ATTACHMENT D

Prepared for White Horse Australia Lindeman Pty Ltd

Water Quality Monitoring Plan

Lindeman Great Barrier Reef Resort

November 2025

Project Number: 250755

Document verification

Project Title:	Lindeman Great Barrier Reef Resort
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Revision	Project Number/ Ref	Date	Prepared by	Description	Reviewed by
V2.1	JW181157	26/9/2018	Matthew Ayre	Final - Updated following regulator review	Nicholas Baker
Draft V0.1	250755	10/10/2025	Rachelle Brown	Draft update of V2.1 Final report following monitoring location updates and company changes	Jaclyn Wells
V1.0	250755	3/11/2025	Rachelle Brown	Final version following client review and approval	Jaclyn Wells

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We acknowledge the Traditional Owners of this land and pay our respect to Elders past, present and emerging. We recognise that the First Nations peoples of Australia have traditionally managed the resources of this land in a sustainable way, and that they are the original custodians of the Australian environment.

Explanatory Note- Version Information

Catchment Solutions has been engaged by Well Smart Group to undertake water quality monitoring of the marine waters surrounding Lindeman Island, and terrestrial waters within creeks and dams on the island, since April 2024 in accordance with the Lindeman Island Great Barrier Reef Resort Water Quality Monitoring Program (prepared by Wild Environmental Consultants in September 2018). In undertaking the sampling program, Catchment Solutions identified that the location of two of the terrestrial water samples (LIND03 and LIND06) required alteration. These changes have no impact on the objectives or outcomes of the water quality monitoring program, as assessed by Catchment Solutions. The revised site locations were reviewed and recommended by Catchment Solutions based on the following, as provided to NGH by Well Smart Group:

- LIND03 – the sample location could not be safely accessed and has been relocated 90 metres downstream of the original location on the same steep bedrock confined waterway on the western side of the island. The purpose of the sample location is to monitor water quality downstream of the golf course. The change of location has no impact on this objective as there is an increase in area of golf course within the catchment of the revised sample location.
- LIND06 – the objective of the sample location was to monitor the water quality of runoff from the golf course. Inspection of the original location failed to identify a defined waterway as the landscape is steep (>30%) with overland flow occurring as undefined sheetwash. The absence of a defined watercourse renders it difficult to collect a representative water sample of runoff from the golf course. A defined watercourse was identified approximately 140 metres to the south southeast that also receives runoff from the golf course and is in the same topographic setting.

It is understood the Department of Environment, Climate Change, Energy, Environment and Water have requested preparation of a revised Water Quality Monitoring Program reflecting the aforementioned sampling location changes. This report updates the Lindeman Island Great Barrier Reef Resort Water Quality Monitoring Program prepared by Wild Environmental Consultants in September 2018 to reflect these minor amendments and is issued by Fyfe (formerly NGH, and formerly Wild Environmental). In 2022, NGH expanded its environmental expertise through the acquisition of Wild Environmental. More recently in 2025, NGH and Fyfe have joined to further expand service offerings, enhance project delivery, and provide greater value to clients from development to execution.

This updated version was prepared at the request of Well Smart Group to incorporate revised GPS coordinates and figures showing the new sample locations. The template, style and some regulatory agency names have also been updated. There are no other changes to background information, objectives, parameters or recommendations.

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Acronyms and abbreviations

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS	Australian Standard/New Zealand Standard
BACI	before-after, control-impact
BOM	Australian Bureau of Meteorology
C	Celsius
Cardno	Cardno QLD Pty Ltd
COC	chain-of-custody
DCCEEW	Department of Climate Change, Energy, the Environment and Water (formerly DEE, Department of the Environment and Energy) (Qld)
DEE	Department of the Environment and Energy (Qld)
DEHP	Department of Environment and Heritage Protection (Qld)
DETSI	Department of Environment, Tourism, Science and Innovation (formerly DEHP, Department of Environment and Heritage Protection) (Qld)
EIS	Environmental impact statement
EPBC	Environment Protection and Biodiversity Conservation
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPP Water	*Environmental Protection (Water) Policy 2009*
ESCP	Erosion and Sediment Control Plan
EY	exceedances per year
g	grams
GBR	Great Barrier Reef

GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GDA	Geographic Datum of Australia
GIS	Geographic information system
GPS	Geographical positioning system
ha	hectares
IFD	Intensity-Frequency-Duration
km	kilometres
L	litres
LOD	limit of detection
m	metres
MD	moderately disturbed
MEDLI	Model for Effluent Disposal using Land Irrigation
MRC	Mackay Regional Council
MWQMP	Marine Water Quality Monitoring Program
NATA	National Association of Testing Authorities
NTU	nephelometric turbidity units
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
S	Siemens
SD	slightly disturbed
Sp/spp	Species/multiple species
TWQMP	Terrestrial Water Quality Monitoring Program

WHAL	White Horse Australia Lindeman Pty Ltd
WQ	water quality
WQMP	Water Quality Monitoring Program
WQO	Water Quality Objective

1. Introduction

1.1. Background

White Horse Australia Lindeman Pty Ltd (WHAL) is proposing to develop the Lindeman Great Barrier Reef Resort on Lindeman Island, approximately 12 km southeast of Hamilton Island, Queensland (Figure 1). The project will involve the redevelopment of the existing Lindeman Island Resort as well as the construction of additional resort areas. The project has been declared a controlled action, for which an EIS has been prepared. As part of the approvals process, WHAL has been issued with a decision notice under the *Environment Protection and Biodiversity Conservation Act 1999.* A requirement of which is the preparation and implementation of a water quality monitoring program. This document has been prepared as the Marine Water Quality Monitoring Program (MWQMP). A supporting Terrestrial Water Quality Monitoring Program (TWQMP) is attached at Appendix A.

The purpose of this monitoring program is to protect the Great Barrier Reef World Heritage Area, National Heritage Place, and Marine Park's values, including but not limited to:

- Impacts on ecological values;
- Impacts on social values.

Specifically, the program aims to protect water quality which in turn protects the condition and trend of habitats and populations of species, supported by good water quality including at a minimum:

- Coral reefs and corals;
- Seagrass meadows, and seagrasses.

Wild Environmental Consultants (now NGH – A Fyfe Company) have prepared this monitoring program on behalf of White Horse Australia Lindeman Pty Ltd.

Datum: WGS 84

0 250 500 750 1,000 m

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Lindeman Island Water Monitoring

Figure 1 - Site Location

Ref: Lindeman Island Water Monitoring \ Site Location Author: Oscar Puignou Lopez Date created: 13/10/2025 © NGH 13/10/2025 © ESRI 2022

1.2. Project Description

White Horse Australia Lindeman Pty Ltd is seeking to redevelop the Lindeman Island Resort on Lindeman Island, Queensland. The resort redevelopment will be comprised of 325 suites and villas over three (3) resort areas (Figure 2). The development will include:

- redevelopment and expansion of the existing resort to include a 5-star Beach Resort, 6-star Spa Resort, a 5-star Eco Resort and 4-star Tourist Villa Precinct facilities including a conference centre, beach club, restaurants and lounges;
- a central village precinct comprising restaurants, bar, night club, conference facility buildings, arrival centre, shops, sport and recreation centre and a staff village;
- expansion of the current services area including power generation (solar with diesel back-up), sewage treatment and water treatment;
- existing airstrip and golf course upgrades;
- upgrade to the existing jetty and additional moorings;
- ecotourism facilities - a National Park and Great Barrier Reef Educational Centre; and
- environmental enhancements - native vegetation replanting, improvements to stormwater management and a shift towards renewable energy sources[1].

[1] White Horse Australia: Limited, 2018, Lindeman Island Environmental Impact Statement, Executive Summary and Information Package, Proposal to develop and operate the Lindeman Great Barrier Reef Resort, Figure 1.

LEGEND

Proposed Site Boundary

Construction Staging:

Stage 1
- Civil Works
- Construction Camp
- Demolition
- Infrastructure

Stage 2
- Jetty Upgrades
- Beach Resort
- Beach Resort Central Facilities
- Arrival and Departures Facilities
- Airstrip Runway and Facilities
- Village, Sports Centre, Education Centre and Facilities
- Staff Accomodation
- Golf Course and Fixtures
- Fittings and Equipment
- Luxury Villas (7) and Apartments

Stage 3
- Spa Resort and Facilities including Rock Bar and Day Spa, Facilities and Fixtures, Fittings and Equipment and Luxury Villas

Stage 4
- Villa Construction

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Lindeman Island Water Monitoring

Figure 2 - Site Layout

1.3. Site Description

The development is located on Lindeman Island, an island within the Whitsunday Island Archipelago, approximately 12km southwest of Hamilton Island (Figure 1). Table 1 presents the key site information, including details on land tenure, local government area, total land and development area.

Table 1 Site Description

Address	Lindeman Island, Whitsunday Archipelago, Queensland
Lot/Plan	– Lot 2 on CP858366; – Lot 3 on CP858361; – Lot 8 on HR1954; – Lot B on HR2029; – Lot C on HR2029; and – Lot D on HR2029.
Total Area	140.5 Ha
Site Owner	White Horse Australia Lindeman Pty Ltd
Site Operator	White Horse Australia Lindeman Pty Ltd
Local Government Area	Mackay Regional Council
Current Land Use	Special Activities (Tourism)
Proposed Land Use	Special Activities (Tourism)

1.4. Existing Land Use

The development site is currently occupied by the Former Lindeman Island Resort owned previously by Club Med Pty Ltd. The resort was closed on the 31st January 2012 and was acquired by WHAL during April 2012. Since its acquisition, the resort has remained in a state of care and maintenance while the planning and environmental approval process for the redevelopment is finalised.

2. Integration with the Terrestrial Water Quality Monitoring Program

Modifications of land and unsustainable land use practises have resulted in adverse outcomes for the Great Barrier Reef Marine Park (GBRMP). Increased sediment and inputs of nutrients and pesticides to reef ecosystems have the potential to impact on receiving great barrier reef environments.

Freshwater inflows to the GBR from the redevelopment of the Lindeman Great Barrier Reef Resort, will lead to the construction of additional impervious areas which have the potential to increase the amount of freshwater and associated contaminants including sediments, nutrients, and pesticides leaving the development, entering the natural watercourses and eventually entering the receiving marine receiving environment. The discharge of elevated volumes of runoff into the receiving environment, has the potential to directly impact the water quality of the marine waters of Lindeman Island.

It is important for the protection of the GBR environmental values, that the water quality parameters of the Island's ephemeral streams which discharge runoff into the receiving environment, be monitored. Terrestrial water monitoring can detect elevated water parameters within the stream which in turn, act as an early warning to potential adverse effects of the GBR. If the results of terrestrial water quality monitoring determine that sediment loads and/or contaminant concentrations are above the site specific or the Queensland Water Quality Objectives (2009) Trigger Limits, corrections to site operations will occur to mitigate the potential damage, to prevent any further impacts to the GBR.

A supporting Terrestrial Water Quality Monitoring Program has been prepared in accordance with Section 5.1.4 of the Coordinator General's Report which states that *"Monitoring and maintenance programs to manage terrestrial and marine water quality will be implemented as part of the project."* This program is at Appendix A.

This WQMP specifically addresses Conditions 1 and 2 of the EPBC Approval however is directly impacted by the outcomes of the TWQMP, the TWQMP has been included as an appendix to this document.

3. Environmental Context

3.1. Climate and Rainfall

Climate data for the development site is sourced from Hamilton Island (Station 033106) approximately 11km to the northwest of Lindeman Island. Climate and weather data indicates that the coolest month is July with an average minimum temperature of 17.9°C and an average maximum temperature of 21.5°C (Figure 3). The warmest month is January with an average minimum temperature of 24.8°C and an average maximum temperature of 29.9°C. The annual average rainfall is 1456mm (Figure 4). However, during 2017/18, the recorded annual rainfall was 1040mm [2].

