infrastructure options were found to address problems 1-3, by providing water and wastewater services that are reliable and compliant with the required standards (addressing Problem 1), providing these at a cost comparable to previous schemes (addressing Problem 2), and resolving the inequity currently felt by the residents of Scotland Island (addressing Problem 3).

Among the four options, Infrastructure Option 1 is the most cost effective and is therefore the recommended option.

The Funding Analysis investigated how the cost of the scheme could be recovered through funding from SWC / the NSW Government.

Funding contributions by Northern Beaches Council and/or island residents was considered but was not investigated due to being unacceptable to the Council, and unfeasible and inequitable for residents.

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1 INTRODUCTION

1.1 Background

Scotland Island is one of the largest villages in greater Sydney without a reticulated potable water supply or wastewater service. Scotland Island lies in close proximity to urban Sydney. Scotland Island has 370 lots, is densely populated and has little growth potential. The drinking water supply consists of household rainwater tanks and an emergency pipeline, intended for firefighting purposes. The pipeline supplies non-potable water and is now used by the majority of residents.

This current arrangement on the island carries a risk to public health. The rainwater tanks are not able to supply residents with a constant source of drinking water. A small diameter emergency water supply pipe servicing Scotland Island is not a compliant drinking water supply. Because the rainwater tanks do run out of water, the small diameter non potable service is being used as a top up supply. The pipeline is in poor condition, with risk of contamination from contact with contaminated ground water. During increased flow in the pipeline sections of the pipe can experience negative pressure, and a fault within the pipe can provide an intake point for contaminated ground water. The process of filling rainwater tanks provides avenues for contamination of the supply because the fill points generally do not have compliant backflow protection, and the fill hoses can have direct contact with contaminated ground water. The flow rate from the emergency pipeline is limited, so residents must book for use of water supply on a rotational basis. Use of the water supply for frinking is not consistent with primary agreement for the supply of non-potable water to Scotland Island which is between the Scotland Island Residents' Association (SIRA) and Sydney Water ('Scotland Island – Emergency Water Pipeline & Non-Potable Water Supply 2017'), nor SIRA's Agreement for Sale of Non-Potable Water, which must be signed by all members accessing the water supply.

Current wastewater systems consist of on-site management systems that are generally unsuitable for the topography and geology of the island. In previous monitoring studies, streams have been found to have elevated nutrient, sediment and bacterial concentrations exceeding the ANZECC (1992) guidelines. Moreover, exposure to septic overflow carries public health risks, which in combination with the water supply arrangements are issues of concern to island residents and surrounding communities.

To investigate potential solutions to these issues, Northern Beaches Council commissioned Pressure System Solutions (PS Solutions) to identify and assess the feasibility of options for water and sewerage servicing.

1.2 Scope of services

RPS was tasked with assessing the investment case for supplying Scotland Island with water and sewerage services. The results are documented in this report (Case for Investment).

This assessment includes:

- a qualitative assessment of the benefits of supply infrastructure (Benefits Assessment)
- an analysis of the potential funding models (Funding Analysis).

Benefits Assessment

The Benefits Assessment characterises the benefits of water and sewerage services. The assessment considered the benefits that would accrue to a range of stakeholders including island residents and visitors, the Council, the local environment and recreational users of the Pittwater estuary, which the island is located in.

The assessment discusses the benefits accruing to these stakeholders but does not provide a quantitative estimate of the benefit.

Funding Analysis

The funding analysis explores how the costs of options are paid for (i.e. who ultimately pays for the costs).

Each of the options will result in incremental capital and operating costs of new water infrastructure. Most water infrastructure in Sydney Water's area of operations is paid for through charges applied by Sydney Water Corporation (SWC). In simple terms, in most cases, augmentations to Sydney's water infrastructure are paid for by SWC, who in turn recovers these costs through charges they apply to all their customers. All previous Backlog and Priority Sewerage Program (PSP) schemes have been delivered in this way and date back to the late 1990's. In addition, the nearby Brooklyn Dangar Island sewerage scheme was delivered as part of the PSP and completed in 2006.

The Independent Pricing and Regulatory Tribunal (IPART) determines the amount of capital and operating expenditure that SWC is allowed to recover through charges. SWC is a government owned corporation and returns dividends to government from the profit they earn through their operations.

The Funding Analysis tests the SWC / Government model as one funding option. For this funding option, the analysis estimates the additional capital and operating expenditures required to be made by SWC. Other options include:

- Funding of the infrastructure through contributions from SWC and the residents of Scotland Island.
- Funding of the infrastructure completely by the residents of Scotland Island, either directly or through a special charge.

Note that the funding models should be distinguished from financing models and delivery models.

Financing considers where the capital to pay for infrastructure is sourced from. For example, the infrastructure could be financed through commercial bank debt, NSW Government bonds, NSW Government general revenue, equity from superannuation funds or SWC's cash reserves. Each of these sources of financing will have a different 'cost of capital' (i.e. the rate of return the investors expects to make on their investment, such as the rate of interest). Financing is distinguished from funding because the financiers ultimately need to be repaid by those that ultimately bear the costs / fund the infrastructure.

Delivery considers who builds and operates the infrastructure. The delivery business or agency is responsible for constructing the infrastructure. They can also choose to operate the infrastructure or equally, transfer ownership to a separate business or agency to operate it once commissioned. In some cases, the delivery business or agency can also be the financier. For example, a business or agency can use their own cash reserves to fund infrastructure. However, they expect to recover that investment through charges they apply to others (e.g. the users of the service), or amounts they receive from others (e.g. greenfield property developers).

This report focuses on funding models, as the issue of funding needs to be addressed before potential financing or delivery models can be determined.

Many of the funding assumptions have been estimated through desktop research using data provided to RPS and other publicly available sources / published guidelines. Some of the assumptions are uncertain. Sensitivity Analysis was used to assess the impact of uncertain assumptions that are material to the analysis (i.e. likely to affect the key findings).

1.3 Limitations

This Case for Investment report provides qualitative data about the benefits of supply infrastructure and a summary analysis of hypothetical funding models. The report is not intended as a CBA or Business Case for government investment in supply infrastructure.

1.4 Structure of report

The remainder of this report is structured as follows:

- Section 2 summaries the problems that the supply infrastructure is addressing
- Section 3 outlines potential infrastructure options

- Section 4 provides a qualitative assessment of the benefits from investment
- Section 5 analyses potential funding models
- Section 6 provides conclusions.

2 PROBLEM AND PROJECT NEED

Understanding the problem to be addressed is an important first step when investigating the case for infrastructure investment. In this case, the issues that have driven this investigation are that:

- the existing infrastructure is not fit-for-purpose, is failing, and results in poor amenity and local environmental impacts
- previous investigations into infrastructure solutions have not been progressed due to the perception that solutions are likely to be cost prohibitive, when this may not necessarily be the case
- island residents have expressed a strong preference for a fit-for-purpose infrastructure solution and note that other similar communities have been provided one.

2.1 Problem 1: Existing infrastructure not fit-for-purpose and failing

The water and wastewater infrastructure currently servicing the island is not fit-for-purpose in many ways. This is evidenced by the fact that some of the on-site septic tanks either (Council source, email correspondence, 13 November 2018):

- do not have current approval to operate an on-site sewerage management system (around 20 per cent);
- have never received such an approval (around 4 per cent);
- have a history of failure requiring action in 2018 (around 10 per cent); and
- did not pass initial approval to operate on-site (around 33 per cent).

The issues with the sewerage infrastructure that led to these challenges included the unsuitability of the local geology, land reservation requirements, lack of compliance with Australian Standards and island topography.

Similarly, the rainwater tanks run out of water during periods of low rainfall, prompting island residents to use the emergency water supply for potable water. The water supply was not designed as a potable water supply and is not fit-for-purpose for use as a potable water supply, particularly as it does not provide any design components to prevent backflow. A 1997 study found that the non-potable water supply was contaminated with faecal coliforms (Martens and Associates, 1997). Moreover, the same study found that the polyethylene pipe was exposed in many locations, was in poor condition, and was susceptible to puncture, burning, melting and at risk of wastewater infiltration in the event of a leak. The system has since had some repairs.

The results of non-compliant systems and systems that were not designed to be used in the manner that they are being used has impacted on amenity and the local environment. Soil testing in February 2019 indicated high levels of faecal coliforms in the soil in several locations (PS Solutions, 2019b). Other amenity issues that were anecdotally reported included odour and pests (mosquitoes).

A review of environmental factors also found a large extent of noxious weeds and poor health of vegetation, which may be explained by excessive nutrient loads, albeit testing data were not available to confirm this conclusion (PS Solutions, 2019a). These impacts are likely due to contaminants accumulating in the soil, with the potential for these contaminants to run-off into the estuary.

2.2 Problem 2: Perception of high cost without sufficient investigation

There have been previous investigations into the potential cost of servicing the island with grid-connected infrastructure (e.g. Sydney Water, 2018), however, these investigations have largely concluded that the cost of such solutions are likely to be prohibitive, and much higher than solutions provided to similar communities. The scope and inclusions in the Sydney Water assessment are not known in detail, but the submitted costs were high compared to other PSP projects.

However, the design and cost investigations undertaken by PS Solutions as part of the feasibility assessment work suggest that infrastructure can be delivered at costs comparable to other similar infrastructure. The work to identify these costs included functional design solutions, on island investigation, detailed market assessment, price estimation with contactors and peer review risk assessments that include client, contractors and consultants.

A previous cost investigation by Sydney Water (2018) found that a scheme that provides wastewater services to Scotland Island would cost $252,000 per lot (2017-18 prices), which was reportedly 2-3 times higher than previous Priority Sewerage Program (PSP) schemes.

Cost investigations by PS Solutions have estimated that a scheme that delivers both water and wastewater services would cost approximately $68 million or $185,000 per lot (in 2019 prices). Approximately 70% of the cost would be attributable to wastewater services, or approximately $129,000 per lot.

The estimated cost per lot is much lower than the Sydney Water estimate, which would have equated to approximately $260,000 per lot (in 2019 prices). The PS Solutions cost estimate is also a similar order of magnitude to previous schemes. For example, PS Solutions estimates the cost per lot of the sewerage infrastructure provided to Brooklyn-Dangar islands at approximately $150,000 (in 2019 prices).

2.3 Problem 3: Inequity as comparable services having been provided to similar communities

Scotland Island is approximately 30km from the Sydney CBD in one of Sydney's largest council areas. However, the island does not have the same quality of water supply provided to communities that are even further from the CBD, or have fewer residents.

Island residents, who have expressed a strong preference for grid-connected water and sewerage infrastructure, note that similar solutions have been provided to other communities including:

- Picton Regional, Gerringong Gerroa, Brooklyn and Dangar Island, Jamberoo, Stanwell Park, Stanwell Tops & Coalcliff, Oakes & Oakdale, the Villages through the Blue Mountains and many others (delivered by Sydney Water)
- Mooney Mooney and Cheero Point also incorporate similar characteristics (delivered by Gosford Council).

2.4 Project need

The need for this project is based on the requirement to address the three main problems outlined above. The remainder of this Investment Case briefly discusses the solutions that aim to address these problems, the benefits of these solutions and the potential funding approaches.

3 INFRASTRUCTURE OPTIONS CONSIDERED

3.1 Base Case

All options are assessed relative to a base case, which represents the business as usual (BAU) situation for the island including rainwater tanks, septic tanks and the emergency pipe.

The Economic and Funding Analysis do not estimate any costs or benefits for the base case. Instead, the costs and benefits of other options are expressed as incremental to the base case (i.e. benefits and costs include only those that are additional to / not incurred in the case case).

3.2 Alternative options

Table 1 summarises the infrastructure options assessed against a BAU base case. These options are discussed in much greater detail in the *Scotland Island Water and Wastewater Feasibility Study Stage 1b Options Report* (PS Solutions, 2019).

Table 1: Assessed options

Systems		Infrastructure Option 1	Infrastructure Option 2	Infrastructure Option 3	Infrastructure Option 4
Sewer Collection System Options	Pressure Sewerage System	✓			
	Hybrid System		✓	✓	✓
Sewage Treatment Disposal	On Island Treatment System				✓
	Discharge to Sydney Water	✓	✓	✓	
Water Supply	Low Flow Reticulation		✓		
	Full Reticulation	✓		✓	✓

Descriptions of the relevant systems:

Pressure Sewerage System	A dedicated pressure sewer pumping unit located on each lot discharging to a common collection main.
Hybrid System	A combination of gravity sewerage and pressure sewerage. Gravity sewerage is provided where the topography is conducive to pipelines installed at grade, including sewage pumping stations, and in constrained areas lots are serviced by pressure sewerage.
On Island Treatment System	A sewage treatment plant located on the Island, treating sewage to a tertiary level, suitable quality for discharge to Pittwater.
Discharge to Sydney Water	Pumping sewage discharge to Sydney Water system on the mainland at Church Point.
Low Flow Reticulation from Sydney Water	Low flow drinking water point within the residence and low flow top up to rainwater tanks.
Full Reticulation from Sydney Water	Full mains pressure supply to residences.

4 BENEFITS ASSESSMENT

By addressing the problems outlined in Section 2, the infrastructure will deliver a wide range benefits to island residents and visitors, the Council, the local environment and recreational users of the Pittwater.

The primary benefits identified in this assessment are:

- the mitigation of stakeholder risks, including health, environmental and property risks;
- meeting the needs of the community, who have been requesting services for over 30 years;
- increasing the quality of service ; and
- improving amenity and the local environment.

Table 2 on the next page summarises each of these benefits including the main beneficiaries and how they benefit.

There are clear benefits in reducing health risks and improvements to the local environment.

Previous investigations have shown that the rainwater supply is susceptible to contamination from foliage and animal droppings from roofs contact of fittings with contaminated soil, and top-ups from the non-potable supply. Similarly, testing has shown elevated faecal coliform in the soil, and evidence of high nutrient loads affecting the local waterways.

Providing reticulated water and wastewater services will likely have a strong benefit in reducing:

- the health risks associated with rainwater tanks identified by both previous Scotland Island investigations and previous published studies (refer to Table 2),
- the health and environmental risks caused by the on-site treatment systems, as evidenced by the previous investigations and Council records on the suitability / compliance of those systems.

The end result is likely to be significantly reduced health risks, and a significantly improved local environment.

Table 2: Benefits assessment

Benefit	Beneficiaries	Description of benefits
Mitigation of risks	Residents and visitors, Council, Sydney Water	Providing water and wastewater services will mitigate the following risks: • risks to human health (illness); • risks of property and environmental damage on the island if water is unavailable for emergency purposes; **Health risks** Although roof-harvested rainwater is perceived to be safe to drink, published studies have reported the presence of potential pathogens that cause gastrointestinal illnesses in humans (e.g. refer to Ahmed et al, 2010). In the case of Scotland Island, site visits have noted that foliage can fall into the rainwater tanks, and a 1997 study found faecal coliforms present in the tanks, most likely due to animal droppings (Martens and Associates, 1997). **Property and environmental damage risks** The emergency water supply may have insufficient capacity or could fail (refer to Section 2.1) in the event of an emergency requiring immediate water supply (e.g. a fire). This poses risks to properties and to the local environment.
Meeting community needs	Residents and visitors	The Scotland Island community has been requesting water and wastewater services for over 30 years (PS Solutions, 2019b). During that time, many other similar communities have been provided wastewater services through Sydney Water's Priority Sewerage Program (PSP), and water services. As is the case with energy infrastructure, water and sewerage are considered essential services. Providing these essential services to Scotland Island will meet community needs, and also improve equity.
Quality of service	Residents and visitors	In 2017, NSW Health declared that the local kindergarten and community hall were no longer permitted to provide or sell food, as it was discovered that non-potable emergency pipeline was being used to top-up rainwater tanks (Northern Beaches Council, 2017). This shows that the rainwater supply is not considered reliable enough to deliver the quantity of water needed to support some desired uses. While the emergency pipeline could and has been used to supplement the rainwater, the quality of that water is not considered safe for some use. Therefore, providing water services will increase the quality and reliability of water supply for a range of uses.
Amenity	Local environment, bay recreational users	Providing reticulated water and wastewater infrastructure would reduce the risks created by relying on rainwater and septic tanks, and therefore reduce contamination in the soil and ultimately the bay. This would contribute to addressing the health risk, odour, pest, noxious weeds and vegetation health issues, and improve the amenity of the estuary for recreational users.

5 FUNDING ANALYSIS

5.1 Methodology

The Funding Analysis used two calculation steps:

- a discounted cashflow (DCF) analysis to estimate the annual and total (NPV) costs of the infrastructure based on the likely cost of capital for each funding option;
- calculating the annual funding contribution from each funding party, with the capital either being:
  - funded by the party as a lump sum at the beginning of the modelling horizon; or
  - spread over the modelling horizon (i.e. 'amortised') to allow the funder to pay for the infrastructure capital over time.

5.2 Assumptions

General Assumptions

Table 3 lists the general assumptions applied in the Funding Analysis.

Table 3: General assumptions

Assumption	Value
Construction period	One year (assumed to be in 2020)
Funding analysis period	21 years (2020 – 2040, inclusive)
Number of dwellings	370 (377 lots)
Number of residents	579 permanent residents

Costs

Table 4 summarises the cost assumptions.

Table 4: Cost assumptions

Cost assumption	Value
Capital cost of upgrade works (taken from Stage 2 Report Cost Plan)	Infrastructure option 1: $68.4 million Infrastructure option 2: $76.2 million Infrastructure option 3: $76.9 million Infrastructure option 4: $96.3 million
Removal of existing water pipeline that connects to Scotland Island from the Sydney Water main at Church Point	Unquantified[1]
Operating costs associated with new infrastructure (e.g. energy, pipe/pump maintenance etc.)	**Infrastructure Options 1 – 3:** ~$362/dwelling/year **Infrastructure Options 4:** ~$362/dwelling/year, plus an additional ~$2,000/dwelling/year due to on-island sewerage treatment costs (Advice from PS Solutions)
Allowance for downstream pumping (Warriewood Wastewater Treatment Plant)	+15% of above on-island operating costs (~$54/dwelling/year) (advice from PS Solutions)
Local amenity impacts on residents from the construction works	Unquantified[1]

Note [1]: These costs are not material to the key findings in this report.

Discount rates

The Funding Analysis applied a cost of capital (i.e. commercial discount rate) to the cashflows for each option, by making an assumption about how the infrastructure is financed in each option.

- Funding Option 1 (SWC / NSW Government Funding) assumes that the infrastructure is financed by SWC cash reserves and potentially corporate debt used to increase those cash reserves, and / or through a NSW Government contribution. Option 1 uses a commercial discount rate equal to SWC's published weighted average cost of capital (WACC) of 5.9 real pre-tax WACC, which is equivalent to an 8.5 per cent nominal pre-tax WACC (IPART, 2016).
- Funding Option 2 (Distributed Funding) assumes that the infrastructure is funded:
  - partly through a 50 per cent capital contribution from island residents;
  - the remaining capital and all operating costs being funded by SWC, financed through its cash reserves and / or additional corporate debt.

A third, somewhat theoretical, option would include the residents of Scotland Island paying entirely for the infrastructure. However, this funding model was not further analysed because it would result in a cost per household of approximately $200,000-$300,000, which is not a practicable sum for homeowners to fund. It is also unprecedented for households to directly fund grid connection costs of that magnitude, which in previous similar situations have been funded by developers, water utilities and / or directly by government.

All figures in the Funding Analysis are presented in nominal terms, using an annual inflation rate of 2.5 per cent, which is the mid-range of the Reserve Bank of Australia (RBA) target inflation band.

5.3 Results

The Funding Analysis assumes that Infrastructure Option 1, which is the most cost-effective option, is implemented.

Funding Option 1 – SWC / NSW Government Funding

Funding Option 1 would require direct capital expenditure from SWC of **$68.4 million** in financial year 2020/21. Figure 1 shows the ongoing operating costs to SWC following this capital expenditure. The costs are presented in nominal terms (i.e. including inflation effects) and therefore increase at 2.5 per cent per year.

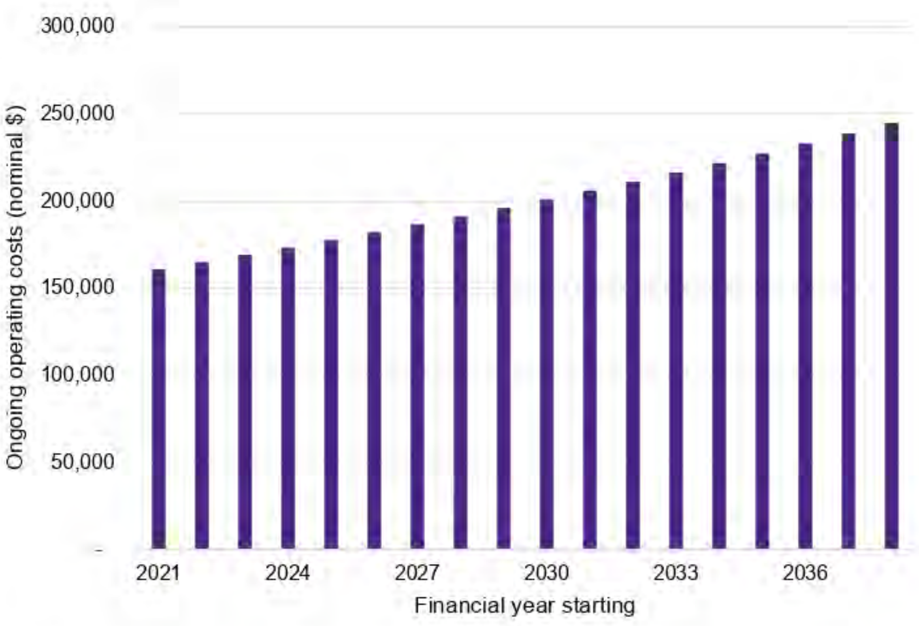

Figure 1 Ongoing costs to SWC 2021 to 2039 (Funding Option 1)

Funding Option 2 – Distributed Funding

Funding Option 2 assumes that two entities contribute to the capital expenditure (refer to Table 5).

Table 5: Funding Option 2 capital contributions

Stakeholder group	Total capital contribution	Cost per household [3]
Island residents	$36.6 million	$97,082
SWC	$36.6 million	Negligible / not modelled [1]

Note [1]: SWC would recover this cost by spreading the additional expenditure across all water rate payers. Due to the size of the SWC's customer base, this would be a negligible increment.

Note : Each household will also have connection charges which may require plumbing and electrical upgrades to comply to current Australian standards.

The remaining ongoing operating costs would be funded by SWC (as per Figure 1).

Comparison of funding options

Table 6 summarises the advantages and disadvantages associated with each funding option.

Table 6: Comparison of funding options

	Funding Option 1 (SWC Funding)	Funding Option 2 (Distributed Funding)
Advantages	• Consistent with precedent • Ability to utilise SWC's strong balance sheet • Affordable to island residents	• Spreads costs across the main beneficiaries • Reduces funding commitments from SWC
Disadvantages	• Requires SWC approval	• Island residents unlikely to agree to funding amount

Note : SWC would recover this cost by spreading the additional expenditure across all water rate payers. Due to the size of the SWC's customer base, this would be a negligible increment.

Funding Option 1 is consistent with precedent, leverages SWC's strong balance sheet and much more likely to be accepted by the various stakeholders (i.e. SWC, Northern Beaches Council and island residents).

On that basis, this report recommends Funding Option 1 as the preferred funding option.

Uncertainty in costs and funding requirements

Funding costs in each option are based on capital cost estimates provided to RPS by PS Solutions. Future design work may estimate higher or lower capital costs, and the actual costs of the project may be higher or lower than estimated based upon project delivery model adopted and current market conditions. Funding requirements will scale in direct proportion to costs.

6 CONCLUSIONS

The Benefits Assessment has shown that, by reducing contamination in the water supply and soil, and by providing water supply in accordance with NSW Health standards, the options for water and sewerage servicing for the residents of Scotland Island:

- will significantly reduce health risks;
- address a long-standing community need for the services, which have been provided to similar communities in the past, and at a cost that is comparable to similar schemes;
- improve the quality of service for island residents; and
- significantly improve the local environment.

These benefits accrue to a broad range of stakeholders including island residents and visitors, the Council, the local environment and recreational user of Pittwater.

Importantly, all infrastructure options were found to address problems 1-3, by providing water and wastewater services that are reliable and compliant with the required standards (addressing Problem 1), providing these at a cost comparable to previous schemes (addressing Problem 2), and resolving the inequity currently felt by the residents of Scotland Island (addressing Problem 3).

Among the four options, Infrastructure Option 1 is the most cost effective and is therefore the recommended option.

The cost, which is comparable to previous schemes funded under the Priority Sewerage Program (PSP) program, is most appropriately funded through SWC.

Of the four infrastructure options considered, Infrastructure Option 1, which involves full reticulation of water supply and a pressure sewerage system that transfers and discharges to Sydney Water, is the most cost-effective.

Funding the infrastructure through SWC / NSW Government is the preferred option, as it leverages SWC's strong balance sheet and is much more likely to be accepted by the key stakeholders (i.e. SWC, Northern Beaches Council and island residents). This funding option is also consistent with the implemented SWC Backlog and PSP schemes and is therefore more equitable.

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Community and Stakeholder Engagement Report

Feasibility study for the provision of water and wastewater services to Scotland Island

Impact level: Two

Report date: 2 November 2020

Contents

1. Introduction[1]

Project Title	Feasibility study for the provision of water and wastewater services to Scotland Island
Impact Level	2
Stages	2
Report Period	30 September to 28 October 2020
Version	2.0
Status	Final

This report outlines the community and stakeholder engagement conducted as part of the feasibility study for the provision of water and wastewater services to Scotland Island project. The consultation period documented is from 30 September 2020 to 28 October 2020.

317 submissions were received from a cross section of our community including:

- Scotland Island Residents Association
- local stormwater businesses
- Scotland Island residents
- residents of the Western Foreshores of Pittwater
- residents of the Northern Beaches
- Sydney Water

Feedback collected through the engagement process identified several recurring themes. The results of the engagement process indicated most Scotland Island residents support a water and wastewater scheme and are concerned with the existing water supply and wastewater disposal systems and the impacts on human and environmental health.

The majority of the 317 submissions received were overwhelmingly supportive of Council making a recommendation to the state government to provide a water and wastewater scheme for Scotland Island (96%), and willing to pay connections costs (77%). Most of those who responded were residents. Relative to the total number of people living on the island, there was a very high engagement rate.

