Environmental Management Plan

Middle Point Farm

Humpty Doo Barramundi Pty Ltd

DOCUMENT CONTROL RECORD

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5	Humpty Doo Barramundi	NT EPA for EPL239 amendment to include the East Farm – updated discharge points, waste management plan and pond sediment management.	4 August 2020

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ACRONYMS AND ABBREVIATIONS

AAPA	Aboriginal Areas Protection Authority
AEP	annual exceedance probability
AI	Adelaide Intake – water intake point from Adelaide River
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AQIS	Australian Quarantine and Inspection Service
ASS	acid sulfate soils
BAP	Best Aquaculture Practices program
BOD	biochemical oxygen demand
Chl-a	chlorophyll-a
DENR	Department of Environment and Natural Resources (Northern Territory)
DO	dissolved oxygen
DP	Discharge Point
DP1	Discharge Point 1
DP2	Discharge Point 2
EC	electrical conductivity
EF DP	East Farm Discharge Point
EMP	Environmental Management Plan
EPL	Environment Protection Licence
FRP	filterable reactive phosphorus
HDB	Humpty Doo Barramundi Pty Ltd
HDPE	High Density Polyethylene
NATA	National Association of Testing Authorities
NOx	nitrate NO_3 + nitrite NO_2
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
NOI	Notice of Intent
PASS	potential acid sulfate soils
QA/QC	quality assurance, quality control
S1N	Stage 1 Nursery
SDS	safety data sheet
SOCS	Sites of Conservation Significance
SSTV	site specific trigger value
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
WMPC Act	*Waste Management and Pollution Control Act* (Northern Territory)
WQMP	Water Quality Monitoring Plan

1 INTRODUCTION

Humpty Doo Barramundi Pty Ltd (HDB) is a privately owned and operated family business producing premium saltwater barramundi fish for markets across Australia and overseas. This Environmental Management Plan (EMP) outlines HDB's management practices for minimising environmental impacts in producing barramundi at the HDB farm located at Middle Point, approximately 58 km east of Darwin on the Adelaide River floodplain (Figure 1-1).

The current system of header ponds (for gravity flows), production (grow-out) ponds, and wastewater wetland treatment ponds at HDB was developed over a 10-year period of research and development testing a range of aquaculture systems. It allows for the constant recycling of water from the wetland treatment system back into the header and production ponds, and minimises the need for discharge to, or refilling from, the Adelaide River.

Following the period of research and development, commercial operations started with the North Farm in 1993, then South Farm (operating since late 2016), and East Farm (12 ponds operating since late 2019, and a further 11 ponds planned for construction in late 2020; see Figure 1-2). The total area of production ponds (North, South and East Farms combined), is 45 ha. This includes the remaining East Farm production ponds to be constructed late 2020. The total area of wetland treatment system servicing the production ponds is 63 ha, i.e. the area of wetland treatment system is around 1.4 times the area of production ponds.

The HDB farm also has a Stage 1 Nursery (fingerlings up to 1 g), Stage 2 Nursery (fish between 1 and 30 g), and recently completed in early 2020, Stage 3 Nursery (fish between 30 and 200 g). Each of these nurseries utilises a wetland wastewater treatment pond system; negating the need to constantly extract from, or discharge to, the Adelaide River. Once juvenile fish are large enough, they are transferred to the production ponds for grow out.

The Middle Point farm does not include a hatchery. Fingerlings are brought in from interstate, and increasingly from HDB's hatchery facility at Channel Island on Darwin Harbour. Note this EMP does not include the HDB hatchery facility. A separate EMP covers the hatchery.

It takes around 24 months to grow the barramundi from fingerlings to an average harvest size of >3 kg. Once harvested, fish are transferred into large bins with an ice-brine slurry, where they are euthanised by cold shock. They are then sorted and packed. Only chilled whole fish are dispatched from the farm; no filleting or processing of fish occurs on site.

Supporting infrastructure at the farm includes a packing shed, offices, feed shed and workshop (Figure 1-2).

1.1 Purpose

This EMP assists HDB in its commitment to environmental sustainability and minimising environmental impacts (Appendix A provides HDB's Sustainability Policy). The farm is currently certified under the Australian *Sustainably Farmed Barramundi Certification* program and international *Best Aquaculture Practices* (BAP) program. An effective EMP is a condition of both these programs, and to achieve and maintain certification, HDB is subject to rigorous annual inspections and audits.

HDB is licenced under the Northern Territory (NT) *Waste Management and Pollution Control Act* (WMPC Act). The NT Environment Protection Authority (NT EPA) has issued HDB an Environment Protection Licence (EPL239) to allow the collection, transport, storage, recycling, treatment and disposal of a 'listed waste'; the listed waste being 'animal effluent and residues' i.e. fish waste. The main activity undertaken in this regard is the treatment of wastewater from the barramundi production ponds in wetland treatment systems. Most of the time, the treated wastewater is recycled back into the production ponds, but on occasions requires discharge to the Adelaide River.

The handling of any other fish waste at the farm is also covered under EPL239, such as fish carcasses and any liquid or solid waste from the packing facility. This is minimal however, given fish are not filleted or processed on site; all fish are transported whole from the farm.

The development and implementation of an EMP is a requirement of EPL239, Condition 8.

1.2 EMP update

This EMP version, updated March 2020, is to allow amendment of EPL239 to include the East Farm, and also other changes to HDB operations; including a change to the EPL239 authorised discharge point for the South Farm.

Construction of the East Farm commenced in mid-2019. To date, 12 of the 23 planned production ponds have been completed, as well as the entire wetland treatment system required to service all 23 production ponds (Figure 1-2). The remaining 11 production ponds are scheduled for completion and commissioning in late 2020.

In order to allow construction of the East Farm, HDB applied for an exemption to the requirement for an Environment Protection Approval. On 24 September 2019, the NT EPA issued this exemption, pursuant to section 30(6) of the WMPC Act, authorising construction of the East Farm, stating that the risks of environmental impact can be appropriately managed through HDB's current management plans and development permit. This EMP version has been updated with the details, risk assessment and management measures associated with the East Farm.

The EPL239 authorised discharge point for the South Farm into the Adelaide River was previously DP2. Discharge from the South Farm is now from the point 'AI' (Figure 1-2).

This EMP update also includes the following general improvements:

- Increased detail on staff roles and responsibilities for environmental management (Section 2)
- Update to sediment/sludge removal from ponds and its subsequent management (Section 5.6)
- Increased detail on mortality management (Section 5.12)
- Increased detail on chemical storage and handling (Section 5.15)
- Erosion and sediment control discussion (Section 5.16)
- Improved conceptual site model (Section 6)
- Incident reporting framework with integrated corrective action process (Section 9.3.1)
- Increased detail on staff training and awareness of environmental requirements (Section 10)
- Inclusion of HDB's Sustainability Policy (Appendix A)
- Update of Environmental Obligations Register to reflect licence renewals (surface water extraction licence, wildlife permits etc) (Appendix C)
- Update of Water Quality Monitoring Plan to include East Farm monitoring requirements and streamlining of monitoring program (Appendix E)
- Inclusion of Environmental Obligations Staff Training Module (Appendix I)
- Update of Waste Management Plan with changes to management of mortalities from an on-site pit to delivery off-site to neighbouring organic produce farm for reuse as fertiliser (Appendix K).

1.3 Scope

This EMP is drafted in accordance with the NT EPA *Guideline for the Preparation of an Environmental Management Plan*, Version 1.0, May 2015.

This EMP covers the HDB Middle Point farm, it does not include the HDB hatchery at Channel Island, Darwin Harbour.

A number of HDB standard operating procedures (SOPs), management plans and other documents support implementation of this EMP. These are referenced, where relevant, throughout.

Management plans specifically required as a condition of EPL239, are provided as appendices to this EMP; these are the:

- Water Quality Monitoring Plan as per EPL239 Condition 8 (Appendix E)
- Waste Management Plan as per EPL239 Condition 52 (Appendix K)
- Emergency Response Plan as per EPL239 Condition 8 (Appendix L)
- Consultation and Communications Plan as per EPL239 Condition 11 (Appendix P)

This EMP is a working document that is reviewed at minimum annually, and updated to reflect changes to farm operations, environmental risks and environmental management practices.

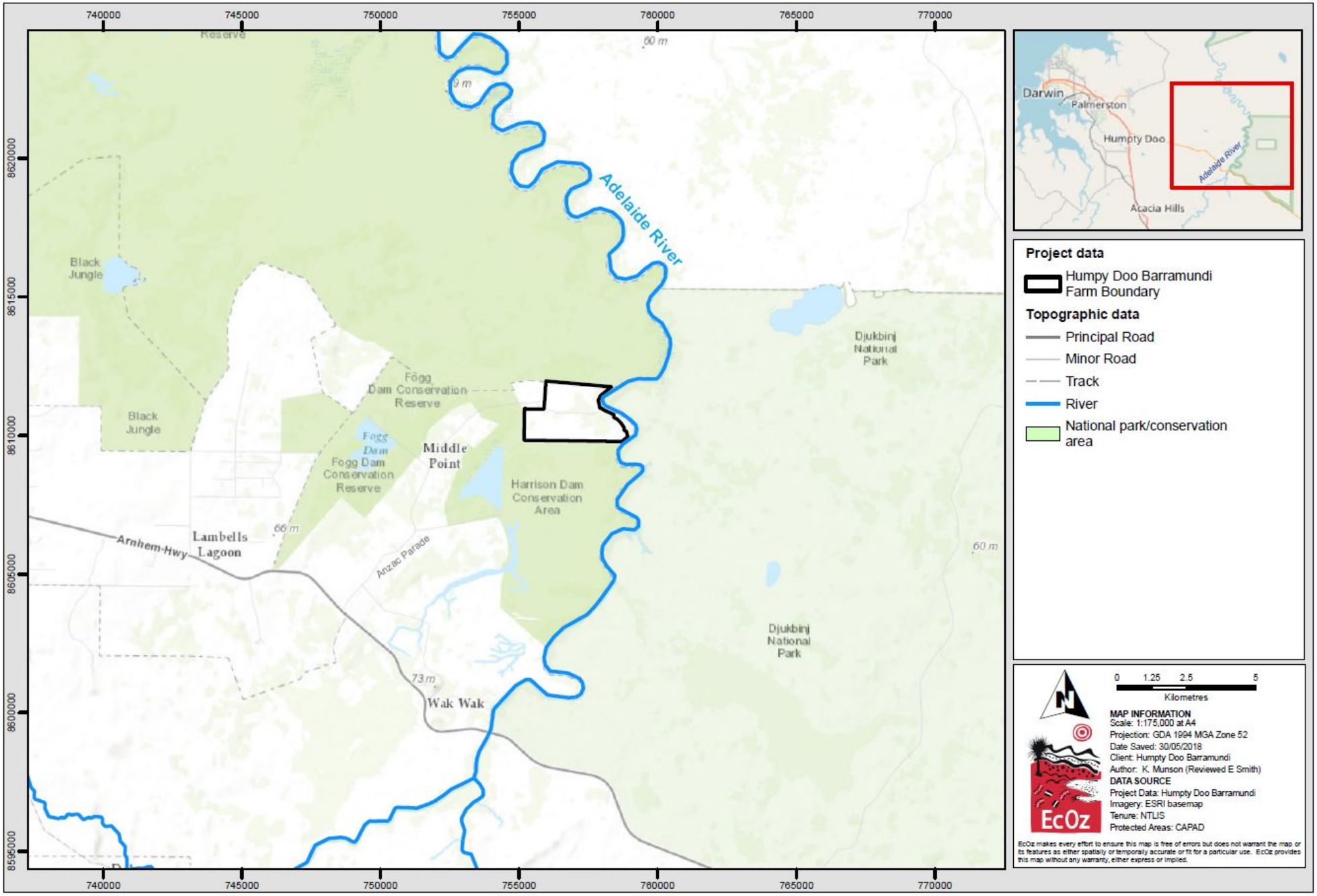

Figure 1-1. Location map of HDB farm.

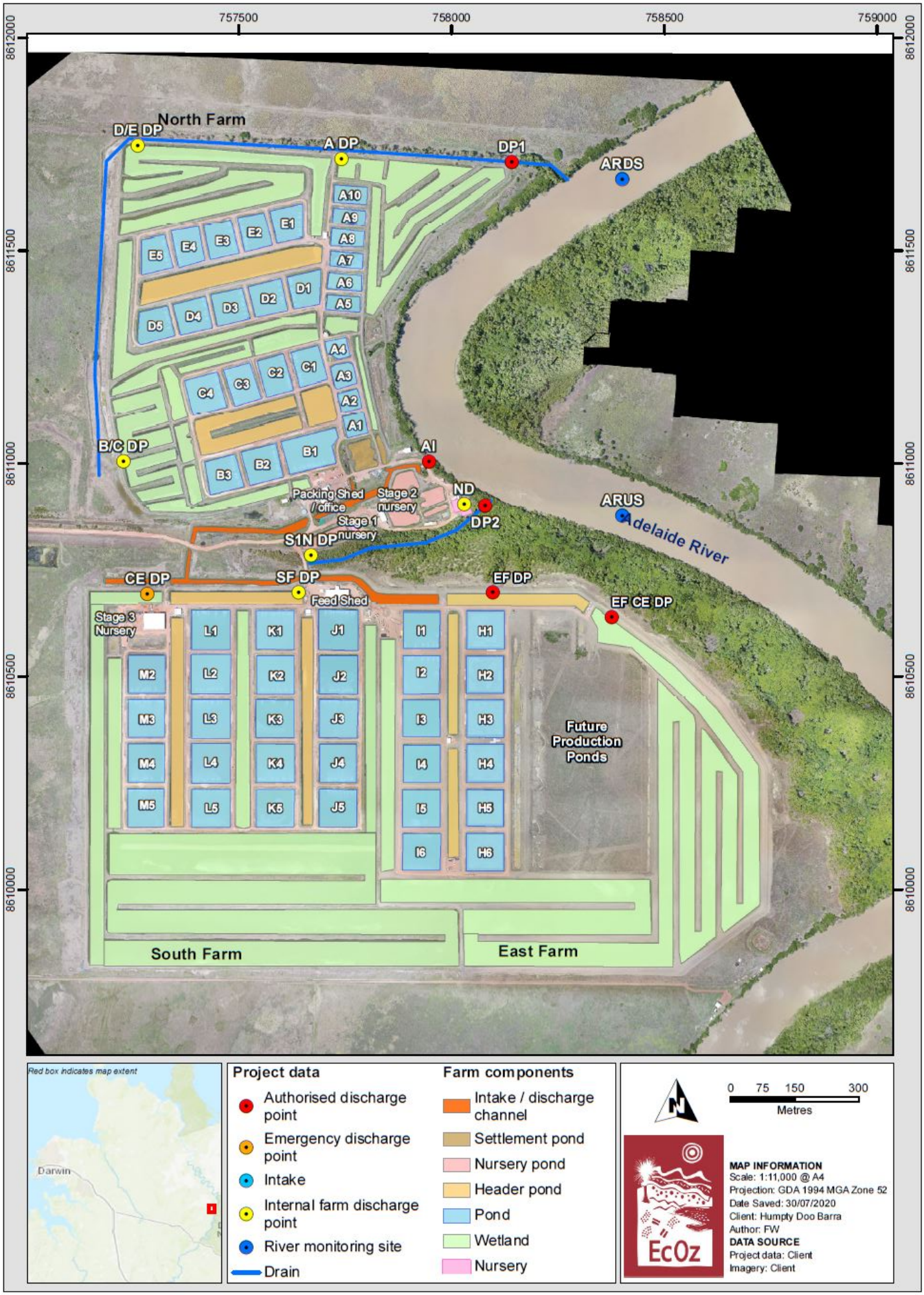

Figure 1-2. Map of farm layout, monitoring locations and discharge points.