[2] Australian Government Bureau of Meteorology, 2018, Climate Statistics for Australian Locations – Hamilton Island, Available Online, http://www.bom.gov.au/climate/averages/tables/cw_033106.shtml

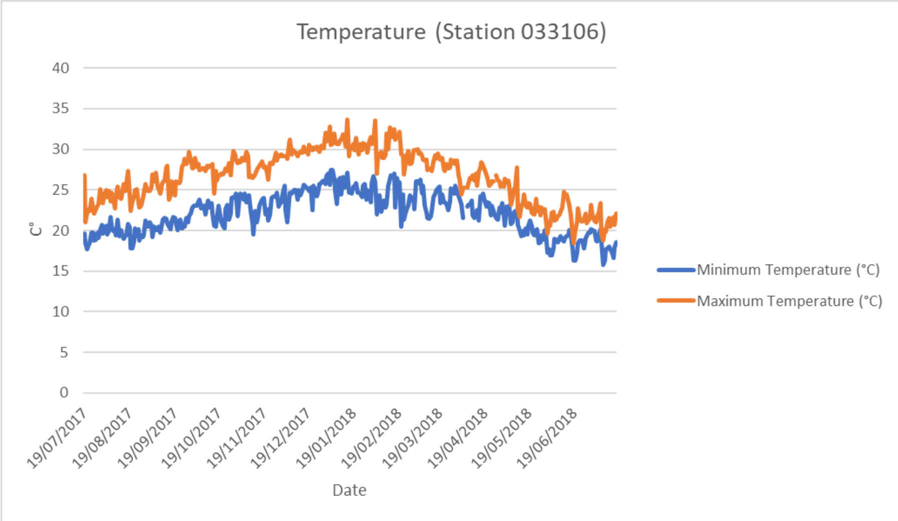

Figure 3 Temperature Data

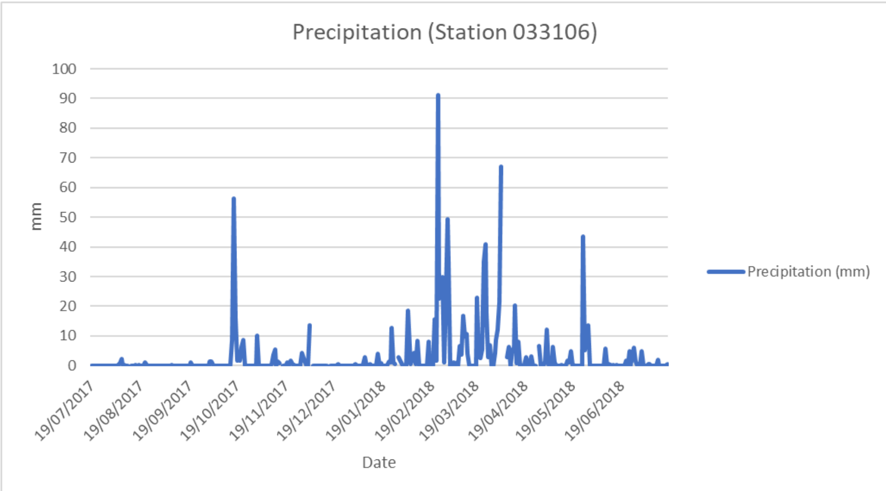

Figure 4 Precipitation Data

3.2. Topography

Lindeman Island's topography is characterised by steep cliffs and undulating hills. The island reaches a maximum elevation of approximately 200 m AHD. Steep escarpments towards the sea can be found on the west, north and east of the Island. Site specifically, the topography of the development consists of undulated hills ranging from approximately 65 m AHD trending south to sea level (Figure 5).

Ref: Lindeman Island Water Monitoring \ Sub-catchments and Watershed Author: Oscar Puignou Lopez Date created: 13/10/2025 © NGH 13/10/2025 © ESRI 2022

Datum: WGS 84

0 100 200 300 400 m

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Lindeman Island Water Monitoring

Figure 5 - Sub-catchments and Watershed

3.3. Geology

3.3.1. Regional Geology

Lindeman Island is a part of the Whitsunday Volcanics Province, an Early Cretaceous formation of extrusive and intrusive igneous rocks. The formation expresses a broad range of rock compositions from basalts through to rhyolites and other intermediate silicic rocks. Regionally, the Hamilton Island and Lindeman Island groups are characterised by lithic breccias and coarse lithic ignimbrites which are indicative of large volume explosive volcanism with significant water contribution[3].

3.3.2. Site Geology

Lindeman Island is dominated by of pyroclastic deposits. Specifically, petrological analysis has determined that island is underlain by tuff, defined as *"pale green hornblende, plagioclase, fine grained volcanic rock fragments and quartz set in a devitrified and recrystallised matrix".* Minor amounts of Tuffaceous cobble conglomerate, andesite and pyroclastics can be identified on the south coast of the island while smaller outcrops of trachyte and andesite along the northeast and north coastline[4]. There are three faults on Lindeman Island which strike at a bearing of approximately 170° [5].

3.4. Soil

According to the Cardno's Preliminary Geotechnical Assessment prepared for the EIS, the soils of the development appear to be thin and are either the product of colluvial processes or residual weathering of parent material. These occur as clayey gravels or gravelly clays up to 0.3 m thick with an organic-rich topsoil. The boundary between the soils and rock tends to be abrupt and well defined[4].

3.5. Hydrology

3.5.1. Surface Water

The development site is characterised by 12 sub-catchments (Figure 5). The streams within these sub-catchments are ephemeral in nature with watershed occurring seasonally. The exception to this is the site dam within sub-catchment D, which is a perennial waterbody and will serve as the main water source for the redevelopment.

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[3] Clarke. D.E, Paine. A.G.L & Jensen A.R, 1972, Geology of the Proserpine 1:250,000 Sheet Area, Queensland, Australian Government Publishing Service, Canberra, ACT.

[4] Cardno (Qld) Pty Ltd, 2015, Preliminary Geotechnical Assessment- Lindeman Island Redevelopment, Mackay, Queensland

[5] Queensland Government, 2018, Queensland Globe – Geoscientific Information – Geology – Detailed 1:100,000, Brisbane, Queensland

3.5.2. Groundwater

As mentioned in Section 3.3.2, the site is underlain by pyroclastic deposits as well as some minor andesite and trachytes. This specific geology is not conductive to the formation of aquifers. Historical bore records indicate groundwater resources are limited to periods of high rainfall. Therefore, it is inferred that groundwater underlying the site is restricted to areas of intense fracturing within the rock which allows water to accumulate intermittently[6].

3.6. Vegetation

As a part of the EIS, Cardno QLD Pty Ltd (Cardno) conducted a Flora and Fauna assessment of the development area and surrounding area. The assessment included the georeferencing of the regional ecosystems previously mapped by the Queensland Government. These georeferenced regional ecosystems are described in Table 2.

Table 2 Regional Ecosystems

Code	Short Description	Biodiversity Status
8.3.2	Melaleuca viridiflora woodland on seasonally inundated alluvial plains with impeded drainage[7].	Endangered
8.12.11a	Semi-evergreen microphyll vine thicket. Emergent species include *Araucaria cunninghamii*, *Falcataria toona*, *Terminalia porphyrocarpa* and *Argyrodendron polyandrum*. The canopy is often dominated by *Cleistanthus dallachyanus*, *Mimusops elengi*, *Terminalia porphyrocarpa* and *Euroschinus falcatus*[8].	Least Concern
8.12.12d	*Corymbia clarksoniana* woodland to open forest (8-30m tall). Common associated to codominant species may include *C. tessellaris*, *Eucalyptus platyphylla*, *C. dallachiana*, *E. drepanophylla*, *E. tereticornis* and *Allocasuarina littoralis*. (The canopy often consists of a mixture of several Corymbia and/or Eucalyptus species). *Corymbia intermedia* may occasionally be present. *Eucalyptus tereticornis* is an occasional emergent[9].	Least Concern

[6] White Horse Australia Limited, 2017, Lindeman Great Barrier Reef Resort Project - Environmental Impact Statement, Chapter 18, Robina, Australia.

[7] Queensland Government, 2017, Regional Ecosystem Details for 8.3.2

[8]Queensland Government, 2017, Regional Ecosystem Details for 8.12.11a

[9] Queensland Government, 2017, Regional Ecosystem Details for8.12.12d

8.12.13a	*Themeda triandra* and/or *Imperata cylindrica* and/or *Chionachne cyathopoda* tussock grassland to closed tussock grassland (0.3-0.7m tall), or *Xanthorrhoea latifolia* subsp. *latifolia* dwarf open shrubland to open heath (0.3 - 2m tall). Occasional emergents may include *Banksia integrifolia* subsp. *compar*, *Pandanus* spp. and rainforest spp. *Themeda triandra* is the most common dominant species in this ecosystem and often forms the majority of the ground cover[10].	Of Concern
8.12.14c	*Lophostemon confertus* closed forest to tall shrubland (3.5-28m tall). The canopy is often exclusively *L. confertus*, however occasional associated species may include *Eucalyptus exserta*, *E. tereticornis*, *E. drepanophylla* and *Acacia spirorbis* subsp. *solandri*. There is sometimes a very sparse to mid-dense lower tree layer dominated by species such as *Lophostemon confertus*, *Mallotus philippensis*, *Pittosporum ferrugineum*, *Acronychia laevis*, *Neolitsea brassii* and *Acacia leptostachya*[11].	Least Concern

3.7. Marine Environment

3.7.1. Marine Environment Features

The Marine environment of Lindeman Island is within the NB6 Inner Shelf Lagoon Continental Islands Bioregion and the Whitsunday region of the Great Barrier Reef Marine Park. This non-reef bioregion is characterised by “Strong currents, with some gravel and hydroids around Pine Peak Island. Some gorgonians and low reef sites, water very turbid. Seagrass meadows in some bays”[12]. Specifically, Lindeman Island’s Marine Environment is characterised by sandy beaches, Rocky intertidal zones, fringing coral reefs, soft bottom areas and soft sea grass areas[13].

Fringing Coral Reef

According to aerial imagery, fringing coral reefs exist on rocky outcrops surrounding Lindeman Island. These coral reefs extend at variable distances from the shoreline from approximately 20 to 100m. Since 2013, there has been four (4) marine ecology surveys conducted for the marine environments surrounding Lindeman Island. During 2013, BMT WBM conducted the first marine ecology survey consisted of four (4) survey locations. The survey determined that the coral cover at these survey points was variable from <25% to 100% adjacent to the existing resort jetty. Subsequent

