Martin Road, Badgerys Creek

Dewatering Management Plan

Water Transfer to Western Sydney Airport

Project Application Number:	10_0014
Project:	Badgerys Creek Quarry and Brick Making Project
Date:	2 October 2020
Revision Number:	1

Background

The site at Badgerys Creek is owned by PGH Pavers & Bricks Pty Limited (PGH), which is a subsidiary of CSR Limited (CSR). The property features a brickplant with 3 large water bodies containing approximately 1,000ML, which are former quarry pits that have filled with surface water that drains into them. The plant was mothballed by the previous owners in 2012.

In 2019 Modification 3 & 4 was lodged to amend the approval to facilitate Pit Dewatering, VENM importation and Manufacturing upgrades. Modification 3 & 4 was approved in August 2020 (the Approval).

The Western Sydney Airport (WSA) construction site is located on the other side of Badgerys Creek, to the west of the property. Given the geographical adjacency CSR engaged with WSA about their water requirements and during this process it was established that PGH did not own the water, which lead to discussions with the Natural Resources Access Regulator (NRAR).

On 3 June 2020 PGH entered into an Enforceable Undertaking (EU) with NRAR, which outlined:

1. The basis of an agreement to supply WSA with stored water from the Badgerys Creek PGH site, thus preventing further extraction of water that would otherwise be required to facilitate development works by WSA.
2. A requirement that PGH purchase the water, at twice its value, that was unlawfully taken under s60G of the Water Management Act 2000
3. The obligation to undertake works by 2 December 2020 to prevent the capture of surface water in the form of rainfall runoff.

A Water Access Licence to supply the pit water has been agreed between PGH and WSA Co Limited (“WSA Co”), which is the government business enterprise established to develop and operate Western Sydney International (Nancy Bird Walton) Airport at Badgerys Creek. This water will be used by WSA Co for dust suppression purposes during the construction phase and will be transferred using the pipework infrastructure that forms part of the Dewatering Infrastructure Plan dated 29 September 2020 (Revision 2). That plan has been submitted for approval in accordance with Schedule 3, Condition 23A of the Approval.

The Approval provides for the dewatering to occur by providing it to WSA or to drain it to Badgerys Creek (subject to a number of requirements), but this plan only provides for dewatering using the infrastructure detailed within the Dewatering Infrastructure Plan (DIP) servicing the WSA site and does not seek or provide approval to dewater to Badgerys Creek.

Statutory Approvals and Requirements

Schedule 3, Condition 23B of the Approval sets out the following requirements in relation to a Dewatering Management Plan (DMP):

Dewatering Management Plan

23B. The Proponent must prepare a Dewatering Management Plan for the project to the satisfaction of the Secretary. This plan must:

(a) be prepared in consultation with DPIE-Water and NRAR;

(b) be submitted to the Secretary for approval prior to dewatering activities from Pit 1, unless otherwise agreed by the Secretary; and

(c) include:

- details of:
  - off-site water transfer or discharge arrangements; and
  - procedures for monitoring on volumes transferred off-site and reporting on this as part of AEMR;
- a Fauna Relocation Plan regarding the transfer of aquatic fauna from Pits 1, 2 and 3 prepared by a suitably qualified ecologist which includes details on:
  - native fauna species known to inhabit and/or use the pits which require transfer from the pits;
  - methodology proposed to transfer the fauna;
  - location and suitability of the proposed relocation sites;
  - any potential impacts of relocating the fauna to the relocation sites and proposed mitigation measures; and
  - details of ecologists to monitor dewatering activities;
- a Geotechnical Monitoring Program, prepared by a suitably qualified and experience geotechnical engineer, to examine and monitor the faces and high walls of the quarry pits to determine potential geotechnical hazards and evaluate risks of potential failures;
- a program to monitor and report on dewatering that involves any discharge from the site, including:
  - the quality of any water discharged from the site;
  - surface water flows and quality in local watercourses; and
  - the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially be affected by the discharges; and
- a plan to respond to any exceedances of the performance criteria and mitigate and/or offset any adverse surface water impacts of the discharges.

The Proponent must implement the Dewatering Management Plan as approved by the Secretary.

Satisfaction of the above requirements of Condition 23B are detailed within this plan as follows:

(a) There will be consultation and provision of information to NRAR in accordance with the EU only, as the DMP does not seek approval to dewater to any local watercourses
(b) It is not intended to undertake dewatering activities until the DMP is approved
(c) Off site water transfer and arrangements
(d) Fauna relocation plan
(e) Geotechnical Monitoring Program

This plan does not address the monitoring or details associated with dewatering to local watercourses as there is currently no intention of dewatering in that manner and this plan does not seek approval for that to occur.