2 HDB CONTACTS AND STAFF ENVIRONMENTAL ROLES AND RESPONSIBILITIES

HDB contact details are as follows:

Business name:	Humpty Doo Barramundi Pty Ltd
Address:	1105 Anzac Parade, Middle Point, NT 0822 PO Box 770, Humpty Doo NT 0836
ACN/ABN:	059 248 038 / 87 059 248 038
Head Office:	Ph: 08 8988 8121 Environmental enquiries email: compliance@hdbarra.com.au
24-hour Emergency Contact	Robert Richards – Managing Director 08 8988 8121 (business hours) 08 8927 4453 (after hours) 0427 274 453

Appendix B provides HDB's organisational chart, with staff names, as of February 2020. This chart is a live document, which is updated in accordance with staff changes, organisational restructures and operational changes. This EMP refers to these roles in assigning environmental responsibilities. Table 2-1 below provides a general outline of HDB staff environmental responsibilities.

Table 2-1. HDB staff environmental roles and responsibilities.

Position	Responsibility
Managing Director and Chief Executive Officer	Overall legal responsibility to ensure the farm does not cause environmental harm and complies with all environmental legal obligations. Review and approve this EMP.
Chief Operating Officer	Ensures compliance with all environmental legal requirements, licence and permit conditions (e.g. EPL239, development permit, water extraction licence, wildlife permit). Oversees that all departments of farm operations comply with this EMP. Review and input into this EMP and related documents (Water Quality Monitoring Plan, Waste Management Plan, Emergency Response Plan etc).
Infrastructure and Development Manager	Ensures the installation and design of new infrastructure and developments at the farm comply with this EMP and all environmental legal obligations. Ensures all staff and contractors working on new infrastructure and developments at the farm comply with this EMP and do not cause environmental harm
Operations Manager	Oversees that frontline managers for harvest and pond operations, and plant and equipment maintenance are ensuring their staff and tasks are undertaken in accordance with this EMP and all environmental legal obligations, and do not cause environmental harm.
Fish Performance Manager	Oversees that frontline managers for nursery and fish response operations are ensuring their staff and tasks are undertaken in accordance with this EMP and all environmental legal obligations, and do not cause environmental harm. Overall responsibility for ensuring frontline managers and their staff complete all data collection and record-keeping responsibilities in regards to fish stock management and care (e.g. movement of stock, feeding, growth and mortality rates, water quality). This includes data quality control, accuracy and traceability. Oversees that data is maintained in the relevant databases/registers or management software e.g. AquaFarmer, AquaManager.

Position	Responsibility
Pond Operations Frontline Supervisor	Ensures operation of production (grow out) ponds complies with this EMP, all staff are trained in their environmental responsibilities and all day-to-day tasks are undertaken in accordance with the relevant SOPs, management plans (e.g. Waste Management Plan, Biosecurity and Fish Health Management Plan) and in a manner that does not cause environmental harm. Ensures that staff are completing all record-keeping tasks e.g. feed used, batch records, wildlife interactions, water quality monitoring, fish health/behaviour, mortalities etc and maintaining corresponding databases/registers.
Nursery Frontline Supervisor	Ensures operation of the nurseries complies with this EMP, all staff are trained in their environmental responsibilities and all day-to-day tasks are undertaken in accordance with the relevant SOPs, management plans (e.g. Biosecurity and Fish Health Management Plan) and in a manner that does not cause environmental harm. Ensures that staff are completing all record-keeping tasks e.g. fingerling batch records, water quality monitoring, fish health/behaviour, feed, mortalities etc and maintaining corresponding databases/registers and fish production management software e.g. Aquafarmer.
Fish Response Frontline Supervisor	Ensures fish response operations complies with this EMP, all staff are trained in their environmental responsibilities and all day-to-day tasks are undertaken in accordance with the relevant SOPs, management plans (e.g. Biosecurity and Fish Health Management Plan) and in a manner that does not cause environmental harm. Ensures that staff are completing all record-keeping tasks e.g. batch records, water quality monitoring, fish health/behaviour, feed, mortalities etc and maintaining corresponding databases/registers and fish production management software e.g. AquaFarmer/AquaManager.
Harvest Frontline Supervisor	Ensures harvest operations comply with this EMP, all staff are trained in their environmental responsibilities and all tasks are undertaken in accordance with the relevant SOPs and in a manner that does not cause environmental harm. Ensures that staff are completing all record-keeping tasks e.g. batch records, fish health/behaviour, mortalities etc and maintaining corresponding databases/registers.
Post-Harvest Frontline Supervisor	Ensures post-harvest operations (including fish packing and dispatch) comply with this EMP, all staff are trained in their environmental responsibilities and all tasks are undertaken in accordance with the relevant SOPs and in a manner that does not cause environmental harm. Ensures that staff are completing all record-keeping tasks e.g. fish dispatched, rejects and scales sent to mortality area etc and maintaining corresponding databases/registers.
Plant and Equipment Frontline	Ensures vehicle, equipment and infrastructure maintenance activities comply with this EMP, all staff are trained in their environmental responsibilities and all tasks are undertaken in accordance with the relevant SOPs and in a manner that does not cause environmental harm.
Chief Marketing Officer	Responsible for consultation and maintaining communications with stakeholders regarding farm operations in accordance with Consultation and Communications Plan. Review, input into, and approval of Consultation and Communications Plan.
Environmental Consultant	Responsible for EPL239 monitoring and reporting requirements, including water quality monitoring, discharge compliance reporting, maintenance of water quality monitoring database and environment-related management plans and documentation.
Personnel Officer	Ensures all staff receive and understand the HDB employee induction and environmental obligations training. Ensures that staff receive additional environmental training, where required, and where relevant to their specific tasks e.g. chemical handling. Record-keeping of training completed, currency of training, and training still required for each staff member.
All staff	Ensuring their day-to-day tasks are undertaken in accordance with their training and the relevant SOPs, and does not cause environmental harm. Responsibility to report all environmental incidents or near misses to supervisor or management using incident reporting process and incident report form.

3 LEGAL AND OTHER OBLIGATIONS

HDB maintains a list of its environmental compliance obligations in its *Environmental Obligations Register* (version as of February 2020 provided in Appendix C). This register contains:

- Obligations from acts and regulations
- Obligations in permits, licenses and approvals
- Any other obligations that HDB choses to subscribe to

The Environmental Obligations Register lists the controls that are proposed to manage each obligation, and the responsible HDB representative. The Chief Operating Officer is responsible for maintaining the Environmental Obligations Register. HDB's legal obligations are summarised in Table 3-1.

Table 3-1. Legislation relevant to HDB

Legislation	Regulation/ approval	HDB relevance
NT Animal Welfare Act	Animal welfare standards	HDB have developed an Animal Welfare Induction that encompasses the requirements of the *Animal Welfare Act*, which all employees must complete. The HDB Biosecurity and Fish Health Management Plan also includes the measures for ensuring fish welfare at the farm.
NT Environmental Assessment Act	Environmental assessments	A Notice of Intent (NOI) was submitted to the NT EPA for the South Farm and East Farm expansions (inclusive) in 2016. The NT EPA provided a *Statement of Reasons* in June 2016 for the decision that the project did not require further assessment under the *Environmental Assessment Act*.
NT Fisheries Act and NT Livestock Act	Aquaculture licence	The HDB farm operates under Aquaculture Licence Number C1/502 that is due to expire 30 June 2020. To assist in meeting a number of its obligations under the *NT Fisheries Act* and *NT Livestock Act*, HDB operate in accordance with its HDB Biosecurity and Fish Health Management Plan. This plan was developed with assistance from specialists in this area, and is regularly reviewed and updated at least annually.
NT Heritage Act	NT Heritage Register	Heritage listed objects are known to occur on the northern extent of Section 1773. This area is included in all employee inductions, and is not impacted by current HDB operations.
NT Aboriginal Sacred Sites Act	Aboriginal Areas Protection Authority (AAPA) certificates	A search of the AAPA register undertaken for the Development Permit process (see below under *NT Planning Act*) returned no records of sacred sites within the current HDB site boundary.
NT Planning Act	Development Permits	Progressive development at HDB has been approved in accordance with the *NT Planning Act* under the following Development Permits (DPs): • DP99/0183, issued 05/1999 • DP99/0183B, issued 04/2012 • DP99/0183C, issued 07/2012 • DP16/0289, issued 06/2016 DP16/0289 authorises the most recent phase of farm expansion, which includes the South Farm (completed in 2016) and East Farm (partially completed; remaining ponds to be completed in late 2020).

Legislation	Regulation/ approval	HDB relevance
Territory Parks and Wildlife Conservation Act	Permit to take wildlife for commercial purposes	A permit to take and wildlife for commercial purposes has been granted by the NT Parks and Wildlife Commission for the following: Birds (Permit No. 62311), expires 31 December 2023, for the removal of predatory birds to minimise impact on pond fish population. Methods are limited to bird fright and shooting whilst looking to implement other long-term strategies. The permit allows the following maximum number of bird takes: Pied Heron 100 Whistling Kite 33 Square-tailed Kite 33 Black Kite 33 Australian Pelican 200 Little Black Cormorant 100 Australian White Ibis 100 Crocodiles (Permit No. 65709), expires 13 October 2024, for the trapping and removal of crocodiles to prevent them from eating Barramundi in the breeding ponds and to assure staff safety. The permit allows the following maximum number of crocodile takes: Freshwater Crocodile 10 Estuarine Crocodile 50
NT Waste Management and Pollution Control (WMPC) Act	Environment Protection Licence (EPL) and Environment Protection Approval	HDB are authorised to transport, store, recycle, treat and dispose of the listed waste 'animal effluent and residues' under EPL239, which commenced 6 June 2018 and expires 5 June 2023. In particular, the discharge of treated wastewater from the two authorised discharge points DP1 and DP2 is approved and administered under EPL239. Also, the handling of any other liquid or solid wastes potentially containing animal effluent or residues from barramundi farming. This EMP and associated documents (Water Quality Monitoring Plan, Emergency Response Plant) must be maintained and implemented as stated in Condition 8 of EPL239. The implementation and maintenance of HDB's Consultation and Communications Plan is a requirement of Condition 11 of EPL239. A Waste Management Plan is a requirement of Condition 52 of EPL239. The NT EPA have issued an exemption to the requirement for an Environment Protection Approval authorising construction of the East Farm, stating that the risks of environmental impact can be appropriately managed through HDB's current management plans and development permit. The *Environment Protection Approval Exemption* was issued pursuant to section 30(6) of the WMPC Act on 24 September 2019. This EMP version, updated February 2020, is to allow amendment of EPL239 to include the East Farm.

Legislation	Regulation/ approval	HDB relevance
NT Water Act	Surface water and groundwater extraction licences	HDB hold a *Licence to Take or Use Surface Water* (Lic. No. 817399), which permits extraction of surface water from the Adelaide River. Maximum entitlement 4000 ML per year. Licence expires 25 August 2021. Potable water is obtained from groundwater bores RN028708 and RN021345 on a neighbouring property (Lot 1552 Hundred of Guy). HDB's allocation of 10 ML per year for aquaculture is specified in the groundwater extraction licence for Lot 1552 Hundred of Guy (Lic. No. HGSS10053). Licence expires 22 November 2028. HDB are licenced to extract groundwater from the hypersaline on-site bore RN031329. Licence approved 4 July 2016 for 6 ML per year.

4 EXISTING ENVIRONMENT

4.1 Surrounding land use and land use history

The HDB farm is located within Section 1773, Hundred of Guy (boundary shown in Figure 1-1 and Figure 4-1). Section 1773 is wholly owned by Humpty Doo Barramundi Pty Ltd.

Figure 4-1 is a map of the land tenue and land uses surrounding the HDB farm and Section 1773. The farm is bordered to the east by Section 1612, which is a narrow strip of Vacant Crown Land that runs along the banks of the Adelaide River. Djukbinj National Park occupies the land on the opposite side of the river. To the south and west, the farm is bound by the Harrison Dam Conservation Area, and also to the west by a parcel of Crown Lease (Section 1530). Further to the west is the Fogg Dam Conservation Reserve, rural residential lots, irrigated horticulture (melons, turf, mangos), and the University of Sydney's Tropical Ecology Research Facility. All land to the north of the farm is perpetual pastoral lease (Koolpinyah Station) used for cattle grazing.

A public road runs along the southern boundary of the farm and provides access from Anzac Parade to the Adelaide River. This road is used by Adelaide River Cruises to access the river to conduct crocodile and wildlife tours. Pontoons, buildings and amenities erected on the riverbank by Adelaide River Cruises are located at the end of the public road within Section 1612.

The HDB farm site, together with much of the surrounding land, has historically been used for cattle grazing. In the early 1950s, the area was developed as part of the failed Territory Rice Ltd project, which included the establishment of rice fields, irrigation channels, pump stations and Harrison and Fogg Dams, with the HDB site used as a rice field. Rice growing ceased in 1964, and the site remained unused until development of the HDB farm.

The site is thought to have been heavily grazed by feral buffalo prior to their removal under the National Brucellosis and Tuberculosis Eradication Campaign, which started in the early 1970s. The site has also been subject to past use of herbicides to treat weed infestations.