[10] Queensland Government, 2017, Regional Ecosystem Details for 8.12.13a

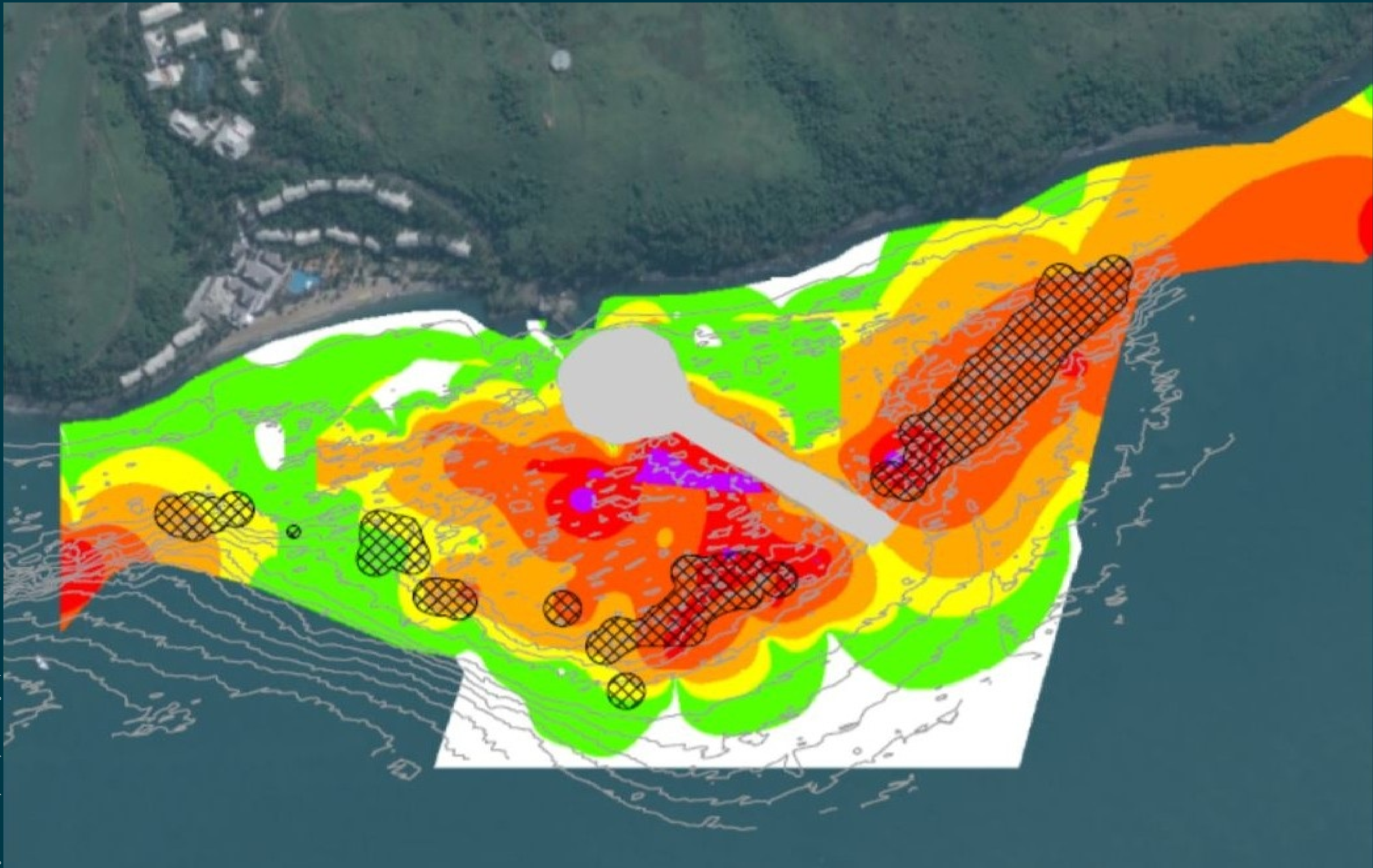
[11] Queensland Government, 2017, Regional Ecosystem Details for 8.12.14c

[12] Great Barrier Reef Marine Park Authority. 2002. *Non-reef bioregion: NB6 Inner Shelf Lagoon Continental Islands,* GBRMPA, Townsville, viewed 31 July 2018, http://www.gbrmpa.gov.au/__data/assets/pdf_file/0016/6082/nb6.pdf

[13] Cardno Qld Pty Ltd, 2017, Lindeman Great Barrier Reef Resort Project - Marine Ecology Assessment, Level 11 Green Square North Tower, 515 St Paul’s Terrace, Fortitude Valley QLD.

surveys conducted by the Great Barrier Reef Marine Park Authority (GBRMPA) and Cardno, confirmed the coral density of the previous survey (Figure 6)[13,14].

[14] The details of this figure have been sourced from the Environmental Impact Statement (EIS) prepared by Cardno (QLD) Pty Ltd. NGH/Fyfe does not own any intellectual property contained within this figure.



Datum: WGS 84

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Lindeman Island Water Monitoring

Figure 6 - Coral Distribution Adjacent to Jetty

4. Potential Water Quality Impacts

The nature of the construction and operational activities may have potential impacts to the receiving environments water quality. Development activities and their associated potential impacts are summarised in Table 3.

Table 3 Potential Impacts and Contaminants

Activity	Potential Impacts	Water Quality Contaminants
Construction activities	Increased turbidity due to soil loss and erosion control failures. Elevated suspended sediment loads, which can have adverse impacts on coral reefs. Disturbance of acid sulfate soils.	pH, sulphate, suspended solids, turbidity, toxicants (metals/metalloids and other chemicals).
Sewage effluent (treated)	Increased nutrient loads. Increased biological oxygen demand, leading to the potential asphyxiation of aquatic animal life (e.g. low dissolved oxygen), algal blooms, smothering of flora and fauna, impairment of ecosystem structure and function, and public health risks.	Nutrients, pathogens, suspended solids, toxicants (metals/metalloids, pesticides, residual disinfectants and pharmaceuticals).
Golf course and landscaping irrigation	Increased nutrient loads, pesticides and asphyxiation of aquatic animal life (e.g. low dissolved oxygen levels leading to fish kills). Eutrophication leading to algal blooms, smothering of flora and fauna, impairment of ecosystem structure and function, diseases and introduced species.	pH, nutrients (ammonia, nitrate, phosphorus), pesticides, and other chemicals), suspended solids, and carbonaceous material.

4.1. Characteristics of Any Releases

The quality and quantity of any discharge from the above activities discharging into the receiving environments difficult to determine, as they will only occur during event runoffs, or failures in management controls. Strict management plans will be in place to prevent, control or abate the release of contaminated water or to mitigate the impacts through alternative release strategies. Water specific plans for the project include:

- Irrigation Management Plan;
- Lindeman Stormwater Management Plan and Water Balance; and
- Waste Management Technical Report

Additional water specific management plans are yet to be prepared.

Discharge into the receiving environment would be diffuse land runoff. In the event of runoff or spills, contaminants of concern will be conveyed into gullies, drainage features, and intermittent streams of the island, prior to being discharged into the Marine Park.

4.2. Release Locations and Configuration

4.2.1. Stormwater

Stormwater from the development includes runoff from vegetated areas including constructed gardens, golf courses and natural vegetation as well as impervious surfaces (e.g. paths, roads, roofs, hardstands etc.).

Currently, runoff intersects vegetated swales located around the site. These swales provide some polishing of runoff prior to discharge into the receiving environment via existing watercourses. No other treatment of stormwater currently occurs[15].

The development will involve the disturbance of soil. An Erosion and Sediment Control Plan (ESCP) is required to be prepared to take all reasonable and practicable measures, to minimise short and long-term soil erosion and the adverse effects of sediment and/or pollutant transport on the receiving environment. This includes the delineation of watershed direction, quality and quantity. As of the preparation of this WQMP, an ESCP is yet to be prepared for the Lindeman Great Barrier Reef Resort.

The location of these sedimentation basins and the configuration of the additional treatment features are yet be determined. It is assumed that following primary and secondary treatment, discharge from the detention basins will be discharged into the receiving environment[15].

4.2.2. Sewage Effluent

Sewage produced by the development is to be treated onsite. Wastewater generated will be collected and pumped to the new wastewater treatment plant. The treatment plant will consist of a membrane bioreactor capable of producing Class A^+ recycled water. Once treated, wastewater is to be held within a 15ML storage tank. The treated wastewater will be either returned to the resorts for non-potable use or will be used for irrigation on landscaped areas and the golf

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[15] Cardno QLD Pty Ltd, 2017, Lindeman Great barrier Reef Resort Project – Environmental Impact Statement: Appendix P Lindeman Stormwater Management Plan and Water Balance.

course. As there are limited industrial uses, it has been determined that Biosolids are to be collected, dried, treated and transported to the mainland for use in soil amelioration.

As per the Coordinator Generals Report "*Modelling indicates, based on 100 per cent occupancy of the resort, with an irrigation area of 11.88 ha, an irrigation rate of 5.6 ML/ha/year and a storage of 15 ML, that zero overflows or discharges are anticipated, with less than 4mm run-off each year. MEDLI modelling shows the receiving environment has the capacity to handle the proposed application rate*".

In the event of plant failure or adverse climatic conditions, the following contingency measures are committed:

- Additional individual collection tanks;
- 100% stand by pumping capacity;
- Emergency by [pass connection points in accordance with the MRC Guidelines;
- Mechanical failure alarm;
- Backup power supplies; and
- Emergency storage capacity incorporated into the pump well[16].

In the event that all management measure fails, it is expected that effluent will discharge into the storage dam. In the event that the dam overflows, wastewater will flow into the receiving environment via the ephemeral streams.

In addition, sewage may be released from the increased number of moored vessels which may increase as a result of the development.

4.2.3. Golf Course and Landscaping Contaminants

The implications of impacts on surface waters of irrigation and maintenance of the golf course and landscapes is related to the application of fertilizers and pesticides. Pesticides are biologically active compounds designed to interfere with metabolic processes.

Pesticides commonly used in golf courses and landscaping include:

- Organophosphates (e.g. Round up);
- Fungicides;
- Other broad-spectrum herbicides.

The fate of most of the chemicals is expected to be captured in water features of the golf course, and the main lake.

Pesticides commonly cited in water quality guidelines such as: atrazine, diuron, ametryn, etc., are primarily applied in large scale agriculture. Although they may be present due to catchment land use, it is not considered necessary to monitor due to not being associated with the development.

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[16] State of Queensland: The Department of State Development, Manufacturing, Infrastructure and Planning, 2018, Lindeman Great Barrier Reef Resort project: Coordinator-General's evaluation report on the environmental impact statement,

4.3. Negligible Contaminants

Several other potential contaminants were considered, however the likelihood of increased loads and therefore potential risks associated with them, was considered negligible. These include:

- petroleum hydrocarbons, primary due to small scale spills of diesel or fuel oils from small vessels and moored larger vessels; and
- anti-fouling coating residues, containing biocides. These are predominantly used on large commercial vessels and ships, and have been banned in Australia since 2008.

5. Receiving Environment Values

Potentially impacted water includes both intermittent ephemeral streams and surface water of the island, and the coastal and marine waters of the Conservation Park Zone of the Marine Park under the *Great Barrier Reef Marine Park Zoning Plan 2003* and within the Conservation Park Zone of the Queensland Coast Marine Park under the *Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004*.

ANZECC and ARMCANZ (2000) guidelines prescribe the six environmental values for consideration as:

- Aquatic ecosystems;
- Primary industries (irrigation and general water users, stock drinking water, aquaculture, and human consumption of aquatic foods);
- Recreation and aesthetics (primary recreation, secondary recreation, visual appreciation);
- Drinking water;
- Industrial water; and
- Cultural and spiritual values.

Environmental values for specific receiving waters in Queensland are defined under Schedule 1 *Environmental values and water quality objectives for waters* of the *Environmental Protection (Water) Policy 2009* (EPP Water).

Water of Lindeman Island relevant to the development of the resort includes:

- Mackay Whitsunday coastal waters – Whitsunday Islands Fresh Waters; and
- Mackay Whitsunday coastal waters – Coastal waters landward of plume – Open coastal waters.

The EPP Water scheduled values for surface water for the receiving environment is described in Table 4.

Table 4 Environmental Values for Lindeman Island Waters

Waterway Name	Environmental Values	Relevance to Monitoring Program
Whitsunday Islands fresh waters	Aquatic ecosystems – moderately disturbed (MD)	Intermittent streams of the island may contain biological diversity.
	Irrigation	Irrigation of golf course and landscaped amenity will be required from storage dam.
	Secondary recreation	Island fresh waters are used for secondary contact activities such as hiking, bushwalking, general enjoyment.
	Visual recreation	Island fresh waters are part or and connected to the Lindeman Island National park, and have high visual amenity value.
	Drinking water	This is potentially relevant to the water contained in the storage dam, which may be treated for use as drinking water.
	Cultural and spiritual values	Traditional owners of the monitoring area are the Ngaro people. Results of the assessment area relevant to this study.
Whitsunday Islands coastal and marine waters SD2381 Open coastal waters	Aquatic ecosystems – slightly disturbed (SD)	Biodiversity values of the receiving environment include fringing coral reefs and Great Barrier Reef World Heritage Area.
	Primary recreation	Receiving marine waters are used for primary contact activities such as swimming, snorkelling, diving, and water sports. Free from faecal contamination and poor visibility.
	Secondary recreation	Receiving marine waters are used for secondary contact activities such as boating and fishing. Protection of water to maintain fish habitat and safety is important.
	Visual recreation	Waters part of Great Barrier Reef World Heritage Area and have high visual amenity value. Receiving water should be free of visual impacts such as floating debris, oil, grease, and other objectionable matter. Protect receiving waters from algal blooms.
	Drinking water	Reverse osmosis (desalination) plants may be in use to treat sea water for drinking water.
	Cultural and spiritual values	Traditional owners of the monitoring area are the Ngaro people. Results of the assessment area relevant to this study.

5.1. Water Quality Objectives

This monitoring program adopts the scheduled water quality objectives (WQO) in the absence of more locally applicable baseline data. To ensure that all of the environmental values identified are protected, the most stringent guidelines were selected.

