Platypus Management Plan

QHY-QHY-PLN-ENV-00003

239 George Street,
Brisbane City, QLD, 4000

info@qldhydro.com.au

qldhydro.com.au

Document Control:

Document	
Title	Platypus Management Plan
Number	QHY-QHY-PLN-ENV-00003

	Name
Author	Queensland Hydro
Reviewers	Wildlife Queensland's Platypus Watch Network
Approver	Queensland Hydro

Distribution Record

Number	Title
1 - Final	Platypus Management Plan
2	
3	

Contents

1 Abbreviations and Acronyms

Abbreviation/ Acronym	Description
CEMP	Construction Environmental Management Plan
DES	Department of Environment and Science
EM	Electro-magnetic
EMF	Electrical Magnetic Fields
EMP	Environmental Management Plan
FSL	Full Supply Level
GPR	Ground Penetrating Radar
Hz	Hertz
km	kilometre
m	metre
MW	Megawatt
NC Act	Nature Conservation Act 1992
PHES	Pumped Hydro Energy Storage
the Projects	Borumba Pumped Hydro Energy Storage and Pioneer-Burdekin Pumped Hydro Energy Storage
$\mu V\ cm^{-1}$	Milli-volt per centimetre
Qld	Queensland

1 Purpose of the Platypus Management Plan

This document identifies the requirements for the implementation of a Platypus Management Plan for the investigative works, construction, and operational phases of the Pioneer-Burdekin and Borumba Pumped Hydro Energy Storage (PHES) Projects (the Projects).

The Plan represents Queensland Hydro's commitment to mitigating potential impacts to platypus and platypus habitat areas by providing a structured approach to ensure appropriate mitigation measures and controls are implemented.

This Plan is a 'live' document and will be reviewed and updated during all phases of the Projects. The activities and mitigation measures detailed in this plan currently prioritise the investigative works, however the activities will be updated as details regarding the construction and operational phases become available.

This Plan includes:

- Requirements associated with statutory approvals
- Potential impacts to platypus and relevant management measures
- Roles and responsibilities
- Communication requirements
- Induction and training requirements
- Procedures for monitoring and evaluating environmental performance and taking corrective action
- Reporting requirements and record-keeping
- Procedures for emergency and incident management
- Procedures for audit and review.

This Plan should be read in conjunction with the Environmental Management Plan (EMP), and any associated plans (e.g. Erosion and Sediment Control Plan, Spoil Management Plan, Waste Management Plan), for the Projects. The EMP and supporting plans will incorporate conditions associated with all approvals, licences and permits obtained for the Project, once received. The EMP includes measures to manage the risk of potential impacts from investigative works and Project construction and operation. During operation, the Platypus Management Plan will be used in conjunction with the Operations Manuals for the Projects.

2 Project outline

2.1 Background

The Queensland Government is committed to both reducing Queensland's emissions in line with its target of a 30% reduction on 2005 emissions by 2030 (as well as the longer-term target of Net Zero Emissions by 2050), and reaching 50% renewable energy generation by 2030. The resulting pace of power system transformations has increased to match these interim and net zero emission targets. Queensland Hydro was established by the Queensland Government in September 2022 to plan, deliver, own, operate and maintain the Borumba and Pioneer-Burdekin PHES Projects.

2.2 Borumba

The Borumba PHES is located adjacent to the existing Lake Borumba reservoir in the Gympie and Somerset Regional Council LGAs. The Project is 13 km south-west of Imbil, 48 km south-west of Gympie, and 180 km north-west of Brisbane (Figure 2-1).

The proposed Project will have the capacity to generate up to 2,000 MW of power over a period of 24 hours. Key project components would include:

- a new lower Borumba dam and reservoir that would involve:
  - raising the full supply level (FSL) of Lake Borumba through the construction of a new dam wall immediately downstream of the existing Borumba dam wall
  - partial demolition of the existing Borumba dam wall after the construction of the new dam wall
- an upper dam and reservoir including the construction of a main dam wall, saddle dam and minor saddle dams to establish the new upper reservoir
- underground components:
  - waterway tunnels (i.e. power waterway) and underground works for the transfer of water between the upper and lower reservoirs
  - underground power station and pump turbines
  - access, emergency egress, cable, and ventilation tunnels
  - electrical switchyard
- ancillary infrastructure including quarries, construction camp and access roads.

2.3 Pioneer-Burdekin

The Pioneer-Burdekin PHES is located approximately 70 km west of Mackay, within the Mackay local government area (Figure 2-2). The proposed Project will have the capacity to generate up to 5,000 MW of power over a period of 24 hours.

Key project components include:

- a lower dam and reservoir across Cattle Creek (south branch)
- realignment of the Mackay-Eungella Highway around the new lower dam and reservoir
- two upper dams and associated reservoirs (including major and minor saddle dams) at Dalrymple Heights, across Pla Creek and Quandong Creek respectively
- underground components:
  - waterway tunnels (i.e. power waterway) and underground works for the transfer of water between the upper and lower reservoirs
  - underground power station and pump turbines
  - access, emergency egress, cable, and ventilation tunnels
  - electrical switchyard
- ancillary infrastructure including quarries, construction camp and access roads.