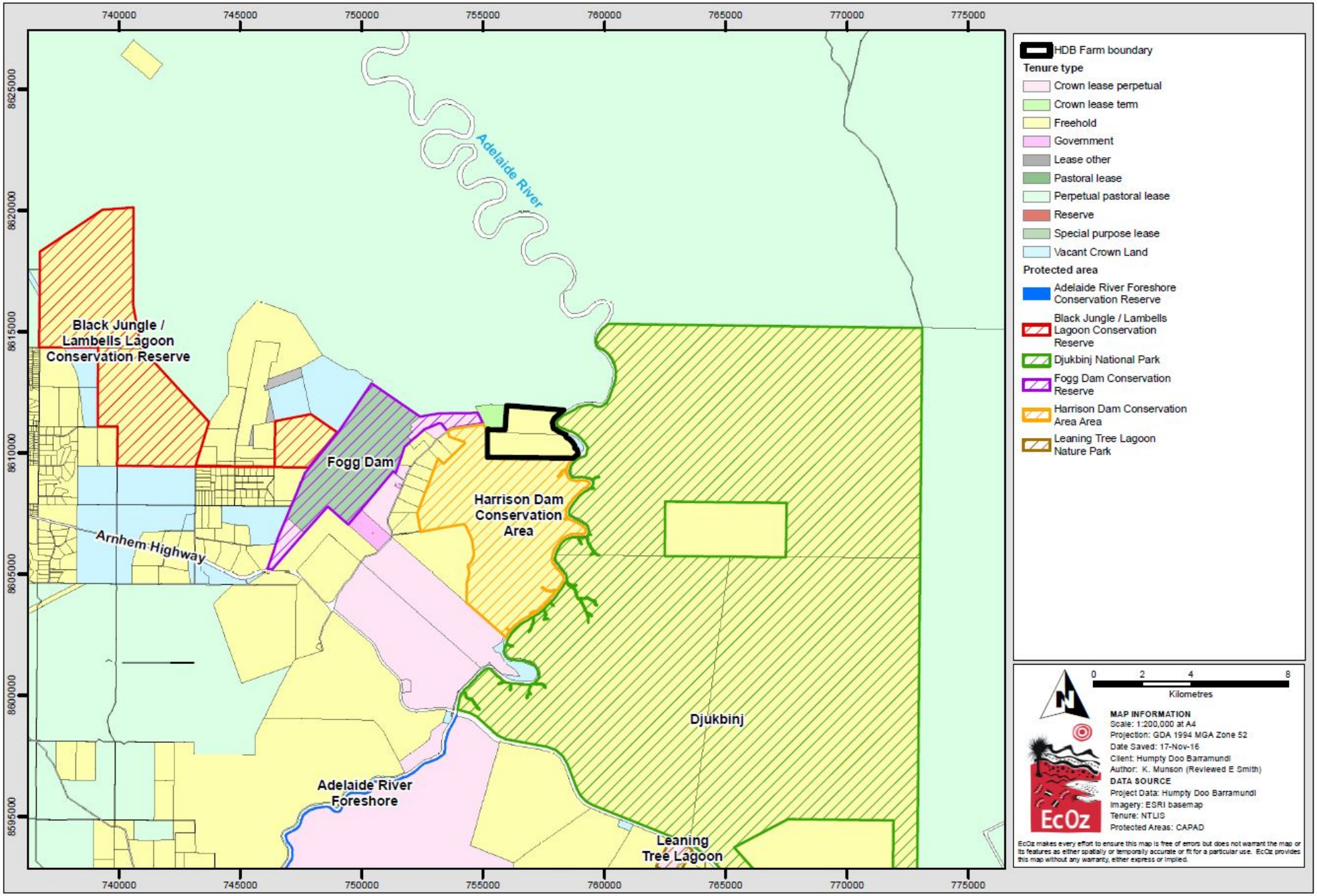

Figure 4-1. Map of land tenue and land uses surrounding the HDB farm.

4.2 Climate

The HDB farm experiences a tropical monsoonal climate with distinct wet and dry seasons and little variation in temperature. The wet season is characterised by higher humidity and rainfall, and occurs between October and April. The dry season extends from May to September, and is characterised by lower humidity and very little rainfall.

Climate observations are made by the Bureau of Meteorology (BoM). The closest BoM weather monitoring station to the site is Middle Point Rangers (ID 14090) located approximately 7 km to the west. Long-term temperature, rainfall and daily evaporation averages from the Middle Point Rangers station for the years 1957 to 2019 are presented in Table 4-1 together with long term regional monthly evaporation averages.

Average annual rainfall is 1435 mm with the highest rainfall occurring in January and the lowest in July. Over 86% of annual average rainfall falls between November and March. The average annual regional evaporation is 2400 mm and exceeds the average annual rainfall. Evaporation is highest in October and lowest in February.

Table 4-1. Long-term climate data for Middle Point Rangers BoM station (14090) 1957-2019.

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Temperature														
Mean max temp (°C)	32.6	32.0	32.4	33.1	32.5	31.3	32.9	34.7	34.7	35.6	35.1	33.8	33.1	31
Mean min temp (°C)	23.8	23.9	23.6	22.1	19.4	16.1	14.9	16.8	20.1	22.7	23.7	23.9	20.9	31
Rainfall														
Mean rainfall (mm)	347	280	252	89	24	1.4	0.7	2.2	13	57	130	228	1435	45
Mean no days of rain ≥1mm (mm)	17.6	16.2	14.7	5.9	1.7	0.2	0.2	0.3	1.3	4.8	9.8	13.6	86.3	51
Evaporation														
Mean evap (mm)	150	150	150	150	175	175	200	200	200	250	250	200	2400	29
Mean daily evap (mm)	4.7	4.5	4.7	5.2	5.2	5.2	5.5	6.1	6.8	7.1	6.3	5.2	5.5	29

4.3 Soils and land units

The HDB farm is located on the Adelaide River coastal floodplain. Soils reflect that expected of an area proximal to an estuarine, mangrove-lined macro-tidal river, and at a general scale, the NT Land Systems mapping indicates the soils are aquic vertosols over mainly calcic estuarine muds.

Soils underlying the farm were investigated as part of the regulatory approvals process required for development of the South Farm and East Farm (see Entura 2016). The dominant soils found on the site comprise vertosols, which are hydrosolic in nature; being saturated during the wet season. Clay content is generally very high (up to 40% of the soil profile), with silt and sand comprising the remainder. Soils are dominated by the clay mineral montmorillonite and have a high shrink-swell potential.

Some areas of the site are saturated for most of the year and vertosols at these locations typically have elevated levels of organic matter. The depth to the vertosols decreases toward the western side of the site but is likely to exceed 1.5 m where the farm is located. The underlying material contains gravels and sands.

In regards to land units, the HDB farm is predominantly covered by land unit '8a1', with a small section of 'CP' and 'CA' on the western boundary of the property. Land unit 8a1 is described as aquatic vertosols, which typically support grasslands and sedge lands, with emergent trees and small patches of *Samphire* sp., to low closed forest of mangrove species, subject to wet season flooding. Land unit CP consists of clay plains subject to inundation that support grassland to *Pandanus spiralis* low woodlands; and land unit CA consists of clay plains subject to inundation that support grasslands and sedge lands.

4.3.1 Acid sulfate soils

Mapping of acid sulfate soils (ASS) across the Adelaide River floodplain (see NRETAS 2009) indicates the HDB farm site is in an area with 'high probability of occurrence of acid sulfate soils (ASS)', with ASS and potential acid sulfate soils (PASS) generally below 1 m depth.

Prior to construction of the South Farm and East Farm, a site investigation was undertaken to determine the presence and nature of ASS (Howe 2016). Seven test pits were excavated across the area now occupied by the farms; six test pits to a depth of 1.8 m and one to a depth of 2.5 m. No ASS or PASS were encountered, and soil pH was 8.0 to 9.0 with no tendency for oxidisation detected. Similarly, no ASS or PASS were encountered within 1.8 m of the surface at a number of sites located at the HDB farm for the NT Government investigation *Acid Sulfate Soils of the Darwin Region* (NRETAS 2008a).

Excavation of header ponds, production ponds and wetland treatment systems for all three farms (North, South and East), to depths of approximately 1.2 m below the original ground surface, encountered no ASS or PASS. ASS and PASS across the Adelaide River coastal plains, including the HDB farm, is restricted to marine sediments, which are deeper in the profile and visually, recognisably different from the overlying freshwater sediments. Both the marine and freshwater-derived sediments are dominated by clay, but the ASS-associated marine sediments are darker in colour, wetter, softer and plastic. These marine sediments are assumed to have formed as mangrove swamps and have consistently been found below 2 m depth in the profile. The more recent overlying freshwater sediments vary in colour, but are consistently lighter in colour, drier, stiffer, and are alkaline with free carbonate nodules present.

Water quality in the farm ponds does not indicate any impacts from ASS. Continuous monthly pH measurements in the wetland treatment system of the North Farm (since 2015) and South Farm (since 2016) has not once measured a pH below 6.95. These wetland treatment systems are unlined, and the water contained within them is in direct contact with the soil substrate. Similarly, the production ponds, which are unlined across the base, have never experienced acidic conditions. Optimal pH for barramundi health is between 7.2 and 8.0, and this is maintained across all ponds without the need to add lime, or other neutralising agents.

4.3.2 Soil permeability

HDB commissioned a geotechnical investigation to determine soil properties relevant to pond construction for the East Farm (WANT Geotechnics 2019). The investigation concluded that the clay soils comprising the site are unlikely to present any significant geotechnical construction issues. The clay is also practically impermeable, and comparable to the permeability of man-made liners for landfill/ponds. At a permeability of around $1x10^{-10}$ m/s, seepage of water through the clay would take around 317 years to travel 1 m.

The impermeable clay extends to at least 15 m depth based on the drilling log for the groundwater supply bore for the farm (RN031329) located near the Stage 2 nursery. The shallowest water-bearing bed was recorded at 31 m below ground level. As such, the risk of seepage of water from farm ponds into groundwater aquifers is negligible. Similar soil properties to that of the East Farm can be assumed to also extend to the South Farm and North Farm based on these areas being within the same land unit (i.e. '8a1' see section above). Additionally, observations by staff at the farm experienced in soil conservation, who were involved in construction of all three farms (North, South and East), is that the same clay substrate extends across the entire farm area.

4.4 Adelaide River

4.4.1 Catchment run-off and tidal flow

The Adelaide River catchment is approximately 7462 km^2, and has a mean annual discharge into the sea of 2693 GL (Hughes et al 2018). Most runoff (82%) occurs during the wet season months, January to March, with a significant proportion (>40%) generated on the large coastal floodplains.

The Adelaide River mouth is a tide-dominated estuary (see www.ozcoasts.gov.au and Ryan et al 2003). The tidal limit is located at Marrakai Crossing, approximately 150 km upstream of the river mouth following the very sinuous river channel (~100 km direct along general river course excluding small bends). The HDB farm is approximately 77 km upstream of the river mouth following the sinuous river channel (~50 km direct along general river course), and at this point, the river is mangrove-lined, and brackish to saline; salinity ranging from 16 ppt during the dry season, to less than 1 ppt during the wet season. The strong tidal currents, and resuspension of fine sediments, also mean the river water is highly turbid; typically ranging between 60 NTU and 200 NTU depending on the tide, season, rainfall and river flows.

The tidal range where the HDB farm is situated, is typically around 3 m during spring tides, and 2 m during neap tides; as measured at the nearest river level gauge, which is approximately another 20 km further upstream of the farm, at the Arnhem Highway crossing (NT Government Gauge Station No. G8170021).

The estimated volume of water flowing past the farm during each 12-hour tidal cycle is 13,333 ML based on the assumptions below:

- Average tidal range of 2 m
- River width at the farm is 200 m
- River is tidal for a distance of 50 km upstream

The volume of the pyramid of water flowing past the farm during a single incoming or outgoing tide is 6,666,667 m^3, which equals 6,667 ML. This volume would more during a spring tide when the tidal range is around 3 m.

At the lowest point of the tide, when flow volumes would be at their lowest, flows are in excess of 150 m^3/s at the upstream gauging station (No. G8170021). This volume was provided in the Water Assessment Report for determining the availability of flow when considering HDB's application for water extraction from the Adelaide River (see *Water Extraction Licence Decision* issued by NT Controller of Water Resources dated 9 January 2020). The volumes of water flowing past the HDB farm in the Adelaide River are relevant for assessing the potential impact of discharges from the farm's wetland treatment systems when they occur (see Section 5.2.4 below for more discussion).

4.4.2 Flooding

The location of the HDB farm on the Adelaide River floodplain means that it is subject to periodic flooding during the wet season; most likely mid- to late wet season (January-March). Flooding generally occurs when severe rainfall or cyclones occur in the upper catchment. Given the Adelaide River is tidal at the site, floods are also influenced by tidal conditions. Flood levels measured in AHD at the flow gauge 20 km upstream (G8170021) for 20%, 10%, 2% and 1% AEP flood events are 3.08 m, 3.43 m, 4.06 m and 4.30 m respectively.

During floods, the river levee overtops upstream of the farm, and water flows across the floodplain in a northerly direction towards the sea. Some water flows back to the river (to the east), along the channels that discharge at DP1 and DP2 (Figure 1-2), but the majority of flow is northward via the floodplain. Perimeter walls surrounding the farm prevent flood waters inundating farm ponds and infrastructure.

A record flood, estimated as a 1 in 100 year (1%AEP) flood, occurred on the Adelaide River on 31 January 2018. The north-east portion of the wetland treatment system of the North Farm was inundated, however, all production ponds, of the two existing farms at the time (North and South Farms), remained above the flood level. No barramundi escaped or was lost from the farm.

The perimeter wall that overtopped during the January 2018 flood will be raised during the 2021 dry season, when the entire North Farm pond system will be dried out and refurbished. Raising the wall is not feasible until this time as the risk of heavy machinery operating on this wall whilst the ponds are operating is too great.

The East Farm perimeter wall (earthen levee bank) height is designed to withstand at least the 1%AEP flood levels reached in January 2018.

4.5 Surface water values and usage

The HDB farm is located just inside the far eastern boundary (i.e. delineated by the Adelaide River) of the *Darwin Rural Water Control District* (first declared under the *NT Water Act* in June 1999) and *Howard Water Allocation Plan* (currently under development). Beneficial uses recently declared in June 2019 for the Darwin Rural Water Control District are agriculture, aquaculture, public water supply, environment, cultural, industry, rural stock and domestic, mining activity, and petroleum activity.

The Adelaide River near the farm is tidal, naturally saline (around 16 ppt during dry season) and highly turbid. It is unsuitable for stock, irrigation, and most industrial and domestic uses. Apart from HDB, there are no other users of surface water along this section of river. HDB extract water from the Adelaide River to top-up farm production ponds and nursery tanks in accordance with surface water extraction licence No. 817399; maximum entitlement 4,000 ML per year. The water is pumped from the Adelaide River at the point 'AI' in Figure 1-2.

The only other surface water extraction licences granted for the Adelaide River are located at least 60 km upstream of the HDB farm, where the river water is fresh. The other extraction licences are granted to the Office of the Australian War Graves in Adelaide River township (15 ML), Mount Ringwood Station (1,050 ML), and North Australia Beef Limited (500 ML).

Other uses/values for the Adelaide River in the vicinity of the HDB farm are for recreation and tourism i.e. fishing, boating, nature appreciation and wildlife tours.