A variety of topics were raised by the respondents including equality with the mainland, human and environmental wellbeing, and cost for individuals. While a high percentage were willing to pay connection fees, a smaller proportion of respondents expressed concerns about costs including that they were unwilling or unable to fund the connection expenses. There were also concerns about infrastructure servicing and the competence of the stakeholders involved in installing the associated infrastructure.

Sydney Water made a submission and based on their estimates, both Sydney Water and IPART consider servicing of the area to be financially unviable.

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[1] Community and stakeholder views contained in this report do not necessarily reflect the views of the Northern Beaches Council or indicate a commitment to a particular course of action.

Further detail on the engagement approach and findings are available below.

1.1. Who we engaged[2]

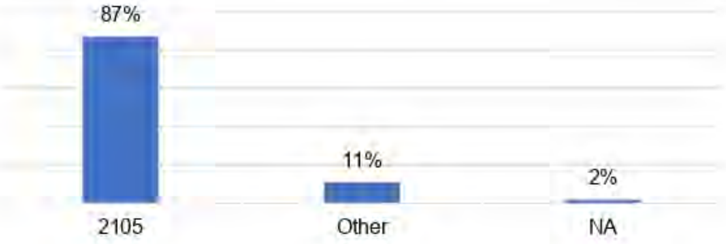
Total engaged 1469

Total submissions 317

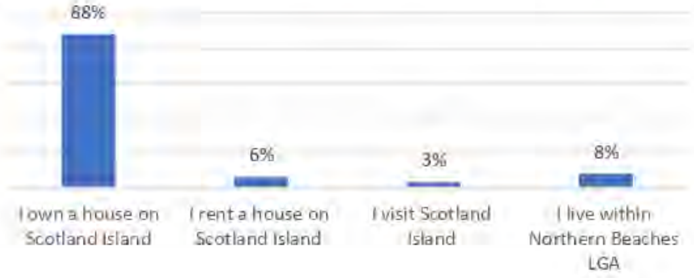
Gender

Age groups

Postcodes



Residents



1.2. How we engaged

Have Your Say

Visitors: 753

Visits:1394

Av. time onsite: 3.5 minutes

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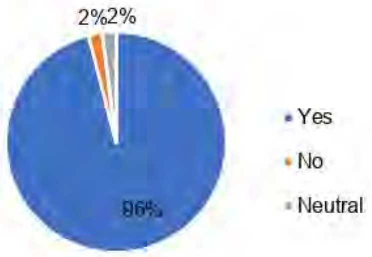
[2] No demographic data was captured for respondents who contributed feedback through direct letter to Council

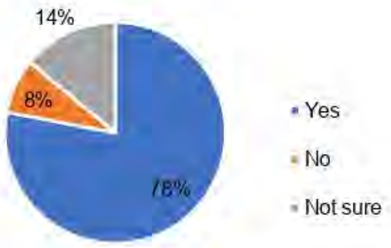
Face-to-face	Information session: 1	Attendance: 35
	Pop up / Drop in: 3	Attendance: 40
Survey and form	Have Your Say survey: 1	Completions: 313
	Additional letters*:	Received: 10
	*Some people used both methods of communication. Their submissions have been counted once.	

1.3. Results

Question 1: Do you support Council making a recommendation to the state government to provide a water and wastewater scheme for Scotland Island?



Question 2: Would you be willing to pay connection costs for water and wastewater schemes?



Feedback themes	• General support for a scheme. • Public health impacts. • Quality of current drinking water supply. • Environmental impacts. • No secure water supply for firefighting.	• Lack of equity with other similar areas. • Cost and ability to pay. • Increased demand for improved roads and stormwater drainage on the island.

2. Background

On behalf of the state government, Northern Beaches Council completed a feasibility study for the provision of water and wastewater services to Scotland Island. The study made recommendations on options for water and wastewater services and what they are expected to cost the government and residents to construct and operate.

The community were asked whether they support Council making a recommendation to the state government to provide a water and wastewater scheme for Scotland Island and whether they would be willing to pay connection costs. As the community would have to pay for the private property connection to the system, an indication of their willingness to pay is essential. Northern Beaches Council's willingness to lobby the State Government for services is predicated on having enough community support to progress a future scheme.

The project's community and stakeholder engagement was devised on a two-stage approach:

- **Stage 1:** Establishment of a resident working group made up of key stakeholders. Consultation was undertaken with the group to explore issues, constraints and assist in the identification of a shortlist of options.
- **Stage 2:** Public exhibition of feasibility study and associated reports.

3. Engagement objectives

Council's engagement objectives were to:

- provide accessible information so community and stakeholders can participate in a meaningful way (inform)
- identify community and stakeholder concerns, local knowledge and values (consult)
- recognise, manage and communicate the needs and interests of community and stakeholders, including decision makers (consult-involve)
- seek out and facilitate the involvement of those affected by or interested in a project (involve)
- communicate to community and stakeholders how their input was incorporated into the planning and decision-making process (inform).

4. Engagement approach

Community and stakeholder engagement for the feasibility study for the provision of water and wastewater services to Scotland Island project was conducted over a four week period, from 30 September to 28 October 2020 and consisted of a series of activities that provided opportunities for community and stakeholders to contribute feedback. Council strove to ensure information was presented in an accessible way to our community.

The engagement was planned, implemented and reported in accordance with Council's Community Engagement Matrix (2017). A documented consultation strategy is outlined in the Community and Stakeholder Engagement Strategy and Plan for the project (Stage 1: 5 April 2018 and Stage 2: 21 September 2020).

4.1. Engaging with 'hard to reach' communities

Lack of access to information or activities is a key barrier in engaging our offshore communities. We took a proactive approach to engagement by running drop-in sessions and an information session on the island and providing residents with the opportunity to complete their survey over the phone. By doing this we were able to access the less mobile residents on the island.

4.2. Engagement activities

Engagement activity	Overview
Desktop research	Existing feasibility studies for the provision of wastewater services for Scotland Island were reviewed, including community consultation conducted by the Scotland Island Resident's Association in recent years.
Have Your Say (online)	Your Say Northern Beaches was used to conduct online engagement. It provided a portal for users to visit, find information to support their engagement and provide their feedback.
Associated documentation	Exhibition documents including four technical reports and attachments, frequently asked questions and project background information were available on the Your Say project page.
Feedback form	An online form gave community and stakeholders an opportunity to provide quantitative project feedback. Specific questions were asked to gauge community support for the feasibility study recommendations and willingness to pay for any future water and wastewater supply system. A copy of the survey comments is available in the report appendices.
Face-to-Face drop-in / pop up / information sessions	Face-to-face sessions offered Scotland Island residents and property owners and visitors another opportunity to find out more from project staff, ask questions and provide feedback. Facilitators were available at the sessions to engage the public and provide a forum for deeper conversations. iPads were used to direct people to an online feedback form that captured feedback.

	Four face-to-face sessions held across the area, at Church Point and Scotland Island; Tennis Court Wharf and the Fire Shed, allowing face-to-face discussions with 70-75 community members. Of the total 313 surveys received, 6 were completed at these sessions.
Direct Australia Post mail	Letters to properties on the island inviting people to attend the drop-in sessions and visit the Your Say page.

5. Key findings[3]

Theme	Commentary	Response
Public health	The current water and wastewater provision significantly impacts public health, directly through poor drinking water quality; secondarily through pollution of soils and waterways on the island, pollution of Pittwater and aquatic species, odour, and mosquitoes. Clean drinking water and an environment that doesn't impact health is a basic right.	Noted. The proposed solution will address these concerns. Council's Environmental Health team has a dedicated officer to regulate wastewater systems on the island. These comments have been forwarded to Council's Environmental Health and will be provided to Sydney Water and NSW Health.
Need	Reticulated water and wastewater is needed on the Island now. A reticulated water supply is necessary as the current emergency water supply is inadequate for fire protection. The Island is unable to support on-site wastewater systems.	Noted. The proposed solution will address these concerns. These comments have been forwarded to the relevant staff in Council and will be provided to Rural Fire Service, Sydney Water and NSW Health.
Equity	Residents of Scotland Island deserve the same quality of life and services as the rest of Sydney and similar areas such as Dangar Island. Obligation under priority sewage program. Difficult and stressful to arrange drinking water and manage on-site wastewater system. Council and the State Government are in breach of their duty of care to Scotland Island residents.	The proposed solution will address these concerns. These comments will be forwarded to Sydney Water and NSW Health. Council and the State Government work within relevant legislation and guidelines for the supply and management of water and wastewater. Under the Local Government Act, on site sewerage management is the responsibility of single lot property owners.

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[3] Note: This analysis does not include any 'late' feedback received after the advertised closing date for consultation except Sydney Water's submission.

Theme	Commentary	Response
Environment	Replacing on-site wastewater systems with a reticulated system is necessary to reduce the current impact on native vegetation on the Island, especially the Spotted Gum population, and the receiving waters.	Noted. The proposed solution will address these concerns. These comments have been forwarded to the relevant staff in Council and will be forwarded to Sydney Water.
Cost	Concerned about the ability to pay for upgrades to household plumbing of $12,500. Shouldn't have to pay. It would be necessary to provide assistance/payment plans for those able to demonstrate hardship Would only connect if costs were reasonable.	Noted. Council acknowledges the estimated connection costs are not supported by some residents. This is the funding model currently in place by Sydney Water. These comments will be provided to Sydney Water.
	Existing water is expensive. Project calculated to be financially unviable (Sydney Water). Flow rate calculations require clarification (Sydney Water).	Noted. Council acknowledges the project delivery costs are not financially viable for Sydney Water. Noted. This information will be provided to the consultant.
Benefits and impacts if a scheme went ahead	Good local employment opportunities. The scheme should use renewable energy. Concerns about impacts to parking at Church Point. Public toilets should be provided on the Island. Council would need to address the condition of the Island roads and stormwater drainage. Connection needs to be forced.	Noted. These comments have been forwarded to the relevant staff in Council and will be provided to Sydney Water.
Unnecessary	New systems would be a waste of money as the current systems are suitable if they are made compliant. Not concerned about current water supply. Want to retain existing tanks.	Noted. These comments will be provided to Sydney Water.
Western Foreshores	The Western Foreshores of Pittwater should be included in	Noted. These comments will be provided to Sydney Water.

Theme	Commentary	Response
	any scheme to provide water and wastewater services to Scotland Island	

Appendix A – Full summary of community and stakeholder online verbatim responses

The Western Foreshore, which tip (Elvina Bay and McCarrs Creek) is as close to the Church Point as Scotland Island should, in my view, be included in this.
I think that this is a fantastic idea and should be fast tracked.
Would it be possible to pay in instalments?
It is important to have clean drinking water for people to drink and use for hand washing in the parks on Scotland island as well as toilet facilities. At the moment no drinking water or toilet facilities are available for people visiting the parks on the island
It would be wonderful to have fresh clean water, and it would be nice not to have the smelly dirty tanks and not to be fearful of swimming in the water and getting encephalitis and meningitis from the sewage in the water. I doubt that the $13,000 is near to the price and I would have trouble affording this. I'm concerned about stormwater running over the road down my property. I am very worried about how it could be done without major obstruction to roads I am disabled & need buggy to get to wharf.
The benefits to the health of the community and to the land quality and flora and fauna far outweigh the costs. It is puzzling why such a similar community as Dangar has had their waste and water supply upgraded but Scotland Island has not despite being one of the villages recognised in the original Sewerage Priority scheme. Given that we pay State taxes and Council rates it is hard to fathom why we don't seem to be treated in the same way as other citizens.
Fresh clean drinking water should be available at the parks on Scotland Island as should proper toilet facilities at the moment there is nowhere visitors can wash get a drink of clean water wash their hands or go to the toilet unless they know someone on the island
I think it is important to have proper facilities for people that visit Scotland Island be it visiting friends or one of the parks on the island. Clean fresh water should be available for people to drink and wash their hands in. Also proper toilet facilities should be available for people visiting the parks which currently have no such facilities at all
I strongly urge NBC send a strongly worded recommendation to State Government to proceed urgently to approve implementation of the plan. At present the land surface on Scotland Island cannot cope with the wastewater produced by residents. Over the past 15 years I have noticed increased septic sullage unabsorbed in the heavy and stony clay soil. After rain the combination of septic waste and surface water flow pools and creates offensive pollution problems. This problem is exacerbated because of increased time between rain brings to pools higher concentrations of septic overflow. As a consequence the risk of infection is increased.
It is impossible to answer a question with regards to connection costs without giving a reasonable cap on those costs. Would b willing to contribute a sensible amount to connection costs but not open ended. Scotland Island needs to be treated equitably in comparison to other areas that were part of the PSP that Scotland Island was on and the Government allowed Sydney water to continually push out timeframes until it didn't happen.

As the study says the do nothing options are not viable or sustainable, it is time for local and state governments to make this happen as a priority
I am keen to see improvement of the quality of water and wastewater service for island residents. It is vital that this is addressed to mitigate public health risks. Clean drinking water and sanitation are essential to the realisation of all human rights. Australia recognizes that everyone has the right to an adequate standard of living under Article 11 of the International Covenant on Economic, Social and Cultural Rights, therefore action should be taken soonest!
This is an excellent initiative which will greatly assist all homeowners and residents in the island, as well as remove several hazards to general health and local waterways and environment. We hope this gets approved and goes ahead as soon as possible
A reticulated 'Town Sewage system is inevitable and urgently needed for all the reasons in the latest Study and all previous studies. The sooner the better.
Current sewerage disposal systems are very obviously sub-standard, as evidenced by numerous continuous seepage problems at numerous sites. The sample data also shows more accurately the unacceptable levels of nutrients and pathogens in soils across the island. As NBC appears unwilling and/or unable to effectively monitor and regulate the current system, an upgrade appears essential for the health of local residents and the environment, both on the island and in surrounding waterways. The health of the Endangered Ecological Community, Spotted Gum Forest, and the habitat of Vulnerable native species, the Powerful Owl, is being continuously and unnecessarily degraded by the current systems. Failure to act promptly ensures accelerating failure of the natural environment. Improvement please...asap
We would be willing to undertake this important work due to the sewage seepage from others into the water and around the island, recognising our Septic/water infrastructure is very new. There will be others unable to pay for this themselves I would imagine and it would be really good if there was a forced decision that everyone had to move to this, if there was hardship option/help to ensure the decommissioning of the individual tanks was able to be completed properly. Thank you
I am on the island every weekend and school holidays
Existing arrangements are detrimental to health and the local environment. The soil is being contaminated from septic runoff.
Happy with the proposal as outlined above.
Sewage is desperately in need of an upgrade. Land is full of contaminated water
As the connection costs are an estimate I would want this to be subsidised. I would want to be able to redirect our grey water to the block to maintain the health of our spotted gums, numbering over 40 to avoid a sudden removal of the water they now enjoy.
This is an excellent idea and I wholeheartedly approve.

I believe this is a natural progression for the island to enhance the health of residents as well as the health of the natural environment.
Smell of Septic tanks is pervasive. Always wet patches on roads from septic tank trench and distribution system breakdowns. Appears poor maintenance or none of existing tanks, with little obvious oversight by Council officers. Concerns for Pittwater effluent effects Concerns for hygiene in public spaces especially for children Support resident house owners contributing to cost of sewage system, however concern that such costs of $1000s needs to be amortised across five or ten years of rate periods so that owners, not all of whom are wealthy, can afford to contribute without being forced into debt. Thankyou. Bring it on.
"Generally current water and sewerage systems are insufficient and in many instances are failing." Reason enough to upgrade the systems for the 370 dwellings currently on Scotland Island to reduce the risks to public health and the local environment. I would urge consideration be given to the initial cost of implementation in regard to a property owner's financial situation. Low-interest loans perhaps and non-adjustment of Council rates re water and sewerage until the loan is paid off.
These services would be beneficial to both the occupants of homes on the Island as well as the general wellbeing and restoration of the natural environment
I feel that Scotland Island deserves to have the same wastewater facilities as the mainland and (I believe) Dangar Island. Surely having standing water which smells distinctly of sewerage is a health hazard and should be dealt with as soon as possible?
It's about time!
I would be willing to pay as long as upfront costs were manageable I.e instalments. Totally in favour of looking ahead to the future and not having to wonder about the dysfunctional septic systems on island as difficult to get fixed and serviced. Also buying water is stressful. Anything to make life easier and better for the environment.
Great idea and initiative. We are behind the scheme.
Much needed service. Will be good.
Connecting water and wastewater services is critically important to Scotland Island. I strongly support Council making a recommendation to the state government for these services, as determined in the feasibility study.
I'm a pensioner, and could not afford it.
There are plenty of people on the island that will not have the money to pay to connect, and they will most likely be the ones with the older systems that need to be replaced. Also we already pay a lot of money for parking our cars and boats as well as other costs with very little to show for the expense. The car parks are in a state of disrepair, the boat parks

don't have enough parking places for residence to park their boats and now we maybe asked to pay for a service that most likely should have been provide a while ago.
Looking forward to this getting underway.
I would be willing to pay $12500 however, if costs to home owners became astronomical we wouldn't be able to take the offer.
Anything would be better than the system currently used on the island where the roads get flooded with water from leaking tanks/underground streams, causing potential health hazards and stinking dirty standing water - a health hazard and disgusting sight!
Scotland Island desperately needs a decent sewer system. Please make this happen!
Should this scheme go ahead, what is the timeframe for completion and what disruptions could we expect? Would this involve Sydney Water commandeering part of the old car park?
We agree on the basis of the information provided above.
We are on tank water that tastes like eucalyptus an upgrade would be much appreciated.
I would only be willing to pay the similar costs that Dangar Island residents paid to have their systems connected. It seems crazy that we are a suburb of Sydney without water and sewage.
From a safety point of view would there be funds for drains and curvature of road correction with these works.
We really need our wastewater issue addressed. Current method of wastewater unsatisfactory.
Strongly support for health and environmental benefits to community
During the exhibition, I was told that the cost to each household was estimated to be in the order of $29,000 which would possibly be subsidised to reduce it to $12,500. Will consideration be given to allowing householders to make their own arrangements for tanks and macerators to be installed?
This is a must - the current wastewater arrangements on the island are destroying the ecosystem, you just have to look at the deterioration of the trees across the island, let alone the significant amount of run-off into the Pittwater. This is not a WANT, this is an absolute NEED and a fundamental responsibility of the Northern Beaches Council to manage the environment responsibly.
We are a family of five. Both of us work fulltime to support our family and live a very humble life. We pay our rates like every other home owner on the northern beaches. We simply could not afford this additional cost. Water services installed would be beneficial to all surrounding water ways too, not just us as individuals. Pollution reduction from the septic tanks that are all within the 200m of the water line would be no more.

The expectation for home owners to pay is simply not achievable for majority of residents, including ourselves.
Scotland Island is the only suburb in the Sydney metropolitan district with no water and no sewerage. In heavy rain our septic systems drain into the pristine waters of Pittwater. It is totally unacceptable that we are now in the third decade of the new millennium without services that the rest of Sydney have taken for granted for decades.
An assessment needs to be done re what effect the loss of the nutrients and water will have on the Islands vegetation.
As soon as possible please!
We need to have access to water and especially to sewage. The number of residents on Scotland Island is now too high for the current septic system to perform properly. We need a proper system that is not going to pollute the land and the water,
I believe and recommend that the roads will need to be sealed and kerbed and guttered and better stormwater piping into Pittwater provided shortly after sewer and Sydney water supply is completed, as part of the funding because 1. sewer and water supply will be in and along roadways 2. they will be exposed to damage by essential truck service Danger Island is a precedent
Supportive of this initiative for the following reasons: [1] quality of life equity for residents [2] mitigate the public health risk issue [3] address environmental impact and soil coliform saturation [4] it is the twenty first century and this is a first world country
Very keen to improve the condition of the island and the public health and environmental impacts.
This scheme is needed for the next generation.
Excellent project. Desperately needed.
We live with young children on the island and I am very concerned about the negative health implications of the wastewater run-off, sewerage tanks overflow and the associated mosquito problem. A mains water and wastewater service for the island is not a nice to have it's a vital and necessary public service.
This proposal is overdue. The situation needs urgent attention due especially to pollution of the environment. I urge council to move quickly.
It's been a long time coming, with the clay soils and dying trees on Scotland island this should have been undertaken years ago.
I have lived on the Island for 25 years and have always been told that water and sewage is 10 years away. From what I have read here the state government and NBC are responsible for several breaches of different environmental laws/rules for letting so many houses be on SI, so should immediately get started on the best system to make the area safe for all the ratepayers/taxpayers as well as taking care of the natural environment that they are responsible for too.

I fully support water and sewerage scheme.
I think septic is an issue on the island, however, considering the already high costs for island residents to potentially park at church point (mostly never getting a spot), residents are likely to be sceptical that this will benefit them at all.
It's a shame on council and State Government to ask. You never ask for electricity upgrade that works are now destroying our beach. You never asked for NBN that is 2 years late and speeds are like in third world country. Why is that Scotland island is the only post code in Sydney without these essential services and you dare asking if we would like. I was born in third world country and we got sewerage and water 1963. Shame
Scotland Island services are well below those provided to mainland properties despite Scotland Island residents paying Land tax, rates, Government taxes, and Stamp Duty. It has been determined that the water and waste water quality is below acceptable National Standards that is a risk to human health and the environment, therefore the Water and Waste water services should be installed to match those of our neighbouring suburbs on the mainland.
This needs to happen.
These services should be taken for granted in a suburb of any major city. The wastewater system in particular would be most welcome as the local conditions - a combination of small lot sizes and clay soils - are unsuitable for on-site disposal. These systems would provide significant environmental and health benefits and it is well beyond time that they were available on Scotland Island.
I wholeheartedly support this excellent study. Water and wastewater provision to Scotland Island is an absolute necessity for public health and environmental reasons. The proposed solutions seem entirely sensible and appropriate in my view and given the pressing and urgent health and environmental concerns are entirely writhing the gift of state government to fund, particularly given the focus on infrastructure projects during this difficult time of Covid-19 recovery.
* own the house with mortgage * not sure how to pay for high connection cost of $12,000 but it seems to be only cheaper available option. The best support we need is to divide into small amount of instalments with no interest or fee charge.
The sooner the better. So we can have the same convenience as mainland for fresh water for drinking and washing and a wastewater system to prevent any wastewater leaking from tanks.
This a no-brainer , the environment is screaming for this to happen ..... Spotted gum trees won't be as badly affected (overflowing / leaking septics flowing into the root systems) .... No stench on the daily stroll around the Island . Is this the last ' suburb ' in greater Sydney to get mains water and sewage ?????? To my knowledge it is .... IT'S ABOUT TIME IT HAPPENED !!!!!!
With respect to the Risk Analysis in the Commercial Assessment please consider the following risks: 1)The risk of pump failure after warranty period has expired has not been considered

the likelihood would be likely with a consequence of moderate giving a high risk what mitigation strategies are planned for this occurrence ?. The hybrid system which has some houses using gravity to drain away waste water would reduce the number of pressure pumps that will eventually fail and require replacement
2)The risk that project is slow to be implemented or not implemented at all
the Likelihood is likely the consequence is major giving an extreme risk
what mitigation strategies are intended for this scenario of clean water not being easily accessible by residents on the island, resulting in many families not being able to easily bath in wash in or drink clean water. With their waste water being disposed of in a fashion that can have detrimental effects on their health and the environment. Mitigation strategies in these circumstances would be to improve the existing system making use of the poly pipework and the connection to the mainland water already in place. improving the water reticulation system so that there are permanent connections to the household water tanks of anyone that wants such a connection and water meters provided at each tank to allow an easy monitoring system for the purchase of water directly related to the household consuming it. also non-return valves to be included at each tank connection to stop contamination of the system from the water tank being filled. Waste water to be separated into grey (Shower, bath, washing machine and dishwasher)and black water (toilet), black water only to go to septic tank with separate absorption trench to that for grey water. that way septic tanks do not become overloaded providing adequate time in the tank for processing of the effluent thus substantially reducing bad odours and germs emanating from the septic system . This is a relatively low cost strategy that can be implemented quickly and it will have a highly beneficial impact on the residents of and visitors to the island not to mention the environment itself. This is something that can and should be done straight away. This can be done as an interim measure until the recommendations of this feasibility study are adopted and implemented which if history is any indicator could take many years.

Would it not be prudent to have an implementation strategy possibly attacking this project in stages addressing the lower cost, higher impact facets (in terms of improving the life of island residents) of the project first, namely the provision of clean water to the residents this is roughly one fifth the cost of providing waste water management according to figures quoted in this study i.e. approx $15,000,000 compared to $70,000,000 I can't see how having more clean water on the island can be considered detrimental especially if its distribution is controlled and metered so people pay for what they use. The waste water management could be addressed as the next stage. In this way the gaping need of the Scotland Island community for clean fresh water could be filled relatively quickly

About time. It has been too long watching the beautiful spotted gums die from excessive septic.