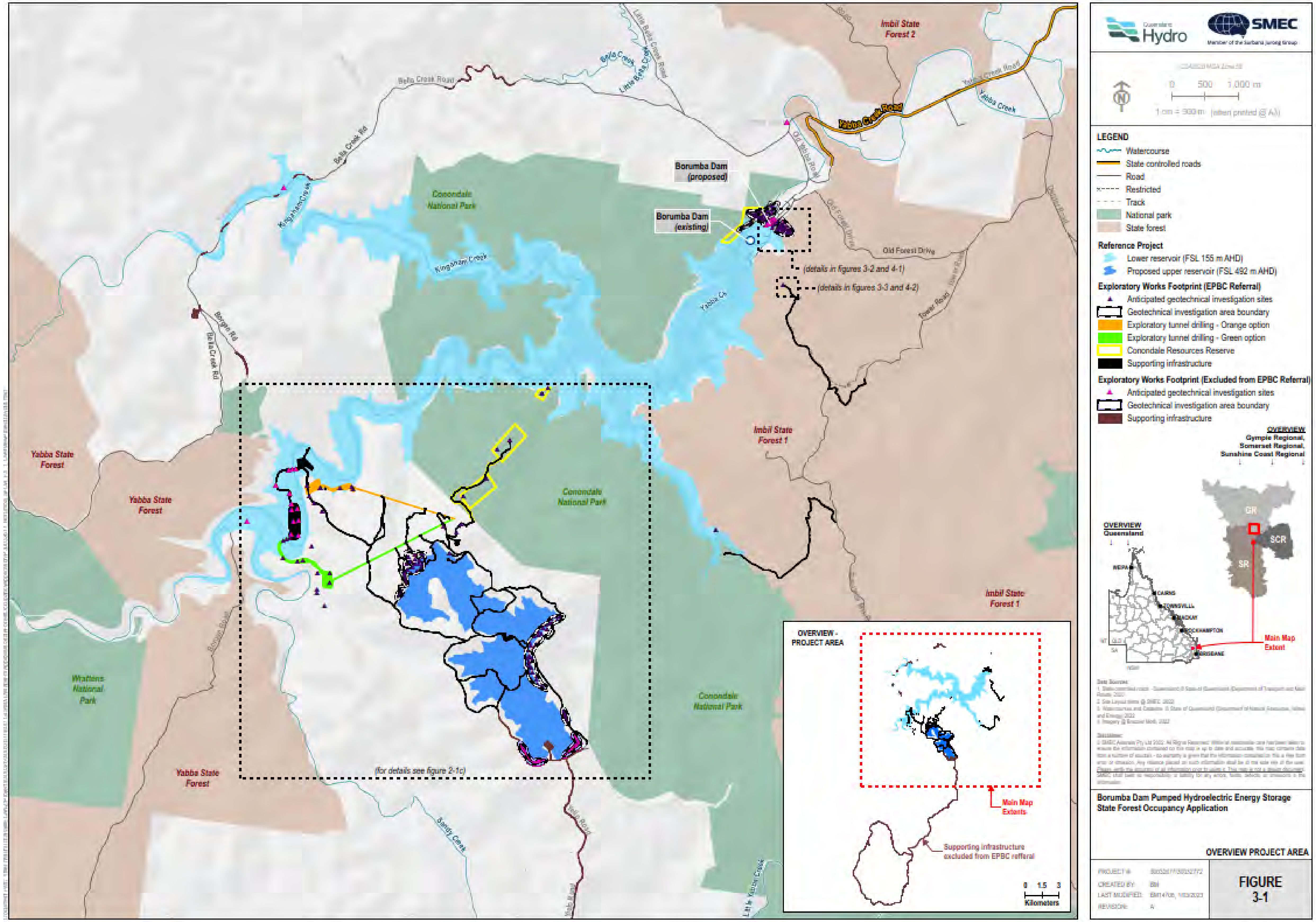

Figure 2-1 Borumba PHES Project layout

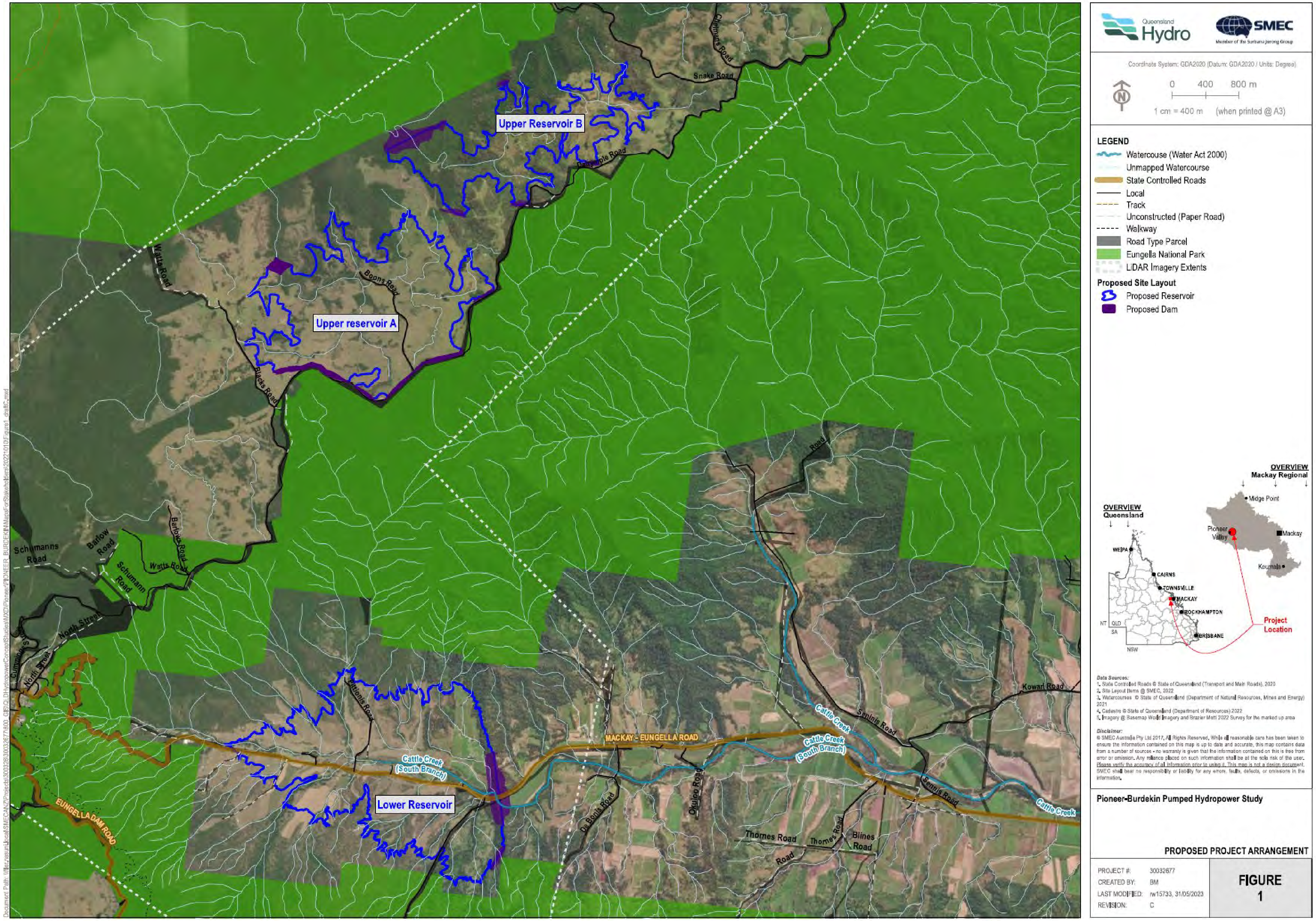

Figure 2-2 Pioneer PHES Project layout

3 Project activities relevant to platypus

Similar activities will be used for both Projects during all phases of operations. These are identified in the following sections:

- investigative works – Section 3.2
- construction – Section 3.4
- operation – Section 3.5.

Given the early stage of development of the Projects, this plan focuses on the investigative works. Further detail will be added for all phases (including construction and operations) as additional information on the planned activities becomes available.

Activities that are more likely to impact platypus have been reviewed in more detail. This includes activities that:

- generate electrical and magnetic fields (EMFs)
- generate significant vibrations
- result in direct physical disturbance to platypus and platypus habitat
- result in indirect disturbance to platypus habitat.

3.1 Geophysical assessment

Geophysical assessments are expected to occur across the entire Project area and throughout all seasons in order to provide information for detailed design. Noting this, where seismic tests are required along a potential platypus watercourse, these will be conducted outside of breeding periods and juvenile emergence (i.e. July to February). If works are to occur during these periods, habitat assessments will be conducted prior to investigative works.

3.2 Investigative works

Investigative works will consist of a variety of activities that may result in direct, indirect, and facilitated impacts to platypus. These activities include:

- geological and geotechnical assessments including drilling, test pitting, and seismic survey
- supporting activities such as clearing of access tracks or establishing temporary storage facilities.

Potential impacts from the two key overarching activities identified above, and other associated activities, are presented in Section 8.1.

Further information on key activities for the investigative works is presented in Section 3.3.

3.3 Geophysical assessment

3.3.1 Ground penetrating radar

Ground penetrating radar (GPR) using drones may be employed to assist in mapping subsurface geology. The height of the drone above the ground will be influenced by vegetation canopy and other obstructions, but it will typically operate at a height of approximately 50 m. The GPR produces electro-magnetic (EM) waves that are typically in the range of 10 megahertz to 2.6 gigahertz.

The penetration of the GPR is influenced by a variety of environmental factors, particularly the presence of water (including water bodies and soil water) and dense clay soils. In these instances the signal would be rapidly attenuated with minimal penetration through a process known as Compton scattering. As such, ground penetration is expected to become highly attenuated at shallow depth (i.e. <30 cm) where water-logged substrate is encountered).

3.3.2 Soil resistivity testing

Soil resistivity testing is conducted to establish a model of the underlying substrate across the tested area. The testing works by running a low voltage and current through a series of electrodes placed within the soil. The signal derived from the change in electrical current between the electrodes indicates underlying geophysical masses (e.g., peal, loam and mud or bedrock).