Following the pre-development baseline monitoring, locally significant guideline values may be developed for all parameters to be analysed based upon the data collected during baseline monitoring. In accordance with the Queensland Water Quality Guidelines, the 20th and 80th percentiles will be calculated to form guideline values against which monitoring data obtained during construction and operational monitoring can be compared. Subsequent monitoring data will then be plotted against these guideline values.

5.1.1. Whitsunday Islands Fresh Water

As per Section 3.5.1, watershed on Lindeman Island is dominated by ephemeral streams which flow intermittently dependant on seasonal variation. Generally environmental values for specific waters in Queensland are defined under Schedule 1 *Environmental values and water quality objectives for waters* of the *Environmental Protection (Water) Policy 2009.* Schedule 1 was reviewed and found that no environmental values or water quality objectives have been identified specifically for ephemeral waters.

The application of water quality objectives to ephemeral waters is defined as problematic. As flow decreases during seasonal change, water quality of the stream becomes less dependent on upstream flow and more dependent on local influences. As the stream ceases flow, and local influences increase, water quality between segregated waterholes within the stream can vary significantly.

Physical parameters can become highly variable within waterholes formed by the cease of stream flow. The size of waterholes tends to define the extent of variation in physical parameters. Specifically, the stagnation and stratification of waterholes can give rise to highly variable pH values. Therefore, the application of the guidelines for these indicators to waterholes in non-flow conditions may be inappropriate. However, larger waterholes may express water quality values similar to perennial streams.

Indicators such as nutrients could also be affected by non-flow conditions. Smaller waterholes tend to exhibit increased levels of organic N while larger waterholes would not undergo large variations. In addition, biological indicators can also be affected by non-flow events. Smaller waterholes tend have lower species diversity due to lack of resources.

While waterholes within ephemeral streams are often of lower quality than flowing streams, they often serve as an important resource for species when resources are limited. According to the ANZECC 2000 guidelines, there is ongoing studies into the development of better indicators for ephemeral streams. However, currently there is a lack good data on these stream types while not offering adequate advice on the issue.

However, as per the *Environmental Protection (Water) Policy 2009* for the *Proserpine River, Whitsunday Island and O'Connell River Basins*, in the absence of locally applicable information, the 20th, 50th and 80th percentiles for Whitsunday Islands fresh waters are to be based on the WQOs sourced from Repulse Creek Sub-catchment (for moderately disturbed ecosystems). All applicable objectives are displayed in Table 5.

Lindeman Island does contain one (1) perennial fresh water source, the water storage dam, for which the WQOs defined in Table 5 have also applied.

Table 5 Baseflow Water Quality Objectives

Parameter	Water Quality Objective
Dissolved Inorganic Nitrogen (µg/L)	< 31
Particulate Nitrogen (µg/L)	< 52
Filterable Reactive Phosphorus (µg/L)	< 15
Particulate Phosphorus (µg/L)	< 17
Dissolved Oxygen (%)	**No-flow**: 20th and 80th percentile: 50%–120% saturation **Flow**: 20th and 80th percentile: 90%–105% saturation
Suspended Solids (mg/L)	< 3
pH	7.2–7.6
Electrical Conductivity (µS/cm)	< 780
Ametryn	< LOD
Atrazine	< LOD
Diuron	< LOD
Tebuthiuron	< LOD
Organophosphorus pesticides	As per ANZECC
Intestinal enterococci (/100mL)	95^{th} percentile – 40 organisms per 100 mL
Cyanobacteria/algae	**Level 1**: ≥10 µg/L total microcystins; or 50,000 cells/mL toxic Microcystis aeruginosa; or biovolume equivalent of ≥ 4 mm^3/L **Level 2**: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present

5.1.2. Whitsunday Islands Open Coastal Waters – Slightly to moderately disturbed

The WQOs applicable to the marine receiving environment are outlined in Table 6. Lindeman Island is situated within Open Coastal Waters section of Great Barrier Reef Marine Park Conservation Park Zone under the *Great Barrier Reef Marine Park Zoning Plan 2003.* The site is located within Reef Bioregion RHC High Continental Island defined as *"Geomorphologically unique. Both cross-shelf and north/south gradient in benthic communities. Species-poor, muddy reefs close to the Proserpine River. Unique and very fragile hard and soft coral communities in the inlets"*[17]*.* The Island is within the "plume line" and is subject to variations in physical and chemical parameters resulting from poor land management, erosion, pollutants from the continent and rainfall.

The *Environmental Protection (Water) Policy 2009* - Whitsunday Islands coastal and marine waters (including Whitsunday, Lindeman groups, Circular Quay Reef) outlines environmental values for the marine waters surrounding Lindeman Island.

[17] Great Barrier Reef Marine Park Authority, 2001, Bioregions of the Great Barrier Reef World Heritage Area, Townsville, Queensland.

Table 6 Open coastal waters landward of the plume line WQOs

Parameter	Water Quality Objective
Particulate N (annual mean)	≤ 20µg/L
Particulate P (annual mean)	≤ 2.8 µg/L
Chlorophyll-*a* (annual mean)	≤ 0.45 µg/L
Dissolved Oxygen	95–105 % saturation
Turbidity (median)	<1 NTU
Secchi Depth (annual mean)	(annual mean): ≥ 10 m
Suspended Solids (annual mean)	(annual mean): ≤ 2.0 mg/L
pH	8.1–8.4
Temperature	<1˚C increase above long-term average maximum
Ametryn	<0.5 µg/L
Atrazine	<0.6 µg/L
Diuron	<0.9 µg/L
Hexazinone	<1.2 µg/L
Tebuthiuron	<0.02 µg/L
Tributyltin	<0.0004 µg/L
Organophosphorus pesticides	As per ANZECC

6. Marine Water Quality Monitoring Program

6.1. Monitoring Program Design

The Program adopts a long term before-after, control-impact (BACI) design and includes a combination of replicated sampling in time and replicated sampling at appropriate spatial scales to determine impacts and consider natural variation. The BACI design will measure change using statistical analysis, which is sufficient to deal with the often non-normally distributed data. The proposed BACI design introduces methods to estimate the natural variability and measure the potential or actual changes in the receiving environment.

The program design is prepared to examine the interactions in time between the potential impact sites (BAC**I**) and a set of control (BA**C**I) locations. The statistical analysis will demonstrate whether the interactions between the impacted sites and control sites, are statistically different from the naturally occurring interactions

in time among the control sites. The purpose of the analysis of natural variation in space and time is to identify whether a small impact is or is not within the bounds of what occurs naturally. In the event that there is evidence of an impact that is outside of natural variability, it will act as a trigger for management or remedial action in accordance with the reporting framework identified later in this WQMP.

6.2. Baseline versus Construction/Operation Monitoring

Water quality monitoring will be broken into two (2) distinct phases:

1. Pre-development (Baseline) Monitoring
    a. Ambient monitoring; and
    b. Event monitoring.
2. Construction / Operational Monitoring
    a. Ambient monitoring; and
    b. Event monitoring

Baseline monitoring is necessary to characterise the receiving waters prior to disturbance and characterise the baseline. Results of the baseline monitoring can be used to compare water quality results during construction and operational phases.

6.3. Objectives

The objectives of the Marine Water Quality Monitoring Program are:

- to ensure that there are no negative impacts on Great Barrier Reef World Heritage Area and National Heritage Place, and Great Barrier Reef Marine Park water quality to protect environmental values of ecosystems, habitats and species on which they rely;
- identify suitable monitoring locations for potentially impacted sites and control/ reference sites;
- describe the pre-development baseline condition of the water quality in the receiving environment at both the potentially impacted locations and control locations;
- identify water quality threshold levels that may result in a negative impact on the water quality values;

- identify water quality objectives, which are suitable for protecting the environmental values of the receiving waters;
- detail an appropriate monitoring methodology which includes robust statistical assessment and quality assurance and control;
- identify the threshold levels that will require a management response; and
- include details of ongoing monitoring to be implemented.

6.4. Proposed Monitoring Parameters

Water quality parameters that will be measured at each monitoring location during each monitoring event, are based on the listed contaminants of concern in the foregoing information and are related to the possible contaminants from the construction and operation of the development. Parameters to be analysed are specified in Table 7.

Table 7 Parameters to be analysed

Parameter		Units	Analysis
Physical	Temperature	°C	In-situ/Automatic
	pH	pH	
	Total Suspended Solids	mg/L	
	Dissolved Oxygen	%	
	Electrical Conductivity/Salinity	EC	
	Turbidity	NTU	In-situ
	Secchi Depth	m	
Chemical	Total Dissolved Solids	mg/L	Laboratory
	Total Nitrogen	mg/L	
	Ammonia	mg/L	
	Oxidised Nitrogen	mg/L	
	Total Phosphorus	mg/L	
	Reactive Phosphorus	mg/L	
	Organophosphorus Pesticides	µg/L	
Biological	Faecal Coliforms	CFU/100 mL	Laboratory
	HPC	CFU/100 mL	
	Total Coliforms	CFU/100 mL	
	E. coli	CFU/100 mL	

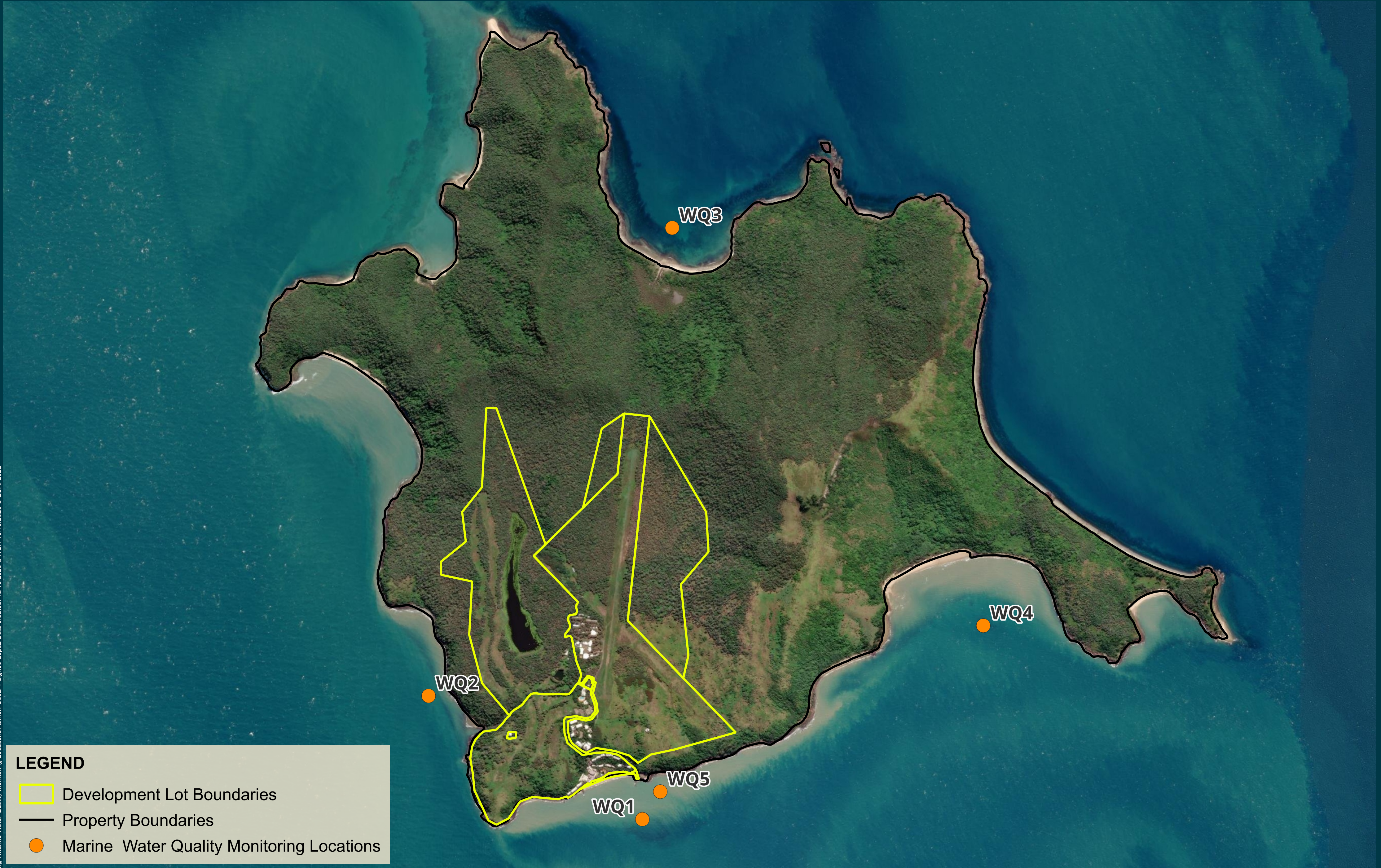
6.5. Sampling Locations

The sampling locations for the baseline pre-development (ambient) water quality monitoring and the construction/operational phase monitoring have been selected to capture water quality data within the most sensitive receiving environment (fringing coral reefs).