4.6 Groundwater values and usage

Groundwater beneath the HDB farm is hypersaline. Groundwater extracted from the onsite bore near the Stage 2 nursery (RN031329) records electrical conductivities (EC) above 60,000 µS/cm. During drilling of this bore, the shallowest water-bearing bed was encountered at 31 m below ground level. No significant groundwater aquifer exists near the surface, with impermeable clay extending to at least 15 m depth (see Section 4.3.2 *Soil permeability* above).

The groundwater extraction licence approved 4 July 2016 allows an allocation of 6 ML per year. There are no other users of this hypersaline groundwater in the region given it is unsuitable for most agricultural, industrial or domestic uses.

Groundwater becomes less saline with distance from the Adelaide River, and approximately 4 km west of the HDB farm, groundwater is relatively fresh, with ECs less than 300 µS/cm. There are numerous bores used for horticulture, domestic and other uses along Anzac Parade; the closest being 4 km to the west, in the neighbouring property, Lot 1597 Hundred of Guy.

Groundwater in the area along Anzac Parade is included the 'Howard Groundwater System, South', which covers an area of 1,462 km^2 and underlies a large portion of the Darwin Rural area. The *Howard Water Allocation Plan*, which is currently under development, will dictate the future allocation and management of groundwater in the Howard groundwater system (see the NT Department of Environment and Natural Resources website for more information).

Potable water is obtained from groundwater bores RN028708 and RN021345 on a neighbouring property (Lot 1552 Hundred of Guy). HDB's allocation of 10 ML per year for aquaculture is specified in the groundwater extraction licence for this property (Lic. No. HGSS10053). HDB's allocated volume is insignificant in comparison to other groundwater users along Anzac Parade.

4.7 Flora and fauna

The HDB farm is located within the NT Government-listed *Sites of Conservation Significance* (SOCS), *Adelaide River coastal floodplain* (see NRETAS 2008b). This area is described on the NRETAS (2008b) SOCS Fact Sheet as:

> *A large seasonally-inundated freshwater floodplain that is traversed by a major and permanent tidal river. The floodplain comprises a mix of tidal and seasonal wetland habitats and is dominated by grass and sedge communities and is fringed by open woodland with pockets of monsoon forest.*

Ecological values include supporting large numbers of waterbirds (Magpie Geese, Whistling Ducks, egrets etc.) and periodically migratory shorebirds. All areas where these birds are known the nest, breed and feed are located at least 5 km away from the HDB farm.

The condition of the floodplains varies, and parts are heavily impacted by weeds, feral animals, and freshwater groundwater extraction. Saltwater intrusion is also impacting the wetlands near the coast, and it likely to be exacerbated with sea level rise due to climate change.

Under the National Vegetation Management System, vegetation across the site is mapped as *Oryza* tall closed tussock grassland consisting of *Oryza* species, *Eleocharis spp*, tussock grass and sedge.

NT Land System mapping records the site as *Cyperus,* which is associated with vegetation communities of mid-high closed grassland of *Dichanthium sericeum*, *Germania grandiflora*, *Eleocharis spiralis*. Mangroves line the banks of the Adelaide River where the farm is situated.

No species listed under the *Territory Parks and Wildlife Conservation Act* or the *Environment Protection and Biodiversity Conservation Act 1999* have been recorded within the site. Threatened flora and fauna species potentially within a 5 km radius of the HDB farm identified using the Protected Matters Online Search Tool are listed in Appendix D. The risk to these species from HDB operations and planned expansion (South Farm and East Farm) was assessed as very low during the approvals process for construction of the South Farm and East Farm in the NOI submitted for assessment under the *Environmental Assessments Act*, and also the Statement of Effect submitted in order to obtain a Development Permit (see Entura 2016).

5 HDB FARM OPERATIONS DESCRIPTION

5.1 Historic overview

The HDB farm was established in 1993 on Section 1703, Hundred of Guy, on freehold land owned by HDB. From 1993 to 2016, the HDB farm pond system developed to reach an area covering approximately 60 ha. This area, now referred to as the North Farm, includes 27 production ponds, as well as the associated settlement ponds, header ponds and wetland treatment systems (Figure 1-2; Table 5-1). The Stage 1 and Stage 2 nurseries, and their associated wetland treatment systems, were also developed during this period, as well as the mechanical workshop, office building and packing shed.

In 2016, HDB purchased the adjacent property, Section 1624, Hundred of Guy. The amalgamated land is now titled Section 1773, Hundred of Guy; covering a total area of 585 ha. In June 2016, HDB were granted a Development Permit DP16/0289 under the NT *Planning Act* to expand the farm to include a new South Farm and East Farm (Figure 1-2). Following submission of a Notice of Intent (NOI) for assessment of the farm expansion under the NT *Environmental Assessments Act,* the NT EPA determined the proposal did not require further assessment, as outlined in a *Statement of Reasons* issued June 2016.

The South Farm pond system was completed in late 2016. This farm covers an area approximating 70 ha, and comprises 19 production ponds, and the associated settlement ponds, header ponds and a single large wetland treatment system. The Stage 3 nursery, recently completed in early 2020, is also located within the South Farm area. This nursery uses the South Farm wetland treatment system for water treatment. A feed storage shed and services pad are located within the South Farm area.

In late 2019, development of the East Farm commenced with the completion of 12 production ponds, two header ponds, and the entire wetland treatment system. A further 11 production ponds and two header ponds are scheduled for completion by the end of 2020.

The total combined area of the North Farm, South Farm and East Farm, including ponds, wetland treatment systems, access roads, and infrastructure is approximately 200 ha.

5.2 Water flows through the farm system

Water flows, via gravity, from the header ponds, to the production ponds, to the wetland water treatment system, and is then pumped back to the header ponds. When required, new water is pumped from the Adelaide River at the point 'AI' in Figure 1-2. This is undertaken in accordance with water extraction licence number 817399. Saline water is usually extracted from the Adelaide River during the dry season, when water is required to replace water lost from the system through evaporation.

HDB's surface water extraction licence requires the metering and recording of all extraction volumes from the river and monthly reporting of these volumes to the NT Controller of Water Resources.

River water is highly turbid; typically ranging between 60 NTU and 200 NTU depending on the tide, season, rainfall and river flows. To reduce this turbidity, water is pumped into a series of settlement ponds to settle-out suspended sediments before pumping into the header ponds.

Screens on the intake pipe prevent wild fish in the river from being pumped into the farm. These screens are regularly checked and cleaned.

Table 5-2 below outlines the EPL239 authorised discharge points into the Adelaide River, and the parts of the farm that report to each of these discharge points. The sections below, further describe water flows through each of the farms (i.e. North, South and East Farms).

Table 5-1. HDB farm pond extent summary

Farm area	Pond type	Total number	Water Area m²	Approx. total stored water volume	Approx. total farm area incl. land around ponds
North Farm	Header ponds	3	42,400	**900 ML**	**60 ha**
	Production ponds	27	128,300		
	Wetland treatment	3	178,074		
	Total	**33**	**348,774 (35 ha)**		
South Farm	Header ponds	2	26,168	**1050 ML**	**70 ha**
	Production ponds	19	151,923		
	Wetland treatment	1	232,584		
	Total	**22**	**410,675 (41 ha)**		
East Farm	Header ponds	4 *Currently only 2 installed*	25,380 *Currently only 12,690 installed*	**1002 ML**	**68 ha**
	Production ponds	23 *Currently only 12 installed*	174,599 *Currently only 91,095 installed*		
	Wetland treatment	1	216,151		
	Total	**28** *Currently only 14 installed*	**416,130 (42 ha)** *Currently only 319,936 installed*		
All farms combined	**Header ponds**	**9**	**93,948**	**2052 ML**	**198 ha**
	Production ponds	**69**	**454,822**		
	Wetland treatment	**5**	**626,809**		
	Total	**83**	**1,175,579 (118 ha)**		

Table 5-2. HDB farm discharge pathways.
Refer to Figure 1-2 for locations.

Farm area	Production pond series / Nursery	Discharge point from end of wetland treatment system	Discharge Point into Adelaide River	Comments
North Farm	A5 to A10	A DP	**DP1**	Discharge from A DP, B/C DP and D/E DP flows into a perimeter drain that flows to DP1. Water from DP1 discharges into the Adelaide River. DP1 has an automated flow gauge to record discharge volumes.
	B1 to B3 C1 to C4 A1 to A4	B/C DP		
	D1 to D5 E1 to E5	D/E DP		
South Farm and Stage 3 Nursery	J1 to J5	SF DP If required during heavy rain also: CE DP	**AI**	All discharge from South Farm production ponds and Stage 3 Nursery flow into one large wetland treatment system that discharges from SF DP. SF DP has an automated flow gauge to record discharge volumes. An additional discharge point CE DP, is for extreme flood events, if required, when the capacity of SF DP is exceeded. Both SF DP and CE DP discharge into the channel that discharges into the Adelaide River at AI.
	K1 to K5			
	L1 to L5			
	M2 to M5			
	Stage 3 Nursery			
East Farm	F2 to F6	EF DP If required during heavy rain also: EF CE DP	**EF DP** If required during heavy rain also: **EF CE DP**	All discharge from East Farm production ponds flows into one large wetland treatment system that discharges from EF DP. EF DP has an automated flow gauge to record discharge volumes. An additional discharge point EF CE DP, is for extreme flood events, if required, when the capacity of SF DP is exceeded. Both EF DP and EF CE DP discharge direct into the Adelaide River.
	G1 to G6			
	H1, to H6			
	I1 to I6			
Stage 1 and Stage 2 Nurseries	Stage 1 Nursery	S1N DP	**DP2**	Stage 1 Nursery discharges via S1N DP and Stage 2 Nursery discharges via ND into a drainage channel that flows into the Adelaide River at DP2. Discharge volumes from S1N DP and ND are measured manually.
	Stage 2 Nursery	ND		

5.2.1 North Farm

In the North Farm, there are three groupings of production ponds, each with their own associated header ponds and wetland water treatment system. These three pond groupings are:

1. A5 to A10

2. B1 to B3, C1 to C4, and A1 to A4

3. D1 to D5 and E1 to E5

The first group of ponds drain into the north-eastern wetland treatment system, the second into the south-western wetland treatment system, and the third into the north-western wetland treatment system (Figure 1-2).

When discharge occurs from the North Farm, water flows into the perimeter drain from the wetland treatment systems at the points A DP, B/C DP and D/E DP (see Figure 1-2). At each of these points, when water levels meet the maximum allowable level in the wetland treatment system, water flows into a pipe and through the earthen bank into the perimeter drain. The water then flows to the discharge point DP1 and into the Adelaide River. This is an authorised discharge point under EPL239.

An automated flow meter is installed at DP1 to measure the volumes of discharge leaving the North Farm. No water from the North Farm flows to DP1 unless discharge from the wetland treatment systems is occurring. Valves installed downstream of the flow meter prevent tidal inflows up the perimeter drain from the Adelaide River.

5.2.2 South Farm

In the South Farm, the 19 production ponds are numbered J1 to J5, K1 to K5, L1 to L5 and M2 to M5 and all these flow into the single large wetland water treatment system. The Stage 3 Nursery also utilises this wetland treatment system. Once water reaches the end of the wetland treatment system, it is pumped back into the header pond. When discharging, an operator-controlled valve at SF DP (see Figure 1-2) is opened, and water from this header pond is released through a pipe in the earthen bank into a drainage channel. This water then flows to discharge point AI, where it enters the Adelaide River.

An automated flow meter is installed at SF DP to measure the volumes of discharge leaving the South Farm.

An additional discharge point CE DP, is located where the wetland treatment system for the South Farm discharges into the drainage channel during extreme flood events, if required, when the capacity of SF DP is exceeded. Discharge volumes from CE DP would be measured manually if discharge was to occur.

5.2.3 East Farm

The East Farm (once fully complete) comprises 23 production ponds numbered F2 to F6, G1 to G6, H1, to H6, and I1 to I6. Ponds H1 to H6 and I1 to I6 were completed in 2019, and F2 to F6 and G1 to G6 are scheduled for completion in late 2020. The wetland water treatment system to service all 23 ponds is already fully constructed and operating. Once water reaches the end of this wetland treatment system, it is pumped back into the header pond.

When discharging, an operator-controlled value at EF DP (see Figure 1-2) is opened, and water from this header pond is released through pipes in the earthen bank into the mangroves that line the Adelaide River. An automated flow meter is installed at EF DP to measure the volumes of discharge leaving the South Farm.

An additional discharge point EF CE DP, is located where the wetland treatment system for the East Farm discharges during extreme flood events into the mangroves that line the Adelaide River, if required, when the capacity of EF DP is exceeded. Discharge volumes from EF CE DP would be measured manually if discharge was to occur.

5.2.4 Discharge volumes to the Adelaide River

The flow system design at HDB means that no wastewater is discharged from the production ponds directly to the Adelaide River. When discharges are required, this occurs from the end of each wetland treatment system. Wastewater from the production ponds is sufficiently treated through the wetland water treatment system (in regards to reducing nutrient and organic concentrations, and oxygen demand) for indefinite recirculation through the production ponds. Discharge is only typically required during the peak of the wet season (January – March), when rainfall enters the ponds and water levels need to be reduced to prevent over-topping.

On occasions, discharge may be required from the wetland treatment systems during the dry season to replace water lost through evaporation and to increase production pond salinity to optimise fish health. During water intake, excess water from the wetland water treatment system may be released to the Adelaide River via the specified discharge points. Note this type of release is infrequent and has not been required at any time during the last eight years, as there was sufficient evaporation and freeboard available in the wetland system to accommodate all water added from the Adelaide River.

Occasionally, small discharges are required from the Stage 1 and Stage 2 Nurseries during the peak of the wet season to lower water levels, and during the dry season for non-routine maintenance, such as upgrades to the nurseries or wetland treatment ponds. Discharge from the Stage 1 and Stage 2 Nurseries is into the drainage channel that flows to DP2, then into the Adelaide River (Figure 1-2).

The volume of all discharges into the Adelaide River is recorded and reported to the NT EPA in accordance with the conditions of EPL239. As outlined in the sections above, automated flow gauges are located at the primary discharge points of each farm (North, South and East) and manual flow volume measurement is undertaken at occasional discharge points i.e. nurseries and emergency discharge points; see EPL239 and Environmental Obligations Register (Appendix C) for reporting requirements.

Table 5-3 outlines the details of all discharges since August 2016, when consistent monthly monitoring of the monitoring sites shown in Figure 1-2 commenced (as well as weekly monitoring during discharge). Table 5-3 also lists the monitoring reports provided to the NT EPA in relation to each discharge.