The electrical current for the testing is usually derived from a low-power source and is typically of a lower voltage (<24 volt) and current (<1 amp) and produce relatively small electrical fields. As the voltage and current used for assessment are low, interactions of the electrical signal with fauna and flora are considered to be low risk and typically result in changes to data quality due to changes in high resistivity (in comparison to surrounding substrata).

3.3.3 Airborne drone magnetics

Airborne drone magnetics could potentially be utilised to obtain magnetic-imagery of subsurface geophysics. Detection using airborne drone magnetics is typically passive in nature (i.e., no active creation of signal), and would therefore not impact platypus.

Should an active survey method be utilised, an assessment similar to the passive magnetic assessment is made with the aid of additional detector instruments.

The time-domain active magnetic assessment utilises the production of electro-magnetic waves which penetrate the ground, creating a primary field. As the primary field interacts with subsurface conductors (e.g., a metallic bed rock), a secondary electro-magnetic field is produced which interferes with the primary field. The measuring apparatus utilises the interference to assess the presence of the bedrock and geometry. Depth of penetration typically relies on the frequency of the primary field and the conductivity of the medium. Frequencies utilised by the active magnetic assessment vary in relation to the target of the survey (i.e. low frequency for deeper resolutions or high frequency for shallow resolution). Due to the nature of the survey (i.e., assessment of bedrock for tunnelling and dam construction), the frequencies are expected to be relatively high (i.e., tens of kilohertz to several hundred kilohertz) and will be outside of frequencies detectable by the Platypus. Noting this, different systems have different frequency ranges, so ongoing management is expected in order to identify and reduce risk to Platypus individuals.

3.3.4 Seismic refraction

Seismic analysis will be conducted to identify sub-surface strata, principally using two-dimensional seismic reflection (i.e. measurement of the reflection of elastic waves at boundaries between different rock formations). This will give a single cross-section view of sub-surface environments.

The seismic signal is typically generated by striking a steel plate on the ground repeatedly with a sledgehammer, or by using a vehicle-mounted mechanical vibrator known as a “thumper”. The signal reflects off the underlying rock strata and is received by an array of geophones that are placed along the surface of the ground (refer Figure 3-1).

The signal is interpreted using complex analytical software to provide a cross-sectional image of the underlying geology.

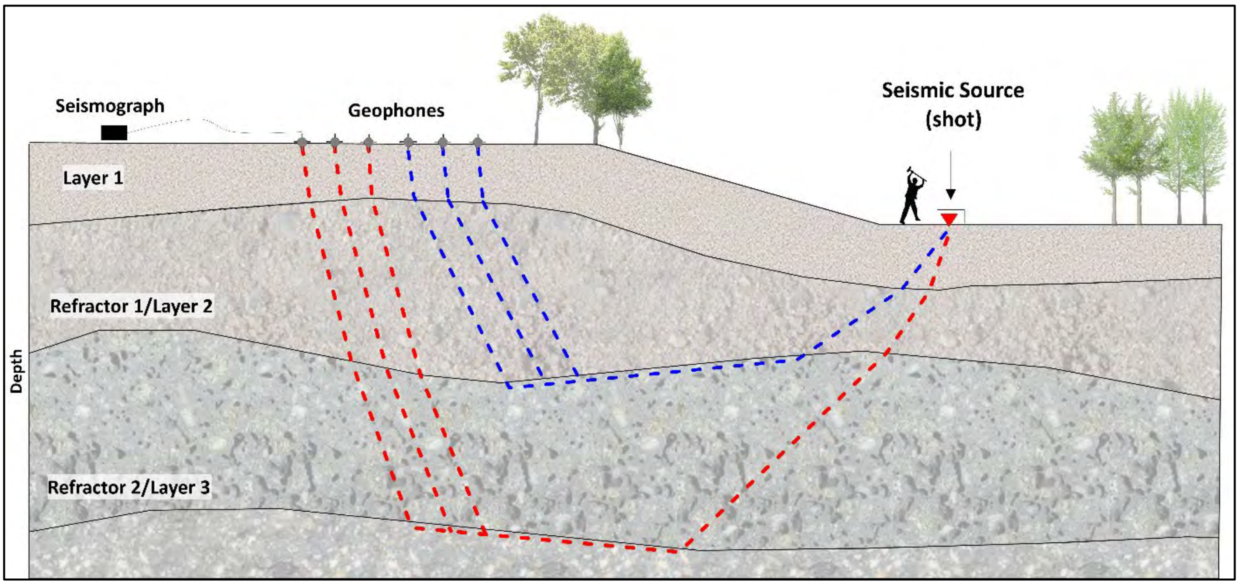

Figure 3-1 Seismic survey schematic

3.3.5 Geotechnical test pits

Test pitting involves the excavation of earth pits to assess shallow soil and rock characteristics. The pits are typically excavated using a tracked excavator or rubber-tyred backhoe fitted with a standard, general purpose toothed bucket. The depth of the test pits is dictated by a range of factors including hard rock refusal, water ingress, limit of excavator reach, and stability of the walls, however they do not typically exceed 3 m.

Once the assessment has been completed, test pits will be backfilled with the excavated spoil placed in reverse order to match the in-situ strata as best as practicable. Backfill material will be tamped down using the excavator bucket and then tracked over. Test pits located on or adjacent to access tracks may require a compaction plate attached to the excavator arm to achieve compaction of the backfill.

Dynamic Cone Penetrometer (DCP) testing will also be undertaken adjacent to each test pit to aid in assessment of the consistency and relative density of the subsurface materials. DCP testing entails manually hammering a steel stake into the ground and measuring the force needed to achieve penetration. The activity causes minimal surface disturbance.

3.3.6 Geotechnical boreholes

Geotechnical boreholes will investigate subsurface geological and geotechnical conditions, primarily to classify the subsurface conditions at key or critical design locations and to develop an appropriate ground model.

Each borehole will require a drill pad that is at least 3-5 m wide by 13 m long. The layout of a typical drill pad is illustrated in Figure 3-2. These may be located on an existing track or cleared area, on a knockout pad from a track. Areas of vegetation will be avoided to the greatest extent possible. To establish a drill pad, ground surface levelling to achieve suitable gradients and construction of safety bunds may be required. Vegetation clearing may also be required where pads extend in a vegetated area. In the first instance, the preference is to locate drill pads on access tracks or in areas that do not require clearing (i.e., no trees present) to reduce overall vegetation clearing.

Figure 3-2 Geotechnical drill rig

The geotechnical boreholes will be drilled with either track mounted or truck mounted drilling rigs, depending on the individual borehole requirements and specific site constraints. Drilling in soils is done by using a rotary (not percussive) drilling method. Temporary casing may need to be installed progressively through the soil profile to prevent the bore collapsing.

Drilling fluids (comprising water and biodegradable liquid polymers) are required during drilling to aid in flushing cuttings from the hole, lubricating/ cooling the drill bit, and stabilising the borehole walls. Water for drilling will either be brought to site in a truck or sourced from a nearby waterway in accordance with applicable permits. Drilling fluids will be recirculated within purpose-built mud tanks during the drilling, which will allow sediments and cuttings to settle out. Throughout the drilling process, vacuum trucks or similar will be used to remove dirty water and cuttings from the mud tanks. Sediment and erosion controls such as seedless hay bales, coir logs, jute meshing, or synthetic fencing will be installed downgradient of all drill pads (and on access tracks) where overland flow may directly enter a waterway.

The time required to complete each borehole (i.e., including mobilisation, set up, drilling, roster breaks, pack up, demobilisation) will be dependent on the target depth, in-situ testing required, subsurface conditions encountered, and working roster. Shallow boreholes of up to 50 m may be completed within a week, whereas deeper boreholes may take several weeks.