The sampling locations are shown Figure 7 and outlined in Table 8.

Table 8 Marine Sampling Locations

Sampling Point	Description	Treatment	Method	Latitude	Longitude
WQ1	Approx. 200m off Home Beach over the fringing coral reef	Impact	Grab	-20.460800°	149.040717°
WQ2	Approx. 70m off the western Lindeman Island coast	Impact	Grab	-20.455917°	149.031700°
WQ3	Approx. 100m off Gap Beach	Control	Grab	-20.437400°	149.041967°
WQ4	Approximately 300m off unnamed beach 1.7km from the existing resort	Control	Grab	-20.453133°	149.055100°
WQ5	Resort Access Jetty approx. 100m from Home Beach	Impact	Automatic	-20.459717°	149.041450°



Datum: WGS 84

0 250 500 750 1,000 m

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Lindeman Island Water Monitoring

Figure 7 - Marine Water Quality Monitoring Locations

Ref: Lindeman Island Water Monitoring \ Marine Water Quality Monitoring Locations Author: Oscar Puignou Lopez Date created: 13/10/2025 © NGH 13/10/2025 © ESRI 2022

6.6. Sampling Frequency

The sampling frequency for the MWQMP is to be divided into Pre-development (Baseline) Monitoring, and Construction/Operational Phase Monitoring. The sampling frequencies for both phases have been summarised in Table 9 and Table 10.

Table 9 Marine Monitoring Frequency - Predevelopment

Parameter	Method	Interval
Temperature	Fixed Continuous	Hourly
Electrical Conductivity		
Temperature	Grab/in-situ	Monthly 2x High Rainfall Event Monitoring Post-Cyclonic Event
pH		
Total Suspended Solids		
Electrical Conductivity		
Dissolved Oxygen		
Turbidity		
Secchi		
Total Dissolved Solids		
Total Nitrogen		
Ammonia		
Nitrite and Nitrate		
Oxidised Nitrogen		
Total Phosphorus		
Reactive Phosphorus		
Faecal Coliforms		Quarterly 2x High Rainfall Event Monitoring Post-Cyclonic Event
HPC		
Total Coliforms		
E. coli		
Organophosphorus pesticides		

Table 10 Marine Monitoring Frequency – Construction/Operational

Parameter	Method	Interval
Temperature	Fixed Continuous	Hourly
Electrical Conductivity		
Temperature	Grab/in-situ	Quarterly 2x High Rainfall Event Monitoring Post-Cyclonic Event
pH		
Total Suspended Solids		
Electrical Conductivity		
Dissolved Oxygen		
Turbidity		
Secchi		
Total Dissolved Solids		
Total Nitrogen		
Ammonia		
Nitrite and Nitrate		
Oxidised Nitrogen		
Total Phosphorus		
Reactive Phosphorus		
Faecal Coliforms		
HPC		
Total Coliforms		
E. coli		
Organophosphorus pesticides		

6.6.1. Pre-Development Sampling

Ambient sampling will be conducted:

- monthly for physical parameters and nutrients; and
- quarterly for pesticides and biological parameters.

The pre-development baseline monitoring program will be conducted for at least 12 months prior to the commencement of construction.

Construction means construction of any infrastructure, any preparatory works required to be undertaken including clearing vegetation, the erection of any onsite temporary structures and the use of heavy-duty equipment for the purpose of breaking the ground for buildings or infrastructure. Construction excludes erecting fences, signage, and upgrade of the jetty.

6.6.2. Event Sampling

Rainfall Events

High rainfall events will be monitored to determine the direct impact that rainfall events have on receiving waters. Consideration is given to the determination of rainfall events which are likely to generate adequate flows and runoff to enable samples to be collected. The objective is to ensure enough sampling of runoff events occurs to adequately characterise event flows and impacts during pre-development baseline conditions.

Given the remoteness and difficulty for accessing the site to conduct water quality monitoring, collection of samples during every rainfall event is not technically feasible. Monitoring will be undertaken in relation to at least two separate high rainfall events each year.

For the classification of a ‘high rainfall event’, it is expected that site-based experience will provide further information. However, for the baseline study, the intensity and duration of rainfall to be classified as an event, has been determined using the Bureau of Meteorology’s 2016 Intensity–Frequency–Duration (IFD) data system. The IFD data system calculates design rainfalls using a database comprising rainfall data from the BOM’s network of weather stations and subjects the data to a variety of statistical analyses.

For the calculation of the Lindeman Great Barrier Reef Resort design rainfall, the following conditions were applied to the IFD data system:

- Design rainfall – Very Frequent being “design rainfalls with probabilities from 2 to 12 exceedances per year”.
- Standard duration – 24 hours
- 6 exceedances per year (EY) being “the number of times an event is likely to occur or be exceeded within any given year.”[18]

Using the above conditions, the Design Rainfall has been determined as 52.1mm. Therefore, high rainfall event monitoring will be undertaken for at least two separate non-cyclonic rainfall events that produce >52.1 mm of

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[18] Australian Government – Bureau of Meteorology, 2018, Intensity, Frequency, Duration – 2016 IFDs(new):Frequently Asked Questions, Available Online, http://www.bom.gov.au/water/designRainfalls/ifd/ifd-faq.shtml#sec1q5, Accessed 22/08/2018.

precipitation over a 24-hour period. A total of two **non-cyclonic** rainfall events are to be monitored during the calendar year.

Environmental personnel will monitor weather reports from Bureau of Meteorology's Hamilton Island weather station (Station 033255). If a rainfall event >52.1mm/24hrs is identified from weather data, event sampling will be triggered. When safe to do so, environmental personnel will attend the development site and sample the receiving environment monitoring locations (Figure 7).

Cyclonic Events

It is acknowledged that event rainfall is not the only contributing factor to receiving water quality. In the wet tropics, Tropical Cyclones are a frequent occurrence. The Australian Bureau of Meteorology (BOM) classifies Tropical Cyclones as non-frontal low-pressure systems of synoptic scale, which express an organised clockwise wind convection and a mean wind speed of 34 knots or greater, extending more than halfway around near the centre, persisting for greater than six (6) hours[19]. The BOM monitor each tropical low and will issue a tropical cyclone warning if the criteria above are fulfilled. Cyclones often will express a sporadic path, and it is historically difficult to track and predict cyclonic direction and speed.

Given that cyclones deliver very intense rainfall and wind over a relatively short timeframe, event sampling will be required for **each cyclonic event**. Cyclonic event sampling will occur when:

- the development is directly impacted by a cyclone; or
- the development is within the convectional cloud mass and subject to intense rainfall, yet not subject to the associated cyclonic winds (34 knots or greater).

Environmental personnel will monitor live rainfall data and wind conditions leading up to, and during cyclonic events from a safe location. If it is determined that the development is directly or indirectly influenced by a cyclone, event monitoring will be scheduled. **When safe to do so**, environmental personnel will attend the development site, and sample the receiving environment monitoring locations, usually within 7 days of the cyclones passing.

As cyclones are associated with destructive winds, there is a risk that in-situ equipment may be damaged. Therefore, the automatic multiparameter sonde established at WQ5, will be removed prior to the cyclone potentially impacting the development. Construction/Operational Staff are to be trained in the retrieval and disconnection of the Sonde. The Sonde will be stored in a safe location until the storm dissipates. The multiparameter sonde will be re-established by environmental technicians during the event sampling event if it is safe to do so. In addition, In-situ analysis also will occur at WQ5 during sonde recommissioning.

6.6.3. Ambient Salinity Monitoring

Sample point WQ5 is to be established to analyse physical parameters including salinity, temperature, and electrical conductivity automatically at set intervals. Analysis is to be conducted automatically via a calibrated automatic water quality analysis sonde. The sonde will be established to a fixed structure to ensure its survival during extreme climatic conditions. With the Lindeman Jetty positioned within the receiving environment between the fringing reef and the shoreline, it has been determined as the event monitoring location.

[19] Australian Government Bureau of Meteorology, 2018, About Tropical Cyclones – What is a Tropical Cyclone? Available Online, http://www.bom.gov.au/cyclone/about/, Accessed 21/08/2018.

Prior to establishment, a suitably qualified environmental professional will calibrate and format the device to sample at the preferred interval (Table 9; Table 10). The sonde will be protected by PVC casing and attached to the Jetty. Installation will be conducted by a fully qualified environmental professional during the first sampling event of the pre-development phase monitoring. The installation will consist of the following:

- The depth of the sonde will be determined as 1m off the sea bed.
- PVC casing of appropriate diameter shall be cut to the appropriate length (top of jetty to 1m below the maximum low tide mark).
- Slots will be cut at approximately 30mm intervals, perpendicular to the PVC orientation for 1m upwards from the base of the PCV casing.
- The slotted PVC casing shall be attached to the jetty using appropriate fastening devices.
- The sonde will be lowered into the PVC casing to commence monitoring.
- A GPS location of monitoring point shall be taken.

Analysis retrieval will be via a transmitter/data receiver fixed to the top of the jetty. Data will be collected using a handheld data receiver during monthly/quarterly sampling events.

6.6.4. Incident Monitoring

If construction and/or operational staff suspect or observe any of the contaminants (including contaminants listed in Section 6.4) entering waterways within the development area, the project manager will be notified immediately. Personnel shall contain the contamination as per the allocated incident response procedures. Once the damage to waterways has been mitigated, a qualified environmental professional will conduct a site inspection to determine the potential for adverse effects on the receiving environments. This inspection shall involve additional sampling of the receiving waters directly affected by potential contamination. Parameters to be monitored are dependent on the type of incident contaminant and shall also include parameters not included in routine monitoring procedures which may have been affected.

Ongoing monitoring is to continue until such a time that it is determined that contamination is no longer present or an evaluation by a suitably qualified person determines that monitoring in relation to the incident is no longer required.

In the event of an incident, the incident reporting procedures in accordance with section 10.3 of this plan are to be followed.

6.7. Sampling and Analysis Methodology

6.7.1. Sample Collection

Water sampling is to be undertaken in accordance with the methods specified in the Australian Standard for

Water Quality Sampling – AS/NZS 5667.1:1998 and the Department of Environment and Heritage Protection's Monitoring and Sampling Manual 2018 (or subsequent versions as updated from time to time) for monitoring locations WQ1 - 4.

Grab Sampling

For samples requiring in-situ and laboratory analysis, manual grab samples will be taken using a suitable sampling container. Sampling will be undertaken using the following methodology derived from the Department of Environment and Heritage Protection (DEHP) Monitoring and Sampling Manual 2009:

1. Remove the lid from a 1 L sample bottle and attach the bottle to the end of a sampling pole.
2. Extend the sampling pole into water. Submerge the bottle to a depth of at least 0.3 m, keeping the mouth end pointing down.
3. Whilst submerged, rotate the sampling pole 180 degrees to bring the mouth of the bottle facing up, and allow the bottle to fill with water; and retrieve bottle.
4. Replace the lid and shake the bottle ensuring the inside of the bottle and the lid come into contact with the liquid. Discard the rinse liquid down current of where you are sampling. Be sure to keep hands away from the mouth of the bottle and the underside of the lid.
5. Repeat steps 3 to 4 so that the sample bottle and its lid are rinsed twice with sea water then proceed to step 6.
6. Repeat step 1 to 3 to fill the bottle. If samples require in-situ analysis, samples can be directly analysed from battle using calibrated water quality meters/sondes. If samples require laboratory analysis, sample bottles are to be sealed and stored appropriately. If sample requires freezing, ensure you leave 10–20 per cent space free.