Supporting Documentation
This plan incorporates the following plans to support the delivery of the DMP:

1. Fauna Relocation Plan prepared by Narla Environmental Pty Ltd
2. Geotechnical Monitoring – Proposed Dewatering of Quarry Pits by Douglas Partners Geotech

Limitations of DMP
This plan only applies to the supply and transfer of water to the WSA construction site, as outlined in the Dewatering Infrastructure Plan and **does not** seek approval for the dewatering to be discharged into any local watercourses. This is because a Water Access Licence has been agreed with WSA Co to take the water in Pit 1 (Pit Water), meaning that there is unlikely to be a requirement to discharge Pit Water to either Badgerys or South Creek.

If these circumstances change and there is a need to dewater Pit Water via a watercourse, the DMP will be updated and resubmitted for approval prior to any water being discharged.

Water Transfer Infrastructure
The transfer of water to WSA will occur utilising the infrastructure outlined within the DIP and the associated reporting and monitoring provisions outlined within that plan.

In summary the DIP outlines the details of a pipeline that connects Pit 1 with the WSA site. This features a pipeline that is predominantly located on the ground, but which is bored under Badgerys Creek in the section of the site where the land is below the Probable Maximum Flood (PMF). The water will be pumped through the pipeline utilising a submersible mains powered pump in Pit 1, which will be controlled via a telemetry system operated by WSA.
This system will feature water flow meters that will monitor the amount of water being transferred. This water monitoring data will be collected and reported to NRAR on a regular basis, which will be at least every 3 months. This information will also be available for use as part of AEMR.

Off-Site water transfer to WSA construction site
The transfer of water to WSA is the subject of a Water Access Licence between PGH and WSA Co, which places various obligations on each party to ensure compliance with the Water Management Act 2000, in addition to other legal and authority requirements.

The agreement to transfer water to WSA to facilitate construction is for up to 3 years and provides for the transfer of between 800 to 1,200ML.

The water transfer infrastructure will deliver a significant water source to support the WSA construction project. The WSA project will disperse the water via a network of over 15km of HDPE pipework and other storage and filling infrastructure designed to support the estimated peak usage of 10ML per day. The pipework from Pit 1 will accommodate the transfer of approximately 3ML of water per day.

Fauna Relocation Plan
A fauna relocation plan has been prepared by Narla Environmental Pty Ltd to address the requirements of Condition 23B and forms part of this plan.

This plan details a number of steps that will be undertaken prior to and during dewatering to check for fauna that may be present and which could be affected during the dewatering process.
This procedure will involve the engagement of an ecologist to inspect the site during the specified stages of the dewatering process. Where required this may require the capture of impacted fauna and management of that fauna in accordance with the plan.

The ecologist will keep a detailed record and report on the results from the dewatering to ensure that accurate counts are available of:

1. Fauna captured and their description
2. Native fauna released at each recipient site
3. Pest fauna euthanised
4. Injured native fauna taken to the vet or care facility.

Geotechnical Monitoring Programme
A geotechnical monitoring programme will be implemented to support the dewatering process, in accordance with the process outlined in the proposal from Douglas Partners dated 16 September 2020.
The nature of the highwalls and difficulty in gaining access to them will mean that regular drone surveys will be conducted to assess the condition of the walls and any required action. This will feature repeat surveys at each 3m interval of water draw down and this will provide an ongoing record of the walls and any actions required to be taken and those implemented.

Water quality and contingency plans
The quality of water transferred to the WSA site will be constantly monitored by telemetry equipment that forms a key component of the pipework infrastructure being constructed in accordance with the DIP.
Initial testing of the pit water has confirmed that it is suitable for use by WSA, however should this ongoing monitoring indicate that there are unacceptable changes with the water quality during the life of the project then the system will stop transferring water so that investigations can be undertaken to determine the cause(s) and the actions required to remedy the situation so that only water of suitable quality is transferred to WSA.

Avoiding significant impacts and minimising impacts generally
Detailed planning combined with comprehensive processes and procedures have been adopted to ensure the project is implemented and operated without causing unintended impacts. These are detailed throughout the DIP, the Water Access Licence and the Approval.

Reporting & Monitoring Program
The construction of the pipeline infrastructure will be managed via a Project Control Group (PCG) with representatives from WSA Co, the contractor (including their pipeline sub contractor NPE) and CSR.

This structure will ensure measures are in place to address and communicate any incidents, complaints or non-compliances.

Following completion of the implementation phase a regular Operational Review Group (ORG) will be established and scheduled to review the operation of the pipeline. This will occur monthly initially to address any unforeseen issues and when appropriate will be scheduled to occur quarterly to review transfer data and monitor and address any issues as required.

Once the water has been transferred the ORG will then handover the infrastructure to a new PCG responsible for the decommissioning in accordance with the DIP.