I am mostly in favour of the scheme, but we simply don't have $12,500 (and certainly not $39,000!!!) lying about to pay for connection. If there was a payment plan available with some co-funding, then it would be a possibility, perhaps. Council needs to remember that many of the people living on the island are retirees, artists or gig-based workers and, especially lately, our finances have taken a big hit. Many of us came to the island chasing a dream of affordable home ownership on the northern beaches, and many of us feel that this is being eroded by the constant 'island taxes' that seem to be cropping up. Parking fees (for non-existent parking spaces), fees to tie up our boats at wharves, fees to have a

vehicle on the island are all things that clip the ticket, and make somewhere that used to be idyllic, less so.
Most household septic system are malfunctioning. The Island desperately needs this solution
Island land seems to be pretty well saturated and smells of sewage after rain. Extremely hazardous to health of residents and our children and pets.
This is an excellent idea.
Scotland Island is the only suburb in the Sydney metropolitan that is not connected to water and sewerage. The water and wastewater scheme for Scotland Island is long, long overdue. NSW State Government must prioritise this project.
The environmental benefits would be a very exciting development for all on and around the Island. Please try and get this done. We are happy to respond quickly to see this come to fruition. Many thanks to all involved.
Many residents on Scotland island would not have the capacity to pay the $12,000 connection cost. In the interests of the environment the State Government should be covering these costs. If reports are true which indicate septic overflow then it is negligent for the government and Council not to resolve immediately
I understand there probably needs to be some sort of cost associated with getting these services but it need to be accessible to ll some sort of payment plan though rates or something as the suggested cost all up front would be tough for people When do you propose to start if it goes ahead??
We have a state of the art rainwater/septic system installed 3 years ago with a lifespan of 30 years...69 million dollars for 377 house is a ridiculous waste of tax payers money...$183,000 per household. The current water supply system works fine.
I think this would be great! The environmental impact of the current (failing) waste water systems is enormous! Drinking water connection is less of a concern.
Given the track record of the environmental mismanagement on Scotland Island, (Case in point: Carols beach at the moment), there is no guarantee that this would not be another disaster. While I am not qualified to comment on wastewater management, I do feel the pressure to suburbanise the island by wealthy investors is palpable and instils a sense of helplessness in those of us who have loved and lived on this island for many years and cared for its fragile environment. In my opinion, if every property had to have a proper wastewater management system (Enviro-cycle) and proper tanks for collecting rain water, Scotland Island would be better served. I am not against progress and I get that I am probably a lone voice that nobody will listen to, but I am really angry about what Ausgrid has done to Carols without ever consulting or apologising to the residents, or telling us what they are now doing, or if , in fact, they will ever be able to restore the beach, or give us a timeline. The pipe they have installed just under the water without any lights or warning, has already wrecked propellers and the beach is contaminated. I do not trust this

state govt. to undertake the enormous project of providing a responsible new wastewater and water scheme to the island, given what has already happened with trying to install a new power supply.
I own and live on Scotland Island permanently - family of 4.
Infrastructure Option 1 would be the most cost effective long term solution. This amenity is a necessity for the residents of Scotland Island and also for those who use Pittwater for recreational activities. My concern would be that a small proportion of lower income householders on the island would struggle to pay the connection and ongoing fees associated with this project. These households would likely benefit from a loan arrangement with SW or State Government. The cost per household needs to be very clearly explained so that residents understand the importance of finally getting this desperately needed infrastructure.
Fully supported - long overdue to bring the Island into the 21st century. It will eliminate a few people illegally tapping into the RFS water supply that runs across the seabed from Taylors Pt, and bring about a system that is equitable to all on the Island. A proper sewerage system will eventually eliminate the pollution of Pittwater that has occurred after long periods of heavy rains, which results in benefits to all living in the LGA. There will probably be those that moan about the cost involved but, many on the mainland have had to go thru similar expense in the past. It's all part of improving society. If you move to an Island in suburbia because it's cheaper and with less infrastructure, then with time, you have to expect that improvements will be required and that there will be a cost burden involved.
2 years ago I was forced to spend $30,000 for a new wastewater system (including septic trenches) due to Council rules. This year I spent another $10,000 on new water tanks, as my old tank is reaching end of life. To expect that I now have to pay another $12,500 is extremely unreasonable. The connections should be fully funded by the government. This is a base utility. Islanders have already been forking out large amounts of money that their mainlander neighbours have not due to the slackness of the government to provide this basic utility. I think we've paid enough!
Many of the dwellings on the island were built as weekenders or holiday houses and had minimal septic systems installed for their occasional use. These are now used as primary full time dwellings and the septic systems may not have been upgraded. The house we bought required the septic system to be upgraded because of this reason. Even modern built dwellings have been built without adequate wastewater systems with D.A approvals hiding bedroom capacities listed as offices etc. to avoid the build costs of larger septic systems . I know of at least one specific case regarding this matter. The benefit to the local ecosystem of a first world wastewater system cannot be underestimated. The surrounding waterways, seagrasses and the spotted gum forest on the island would benefit greatly. The safety of all who use Pittwater for recreational would also be greatly improved.
For all the reasons listed in the Council's document, this project is vital and long overdue. The status quo is indefensible and unacceptable in a Sydney metropolitan region in this age. A subsidised program such as a payment plan should be offered to the residents who are financially challenged. The State Government should help as much as it possibly can,

and should. Perhaps there are federal financial support schemes available for helping with environmental issues, as this one is.

It is a necessary for the environment and the water quality of the waters around the island

The provision of water and sewerage is long overdue, the current systems are an environmental and health issue for island residents and impact on the water quality of Pittwater.
The cost per resident is estimated at $12 500 per property, multiplied by 377 properties equals to $4 712 500 which is approx. 7% of the overall $69 000 000 project costs. Given similar project in other areas e.g. Dangar Island were totally funded, why should Island residents have to pay this amount? Why shouldn't Sydney Water fund the Project in its entirety, including connection to each household?

Full support for the report & the report's recommendations. Current issues with water collection, dependency on the non-potable water supply due to drought, septic odours, septic runoff, faecal coliform levels & the unusually high mosquito population due to large amounts of standing water supplies make acting on the report essential.

In 2020 it is unacceptable that one of the most significant and environmentally sensitive waterways in Sydney, a wealthy, modern international city, has untreated human waste leeched into it every time it rains. Scotland Island smells of human waste after rains. Swimming in Pittwater after rains causes illness and infections. Oysters around the island are dangerous to eat, other sea creatures are probably suspect. The soil of my backyard is constantly soaked with untreated wastewater. When we have guests raw sewage water flows through the yard because the gradient is so steep and the soil is mostly clay. During sustained periods of rain the soil can no longer absorb all the wastewater and it flows openly. Even when our own system doesn't overflow we can smell the wastewater overflow around the island. The current system is a hazard to health and a blight on what could be a pristine waterway. The local environment - Pittwater, Ku-Ring-Gai National Park, Broken Bay is heavily used by many people: Sydney residents and visitors. Both the land and water and the people who enjoy them, deserve better than constant exposure to untreated human waste.

A wastewater scheme is absolutely essential in bringing Scotland Island up to the service and hygiene standards of the times. There are so many risks associated with the improvised septic systems that characterise Scotland Island - ask any resident how many times they have picked up gastro or another nasty bug to get an idea.
I anticipate resistance with having to pay for this scheme, so hopefully this side of things will be well thought out, with payment plans and subsidies in place to get the more reluctant residents on board.
Parking is an ongoing issue for residents, and council should consider alternatives to using the Church Point car park as it complicates daily life for residents in a way that I think is difficult to grasp for non-locals.

I think it is critical to deliver a proper wastewater system in particular in order to protect the beautiful environment of the island.

Such a scheme is LONG overdue. My only suggestion would be that residents have the option of retaining their existing water storage tanks and that the new supply feeds those tanks rather than direct to the house

While getting sewerage services on Scotland Island is well overdue I feel that the cost to connect is going to be prohibitive for low-income earners. I would hope a long-term payment plan can be made available to those who require it.
The current non-potable water reticulation system runs counter to the environment of Scotland Island: a) Surface dispersal of water from Enviro-cycle type units adds to the growth of noxious and imported weeds (i.e. Trad [Tradescantia fluminensis] and lantana). Being shallow rooted ground covers they prevent the growth of deeper rooted vegetation needed for substrata stabilisation. In addition there has been a recent upsurge in the growth of madeira vines which climb and cover existing trees. The issue of die-back has already been addressed. b) The evolution of the emergency water supply into a de facto system without the concomitant commitment to waste water disposal results in an excess of water the island has to cope with, as the non-potable supply combines with naturally occurring rainwater to inundate native growth which has not evolved to cope with a constant excess of water. This excess of water contributes to the degradation erosion of the island's roads system, adding a greater impost on Council; c) The cost of the island's non-potable water far exceeds the cost of potable water at Church Point (these costs include SIRA levy 100%; compulsory SIRA membership to obtain water $25; fees to line monitors (between $5 and $10 per fill) as well as the cost of tanks and their maintenance--transport of a replacement tank between Church Point and to an island residence can exceed $300)
Would be willing to pay subsidised connection costs totalling $12500 only, which is expensive. You do not make clear whether owners who do not connect would pay the service charges despite not connecting
As I'm renting I would expect the property owner to take care of the connection to the water supply.
We are in. But does this imply that the car park would again have restricted areas for the works? There must be a better proposal than the current Ausgrid "solution" we are enduring (begrudgingly) now. Perhaps restrict non-essential parking at the reserve and new carpark to residents only? Please?
Not having this type of system is a major health hazard. Most septic systems on the island are totally inadequate. There is not enough land and the soil is not suitable for septic trenches. This has been an ongoing problem for a long time. With Airbnb rentals increasing on the island, existing inadequate systems are being even more overloaded.
This will be an important improvement to Scotland in many ways. Improved water and soil quality, improved water quality in Pittwater, less offensive odours and sludge areas on roads and around houses, no requirement for septic "pump-outs" and maintenance inspections, less insects and vermin congregating around areas of sewage overflow, bringing us more into line with other areas in the Sydney metropolitan region. We fully support this recommendation.

Willing to pay reasonable and fair costs for connection as long as it is not astronomical. The community really needs this to be sorted, it is an environmental and public health hazard to have our effluent draining into Pittwater
1) I support delivery of reticulated water and sewerage services to Scotland Island 2) Delivery of a sewerage service will reduce the incidence of pollution into the surrounding waterways from leaking septic systems 3) Energy will be required to pressurise the sewerage system. This energy should be 100% supplied by renewable energy, preferably generated locally to avoid electricity distribution system losses.
Very happy with these proposals.
This water system would ensure Pittwater would be pristine for generations to come and should have been completed many years ago. Full support
Thanks to Council for managing this Feasibility Study and of course thanks to the NSW Government for funding it. The options proposed seem to be the most sensible and practical. This solution to our water and wastewater problems has been a long time coming and though there will be short term costs the longer term health, environment and community benefits will be significant. One additional advantage is that this project will also create economically stimulating employment opportunities.
Living full time on the island and seeing the wide variety of systems, most non-compliant, it is the only way to ensure the preservation and protection of the environment. A levy payable on the sale of their house should be placed on people who say they can't raise the money
Yes yes yes. I have an old septic and worry about the environment! I am not very financial but believe this is an important vital long term investment.
There has to be a financial support programme for people who cannot afford the connection costs. If this is not made clear, many people will be against this even though it is absolutely necessary to do this and to do it as quickly as possible. Our entire family suffers from repeated parasite infections due to the poor quality of local water (our own house water supply is UV treated with various filters and probably better than what comes out of the tap on the mainland) and the pollution cause by septic tank run off which makes most of the island smell like an open sewer after heavy rainfall. Many of our friends have had similar health issues. Please do not delay this any further.
Absolutely discussing the waste that flows into the Pittwater every time it rains. Pollution is sickening (literally). It's not just about overflowing septics it's due to over population on the island and decades of septic being pumped into the soil. After rain people get sick of they swim. God knows what it does to the fish. Please get sewage for this island.
The option look good. The overall cost as well. I am wondering if Harold Park will be impacted to the extend the community cannot use the side any longer. While the cost of

connection is estimated at 12.5K, clarification is required whether or not this includes the new pressure tank and transport costs on the island. I would support additional financial support as it adds up, there is also the decommissioning of the septic tank which would cost significantly. Also, Our site being very steep, I would appreciate some understanding of the new works constraints.
Bring it on! Great proposal. Full support.
This is a long overdue service that's needs attention ASAP. I feel it should be funded by the Government & Council entirely as residents are sick & tired of this councils unfair user pays system in this area. This is a serious health risk & also a environmental disaster waiting to happen.
$12.5k to connect is a serious cost, which not all residents can afford. This should be brought down within local residents budgets. Otherwise, I'm happy with the proposal
This is long outstanding piece of infrastructure required for a first world community both to preserve the environment on Scotland Island And Quality of water in Pittwater .
this is a great idea and the island would be a much better place without all the enviro cycles and septic systems. Taking out all the tanks would reduce the mosquito population as well. Let's do it....
Under the PSP Scotland Island was to be connected to sewerage by 2011. Scotland Island should be provided with a wastewater scheme equitable to those provided to other communities under the PSP. State Government and Sydney Water should not be permitted to avoid their obligations under the PSP. Scotland Island currently has no viable potable water supply, which simply cannot be allowed to continue in a suburban community. Thank you
Yes I completely support a networked water supply on Scotland Island. The local environment and waterways are severely impacted by sewerage systems. Native trees that have a shallow root system due to excess water and are affected by the higher level of nutrients create a danger to residents and buildings. Native vegetation is also impacted including the threatened ecological community of the Pittwater Wagstaff Spotted Gum Forest. Our household would be willing to pay a reasonable fee for this essential service to be installed. The current utilities on Scotland Island are not suited to this high density residential suburb and an upgrade is decades overdue. Thanks for the opportunity to provide comment.
In the early 1990s the Scotland Island Landcare Group commissioned several expert wastewater reports funded through government grant programs that concluded that water and sewerage was the only sustainable option for Scotland Island. Following submission of these reports to Sydney Water, Scotland Island was placed on the Priority Sewerage Program (PSP) with a program date of 2011/2012. It was subsequently removed from the PSP by Sydney Water without reference to the community.

There is a lack of equity with other communities such as Galston and Glenorie that are currently being connected to water and sewer as part of the PSP and at no cost to the residents. There is also a need to coordinate infrastructure service projects to ensure efficient integration and minimise damage to roads and drainage. There needs to be consideration given to disruption to car parking at Church Point with alternate arrangements put in place.
Scotland Island was on Sydney Waters list to sewer for free in the early 2000s with a promise to complete in 2010. Why do we now need to pay as previously this was going to be done for free? Sydney Water still owes at least explanation. Waster/Water on the Island will be good but I am concerned with environmental, roads and parking at Church Point impacts.
I can't find reference to what the impact will be on the main land... if any? Will all the infrastructure be underground? The Church Point mainland has been subjected to months of drilling from Ausgrid for the new underwater electricity cables to Scotland Island. The heavy vibration is resulting in houses and retaining walls cracking, land is subsiding and working from home is a struggle due to the noise. There doesn't seem to be any allowance for this type of impact to local residents, has this been considered in the options?
This has all the hallmarks of an exercise in obfuscation, where a proposal is put forward with a proposed unjustifiable cost (levied on NO other Sydney residents) and that is designed to fail. I note that the residents of Dangar Island were not charged for the provision of water/sewage services, and as many residents would likely be unable to pay the proposed $12,500 cost, especially while most people are reeling from the economic impact of the pandemic this proposal represents an abrogation of the duty of both Northern Beaches Council and the NSW State Government. Four years ago I installed a state of the art AWTS while building a new dwelling (a condition of the DA) which functions perfectly, causes no ground pollution and no contaminated runoff into Pittwater. Accordingly I would probably opt in for the provision of a mains water supply however I understand that this would not be available unless I accept the sewage package as well (at $12,500) and this is just plain price gouging and manipulation. A further question that begs asking is why NBC (and previously Pittwater Council) has been unable to adequately address the inadequate storm water management and road maintenance issues on Scotland Island.
I think providing water and septic to Scotland island is essential for the health and sustainability of the island, it's inhabitants and Pittwater.
Obviously, we need an improved water and wastewater system, but we should have funding from the government for its implementation.
I believe this is an extremely important issue for the island and fully support it. I would like to suggest however, that when discussing the costs of the upgrades per household, that council also suggests some sort of payment scheme. The fear of a large payment for something like this may drive many islanders away, but if they know there is some longer term support available (loan, bond issue etc.) then I believe more people would be on side

The state government or the people of Scotland Island should be paying for anything 'extra' the residents require on top of the basic necessities.
I would lend cautious support to the project, if a commitment is made to hold the water service charge and water the usage charges to the same levels as the adjacent mainland. Elevating charges for decades on an essential and mandated service, to payback an installation cost, is very likely to generate significant community resentment. Feeling around the new Church Point car-park provides a useful guide to this. As an alternative, I would support more rigorously enforcing maintenance, and replacement over time, of the current (mostly decades old) waste water treatment systems. Such a solution is likely to provide similar environmental results, at a tiny fraction of the $69 million cost estimate. For under $4 million, every house could have a new state-of the-art Aerated Septic System or similar, including installation (Please see attached quote). This solution uses existing household piping and requires no new public infrastructure. New Aerated Septic systems are likely to cost effectively reduce both nutrient and faecal coliform levels, as such addressing all the main concerns expressed by the community.
Health risks and ongoing damage to vegetation, particularly at the bottom of slopes suffering run off from septic systems, are an unacceptable situation in a first world country. This problem has developed over a long time and will continue to grow until an acceptable system for sewage disposal is provided.
From an environmental and public health perspective it sounds like the right thing to do.
This essential service has been debated for the last 30 years as mentioned in the report. I believe that we are entitled to the same essential service as other metropolitan suburbs have in the greater county of Cumberland. Not the impose of additional fees to selective citizens.
Scotland Island has been on the Priority Sewerage Program for many years and has not been progressed due to reluctance by Sydney Water to invest in the necessary infrastructure. The lot sizes and the nature of the soils on Scotland Island make it impossible to have compliant septic systems with resulting health and environment problems due to contaminated ground water. The feasibility study shows that it both feasible and practical to deliver both water & wastewater services to Scotland Island. We now need the State Government to proceed to fund the necessary infrastructure investment to ensure an equitable outcome for Scotland Island residents.
The septic tank system on the island at present just can't cope with the density of population and the consequent amount of wastewater this produces. A new system of waste disposal is crucial to improving the local environment - the soil, trees and vegetation and the surrounding waterways - and the health of residents, visitors and users of Pittwater. I do think residents will need to be encouraged to keep collecting water from their roofs to assist in the control of erosion and water pollution from runoff.
I am not that concerned with water connection however sewage removal would be great for Scotland Island.
After rain like this weekend the island stinks as run off from peoples enviro cycle sprinkler beds wash out onto the road. As summer comes on the mosquitoes own the night and we all live in a haze of

insecticide.
Town water and sewage would make such a huge difference to the island ...it would cure both these problems

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I think it is a great idea that is long overdue and will make the island a happier, healthier and less smelly place!

I fully support these developments. In particular, I am concerned about the present sewage arrangements in relation to the health of the native trees on the island, as well as the effect that the current septic systems have on encouraging mosquitoes and invasive weeds, both of which are major pests on the island.
I also have some concerns about the island's current water supply and its implications for criminal liability under the Public Health Act 2010 (NSW). In short, s 15 prohibits the supply, by means of a reticulated water system, of 'drinking water'. The problem lies with the definition of 'drinking water' as found in s 13: water intended, OR LIKELY, to be drunk or used for cooking etc. There is no point in denying that many households rely on the island's 'emergency' water system, run by the residents' association (SIRA), for all their domestic needs. Undoubtedly SIRA, as well as the individuals involved in the water supply, are altruistically motivated. The island is vulnerable to bushfire, and it is vital that every household be able to maintain a full water tank if the fire brigade is to stand any chance of defending houses. Without SIRA's water system it would be impossible for households to maintain a full tank during dry periods.
I submit that it is unconscionable that well-meaning and public-spirited individuals should be exposed to even the suggestion of criminal liability when they simply trying to attenuate the effects of failings by public bodies to provide a water supply.

The island is recognised as being home to the Pittwater Wagstaff spotted gum endangered ecological community of the Sydney Bioregion. A majority of blocks are quite small and have limited space for wastewater absorption. Characterized by steep topography and shallow topsoil wastewater travels over the clay subsurface having an adverse effect on the endangered forest community due to changes in nutrients and moisture levels. During rain runoff flows downhill into the Pittwater estuary.

The Scotland Island Water and Wastewater study (D. Martens 1997) highlighted the contamination to stormwater runoff from the island to Pittwater estuary, a significant recreational site for swimming, boating and fishing for local and Sydney resident.
Septic runoff has been an issue for our household causing the death of 2 mature spotted gums adjacent to our septic field, ear infection from swimming and a possible longer term intestinal upset. The issues are easily verified by the turbidity of the water surrounding the island after rain, the loss of canopy and dieback of the forest trees and weed growth in water logged soils.
Moist soil and pooled runoff provide an ideal breeding ground for mosquitoes which carry diseases of the Barmah Forest and the Ross River Fever viruses and have been reported on the Northern Beaches.

While the Scotland Island is not a large island land mass it is densely populated with between 800 and 1000 inhabitants and about 350 homes. Until sewage and water are available to the island fire remains a very real threat to the community. The island rural first service is dependent on access to residents private water tanks and two emergency at the top of the island.

With only 4 minutes of water on a single truck there is no chance of stopping an intense fire. With increasing periods of drought, erratic weather and intense storms having an

improved water supply makes good sense not only for the local community, but those across the water that might experience ember attack.
Some 25 years ago when we were at Bayview, we were then connected to the Sewerage system To the best of my knowledge we did not have to pay anything. Perhaps it was built into the annual/quarterly fees over a period. Can you tell me what the situation would have been then. If we are being asked to pay now, then that would be inequitable. We await your answer on this so that we can modify our answers. I'm tipping that a large % of home owners on Scotland Island would find it very difficult to come up with an amount of $12000 (an estimate that almost certainly will increase) Therefore a small amount over a period should be set down as a related question in regard to this question 'will you be willing to pay?' - if this is the same situation as with the mainland
I fully support bringing water and wastewater service to Scotland island, please make it happen!
Water and Waste water are vital for our off shore community for health and safety reasons not to mention keeping the Pittwater free from septic run off.
The number of mosquitos are increasing each year and recently there have been cases of ross River fever, which comes from mosquitos. Even with septic checks there are occasions when septic tanks are overflowing and it is quite unpleasant. Recently we have been unable to obtain a septic waste clear cut as the operating has been unable to come to the island. For hygiene and safety main waters would alleviate these issues.
The danger of a fire on Scotland Island & not having adequate water pressure to fight fires. Overflow of septic systems with water lying around, being a breeding ground for mosquitos - The lack of good drinking water
My concern that if there's a fire on the island we're very vulnerable having no water pressure to fight the fire. The quality of the drinking water is poor. The overflow of the septic systems leaving water lying around, mosquitos breeding - there's been a number of Ross River Fever cases diagnosed recently.
After last summer's fires the reality of the vulnerability of the residents of Scotland Island having inadequate water pressure to fight any fires. The health issues that are arising - cases of Ross River Fever due to overflowing septic systems with water lying around . The quality of the drinking water.
As a resident on Scotland Island, we have major concerns of the fire risks on the island without proper under pressure water to fight fires. The major concern of overflowing septic systems with water lying around where mosquitoes are breeding & I'm aware of three cases of Ross River Fever recently. Good healthy clean water for the residents including children on the island.
I strongly support the need to for the count in and the state government to support the need to provide water and wastewater to Scotland Island. Having lived on the island for 3

years I have witness the pollutions from septic systems and also noted the water quality in Pittwater is poorer as a result Scotland Island not have a proper wastewater management scheme in place. I've also experience that even though most residents rely on rain water harvesting global warming is definitely impacting harvesting and there should be an encouragement to have water supplemented with rainwater harvesting. This is good responsible step that the council is make with proposing water and wastewater scheme for the island.
HOPEFULLY, THIS WILL BE NOT BE JUST ANOTHER SURVEY THAT GOES NOWHERE. IN 2020 IT IS UNBELIEVABLE THAT A SUBURB OF SYDNEY HAS NO SEWERAGE AND NO WATER SUPPLY.
We've had our home here for 17 years and this infrastructure is long overdue. Everywhere else in Sydney has this infrastructure , which is a first world service. We've seen many trees die and our arborist believes this is due to the effluent run-off and detergents . I imagine the run-off into Pittwater detrimentally affects the marine life. I would appreciate your urgent consideration to this matter.
I have been a resident for 20 years. When I moved to the island I was excited that a water and sewage Sydney Water connection was a government priority and was due to occur within a few years. I have been highly disappointed that this has still not eventuated and it has even somehow slipped of the priority list, despite growing number of houses and people on the island. Not being provided clean drinking water when it is easily available within a metropolitan area is a public health risk and shows obvious inaction by government. There is inequality between Island residents and other residents with the Northern Beaches as water on the Island is not subject to regular testing and does not have fluoride and disinfectant. Having mains water under pressure would be an enormous benefit toward firefighting and again lack of mains water for this purpose is neglect by the government. The emergency firefighting water is a poor substitute as this line is regularly unavailable, it has poor pressure and it cannot be relied upon. The time for connection to mains water is more than urgent than ever considering the increasingly more intense weather we are receiving. There are approx 560 people of the island (2016 census) and the current firefighting resources are useless. A reliable water supply would significantly enhance our ability toward controlling fire. Not being provided with a modern sewerage system is likely to create significant public health and environmental risks. There is likely to be high number of unreported community sickness and also environmental impacts. Old septic tanks and similar waste water systems are not acceptable when a sewerage system is available within a metropolitan area. Many island waste water systems are too old and well beyond their use by date, patched together in a band-aid manner. Many are not designed for their current load and it is not possible that regulatory overview can satisfactorily address all of their deficiencies. I have often noticed areas around waste water systems that have puddles, over land flow, odour, mosquitoes and noxious weeds. There have been times where it is embarrassing to have friends over due to strong odours noticed from

neighbouring waste water systems. It is likely that the good water quality results are noted due to dilution and tidal flushing in Pittwater. Water sampling taken close to the island and/or in small creeks on the Island may provide significantly differing results.

The planning for the island does not allow for satisfactory land application sizes to adequately manage on site waste water. Further the soil type, dense overhead foliage, aspect and steep slopes are other factors on the Island that significantly reduce the effectiveness of waste water land application. I have personally noticed an increase in gum tree dye back. The spotted gums on the Island are protected and are meant to be significant to the area. There is serious encroachment of weeds that are impossible to control and overland water is noticed at times - particularly on washing day.

Urgent action toward reducing pollution, nutrients, land and water contamination from waste water systems is required and this can only be achieved by a sewerage system that takes sewage off site.

I strongly support the connection of the Island to a sewerage system and mains water. It will be a tremendous environmental and public health benefit. It will also be a huge achievement for the government if this can be delivered in a timely manner. Further during this difficult economic period due to COVID, this project will stimulate many necessary jobs in different sectors and provide a huge positive impact to our local community and beyond.