After drilling is complete, boreholes will be left open until all required downhole geophysical surveys and in-situ testing has been undertaken. Boreholes will then be either filled with cement grout or have a groundwater monitoring instrument installed. Monitoring instruments will be secured with either a lockable steel monument, or a gatic cover.

At the completion of project works, all drilling pads will be rehabilitated.

3.3.7 Exploratory tunnelling

Exploratory tunnelling may be utilised to make direct observations and measurements of sub-surface geology, particularly in critical areas such as the underground powerhouse caverns.

This activity would entail excavation of a tunnel with an internal diameter of approximately 8-9 m, typically using a drill-and-blast excavation method (refer Figure 3-3). Tunnel spoil would be placed in a designated spoil disposal area, where a stable landform would be created, and would be managed in accordance with a Spoil Management Plan. Where possible spoil would be re-used, for example as road base, or concrete aggregate. Spoil that was found to be contaminated would be treated, or – if on-site treatment was not feasible, would be removed to an offsite contaminated spoil disposal facility.

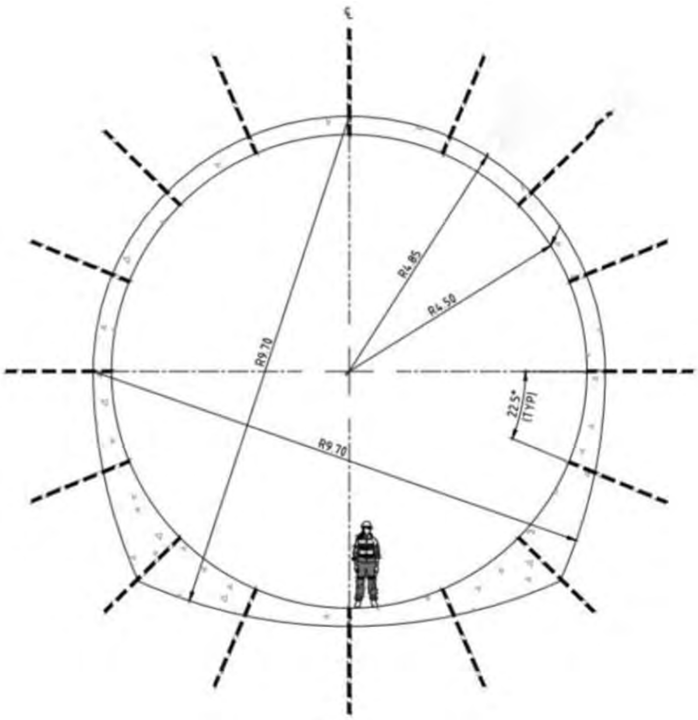

Figure 3-3 Example tunnel schematic

3.3.8 Access and support facilities

While existing access tracks will be used wherever possible, new tracks will be needed to enable works. Detailed design of the tracks will be commenced once survey of the site is complete and sufficient detail is available. It is anticipated that the tracks will be designed to be temporary and they area would be rehabilitated once works are complete and the tracks are no longer required.

New tracks would typically be single lane with a width of approximately 4 m (noting that an additional 1m buffer would be cleared on either side, resulting in a clearing width of 6 m). Tracks would not be sealed with bitumen, although gravel may be imported in areas with a steeper grade.

Temporary support facilities such as shaded rest areas, water or fuel storage, or ablution facilities may also be installed on-site as required. These areas would be rehabilitated once the facilities have been removed.

3.4 Construction

Construction will consist of a variety of activities that may result in direct, indirect, and facilitated impacts. Key activities include:

- construction of a new dam wall for Lake Borumba to increase lower reservoir capacity, and the upper reservoir dam wall (PHES Borumba)
- construction of dams for the upper and lower reservoirs (PHES Pioneer-Burdekin)
- power waterway tunnel boring.

As design of both Projects is ongoing, specific information on construction activities has not yet been included in an overarching Construction EMP (CEMP). Noting this, impacts for the three key overarching activities identified above (and other associated activities) are included in this Plan. These are presented in Section 8.

3.5 Operation

Operation will consist of a variety of activities that could result in direct, indirect, and facilitated impacts. These activities include:

- pumping between reservoirs
- dam operation (flow management associated with reservoirs).

As design of both Projects is ongoing, specific information on Project operation has not been included in Operations Manuals. Noting this, impacts are expected from Project operation, with the two key overarching activities identified above, and other associated activities, include in Section 8.3 of this Plan.

4 Regulatory requirements and compliance

A preliminary register of regulatory and other requirements will be compiled for each Project and retained as a live register (as per ISO14001:2015) for each phase of the Projects. The register will be reviewed at regular intervals by the contractor and Queensland Hydro (for example, during management reviews), and updated with any applicable changes as required.

Any changes made to the regulatory requirements / approvals register will be communicated to the wider Project team, including contractors, through toolbox talks, specific training and changes to Operations Manuals as required.

Key legislation relevant to platypus is the *Nature Conservation Act 1992* (NC Act) and Nature Conservation (Animals) Regulation 2020. These are described briefly below.

4.1 Nature Conservation Act 1992

The NC Act is administered by Department of Environment and Science (DES) and provides the framework for the declaration and management of protected areas and protection of wildlife listed under the *Nature Conservation (Animals) Regulation 2020*. The NC Act, s 71 describes the classes of wildlife to which the Act applies as protected wildlife that is: extinct in the wild, critically endangered, endangered, vulnerable, near threatened wildlife and least concern wildlife, and international and prohibited wildlife.

4.2 Nature Conservation (Animals) Regulation 2020

The *Nature Conservation (Animals) Regulation 2020* prescribes species in accordance with the categories set out in the NC Act. Under the regulation, platypus are classified as special least concern.

For special least concern animals, those exercising a power or carrying out a function for a public sector unit (e.g. regulatory agencies providing permits and approvals) must have regard to the special cultural significance of the animal and the need to conserve existing populations of the animal.

It is an offence for a person, without a reasonable excuse, tamper with an animal breeding place that is being used by a protected animal to incubate or rear the animal's offspring (s 335).

5 Environmental objectives and targets

Environmental objectives and targets have been identified for the assessment of environmental performance as management measures associated with each Phase. These align with the Queensland Hydro environmental policy and will identify the efficacy of management measures identified Platypus Management Plan.

The environmental objectives include:

- Implementing an Environmental Management System that is consistent with ISO14001:2015

- Complying with all environmental approvals for the Project
- Ongoing management of *Nature Conservation Act 1992* (Species of Least Concern), Platypus
- Improving environmental performance throughout the implementation of each phase of each Project.

The performance of the Project against the objectives and targets will be documented in the Project construction compliance reports and will be informed by:

- Inspections
- Compliance reporting
- Management reviews
- Risk registers
- Incident registers.

6 Platypus (Ornithorhynchus anatinus)

6.1 General biology

The distribution of platypus extends along eastern Australia from far north Queensland to Tasmania. This species inhabits areas in and near freshwater creeks, slow-moving rivers, lakes joined by rivers, and dams. The platypus is mostly solitary but can share a waterbody with several other platypus (DES, 2016). Platypus in Queensland are generally smaller than those found in Victoria and Tasmania.

Platypus typically spend around 12 hours foraging for food in the water each day, with the remainder of the day spent in the burrow, moving across land, or basking in the sun. They can spend up to 10 minutes underwater at any one time and are most active at dawn and dusk. Their diet consists of small aquatic invertebrates such as, insect larvae, freshwater shrimp and crayfish. Platypus rely on their bill for finding food due to poor eyesight, with receptors in the bill capable of detecting electrical currents in the water to help locate prey (DES, 2016).