Contingency Plan

Like the PCG structure, the ORG structure will incorporate regular and ongoing risk assessments and plans should unforeseen circumstances arise. This structure will include a responsibility matrix and reporting / notification guidelines, which detail the appropriate protocols and parties for recording and reporting any issues and/or incidents

Non-Compliance Notification Procedure

A core component of the reporting and processes associated with the PCG and ORG structure will be to ensure that there is a process established and responsibilities assigned for managing, reporting and addressing any incidents, complaints or non-compliance with statutory requirements. In addition to ORG reports and minutes this procedure will include the establishment of a register, which will detail the particular event and the steps taken to address them, including any associated communication and documentation.

The transition from the PCG to ORG structure will include common representatives from WSA and CSR to ensure that there is a sound knowledge of the project and the history is maintained throughout the forecast 3 year life of the project.

Plan review

The ORG procedures will ensure that the suitability and operation of the DMP is assessed at least once every 3 months or earlier as required. Should it be determined a change is required to the DMP then it will be updated and submitted to the Secretary for approval, prior to implementation.

Document Control Table

Plan Name	Dewatering Management Plan	
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Prepared by:	Andrew O'Neill	Senior Development Manager
Reviewed by:	Nelma Arancibia	Senior Project Manager
Revision Amendments:	N/A	
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Fauna Relocation Plan

Badgerys Creek Quarry and Brick Making Facility

Report prepared by Narla Environmental Pty Ltd

For CSR Building Products Limited

August 2020

NARLA
environmental

Report:	Fauna Relocation Plan
Prepared for:	CSR Building Products Limited
Prepared by:	Narla Environmental
Project no:	Csrp1
Date:	August 2020
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Report Certification

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Revision	Document Name	Issue Date	Internal Document Review
Draft v1.0	Fauna Relocation Plan	07/08/2020	Alexander Graham
Final v1.0	Fauna Relocation Plan	02/10/2020	Alexander Graham

Contents

1. Introduction

1.1 Background

Narla Environmental Pty Ltd (Narla) were engaged by CSR Building Products Limited (CSR) to provide a Fauna Relocation Plan (FRP) for the proposed dewatering of Pits 1, 2 and 3 within the Badgerys Creek Quarry and Brick Making Facility (hereafter referred to as the Subject Site; **Figure 1**). This FRP has been prepared to accompany a Dewatering Management Plan to mitigate potential impacts on aquatic fauna including fish, reptiles and amphibians, likely to be present within the pits proposed for dewatering.

1.2 Purpose

The purpose of this FRP is to outline the manner in which relocation of aquatic fauna is to occur to facilitate Modification 3 and 4 of the Badgerys Creek Quarry and Brick Making Facility. The aim of this plan is to:

- Identify native fauna species known to inhabit and/or use the pits which require transfer from the pits;
- Propose suitable methodology proposed to transfer the fauna;
- Identify the location and suitability of the proposed relocation sites;
- Address any potential impacts of relocating the fauna to the relocation sites and proposed mitigation measures; and
- Provide details of ecologists to be present during the dewatering activities.

1.3 Site Description

Existing voids on the site comprise Pits 1, 2 and 3, which are proposed for dewatering. Pit 1 is in the west of the site and is used as the main water storage for the site. Pit 2, adjacent to Pit 1 is complete and was previously partially backfilled and rehabilitated. Pit 3 is an active pit where quarry campaigns were focused, prior to the site being mothballed (Element Environment 2017).

1.4 Fauna with potential to be affected by the Dewatering Process

Fauna that have the potential to be affected by the dewatering process include species that may be located within vegetation surrounding the pits, such as frogs, reptiles and nesting birds, as well as aquatic fauna typically located within the pits.

1.4.1 Threatened Species

Green and Golden Bell Frog (*Litoria aurea*) which is currently listed as Endangered under the NSW Biodiversity Conservation Act 2016 (BC Act) and Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) has the potential to occur within the pits. To mitigate disturbance or impact on Green and Golden Bell Frog, the ecologist should ensure that active searches immediately prior to dewatering include undertaking thorough searches for the species.

1.4.2 Native species

Based on the Post-dewatering Report of dams within the adjoining Western Sydney Airport (Narla Environmental 2020), native species likely to be encountered in the pits include:

- Long-finned Eel (*Anguilla dieffenbachia*)
- Eastern Long-necked Turtle (*Chelodina longicollis*)
- Murray Turtle (*Emydura macquarii*)

- Firetail Gudgeon (*Hypseliotris galii*)
- Common Eastern Froglet (*Crinia signifera*)
- Striped Marsh Frog (*Limnodynastes peronii*)
- Eastern Dwarf Tree Frog (*Litoria fallax*)

1.4.3 Pest Species

Pest species that may be encountered include:

- Eastern Gambusia (*Gambusia holbrooki*)
- Common Carp (*Cyprinus carpio*)
- Goldfish (*Carassius auratus*)
- Red-eared Slider Turtle (*Trachemys scripta elegans*)
- Redfin Perch (*Siniperca chuatsi*)

See **Appendix 1** for information on identification of native and pest species that have the potential to occur within the pits.