I can't believe that a place in such a beautiful part of Sydney still doesn't have fresh clean water readily available to its residents. There seems to be a school of thought that thinks the islanders if given the privilege of having easy access to clean fresh water will over indulge in the use of this precious resource and add to the waste water problems of the island.
Firstly I don't see why people who truly know the value of this precious resource people who have had to frugally managed its use over years would turn around and blatantly waste it especially when they will be charged for its use
Secondly regarding the waste water issues maybe more consideration could be given to on site separation of grey water and black water with appropriate treatment to each to minimize adverse effects. This approach would be relatively low cost and would greatly improve the living conditions of the islanders and other off sure residents with no detrimental effects to the environment

I am 2 years old if I could write ,this is what I would say
I wish I could have a bath in clean water without the danger of getting sick
I wish I could drink the water from our tap without getting a tummy ache
I wish mummy could wash my nappies in our washing machine and they look cleaner after they have been washed
I wish I could go to preschool on the island and be able to have a drink of water and go to the toilet and wash my hands if I need to.
I wish I could go outside and not be bitten by mozzies that have been breading in water storage tanks
I wish my mummy and daddy didn't have to worry if we will have enough water to drink, shower and wash our bodies and clothes in, and cook and do the washing up this is a constant worry for my family
And a source of great anxiety to me

Scotland Island has been waiting a long time to receive what most residents in suburban metropolitan Sydney take for granted. We need these services NOW, not in another 20 or so years! Sydney Water quoted what has proven to be a grossly exaggerated cost to provide water and wastewater infrastructure to the Island, now the real cost has been determined there should be no delay in planning and design to progress these services. We have a public health issue with our soils being contaminated by effluent, there is insufficient water to provide good supply during fire emergencies, the mosquitoes just about carry you away and are a source of Ross River Fever (most recently some residents have become very ill), our environment is suffering with trees dying and falling on property and losing our canopy. The PSP programme is within the license agreement of Sydney Water and grant funding was made available to provide reticulated water to Dangar Island years ago. We deserve this consideration and there should be no delay in planning to provide this essential infrastructure to our community.

I strongly support the proposal for both water schemes to be adapted and enacted as a matter of urgency. The waste water issue on the island is evident by the constant odour that is present in many areas. There are systems that are not maintained and managed in a proper fashion. I own a property that is next to a rental property, the system immediately to the south is a constant issue and is a health hazard to my property as it regularly sprays waste water on my roof when it malfunctions. This situation causes the need for disinfecting and washing my roof in order to collect rain water and store it for our household!
It is certainly NOT a positive contribution to a harmonious neighbourhood.

As the population on the island has increased and may continue to do so it is essential that Sydney water finally take charge of its responsibility to secure safe drinking water and sewage removal to the island community.
The matter is urgent as septic systems are constantly failing all over the island for various reasons,
The reasons are....
- lot sizes are too small for effective high volume soaking of grey water.
- The island has deep clay soils which means wastewater trenches can become saturated reducing effectiveness .
- In combination with often saturated clay soils, most lots are steeply sloped meaning water from Septic trenches discharge back to the surface, often onto neighbouring property, dirt roads, bushland and I have been told into the seawater of Pittwater .
- We own two home properties on the island and are experiencing all these problems as I have mentioned above on both lots.

In conclusion because Septic Systems are generally incompatible with the geography, topography, lot sizes, population density and saturated clay soil of Scotland Island there is no excuse for Sydney Water and other entities to not finally engage, to work towards resolving a long standing environmental issue. It's well worth investing in.

this has been too long in coming

I am concerned on the amount of pollution enters the Pittwater after heavy rain from overflow of the septic tanks. Often the smell can be very unpleasant. Concern for swimmers.
Soil Pollution from wastewater from tanks not safe. Please can we fix this problem we are now living in the 2020s and the time has come to fix old methods with new.

Most houses here have smallish waste water systems (catered for part timers it seems of the Island), and as soon as visitors come or during covid when everyone was Home, we could see lots of places in the Island where the seats was evidently overflowing onto the

road, making it slimey & un-pleasant. I cannot help to think of that is good for the environment here & the water as all run off into Pittwater with big rains.
If it ain't broke don't waste NSW taxpayers (net positive) cash.
Our children deserve to live in a sewerage-free environment. It is unhygienic and unhealthy and we should't have to pay for basic hygiene standards like everyone in any other suburb.
Our children deserve to live in a sewerage-free environment. It is unhygienic and unhealthy and we should't have to pay for basic hygiene standards like everyone in any other suburb.
We believe the homeowners of Scotland island deserve the same treatment as other residents in Sydney and the water and sewage services are way overdue. Please support funding for this. We also would like to see action on more reliable parking for offshore residents.
We really need the water and waste scheme to happen urgently, having lived on Scotland Island for over 20 years the population has become far more dense. Many more residents live here now permenantly instead of it being mostly holiday homes, This increases the usage of water and strains the septic systems. I have noticed spotted gums trees have become unhealthy and I expect this is to do with the septic systems. We need upgrades please.
We need a normal water and waste water system just like every other Suburb in Sydney has. We pay the same rates but don't receive the same infrastructure. It is time to correct this.
Sooner the better
I think Scotland Island needs to have water and sewerage. Septic seeping into Pittwater after rain as stormwater drains overflow and the ground becomes waterlogged is disgusting. Its environmentally unsustainable as there are more people moving onto the island all the time so.. more septic. Thank you. Please fix.
Clean Healthy water, No more pollutions running into Pittwater
Excellent initiative and long overdue. Much better for the environment and the pristine waters of Pittwater.
The number of houses on the Island now and the age of a number of septic trenches make it a necessity to have water and sewage on the Island.
Long overdue. This will benefit the environment and residents alike.

Appendix B – Submissions received by mail

21 October 2020

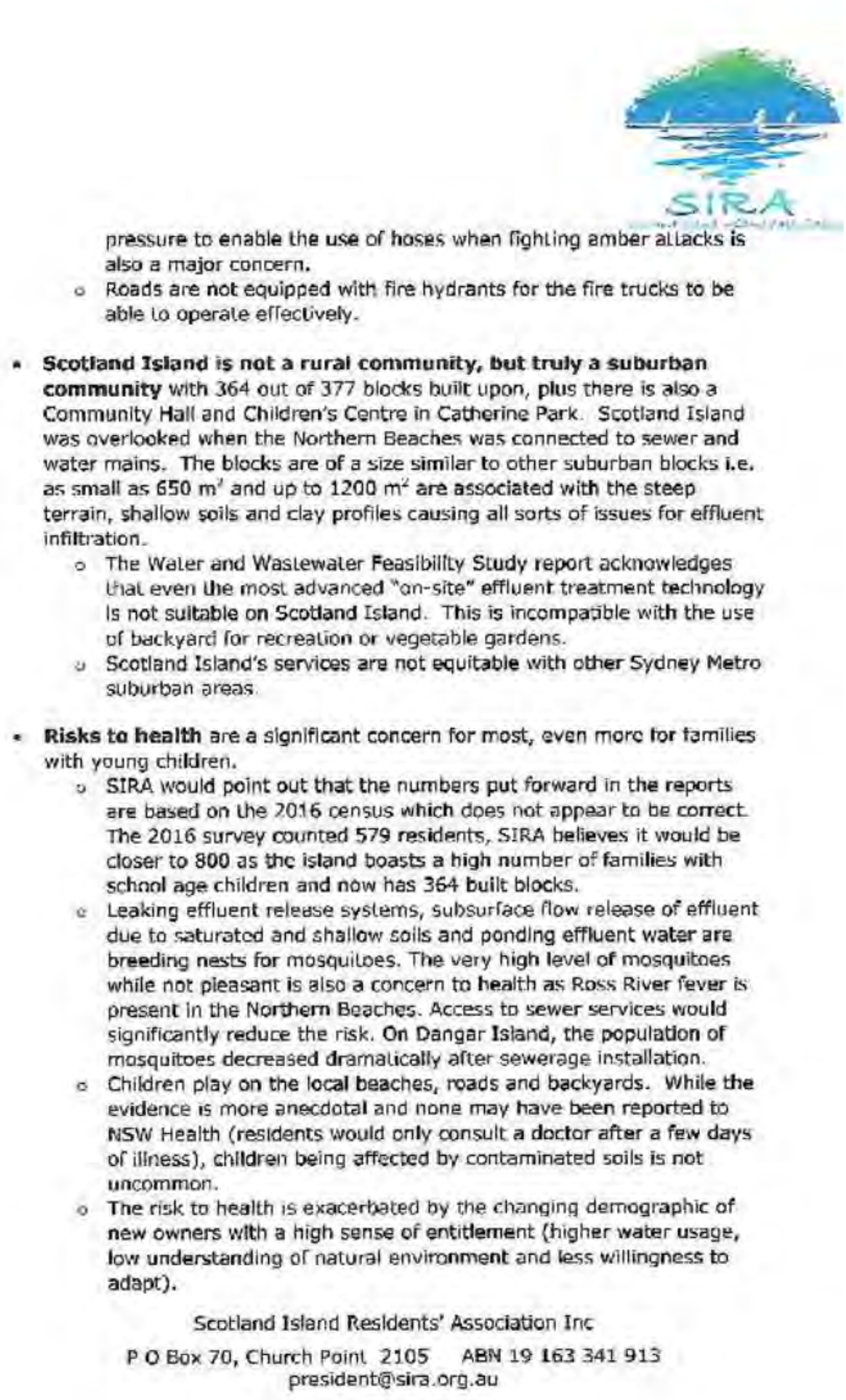
Northern Beaches Council
P.O. Box 82,
Manly, 2095 NSW
Council@northernbeaches.nsw.gov.au

Re: Scotland Island Water and Wastewater Feasibility Study

The Scotland Island Residents Association (SIRA) would like to thank Northern Beaches Council for facilitating the Water and Wastewater Study and the deliverables to investigate the feasibility of providing water and wastewater services to the residents of Scotland Island.
SIRA supports the findings highlighted in the Study and commends the transparency of the methodology and reporting. SIRA is also supportive of the recommendations made in the Study report. We are strongly of the view that doing nothing is not an option.
The Study findings are very important to our community. SIRA stresses that getting access to a secure water supply and wastewater services is critical for Scotland Island residents:

- **Scotland Island has a Category 1, Bush Fire Prone Rating, the** highest risk for bush fire. The vegetation category has the highest combustibility and likelihood of forming fully developed fires including heavy ember production.

  Apart for the bushfire risk, Scotland Island Rural Fire Brigade also has responsibility for any structural/building fires involving the 364 dwellings on the Island. The residents have to rely on the Scotland Island Rural Fire Brigade volunteer supported by the willing community members to manage any bushfire and/or structure fire on the Island. The lack of access to a reliable water source is a critical safety concern. Access to a reliable water supply, would significantly increase the defensibility and safety of Island residents, particularly during times of limited rainfall.
  - Sydney Water has reduced the pressure in its water mains in the vicinity of Church Point, which has resulted in the inability to fill the fire-fighting reservoirs on top of Scotland Island through the HDPE "emergency water supply" line, which was installed initially for the purpose of mitigating risk of bushfire.
  - Residents have a limited supply of water through household water tank storage; in the event of a bushfire, those storage tanks are unlikely to be sufficient, especially when tank levels are low in dry periods. This was the case during the 1994 bush fire emergency in the Ku-ring-gai Chase National Park. The lack of adequate water



pressure to enable the use of hoses when fighting amber attacks is also a major concern.
  - Roads are not equipped with fire hydrants for the fire trucks to be able to operate effectively.

- **Scotland Island is not a rural community, but truly a suburban community** with 364 out of 377 blocks built upon, plus there is also a Community Hall and Children's Centre in Catherine Park. Scotland Island was overlooked when the Northern Beaches was connected to sewer and water mains. The blocks are of a size similar to other suburban blocks i.e. as small as 650 m² and up to 1200 m² are associated with the steep terrain, shallow soils and clay profiles causing all sorts of issues for effluent infiltration.
  - The Water and Wastewater Feasibility Study report acknowledges that even the most advanced "on-site" effluent treatment technology is not suitable on Scotland Island. This is incompatible with the use of backyard for recreation or vegetable gardens.
  - Scotland Island's services are not equitable with other Sydney Metro suburban areas.

- **Risks to health** are a significant concern for most, even more for families with young children.
  - SIRA would point out that the numbers put forward in the reports are based on the 2016 census which does not appear to be correct. The 2016 survey counted 579 residents, SIRA believes it would be closer to 800 as the island boasts a high number of families with school age children and now has 364 built blocks.
  - Leaking effluent release systems, subsurface flow release of effluent due to saturated and shallow soils and ponding effluent water are breeding nests for mosquitoes. The very high level of mosquitoes while not pleasant is also a concern to health as Ross River fever is present in the Northern Beaches. Access to sewer services would significantly reduce the risk. On Dangar Island, the population of mosquitoes decreased dramatically after sewerage installation.
  - Children play on the local beaches, roads and backyards. While the evidence is more anecdotal and none may have been reported to NSW Health (residents would only consult a doctor after a few days of illness), children being affected by contaminated soils is not uncommon.
  - The risk to health is exacerbated by the changing demographic of new owners with a high sense of entitlement (higher water usage, low understanding of natural environment and less willingness to adapt).

Scotland Island Residents' Association Inc
P O Box 70, Church Point 2105 ABN 19 163 341 913
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- **Environmental impacts:** The Island community lives under the canopy of the Pittwater and Wagstaffe Spotted Gum Forest Endangered Ecological Community. The impact of wastewater disposal on the environment has been documented overtime with the observation of die back in the native species, and continued loss of tree canopy. The Water and Wastewater Feasibility Study report also identifies related issues as including soil saturation, high levels of nitrogen and proliferation of noxious weeds.

Both Necessary and affordable: The Water and Wastewater Feasibility Study report estimated the cost of installation of both water supply and wastewater systems to be 69 million AUD, which is significantly less than the cost estimated by Sydney Water, and consistent with the costs occurred at Dangar Island. To note, SIRA has long time advocated Sydney Water has not fulfilled its licence requirements. As a result, there are currently three different water supply substandard schemes (SIRA emergency water system and two private ones to about 18 houses) operating on the Island prone to failure. Thank you again for providing the support of Council's team to facilitate this study and for advocating on the behalf of Scotland Island community.

Yours sincerely,

Colin Haskell
President – Scotland Island Residents Association

p.p. Sharon Kinnison
Vice President

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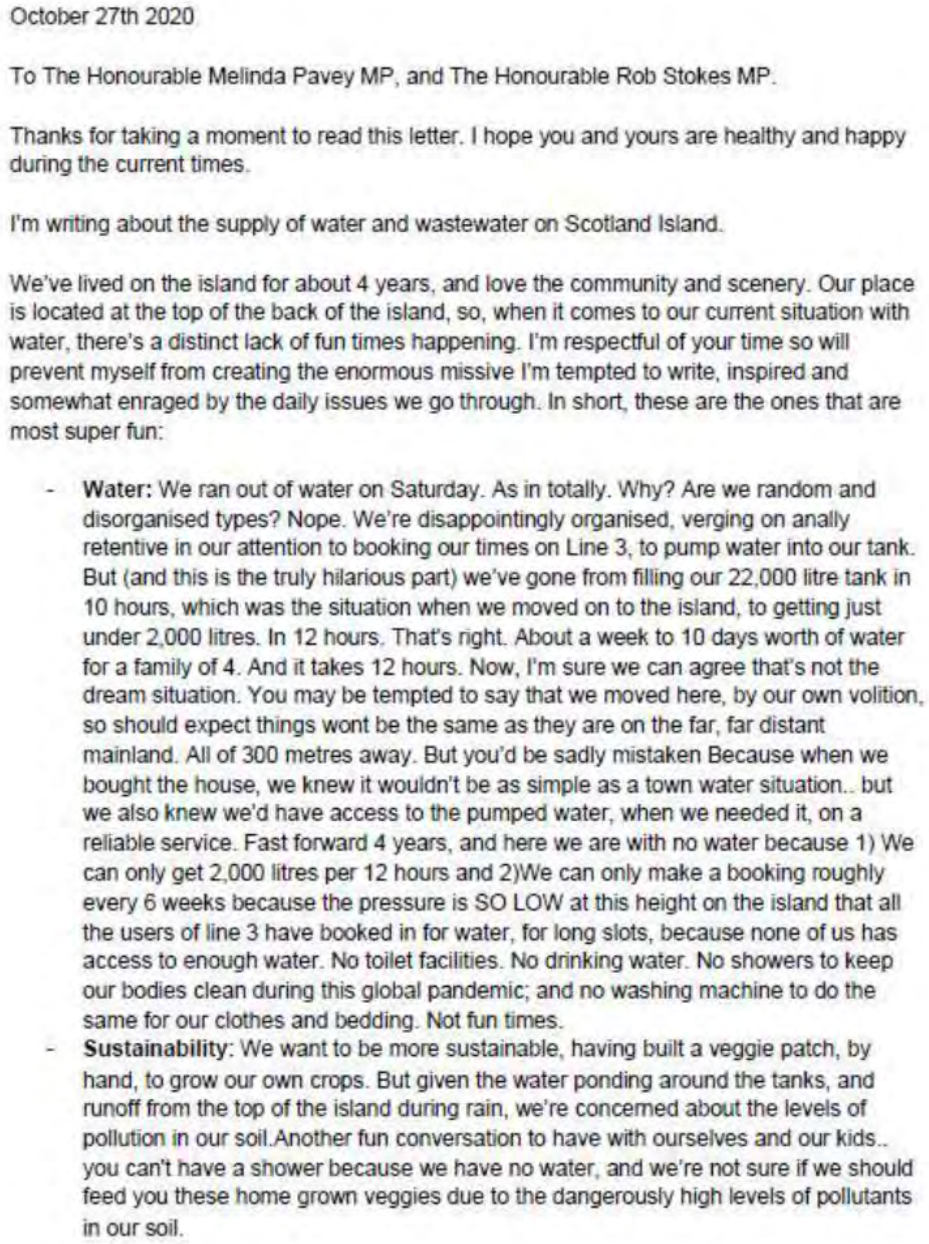


October 27th 2020

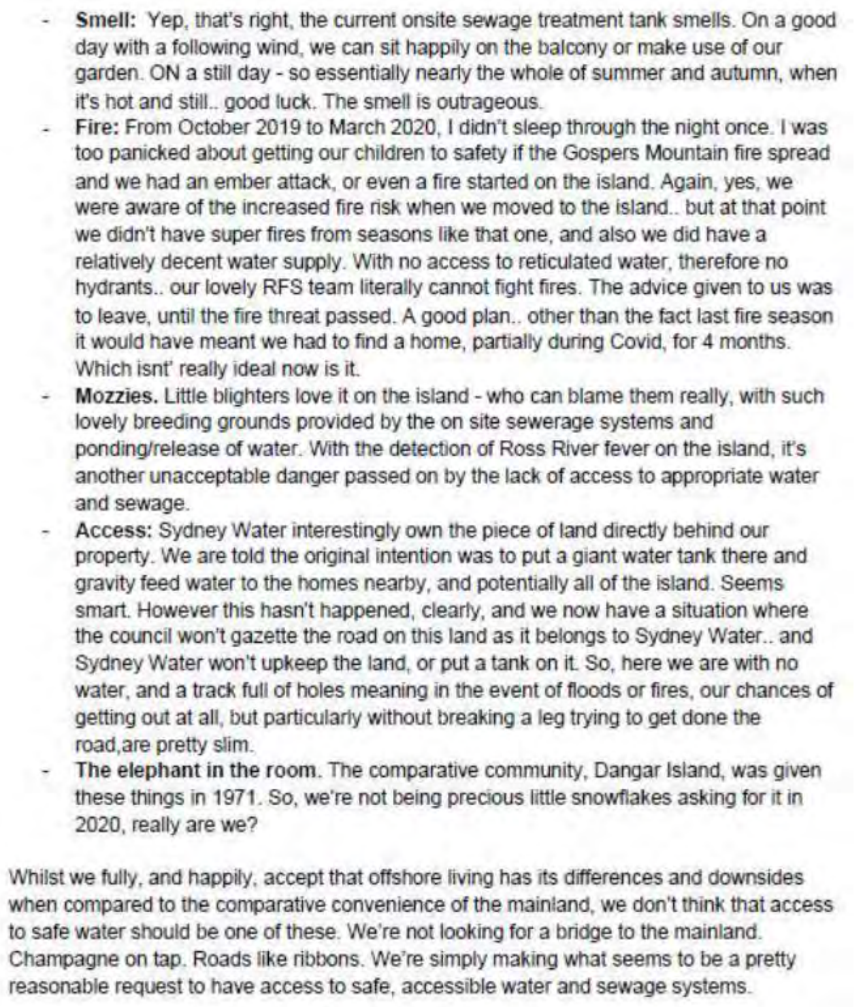
To The Honourable Melinda Pavey MP, and The Honourable Rob Stokes MP.

Thanks for taking a moment to read this letter. I hope you and yours are healthy and happy during the current times.

I'm writing about the supply of water and wastewater on Scotland Island.

We've lived on the island for about 4 years, and love the community and scenery. Our place is located at the top of the back of the island, so, when it comes to our current situation with water, there's a distinct lack of fun times happening. I'm respectful of your time so will prevent myself from creating the enormous missive I'm tempted to write, inspired and somewhat enraged by the daily issues we go through. In short, these are the ones that are most super fun:

- **Water:** We ran out of water on Saturday. As in totally. Why? Are we random and disorganised types? Nope. We're disappointingly organised, verging on anally retentive in our attention to booking our times on Line 3, to pump water into our tank. But (and this is the truly hilarious part) we've gone from filling our 22,000 litre tank in 10 hours, which was the situation when we moved on to the island, to getting just under 2,000 litres. In 12 hours. That's right. About a week to 10 days worth of water for a family of 4. And it takes 12 hours. Now, I'm sure we can agree that's not the dream situation. You may be tempted to say that we moved here, by our own volition, so should expect things wont be the same as they are on the far, far distant mainland. All of 300 metres away. But you'd be sadly mistaken Because when we bought the house, we knew it wouldn't be as simple as a town water situation.. but we also knew we'd have access to the pumped water, when we needed it, on a reliable service. Fast forward 4 years, and here we are with no water because 1) We can only get 2,000 litres per 12 hours and 2)We can only make a booking roughly every 6 weeks because the pressure is SO LOW at this height on the island that all the users of line 3 have booked in for water, for long slots, because none of us has access to enough water. No toilet facilities. No drinking water. No showers to keep our bodies clean during this global pandemic; and no washing machine to do the same for our clothes and bedding. Not fun times.
- **Sustainability:** We want to be more sustainable, having built a veggie patch, by hand, to grow our own crops. But given the water ponding around the tanks, and runoff from the top of the island during rain, we're concerned about the levels of pollution in our soil.Another fun conversation to have with ourselves and our kids.. you can't have a shower because we have no water, and we're not sure if we should feed you these home grown veggies due to the dangerously high levels of pollutants in our soil.



- **Smell:** Yep, that's right, the current onsite sewage treatment tank smells. On a good day with a following wind, we can sit happily on the balcony or make use of our garden. ON a still day - so essentially nearly the whole of summer and autumn, when it's hot and still.. good luck. The smell is outrageous.
- **Fire:** From October 2019 to March 2020, I didn't sleep through the night once. I was too panicked about getting our children to safety if the Gospers Mountain fire spread and we had an ember attack, or even a fire started on the island. Again, yes, we were aware of the increased fire risk when we moved to the island.. but at that point we didn't have super fires from seasons like that one, and also we did have a relatively decent water supply. With no access to reticulated water, therefore no hydrants.. our lovely RFS team literally cannot fight fires. The advice given to us was to leave, until the fire threat passed. A good plan.. other than the fact last fire season it would have meant we had to find a home, partially during Covid, for 4 months. Which isnt' really ideal now is it.
- **Mozzies.** Little blighters love it on the island - who can blame them really, with such lovely breeding grounds provided by the on site sewerage systems and ponding/release of water. With the detection of Ross River fever on the island, it's another unacceptable danger passed on by the lack of access to appropriate water and sewage.
- **Access:** Sydney Water interestingly own the piece of land directly behind our property. We are told the original intention was to put a giant water tank there and gravity feed water to the homes nearby, and potentially all of the island. Seems smart. However this hasn't happened, clearly, and we now have a situation where the council won't gazette the road on this land as it belongs to Sydney Water.. and Sydney Water won't upkeep the land, or put a tank on it. So, here we are with no water, and a track full of holes meaning in the event of floods or fires, our chances of getting out at all, but particularly without breaking a leg trying to get done the road,are pretty slim.
- **The elephant in the room.** The comparative community, Dangar Island, was given these things in 1971. So, we're not being precious little snowflakes asking for it in 2020, really are we?

Whilst we fully, and happily, accept that offshore living has its differences and downsides when compared to the comparative convenience of the mainland, we don't think that access to safe water should be one of these. We're not looking for a bridge to the mainland. Champagne on tap. Roads like ribbons. We're simply making what seems to be a pretty reasonable request to have access to safe, accessible water and sewage systems.

Dear Mr Stokes and Northern Beaches Council Members,

We have been residents on Scotland Island for 22 years. During that time, we have endured constant smell from sewage, not only ours, but from all around the island. It is disgusting.

We would like to swim in the ocean, but after hearing of studies done several years ago now, we began to wonder if we were in danger of illness When we swim, if we swim, we make sure to not put our heads in the water. More than one study has been carried out on the quality of the soil and water around the island. After rain, evidence can be seen of the runoff as the water turns brown. Now yet another study is being done. How many more studies will it take for our state government to wake up and realise that we are living in substandard conditions where adults as well as children are getting sick because of the contamination of the soil from years of sewage leaking into the soil. It doesn't matter how up to date one's system is, with so many people living on the island, this problem, which we have been living with for 22 years is not going away; it is only getting worse.

We don't drink the water from our tank anymore, even though it is a new tank, because we never know how clean it really is. Leaves in the gutter as well as bird droppings can leech into the water.

Filling our tank can take up to 10-12 hours because the pressure is so low. But we are still expected to pay the same council rates as everyone else who has town water and sewage. This disadvantage is added to the parking fees we need to pay yearly that people on the mainland get to do for free.

It is time to bring the offshore community into the 21st century and allow us to live a modern life. The island ecology is suffering and the native canopy struggles to survive.

We are only asking to be able to live free of potential disease and illness in what looks like a pristine environment but is far from it thanks to people who allow surveys, but fail to act.

Thank you for your serious consideration in the this matter.

The Hon Melinda Pavey MP – Minister for Water

By email oxley@parliament.nsw.gov.au

Dear Minister

I am writing to you with a plea that something be done to improve the water and sewerage infrastructure on Scotland Island which currently is akin to living in a third world environment of no permanent water and no sewerage.

Northern Beaches Council has recently completed a study that makes compelling reading as to why we should have such basic services.

I have been a resident of Scotland island for 17 years and I therefore have seen first hand the affects of the unsewered water discharge on local trees and waterways. During this time and particularly after rain you can see the detergents used by household mixed with effluent turn the water brown around the island.

le have also witnessed native gum trees die on our property. Our arborist advice is the increasing numbers of gum trees that are dying is from the distress of the sewerage seeping through the soils.