The volume of discharge from the farm each wet season is highly variable, and dependant on rainfall. This is demonstrated by comparing the total discharge volume from the farm for the 2017/2018 wet season to the 2018/2019 wet season (see Table 5-3):

- Total discharge for the 2017/2018 wet season was 391 ML. This wet season included a 1 in 100 year flood event during January 2018, and overall was an above-average wet season with a total wet season rainfall of 1,908 mm compared to the average total annual rainfall of 1,435 mm (taken from nearest BoM station No 14090)
- Total discharge for the 2018/2019 wet season was 24 ML. This was a below average wet season, with a total wet season rainfall of 974 mm.

The volume of water flowing past the farm during one 12-hour tidal cycle is 13,333 ML (see Section 4.4.1 above). This is very large when compared to the volume of discharges from the farm. Even during an above-average wet season, the entire amount of discharge (391 ML) is 34 times smaller than the volume of water flowing past the farm during one 12-hour tidal cycle. In addition, most discharge occurs during the peak of the wet season (i.e. January – March), when the volume of water flowing down the river from catchment inputs is greatest. In relation to the average estimated annual total flow down the Adelaide River from catchment rainfall and runoff (i.e. 2693 GL see Section 4.4.1 above), it could be said that the 391 ML discharge volume from the HDB Farm makes up 0.015% of this.

Table 5-3. Discharge details since August 2016.

Discharge Source	Discharge Point	Dates	Duration	Volume (ML)	Reported to NT EPA
Stage 2 Nursery	ND -> DP2	05/09/2016	1 day	0.360	Not required at this time
North Farm	DP1	25/12/2016-04/04/2017	101 days	Not recorded	Not required at this time
		Total for 2016/2017:	**102 days**	**Not recorded**	Not required at this time
Stage 1 Nursery	S1N DP -> DP2	15/11/2017-17/11/2017	2 days	10.4	*EPL-239 Monitoring Report, 1 August 2017 – 31 March 2018*, submitted to NT EPA 31 May 2018
North Farm	DP1	25/01/2018-14/03/2018	48 days	291.4	
South Farm	SF DP -> DP2	25/01/2018-10/02/2018	16 days	45.5	
North Farm	DP1	19/03/2018-02/04/2018	14 days	43.8	*EPL239 Monitoring Report, Reporting period: 1 April 2018 – 31 March 2019*, submitted to NT EPA 1 May 2019
		Total for 2017/2018:	**64 days***	**391.1**	*EPL-239 Monitoring Report, 1 August 2017 – 31 March 2018*, submitted to NT EPA 31 May 2018
North Farm	DP1	29/01/2019-13/02/2019	15 days	22.4	*EPL239 Discharge Report, for discharge 29 January – 13 February 2019*, submitted to NT EPA 27 March 2019
North Farm	DP1	07/04/2019-14/04/2019	7 days	1.9	*EPL239 Discharge Report, for discharge 7 - 14 April 2019*, submitted to NT EPA 29 May 2019
		Total for 2018/2019:	**22 days**	**24.3**	*EPL239 Monitoring Report, Reporting period: 1 April 2018 – 31 March 2019*, submitted to NT EPA 1 May 2019
Stage 2 Nursery	ND -> DP2	24/09/2019-30/09/2019	6 days	15	*EPL239 Discharge Report, Stage 2 Nursery discharge, 24 – 30 September 2019*, submitted to NT EPA 23 October 2019
North Farm	DP1	22/01/2020-31/01/2020	9 days	11.6	*EPL239 Discharge Report, 22 – 31 January 2020*, submitted to NT EPA 27 February 2020
South Farm	SF DP -> DP2	23/01/2020-24/01/2020	32 hours	3.8	
East Farm	EF DP -> DP2	23/01/2020-24/01/2020	32 hours	2.6	
North Farm	DP1	21/02/2020-04/03/2020	12 days	65	Discharge report due 30 April 2020
South Farm	SF DP -> DP2	27/02/2020-05/03/2020	7 days	42	Discharge report due 30 April 2020
East Farm	EF DP -> DP2	27/02/2020-05/03/2020	7 days	35	Discharge report due 30 April 2020
North Farm	DP1	09/03/2020-18/03/2020	9 days	42	Discharge report due 30 April 2020
South Farm	SF DP -> DP2	09/03/2020-13/03/2020	4 days	23	Discharge report due 30 April 2020
East Farm	EF DP -> DP2	09/03/2020-13/03/2020	4 days	20	Discharge report due 30 April 2020
Stage 1 Nursery	S1N DP -> DP2	09/03/2020-13/03/2020	4 days	0.20	Discharge report due 30 April 2020
		Total for 2019/2020:	**37 days***	**260.2**	Annual monitoring report due 30 April 2020

** If more than one farm area is discharging during the same day e.g. when North Farm and South Farm are both discharging at the same time, this is counted as one day. This explains why the total number of days is not the sum of the days in the column above.*

The East Farm presently (as of March 2020), comprises 12 of 23 planned production ponds, and the entire completed wetland treatment system (Figure 1-2). Once all 23 ponds are complete, the total water area of the East Farm (including all production, header and wetland treatment ponds) will be approximately 403,440 m^2. The total water surface area of the North Farm is approximately 348,774 m^2 and the South Farm is 410,675 m^2. Therefore, the East Farm represents an increase in farm water area of 53%. A 53% increase in discharge volume for the 2017/2018 wet season would be a total 598 ML, which is still around 22 times smaller than the volume of water flowing past the farm during one tidal cycle.

5.2.5 Discharge water quality

Water quality monitoring is undertaken during discharge in accordance with the HDB *Water Quality Monitoring Plan* (WQMP); see Appendix E. This WQMP outlines the monitoring sites, sampling frequency, parameters measured and sampling methods, in order to meet the requirements of EPL239, and allow for assessment of any potential impacts on the Adelaide River. Monitoring sites are shown in Figure 1-2.

Reporting of water quality results to the NT EPA, and assessment of parameter concentrations against the EPL239 assessment criteria (site-specific trigger values), is required following discharge, and also as part of an annual monitoring report; see EPL239 and Environmental Obligations Register (Appendix C) for reporting requirements.

All discharges have been reported to the NT EPA in reports since at least issue of WDL189-02 in March 2017 (see Table 5-3). Water quality monitoring of all discharges occurring since at least issue of WDL 189 have demonstrated no impact on the Adelaide River. For discharges occurring since June 2018, this is specifically measured at the EPL239 'compliance point' – i.e. Adelaide River monitoring site (usually ARDS), which is downstream of the farm at the time of sampling.

5.3 Wetland treatment systems

The wetland treatment systems operate via biological filtration and recirculation. Water is gravity fed from the production ponds to the wetland treatment systems, where it, is allowed to flow through a sinuous channel (taking approximately two weeks) prior to being pumped back to header ponds and recirculated through the system.

The wetland treatment systems are constructed by pushing up earthen banks from the existing on-site soils. The depth of the formed channels is around 1.2 m below the existing land surface, and 1.8 m below the top of the surrounding earthen banks. The channels are unlined, however, the existing clay substrate is impermeable (see Section 4.3.2 *Soil permeability* above), and there is no seepage of water from the treatment systems into the ground.

The treatment system banks are thickly vegetated with saltwater couch (*Sporobolus virginicus*). This prevents erosion and assists with nutrient uptake.

As explained in section 5.2.1 above, the North Farm production ponds are serviced by three separate wetland treatment systems. The South Farm and East Farm each have a single large wetland treatment system. The area of each wetland treatment system is around 40% larger than the production pond area it services.

The Stage 1 and Stage 2 Nurseries each have their own dedicated wetland treatment system, and the Stage 3 Nursery utilises the South Farm wetland treatment system.

Water treatment systems require periodic maintenance to manage aquatic plant growth. During maintenance, excess aquatic vegetation is removed and placed on the banks and allowed to dry and decompose.

5.4 Header ponds

Header ponds are located between the rows of production ponds and function to provide a source of clean water, which is gravity fed to the production ponds. Header ponds are constructed from the existing on-site soils (clays) by pushing up the soil to create a basin surrounded by earthen berms. Each pond is around 30 m wide, approximately 1.5 m deep, and the earthen berms vegetated with non-invasive grasses.

5.5 Production ponds

The barramundi are grown-out in the production ponds to between 300 g and 5 kg prior to harvest. The fish are grown to a variety of sizes to meet the requirements of different customers.

The production ponds are each approximately 80 m by 80 m, and approximately 1.5 m deep, and have been formed out of the existing on-site soils (clays). The pond walls are lined with high-density polyethylene (HDPE) plastic to prevent erosion and the top of the banks are vegetated with saltwater couch to provide further bank stability and assist with nutrient uptake. The height of the banks around the ponds allows for a one-metre freeboard under normal operating conditions.

Water is constantly circulated from the header ponds into the production ponds, and into the wetland treatment systems via gravity flows through connecting pipes. Pipes are fitted with screens to prevent fish escape from production ponds. The ponds are aerated with three phase paddle wheel aeration units. Maintenance and cleaning of pipes, screens, pumps and aerators is carried-out weekly.

Water quality within production ponds is monitored at least weekly to ensure optimal fish health and performance. Water quality parameters include pH, temperature, salinity, ammonia, and dissolved oxygen.

Periodically, excess plants growing along pond banks are removed and pushed up on top of the banks and allowed to dry and decompose.

Desludging of production ponds has to date, not been required. The North Farm production ponds have been operating for over 10 years and have not yet required desludging. This may be required in the next few years. The build-up of sludge in the ponds is minimised by an exacting feeding regime (see Section 5.6 below) and the removal of suspended sediments in the settlement ponds when adding water to the farm from the river (see Section 5.2 above).

When desludging of production ponds is required, the ponds will be emptied, and the accumulated sludge removed and used to build-up banks on site. The timing of these maintenance works can be timed to occur when there is sufficient free-board available in the wetland treatment system to avoid discharge to the river.

5.6 Sediment/sludge management

Approximately every five to ten years, the production ponds, associated channels and wetland treatment systems require the accumulated benthic sediment to be removed. Previously, this has been undertaken during the dry season by removing the sediment using an excavator, placing the material onto the pond wall and allowing it to dry out. This material is then used as fill or for building-up levees across the farm.

Given a relatively larger area of wetland treatment ponds are due for refurbishment over the next few years, a new method of managing removal of accumulated sediment/sludge is now being used. The process will occur during the dry season, and involves:

- Dewatering the ponds/channels. Water is relocated into adjacent wetland treatment system.
- Dredging the sediment from the ponds/channels.
- Pumping the slurried sediment to purpose-built settlement ponds located on the immediate western side of the North Farm perimeter wall (see Figure 5-1).
- Decanting water to enable dry-out within the settlement pond.
- Water is pumped back into production system.

- Sediment in settlement ponds is dried-out and recovered for use as fill and earthen walls across the farm.

All water and sediment/sludge from this process is retained on-site and there are no discharges associated with this activity.

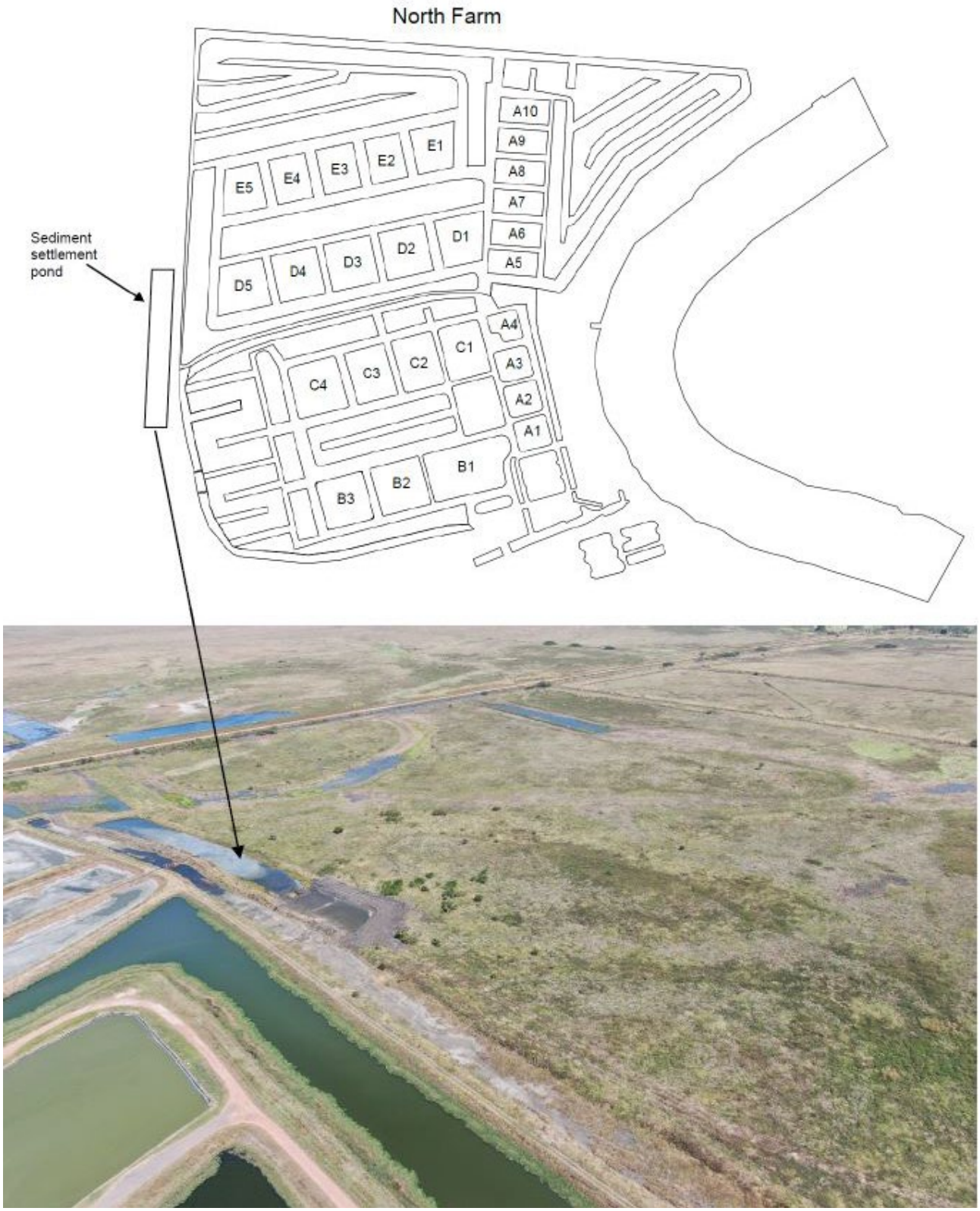

Figure 5-1. Location of sediment settlement pond.