Figure 1. Location of the Pits proposed for dewatering and proposed recipient site

2. Dewatering Procedures

2.1 Pre-Dewatering Mitigation Measures

2.1.1 Ecologist Supervision

A qualified ecologist will be on site to undertake defishing and fauna relocation during the dewatering process. The ecologist will be experienced in species identification and fauna handling, and will be licensed to undertake works by the NSW Department of Planning, Industry and Environment and NSW Primary Industries Fisheries under the following licences:

- Scientific Collection Permit - Fisheries Management Act 1994 (Section 37)
- Department of Planning, Industry and Environment Scientific Licence (Biodiversity Conservation Act 2016)

2.1.2 Selection of Recipient Sites

Suitable recipient sites for aquatic fauna captured during dewatering are determined based on their accessibility and similar conditions for released fauna. Based on suitable environmental conditions, it is recommended that recipient sites be located along Badgerys Creek downstream from the Subject Site. Along Badgerys Creek, three (3) release points should be selected. Prior to the release of fauna, the attending ecologist will consult with CSR Building Products Limited to determine appropriate release points along Badgerys Creek (**Figure 1**).

2.2 Dewatering Mitigation Measures

2.2.1 Immediately Prior to Dewatering

Prior to the commencement of dewatering:

- The attending ecologist will undertake a comprehensive search within emergent vegetation fringing the pits, to identify any concealed bird nests or sheltering frogs and frog spawn.
- The inlet of the pump will be fitted with mesh (3-5mm) to exclude any fauna from entering. The use of fine mesh will exclude even the smallest fauna (tadpoles) from entering the pump inlet. This inlet point will be carefully monitored by the ecologist throughout the duration of pump use. All pumping will take place under the supervision of the ecologist.

2.2.2 Fauna Capture

Where appropriate, during the initial stages of dewatering whilst water levels are high (>500mm), the ecologist may utilise aquatic traps (such as Box and Opera House traps) to attempt to capture fauna. Traps will be routinely checked by the ecologist, and all native fauna captured from the traps will be stored for relocation. All nets and traps that are used in any non-tidal (inland) waters are to be set in such a way that enables; captured, non-target, protected, air breathing animals to access the surface of the water to breathe, without exception. Nets are to be set to minimise entanglement. All nets must be set in such a way that the cod end is floated sufficiently on the surface of the water to allow any entrapped air breathing animals to breath. Nets and traps must not be set in a way that totally obstructs the fish passage in a waterway. Nets and/or, traps and setlines must be cleared regularly to release unwanted fish and animals back to the waters from which they were taken without undue injury.

Once water-levels have dropped to levels deemed suitable by the attending ecologist (approximately 500mm), traps will be removed from the pit (if utilised), and the ecologist will begin capturing aquatic fauna using an extendable net. Eels, Fish and Turtles will be captured through the use of a large net on a telescopic pole, and hand collection.

All traps and dip nets will be carefully maintained and regularly cleaned throughout the work period. This will ensure that each continue to operate correctly and generate no additional risk to the health and safety of fauna or staff.

During the final stages of dewatering, capture priority will be given to all fish (including all exotic species), particularly large specimens. Following the rescue of all fish, eels should be prioritised for rescue. Long-finned Eels are well adapted to spending time out of the water and are therefore not considered to be adversely impacted by short-term low dissolved oxygen levels. All visible fauna will be captured when water has been removed from the pit. It is considered likely that eels will continue to occupy waterlogged silt on the bottom of the pit. The ecologist will undertake an extensive search throughout the silt and rescue all encountered fauna.

2.2.3 Fauna Storage

Prior to relocation, captured native fauna will be stored within large storage bins (100cm x 50cm).

The following controls will be adhered to by the ecologist:

- Fauna species will not be mixed throughout storage boxes;
- Fish and Eels will be stored in separate boxes filled with water from the pit;
- Turtles will be stored in a box that contains a small amount of water (~3cm) to assist with thermoregulation;
- Frogs will be stored within a clean disposable container with damp leaf litter for moisture and shelter. Ensure holes for air are provided.
- Tadpoles will be stored in individual clip-seal bags, or disposal containers with water from the pit;
- All boxes will be placed in the shade whilst occupied by captured fauna;
- No overfilling or 'stacking' of fauna within boxes is to occur;

2.2.4 Fauna Transportation and Release

Fauna will be relocated to pre-determined release sites within one hour of capture.

If large numbers of predatory fauna (e.g. Long-finned Eels) are captured, additional release points along the recipient site (Badgerys Creek) may need to be used. Long-finned Eels should be released at a different release point to fish to reduce risk of predation.