We also have a disturbing health risk you might not be aware of. The island now has a large concentration of mozquitoes due to the effluent discharge and we know of people now struck down with Ross River fever. The mozquitoes are the spreaders of this invasive and deliberating disease and if we could have sewerage managed better we would not have this infestation of mosquitoes. This is very urgent consideration as Ross River fever has only more recently been known to exist on the island.

What is particular concerning is the fire risk, given we live in a high fire zone its very disconcerting that there is no permanent water supply for fire hydrants to fight any fire. I think this is an essential requirement for any high risk fire zone.

I support the principal that the user should pay and as the Council report has suggested the cost should be reasonable given residents want this service.

Sydney Water has in the past identified the infrastructure requirement in forward planning but alas they have not taken action despite every indication they would be.

Yours sincerely

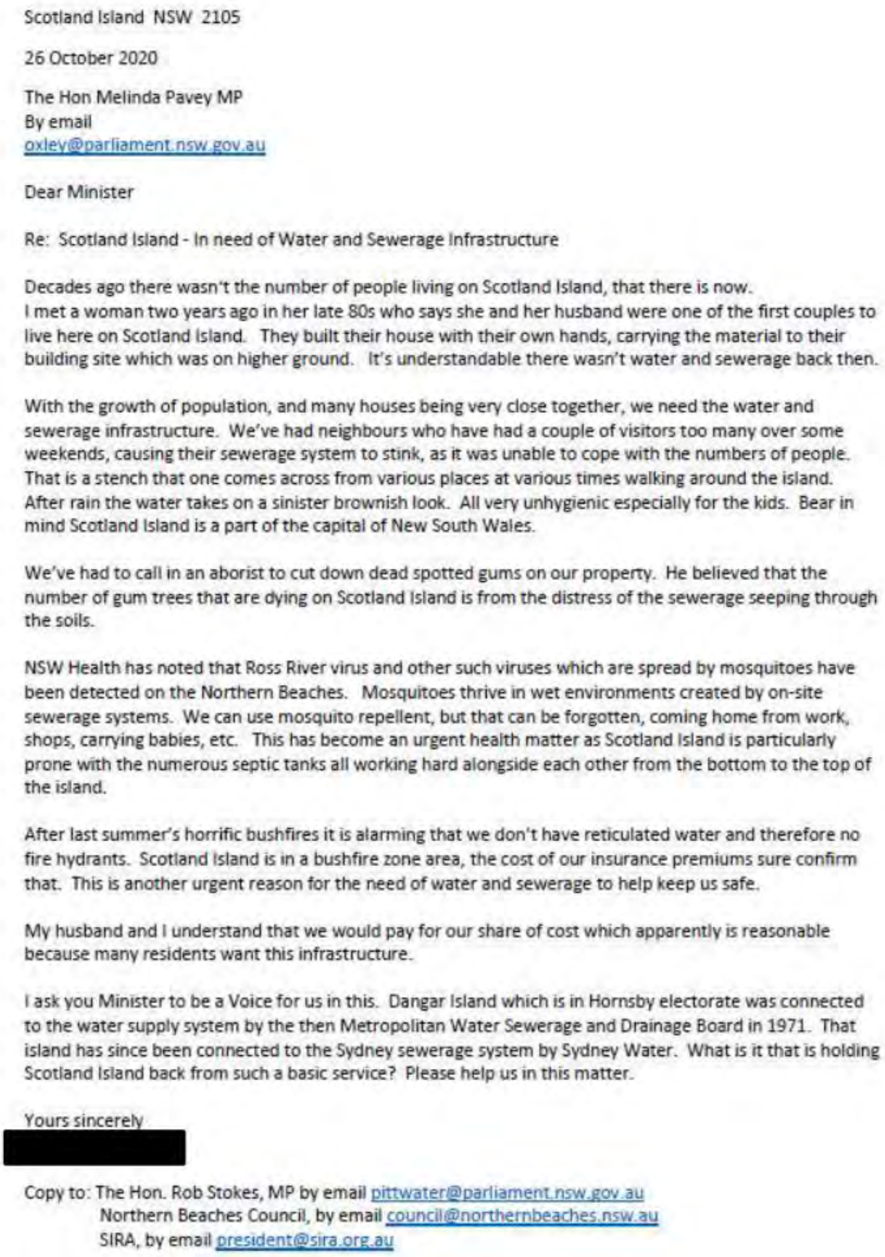
[redacted]

Copy to

The Hon. Rob Stokes, MP by email pittwater@parliament.nsw.gov.au

Northern Beaches Council, by email council@northernbeaches.nsw.gov.au

SIRA, by email president@sira.org.au



Scotland Island NSW 2105

26 October 2020

The Hon Melinda Pavey MP
By email
oxley@parliament.nsw.gov.au

Dear Minister

Re: Scotland Island - In need of Water and Sewerage Infrastructure

Decades ago there wasn't the number of people living on Scotland Island, that there is now.
I met a woman two years ago in her late 80s who says she and her husband were one of the first couples to live here on Scotland Island. They built their house with their own hands, carrying the material to their building site which was on higher ground. It's understandable there wasn't water and sewerage back then.

With the growth of population, and many houses being very close together, we need the water and sewerage infrastructure. We've had neighbours who have had a couple of visitors too many over some weekends, causing their sewerage system to stink, as it was unable to cope with the numbers of people. That is a stench that one comes across from various places at various times walking around the island. After rain the water takes on a sinister brownish look. All very unhygienic especially for the kids. Bear in mind Scotland Island is a part of the capital of New South Wales.

We've had to call in an aborist to cut down dead spotted gums on our property. He believed that the number of gum trees that are dying on Scotland Island is from the distress of the sewerage seeping through the soils.

NSW Health has noted that Ross River virus and other such viruses which are spread by mosquitoes have been detected on the Northern Beaches. Mosquitoes thrive in wet environments created by on-site sewerage systems. We can use mosquito repellent, but that can be forgotten, coming home from work, shops, carrying babies, etc. This has become an urgent health matter as Scotland Island is particularly prone with the numerous septic tanks all working hard alongside each other from the bottom to the top of the island.

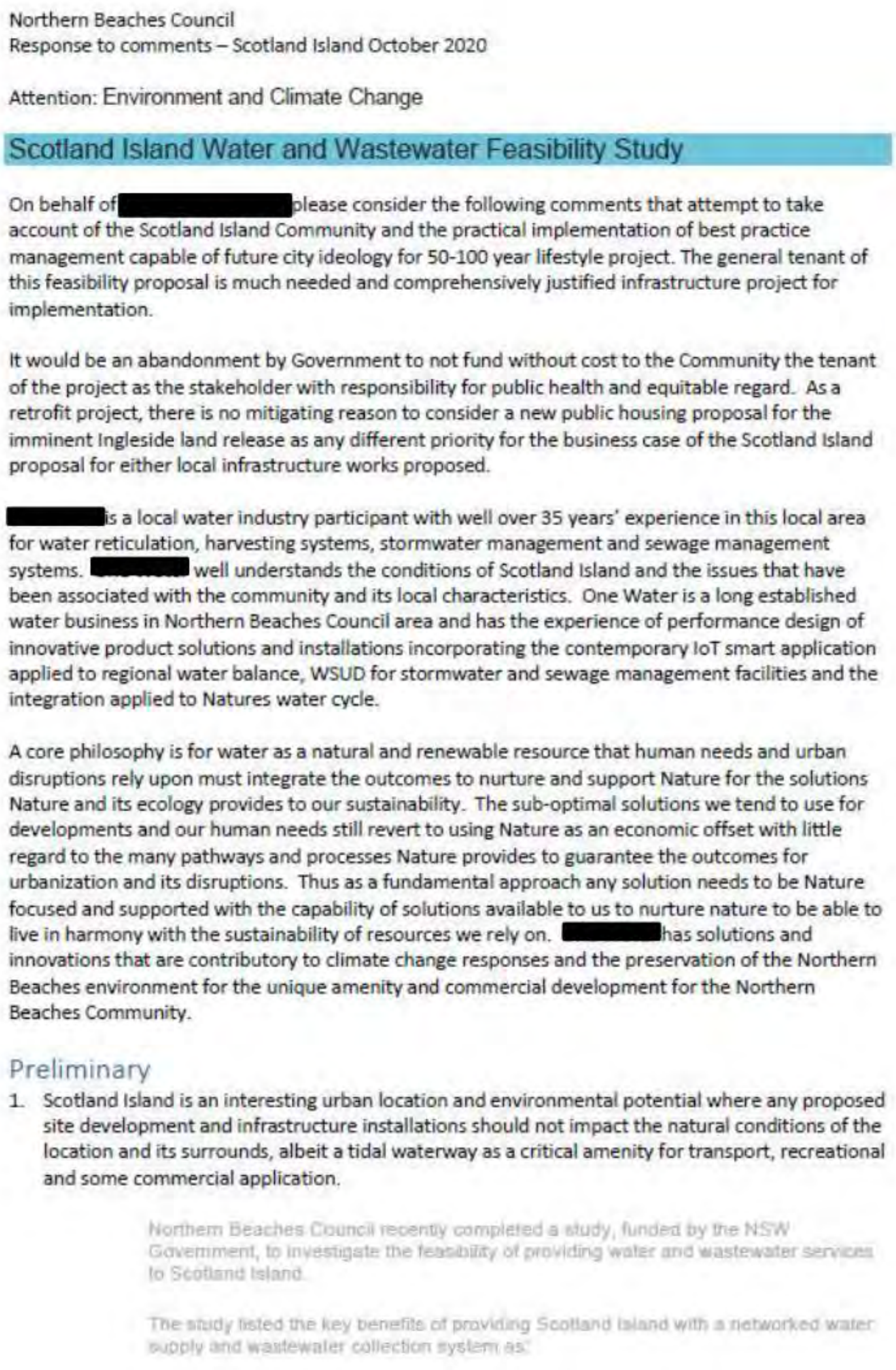
After last summer's horrific bushfires it is alarming that we don't have reticulated water and therefore no fire hydrants. Scotland Island is in a bushfire zone area, the cost of our insurance premiums sure confirm that. This is another urgent reason for the need of water and sewerage to help keep us safe.

My husband and I understand that we would pay for our share of cost which apparently is reasonable because many residents want this infrastructure.

I ask you Minister to be a Voice for us in this. Dangar Island which is in Hornsby electorate was connected to the water supply system by the then Metropolitan Water Sewerage and Drainage Board in 1971. That island has since been connected to the Sydney sewerage system by Sydney Water. What is it that is holding Scotland Island back from such a basic service? Please help us in this matter.

Yours sincerely
[redacted]

Copy to: The Hon. Rob Stokes, MP by email pittwater@parliament.nsw.gov.au
Northern Beaches Council, by email council@northernbeaches.nsw.au
SIRA, by email president@sira.org.au



Northern Beaches Council
Response to comments – Scotland Island October 2020

Attention: Environment and Climate Change

Scotland Island Water and Wastewater Feasibility Study

On behalf of [redacted] please consider the following comments that attempt to take account of the Scotland Island Community and the practical implementation of best practice management capable of future city ideology for 50-100 year lifestyle project. The general tenant of this feasibility proposal is much needed and comprehensively justified infrastructure project for implementation.

It would be an abandonment by Government to not fund without cost to the Community the tenant of the project as the stakeholder with responsibility for public health and equitable regard. As a retrofit project, there is no mitigating reason to consider a new public housing proposal for the imminent Ingleside land release as any different priority for the business case of the Scotland Island proposal for either local infrastructure works proposed.

[redacted] is a local water industry participant with well over 35 years' experience in this local area for water reticulation, harvesting systems, stormwater management and sewage management systems. [redacted] well understands the conditions of Scotland Island and the issues that have been associated with the community and its local characteristics. One Water is a long established water business in Northern Beaches Council area and has the experience of performance design of innovative product solutions and installations incorporating the contemporary IoT smart application applied to regional water balance, WSUD for stormwater and sewage management facilities and the integration applied to Natures water cycle.

A core philosophy is for water as a natural and renewable resource that human needs and urban disruptions rely upon must integrate the outcomes to nurture and support Nature for the solutions Nature and its ecology provides to our sustainability. The sub-optimal solutions we tend to use for developments and our human needs still revert to using Nature as an economic offset with little regard to the many pathways and processes Nature provides to guarantee the outcomes for urbanization and its disruptions. Thus as a fundamental approach any solution needs to be Nature focused and supported with the capability of solutions available to us to nurture nature to be able to live in harmony with the sustainability of resources we rely on. [redacted] has solutions and innovations that are contributory to climate change responses and the preservation of the Northern Beaches environment for the unique amenity and commercial development for the Northern Beaches Community.

Preliminary

1. Scotland Island is an interesting urban location and environmental potential where any proposed site development and infrastructure installations should not impact the natural conditions of the location and its surrounds, albeit a tidal waterway as a critical amenity for transport, recreational and some commercial application.

> Northern Beaches Council recently completed a study, funded by the NSW Government, to investigate the feasibility of providing water and wastewater services to Scotland Island.
>
> The study listed the key benefits of providing Scotland Island with a networked water supply and wastewater collection system as:

- addressing a long-standing community need for the services, which have been provided to similar communities in the past, and at a cost that is comparable to similar schemes
- improving the quality of water and wastewater service for island residents
- significantly improving the local environment, both on and off the island
- reducing public health risks
- upgrading currently non-compliant system.

The Case for Investment Report recommends that the state government fund and operate the networked water supply and pressure sewerage system.

Property owners would (at a minimum) need to pay to connect to these new systems.

2. Scotland island properties are under development controlled of NBC LEP where water and sewage services are in the operating and development licence of Sydney Water. This report appears to create a conflict as to the real stakeholders that are not fully identified in this report, where the authority lies for any approval or infrastructure development and what rights the Scotland Island community have in relation to compulsory development and cost of this proposal. The concept of water services upgrade is welcome and long overdue as it affects the wider local community and the environment just as the contamination issues of septic sewage and other sewage management facilities (SMF) were an environmental and commercial disaster at the time of the introduction of new SMF legislation of 1995 with AS/NZS 1546: part 3 as solutions accredited by NSW Health.

3. The writer applied to NBC for community engagement at the commencement when advertised by NBC but no response was received. Contact was made with the report authors and no response was further engaged in. However at the present stage of this considerations and for limited 'have your say' available, these submissions only have time to basically address the Report 1B. [redacted] would welcome further input as the feasibility progresses as expected.

4. The pathway subject of this feasibility is concerning, limited and somewhat archaic at its highest credit for a major infrastructure project with an expected 50-100 year life cycle as a public health and environmental impact responsibility.

4.1.1 2019 Feasibility study

To identify a pathway for provision of acceptable water supply and sewerage services on Scotland Island, the State Government's Stronger Communities Fund has funded a feasibility study. This report is Stage 1b of a three-stage process:

- Stage 1a - Identification of environmental and social factors associated with water infrastructure servicing (Completed March 2019);
- Stage 1b - review of previous reports and identification of servicing options, shortlisting two in each category, and
- Stage 2 is the commercial assessment and identification of the pathway to delivering services on Scotland Island.

The objective of this Stage 1b report is to identify and assess options for water and sewerage servicing of Scotland Island, and shortlist two options for the next stage of the project which is the commercial viability assessment. This report supplements the Environmental and Social report that was developed and submitted to Council in March 2019.

5. This consultant report appears to have already determined the pathway for implementation that for one misses a unique opportunity to provide innovation in solutions for critical water sustainability in future city type development and to also recognise the existing regulatory framework for new water developments, controls and impacts that others are obliged to act in compliance.

6. The formulation of solutions should also consider any Basix provisions typically required for construction approvals. Understandably this study is public works however any such proposal would be subject to certain controls that have not been raised as far as can be seen!

    6.1. Basix provisions would be a very useful tool for water conservation purposes as a foundation to this community level proposal.

        6.1.1. *Existing Water Infrastructure Systems*
        This current arrangement carries risk to public health. The water supply is non-potable, provided to residents without monitoring and used after being stored within rainwater tanks. As a result, there is potentially low to zero levels of disinfection.

    6.2. The apparent non-potable supply comes from an existing overlayed supply from Church Point that only lacks backflow protections at the property boundary albeit in an unregulated supply pipeline.

    6.3. There is no known public health outbreak that is evident, whether that is because of on-site treatment processes by occupants like boiling water where rainwater tank collection is an important, regulated and effective water sources under the regulation of NSW Health, so should not be poorly regarded that otherwise would have approved air gap for backflow protection for any tank top-up as described, rendering these comments as questionable.

        6.3.1. Evidence of overflow of septic systems was observed during the site inspection and audit conducted as part of this investigation.

    6.4. This generalist comment has not been substantiated in the report beyond its remark that is less than appropriate. If the extent of this coverall claim has militating impact for the purpose of such a study, it would otherwise indicate a failure of regulatory oversight and/or maintenance for serviceability of any SMF for such site(s) as a major condition that has not be shown, not otherwise raised in any detail if at all in attached environmental reporting and is without qualification. The report appears as inadequate to address the community concerns as a foundation of the study.

7. The project proposal is largely a function of streamlining solutions to bring current systems up to a necessary public health, environmental and sustainable standard that appears challenging due to the nature of Scotland Island and the amenity it provides to largely sophisticated inhabitants loosely described as an off-grid type Community. Any investment for public infrastructure essentials would normally be undertaken by public service provisions given the delays and intransigence of Government instrumentalities to commit to essential services, thus the cost proposals for households is questionable. Any such relevant cost can be better planned than the demonstration of this report otherwise using tier 1 contractors but is eminently achievable with supported local businesses involved in delivering this project proposal to build an industry cluster of knowledge and practical skills that should apply in the planning.

8. For the design of an integrated water distribution and wastewater discharge of a site, any design must take account of scarce resources, delivery constraints, alternate water sources and cost. This report would be advanced with appropriate consideration of all the issues and variables to formulate and justify the premise of such a report and its feasibility.

Water Balance

From the Water Balance analysis, the following design criteria has been used to establish the scheme's inputs which in turn helped to establish the options for assessment.

Table 1-1 Preliminary water balance assessment for Scotland Island

Item	Criteria
Number of Lots	377
Ultimate Holiday Population	1,413 EP
TOTAL Water	75 kL/person per year OR 226 kL/home/y Estimated maximum flow rate 30 L/s
Peak Sewage Daily Total	300 kL/day

 # It is noted that the Peak Sewage Daily wastewater flow total(s) of the cost estimation at Option B.9 for an STP of 150 kL/day of treatment is only half this demand requirement as a misrepresentation to the estimates provided!

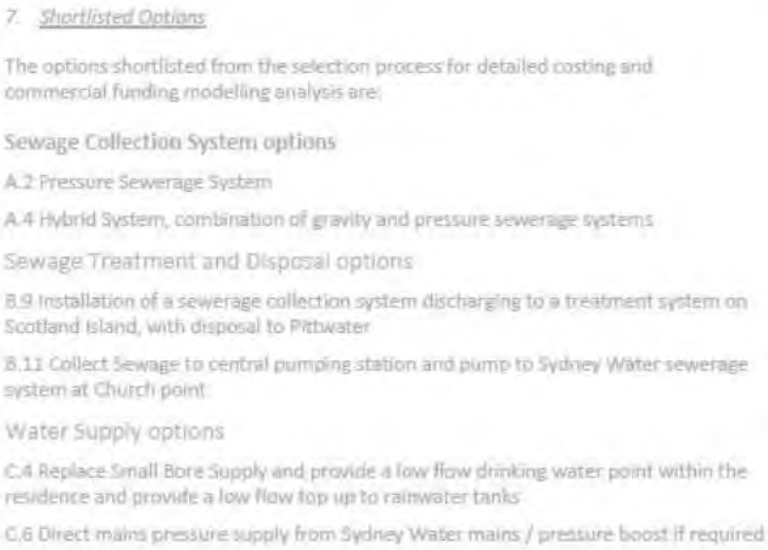
 # It is also noted that the TOTAL (waste)Water Daily wastewater flow rate of Table 1.1 is 35 L/s averaged across the whole days that would distort the design criteria of peak flows and the average across the daily spectrum as performance of the system estimates of the indicative designs proposed!

 # it is questioned that these estimates are reflective of a proper quantitative design model for the system proposed especially any deviation from accepted per person usage (whether for water inflows or water outflows) for the purpose of water balance for Scotland Island.

5.1. These figures appear to be based on an average household of 3 EP units up to 3.75 EP units from holiday populations that is otherwise a design specification criterion by Sydney Water. A more appropriate estimation would be some realistic foundation for this proposal!

The Report

6. The depth of analysis is claimed to have been undertaken by a multi-disciplined team and peer reviewed which renders this feasibility report as somewhat surprising in its basic analysis as reported. The cut and paste approach using other recent studies is not a reliable foundation for a different project and needs a more detailed analysis and review to reliably consider the implications of the feasibility. The feasibility undertake leaves no alternative than to address the options as listed.



7. *Shortlisted Options*

The options shortlisted from the selection process for detailed costing and commercial funding modelling analysis are:

Sewage Collection System options

A.2 Pressure Sewerage System

A.4 Hybrid System, combination of gravity and pressure sewerage systems

Sewage Treatment and Disposal options

B.9 Installation of a sewerage collection system discharging to a treatment system on Scotland Island, with disposal to Pittwater

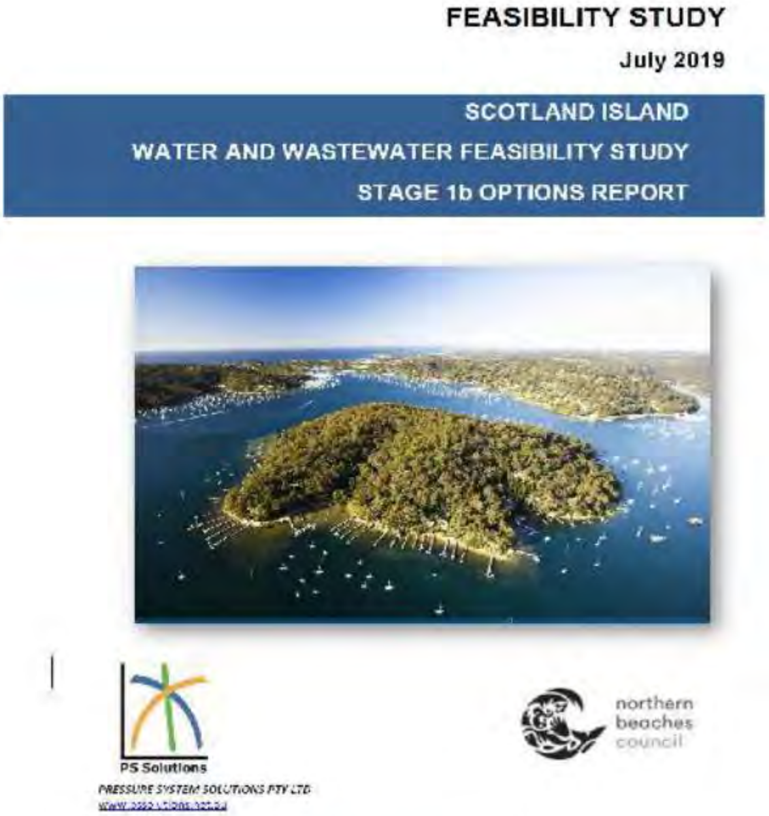
B.11 Collect Sewage to central pumping station and pump to Sydney Water sewerage system at Church point

Water Supply options

C.4 Replace Small Bore Supply and provide a low flow drinking water point within the residence and provide a low flow top up to rainwater tanks

C.6 Direct mains pressure supply from Sydney Water mains / pressure boost if required

8. These options appear as standalone approaches that do not reflect the objectives of advanced water management systems essentially needed for sustainability and future city design concepts that should be provided for such long-term infrastructure for a contemporary and well-integrated solution that is available and economically viable with a more thorough report for options that are commercially recognised.



FEASIBILITY STUDY
July 2019

SCOTLAND ISLAND
WATER AND WASTEWATER FEASIBILITY STUDY
STAGE 1b OPTIONS REPORT

PS Solutions
PRESSURE SYSTEM SOLUTIONS PTY LTD

northern beaches council

Figure 1 - Feasibility Report proposing a range of Options for consideration.

9. The remaining lists are however the shortlisted options for consideration of cost modelling analysis that these remarks will address!
    9.1. Option A.2 is a commencement point where pressure sewage system is more than likely the preferred option in all contexts.

POINT RISK AND THREATS

9.1.1. *This report in my view does not sufficiently take into account the whole of the water balance given a proposal for additional potable water reticulation and the taken-for-granted wastewater and other site discharges considered as a holistic solution for the expenditure proposed.*

9.1.2. *How can the wastewater resource typically taken as discharges be accounted for economically aside from a basic consideration like dumping to Sydney Water existing sewer main at Church Point?*

That dumping is a cost and is expensive processing if capacity is considered on the basis of as an exclamation of capability of Sydney Water sewer infrastructure – that has not taken account of the impending parallel demand from the Ingleside land release for 6,000 new housing developments compared to 377 development on Scotland Island !.

Although Warriewood STP is only to level 2 treatment for ocean disposal, this lassie-faire approach is unsatisfactory premise for the feasibility and may be untenable to the wider local community where compelling innovations should be considered in this unique opportunity to make Scotland Island a feature best practice for water sustainability and infrastructure to support climate change responses that can be achieved within these cost estimates.

9.2. Option B.9 for discharge to Pittwater waterway as blackwater or leachate type wastewater regardless of treatment that would be expected to be at the lower scale of investment and operational cost applied by Sydney Water if at all, given a discernible current management philosophy to rail against expanded services {seen in iPart hearings in November, 2019} even like in Western Sydney Metropolis developments is concerning if not beyond neglect for any authoritive input.

Sydney Water has outsourced its planning responsibility for the next 10 years thus any contribution by Sydney Water should be reduced to temporary unavoidable facilitation only as the current licence holder for water supply and wastewater services. This new management direction of Sydney Water has set back essential and integrated water infrastructure in the Greater Sydney Region that can be seen as disingenuous and grab for revenues led by foreign management ideology that is unsuited to a developing global city, environmental regard and economic development that in comparison Scotland island is a feature region as an excellent opportunity for world best practice and economic growth opportunity.

Sydney Water has rendered itself as no more than a gatekeeper for regulation and revenues from water services although it holds the legislated responsibility and unassailable monopoly for provision of such services that requires a work-around to avoid arbitrary impedance of this project!