The home ranges of adult platypus are large, with males typically ranging between 6-11 km and females ranging 2-4 km (Australian Platypus Conservancy ND). Each platypus has access to numerous burrows scattered along the length of its home range. Therefore, activities affecting a relatively short section of waterway are unlikely to have a significant impact on platypus living in the vicinity (outside breeding periods) provided that the bank and channel habitats recover or are rehabilitated within a reasonably short time post-construction and water quality is not degraded.

Waterways that have moderate to well-developed and undercut banks with a minimum bank height of 0.5 m are considered primary habitat for platypus. Their breeding places generally consist of a simple burrow within the bank just above water level and often among a tangle of tree roots or debris. In Queensland, mating takes place in August, after which the female increases food consumption and builds the nesting burrow. Nursing borrows can be up to 30 m in length, requiring protection of the riparian zone.

When nursing, female Platypus blocks the burrow with dirt for protection from floodwaters and predators. This also helps to create a stable environment for incubation within the nesting chamber. The female generally lays two soft-shelled eggs that are incubated by pressing them against the stomach with the tail. The incubation period lasts for approximately one to two weeks. When the young hatch, they are furless and blind with undeveloped limbs. The young feed from milk secretions from the mother’s mammary glands and remain in the burrow until they are four months of age. Platypus are considered fully grown by one year of age (DES, 2016).

6.2 Specific biology

6.2.1 Habitat requirements

Habitat requirements for ongoing survival of platypus populations depends on several key parameters including:

- plentiful prey items (benthic macroinvertebrates)
- stable banks with resistance to scour from vegetated cover
- suitable water quality to facilitate abundance of macroinvertebrate prey
- contiguous watercourse habitat (with habitat requirements identified above).

Platypus typically require shallow waterbodies for effective foraging (<5 m). Foraging streams range from first order streams to major watercourses (as defined in Strahler 1952). Due to the requirement for a sustainable population of benthic macroinvertebrates as a food source, platypus are more likely to be found in higher order streams where permanent water is more likely. Smaller-order streams are typically identified as marginal habitat, where occupied.

A literature review was conducted by Hydrobiology (2022) for the Borumba Project as follows, *viz.,*

Platypuses are mainly aquatic but are known to occasionally travel over land to move between river catchment and waterbodies. Platypuses are known to inhabit a range of freshwater habitats including permanent freshwater streams and stream banks, shallow lakes, ephemeral streams and isolated pools, wetlands, and artificial water sources such as weirs, storage lakes, artificial ponds, and farm dams. Platypuses are also known to occasionally inhabit caves and brackish areas of estuaries for nesting (Furlan et al., 2013; Grant, 2015).

Substrate composition is an important driver of platypus habitat quality with a substrate composition of pebbles, cobbles, gravel and other coarser rocks forming preferred habitats (Grant, 2004). Platypuses construct burrows above the water surface into the side of streambanks, generally preferring vegetation-consolidated banks of greater than 0.95 m in height (Brunt et al., 2018). Due to this, riparian vegetation is also known as a key platypus habitat driver with vegetation providing bank stability which is essential for platypus burrows (Serena et al., 2001).

Adult platypuses are known to inhabit a territory of 0.5-15 km of a river system with males typically moving larger distances than their female counterparts (Bino et al., 2019). Platypuses are mainly active at night and shelter and burrow during the day, time spent outside of shelter is generally used for feeding. Platypuses will dive when foraging taking several short dives on average of 75 dives per hour when foraging (Grant, 2015).

6.2.2 Electro sensory

A key element of the foraging strategy for platypus is the use of its electrochemical bill neuroanatomy, in addition to mechano-receptors. The platypus utilises the electroreceptive sensory components of its bill to navigate and detect prey items underwater, without the use of eyes or ears. Electroreception is the ability to detect electrostatic fields, predominantly weak, direct current, electrical fields. Electrical fields are the level of charge on particles and their corresponding distance, so electrical fields are a combination magnitude and direction. Therefore, field strengths weaken as the distance from a charged object increases.

Platypus use their bill as an electroreceptor, distributed in lines along the bill (Manger & Pettigrew 1996). Simply, electrostatic fields will result in the creation of an action potential in the sensory cells, which produces a nerve impulse and a behavioural response. The sensory cells are adapted mucous glands that contain low-resistance canals, conducting electrical currents to the nervous system. The bill detects prey items that have a large enough electromyogenic potential, with behavioural studies identifying a threshold of 50 $\mu V\ cm^{-1}$ for immediate detection (Scheich *et al.* 1986) and 20-25 $\mu V\ cm^{-1}$ during further testing of thresholds (Fjällbrant *et al.* 1998). An assessment by Gregory *et al.* (1988) identified that the electroreceptors have the lowest threshold for detecting electrical fields at frequencies of 50-100 Hz with thresholds steeply rising above 300 Hz. Above 300 Hz, Gregory *et al.* (1988) suggest that receptors are unlikely to respond, indicating a limit of detection.

Fjällbrant *et al.* (1998) further identify that the scanning movement, bill shape and use of field decay rather than increased sensitivity thresholds of the platypus creates a high angular directional resolution for detection of prey. This allows specific direction of weak sources at short distances rather than strong sources at long distances, with the potential for suppression of non-prey electrostatic fields at long distance.

The use of highly specific directional electro sensory by platypus is expected to provide protection from weak electrical fields generated during GPR. This is due in part to the direction of the electrical fields generated from the electromagnetic emitter (i.e. vertically orientated) and signal attenuation from the surrounding environment due to both photo-electrical interference and Compton scatter interference.

6.2.3 Key threatening processes

The Tasmanian Platypus Management Plan (DPIPWE 2010), 'The Platypus: evolutionary history, biology, and an uncertain future' (Bino *et al.* 2019) and National Assessment of the Conservation Status of the Platypus (Hawke *et al.* 2021) identified that fragmentation of platypus populations has occurred in individual river systems and is associated with poor land management, adverse effects from river regulation and impoundments, pressure from introduced species, poor water quality, and disease. The Tasmanian Plan (DPIPWE 2010) notes that the effects have been most observable in small streams with low numbers of individuals or where streams are isolated by marginal habitat, upstream and downstream.

Key threatening processes for the Platypus include the following:

- habitat loss and degradation
- modified waterways
- climate change
- disease and introduced species
- direct mortality.

Activities through all phases from the Project are likely to coincide with the following key threatening process:

- habitat loss and degradation
- modified waterways
- direct mortality.

Potential impacts coinciding with the key threatening processes are described further in Section .

7 Platypus in the Project areas

7.1 Borumba

Aquatic surveys were conducted by Hydrobiology (2022) for the Borumba Project to assess the habitat use by platypus relative to the Project area. The method for detection consisted of:

- eDNA testing
- fyke netting
- habitat searches.

In summary, the following summary of habitat use was provided in the Hydrobiology 2022 report, *viz.,*

Suitable platypus habitat attributes were recorded across much of the Study Area. Preferred habitat attributes included:

- *low flow waters*
- *permanent water*

- *unconsolidated banks (in regard to high levels of bedrock)*
- *fine sediments on substrate/banks (to allow burrow construction); and*
- *undercut banks.*

Widespread eDNA detections indicated that platypus likely utilise most of the Study Area, although they were not recorded in Lake Borumba and the proposed Upper Reservoir. The rocky banks in the proposed Upper Reservoir are unsuitable for burrowing.

An area of habitat providing nesting habitat for the special least concern platypus. This represents approximately 56 hectares of available habitat (creek length X width) in the proposed Lower Reservoir.

In summary, platypus likelihood of occurrence assessment conducted by Hydrobiology (2022) identified:

- Known
  - Kingaham Creek
  - Yabba Creek upstream of Lake Borumba
  - Yabba Creek downstream of Lake Borumba
  - Mary River upstream of Yabba Creek confluence, downstream of Lake Borumba
  - Mary River downstream of Yabba Creek confluence, downstream of Lake Borumba
- Likely
  - unnamed creeks upstream of Lake Borumba
  - Bella Creek upstream of Yabba Creek
  - Lake Borumba
- Unlikely
  - unnamed creeks within proposed Upper reservoir
  - downstream of proposed upper reservoir.