The following methodologies will be utilised during the release of fauna:

- Fish will be released by carefully lowering the storage box into the water until partial submersion is achieved. Captured fish will then be able to swim out of the box into the release site. Boxes will not be poured or fauna dropped from height into the waterway, as it may result in injury/shock. In the event that carnivorous fishing birds (Heron, Egret) are present within the waterway, an alternate release point will be used to reduce the risk of predation of captured fauna.
- Turtles will be released by hand. Each specimen will be placed on a semi-submerged creek bank, to allow the turtle to acclimatise before self-relocating into the creek.
- Tadpoles will be placed in individual clip-seal bags and acclimatised to the release site (i.e. bag placed in waterbody for 30 minutes) before being released.

Following release at the recipient site, the ecologist will undertake visual checks downstream to identify any dead or dying fish that should be removed from the waterway. All euthanised and dead fish will be transported to a licensed landfill facility for disposal.

2.3 Post-Dewatering Mitigation Measures

At the completion of dewatering, the ecologist will undertake a thorough search for concealed fauna. Effort will be made to capture all fauna to prevent injuries or predation, including from native predatory birds. Where possible, sediments (silt) will be carefully removed from the pit and gently placed within a sump outside the pit with the use of a large excavator (with bucket attachment) allowing the ecologist to search the silt more thoroughly.

An escape ramp should be graded to allow any trapped fauna to escape overnight. Silt should be left undisturbed overnight and re-examined by an ecologist the following morning. Following the capture of remaining eels, these specimens should be immersed within fresh water to allow them to recuperate and acclimatise prior to release.

2.4 Injured Wildlife

The attending ecologist will be trained in wildlife rescue and have extensive fauna handling experience. An additional trained wildlife rescuer/rehabilitator ecologist will also be available on-call for the duration of the works in case of any wildlife injuries. This additional ecologist will provide specialist advice and rescue where required. All injured fauna will be taken to a nearby veterinarian for assessment and treatment or euthanised by a licensed ecologist in accordance with fisheries permits.

2.5 Biosecurity Measures

2.5.1 Pathogens

Controls set out in the 'Hygiene Protocols for the Control of Diseases in Australian Frogs' (Murray et al. 2011), must be adhered to, including utilisation of single-use disposable latex gloves for frog handling.

The health of all captured fish will be assessed by the ecologist. Any fish with confirmed signs of disease (e.g. ulceration) will be humanely euthanised by the ecologist.

2.5.2 Water Weeds

Disease and water weeds can be spread on equipment; however, this will be prevented by following stringent hygiene protocol with fish trapping. All equipment will be cleaned and sterilised before and after use. Equipment used in locations where contagious disease epidemics will be destroyed and disposed of after use and replaced. All traps will be thoroughly inspected and cleaned of all vegetative material before and after deployment to prevent the spread of water weeds.

2.5.3 Pest Species

In the event that Carp or Gambusia are present within the Pit, the ecologist will thoroughly inspect each storage container for the presence of Carp Eggs or Gambusia that may have been accidently collected during dewatering works. A small hand net will be used to scoop pest species out of each box before being disposed of in accordance with DPI guidelines.

All exotic fauna captured will be humanely euthanised by the attending ecologist immediately following capture. If the pest species cannot be euthanised immediately, it must be placed in humane conditions (bucket of water for aquatic fauna and separate from native fauna) to prevent any suffering prior to euthanasia.

All small to medium-sized exotic pest fish species recovered from the pit are to be humanely euthanised using the advised technique described by Department of Primary Industries (DPI 2020), consistent with the Prevention of Cruelty to Animals Act 1979. Following capture, small to medium-bodied, fish are to be immediately submerged into an icy slurry bucket. The slurry will be maintained at a consistent 0°C and made up of equal parts of water and ice. A thermometer will be utilised to ensure that the slurry remains at a constant 0°C during dewatering

works. Each specimen will be submerged in the ice bath for a total of 20 minutes, following this, the ecologist will assess each specimen for signs of life.

A percussive stunning device (fish bat) will also be kept at hand throughout the duration of the works for use on any larger carp specimens, as set out within DPI guidelines. 'Fish should be hit with a sharp blow to the head in the area just above the eyes (the area adjacent to the brain) using a special tool such as a heavy wooden handle or priest. When applied correctly the fish's gill covers should stop rhythmically moving and the eye should remain still'. Following which, the specimen will be placed into the ice slurry for a minimum of 20 minutes.

2.6 Reporting

The attending ecologist will keep a detailed report on the results of the dewatering, including accurate counts of:

- Fauna captured (native and pest), including delineation by species of each specimen captured;
- Native fauna released at each recipient site;
- Pest fauna euthanised and methods of euthanasia (including disposal location);
- Injured native fauna taken to the vet or care facility.

The ecologist will prepare a dewatering report that will outline the methodologies and summarise the results of the dewatering process.