6.7.2. In-situ Parameter Analysis

In-situ water quality will be sampled using a hand-held electronic multi-parameter water quality meter. In-situ parameters will include at a minimum, the parameters listed in Table 7 identified as in-situ. In-situ water quality measurements will be collected in a scientifically robust manner. Users will be familiar with the equipment, and the calibration methods for each meter. Calibration of water quality meters will be conducted in accordance with best practice and manufacturers instruction. Meters will be checked, maintained and calibration recorded before deploying meters for sampling.

6.7.3. Storage and Transportation

All samples are to be stored in a clean cooler box on ice or equivalent refrigerated conditions at approximately 4°C. All samples will be delivered to the NATA accredited Laboratory within the recommended holding times as specified by the laboratory. Any non-conformance must be documented on the Chain of Custody document.

6.7.4. Laboratory Analysis

Once samples requiring laboratory analysis are collected, stored and transported offsite, the samples will be taken to a NATA accredited laboratory for analysis. Samples will be analysed by accredited laboratory as per their analysis methodologies.

6.7.5. Quality Assurance

Quality assurance and quality control procedures will be implemented to ensure that samples and monitoring data is collected in a scientifically robust manner. Quality assurance procedures are required to consider appropriate laboratory holding times for sample delivery, ensuring that sample integrity is maintained.

6.7.6. Field QA/QC

Quality assurance and quality control measures will be generally in accordance with DEHP's Monitoring and Sampling Manual (2009), and Australian Standard for water quality sampling – AS/NZS 5667.1:1998.

The following specific methods will be employed in field sampling to ensure quality assurance and quality control (QA/QC) measures are implemented throughout all monitoring.

- sampling will be conducted by suitably qualified and experienced environmental staff who are competent in sampling and making field measurements (e.g. experience undertaking field tests);
- prior to sampling – laboratory pre-cleaning of all sample containers, and cleaning of sample equipment;
- all equipment and field instruments will be appropriately maintained, and calibrations and preventative maintenance will be recorded carefully;
- samples will be collected in appropriately cleaned, pre-treated (if required), and labelled sample containers that are provided by the analytical laboratory;
- during field sampling, a register will be filled out, which contains the following information:
  - sample number;
  - sample site;
  - sample technique;
  - time;
  - weather;
  - issues with sample;
  - contamination;
  - date; and
  - technician.
- transportation of samples will occur under a chain of custody documentation procedure;
- chain-of-custody (COC) forms that list all sample numbers and locations will accompany each sample to the laboratory. At each stage of handling, samples are to be checked against the COC forms; and
- where holding times are breached, these instances will be documented.

Field quality control samples

Replicates, and quality control samples will be in accordance with the Australian Standard for water quality sampling – AS/NZS 5667.1:1998.

Field replicate

To determine potential errors in the methodology or cross contamination issues during the sampling and/ or during the transport process, a replicate sample will be randomly selected to be taken during each sampling exercise. This provides the experimental sampling error and thus a measure of the sampling precision.

A replicate sample is defined as the collection of a separate sample from the same location, at the same time.

Sample contamination blanks

Field and transport blanks will be collected once per calendar year to assess sample contamination which may occur during the collection, transportation, or storage of the sample. If sample contamination is identified, additional sample contamination assessment will be conducted.

6.7.7. Laboratory QA/QC

Laboratory QA/QC procedures will be carried out in accordance with the Queensland Monitoring and Sampling Manual 2009 - Environmental Protection (Water) Policy 2009.

Laboratory QA/QC procedures will be appropriate for the potentially low concentration of some water quality parameters and ensure satisfactory limits of reporting to enable detection of limits consistent with the water quality objectives.

In addition to the laboratories own internal procedures, one laboratory blank sample will be analysed with each sample submission to ensure quality assurance.

7. Analysis

Environmental impacts on water quality are often measured in two distinct ways:

1. Assessment of concentrations against receiving environment water quality objectives or trigger values; and
2. Assessment of whether contaminants have reached a level beyond those within the natural (variable) range.

Data from the sampling program will be analysed against the guideline's values but also analysed by statistical analysis for determining environmental impacts during construction and operations.

7.1. Derive Trigger Values

Following the completion of baseline studies, trigger values will be derived and compared with the existing water quality objectives. The site-specific trigger values will then be used to compare construction and operation water quality values and trigger management action.

Results of the 12-month baseline monitoring and associated baseline determinations of trigger levels will be reviewed by an independent expert. A copy of the independent peer review and the revised plan shall be provided to the Department of the Environment and Energy, prior to the commencement of construction activities. The independent peer review will include a review of baseline data, trigger levels for corrective actions, corrective actions and any proposed changes to monitoring methodologies.

The revised plan will identify threshold levels and duration of change in water quality values of the receiving environment that would constitute a significant impact on identified water quality values.

The revised plan and peer review shall be published on the White Horse Australia website.

7.2. Statistical Test of Impact

The purpose of the statistical analysis, aside from analysing the basic statistics from the monitoring program, is to inform an impact assessment to measure the difference between the impacted and control locations. In simple terms, an impact requires there to be a greater difference between the impacted and control locations than is generally among the controls.

7.3. Statistical Design and Methods for the Monitoring Program

The statistical analysis will be conducted using a three-factor mixed model being phase, treatment, and site:

1. Phase
    a. Fixed with two levels of analysis being before and after. Analysis will be unbalanced levels of replication (i.e. number of surveys done during Baseline is likely to be less than number done during operation due to the ongoing nature of the project).
2. Treatment- fixed, two levels:
    a. MWQMP Control (sites WQ3, WQ4) and Impact (WQ1, WQ2, WQ5).
    b. TWQMP Control (LIND02) and Impact (sites LIND01, LIND03, LIND04, LIND05, LIND06)
3. Site- random
    a. MWQMP 5 levels, nested in Treatment (i.e. 2 in control, 3 in impact)
    b. TWQMP 7 levels nested in Treatment (i.e. 1 in 6 in impact)

The advantage of including the ‘site’ factor is that smaller scale spatial trends would be able to be examined. For example, an impact (increase in some variable more than 10% above baseline) may not be picked within one treatment group but may be detectable on a particular site within the group.

Replication will be achieved by a combination of having multiple sites in each treatment group and/or by surveying multiple times.

Frequency may be refined after the baseline – factoring in how variable the data appears to be, logistics and preliminary analyses of temporal patterns. Depending on the data, the analysis may also include a ‘season’ attribute for each sample, as this may be useful in teasing out temporal patterns once discharge is occurring – e.g. impact may only be significant in the dry season, but not during the wet season or vice versa. The design of the analysis will also be reviewed by the independent expert at the 12-month review.

7.4. Suitability of the Statistical Design

The sampling program is considered to be sufficient to identify significant changes. In the event that the analysis shows the results are not significant, it does not mean that the disturbance has had no effect. Instead it indicates that whatever effects have occurred from the discharge are too small to cause any adverse impacts to water quality and therefore the associated environmental values identified as requiring monitoring.

The proposed statistical analysis is robust enough to calculate the differences between the mean concentrations in the impact and control locations and to analyse the difference from before to after in the means of these differences. In the event that the interaction between the difference in the means in the impact and control locations is significant compared to before and after discharge, an environmental impact will be evident.

8. Management Response Plan

Following the pre-development baseline monitoring program, during construction and operation, a reactive monitoring risk response program will be implemented to provide corrective actions against water quality objective exceedances (either locally derived values or set WQOs).

In the event of exceeding water quality triggers, or water quality controls being influenced or impacted by the resort activities, an investigative program will be undertaken to determine the source of non-compliance and implement corrective actions. To guide the decision-making process, the following flow chart will be used (Figure 8).

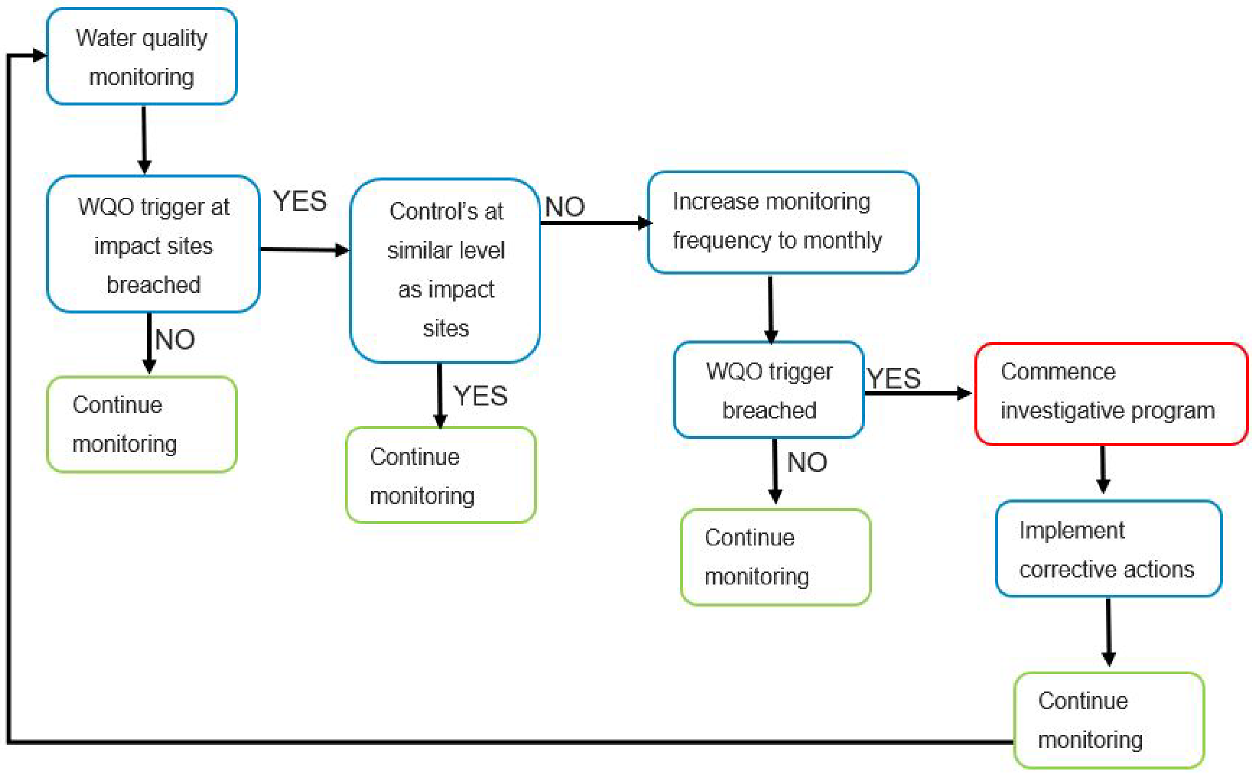

Figure 8 Management Response Framework

8.1. Investigative Program

In the event of exceedance of the nominated trigger values during water quality monitoring, the following investigative/ corrective actions will be undertaken within 72 hours, or as soon as the following can be conducted safely:

- Complete the site inspection form;
- Report on non-conformance;
- Implement necessary corrective actions.

Ideally, inspect the full perimeter of the site, but as a minimum, any current active stages of construction. Corrective actions shall be undertaken immediately in accordance with the recommendations of the results from the inspection form (Figure 9).

Non-compliance with the trigger limits and or water quality objectives will lead notify relevant government authorities. A review of non-compliances and corrective actions will be conducted at the 12-month review.

8.2. Corrective Actions

In the case that the WQMP does not achieve performance targets, corrective actions will be taken. Corrective action will be triggered if the Project does not achieve specified performance targets / outcomes.

Non-compliance with the trigger limits and or water quality objectives will lead to the following corrective actions:

- notify relevant government authorities;
- identification of source of non-compliance; and
- rectification of source of non-compliance if possible.

The Lindeman Island Resort Team is responsible for implementing the corrective actions and notification to the Department of Environment.

SITE INSPECTION FORM

LOCATION . . . .

INSPECTION OFFICER . . . .**DATE** . . . .

SIGNATURE . . . .