7.2 Pioneer-Burdekin

Limited field assessments have been conducted for aquatic ecology values associated with Pioneer-Burdekin to date (with extensive surveys to commence in mid-2023). Noting this, the Project area is near (and intersects) a variety of watercourses, as both mapped and unmapped watercourses (under the *Water Act 2000*), ranging from Strahler stream order one (1) to three (3). Platypus have been recorded from the Project area and are likely to occur in watercourses of Strahler stream order two (2) or higher.

Platypus are expected to occupy habitat within the Project area, specifically areas containing:

- slow flow waters
- permanent water
- unconsolidated banks (in regard to high levels of bedrock)
- fine sediments on substrate/banks (to allow burrow construction)
- high sloping and consolidated banks
- complex benthic substrate
- overhanging vegetation.

8 Potential impacts

Potential impacts to platypus associated with each phase of the project are assessed in Sections 8.1-8.3 below.

Platypus face multiple threats (refer Section 6.2.3) with key potential impacts principally linked to threatening processes including direct disturbance, land clearing and creation of dams that disrupt the natural water flow, and predation. The Projects will result in both temporary and permanent disturbance of foraging and breeding habitat for the Platypus, and as such measures will be implemented to reduce the potential impacts of this disturbance.

The potential impacts are however expected to be localised (rather than affecting regional populations), and the severity of these potential impacts can be significantly reduced provided that appropriate measures are implemented as detailed in Section 9.

8.1 Investigative works

Potential impacts that may occur as a result of investigative works are detailed in Table 8-1.

Table 8-1: Potential platypus impacts during investigative works

Activity	Potential impact	Impact cause
Geotechnical drilling and test pitting	• Reduction in water quality due to sediment influx • Direct mortality • Impact on breeding habitat through loss of access	• Improper implementation of erosion and sediment controls, resulting in reduction in habitat values. • Improper use of management measures resulting in direct disturbance to breeding habitat and individuals.
Ground penetrating radar and/or seismic survey	• Potential disturbance impact due to vibrations or EMFs	• Potential for transient, localised impact to Platypus not within water/burrow habitats. Exposed or overland Platypus individuals in the vicinity of the disturbance may be temporarily disorientated.
Exploratory tunnelling	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control associated with stockpiling of spoil, resulting in reduction in habitat values • Improper implementation of dewatering strategy associated with tunnel works resulting in reduction in habitat values.
Installation of access tracks	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control resulting in reduction in habitat values.
	• Direct mortality	• Direct mortality from Platypus travelling overland and across site access tracks (principally associated with culverts).
Supporting infrastructure	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control resulting in reduction in habitat values.

• Access roads	• Direct mortality	• Direct mortality from Platypus travelling overland and across site access tracks (principally associated with culverts).
• Temporary workers' accommodation camps	• Direct mortality	• Direct mortality due to materials from temporary workers camp leading to entanglement/injury to local population • Improper implementation of erosion and sediment control resulting in reduction in habitat values.

8.2 Construction

Potential impacts that may occur as a result of Project construction are detailed in Table 8-2.

Table 8-2: Potential platypus impacts during construction

Activity	Potential impact	Impact cause
Lower Reservoir wall raising (Borumba only)	• Reduction in water quality due to sediment influx influx to downstream receiving environments	• Improper implementation of erosion and sediment control associated with stockpiling resulting in reduction in habitat values • Improper implementation of dewatering strategy associated with tunnel works resulting in reduction in habitat values.
	• Direct mortality	• Direct mortality due to interaction with construction material and potential inundation of nesting burrows.
Power waterway tunnel drilling	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control associated with stockpiling of spoil, resulting in reduction in habitat values • Improper implementation of dewatering strategy associated with tunnel works resulting in reduction in habitat values.
Vegetation clearing and associated grubbing	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control resulting in reduction in habitat values • Clearing activities coinciding with high rainfall periods and water-flow resulting in unmanageable water quality degradation from erosion and scour.
Excavations	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control associated with stockpiling resulting in reduction in habitat values
Inundation of new reservoir areas	• Direct mortality	• Direct mortality due to interaction with construction material and potential inundation of nesting burrows.

Activity	Potential impact	Impact cause
Supporting infrastructure and facilities	• Reduction in water quality due to sediment influx	• Improper implementation of erosion and sediment control resulting in reduction in habitat values.
Infrastructure construction	• Direct mortality	• Direct mortality due to interaction with construction materials leading to entanglement/injury
Access roads	• Direct mortality	• Direct mortality from Platypus travelling overland and across site access tracks (principally associated with culverts).

8.3 Operation

Potential impacts that may occur as a result of operation of the Projects are detailed in Table 8-3.

Table 8-3: Potential platypus impacts during operation

Activity	Potential impact	Impact cause
Operation of Upper Reservoir	• Direct habitat degradation	• Wetting/drying impacts and conversion of lotic to lentic system resulting in marginal habitat within Lower Reservoir.
Releases from Lower Reservoirs	• Direct habitat degradation	• Flow regime to consider environmental requirements of known Platypus populations downstream of Lower Reservoir.
Operation of Scheme	• Reduction in water quality due to sediment influx	• Changes to water quality through operation resulting in increase in sedimentation and contaminants resulting in reduction of habitat values • Changes from releases during flood regime resulting in loss of habitat downstream of Lower Reservoir.
	• Direct mortality	• Operations of Intakes and Outfalls resulting in direct mortality due to injury • Direct mortality from Platypus travelling overland and across site access tracks (principally associated with culverts).

9 Management measures

9.1 Staged implementation of mitigation

As the Projects will be delivered in stages, mitigation measures relevant to the activities being undertaken are expected to be implemented in each phase. Sections 9.1.1 to 9.1.3 highlight the key measures required for each phase.

9.1.1 Investigative works

Key management measures required during investigative works for both Projects include:

- Complying with management measures identified in the CEMP, including those in the following supporting plans
  - Erosion and Sediment Control Plan
  - Dewatering Management Plan
  - Flora and Fauna Management Plan.
- Implementing pre-clearance surveys (including use of wildlife detection dogs where required) when working within 50 m of a watercourse classified as stream order 2 or higher (Strahler classification).
- Avoiding vegetation clearing to the greatest extent possible.
- Avoiding use of seismic tests within 50 m of a watercourse of a watercourse classified as stream order 2 or higher (Strahler classification), where possible. Where seismic tests are required along a potential platypus watercourse, these will be conducted outside of breeding periods (i.e. August to January). If works are to occur during breeding period, a suitably qualified person must complete pre-clearance surveys in immediate area to confirm platypus are not present.

9.1.2 Construction

Key management measures required during construction of both Projects include:

- Complying with measures identified in the CEMP, including those in the following supporting plans
  - Erosion and Sediment Control Plan
  - Dewatering Management Plan
  - Flora and Fauna Management Plan (including weed management).
- Implementing pre-clearance surveys when working within 50 m of a watercourse of a watercourse classified as stream order 2 or higher (Strahler classification).
- Minimising vegetation clearing needed for construction to the greatest extent possible.
- Implementing measures to protect the downstream receiving environment from changes to water quality associated with releases
- Implementing protective measures during major earthworks and first-fill inundation where breeding periods and juvenile emergence (i.e. July to February) cannot be avoided.

9.1.3 Operation

Key management measures required during operation of both Projects includes:

- Implementing operational flow and water quality rules for dam releases
- Controlling site access though the Operations Manual
- Ongoing review of downstream habitats and associated rehabilitation/improvements.