5.7 Feeding

The main feed supplier is Ridley Aquafeed from Brisbane, although small trials are currently underway with feed from Skretting. The fish are fed pelletised Ridley Aquafeed twice daily. This feed is Australian-produced and contains no hormones, no antibiotics or artificial growth promoters, no melamine, no heavy metals, no dioxins or PCBs, and no pesticides. No nutritional supplements, hormones, growth promoters or pond additives are used. Also, no antibiotics are used in the growing of fish; only in the rare incidence of a medical emergency in juvenile fish in the nurseries. This has only occurred four times since 1993. A medical prescription from a vet is required in this instance.

The timing of feeds is aimed at maximising uptake by the fish and minimising impacts on water quality. An example is not feeding at the end of the day to minimise water column oxygen demand (due to break-down of organic matter in the pellets) during the night, when water plants and algae are not photosynthesising and producing oxygen to counteract that lost to organic matter breakdown. Fish behaviour is also observed, and feed application reduced if fish are consuming less. This is particularly important when daily temperatures are lowering, as barramundi tend to eat less when it is colder. There is a fish behaviour checklist and SOP to support this optimal feeding regime.

The amount of feed used is accurately measured and recorded. Load cells on feed hoppers are used to record the kg of feed applied to each production pond. The operator records this in the Daily Pond Feeds Form, which is provided to Farm Admin who enters the information into the AquaManager aquaculture facility management software.

Feed is stored in the feed shed located within the South Farm (Figure 1-2).

5.8 Harvest

The harvest takes place the day before packing and involves crowd netting of a portion of fish in the pond (these have been starved for a maximum of 2 days). A fish pump transfers the fish into bins with an ice-brine slurry, where they are quickly euthanised by cold shock, before transfer to the packing shed for overnight holding in brine bins with aeration to mix the slurry.

All ice is made onsite using potable fresh water from the neighbouring property i.e. groundwater bores RN028708 and RN021345 on Lot 1552 Hundred of Guy. Saline groundwater from the on-site bore RN031329 is used to make the ice slurry.

5.9 Nurseries

Nursery facilities at the HDB Middle Point farm includes a:

- **Stage 1 Nursery**, where fingerlings are first brought upon arrival to the farm, and grown until around 1 g. Strict quarantine and biosecurity measures apply to the Stage 1 Nursery to prevent the introduction of disease; see HDB Biosecurity and Fish Health Management Plan. This nursery has ten tanks (6 x 10,000 L, 2 x 5,000 L and 2 x 2,000 L) and its own dedicated wetland treatment system.
- **Stage 2 Nursery** for fish between 1 g and 30 g. This nursery has 11 tanks (5 x 45,000 L, and 6 x 10,000 L) and its own dedicated wetland treatment system.
- **Stage 3 Nursery** for fish between 30 g and 200 g, after which they are transferred to the production ponds. This nursery has 12 x 450,000 L tanks and utilises the South Farm wetland treatment system.

Once treated through the wetlands, water returned to the nurseries is dosed with dissolved oxygen gas fed into the water using a large oxygen cone.

The freeboard available in the wetland treatment systems servicing each nursery is normally sufficient to accommodate all water from the nursery tanks, when the tanks are periodically emptied for cleaning and maintenance, and discharge to the Adelaide River is not required.

As mentioned above in Section 5.2, occasionally, small discharges are required from the Stage 1 and Stage 2 Nurseries during the peak of the wet season to lower water levels, and during the dry season for non-routine maintenance, such as upgrades to the nurseries or wetland treatment ponds.

Fingerlings are currently sourced from interstate hatcheries; i.e. MainStream Aquaculture Hatcheries (Victoria), Jungle Creek (Queensland), and Robe Barra (South Australia). However, an increasing proportion of fingerlings are now sourced from HDB's developing hatchery, currently located at a nearby facility at Channel Island, Darwin Harbour.

5.10 Groundwater supply

Fresh potable and fish processing water (to make ice etc.) is supplied via a 6.5 km supply pipe from a neighbouring farm (Lot 1552 Hundred of Guy), which is located above the Adelaide River floodplain where groundwater is fresh (bores RN028708 and RN021345). Water is purchased through an agreement with the bore owner and HDB are included on the owner's groundwater extraction licence (Lic. No. HGSS10053). There is no freshwater supply within the HDB farm boundary.

Groundwater underlying the farm site is highly saline and small volumes of water are used to top up nursery ponds and make ice slurries for processing harvested fish. The groundwater is extracted from bore RN031329, which approved under groundwater extraction licence signed 4 July 2016.

Saline water from the onsite bore (RN031329) is used as top-up water supplies in the nurseries and to make the ice slurries for processing harvested fish.

5.11 Packing shed

In the packing shed, harvested fish are hand sorted, graded, and weighed, then packed into polybins (20 kg) or 300-500 kg cardboard Kin Bins. Following palletisation and labelling, they are stored in the chiller room, then dispatched by road transport to wholesale customers and other processing facilities. No filleting is undertaken at the HDB farm, all fish are dispatched whole.

The packing shed facilities, including the harvest container bins, are cleaned using Australian Quarantine and Inspection Service (AQIS) approved biodegradable cleaners including:

- Amazing – multipurpose hard surface cleaner
- Conquest Sanitiser – non-fragrant sanitiser disinfectant.

The packing shed has a series of drains that report to a collection sump. The collection sump is screened to collect any potential solids (predominantly fish scales that detach from the fish during their handling). Solids are removed from the sump and disposed of off-site through licenced water contractor removal. The remaining water is discharged to an evaporation drain that runs along the southern extent of the HDB farm. The drain is vegetated with saltwater couch, and is not connected to the production ponds or wetland treatment system, therefore has no method of discharge to the Adelaide River.

5.12 Mortality management

Fish mortalities at the farm derive from:

- Fish deaths in the farm ponds (on average 25 kg per week)
- Juvenile fish deaths in nurseries (on average less than 1 kg per week)
- Dead juvenile fish in live shipments from suppliers (minimal)

- Reject harvested fish deemed unsuitable for sale from the packing shed (on average 60 kg per week)
- Fish wastes produced during sorting and packing of whole fish for dispatch i.e. fish scales (less than 1 kg per week)

Fish mortalities throughout the farm, including juveniles and adult fish, are strictly managed in accordance with the HDB Biosecurity and Fish Health Management Plan. All mortalities are recorded, and mortality rates monitored, to identify any fish health or water quality issues requiring attention.

Fish mortalities in the production ponds are collected up several times a week and stored in a cool room until collected by the neighbouring organic farmer for processing and use as fertiliser on the farm. When dead fish are collected from the production ponds, fish are inspected for any abnormalities, or signs of disease. If any issues are identified, the fish are instead be kept in a secure area and sent to a veterinary lab for analysis.

Juvenile fish mortalities, as they occur in the nurseries, are kept in a secure dedicated freezer. Prior to storage, they are inspected for any signs of disease and sent to a veterinary lab for analysis if any issues are identified. The mortalities are kept in the freezer for a period of time prior to collection by the organic farmer.

Reject harvested fish are kept in a dedicated freezer in the packing shed until collected by the organic farmer (occurs once per week).

Feral animal and wildlife mortalities are minimal, but when they occur, they are taken straight to the mortality management area located along the access road into the farm where they left to decompose. All wildlife mortalities are recorded in the Wildlife Register and reported to the NT Parks and Wildlife Commission in accordance with the permits to take wildlife.

In the case of a mass mortality event, fish carcasses in excess of that which can be used by the organic farmer, will be disposed of in purpose-built trenches to be constructed no deeper than 300 mm deep in production areas, and no more than 800 mm deep on the flood plain. The burial location will avoid saturated areas.

5.13 Waste management

Waste management at the HDB farm is covered in the Waste Management Plan (Appendix K).

5.14 Generator sheds and fuel storage

The power supply infrastructure at the farm includes generators and fuel storage that ensures the farm can operate independently of mains power and commercial fuel supplies for up to 14 days in the event of a power outage or flood/cyclone,. This includes all water pumps and pond aerators to ensure fish survival. Fuel is also stored at the farm for use in vehicles and machinery.

Fuel storage includes the following sites:

- Five generator sheds; four with 9,000 L diesel tanks and one with a 60,000 L diesel tank
- Workshop; one 9,000 L diesel tank and one 9,000 L unleaded petrol (ULP) tank

Logitech self-bunded, double skinned fuel containers are in use at the generator sheds and for vehicle refuelling (diesel and ULP). All fuel storage sites have a spill kit. Refuelling of vehicles and machinery occurs within a concrete bunded area with a sump to prevent any fuel spillages or residues from washing into waterways during rainfall - need confirmation of this from HDB.

5.15 Chemicals and hazardous goods

Chemicals are purchased from approved suppliers and stored in locked units that have a warning sign appropriate to the hazardous chemicals being stored. Chemicals are stored near to their area of use, which comprises the:

- Workshop
- Packing shed
- Vehicle refuelling areas
- Nurseries
- Feed shed
- Generator sheds

At each of these locations, there is spill containment equipment, and hard-copy safety data sheets (SDSs) for the chemicals stored. Incompatible chemicals are kept separate, and the storage units are bunded, where required. Hard-copy SDSs are also held at the site office and electronic copies on file.

Staff who regularly handle and use chemicals are required to complete CHEMCERT training. The HDB Training Matrix records the staff who have completed the training, and which staff still need to complete the training.

The HDB Chemical Register lists all chemicals used and stored on-site and includes information on the storage location, chemical brand, volume, active constituent, common use, supplier and link to the SDS. The current version as of March 2020 is provided as Appendix F).

5.16 Erosion and sediment control

The HB farm site is flat (gradients less than 0.2%), with very little relief. This, combined with small catchment areas limited to within the immediate farm area, and low run-off volumes, means that erosion risk is very low. Further, at the beginning of the wet season, the natural soil profile is deeply cracked and typically the first 200 mm of rainfall goes down the cracks before soil swelling is sufficient to close them. Once the cracks have closed, negligible infiltration occurs, however there is little runoff as the surface is naturally pitted with “gilgai” which store significant amounts of surface water.

Erosion risk associated with the farm operations is limited to raised perimeter walls and pond berms. Erosion is minimal, as all perimeter walls, wetland treatment system banks and header pond banks are thickly vegetated with saltwater couch, non-invasive grasses, and other ground-cover plants. The inside walls of production ponds are lined with HDPE plastic, and land areas between ponds that are not used for road access are thickly vegetated.

Continuous monthly turbidity measurements in the wetland treatment ponds for the North and South Farms as part of HDBs water quality monitoring program from 2015 to present (i.e. over 400 measurements across the eight North and South Farm monitoring sites) is always well below the turbidity in the Adelaide River. Turbidity in the treatment ponds is usually always below 40 NTU.

In contrast, the Adelaide River is naturally very highly turbid due to strong tidal currents and suspension of fine muddy sediments from the estuary. Turbidity is also high in the river during the wet season from highly turbid catchment inflows. Turbidity in the river typically ranges between 60 and 200 NTU depending on the tides and volume of catchment runoff; based on continuous monthly Adelaide River (sites ARDS, ARUS, AI) water quality monitoring data collected by HDB from 2015 to present.

5.17 Office and staff amenities

The site administration office is located above the packing shed; location shown in Figure 1-2. Staff ablutions are located at the packing shed, Stage 2 Nursery, Stage 3 Nursery, and small staff accommodation block. All ablutions are serviced by septic systems approved by the NT Department of Health.

5.18 Wildlife management

HDB actively manages problem birds that affect the farmed barramundi. HDB holds a permit (No. 62311) granted by the NT Parks and Wildlife Commission to 'take' the following protected bird species: Pied Heron, Whistling Kite, Square-tailed Kite, Black Kite, Australian Pelican, Little Black Cormorant and White Ibis. The permit specifies a maximum number of each of these bird species allowed to be taken during the permit period (current permit expires 31 December 2023). Methods are limited to bird fright, exclusion and shooting whilst looking to implement other long-term strategies. Destruction of birds is to be used as a last resort after attempting dispersal techniques such as air guns and birdfrite.

HDB has implemented a number of measures to discourage birds away from the production ponds, such as wire lines around the edge to prevent wading birds. Another example is the introduction of large floating cages under which feed is applied to the production ponds. The cages exclude birds from eating the feed and juvenile farmed fish (once the fish are over 300 g they are too large for predation from birds). This measure has resulted in a large reduction in birds attracted to the ponds. The recent commissioning of the Stage 3 Nursery will also significantly reduce predation by birds, as this nursery allows the growth of fish beyond 200 g.

HDB also holds a permit (No. 65709) granted by the NT Parks and Wildlife Commission to trap and relocate crocodiles in order to prevent them from eating the farmed barramundi and to assure staff safety. The permit specifies a maximum number of freshwater and estuarine crocodiles allowed to be removed from the farm during the permit period (current permit expires 13 October 2024). To minimise crocodiles at the farm, HDB maintains a crocodile exclusion fence along the river frontage. Any crocodiles that infiltrate this barrier are trapped are relocated to Crocodylus Park.

All wildlife control actions and interactions are recorded in the HDB Wildlife Register and are reported to the NT Parks and Wildlife Commission in accordance with the permit conditions. Permit conditions are included in the HDB Environmental Obligations Register (see Appendix C), which all staff are made aware of as part of their compulsory environmental induction and training module.

5.19 Feral animals and weeds

Feral animals known to occur within the HDB farm area include feral pigs, cattle, buffalo, cats, cane toads and the Asian House gecko.

Weeds recorded within the HDB farm area include Gamba Grass (*Andropogon gayanus*), Senna – Sicklepod (*Senna obtusifolia*), and Mimosa (*Mimosa pigra*). Mimosa is listed as a Weed of National Significance.

Feral animals are actively controlled on the HDB farm, and the spread of weeds controlled through an herbicide spraying program (with the objective of eradication where feasible).

5.20 Biting insects

Floodplain environments, such as that where the HDB farm is located, are areas where biting insects (mosquitos, midges etc.) are common. Distribution and abundance varies seasonally. HDB's current practices avoids the creation of shallow stagnant water where biting insects are likely to breed. This includes the routine removal of excess aquatic vegetation from production ponds and wetland treatment systems, the depth and design of ponds, and constant water flows through the ponds and wetlands.

6 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representation of the biological, physical and chemical processes that determine the ways that contaminants move from sources through the environmental media to environmental receptors. Environmental media includes soil, water and air that has the capacity to transport contaminants to sensitive receptors such as plants, animals and humans.

A CSM is required in this EMP, as specified in the NT EPA *Guideline for the Preparation of an Environmental Management Plan*. A CSM can assist in identifying where risks to human health or the environment exist, the level of risk, and how to mitigate these risks by reducing/preventing exposure of receptors to contaminants.