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4. Appendix

Appendix A. Descriptions of Native or Pest Species Known or Likely to Occur within the Pits

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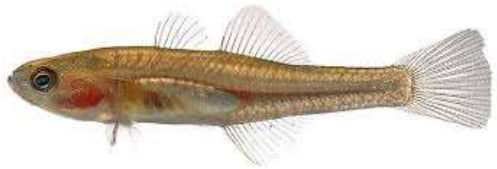
Pest Species				
Gambusia holbrooki (Eastern Gambusia)	*Cyprinus carpio* (Common Carp)	*Carassius auratus* (Goldfish)	Red-eared Slider Turtle (*Trachemys scripta elegans*)	Redfin Perch (*Siniperca chuatsi*)
				
Eastern gambusia are native to south-eastern USA. Eastern gambusia are now common in NSW waters and throughout Victoria, Queensland, Western and South Australian waterways. They have impacted several threatened fish species in NSW directly through competition and predation. The female guppy *Poecilia reticulata*, which is also a non-native species, may be confused with female Eastern gambusia. Additionally, Eastern gambusia may be confused with female and juvenile Pacific blue-eyes *Pseudomugil signifer*, (native species) which have a similar shape and body colour, and it is only the forked tail-fin of the pacific blue-eye that distinguishes them as a different species. Key features for Identification: ▪ small fish; females with deep rounded belly; ▪ livebearers; ▪ single dorsal fin, that starts well behind the anal fin; ▪ rounded tail fin; ▪ large eyes and a flattened head; ▪ lower jaw protrudes further than upper jaw; ▪ males a lot smaller than females; with modified elongated anal fin (gonopodium); ▪ Size: Females to about 60 mm, males to about 35 mm.	Carp are a large freshwater fish native to central Asia. Carp are very versatile, and can live in a great variety of habitats including highly degraded areas. Although small carp can be mistaken for goldfish, carp can be distinguished by having a pair of barbels (whiskers) at each corner of their mouth. They have small eyes, thick lips, a forked tail and a single dorsal (top) fin with strongly serrated spines. The scales are large and thick. The colour of carp varies. In the wild they are usually olive green to bronze or silvery in colour with a paler underside. Koi (or Japanese) carp are domesticated ornamental varieties of common carp and show a much broader range of colours and colour patterns, with various combinations of white, black, red, yellow, blue and orange markings. Scale variations, including large shiny scales either scattered or in a line along the flanks (mirror carp) or an absence of scales (leather carp) are also common in ornamental and wild fish. Carp can grow to a very large size, with overseas reports of fish as large as 1.2 metres in length weighing 60 kg. Fish of up to 10 kg have been caught in Australia, but weights of around 4-5 kg are more common.	Goldfish were originally imported into NSW as a colourful and easy to maintain coldwater aquarium fish. Over many decades they have become widely distributed throughout lowland rivers. Goldfish are related to carp (both from the Cyprinidae family) and feed mostly on small shellfish and plant material. They survive in still and sluggish water and can tolerate relatively high temperatures and low oxygen levels. Goldfish reproduce in summer. A large fish can lay several hundred eggs which hatch in about a week. Observations made by DPI research staff suggest that goldfish can be a food source for some predatory freshwater fish such as Murray cod. Goldfish are commonly up to 200 mm in size but can reach 400 mm.	The red-eared slider turtle (*Trachemys scripta elegans*), originates from the midwestern states of the USA and northeastern Mexico. An adult red-eared slider turtle has a carapace length of 12.5 to 28 cm. It has a distinctive, broad red or orange stripe behind each eye, while narrow yellow stripes mark the rest of the animal's head and legs. The carapace is dark green with yellow markings, and the plastron is yellow with some dark rings, blotches or swirls. Some individuals have a dark pigment that covers their coloured markings so that they appear nearly black in colour. Male red-eared slider turtles are usually smaller than females, and have very long claws on the front feet.	Redfin perch, also known as English perch, is a medium sized freshwater fish native to northern Europe. First introduced to Australia in the 1860s for angling, Redfin perch are now widespread across the cooler parts of NSW, ACT, Victoria, Tasmania, south-eastern South Australia and the south-western corner of Western Australia. Redfin perch belong to the family Percidae. They can be recognised by the following features: ▪ a deep body and a slightly forked tail; ▪ two distinctly separate dorsal fins, the first with 12-17 strong spines and a distinct black blotch at the rear; ▪ a pattern of five or more broad black vertical bands across the back, tapering on the sides (more prominent in younger fish); ▪ bright reddish-orange pelvic and anal fins and tail. The body colour varies from olive green to grey on the back, fading to greenish or silvery on the sides and whitish on the belly. While Redfin perch can reportedly grow to 60 cm in length and around 4.8 kg in weight, specimens in NSW are mostly smaller, with 95% of fish less than 230 mm and 200 grams.