9.2 Summary of management measures

Table 9-1 presents a summary of the management measures required to mitigate impacts to platypus in all phases of the Projects.

Table 9-1 Management measures for Platypus for the PHES Borumba and PHES Pioneer-Burdekin

Activity	Impact	Mitigation Measures	Stage of Implementation
Geotechnical investigations	• Disturbance impact from geophysical assessments	• Unmanned aerial vehicle surveys to avoid lingering over watercourses known to contain platypus habitat or populations. • Where seismic surveys and test pitting are to occur within 50 m of watercourses that may contain platypus habitat, works must not commence until a fauna spotter catcher has ensured there are no platypus or active platypus burrows present.	Borumba – investigative works Pioneer-Burdekin – investigative works
General works (Planning of works / scheduling)	• Indirect water quality degradation • Injury and/or death of platypus	• Undertake major earth works during periods of low rainfall and low flow (e.g. dry season) as far as practicable. • Develop a vegetation/land clearing strategy that includes minimisation, staging, progressive rehabilitation, and salvage and re-use. • Determine population dynamics via an assessment of significant infrastructure locations to assist development of a platypus relocation plan during construction of major infrastructure. • Manage the use and storage of hazardous substances in accordance with relevant legislation, guidelines and standards. • Implement spill management procedures and provide spill management kits on site and in vehicles.	Borumba – investigative works, construction Pioneer-Burdekin – investigative works, construction
General works (excavation, major earthworks, waterway crossing construction and inundation)	• Injury and/or death of platypus • Impacts to breeding habitat • Impacts to individuals	• Avoid drilling, blasting, and instream works during critical breeding periods and juvenile emergence (i.e. July to February), where practicable. • Implement a 6m x 6m exclusion zone marked by flagging tape around areas where active platypus burrows are identified. If the burrow will be impacted by major earthworks or dewatering releases, assessment of the burrow to determine if it is an active breeding place is required.	Borumba – investigative works, construction Pioneer-Burdekin – investigative works, construction

Activity	Impact	Mitigation Measures	Stage of Implementation
		• Where active burrows are identified and platypus are present, a suitably qualified person is to relocate the platypus, if conditions are suitable.	
General works (all activities)	• Injury and/or death of platypus	• The site induction should educate site personnel on how to recognise the physical attributes of platypus and platypus burrows and to STOP, MANAGE and NOTIFY when encountered.	Borumba – all phases Pioneer-Burdekin – all phases
Dewatering of retention basins	• Damage and/or death of platypus • Impacts to breeding habitat	• Locate dewatering discharge points as far from potential platypus breeding habitat as possible during construction. • Settle and test dewatering releases before release. Water quality criteria are to be identified within relevant CEMP plans. • Engage suitably qualified personnel to undertake water quality monitoring in accordance with the Dewatering Management Plan. • Monitor discharge near potential platypus habitat to ensure that scouring of the bed and banks is prevented via use of a dissipater and that water levels do not rise above the undercut bank level (i.e. burrow height). If scouring occurs, attach a dissipater to the end of the release outlet. • Decrease the discharge rate if water levels are likely to rise above the undercut bank level due to dewatering or release the water at more than one discharge point to reduce any localised increase in water levels.	Borumba – investigative works, construction Pioneer-Burdekin – investigative works, construction
Siting of basin spillways and pump-out locations	• Damage and/or death of platypus • Impacts to breeding habitat	• A fauna spotter catcher must confirm there are no active platypus burrows at the site of overflow releases before disturbance of the banks commences. Platypus detection dogs are to be used where environments reducing likelihood of identifying active burrows.	Borumba – investigative works, construction Pioneer-Burdekin – investigative works, construction
Major earthworks	• Indirect water quality degradation and	• Leave temporary erosion control measures in place following construction until bare soil has stabilised / progressive rehabilitation is implemented.	Borumba – investigative works, construction

Activity	Impact	Mitigation Measures	Stage of Implementation
	interruption/decrease in platypus prey items	• Rehabilitate all disturbed areas to achieve stable and sustainable soil cover and minimise sediment run off. Employ sediment and erosion control measures on site (e.g. bunding stockpiles, minimising exposed soil areas, containing site runoff from exposed areas using silt fences) in accordance with Erosion and Sediment Control Plans within the CEMPs. • Situate stockpiles away from areas of natural drainage. • Ensure all personnel are advised of designated stockpile areas.	Pioneer-Burdekin – investigative works, construction
Site access by vehicles	• Damage and/or death of platypus	• Implement ‘Go-Slow’ zones around high-risk areas for platypus movement (i.e. at waterway crossings) and/or overarching speed regulation. Unless required for works, driving of any machinery and vehicles is to be limited to within 50 m of waterway edges and banks	Borumba – all phases Pioneer-Burdekin – all phases
Dam flooding and releases during floods	• Changes to flow regime for downstream receiving environments.	• Assessment of hydraulics during detailed environmental assessments required to identify impacts of high-flow releases associated with flooding, on downstream platypus populations. • Assessment of hydraulics during detailed environmental assessment required to identify impacts of releases during declared drought conditions within catchment, on downstream platypus populations.	Borumba – operation Pioneer-Burdekin – operation
Operation of dams	• Indirect water quality degradation and interruption/decrease in platypus prey items	• Implement release rules to maintain water quality of downstream receiving environment. • Install multi-level offtakes to allow for releases with water quality that meets guidelines identified in the Operations Manuals. • Invasive or pest species should be controlled in accordance with Department of Agriculture and Fisheries (DAF) and Biosecurity Queensland Invasive Species Guidelines (DAF, 2016)	Borumba – operation Pioneer-Burdekin – operation

Activity	Impact	Mitigation Measures	Stage of Implementation
		• Implement aquatic macroinvertebrate assessments to determine changes in diversity and abundance of prey items	
Lower Reservoir volume changes	• Loss of habitat • Degradation of water quality (and changes in prey composition)	• Implement water quality monitoring program to assess potential changes to water in receiving environments.	Borumba – construction, operation Pioneer-Burdekin – construction, operation
General operations	• Damage and/or death of platypus	• During Project design, review type and use of screens for other aquatic species to assess risk for platypus attraction, entanglement and injury.	Borumba – operation Pioneer-Burdekin – operation

10 Competence, training, and awareness

Any required environmental training will be provided, principally through a compulsory environmental induction, along with regular toolbox and daily pre-start meetings.

10.1 Awareness

10.1.1 Environmental induction

All personnel conducting activities during the investigative works and construction will be required to attend a compulsory environmental induction, before commencing any activities. Facilitation of environmental inductions will be the responsibility of the Environmental Management Representative and will cover general management measures plans as per the EMP for each Project. It is expected that management measures associated with the Platypus will be addressed within the EMP and this management plan.

A record of all environment inductions will be maintained and kept on-file.

10.1.2 Daily pre-start meetings

The Site Supervisor is expected to conduct a daily pre-start meeting with the site workforce before work commences each day. This will include, at minimum:

- Day activities
- Relevant environmental management measures
- Any work area restrictions (i.e., no-go zones).

Daily pre-start meetings will briefly reiterate any environmental receptors of concern and relevant sections of environmental management measures for the day.

Daily pre-start attendance is considered mandatory (for relevant workforce members) for the duration of the exploratory works and construction and attendees will be required to sign an attendance register that is recorded and maintained as part of a compliance register.

10.1.3 Toolbox talks, training, and awareness

Weekly toolbox meetings will be used to ensure all relevant parties associated with construction will be aware of environmental constraints. The toolbox meetings will also allow for continued updates on any relevant changes (upon CEMP or supporting plan revision).

Facilitation of the pre-start meeting is considered the responsibility of the Environmental Management Representative.