A CSM for the HDB farm is presented below that identifies potential:

- Contaminant sources
- Contaminants
- Contamination pathways
- Sensitive receptors

Potential contaminant sources

Sources of potential contaminants include:

- Feed inputs, faecal matter, urine and mortalities in production ponds (water and sludge) and nursery tanks (water)
- Fuel and chemicals used in farm operations (see Appendix F Chemical Register) including:
  - Fuel storage (generator sheds and workshop) and refuelling areas
  - Lubricants, engineering chemicals etc used in vehicle and machinery maintenance in workshop
  - Cleaning and sanitising chemicals used in packing shed and nurseries
  - Pesticides and herbicides used in pest and weed control (stored in workshop)
- Waste materials stored prior to collection by waste contractors
- Sewage from ablutions.

Potential contaminants

Based on the above potential sources, potential contaminants identified are:

- Nutrients (nitrogen, phosphorus etc), bacteria (*E. coli*, enterococci etc) and pathogens in production pond and nursey tank wastewater
- Hydrocarbons from fuel storage and usage
- Hydrocarbons and solvents from workshop chemicals
- Nutrients and solvents in cleaning chemicals
- Pesticides and herbicides used in the environment and from storage areas
- Rubbish and other waste materials in waste storage areas
- Nutrients and bacteria in sewage.

Potential pathways

Potential pathways for the migration of contaminants include in discharge water from the wetland treatment systems into the Adelaide River and surface water runoff from operational areas into waterways, and drainage lines that flow into the Adelaide River. Groundwater is not a potential pathway given the impermeable soils (see Section 4.3.2 above).

Potential receptors

Potential sensitive receptors include aquatic and fringing ecosystems along the Adelaide River and in downstream estuarine habitat. Also, commercial and recreational users of the river.

Risk assessment and mitigation measures

The risk of contaminants identified in the CSM migrating from the site and impacting sensitive receptors is assessed in Section 7 below. Mitigation measures to prevent or minimise contaminant migration are outlined in Section 8.

7 ENVIRONMENTAL RISK ASSESSMENT

The operational activities of the HDB farm have been considered through an environmental aspects and impacts register, which assesses the environmental risks. The likelihood and consequence categories adopted are provided in Table 7-1 and Table 7-2, and were combined to derive an overall risk rating using the matrix in Table 7-3. The environmental aspects and impacts register is included as Table 7-4.

Table 7-1. Likelihood categories

Level	Descriptor	Likelihood Description
1	Remote	No previous occurrence, but not impossible
2	Rare	May occur in exceptional circumstances
3	Unlikely	Uncommon, but has been known to occur
4	Possible	Possible occurrence at HDB
5	Occasional	May occur on occasion
6	Likely	It is expected to occur

Table 7-2. Consequence categories

Level	Descriptor	Consequence Description
0	Negligible	Insignificant impact. Unlikely to be measurable at the scale to receiving environment (i.e. ecosystem/community/stock) against natural background variability.
1	Minor	Possibly detectable but minimal impact on receiving environment ecosystem structure/function or dynamics.
2	Moderate	Maximum appropriate/acceptable level of impact (e.g. full assimilation rate for nutrients)
3	Severe	This level will result in wider and longer-term impacts occurring to receiving environment (e.g. plankton blooms)
4	Major	Very serious impact with relatively long time frame likely to be needed to restore to an acceptable level.
5	Catastrophic	Widespread and permanent/irreversible damage to receiving environment will occur - unlikely to ever be fixed (e.g. extinctions)

Table 7-3. Risk matrix

		Consequence					
Likelihood		Negligible (0)	Minor (1)	Moderate (2)	Severe (3)	Major (4)	Catastrophic (5)
	Likely (6)	Negligible	Low (6)	Moderate (12)	High (18)	Extreme (24)	Extreme (30)
	Occasional (5)	Negligible	Low (5)	Moderate (10)	High (15)	Extreme (20)	Extreme (25)
	Possible (4)	Negligible	Low (4)	Moderate (8)	Moderate (12)	High (16)	Extreme (20)
	Unlikely (3)	Negligible	Low (3)	Low (6)	Moderate (9)	Moderate (12)	High (15)
	Rare (2)	Negligible	Low (2)	Low (4)	Low (6)	Moderate (8)	Moderate (10)
	Remote (1)	Negligible	Low (1)	Low (2)	Low (3)	Low (4)	Low (5)

Table 7-4. Environmental aspects and impacts register.

				INITIAL RISK					RESIDUAL RISK		
Activity	**Aspect**	**Impact**	**Background information and assumptions**	**Likelihood**	**Consequence**	**Risk Score**	**Controls**	**Relevant Documents**	**Likelihood**	**Consequence**	**Risk Score**
Filling and replenishing ponds	Extraction of surface and groundwater from Adelaide River and RN031329	Reduction of environmental flows in the Adelaide River	The project footprint is equivalent to 0.07% of the Adelaide River coastal floodplain area. There are no major water users downstream of HDB Farm as water is saline and highly turbid. Total annual flows in the Adelaide River are estimated at 2693GL. HDB operate under Surface Water Extraction Licence 817339 which allows for 4000ML to be extracted annually. HDB hold a Groundwater Extraction Licence for RN031329 for 6 ML to be extracted annually. The total cumulative volume of extraction licences from the Adelaide River for all users is 1,952 ML/year, therefore impacts on environmental flows are considered negligible.	3	1	**Low (3)**	Extract water within permitted volumes. Meter and monitor water extraction rates to ensure volumes are within permit. Continued water level monitoring throughout the HDB farm system to recirculate water for reuse.	Water Extraction Licence (817339)	2	1	**Low (2)**
Discharging farm water to the Adelaide River	Discharge of water from ponds or nursery (active or passive)	Reduction in water quality downstream of discharge point (addition of nutrients), and subsequent impacts on aquatic ecosystem health downstream of discharge point.	The wetland treatment system comprise 60% of the overal HDB farm will comprise of wetland treatment systems once completed. Wastewater discharge will be kept to a minimum as pond water is recirculatred through the wetland treatment system for reuse. The pond and wetland treatment sysytems walls constructed to withstand a greater than 1:100 year flood event to minimise uncontrolled discharge from large flooding events. Vegetation and other biological processes in the wetland treatment system remove nutrients before water is recirculated to the production ponds. HDB farm does not use chemicals, hormones or antibodies in its operations. The main potential contaminants will be nutrients (ammonia, nitrate and phosphorus) from metabolic waste products. Discharges will be occasional, mostly in the wet season when rainfall requires excess water to be discharged from the system. Occasional discharges of treated water will also occur in the Dry season (when new salt water is pumped from the river to replenish water and salinity levels) and when nursery tanks are drained. HDB do not use hormones or antibiotics.	4	3	**Moderate (12)**	All water discharged via the authorised discharge points is treated within the wetland treatment systems. Discharge water is only released from authorised discharge points (DP1 and DP2) as per EPL239. Monitor water quality prior to, during and following discharge, which includes monitoring at the discharge point, upstream and downstream along the Adelaide River to ensure it meets the conditions in EPL239 - Attachment A Monitoring Program. Undertake routine water quality monitoring in accordance with the HDB Water Quality Monitoring Plan. Record all water quality results in the Water Quality Database and compare to guideline values. Monitor and record discharge volumes, and record the start and end of all discharges for reporting to the NT EPA. Record and respond to any complaints received in regards to discharges. Record and report any non-compliances with conditions of EPL239 and associated management plans.	Environment Protection Licence (EPL) 239 EPL239 Non-compliance Notification (where required) EPL239 Monthly Discharge Report EPL239 Annual Return EPL239 Monitoring Report (annual) Environmental Management Plan Consultation and Communication Plan Water Quality Monitoring Plan Water Quality Database	3	2	**Low (6)**
Storage and use of chemicals, hydrocarbons and hazardous substances	Spills of chemicals, hydrocarbons or hazardous substances	Contamination of soils and water within the HDB farm as a result of uncontrolled spills. Release of contaminated water to the Adelaide River and reduction of water quality and/or impacts to aquatic health.	All refuelling of vehicles occurs within a designated area. No hazardous chemicals are added to the ponds from which discharge occurs. Fuel storage quantities at one time below: - Diesel Northern Generator Shed (self bunded) 9,000 L - Diesel Southern Generator Shed (self bunded) 60,000 L - Diesel Tank (self bunded) 9,000 L - Unleaded Petrol Unleaded Tank (self bunded) 9,000 L All other chemicals stored in quantities less than 4 L in designated area	3	3	**Moderate (9)**	Training and site inductions provided to all employees in the appropriate handling and storage of chemicals and hazardous substances. All products will be stored in accordance with AS:1940(2004) and NOHSC:1015 (2001), including bunding or self-bunded containers. All fuels are stored in double lined and bunded fuel tanks. Spill kits will be onsite, adequately sizes and stocked to respond to a spill if required. All staff will be trained in the use of spill kits. Safety Data Sheets (SDS) will be kept onsite and in storage areas for all products. Chemical register is kept up to date for all chemicals, their volumes and storage locations. Routine site inspections on all chemicals and hazardous goods containers. Robust incident reporting system/culture. Conduct water sampling as per the Water Quality Monitoring Plan.	Environmental Management Plan (Spill response plan) Refuelling procedures Chemical register and SDSs Water Quality Monitoring Plan Water Quality Database	2	1	**Low (2)**

Pond maintenance (de-silting, de-sludging)	Desludging and disposal of sludge material	Reduction in water quality (addition of suspended solids and nutrients) and subsequent impacts on aquatic ecosystem health downstream of discharge point	Sludge removal occurs as required to maintain production ponds and wetlands, through excavations when water levels are drained. No sludge is disposed of off-site, and sludge utilised in construction and maintenance activities of pond/wetland walls, earthen berms, access roads, etc.	3	1	**Low (3)**	Pond maintenance is required approximately every 5 years. No sludge or silt material is disposed of off-site and all materials are reused in maintenance across the HDB farm. Turbidity is regularly monitored within the Adelaide River downstream of the HDB farm to determine any impacts to water quality as a result of operations.	HDB farm maintenance schedule Incident reporting Environmental Management Plan Water Quality Monitoring Plan Water Quality Database EPL239 Monitoring Report and Annual Return	2	1	**Low (2)**
Emergency flooding event	Overtopping of ponds due to flood event from high rainfall or tropical storm (i.e. cyclone) events	Discharge from the authorised discharge points, or in extreme cases of flooding, discharge from non-authorised points due to whole of farm flooding.	HDB pond and wetland system has been designed to withstand a 1:100 year AEP flood event. Production pond perimeter walls are to be raised above the 1:100 year flood event prior to 2023, for the whole HDB farm. Water levels are continuously monitored throughout the system and water is actively moved to raise and/or lower water levels in the system in preparation for flood events. Controlled discharges are undertaken when required in accordance with EPL239, including in the wet season when water levels are elevated from high rainfall events. HDB provide the NT EPA with notification of the commencement and cessation of discharge, the flow meter readings at the beginning and end of a discharge event, and monitoring results throughout discharge events.	4	2	**Moderate (8)**	Freeboard levels in the ponds and wetland systems are continuously monitored. Water levels are actively controlled throughout the system through adjusting spillway heights, pumping water to areas of lower freeboard or recirculating water throughout the system. A relief pipe is in place in the production ponds that drains to the wetland treatment systems, to allow at least 400 mm freeboard, in the event of high rainfall events. Weather events are monitored throughout the year to anticipate periods of high rainfall in advance. Where required, water is discharged through the authorised discharge points to reduce water levels within the system. Flow meters are installed at the authorised discharge points to measure and record volumes of water released to the Adelaide River. Water quality is monitored during all controlled and uncontrolled discharge events and reported to the NT EPA as per EPL239.	Environment Protection Licence Conditions EPL239 Non-compliance Notification (where required) EPL239 Monthly Discharge Reports EPL239 Annual Return EPL239 Monitoring Report (annual) Environmental Management Plan (including an Emergency Response Plan and Consultation and Communication Plan) Water Quality Monitoring Plan Water Quality Database	3	2	**Low (6)**
Farming of barramundi	Fish mortality, introduction of diseases or fish escape to the Adelaide River	Quarantine issues or spread of diseases (if fish are ill). Barramundi are native to the Adelaide River so no impacts associated with the introduction of pest or alien species as a result of fish escapes have been considered.	Strict quarantine practices as required by the NT Government for imported juveniles. Adherence to HDB Biosecurity and Fish health Management Plan. Production fish mortalities are contained and managed in accordance with HDB Waste Management Plan. Chance of fish escape is minimal due to concentric containment of all production ponds. Any escaped fish would be contained within the wetlands, which rarely discharge, and only do so via screened pipes, which barramundi are reluctant to enter.	3	1	**Low (3)**	HDBs pond and wetland system has been designed to withstand a greater than 1:100 year AEP flood event to prevent fish release during a flooding. Production pond outlets have a screened mesh installed to prevent fish escape. A perimeter drain is in place to capture any fish that potentially escape from the pond/wetland systems. Established quarantine practices within HDB farm and contracts with reputable hatchery suppliers. Annual audits conducted through the Sustainably Farmed Barramundi Certification and Best Aquaculture Practices programs. Established monitoring and surveillance program to identify any potential disease outbreak. Strictly no use of antibiotics within the HDB farm.	Quarantine certification records HDB Biosecurity and Fish Health Management Plan Incident reporting records Aquaculture Licence (Number C502) Conditions Environmental Management Plan Waste Management Plan Audit reports	1	1	**Low (1)**

8 ENVIRONMENTAL MANAGEMENT PLAN IMPLEMENTATION

The following section provides information regarding the implementation of environmental management measures to ensure the potential risks to the receiving environment are mitigated. Table 8-1 provides a summary of how this EMP will be implemented to address the potential impacts associated with the HDB farm operations. This includes the environmental objectives, management and mitigation measures, performance criteria and target indicators, corrective actions and contingencies, monitoring, and reporting and record keeping mechanisms.

Table 8-1. Environmental management summary

Aspect	Potential impact	Objective / outcome	Management action	Targets / performance indicators	Monitoring	Corrective actions and contingencies	Reporting & record-keeping
Filling and replenishing ponds	Reduction of environmental flows in the Adelaide River.	No reduced environmental flows within the Adelaide River due to extraction.	• Extract water within permitted volumes. • Meter and monitor water extraction rates to ensure volumes are within permit. • Continued water level monitoring throughout the HDB farm system to recirculate water for reuse.	No exceedance of licenced surface or groundwater extraction volumes.	Monitor extraction and usage through meter readings on the surface water extraction point (AI), and groundwater bore (RN031329).	• Revise meter monitoring procedure and introduce a more frequent meter reading schedule. • Review water reuse operations. • Assess extraction limits and investigate potential to increase extraction volumes.	• Water usage is recorded in the Annual Eco-efficiency Database (AED) • The AED is audited through the BAP and Sustainably Farmed Barramundi Certification Program Audit.
Discharging farm water to the Adelaide River	Reduction in water quality downstream of discharge point (addition of nutrients), and subsequent impacts on aquatic ecosystem health downstream of discharge point.	No reduction of Adelaide River water quality resulting from a discharge event.	• HDB do not use hormones or antibiotics. • The main potential contaminants will be nutrients (ammonia, nitrate, phosphorus) from metabolic waste products. • Discharges will be occasional, mostly in the wet season when rainfall requires excess water to be discharged from the system. • Occasional discharges of treated water will also occur in the dry season (when new salt water is pumped from the river to replenish water and salinity levels) and when nursery tanks are drained.	No exceedance of authorised wastewater discharge Site Specific Trigger Values (SSTVs) as per Appendix A of EPL239.	• Monitoring of discharge water quality in accordance with Appendix A of EPL239, including discharge volumes, duration, and water quality analysis. • Routine water quality monitoring is undertaken in accordance with the Water Quality Monitoring Plan (WQMP).	• Review water reuse options and revise procedure for water recirculation prior to discharge. • Review WQMP to allow for further detection of potential contaminants.	• Discharge events, volumes, duration and water quality monitoring results are recorded in the Water Quality Database. • Discharge reporting is undertaken through Monthly Discharge Reports, the Monitoring Report and the Annual Return as per EPL239 conditions.