Native Species			
Long-finned Eel (*Anguilla dieffenbachii*)	**Eastern Long-necked Turtle** (*Chelodina longicollis*)	**Murray Turtle** (*Emydura macquarii*)	**Firetail Gudgeon** (*Hypseliotris galii*)
			
Long-finned Eels have an olive-green, heavily mottled back and sides and a silvery-white to pale yellow belly. They are the largest freshwater eel in Australia, with females growing much larger than males. It is a good recreational species because of its large size and strength. Commonly caught at night on baited hooks, particularly pieces of fish and earthworms. Reaches a maximum length of approximately 1.7 m and 22 kg in weight. Commonly found up to 1 m in length. Closely related and very similar to the Short-finned Eel, however, the dorsal fin starts much closer to the head on the Long-finned eel. Often incorrectly referred to as conger eel in Victoria and NSW. They may also resemble lampreys, especially when small.	This is the most widespread species, occurring in water bodies throughout NSW with the exception of the highest parts of the Alps. It is easily distinguished by its wide plastron (the under part of the shell), made up of pale yellow shields with black margins. It is often seen crossing roads, where unfortunately it is frequently killed by motor vehicles. When handled it exudes a smelly secretion that helps to repel predators. It is a carnivorous species, feeding mostly on small invertebrates such as worms, snails and insect larvae, including mosquitoes.	Also known as the Macquarie turtle or Murray short-necked turtle, this turtle can grow to about 30cm in length. The male has a much fatter and longer tail than the female. There are two fleshy barbels under its chin. The shell is predominantly medium to dark brown above, cream coloured below. The skin is greyish and there is a distinctive creamy-yellow stripe running back along the side of the head from the corner of the mouth. The eyes are small and yellow with a round black pupil.	The Firetail Gudgeon has a compressed body, two dorsal fins and a small, oblique mouth that reaches to below the front of the eye. The colouration of the species varies with age, habitat and season. The body is generally grey to bronze with black scale margins. During the breeding season males can be almost black, with intense red-orange fins. There is often a black bar above the pectoral fins base and a faint stripe along the side of the body. Female Firetail Gudgeons can be easily distinguished from other species of *Hypseleotris* by the black area around the vent. This area is usually brown in males.

Common Eastern Froglet (*Crinia signifera*)	**Striped Marsh Frog** (*Limnodynastes peronii*)	**Eastern Dwarf Tree Frog** (*Litoria fallax*)
		
The Common Eastern Froglet shows a great deal of variation in colour, markings and size. It can be predominantly grey or brown or black, with dark bands, irregular patches or vertical stripes of any of these colours. Its skin also varies in texture from smooth to warty and may even have raised folds like ridges. The Common Eastern Froglet is found in many sufficiently wet habitats from the mountains to the coast, usually in shallow water, such as suburban fish ponds.	One of the most common frogs of the eastern coast of Australia, the Striped Marsh Frog is found from northern Queensland to Tasmania. The Striped Marsh Frog is predominantly a pond-dweller but nearly any kind of water will do, including fish ponds and polluted ditches. It is an adaptable frog and often encountered in urban environments.	A small species of frog reaching up to 2.5 cm in body length. It has a bright green or bronze back, with a bronze stripe from the tip of the snout along the sides if the back is green, or small green patches if the back is bronze. There is a white stripe from under the eye to the arm. The belly is white, and the male has a yellow throat. The pupil is horizontal, and the iris is gold. The front sides of the lower legs and the groin are orange. Fingers are slightly webbed and toes are three-quarters webbed, both with small discs.

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MAC200282
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Attention: Nelma Arancibia

Proposal for Geotechnical Monitoring
Proposed Dewatering of Quarry Pits
235 Martin Road, Badgerys Creek

1. Introduction

Further to receipt of your email dated 7 September 2020, we are pleased to provide our proposal for geotechnical monitoring for the proposed dewatering of quarry pits at 235 Martin Road, Badgerys Creek.

It is understood that the site includes three disused shale quarry pits which are currently filled with water. The proposed development includes the dewatering and backfilling the pits and that a geotechnical monitoring programme is required to comply with the conditions of approval for the project provided by the Department of Planning, Industry and Environment (DPIE).

It is understood that the pits are up to 25 m deep and dewatering will likely occur over a number of months. Following the dewatering, the pit will be backfilled, necessitating safe access below the highwalls by construction plant.

2. Scope of Work

The highwalls will be difficult to access for inspection during the dewatering process. Consideration has initially been given to personnel access by rope or by boat however these are limited by safety and practical issues. Instead, we propose to carry out regular drone surveys of the highwalls during the dewatering process. The drone surveys will allow initial identification of dangerous rock wedges and through subsequent surveys, the ongoing monitoring of movement, such formation of new cracks or widening of existing joints. We propose to carry out a drone survey at 3 m interval of water drawdown. This will allow rectification to be carried out on identified instability hazards while still accessible by barge.