POINT RISK AND THREATS – FEASIBILITY REPORT STAKEHOLDER REVIEW

9.2.1. The proposal for a dedicated full-process STP on-island is expected to be advantageous in avoiding mechanical means for site disposals of all sewer but is impractical for the finite scale of the Island.

> *5.8.5 Technical Risk*
>
> *The Collection system would be required to transport septic effluent to a sewage pumping station, for pumping across Pittwater to the mainland.*
>
> *Technical complexities would arise with the various property connection configurations and arrangements required to collect effluent from existing septic tanks.*
>
> *The under bore required across Pittwater, also has complexities associated with this option, such as:*

- *Pumping (septic, treated) effluent across Pittwater for discharge into suitable location within the Sydney Water network;*
- *Effluent pumps required at each property (same principle as pressure sewer system, but different type of pumps).*

Evaluation team deemed: *Technically negative impact / high risk option,*[1]

9.2.2. 5.9 Installation of a Sewerage Collection System Discharging to a Treatment System on the Island, with Disposal to Pittwater[2]

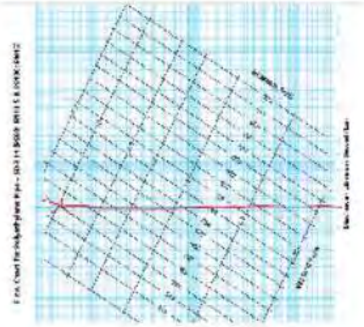
5.9.1 Description of an option as B.9 for installation of a new sewerage collection system, discharging to a treatment facility located on Scotland Island, with treated effluent disposal into Pittwater. Decommissioning/removal of on- site septic systems. Assumption: Pressure sewerage system was evaluated as the collection system for this option.

5.11 Collect Sewage and Pump to Sydney Water sewerage system

5.11.1 Description of Option Installation of a new sewerage collection system, with pumped flow via an under bore across Pittwater, discharging into Sydney Water's sewerage system. Decommissioning/removal of on-site septic systems.

9.2.3. *Another issues is the under tunneling to Church Point in a 140mm polyethylene pipe for discharge into Sydney Water existing gravitational mains creates pipeline dip issues that would need to have a clearing mechanism and a break pressure point on the mainland that is not tenable.*

 # it is noted that the flow rate of a 140mm PE #100 PN 16 pipe is 30 L/Sec requiring 3 M/S velocity for every second of the day 360/24/7 has not met the design criteria and appears underspecified. The report indictive specification and costing appears unreliable.



9.2.4. *Direct discharge into existing sewage main at Church Point will only*

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[1] Stage 1b Option Evaluation Workshop Notes Issue F pp47(53)

[2] Ibid pp 48(54)

occur at higher pressure given the nature of the sizing and laying of a protected main across from the Island to Church Point. The technical specifications for gravity sewer mains is 2 litres per second that would be significantly exceeded. Thus Sydney Water sewage mains is of itself a questionable discharge point for multiple issues that do not need reciting here with the current design proposal.

9.2.5. *Even though this option is readily achievable on the physical development however any STP on the island is more than likely to the extent of highly unlikely, is not a valid option amazingly displayed in the 1B report cover page {see* Figure 1 - Feasibility Report proposing a range of Options for consideration.*}*

9.2.6. *This hybrid proposal for Scotland Island circumstances would likely be rejected on environmental and amenity grounds. It would be a lower order and expensive option. This Option would result in lowering property values and disruption of the nature of the Island, waterways pollution reliant on nature to overcome that would significantly damage recreational and tourism amenity that is the prime asset of Pittwater, thus would not be justifiable.*

9.3. New Option B.9.A as a proposal by One Water, should be considered in a different light. Taking the upstream issues for cost of treatment, delivery to the alternate proposed STP and environmental impact of secondary treatment before disposal to any waterways outfall into account (discharge at mouth of Pittwater or directional drilling under Bilgola to an ocean outfall), the same investment for a modern natural energy option is eminently viable and efficient option to undertake for the needed waste processing. The way in which Option B.9.A is engineered incorporated the below in varying degrees and configurations.

9.3.1. *The basic analysis of a Sewage Management Facility (SMF) is 'water in verses water out' (WiWo). Given the inclusion of a water supply requirement for a Scotland island cluster of residential servicing, a smarter analysis of WIWO should be considered.*

9.3.2. *An effluent processing STP on Scotland Island can provide an environmentally and community resource at a lower cost of treatment or carriage of waste options without environment impact.*

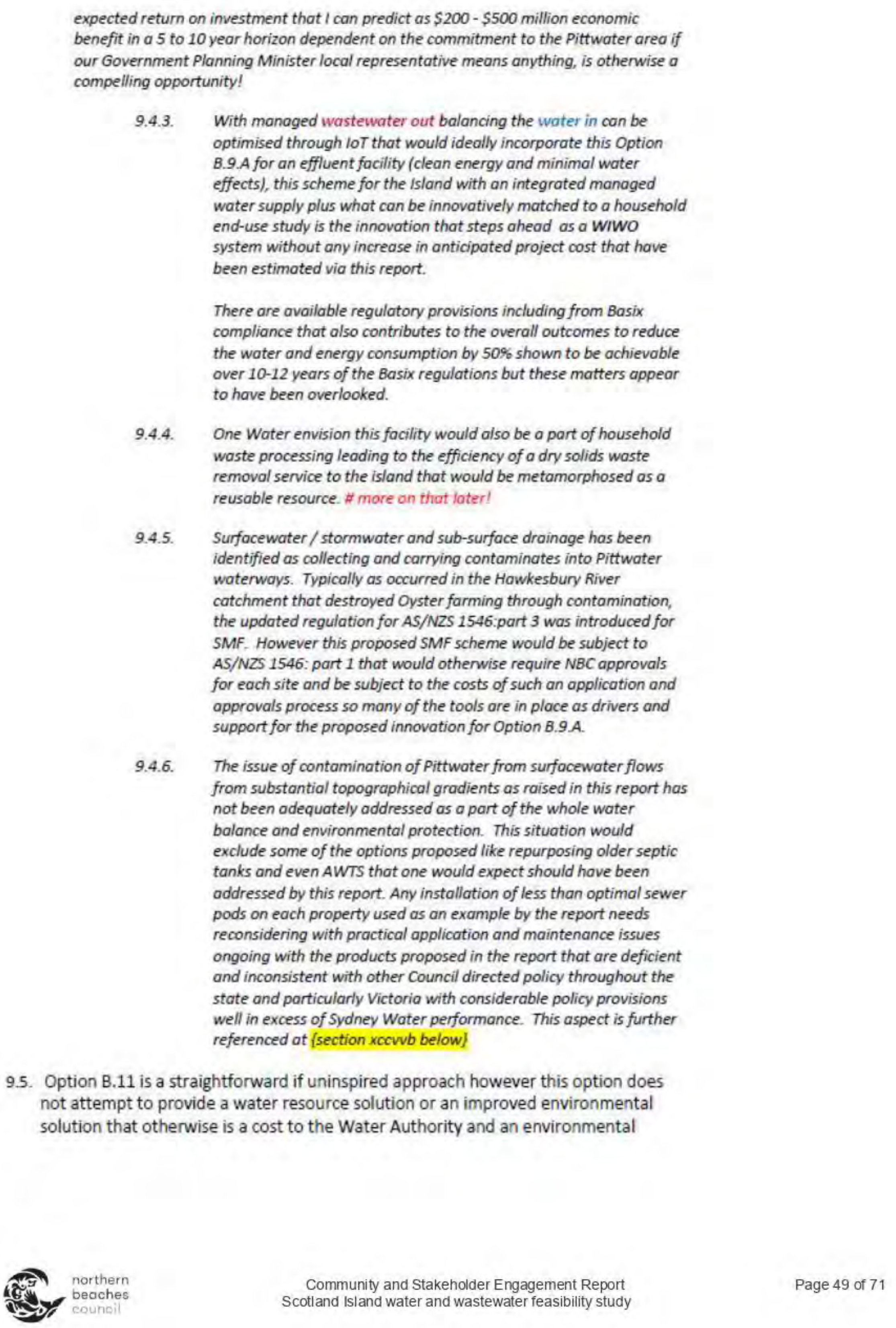
9.3.3. *Option B.9.A as a standalone effluent treatment processing as a* **decentralized system** *for a community facility of the size of the Island is eminently viable using clean energy resources and Natures biological processes for high grade healthy naturally processed water that can be discharged at the extremities of Pittwater. The Capex and Opex option of this proposal stands with considerable economic and environmental merit for the finite size of this Island project.*

9.4. [redacted] would see Scotland Island as a potential pilot for international acclaim as BPM for not only renewable /climate response in energy and water resources but incorporated waste reduction especially as dry waste recycling that can be transferred to and from the island safely and economically that adds value to the locality for economic development as well.

9.4.1. Stakeholders express concern that Scotland Island is not politically attractive especially to Sydney Water as the monopoly licence holder of questionable and divesting capability affecting the whole of Greater Sydney. Sydney Water bemoan increasing their client services with expansion relying on iPart to simply increase pricing as much as 50% with 60% dam level reserves to artificially sustain Sydney Water as a licensed water operator. This conduct when taking account of their waste, their exploiting public financial appropriation, their political dividends and in the circumstances where they have demonstrated they have made themselves irrelevant to the planning schemes like the Greater Sydney planning Commission (GSPC). The point of any reliance on Sydney Water is totally misguided where Sydney Water have little or no initiative for innovative schemes to reduce the cost of water and wastewater, have not provided for Sydney expansions and water resilience preferring to surround Sydney with their sewage plant discharges so that the whole of Greater Sydney is totally surrounded by an increasing polluted water and other deleterious environments. Until there is a step change in the operating conditions of the regulated monopoly licence holder other considerations and Government support is needed independently.

This irrefutable situation renders Sydney Water irrelevant such that stakeholders otherwise have a strong business case to independently develop the essential public health infrastructure for Scotland island and build economic activity for Pittwater and Northern Beaches as a part of the process of this infrastructure development.

9.4.2. The present proposal is however limited in outlook as low pressure sewage schemes are no longer so innovative where IoT autonomously managing these schemes is relevant and necessary for a 50-100 life-cycle project essential for such a proposal and is only estimated to be $69 million investment (typically the NSW Government attempts to off-sets that cost upon the Community that is an exploitative business case on their part). A proper business case in the current economic climate of low interest rate warrants this project progressing now and in line with the parallel investment for electricity supply upgraded to the Island currently underway. An essential service that renders an



expected return on investment that I can predict as $200 - $500 million economic benefit in a 5 to 10 year horizon dependent on the commitment to the Pittwater area if our Government Planning Minister local representative means anything, is otherwise a compelling opportunity!

9.4.3. *With managed wastewater out balancing the water in can be optimised through IoT that would ideally incorporate this Option B.9.A for an effluent facility (clean energy and minimal water effects), this scheme for the Island with an integrated managed water supply plus what can be innovatively matched to a household end-use study is the innovation that steps ahead as a* ***WIWO*** *system without any increase in anticipated project cost that have been estimated via this report.*

There are available regulatory provisions including from Basix compliance that also contributes to the overall outcomes to reduce the water and energy consumption by 50% shown to be achievable over 10-12 years of the Basix regulations but these matters appear to have been overlooked.

9.4.4. *One Water envision this facility would also be a part of household waste processing leading to the efficiency of a dry solids waste removal service to the island that would be metamorphosed as a reusable resource. # more on that later!*

9.4.5. *Surfacewater / stormwater and sub-surface drainage has been identified as collecting and carrying contaminates into Pittwater waterways. Typically as occurred in the Hawkesbury River catchment that destroyed Oyster farming through contamination, the updated regulation for AS/NZS 1546:part 3 was introduced for SMF. However this proposed SMF scheme would be subject to AS/NZS 1546: part 1 that would otherwise require NBC approvals for each site and be subject to the costs of such an application and approvals process so many of the tools are in place as drivers and support for the proposed innovation for Option B.9.A.*

9.4.6. *The issue of contamination of Pittwater from surfacewater flows from substantial topographical gradients as raised in this report has not been adequately addressed as a part of the whole water balance and environmental protection. This situation would exclude some of the options proposed like repurposing older septic tanks and even AWTS that one would expect should have been addressed by this report. Any installation of less than optimal sewer pods on each property used as an example by the report needs reconsidering with practical application and maintenance issues ongoing with the products proposed in the report that are deficient and inconsistent with other Council directed policy throughout the state and particularly Victoria with considerable policy provisions well in excess of Sydney Water performance. This aspect is further referenced at {section xccvvb below}*

9.5. Option B.11 is a straightforward if uninspired approach however this option does not attempt to provide a water resource solution or an improved environmental solution that otherwise is a cost to the Water Authority and an environmental impact beyond option B.9.

9.5.1. With the use of this option all wastewater is emulsified creating greater treatment processing at the Warriewood STP

9.5.2. Warriewood STP is also expected to have a significant increase in sewage loads from the imminent Ingleside land release for 6,000 houses predicted for approval before 2021 in conjunction with transport upgrades in bus services and Mona Vale Road upgrade for that land release purpose. Thus the casual reference to Sydney Water saying it has capacity in sewer mains and at Warriewood STP is questionable proposition.

9.6. Option C.4 would not advance the water supply facility that is a worthless cost option that would not last the life cycle requirements.

9.7. Option C.6 is the only intelligent distributed water supply option for a modern urban residential area whether to supplement a rainwater harvesting on-site installation. The Basix provisions would then allow conservation of the water resource using a rainwater tank and a change-over device commonly used in new housing construction that priorities rainwater harvesting and ensures a guaranteed water supply for a household when alternate water resources are not available.

10. The feasibility report option for top-up of rainwater tanks already installed on Scotland Island is inappropriate and without current knowledge of smart water resource systems that renders the authors knowledge questionable. This top-up system is inefficient, energy intensive and prone to addition public health risk that was abandoned by the water industry 6 months after the introduction of Basix legislation some 12 years ago. The introduction of change-over devices to improve to water resources supply was led by Onga Water Switch, Davey Rainbank and OneWater WiWo and another alternate pure mechanical changeover device that the report has failed to recognise. Indicative costing estimates given in Table 1-3 appear excessive.

10.1. Project costing estimate skews the cost without demonstrating what is involved or how value is derived from such high cost estimates. There are significant project management cost savings available as indicated below.

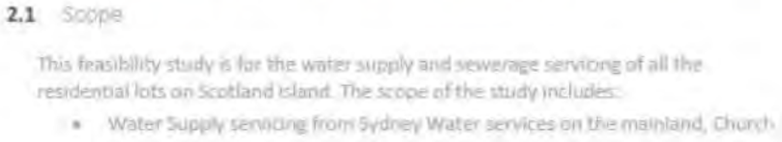
10.2. Whilst wastewater collection and delivery costs applicable to Option A.2 need to be examined more closely the value from Hybrid system is not of any value proposition. Wastewater treatment and disposal costs shown are widely variant that off-set costs for Option B.11 do not appear to have been properly contended. Option B.9 in a more efficient WIWO water balance and select innovative processing would be roughly be equivalent to the direct disposal from option B.11

Alternate Table 1-3

Project	Management edge and IoT cloud management with predictive maintenance and operational control.	50% reduction to estimate

Water	C.6 reticulated system	25% reduction t estimate
Wastewater collection and delivery	A.2 Low pressure System for SMF	50% reduction to estimate
Wastewater treatment and disposal	B.9 On-island effluent treatment facility 80% reduction of discharge to Sydney Water land / submerged gravitational transport to local STP	25% reduction to estimate
Total cost systems combined		$10,000,000 $ 12,500,000 $14,250,000 $28,250,000 $65,000,000
Total cost per lot (377)	Minimum 30% cost reduction per lot below estimate	$172,400
Smart Water Balance system value improvement	Water conservation 50% reduction Energy conservation 25% reduction Project management and operational cost with smart monitoring for sentinel oversight and supervision high level control with IoT cloud plus edge meshed IoT systems for autonomous operation	+ 25% economic value improvement + 25% resource demand improvement + 25% environmental impact reductions

10.3. The Scope of the feasibility study has displayed mixed and narrow option justifications. Local conditions and externalities do not appear to have been mentioned in this report such that the scope outline appears limited in innovation and contemporary water balance capability for engineering and emerging solutions.



2.1 Scope

This feasibility study is for the water supply and sewerage servicing of all the residential lots on Scotland Island. The scope of the study includes:

- Water Supply servicing from Sydney Water services on the mainland, Church

Point

- Decentralised Sewage solutions
- Innovative solutions treatment and reuse and hybrid systems
- Centralised treatment and disposal system
- Pumped discharge to Sydney Water Sewerage System on the mainland

Key Areas

- Safety
- Environment
- Community / Key Stakeholder engagement
- Engineering / Technical
- Commercial / Legal / Financial
- Delivery / Operating Models

10.4. Any available Church Point water and sewage services is an unqualified option used by the report to base such a premise upon, especially without a deeper analysis of local conditions.

10.4.1. Church Point and Bayview Heights struggle for water supply in heatwave conditions and bushfires as seen in 1994 where this whole area was under intense fire conditions and without mains water supplies being accessible.

The water supply conditions have seen a reduction in water mains guaranteed pressure supply due to the extremity of the supply lines to that location and general pressure reductions by Sydney Water.

10.4.1.1. There is also an issue in the locality of mains bursts from the nature of the infrastructure and the conditions in occupies. Although some lateral branch line improvements have occurred there is still a reduced supply to the Church Point area. No doubt the Option C.4 is directed to that circumstance without identifying its purpose relevant to its inclusion.

10.4.1.2. Attachment E of the feasibility report details a discharge rate that significantly exceeds Sydney Water inflow to sewer main provisions, that would otherwise compromise the existing sewage main and potentially cause surcharges that needs further investigation and approval. This issue contributes to the notion of an on-island effluent treatment facility as a system wide improvement.

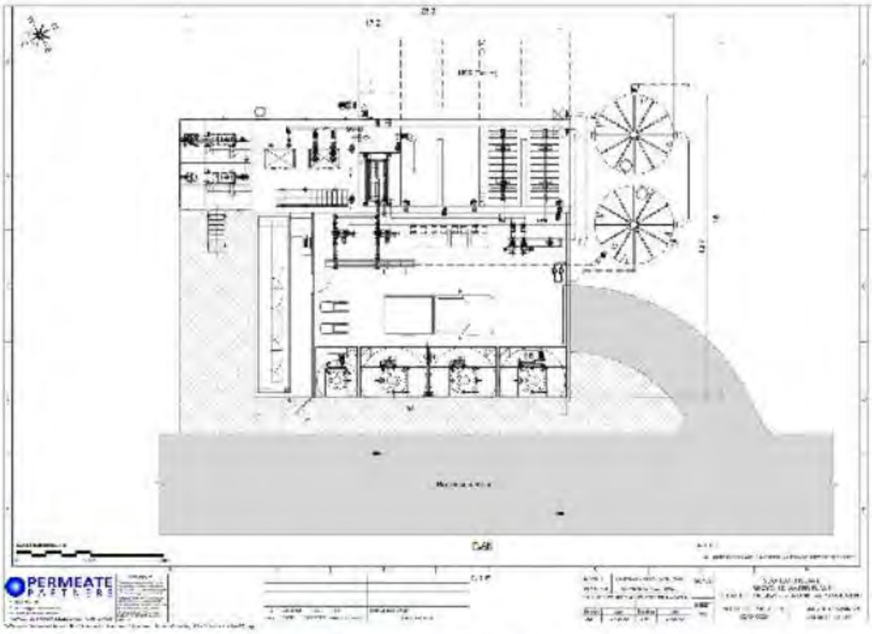


Figure 2 - an unacceptable and high cost proposal that is no more than half the estimated capacity of 300kL per day deemed as a minimum requirement in this proposal

10.4.2. The existing sewage gravitational main network is below the tidal level for the area and is subject to regular pump station to raise the wastewater elevating to the next gravity segment all the way back to Warriewood STP. Warriewood STP treatment is a limited secondary class treatment relying on waste discharge to an ocean outfall that contributes to Sydney Water waste discharge circling the Greater Sydney region through the Hawkesbury and Nepean River, Berowra Creek and others discharge system from other inland STP facilities. Thus an on-island effluent treatment facility would be a significant reduction in volumes and reductions to contaminate issues that must avoid impeding local waterway ecology and reach the recreational conditions that must be undertaken to reduce the overall level of Sydney Water waste convenience.

10.4.3. An on-island effluent treatment facility (ETF) would provide high quality from wastewater as a substantial environmental improvement to Warriewood STP discharges with the Scotland Island EFT high grade water quality discharged to its dedicated small pipe DN200 to a suitable determined ocean outfall largely using a gravitational discharge. The options for an Ocean outfall of non-potable standard would be acceptable with potential outfalls located at either of:

- To the east of Lion Island (would be preferred for cost and environmental reductions)

- A directional drilled discharge line under Avalon Golf Course to Bilgola Headland ocean discharge

These ocean outlets are preferable with high grade treated water devoid of nitrogen and phosphorous would be acceptable with minimum impact on the environment or recreational issues given the low cost of directional drilling.

10.4.3.1. This Option B.9 proposed fully treatment STP plant and its larger infrastructure requirements would be considered as inappropriate and in a poor proposed location. It would be considered as unnecessary and excessive to the requirements of an effluent plant using transpiration and vegetation uptake of nutrient and other contaminate reduction measures without operating costs or excessive environmental impact largely created by the area of land usage that also has the design advantage of landscaped buffering and concealment in a highly vegetated Scotland Island.

The naturally processed effluent treatment option B.9.A overcomes the deleterious provisions of a full STP where such a plant would otherwise demand a high energy requirement and a high chemical storage and usage that is unacceptable and high risk on the environment. A substantial infrastructure impact on the island would also be an unavoidable impact and cost that would otherwise be out of scale for the island and transform its character unwarrantedly

The question of ongoing cost and maintenance is significant and there also remains a high concentration sludge waste component still requiring disposal otherwise proposed to be emptied into Pittwater as an unacceptable proposal.

10.4.3.2. A naturally aspirating and low-impact treatment process would be an industry leading advancement and only represent 35% of the Opex and Capex cost of the ETP off-set development.

Figure 3 - Ocean Outfall facility for secondary treatment processing – Surfrider Foundation

10.4.3.3. Any residue solids waste would be preferentially removed from the Island to a dry waste or recycling facility for soils or fertilizer use to make better use of that resource as conducted at North Head STP and others in the Sydney region. These processes are highly achievable and desirable for environmental protects that is an alternative to dumping such waste on nature in waterways that is untenable in today's outlook and climate change issues that must be addressed rather than taking the easy route for waste disposal that is not evidenced in this feasibility outlook. The residents and visitors as well as local community are quite green orientated and would accept these measures as progressive and acceptable in a long-term infrastructure implementation that would easily mitigate any inadvertent discharges of concern.

11. These matters are a part of the solution consideration that now requires a deeper regard to water balance for scarce water resources. The Scotland Island community is used to conservation measures and would welcome a modern technology to manage their water needs whilst at the same time provide resilience and sustainability in a green environmental setting.

The Way Ahead

12. A closer analysis of the current proposal for Option A.2: Pressure Sewerage *{see Draft Final Report, option assessment summary sheet pp 32}* is needed to balance the remarks for objective balance. The concept design developed for the assumptions given need to be reviewed and considerations expanded before any finalisation and progress to Stage 2.

12.1. The technology outline may be considered as staid and has a requirement for a more progressive solution and emphasis of the key components of such concept.

Technology

- Small diameter pipes are end of line dimensions that increase in line with dwelling waste capacity. Directional core drilling is the ideal method of pipe installation however the short run nature of Scotland Island service connections remains as somewhat costly installation.
- A booster pump station for cross Pittwater flows understates the lack of detail of the concept plan.

  # Cost minimization for the project calls for additional steps in innovation. Those steps are engineering and capacity design issues however the concept has an indicative cost estimate that is likely to be misrepresented as a reliable feasibility estimate in many categories highlighted, like for instance rock for every meter of pipe line installation as variation expense, duplication of expenses for an integrated wastewater collection and water reticulation installation expense, on property expenses that exceed relevant and worthwhile expenses for misguided solutions incorporating or decommissioning existing rain water tanks and septic / SMF resources and proposal for the lowest gradient locations for low pressure sewage pods especially around the foreshore.

Environmental Impact

- The remediation potential for decommissioned septic SMF is overlooked that may leave a legacy of environmental impacts for waterway leaching for many years that should be reconsidered.
- Stormwater management has not been taken into account for a proper water balance consideration. A stormwater management plan is essential given the contaminate issues of legacy SMF of septic and AWTS that have been operated for so many years. The potential for

addressed waterways contamination is just as critical for consideration and remediation as other aspects – appearing as solely directed to cost issues and neglecting the protection of the environment and nurturing Nature for the intricate part Nature plays in the total water cycle and such neglect or regard that is a route cause of climate change impact for the Scotland Island ecology and its fauna and flora.

#These matters are equally critical and must not be disregarded in a proper feasibility planning that has postured on detail of Options to the exclusion of a holistic report for the true feasibility for Scotland Island and its surrounding community and commercial considerations.

it is noted that the Water Authority for South East Melbourne undertook a replacement program for all existing septic and apparent AWTS systems of the order of 2,000-3,000 lots withing there area of responsibility for the very purpose of ground contamination issues for remediation.

- The highlighted advantage from any potential sewage leaching into the soils and ground water using an enclosed system like a low pressures sewage system is positive but there is no assurance that a concept design has been sufficient to ensure this risk is substantially or fully avoided. Mechanical breakdowns can result from installation failures, simple blockages, lack of maintenance, power interruptions and power conditioning etc.