Aspect	Potential impact	Objective / outcome	Management action	Targets / performance indicators	Monitoring	Corrective actions and contingencies	Reporting & record-keeping

Storage and use of chemicals, hydrocarbons and hazardous substances	• Contamination of ponds, and discharge of contaminated water into Adelaide River.
	• Reduction in water quality downstream of discharge or spill point, and subsequent impacts on aquatic ecosystem health downstream of discharge point.
		No contamination to farm water or sediments, or contamination to the Adelaide River as a result of chemical, hydrocarbon or hazardous substance spill.	• All refuelling of vehicles occurs within a designated area.
			• No hazardous chemicals are added to the ponds from which discharge occurs.
			• Fuel storage quantities at one time below:
			  ○ Diesel Northern Generator Shed (self bunded) 9,000L
			  ○ Diesel Southern Generator Shed (self bunded) 60,000L
			  ○ Diesel Tank (self bunded) 9,000L
			  ○ Unleaded Petrol Tank (self bunded) 9,000L.
			• All other chemicals stored in quantities less than 4 L in designated area.
				• No indication of spills of chemicals or hazardous substances.
				• Any spill of stored product is contained and remediated through the spill response procedure.
				• No leaks from equipment.
					• Regular inspections of chemical and hazardous substance storage areas through operational activities.
					• Water quality performance will be monitored through the WQMP.
					• Monitoring of the Adelaide River as per Appendix A of EPL239.
						• Review storage and handling practices for chemicals and hazardous substances.
						• Increase the amount of bunding and containment for chemical and hazardous substance storage areas.
						• Increase the number, capacity or type of spill kit materials.
							• Incident reporting records
							• BAP audits
							• Water Quality Database
							• Reporting is undertaken through, the Monitoring Report and the Annual Return as per EPL239 conditions.

Pond maintenance (desilting, desludging)	Reduction in water quality (addition of suspended solids and nutrients), and subsequent impacts on aquatic ecosystem health downstream of discharge point.	No release of sediments or sediment and nutrient laden water to the Adelaide River.	• Sludge removal occurs as required to maintain ponds and wetlands. No sludge is disposed of off-site or removed from the perimeter wall. Sludge is relocated within the ponds system and used in construction and maintenance activities.	No introduction of contaminants to Adelaide River through pond maintenance activities.	• Visual monitoring of pond condition to inform routine pond maintenance requirements. • Monitoring of pond bank condition to determine where materials can be reused. • Monitoring of pond and Adelaide River water quality through the WQMP.	• Review pond maintenance activities and revise procedures for reuse of sludge materials. • Ensure any sediment or nutrient laden water is directed to the wetland treatment systems prior to its potential discharge through an authorised discharge point.	• Incident reporting records • Water Quality Database • Reporting is undertaken through, the Monitoring Report and the Annual Return as per EPL239 conditions.

Aspect	Potential impact	Objective / outcome	Management action	Targets / performance indicators	Monitoring	Corrective actions and contingencies	Reporting & record-keeping
Emergency flood event	Discharge from the authorised discharge points, or in extreme cases of flooding, discharge from non-authorised points due to whole of farm flooding.	No reduction in water quality within the Adelaide River as a result of flood events.	• HDB pond and wetland system has been designed to withstand a greater than 1:100 year AEP flood event. • Production pond perimeter walls to be raised above 1:100 year flood events prior to 2023. • Water levels are continuously monitored throughout the system and water is actively moved to raise and/or lower water levels in the system. • Controlled discharges are undertaken when required, including in the wet season when water levels are raised, as per EPL293. • HDB provide the NT EPA with notification of the commencement and cessation of discharge, the flow meter readings at the beginning and end of a discharge event, and monitoring results throughout discharge events.	No reduction of water quality due to discharge water as a result of flood events.	• Continuous weather monitoring through the wet season. • Visual monitoring of freeboard levels within the ponds and wetland treatment systems. • Meter readings at internal discharge points and at the authorised discharge points to the Adelaide River. • Monitoring of discharge durations and water volumes during periods of discharge. • Monitoring of discharge water quality in accordance with Appendix A of EPL239.	• Increased frequency of planning meetings by the Emergency Response Team. • Amend operational practices to further reduce freeboard capacity prior to emergency events. • Provide additional training to all personnel in emergency response preparedness.	• Incident reporting records • Water Quality Database • Reporting is undertaken through, the Monitoring Report and the Annual Return as per EPL239 conditions.

Aspect	Potential impact	Objective / outcome	Management action	Targets / performance indicators	Monitoring	Corrective actions and contingencies	Reporting & record-keeping
Farming of barramundi	• Quarantine issues or spread of diseases (if fish are ill). • Barramundi are native to the Adelaide River so no impacts associated with the introduction of pest or alien species as a result of fish escapes have been considered.	• No release of fish to the Adelaide River. • No introduction or spread of fish diseases to the Adelaide River	• Strict quarantine practices as required by the NT Government for imported juveniles. • Adherence to the HDB Biosecurity and Fish Health Management Plan. • Production fish mortalities are contained within a designated retention structure. Chance of fish escape is minimal due to concentric containment of all production ponds, screening of outlet pipes. • Any escaped fish would be contained within the wetlands, which rarely discharge, and only do so via pipes, which barramundi are reluctant to enter.	• No detection of fish disease within the HDB farm. • No release of fish Adelaide River.	• Visual monitoring of fish health within ponds. • Visual monitoring of hatchling stock and quarantine records from suppliers. • Visual monitoring of the intake point (AI) and the authorised discharge points for fish movement.	• Remove and/or dispose of stock with detected illness or diseases. • Review operational activities that control the movements of fish throughout the farm (i.e. preventing fish from entering the wetland treatment systems).	• Quarantine certifications records • HDB Biosecurity and Fish Health Management Plan • Incident reporting.

9 MONITORING, REPORTING AND REVIEW

The following sections detail the environment monitoring, reporting and review actions undertaken by HDB to meet the conditions of EPL239, Best Aquaculture Practices (BAP) Certification, Sustainably Farmed Barramundi Certification and general environmental obligations.

9.1 Monitoring

HDB monitor and record a number environmental and sustainability aspects across the farm including, electricity, fuel, water, feed and other resource use, waste recycled, sent to landfill or disposed on site, discharge volumes of water into the Adelaide River, and water quality monitoring.

Resource inputs and waste generated

Table 9-1 provides the resource inputs and waste generated for all HDB farm operations for the last 10 years (2009 to 2019).

Table 9-1. Resource inputs summary 2009-2019.

	Staff	Electricity	Oxygen	Diesel (38.68 GJ/m3)	Petrol	LPG	Water Ground	Water Surface	Total Water (All sources)	Waste to landfill	Recycling off farm	Growout HE Pellets	Nursery Pellets
	FTE	kWhr	m3	L	L	m3	kL	kL	0	m3	m3	kg	
2009-10		1,108,367		10,000	10,000	0.5000	22	395,280	395,302	75	200	589,000	7
2013-14	17.0	2,516,397	5,322	25,528	10,279	225.0000	290	360,000	360,290	150	10	1,260,000	7,110
2014-15	17.0	3,175,740	9,095	28,268	11,402	330.0000	1,750	360,000	361,750	155	104	1,821,539	9,780
2015-16	23.0	3,635,510	16,802	32,097	13,499	370.0000	2,200	360,000	362,200	210	240	2,417,958	17,340
2016-17	46.0	4,900,104	18,402	191,465	38,005	330.0000	3,220	360,000	363,220	260	300	3,168,127	46,761
2017-18	52.0	5,488,656	36,727	63,882	9,500	330.0000	4,302	400,000	404,302	180	480	4,317,154	66,346
2018-19	84.0	7,002,320	19,875	85,874	26,003	220.0000	4,038	440,000	444,038	400	1,859	4,875,333	122,324

Water Quality

HDB conduct water quality monitoring in accordance with Attachment A of EPL239, which includes a series of authorised monitoring points, where field readings and samples are collected on a weekly and monthly frequency and analysed by a NATA accredited laboratory.

Water quality monitoring methods and quality assurance, quality control (QA/QC) techniques are detailed in the Water Quality Monitoring Plan (Appendix E). All field and laboratory data is kept in the HDB Water Quality Monitoring Database. Any exceedances of the trigger vales specified in Attachment A of the EPL are recorded in the database.

Any non-compliances in regards to water quality results during discharge events as defined by the criteria in Condition 39 of EPL239 must be reported to the NT EPA within 24 hours of becoming aware of the non-compliance.

An annual Monitoring Report presenting all water quality data collected and assessing long-term water quality trends must be submitted in accordance with EPL239 Conditions 45 and 46 (see Table 5-3).

Water Quantities

Water extraction from and water discharges into the Adelaide River are monitored through automated flowmeters. Water extractions occur at the intake point known as the Adelaide Intake (see AI in Figure 1-2), which is metered on the pipe work between the pump and the header ponds.

Discharge point locations are shown in Figure 1-2 and outlined in Table 5-2. Discharge volumes are recorded at the following points:

- From the North Farm wetland treatment systems discharge volumes are recorded by an automated flow gauge located at the discharge point DP1 into the Adelaide River.
- From the South Farm wetland treatment system discharge volumes are recorded by an automated flow gauge located at the discharge point SF DP into the channel that subsequently discharges into the Adelaide River at AI.
- From the East Farm wetland treatment system discharge volumes are recorded by an automated flow gauge located at the discharge point EF DP into a drainage line that discharges into the Adelaide River at DP2.
- Discharges from the Stage 1 and Stage 2 nurseries are small and infrequent and are recorded manually by measuring the flow rate from the discharge pipes and recording the amount of time that discharge occurs. This is undertaken at the discharge point S1N DP and ND for the Stage 1 and 2 Nurseries respectively. Discharge from these points then flows down a drainage line to DP2, where it enters the Adelaide River.

The start and finish of all discharges are reported to the NT EPA as soon as practicable; as per Conditions 27 and 28 of the EPL239. A discharge report must subsequently be submitted to the NT EPA for each discharge event in accordance with Condition 43 of EPL239 (for examples see reports listed in Table 5-2).

9.2 Auditing

HDB are audited annually under the Best Aquaculture Practices (BAP), by the National Sanitation Foundation (NSF) Food Safety Certification, and against their fisheries licence C1/502. The most recent BAP audit occurred over three days in May 2019, and covered community consultation, environmental management, animal health and welfare, food safety, biosecurity, and record keeping for the period January 2018 to January 2019.

A copy of the complete BAP Audit Checklist is provided in Appendix G. The next BAP audit of the HDB farm is scheduled for May 2020 and will cover the period from January 2019 to January 2020.

Additionally, HDB are audited under the Sustainably Farmed Barramundi Certification Program, which is an initiative of the Australian Barramundi Farmers Association. The most recent audit was undertaken in August 2019 and covered sustainability policy, farm design and efficiencies, monitoring, environmental management, environmental impacts, complaints, incidents, corrective actions, reporting, record keeping, and training and awareness. The next Sustainably Farmed Barramundi Certification Program audit of the HDB farm is scheduled for August 2020.

9.3 Reporting and review

This EMP will be reviewed annually, at a minimum to reflect any changes in operations at the farm. HDB report any non-compliances with the EPL by completing a Non-Compliance Notification via the NT EPA website within 24 hours of the event.

A Monthly Discharge Report is submitted to the NT EPA following periods of discharge (Table 5-3). These reports include:

- The flow data, discharge volumes and discharge times
- Water quality data for the authorised discharge point, monitoring points and compliance points following commencement of the discharge
- The concentrations of nutrients, Biological Oxygen Demand and chlorophyll-a in the water being discharged
- Any corrective actions taken in the event of a trigger value exceedance at the compliance point as a result of discharge.

An Annual Return is submitted to the NT EPA at the anniversary date of the EPL to summarise the activities and outcomes of the previous 12 months. Additionally, a Monitoring Report is prepared and submitted with the Annual Return that includes trend analysis of the water quality monitoring data and an assessment of any environmental impacts from the HDB farm operations.

9.3.1 Incident reporting

All HDB staff and contractors are required to report all environmental incidents or near-misses using the Environmental Incident Reporting Form (Appendix H) and to their supervisor/manager. Corrective actions are discussed and implemented and the success, or otherwise, of the corrective actions monitored and followed-up. The reporting of environmental incidents, implementation of corrective actions and final outcomes are recorded and monitored through the Environmental Incident Register. Any current active environmental incidents in the register are discussed and followed up during the weekly staff meetings (occur every Wednesday).

10 STAFF TRAINING AND AWARENESS

Training is provided to all HDB employees and contractors to outline their environmental responsibilities. This training is delivered through site inductions and ongoing staff meetings, such as daily pre-start meetings and environmental toolbox talks to discuss changes and updates to operational aspects of the HDB farm. Other forms of training and awareness delivered to employees and contractors includes incident bulletins and weekly newsletters, which are circulated across the HDB farm.

All staff undergo the environmental obligations training module (provided as Appendix I), which covers:

- The HDB Sustainability Policy
- Environmental roles and responsibilities
- Management plans including this EMP
- Incident reporting and follow-up
- Standard Operating Procedures (SOPs)
- Policy instructions.

Staff training completed and required is managed and recorded in the HDB Training Matrix Spreadsheet. The training recording process is also being improved with the implementation of the online training software Course Genius, which has been established to ensure new employees, casuals and contractors (as applicable) are provided with policies, plans and procedures, that they need to complete and pass assessment or at least acknowledge their understanding. For more detail of the specific training provided to staff, and the numbers of staff that have undertaken this training, see relevant section in the BAP Audit Report (Appendix G).

Staff are trained in their specific tasks and the standard operating procedures (SOPs) they must follow. The current list of SOPs is provided as Appendix J.

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