Legend: ☐ OK ☐ Not OK N/A Not applicable

Item	Performance criteria	Assessment
	Site establishment	
1	All erosion and sediment control structures in proper working order as per approved ESCP?	. . . .
2	All stormwater management controls implemented and working effectively?	. . . .
3	The construction site is clear of litter and unconfined rubbish.	. . . .
5	Site dust is being adequately controlled.	. . . .
6	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	. . . .
7	Up-slope “clean” water is being appropriately diverted around/through the site.	. . . .
54	Drainage lines are free of soil scour and sediment deposition.	. . . .
55	No areas of exposed soil need erosion control.	. . . .
56	Earth batters are free of “rill” erosion.	. . . .
58	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	. . . .
60	Sediment-laden stormwater is not simply flowing “around” the sediment fences or other sediment traps.	. . . .
63	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	. . . .
67	The site is adequately prepared for imminent storms.	. . . .
	Site and vegetation management	

Vegetation and/or landscape management plan is being appropriately implemented?	....
Landscaping chemicals (fertilisers and pesticides) are stored appropriately.	....
Adequate records being kept on chemical usage.	....
Material and waste management	
Chemicals and petroleum products are appropriately stored on site.	....
Adequate waste and litter receptors exist on site.	....
Waste water from construction activities such as wash water, de-watering operations, and dust control is being captured and treated.	....
No uncontrolled discharge from sewage treatment facility?	....

Comments and Action Plan

Figure 9 Site Inspection Form

9. Environmental Management Roles and Responsibilities

9.1. Roles and Responsibilities

The following roles may be subject to change once the project design and implementation is finalised. Position descriptions contain the responsibilities and accountabilities for environmental compliance and management for the WQMP.

9.1.1. Lindeman Island Resort Team

White Horse Australia Management Team refers to the General Manager, Construction Manager, Site Manager, or similar positions which may be filled from time to time.

The key role of the White Horse Australia Team is to review and endorse the WQMP and to ensure that adequate resources are available to comply with the monitoring requirements outlined in the WQMP. Generally, responsibilities include:

- where applicable, supervising the monitoring procedures recommended and implemented by the environmental personnel conducting monitoring;
- assign authorities and responsibilities for environmental compliance and management in accordance with the WQMP;
- ensure compliance with all legal requirements including requirements for development permits, and all other approvals;
- prioritise minimisation of potential impacts wherever possible; and
- taking ultimate responsibility for environmental impacts arising from the development and operation of the Project.

9.1.2. Project Environmental Advisor

The key role of the Project Environmental Consultant is to prepare, review, and assist with the implementation of the WQMP in line with any relevant approval conditions. Key responsibilities include:

- provide advice to White Horse Australia Management teams and personnel in relation to the environmental requirements under the WQMP;
- assist with the integration of WQMP into work procedures and practices;
- conduct induction training and tool box talks on environmental issues if required;
- conduct audits and compliance checks of environmental performance of the project in relation to the WQMP;
- manage monitoring and technical studies relating to the baseline and ongoing monitoring;
- raise corrective actions for any non-compliance with the WQMP or approval conditions, or in response to incident investigations;
- conduct incident investigations, report to White Horse Australia on environmental performance including compliance, non-compliance, and incidents and near misses with potential or actual environmental harm;
- compile environmental reports;

- advise White Horse Australia on changes to environmental legislation, policy, or other obligations and ensure these are incorporated into environmental compliance and management measures, and communicated to the project team from time to time;
- assist with any investigation into the potential causes of the exceedance and potential mitigation strategies; and
- review and update this WQMP from time to time in accordance with permitted conditions and generally in accordance with an adaptive management framework.

9.2. Environmental Training

Appropriate training and induction shall include, but not necessarily be limited to:

- training monitoring personnel to ensure that they are suitably trained and competent person to conduct the monitoring;
- sampling personnel are to be informed of any necessary precautions to be taken in sampling operations and have the appropriate training;
- raising awareness of onsite environmental management issues; and
- training on how to report on project compliance issues.

9.3. Emergency Contacts

Name: White Horse General Manager

Ph: TBA

E: TBA

10. Reporting

10.1. Annual Compliance Reporting

In accordance with EPBC 2015/7461, "*within three (3) months of every 12-month anniversary of the approval, the approval holder must publish a report on its website addressing compliance with each of the conditions of this approval, including implementation of monitoring plans as specified in the conditions. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published*".

An annual report will be prepared summarising the water quality monitoring results and details of the sampling and analysis undertaken.

10.2. Audit of Compliance

Upon the direction of the Minister, an independent audit of compliance with the conditions of approval must be conducted. This audit is to be conducted by an independent auditor and the audit criteria is to be approved by the minister prior to the audit commencement. Records maintained by WHAL, may be requested by the Department and/or an independent auditor in accordance with Section 458 of the EPBC Act or used to verify compliance with the conditions of approval.

10.3. Incident Reporting

If the construction/operations of the development results in a significant impact to water quality, White Horse Australia will notify the Department of the Environment and Energy within seven (7) days of the incident.

Incident response procedures are to be finalised and provided to the Department of Environment and Energy upon revision of this plan.

10.4. Review

Within 12 months of the completion of the pre-development baseline water quality monitoring, an updated version if this WQMP will be published on the White Horse Australia Website and provided to the Department of Environment and Energy. The amended WQMP will include but not be limited to:

- the results of the pre-development baseline monitoring program;
- identification of the significant impact thresholds as well as justification; and

identification of the level of change in water quality which trigger a management response.

11. Conclusion

This WQMP provides a comprehensive and scientifically robust water quality monitoring framework for the Lindeman Great Barrier Reef Resort. The WQMP provides a framework which describes monitoring of water quality compliance with the Water Quality Objectives to be determined as a part of the baseline (background) monitoring, for the listed environmental values. The program also provides a statistically defensible methodology for determining and quantifying potential impacts to the receiving environment.

The WQMP provides succinct details on the following:

- environmental values;
- potential impacts;
- contaminants of concern;
- parameters to be monitored;
- monitoring frequency;
- monitoring locations;
- sampling and analysis methodology;
- quality control;
- environmental Management responsibilities; and
- reporting requirements.

The WQMP details a baseline monitoring program consisting of at least 12 months sampling to be conducted prior to the commencement of construction and complies with the required number of monitoring locations for both the impact site and control sites.

Finally, the WQMP provides a comprehensive reporting and review process which is aimed to ensure the WQMP is adaptive and responsive to any potential issues or changes which may be required from time to time, including but not limited to independent audits and annual compliance reporting as required by EPBC 2015/7461 conditions.

Appendix A – Terrestrial Water Quality Monitoring Program

Terrestrial Water Quality Monitoring Program

The Terrestrial Water Quality Monitoring Program (TWQMP) has been prepared to facilitate the monitoring requirements of the Coordinator Generals Report (See Coordinator Generals Report Section 5.1.4 – Water Quality). This document is the **Preliminary** TWQMP and is not to be included as a part of the Marine Water Quality Monitoring Program.

A.1 Monitoring Program Design

The Program adopts a long term before-after, control-impact (BACI) design and includes a combination of replicated sampling in time and replicated sampling at appropriate spatial scales to determine impacts and consider natural variation. The BACI design will measure change using statistical analysis, which is sufficient to deal with the often non-normally distributed data. The proposed BACI design introduces methods to estimate the natural variability and measure the potential or actual changes in the receiving environment.

The program design is prepared to examine the interactions in time between the potential impact sites (BAC**I**) and a set of control (BA**C**I) locations. The statistical analysis will demonstrate whether the interactions between the impacted sites and control sites, are statistically different from the naturally occurring interactions in time among the control sites. The purpose of the analysis of natural variation in space and time is to identify whether a small impact is or is not within the bounds of what occurs naturally. In the event that there is evidence of an impact that is outside of natural variability, it will act as a trigger for management or remedial action in accordance with the reporting framework identified later in this WQMP.

A.2 Baseline vs Construction/Operation Monitoring

Water quality monitoring will be broken into two (2) distinct phases:

1. Pre-development (Baseline) Monitoring
    a. Ambient monitoring; and
    b. Event monitoring.
2. Construction/ Operational Monitoring
    a. Ambient monitoring; and
    b. Event monitoring.

Baseline monitoring is necessary to characterise the receiving waters prior to disturbance and characterise the baseline. Results of the baseline monitoring can be used to compare water quality results during construction and operational phases.

A.3 Objectives

The objectives of the Terrestrial Water Quality Monitoring Program will be to:

- identify suitable monitoring locations for potentially impacted sites and control/ reference sites;
- describe the baseline condition of the water quality in the terrestrial environment at both the potentially impacted locations and control locations;
- identify water quality threshold levels that may result in a negative impact on the water quality values;

- identify water quality objectives, which are suitable for protecting the environmental values of the receiving waters;
- detail an appropriate monitoring methodology which includes robust statistical assessment and quality assurance and control; and
- include details of ongoing monitoring to be implemented.

A.4 Contaminants of Concern

The contaminants of concern as a part of this Terrestrial Water Quality Monitoring Program are identical to those listed in the Marine Water Quality Monitoring Program. The contaminants of concern are displayed in Table 7.

A.5 Proposed Analytical Parameters

In order to determine the parameters of runoff discharging into the receiving environment, the parameters to be monitored as a part of this TWQMP are to be as per Table 7.

A.6 Sampling Locations

The sampling locations have been adopted from the Water Quality Assessment published as a part of the EIS with three exceptions: LIND02, LIND03 and LIND06. The Sampling Locations are detailed in Table 11 and displayed in Figure 10.

- LIND02 has been relocated to the east of the airstrip. The relocation of LIND02 allows it to be utilised as a control point as it is approximately 91m horizontally and 1m vertically from the development disturbance.
- LIND03 has been relocated 90 metres downstream of the original location on the same steep bedrock confined waterway on the western side of the island. The relocation was necessary for safe access to the site.
- LIND06 has been relocated approximately 140 metres to the south southeast. The relocation was necessary as original location failed to identify a defined waterway as the landscape is steep (>30%) with overland flow occurring as undefined sheetwash. The absence of a defined watercourse renders it difficult to collect a representative water sample of runoff from the golf course. A defined watercourse was identified that also receives runoff from the golf course and is in the same topographic setting.

Table 11 Terrestrial Sampling Locations

Sampling Point	Description	Latitude	Longitude
LIND01	Existing Dam	-20.454192	149.035560
LIND02	East of Airstrip	Sample Area Boundary	Sample Area Boundary
LIND03	Downstream of Golf Course	Sample Area Boundary	Sample Area Boundary
LIND04	Adjacent to Lindeman Jetty	Sample Area Boundary	Sample Area Boundary
LIND05	Downstream of Cleared Area and Airstrip	Sample Area Boundary	Sample Area Boundary
LIND06	Downstream of Golf Course	Sample Area Boundary	Sample Area Boundary

Datum: WGS 84

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Lindeman Island Water Monitoring

Figure 10 - Terrestrial Water Quality Monitoring Locations

Ref: Lindeman Island Water Monitoring \ Marine Water Quality Monitoring Locations Author: Oscar Puignou Lopez Date created: 13/10/2025 © NGH 13/10/2025 © ESRI 2022

A.7 Sampling Frequency

The sampling frequency for the TWQMP is to be divided into Pre-development (Baseline) Monitoring and Construction/Operational Phase Monitoring. The sampling frequencies for both phases are summarised in Table 12 and Table 13.

Table 12 Terrestrial Monitoring Frequency – Predevelopment

Parameter	LIND01 Interval	LIND02-06 Interval
Temperature	Monthly	When Possible
pH		
Total Suspended Solids		
Electrical Conductivity		
Dissolved Oxygen		
Turbidity		
Secchi		
Total Dissolved Solids		
Total Nitrogen		
Ammonia		
Nitrite and Nitrate		
Oxidised Nitrogen		
Total Phosphorus		
Reactive Phosphorus		
Faecal Coliforms	Quarterly	
HPC		
Total Coliforms		
E. coli		
Organophosphorus pesticides		

Table 13 Terrestrial Monitoring Frequency – Construction/Operational

Parameter	LIND01 Interval	LIND02-06 Interval
Temperature	Quarterly	When Possible
pH		
Total Suspended Solids		
Electrical Conductivity		
Dissolved Oxygen		
Turbidity		
Secchi		
Total Dissolved Solids		
Total Nitrogen		
Ammonia		
Nitrite and Nitrate		
Oxidised Nitrogen		
Total Phosphorus		
Reactive Phosphorus		
Faecal Coliforms		
HPC		
Total Coliforms		
E. coli		
Organophosphorus pesticides		

A.8 LIND01 (Lake) Sampling and Analysis Methodology

A8.1 Sample Collection

Water sampling is to be undertaken in accordance with the methods specified in the Australian Standard for water quality sampling – AS/NZS 5667.1:1998 and the Department of Environment and Heritage Protection's Monitoring and Sampling Manual 2009.