All personnel working on site will receive training (principally via the environmental induction) to ensure awareness of environment protection requirements.

Informal information notes may also be displayed in worker crib sheds or break facilities.

Relevant environmental issues relate to management of impacts to Platypus include:

- Erosion and sedimentation control
- Dewatering
- Emergency and spill response
- Threatened species, endangered ecological communities, clearing controls and vegetation protection
- Weed management.

Toolbox talk attendance is considered mandatory for the duration of the early and construction and attendees will be required to sign an attendance register that is recorded and maintained as part of a compliance register.

10.1.4 Operation

Environmental inductions will be conducted for scheme operators and associated staff. The environmental induction will contain the reference to the Platypus Management Plan in addition to other relevant plans associated with environmental constraints and opportunities.

A period of ongoing monitoring will occur as part of the condition of approval for the operation of both Projects and these will be used, in addition to mitigation measures identified within this document to manage to Platypus populations.

10.2 Monitoring

Monitoring will occur during all stages of the Projects, in some capacity. These include monitoring occurring as:

- Incidental
- Weekly
- Monthly.

Monitoring associated with the management of impact to Platypus will consist of the following types of assessment:

- Visual assessment (including burrow searches)
- Surface water quality monitoring
- Erosion and Sediment Control condition assessments
- Operational water quality assessment
- Other monitoring (i.e. visual bank slumping assessments) associated with conditions of licence for operating the PHES
- Environmental DNA monitoring of platypus presence throughout the phases on the project and to monitor disturbance impacts after construction and operations – monitor platypus populations downstream of dam
- Macroinvertebrate assessments – diversity and abundance – changes over time and when any change in water release happen
- Support the community to help monitor platypus populations downstream.

Throughout the duration of the Projects, the Site Environmental Officer will regularly review this management plan to address the management of the Platypus, alongside any changes to knowledge or Project activities.

This plan is to be reviewed, in full, every two years for consistency with performance outcomes (refer Section 5).

10.3 Contingency Plan

In the event that fauna is injured or killed during Project works, or existing mitigation measures cannot be complied with, or potential impact is increased, the current mitigation strategies will be reviewed in conjunction with a suitably qualified person and any recommended changes implemented.

Any new mitigation measures will be discussed with relevant stakeholders prior to implementation.

The platypus specimen or a genetic sample is to be collected and sent to the Queensland Museum or Wildlife Queensland.

11 Reporting

Reporting requirements associated with the management measures (identified in Sections 9.2) include:

- Fauna Spotter/Catcher returns
- Ecological performance auditing
- Surface water quality assessments
- Operational Reporting
- Non-conformance reporting
- Incidents and corrective actions

Further details are provided in Sections 11.1 to 11.6.

11.1 Fauna Spotter/catcher Returns

The following information relates to data to be collected regarding the relocation of fauna which will be submitted as part of animal breeding place register returns:

- Fauna species relocated
- Location of animal breeding place
- Location of release
- Date of relocation

The animal breeding place register shall be lodged within 6 months of interaction with Platypus habitat.

11.2 Ecological performance auditing

Regulatory authorities associated with environmental matters may conduct inspections of the Project works. The Site Environmental Officer will attend these audits.

Quarterly internal audits will also be conducted to ensure compliance during the construction phase of the Project including:

- On-site audits
- Audits of contractor's environmental management
- Work area inspections and monitoring.

Non-conformances will be documented and addressed with appropriate corrective and preventative actions.

11.3 Surface water quality assessments

Surface water quality assessments will be conducted throughout each phase of the Projects and will consists of a both visual, *in-situ* and laboratory assessment of water quality.

Water quality results will be used to inform any significant impact to habitat quality from investigative works (as required), construction and operations.

11.4 Operational reporting

Operational reporting is expected to form the basis of ongoing management of Platypus populations within the receiving environments associated with each PHES. Operational monitoring

- Bank slumping
- Downstream receiving environment habitat assessments
- Pumping volume and time-under-pump

- Fauna interactions (as non-conformance reporting).

11.5 Non-conformance reporting procedure

Where there is a non-conformance with this management plan or conditions of approval, a report must be submitted to the relevant regulatory authority. The report will outline the type of non-conformance and remedial actions taken to ensure that the matter is resolved.

11.6 Environmental incidents and corrective actions

Any injured or shocked fauna (Platypus) should be handled by the licensed fauna spotter catcher and taken the nearest wildlife carer or veterinarian. type of injury sustained will also be identified if possible (without causing the animal further stress).

As part of the injured or shocked fauna (Platypus) incident, a step-wise procedure document should be prepared which includes:

- Detailing suitable qualifications for handling
- Specific incident procedure (within overarching environmental management plans)
- Local contact(s) for veterinary care
- Appropriate platypus veterinary expertise is to be sought to assist the local veterinary practice. This is expected to be from subject matter experts from:
  - Australia Zoo Wildlife Hospital
  - Taronga Zoo
  - Healesville Sanctuary.
- Arrangements for a suitable-qualified wildlife carer for recovery.

The Department of Environment and Science will be notified in the event of any species incident, in accordance with the fauna register. A fauna incident is defined as an injury or death.

12 References

Australian Platypus Conservancy (N.D.) Ecology and Behaviour. Available at: Ecology & Behaviour – Australian Platypus Conservancy.

Bino, G., Kingsford, R. T., Archer, M., Connolly, J. H., Day, J., Dias, K., and Whittington, C. (2019). The platypus: evolutionary history, biology, and an uncertain future. *Journal of Mammalogy*, *100*(2), 308-327.

DPIPWE (2010) Tasmanian Platypus Management Plan. Department of Primary Industries, Parks, Water and Environment. Tasmanian Government.

Furlan, E., Griffiths, J., Gust, N., Handasyde, K., Grant, T., Gruber, B., Weeks, A. (2013). Dispersal patterns and population structuring among platypuses, Ornithorhynchus anatinus, throughout south-eastern Australia. Conservation Genetics, 14(4), 837–853.

Grant, T. (2015). Family Ornithorhynchidae (platypus). In: Wilson DE, Mittermeier RA, editors. Handbook of the mammals of the world: marsupials and monotremes (volume 5). Barcelona (Spain): Lynx Edicions. 58–67.

Gregory, J. E., Iggo, A., McIntyre, A. K. & Proske, U. (1988) Receptors in the bill of the platypus. J. Physiol. 400, 349^366.

Hawke, T., Bino, G., Kingford, R. (2021) National Assessment of the Conservation Status of the Platypus. Centre for Ecosystem Science, University of New South Wales.

Hydrobiology (2022). Aquatic Ecology, Borumba Pumped Hydro Project. Report prepared for Queensland Hydro.

Manger, P. R. & Pettigrew, J. D. (1996) Ultrastructure, number, distribution and innervation of electroreceptors and mechano-receptors in the bill skin of the platypus, Ornithorhynchus anatinus. Brain Behav. Evol. 48, 27^54.

Scheich, H. & Langner, G. (1986) Electroreceptive cortex of platypus marked by 2-deoxyglucose. Proc. Int. Soc. Neuroethol. 1,54.

Serena, M. et al., (2001). Effect of food availability and habitat on the distribution of platypus (Ornithorhynchus anatinus) foraging activity. Australian Journal of Zoology, 49, 263– 277.

Strahler, A. N. (1952), "Hypsometric (area-altitude) analysis of erosional topology", Geological Society of America Bulletin 63 (11): 1117–1142.

Tore T. Fjällbrant, Paul R. Manger and John D. Pettigrew (1998). Some related aspects of platypus electroreception: temporal integration behaviour, electroreceptive thresholds and directionality of the bill acting as an antenna. Phil. Trans. R. Soc. Lond. B 1998 353, 1211-1219.