2.1. 3D Photogrammetry “Reality Model”

The drone surveys will produce a “photorealistic” digital 3D model which would offer the following benefits:

- The ability to measure rock face structures (strike and dip, joint spacing, estimate block sizes etc) in physically inaccessible areas directly from the 3D model;
- A platform for collaboration and communication of site conditions to relevant stakeholders, without needing to physically access the site;
- High resolution (typically 10 to 20mm per pixel) geolocated capture of site features, which may be referred back to for “base line” comparison as features change over time; and
- Derivation of a digital elevation model and 3D point cloud from which vertical cross sections can be prepared.

Figures 1 and 2 show example screenshots from a reality model of a ocean-facing cliff produced by DP on a previous project on the Central Coast.

Figure 1: Example of a photogrammetry reality model of 50m high sea cliff

Figure 2: Detailed view of features captured by the model shown in Figure 1 above

2.2. Data Capture Methodology

Data for the model would be captured using an unmanned aerial vehicle (UAV, colloquially known as a "drone"), and would be processed using industry leading photogrammetry software. DP has extensive experience capturing rock faces, and the quality of the reality model will benefit from our advanced photogrammetry capabilities, which include the following:

- the capability to merge data captured from nadir and oblique perspectives, resulting in a more detail of near vertical features (see Figure 3 below);
- ground control point set out and capture using a high accuracy differential GPS, increasing the absolute accuracy of the model (where required);
- pre-programed autopilot flights, to ensure reliable and well distributed data capture;
- terrain following and obstacle avoidance technology; and
- workflows for model recovery/merging using manual tie points or robotically identifiable "target tags".

It should be noted that photogrammetry can only capture visible surficial features. As the highwalls may have been submerged for some time, the rock face may be covered in mud or algae which could obscure cracks and joints in the rock face.

Under CASA guidelines we are unable to fly within 30 m of other personnel. Accordingly, we may require public access to the site to be restricted for the duration of our survey, and assume that the client would manage this aspect.

Figure 3: Side by side comparison of the 3D reality model level of detail able to be obtained for near vertical features captured using nadir and oblique capture strategies (left and right images respectively)

2.3. Accuracy

The relative accuracy of measurement between features of the processed photogrammetry models is generally better than 300 mm under ideal conditions, although the this may vary due to variations in vegetation cover.

For the purposes of ground proofing the resultant model, we propose to perform the photogrammetry survey prior to geological mapping/field work to allow the accuracy of elements of the model to be confirmed. To assist with enhancing the accuracy of the model, we would establish semi-permanent ground control reference points at approximate 200 m intervals around the permitter of the pits for the duration of the dewatering period.

2.4. Deliverables

Immediately after photogrammetry processing, the reality model would be inspected by an experienced engineering geologist for signs of unfavourable jointing and signs of recent movement. A summary report would be prepared following each survey which would include identification of any stability hazards and recommended rectification options.

3. Fees and Conditions

Our estimated costs for the investigation, based on a schedule of rates, are attached.

We note that the costs for reporting are estimated based on reviewing of the drone survey information and providing assessment of the high walls. In the event that the survey and assessment identify

specific geotechnical hazards or features that warrant stabilisation, then more detailed analysis of stabilisation measures, attendance at meetings, etc, would be required at additional cost.

Based on our current commitments we estimate that we could carry out a baseline survey within 2 – 3 weeks of receiving your written order to proceed. Subsequent surveys could be carried out within 1 weeks notice of the expected target water levels. As the survey intervals are based on water depths not time, the duration and frequency of the monitoring programme will be based on the dewatering progress.

Our proposal should be read in conjunction with our standard conditions of engagement and the other attachments to this letter. Together, these will constitute the terms of our agreement and the basis on which we will provide any Services requested by you. These terms will remain in operation until, and if, we formally execute an alternative written agreement with you (or your organisation) for this work. We reserve the right to consider and negotiate any terms we may be asked to agree to. Payment for services performed by us cannot be withheld on the basis that Douglas Partners must first agree to separate terms.

If you wish us to proceed with the investigation, could you please complete, sign and date the attached Services Order form and return it to us. To avoid any doubt once we have provided this letter to you and if you then request us to provide any services, the terms of this letter and its attachments will bind both you and us in connection with all those services performed by us at your request even if not signed by you unless we agree otherwise in writing. While we may agree in good faith to review other conditions of engagement, such review and any acceptance may be subject to additional fees.

In response to COVID-19, we would like to share with you our business continuity plans and the measures we have in place to enable us to continue to provide a strong level of service throughout these times. This can be found at https://www.douglaspartners.com.au/news/covid-19. We recognise that unforeseen circumstances may arise and, as always, we will endeavour to keep you informed of any issues that may affect our services.

We thank you for your enquiry and look forward to being of service.

Yours faithfully
Douglas Partners Pty Ltd

Eric Riggle
Engineering Geologist

Reviewed by

Christopher C Kline
Principal

Attachments: Services Order
Schedule of Rates
Conditions of Engagement