For samples requiring in-situ and laboratory analysis, manual grab samples will be taken using a suitable sampling container. Sampling will be undertaken using the following methodology derived from the Department of Environment and Heritage Protection (DEHP) Monitoring and Sampling Manual 2009:

1. Remove the lid from a 1 L sample bottle and attach the bottle to the end of a sampling pole.
2. Extend the sampling pole into water. Submerge the bottle to a depth of at least 0.3 m, keeping the mouth end pointing down.
3. Whilst submerged, rotate the sampling pole 180 degrees to bring the mouth of the bottle facing up, and allow the bottle to fill with water; and retrieve bottle.
4. Replace the lid and shake the bottle ensuring the inside of the bottle and the lid come into contact with the liquid. Discard the rinse liquid down current of where you are sampling. Be sure to keep hands away from the mouth of the bottle and the underside of the lid.
5. Repeat steps 3 to 4 so that the sample bottle and its lid are rinsed twice with sea water then proceed to step 6.
6. Repeat step 1 to 3 to fill the bottle. If samples require in-situ analysis, samples can be directly analysed from battle using calibrated water quality meters/sondes. If samples require laboratory analysis, sample bottles are to be sealed and stored appropriately. If sample requires freezing, ensure you leave 10–20 per cent space free.

A8.2 In-situ Parameter Analysis

In-situ water quality will be sampled using a hand-held electronic multi-parameter water quality meter. In-situ parameters will include at a minimum, the parameters listed in Table 7. In-situ water quality measurements will be collected in a scientifically robust manner. Users will be familiar with the equipment, and the calibration methods for each meter. Calibration of water quality meters will be conducted in accordance with best practice and manufacturers instruction. Meters will be checked, maintained and calibration recorded before deploying meters for sampling.

A8.3 Storage and Transportation

All samples are to be stored in a clean cooler box on ice or equivalent refrigerated conditions at approximately 4°C. All samples will be delivered to the NATA accredited Laboratory within the recommended holding times as specified by the laboratory. Any non-conformance must be documented on the Chain of Custody document.

A8.4 Laboratory Analysis

Once samples requiring laboratory analysis are collected, stored and transported offsite, the samples will be taken to a NATA accredited laboratory for analysis. Samples will be analysed by accredited laboratory as per their analysis methodologies.

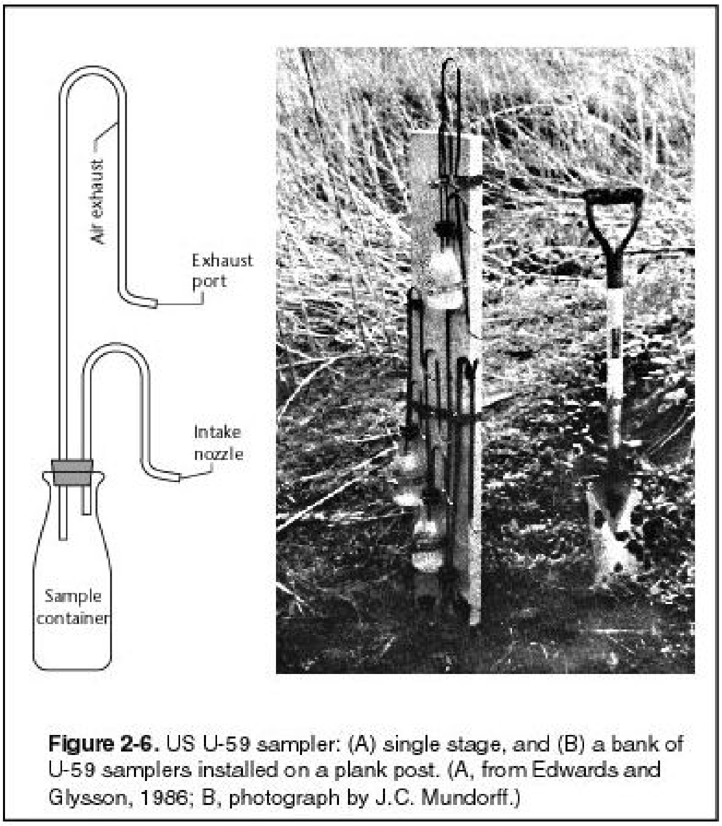
A.9 LIND02-06 Sampling and Analysis Methodology

The streams to be monitored as a part of this WQMP (LIND02-06), are ephemeral in nature with runoff occurring dependant on seasonal rainfall. Therefore, the implementation of in-situ analysis with set sampling frequencies is not appropriate.

A9.1 Automatic Samplers

Automatic samplers allow for the automatic collection of water samples from intermittent streams at remote or not accessible sites[20]. There are two types of samplers which can be implemented when sampling ephemeral streams: (1) powered automatic samplers; and (2) rising stage samplers (Figure 11). The chosen method will be determined following a site visit and budget considerations.

Powered Automatic Sampler



Rising Stage Sampler

Figure 11 Examples of Automatic Samplers

[20] Hyquest Solutions, 2018, Rising Stage Sampler, Available Online, https://www.hyquestsolutions.com/products-services/products-hardware/sediment-sampling/rising-stage-sampler/.

A9.2 Powered Automatic Water Samplers

Powered automatic samplers consist of a number of sample bottles held within a refrigerated housing unit and a water sampler which can either be manually activated when linked to a depth recorder and triggered to collect samples at specified stage heights or frequencies after a minimum stage height was achieved[21]. When triggered, the sampler with sample water which is then held within the internal bottles. These samples will remain chilled until the environmental supervisor or site manager can access the sample sites. This method of sampling allows for accurate samples to be collected while the refrigeration allows the samples to remain within the holding time requirements. However, this method of automated sampling is more expensive than alternatives.

A9.3 Rising Stage Samplers

Rising stage samplers are consisted of sets of samplers which can be erected at set intervals along a support, to capture water quality at different stages of runoff (initial flush etc.). These samples are low cost are requiring no electricity to operate. The stage sampler is erected within the streambed at set heights. The nozzle of the sampler is to face downstream to prevent sediment from accumulating within the sampler. When a rainfall event runoff occurs, water flows into the sample bottle while air is purged out of the exhaust pipe. The samplers will continue to fill until either runoff ceases, or the sample bottle is full. An environmental professional or site supervisor is to attend the sampling locations once the rainfall event has ceased. In-situ analysis (see Section 11.10) and sub sampling for transportation to an accredited laboratory (See Sections Section 11.11 and Section 11.12) will then be undertaken. Although low cost, due to the lack of capacity to refrigerate collected samples, the samples must be transported as soon as possible to the accredited laboratory. If this cannot occur, the analysis result may not be compliant with sample holding times.

A9.4 Depth Loggers

In conjunction with the rising stage sampler, a depth logger is to be installed at each sampling location. At any level within the water column, water will exert equal pressure which increases linearly as depth increases. The difference between atmospheric pressure and the water surrounding around the depth logger's sensor head exerts a force on the sensor diaphragm of which is converted to a proportional electrical value. Pressure exerted on the sensor is the difference in the pressure difference between the water and atmospheric pressure. This difference in pressure is directly proportional to the height of the vertical column of water above the sensor[22].

Depending on the style of depth logger, a barometric logger may be installed within a depth logger arrangement, above the maximum height of the water level (Figure 12). Barometric loggers calculate the absolute pressure which is then used to compensate for atmospheric fluctuations. The result is an accurate measurement of the water level.

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[21] Smith R et al, 2004, Review of Methods for Water Quality Assessment of Temporary Stream and Lake Systems, Australian Centre for Mining Environment Research, Kenmore, Australia.

[22] Dataflow Systems Pty Ltd, Odyssey Pressure & Temperature Water Depth Logger, Available Online, http://odysseydatarecording.com/download/Odyssey%20Pressure%20Depth%20Logger.pdf

These loggers can measure the depth and temperature fluctuations the ephemeral stream, without the requirement of electricity or personnel attending the site. The loggers are to be installed by a qualified environmental professional as per the following methodology:

- PVC casing is to be anchored to a secure above stream location and anchored to the base of the stream bed;
- Slots are to be cut into the PVC at right angles to the flow direction to prevent the accumulation of water within the casing and incorrect data collection;
- The depth logger is to be attached to a steel cable and lowered to the desired depth;
- The depth logger and end of the steel cable is to be secured to the PVC cap;
- A barometric logger is attached to another steel cable and lowered into the casing yet, above the maximum water level; and

The barometric logger and end of the steel cable is to be secured to the PVC cap.

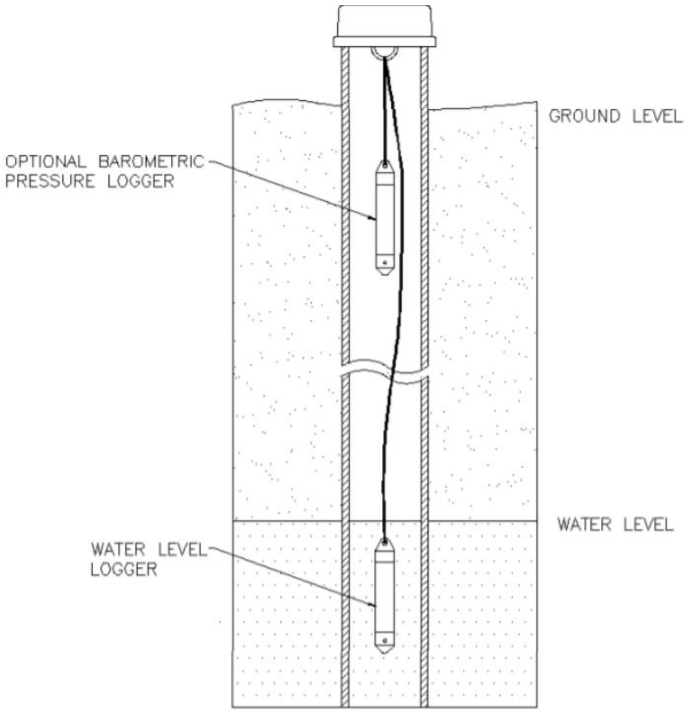

Figure 12 Schematic of Depth and Barometric Logger Design

A.10 In-situ Analysis

In-situ water quality will be analysed using a hand-held electronic multi-parameter water quality meter.

In-situ parameters will include at a minimum:

- temperature;
- pH;
- dissolved oxygen; and
- electrical conductivity
- turbidity

- Total Dissolved Solids
- Salinity

In-situ water quality measurements will be collected in a scientifically robust manner. Users will be familiar with the equipment, and the calibration methods for each meter. Calibration of water quality meters will be conducted in accordance with best practice and manufacturers instruction. Meters will be checked, maintained and calibration recorded before deploying meters for sampling.

A.11 Storage and Transportation

All samples are to be stored in a clean cooler box on ice or equivalent refrigerated conditions at approximately 4°C. All samples will be delivered to the NATA-accredited Laboratory within the recommended holding times as specified by the laboratory. Any non-conformance must be documented on the Chain of Custody document.

A.12 Laboratory Analysis

Once samples requiring laboratory analysis (chemical parameters) are collected, stored and transported offsite, the samples will be taken to a NATA-accredited laboratory for analysis. Samples will be analysed by accredited laboratory as per their analysis methodologies.

A.13 Quality Assurance

Quality assurance and quality control procedures are necessary to ensure that samples and monitoring data is collected in a scientifically robust manner. The quality assurance procedures are to be identical to the MWQMP, outlined in Section 6.7.5 of this report.

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