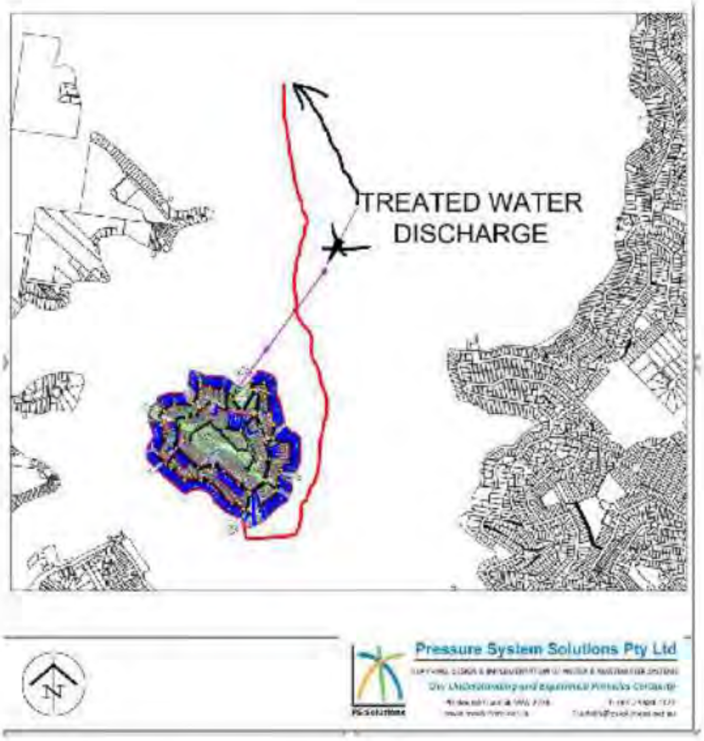
Stakeholder Acceptance

- Certainly a positive proposition for such a dual service project.
- SWC relies on tendered project for such infrastructure works usually at the lowest economic cost, thus the previous experience or likelihood of the contractor being anything other than a planned project that is not prescriptive but independently designed and delivered is not guaranteed to be applied in a new and more detailed scenario with dual services installations in an off-shore location as unique as Scotland Island.
- I reject the similarity applied to Danger Island as not relevant for topology, ground conditions and stage of technology advancement.

Technology Risk

- Such insidious claim(s) undermine the premise of a feasibility report based on the location. If this claim was relevant there would be no need for any expensive and limited feasibility report nor the significant unqualified costs proposed.
- Gravity sewer have a long history of performance and low risk operation when installed in accordance with a prescribed design and standards. Gravity sewers are functional, minimalist servicing costs and reliable long-life infrastructure. Installation costs are significant however with work practices for hands-free plant and procedures additional costs arise. However much the same circumstance occurs with directional drilling with cost savings resulting from non-disturbance and restoration costs to the extent of long run installations like crossing the divide across Pittwater. The Scotland Island costs of directional drillings may be only slightly beneficial where the service main has to be access for every property at some 40 meter iterations that gravity sewer installations avoid as additional costs.
- The reliance in low pressure sewer distributed networks on allied services for power, maintenance of mechanical equipment like pumps with a life expectancy of 5-10 years, sludge build-up, emulsifying all sewage requiring far more treatment than separation technology is a substantial additional hidden cost that cannot be excluded and dismissed in a proper indicative cost of operations feasibility study.

12.2. IoT is available and well programmed {*see attachment Pressure Sewer Description & Rules - Scotland Island*} to integrate with some market solutions beyond the current identification of proprietary product solutions used in this study of a mere mechanical nature.



12.3. There are a number of well setout policy guidelines including Goulburn Valley Water and others that have not been referenced in the feasibility report.

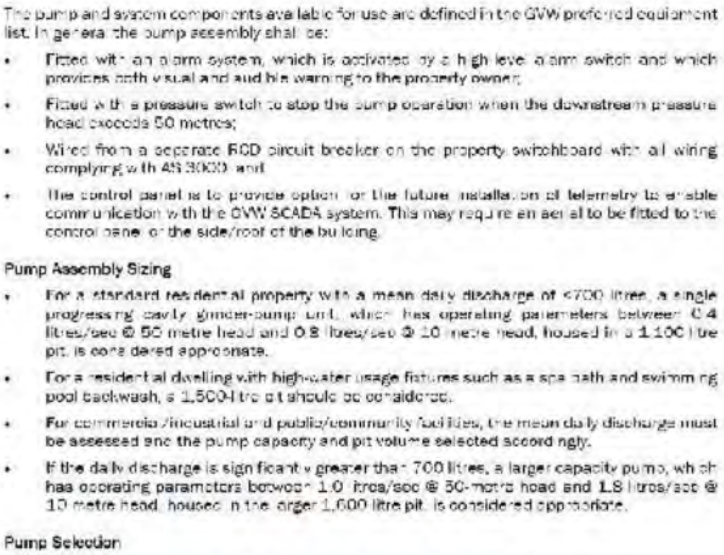
GOULBURN VALLEY WATER

UrbanUtilities

Guidelines for Pressure Sewer

Date: 29 November 2016

QUU Low Pressure Sewers – 2011



The pump and system components available for use are defined in the GVW preferred equipment list. In general the pump assembly shall be:

- Fitted with an alarm system, which is activated by a high level alarm switch and which provides both visual and audible warning to the property owner;
- Fitted with a pressure switch to stop the pump operation when the downstream pressure head exceeds 50 metres;
- Wired from a separate RCD circuit breaker on the property switchboard with all wiring complying with AS 3000 and
- The control panel is to provide option for the future installation of telemetry to enable communication with the GVW SCADA system. This may require an aerial to be fitted to the control panel or the side/roof of the building.

Pump Assembly Sizing

- For a standard residential property with a mean daily discharge of <700 litres, a single progressing cavity grinder-pump unit, which has operating parameters between 0.4 litres/sec @ 50 metre head and 0.8 litres/sec @ 10 metre head, housed in a 1,100 litre pit, is considered appropriate.
- For a residential dwelling with high-water usage fixtures such as a spa bath and swimming pool backwash, a 1,500-litre pit should be considered.
- For commercial/industrial and public/community facilities, the mean daily discharge must be assessed and the pump capacity and pit volume selected accordingly.
- If the daily discharge is significantly greater than 700 litres, a larger capacity pump, which has operating parameters between 1.0 litres/sec @ 50-metre head and 1.8 litres/sec @ 10 metre head, housed in the larger 1,600 litre pit, is considered appropriate.

Pump Selection

Figure 4- partial extract of GVW low pressure system specifications - typical

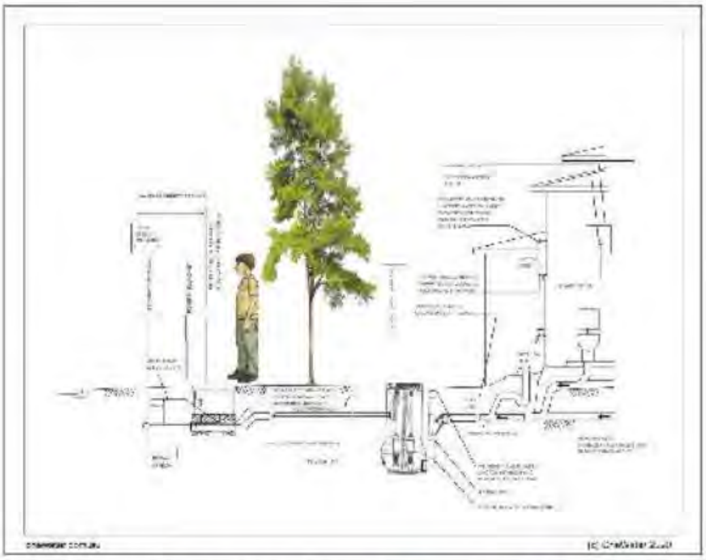


Figure 5 - illustration of alternate SMF with additional specification including for tank capacity, controls and IoT at a higher value solution similarly represented as layout from AS/NZS 3500.

12.4. The feasibility {*Attachment E – concept drawings*} concept displaying product solutions is questioned. There is no acknowledgement of commercial drawings that appear to be a preferred solution for each site installation otherwise claimed as typical. This highlighted design contradicts the well-established policy of other instrumentalities with well researched specifications and may only be represented for commercial interests aligned with limited supply option of any outlook by the authors in this specialist field of low-pressure systems. Given the limitations of the design for capacity, flows and operational performance with considerable risk issues the feasibility report appears without credibility for contemporary and innovative solutions beyond expedience otherwise claimed as typical that should be questioned.

Figure 7 - reference detail of low-pressure sewage system claimed as typical detail Page 2 Attachment E. The limited and pressured inflow capacity and issues with breakdown has to be considered for any typical application. A compromised reuse of existing septic tanks is also questionable, environmentally constrained and potentially expensive option

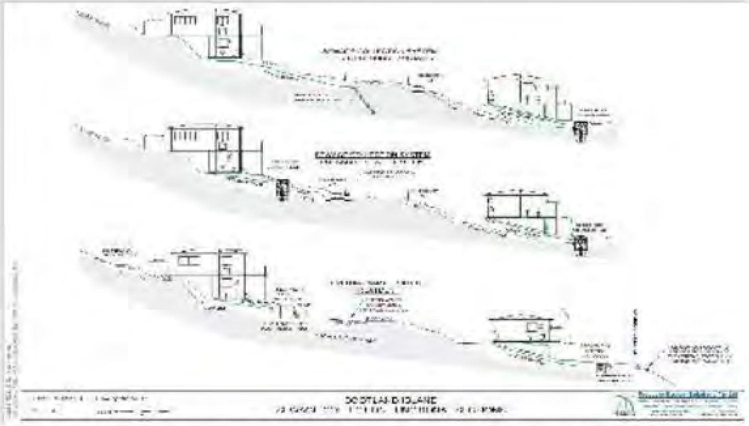


Figure 6 - application layout proposal - alternate collection well detail shown. The eOne system is a deep installation that may not be as serviceable for the Scotland Island sewer maintenance requirements!

13. Some application details are given in the report that presents a limited approach to the scope of the feasibility project

14. There remains nothing innovative about this feasibility and proposal contrary to the scope of the study. This study does not provide any compelling reasons for adoption in the current form, where it would be expected that available, technologically advanced and cost mitigating proposals could and should have been identified in the study for proper consideration.

15. Solutions are available and warranted however this proposal and its feasibility could not be considered to be in accord with the scope of the study and has not gone to outline those detrimental aspects briefly discussed here to allow the formation of the decision process and consideration of stakeholders.

16. [redacted] would propose that savings can be made using a shared sewer pod amongst the design concept briefly outlined that can be expanded for detail and operation in due collaborations. The IoT capability would facilitate a better management system to support the ETP of Option B.9.A where a dual pump feeds effluent to the ETP. This concept manages the solids waste for land reuse or disposal and safe transport by barge across Pittwater reducing the dependance on Warriewood STP, delivers useful recycling and avoids waste dumping into natural systems like waterways for solid and highly contaminated wastes as some innovation to a climate change response with smarter system design and advantages being sought by the community of NSW and NBC. A maintenance benefit and cost benefit results with a well-developed integrated solution to the sewage requirements of Scotland Island that is recommended for consideration beyond the obvious and expedience for legacy solutions that have not kept pace and utility and avoidance of waterways for environmental disregard.

17. In respect of the water supply proposals there is no benefit of Option C.4 over the similar cost of Option C.6.

    17.1. Option C.6 is the only feasible option in respect of the public health protections and significant fire risk on Scotland island, although fire is somewhat of a rare event there have been instances of catastrophic conditions that do not have any reliable community emergency options other than jumping in Pittwater and swimming out as inherent danger.

    17.2. The opportunity for world class water balance and supply infrastructure has a strong reliance on IoT for more complex autonomous management of the Scotland Island circumstance thus a metered supply network facilitates the reductions of wastewater discharge from each dwelling and other public interest measures – like in the current pandemic that would be prudent to take into account.

    17.3. Rainwater tank top-up interferes and removes the benefit of having installed a rainwater harvesting system with roof catchments for the supply of alternate low-cost water supply. A top-up of rainwater tanks is totally unnecessary with a properly engineered reticulated water supply system. This on-site tank top-up system was abandoned by the industry 12 years ago so it is questioned as to why it has been proposed whether in ignorance or if a considered proposal by the author(s) that has not been explained. Utilising such system of top-up causes additional costs as energy is need for total household supply and reliance on mechanical pumps and controls with life expectancy of about 5 year replacement cycle. The only meaningful benefit is for reduced supply pressure from a rainwater pressure pump that may convert to conservation of water use with less wastage. Todays WELS certified water appliances and hot water systems rely on the conservation with a measured supply to achieve their rating so Option C.6 is more relevant as a supply option.

17.4. The misguidance of considering rainwater tank top-up as part of the delivery of potable water supplies curiously overlooks the regulations, standards and guidelines available and immediate compromise of the mains distributed supply blended into a rainwater harvested resource. Mainland water systems where a mains delivery water resource is available is then considered by NSW Health as non-potable water for household applications. These households would basically have a plumbed household system to AS/NZS 3500 compliance so there is no reason or justification to facilitate a single kitchen sink tap scenario, which for a credible feasibility report is at its highest relevance an unimaginable option suggesting the author(s) do not have a proper understanding of rudimentary reticulated water systems. With such proposition any subsequent credibility for water balance is lost from a proper feasibility report and adoption in the future infrastructure project for Scotland Island, such that Option C.6 is not relevant for consideration as put.

17.5. The risk and public responsibility profile must utilises option C.6. The value of the properties of Scotland Island with substantially improved developments taking place demands Option C.6. Any lesser system would waste the opportunity and the cost of a sub-optimal solution. Anything less than Option C.6 would potentially compromise any proposed low pressure sewage and processing system for Scotland island. The environmental impact and any environmental improvements would eb best served by Option C.6 in the absence of any more advanced proposal that the feasibility has not been able to properly advance.

17.6. A good supply of water also represents economic growth and the local community in collaboration with mainland facilities is a dynamic approach to the value Scotland Island and its unique environment and natural conditions represents for the future amenity and prosperity of the community.

18. The parallel water supply option is not well integrated and costed.

Key Drivers for the Recommended Technical Solutions {Draft Final Report – page 71}

19. It is noted that this report claims . . the opportunities for alternate delivery models are limited by the topography and urban context of Scotland island'. This observation could be considered as overly simplistic and its justification is questioned for the purpose of the recommendation.

    19.1. The key driver is that a low pressure sewage system is contemporary engineering but not just on account of the concept of an enclosed wastewater disposal capability otherwise achieved otherwise compared with a low cost of operational gravity solution in a mainland location, but the advanced means to monitor, manage through supervision for disruptions, predictive maintenance and a balanced scheme of discharge to lower the cost of installation for a 24/7 operational all-weather facility for a modern infrastructure project is the intelligent and economic option of choice for locations at the extremity of the Licensee authority network. Due to the occasional capacity of that network to function to the service needs of the community a more independent system is the best solution for adoption.

    19.2. The commercial opportunity for the local community is not served by the limitation of this report that has direct feasibility implications.

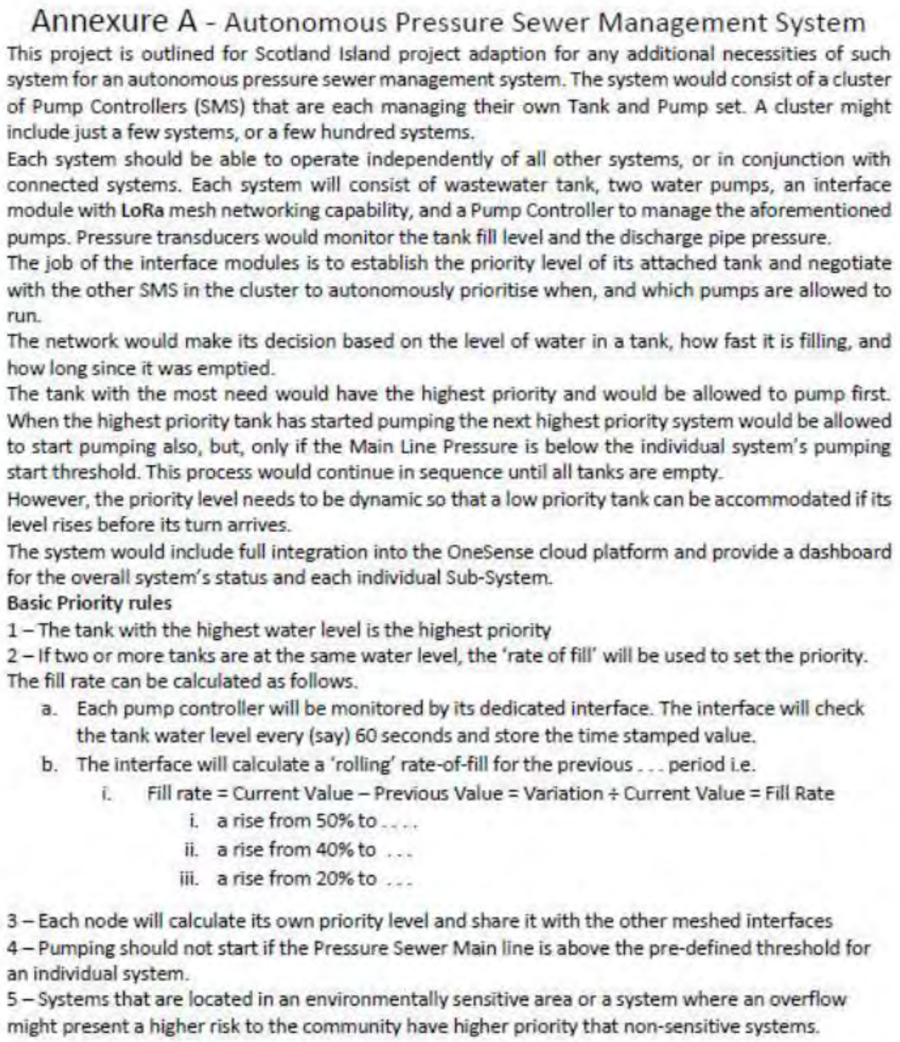
    19.3. That said the low-pressure sewage system is a preferred option in the circumstance where the performance and marginal operational aspects are optimised to service the finite needs of a standalone system for the expected life span of 50 – 100 years. Modern materials should have that capability where ease of servicing is designed into the structure of the network. Waste is a key consideration and waterways certainly have a coping mechanism but over reliance on waterways has contaminated the whole of the waterways systems surrounding greater Sydney to the detriment of future generations and their wellbeing. We can address that situation and the contributory effect on climate response with a more innovative solutions that does not represent additional costs for the value of a BPM for a signature solution that Scotland Island represents. The local regional economy can be advanced in the right circumstances and a better service for the community can be achieved with a better proposal to this feasibility that presently represents mediocre concepts and questionable justifications and costs.

    19.4. The key stakeholders holding out for public investment with reimbursement sought by the Government investment instrumentality is misplaced. The residents of Scotland island deserves this long awaited facility to boost local commerce and business for no less than tourism, skills and enterprise advancement and a signature project to promote to the legacy Sydney Water and the world as best practice with environmental improvement and a positive response contribution to mitigate a measure of climate change.

20. The feasibility reporting relies on disparate information that may compromise a compelling basis for a strong business case to propose to the government and its entities identified as the stakeholder(s) for decisions on the proposal. This report appears to attempt to shift the cost of the public infrastructure onto the community that is unreasonable and excessive with a subjective, marginal and questionable compilation for the report. I reject the quality of the report however wish to support the tenant of the project proposal that can be substantially improved into a world class project that the local community can add to the significant improvements in and around Scotland Island and its preferred transit facilities of Church Point.

[redacted] welcomes any feedback and would be available to further advance the consideration of a holistic design for water balance and community advantage.

[redacted]



Annexure A - Autonomous Pressure Sewer Management System

This project is outlined for Scotland Island project adaption for any additional necessities of such system for an autonomous pressure sewer management system. The system would consist of a cluster of Pump Controllers (SMS) that are each managing their own Tank and Pump set. A cluster might include just a few systems, or a few hundred systems.

Each system should be able to operate independently of all other systems, or in conjunction with connected systems. Each system will consist of wastewater tank, two water pumps, an interface module with **LoRa** mesh networking capability, and a Pump Controller to manage the aforementioned pumps. Pressure transducers would monitor the tank fill level and the discharge pipe pressure.

The job of the interface modules is to establish the priority level of its attached tank and negotiate with the other SMS in the cluster to autonomously prioritise when, and which pumps are allowed to run.

The network would make its decision based on the level of water in a tank, how fast it is filling, and how long since it was emptied.

The tank with the most need would have the highest priority and would be allowed to pump first. When the highest priority tank has started pumping the next highest priority system would be allowed to start pumping also, but, only if the Main Line Pressure is below the individual system's pumping start threshold. This process would continue in sequence until all tanks are empty.

However, the priority level needs to be dynamic so that a low priority tank can be accommodated if its level rises before its turn arrives.

The system would include full integration into the OneSense cloud platform and provide a dashboard for the overall system's status and each individual Sub-System.

Basic Priority rules

1 – The tank with the highest water level is the highest priority

2 – If two or more tanks are at the same water level, the 'rate of fill' will be used to set the priority. The fill rate can be calculated as follows.

a. Each pump controller will be monitored by its dedicated interface. The interface will check the tank water level every (say) 60 seconds and store the time stamped value.

b. The interface will calculate a 'rolling' rate-of-fill for the previous . . . period i.e.

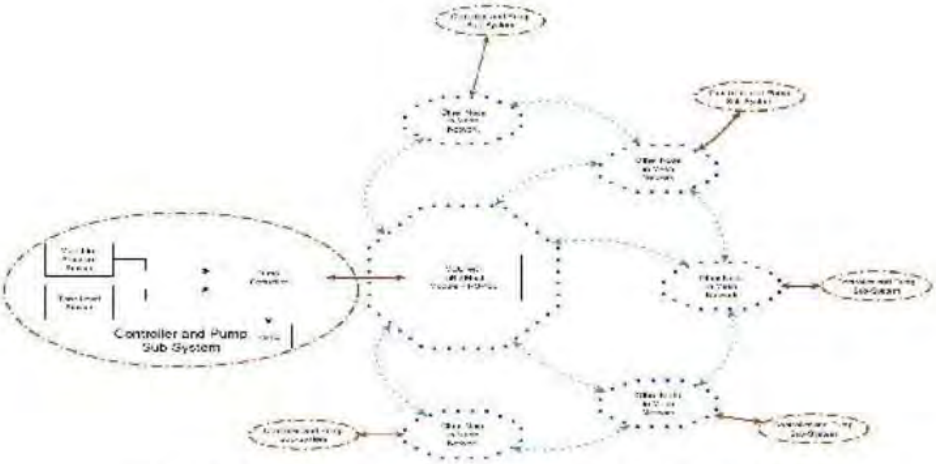
  i. Fill rate = Current Value – Previous Value = Variation ÷ Current Value = Fill Rate

    i. a rise from 50% to . . . .
    ii. a rise from 40% to . . .
    iii. a rise from 20% to . . .

3 – Each node will calculate its own priority level and share it with the other meshed interfaces

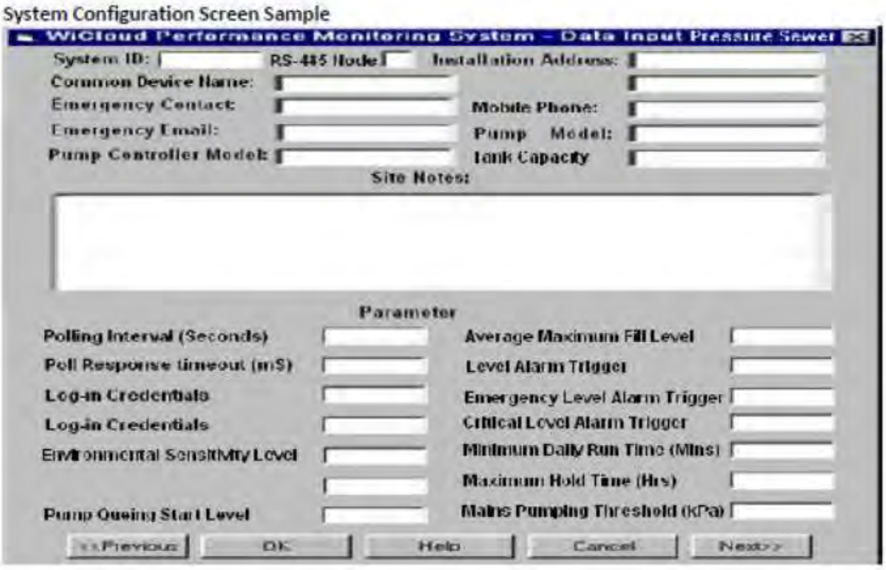
4 – Pumping should not start if the Pressure Sewer Main line is above the pre-defined threshold for an individual system.

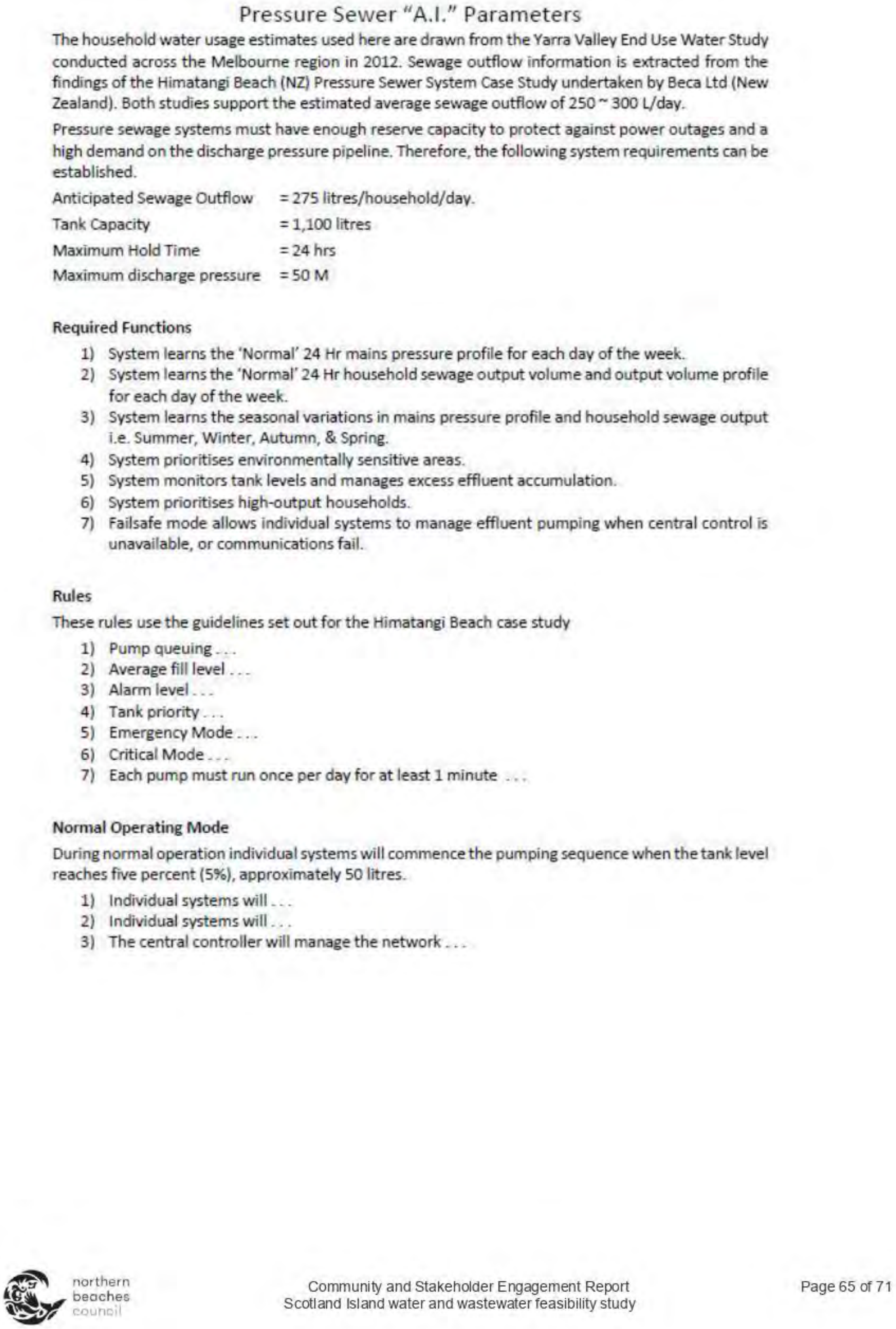
5 – Systems that are located in an environmentally sensitive area or a system where an overflow might present a higher risk to the community have higher priority that non-sensitive systems.



1 All Nodes communicate via a mesh topography to negotiate pumping priority base on a series of rules.
2 - Each Node has its own attached Sub-System of Controller, Pump and Pressure sensors

System Configuration Screen Sample





Pressure Sewer "A.I." Parameters

The household water usage estimates used here are drawn from the Yarra Valley End Use Water Study conducted across the Melbourne region in 2012. Sewage outflow information is extracted from the findings of the Himatangi Beach (NZ) Pressure Sewer System Case Study undertaken by Beca Ltd (New Zealand). Both studies support the estimated average sewage outflow of 250 ~ 300 L/day.

Pressure sewage systems must have enough reserve capacity to protect against power outages and a high demand on the discharge pressure pipeline. Therefore, the following system requirements can be established.

Anticipated Sewage Outflow = 275 litres/household/day.
Tank Capacity = 1,100 litres
Maximum Hold Time = 24 hrs
Maximum discharge pressure = 50 M

Required Functions

1) System learns the 'Normal' 24 Hr mains pressure profile for each day of the week.
2) System learns the 'Normal' 24 Hr household sewage output volume and output volume profile for each day of the week.
3) System learns the seasonal variations in mains pressure profile and household sewage output i.e. Summer, Winter, Autumn, & Spring.
4) System prioritises environmentally sensitive areas.
5) System monitors tank levels and manages excess effluent accumulation.
6) System prioritises high-output households.
7) Failsafe mode allows individual systems to manage effluent pumping when central control is unavailable, or communications fail.

Rules

These rules use the guidelines set out for the Himatangi Beach case study

1) Pump queuing . . .
2) Average fill level . . .
3) Alarm level . . .
4) Tank priority . . .
5) Emergency Mode . . .
6) Critical Mode . . .
7) Each pump must run once per day for at least 1 minute . . .

Normal Operating Mode

During normal operation individual systems will commence the pumping sequence when the tank level reaches five percent (5%), approximately 50 litres.

1) Individual systems will . . .
2) Individual systems will . . .
3) The central controller will manage the network . . .

Alarm Mode

Alarm Mode will commence when the tank level reaches . . .

Emergency Mode

When an individual system reaches . . .

Critical Mode

When an individual system reaches . . .

Failsafe mode

Failsafe mode will be entered when . . .

Central Controller Response

Should the central controller lose contact with an individual system for more than . . . , the central controller will;

1) Notify the maintenance crew that the individual system is not reporting and advise the crew of the systems status.
2) Dispatch a maintenance crew to the site as required.

Local Power Fail Recovery

Following a local power failure, individual systems must enter a 'staged' . . .

Central Controller Power Fail Recovery

Following a power failure, the central controller will poll . . .

Individual System Tank Status

Aerial View of site

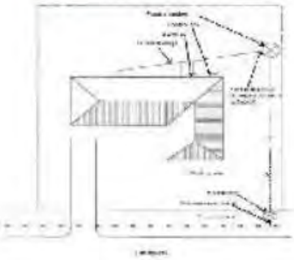
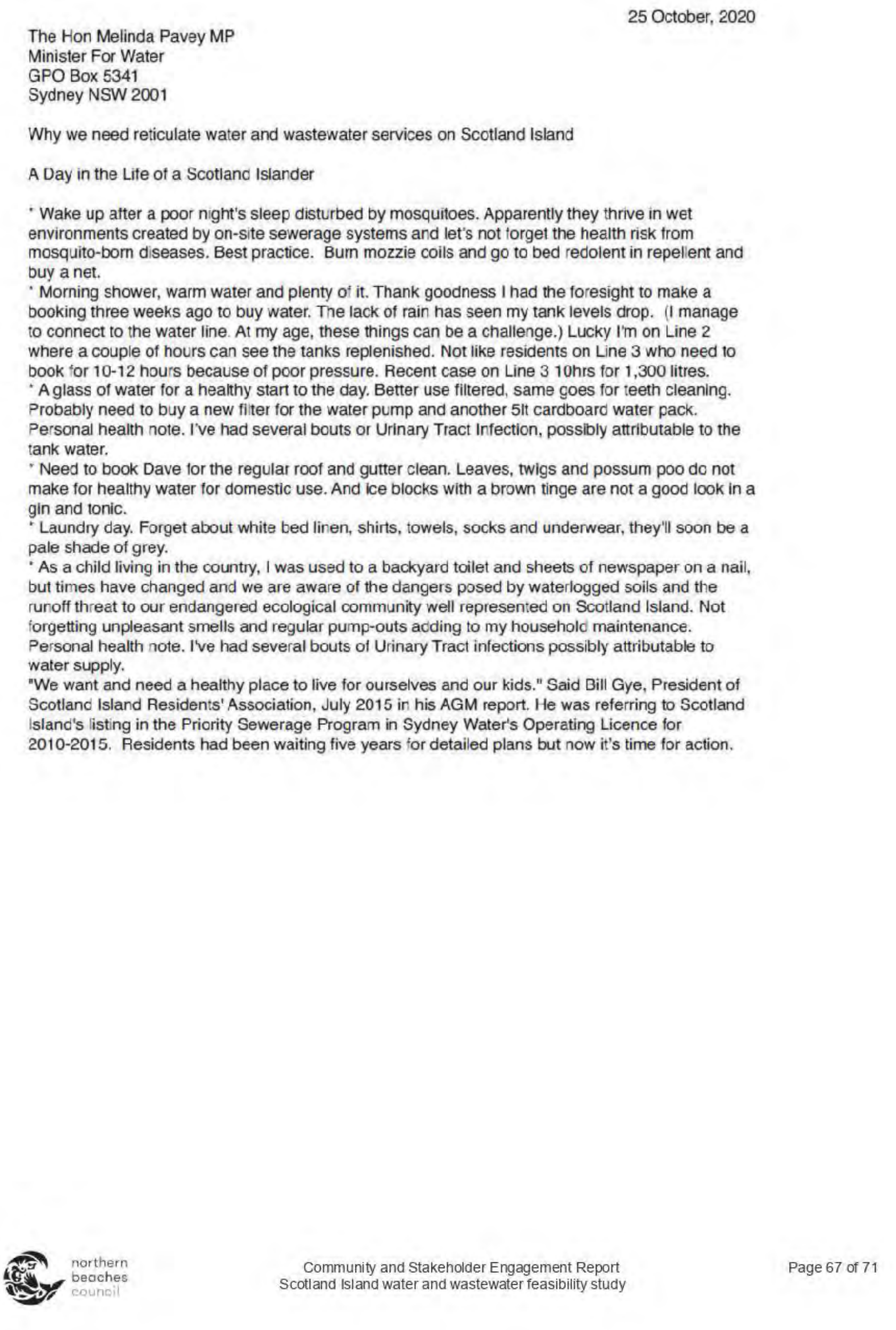


Figure 8- Example of Individual Pressure Sewer Site Configuration



25 October, 2020

The Hon Melinda Pavey MP
Minister For Water
GPO Box 5341
Sydney NSW 2001

Why we need reticulate water and wastewater services on Scotland Island

A Day in the Life of a Scotland Islander

* Wake up after a poor night's sleep disturbed by mosquitoes. Apparently they thrive in wet environments created by on-site sewerage systems and let's not forget the health risk from mosquito-born diseases. Best practice. Burn mozzie coils and go to bed redolent in repellent and buy a net.
* Morning shower, warm water and plenty of it. Thank goodness I had the foresight to make a booking three weeks ago to buy water. The lack of rain has seen my tank levels drop. (I manage to connect to the water line. At my age, these things can be a challenge.) Lucky I'm on Line 2 where a couple of hours can see the tanks replenished. Not like residents on Line 3 who need to book for 10-12 hours because of poor pressure. Recent case on Line 3 10hrs for 1,300 litres.
* A glass of water for a healthy start to the day. Better use filtered, same goes for teeth cleaning. Probably need to buy a new filter for the water pump and another 5lt cardboard water pack. Personal health note. I've had several bouts or Urinary Tract Infection, possibly attributable to the tank water.
* Need to book Dave for the regular roof and gutter clean. Leaves, twigs and possum poo do not make for healthy water for domestic use. And ice blocks with a brown tinge are not a good look in a gin and tonic.
* Laundry day. Forget about white bed linen, shirts, towels, socks and underwear, they'll soon be a pale shade of grey.
* As a child living in the country, I was used to a backyard toilet and sheets of newspaper on a nail, but times have changed and we are aware of the dangers posed by waterlogged soils and the runoff threat to our endangered ecological community well represented on Scotland Island. Not forgetting unpleasant smells and regular pump-outs adding to my household maintenance. Personal health note. I've had several bouts of Urinary Tract infections possibly attributable to water supply.

"We want and need a healthy place to live for ourselves and our kids." Said Bill Gye, President of Scotland Island Residents' Association, July 2015 in his AGM report. He was referring to Scotland Island's listing in the Priority Sewerage Program in Sydney Water's Operating Licence for 2010-2015. Residents had been waiting five years for detailed plans but now it's time for action.

Re: Scotland Island Water & Waste Water

The Hon Melinda Pavey MP
The Hon Rob Stokes MP
Northern Beaches Council

Thursday 22 Oct 20

I am a resident and owner of a properly on Scotland Island. As you will be aware Scotland Island residents have no access to sewerage or town water ...we rely on septic tanks which are in many instances over 30 years old with soils (clay and rock) that cannot cope...with the consequence being that with heavy rainfall the septics overflow into Pittwater. The damage to the environmnet and to or health is unacceptable.

The World Health Organisation notes on their website (https://www.who.int/news-room/fact-sheets/detail/sanitation) that 14% of the world's population (1 billion people) used toilets or latrines where excreta were disposed of in situ. That describes Scotland Island - whilst the rest of Sydney live in the developed world our government has turned a blind eye.

Moreover, the impact of questionable waste water management systems on the island present health risks to the population with respect to mosquito borne illnesses and diseases.

The situation is unacceptable.

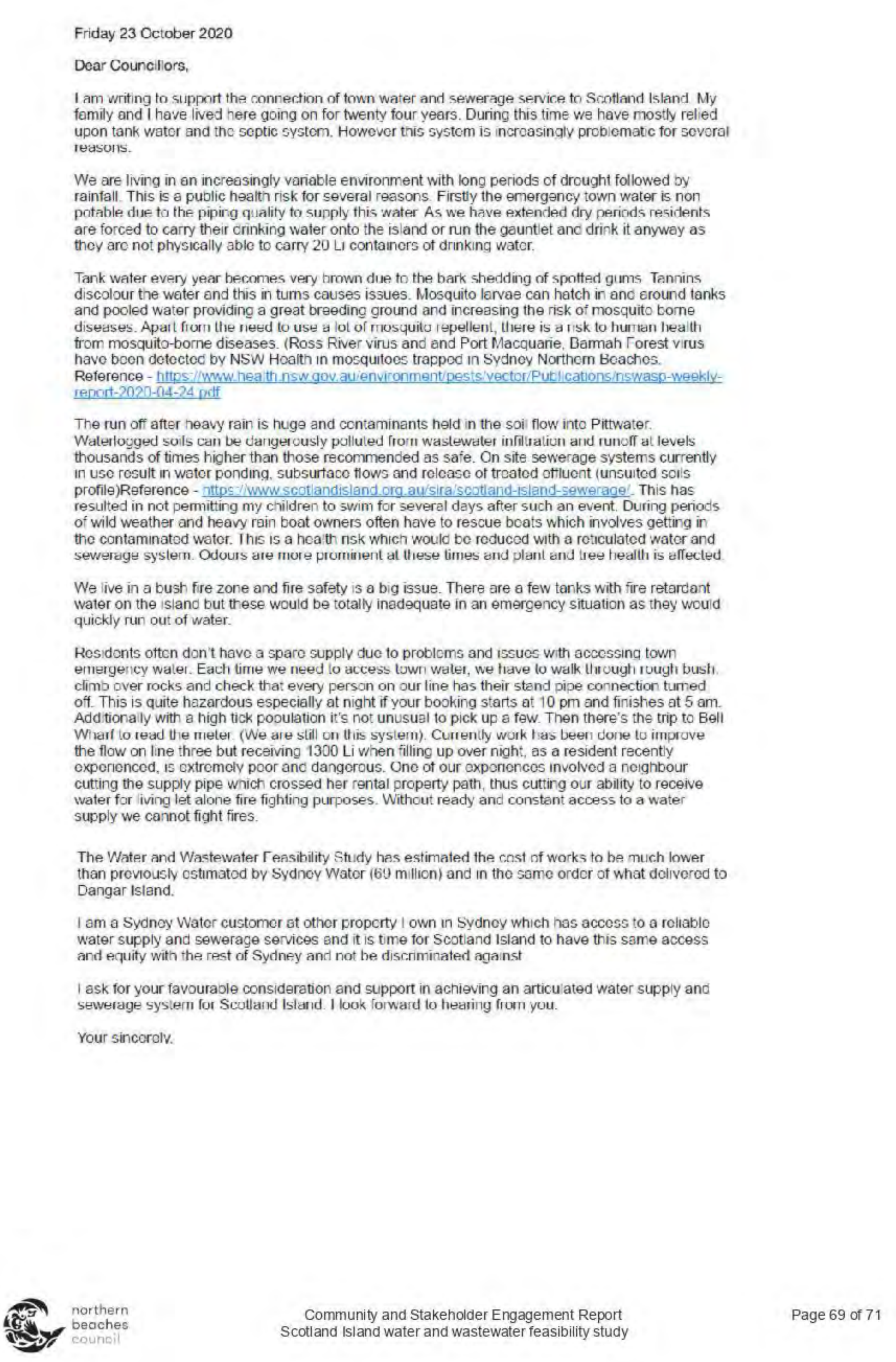
If Dangar Island can have a sewerage system and the rest of Sydney's population can have their health protected with modern sanitation systems (sewerage and running water) - why can't the population of Scotland Island have the same services?

We pay taxes, we are families, we contribute - we are human - yet we are treated no better than the 1 billion on the planet that live in squalor without sanitation!

This situation is shit!

Do something about it please

Yours sincerely



Friday 23 October 2020

Dear Councillors,

I am writing to support the connection of town water and sewerage service to Scotland Island. My family and I have lived here going on for twenty four years. During this time we have mostly relied upon tank water and the septic system. However this system is increasingly problematic for several reasons.

We are living in an increasingly variable environment with long periods of drought followed by rainfall. This is a public health risk for several reasons. Firstly the emergency town water is non potable due to the piping quality to supply this water. As we have extended dry periods residents are forced to carry their drinking water onto the island or run the gauntlet and drink it anyway as they are not physically able to carry 20 Li containers of drinking water.

Tank water every year becomes very brown due to the bark shedding of spotted gums. Tannins discolour the water and this in turns causes issues. Mosquito larvae can hatch in and around tanks and pooled water providing a great breeding ground and increasing the risk of mosquito borne diseases. Apart from the need to use a lot of mosquito repellent, there is a risk to human health from mosquito-borne diseases. (Ross River virus and and Port Macquarie, Barmah Forest virus have been detected by NSW Health in mosquitoes trapped in Sydney Northern Beaches. Reference - https://www.health.nsw.gov.au/environment/pests/vector/Publications/nswasp-weekly-report-2020-04-24.pdf

The run off after heavy rain is huge and contaminants held in the soil flow into Pittwater. Waterlogged soils can be dangerously polluted from wastewater infiltration and runoff at levels thousands of times higher than those recommended as safe. On site sewerage systems currently in use result in water ponding, subsurface flows and release of treated effluent (unsuited soils profile)Reference - https://www.scotlandisland.org.au/sira/scotland-island-sewerage/. This has resulted in not permitting my children to swim for several days after such an event. During periods of wild weather and heavy rain boat owners often have to rescue boats which involves getting in the contaminated water. This is a health risk which would be reduced with a reticulated water and sewerage system. Odours are more prominent at these times and plant and tree health is affected.

We live in a bush fire zone and fire safety is a big issue. There are a few tanks with fire retardant water on the island but these would be totally inadequate in an emergency situation as they would quickly run out of water.

Residents often don't have a spare supply due to problems and issues with accessing town emergency water. Each time we need to access town water, we have to walk through rough bush, climb over rocks and check that every person on our line has their stand pipe connection turned off. This is quite hazardous especially at night if your booking starts at 10 pm and finishes at 5 am. Additionally with a high tick population it's not unusual to pick up a few. Then there's the trip to Bell Wharf to read the meter. (We are still on this system). Currently work has been done to improve the flow on line three but receiving 1300 Li when filling up over night, as a resident recently experienced, is extremely poor and dangerous. One of our experiences involved a neighbour cutting the supply pipe which crossed her rental property path, thus cutting our ability to receive water for living let alone fire fighting purposes. Without ready and constant access to a water supply we cannot fight fires.

The Water and Wastewater Feasibility Study has estimated the cost of works to be much lower than previously estimated by Sydney Water (69 million) and in the same order of what delivered to Dangar Island.

I am a Sydney Water customer at other property I own in Sydney which has access to a reliable water supply and sewerage services and it is time for Scotland Island to have this same access and equity with the rest of Sydney and not be discriminated against.

I ask for your favourable consideration and support in achieving an articulated water supply and sewerage system for Scotland Island. I look forward to hearing from you.

Your sincerely,

Sydney
WATER

28 October 2020

Environment and Climate Change
Northern Beaches Council
PO Box 82, Manly NSW 1655

Scotland Island Water and Wastewater

Thank you for the opportunity to comment on Council's 'Scotland Island Water and Wastewater Feasibility Study'.

Scotland Island covers an area of about 55 ha and 377 lots with lot sizes that are typical of urbanised areas. The island does not have a reticulated drinking water supply or wastewater service. Scotland Island is identified in Sydney Water's Operating Licence as a Priority Sewage Program (PSP) area, however, there is no obligation for Sydney Water to provide a wastewater service to the PSP scheme areas within a particular timeframe.

Northern Beaches Council has engaged Pressure System Solutions (PSS) to conduct a commercial feasibility study for the provision of water and wastewater infrastructure to service Scotland Island. In 2019, Sydney Water provided information to Council to assist with its investigation. The information included capacity assessment on the existing water and wastewater systems assuming a maximum flow rate of 15 L/s for water supply and a daily maximum flow of 300 kL/day of wastewater, as specified by Council.

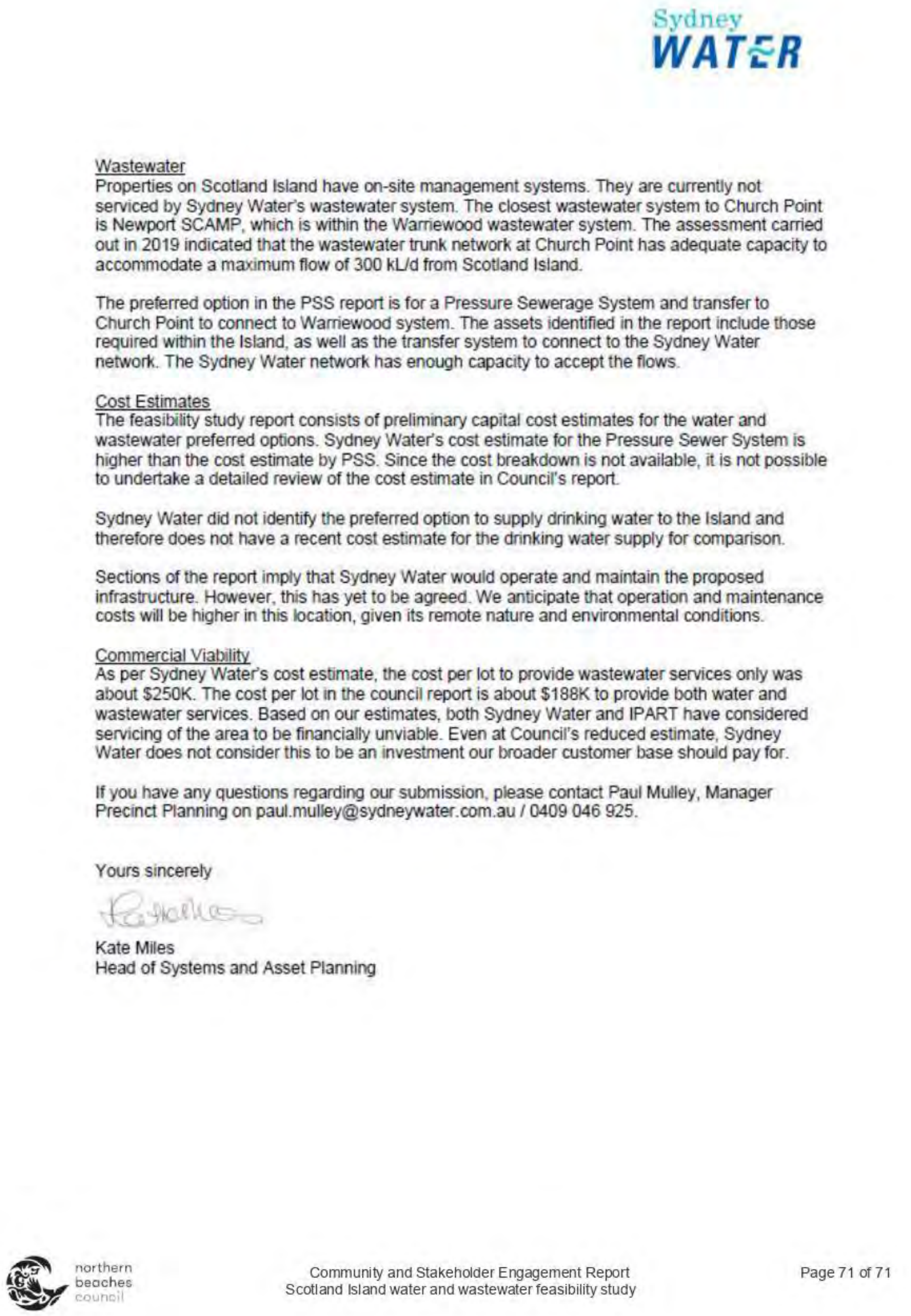
PSS completed a feasibility study for Council in August 2020 and a copy of the report has been published in the council's website for public comment. The feasibility study report details a long list of options, multi criteria assessment and cost estimates of the short-listed options for drinking water, wastewater and wastewater treatment services to the island.

Drinking Water

The existing water supply system in Scotland Island consists of household rainwater tanks and an emergency pipeline connected to Sydney Water's potable water network at Church Point. The supply was originally intended for firefighting purposes and emergency drinking water.

In 2019, Sydney Water assessed the capacity of the existing nearby water network to supply a maximum flow rate of 15 L/s to Scotland Island. Advice regarding available pressure based on this flow rate was provided to Council. However, the report by PSS details the estimated maximum flow rate as 30 L/s.

The preferred option outlined in the PSS report is to directly supply drinking water from Sydney Water mains, with a booster pump if required. The assets considered in the report only account for those required within the Island, with no amplification identified to Sydney Water's supply network. If the required flow rate is now greater than 15 L/s as per the PSS report, further planning is needed to confirm whether augmentation or operational changes to our assets would be required in order to mitigate adverse impacts to upstream customers.



Sydney
WATER

Wastewater
Properties on Scotland Island have on-site management systems. They are currently not serviced by Sydney Water's wastewater system. The closest wastewater system to Church Point is Newport SCAMP, which is within the Warriewood wastewater system. The assessment carried out in 2019 indicated that the wastewater trunk network at Church Point has adequate capacity to accommodate a maximum flow of 300 kL/d from Scotland Island.

The preferred option in the PSS report is for a Pressure Sewerage System and transfer to Church Point to connect to Warriewood system. The assets identified in the report include those required within the Island, as well as the transfer system to connect to the Sydney Water network. The Sydney Water network has enough capacity to accept the flows.

Cost Estimates
The feasibility study report consists of preliminary capital cost estimates for the water and wastewater preferred options. Sydney Water's cost estimate for the Pressure Sewer System is higher than the cost estimate by PSS. Since the cost breakdown is not available, it is not possible to undertake a detailed review of the cost estimate in Council's report.

Sydney Water did not identify the preferred option to supply drinking water to the Island and therefore does not have a recent cost estimate for the drinking water supply for comparison.

Sections of the report imply that Sydney Water would operate and maintain the proposed infrastructure. However, this has yet to be agreed. We anticipate that operation and maintenance costs will be higher in this location, given its remote nature and environmental conditions.

Commercial Viability
As per Sydney Water's cost estimate, the cost per lot to provide wastewater services only was about $250K. The cost per lot in the council report is about $188K to provide both water and wastewater services. Based on our estimates, both Sydney Water and IPART have considered servicing of the area to be financially unviable. Even at Council's reduced estimate, Sydney Water does not consider this to be an investment our broader customer base should pay for.

If you have any questions regarding our submission, please contact Paul Mulley, Manager Precinct Planning on paul.mulley@sydneywater.com.au / 0409 046 925.

Yours sincerely

Kate Miles
Head of Systems and Asset Planning