NSW Department of Education

North Kellyville New Primary School

Dam Dewatering Report

August 2017

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Appendix B – Dam Dewatering Assessment for Offsite Dam No 1

1. Introduction

1.1 Requirement for a Dam Dewatering Plan

The proposed public school site is located within The Hills Shire Council (Council) LGA. Council requires a Dam Dewatering Plan to support the construction of the proposed Public School situated at 120-126 Hezlett Road, Kellyville (Property Lots 2 and 3 DP 27031). With reference to Figure 1 below, the Onsite Dam needs to be dewatered and filled so that a play area can be constructed for the school. A second dam, Offsite Dam 1, is located within the property boundary owned by the NSW Department of Education (DoE) but falls outside the site boundary of the proposed school. In view of the potential risk Offsite Dam 1 presents to school children, it is recommended that this dam also be removed. This Dewatering Plan therefore also provides information on both dams.

The Dam Dewatering Plan is required in terms of information provided by The Hills Shire Council in response to request for comments to be included in a "Secretary's Environmental Assessment Requirements" (SEARs) that was being prepared for the school.

1.2 Requirements to support the Dam Dewatering Plan

The following are required to support the Dam Dewatering Plan:

- Water Quality Data for the water in the storage, including temperature, turbidity, BOD, DO, salinity, heavy metals, amongst others, to be assessed against ANZECC Guidelines, specifically freshwater 95% level of protection trigger values.
- Proposed dewatering plan (e.g. irrigation, pumping into existing drainage channels or creeks, etc.). Data on the sediment contained within the dam.
- Data on the salinity of the soil, particularly if irrigation is proposed.
- Data on the sediment in the storage, to be assessed against the National Environmental Protection Measure (NEPM), 2013.
- Data on Aquatic ecology, including plans for the recovery or euthanising of fauna and protection of the environment against harmful fauna and/or fauna.
- The plan should also include solutions to problems that may be encountered during dewatering.
- The plan should take due cognisance of the dam size and location, water quality, soil contamination, site salinity and evaluation of the methods of water disposal.

1.3 Methodology

The methodology followed in the preparation of this report included the following:

1.3.1 Desktop Review

Completion of a desktop review of site features and issues including:

- Potential site constraints including topography, size of the site, etc. in order to prepare the proposed dewatering methodology.
- Vegetation structure and category.
- Potential site hazards.
- Slope classes and topography.

- Flora and fauna habitat features, including potential aquatic fauna and flora.
- Timing in relation to other construction activities so that the water could be used to the maximum extent to provide water required for these activities.
- Salinity of the area, in particular as denoted by the map titled “Salinity Potential in Western Sydney” Department of Infrastructure, Planning and Natural Resources, 2002 (available at www.environment.nsw.gov.au).

This desktop assessment provided the initial analysis of potentially acceptable solutions and performance requirements for the Dam Dewatering Plan.

1.3.2 Field Assessment

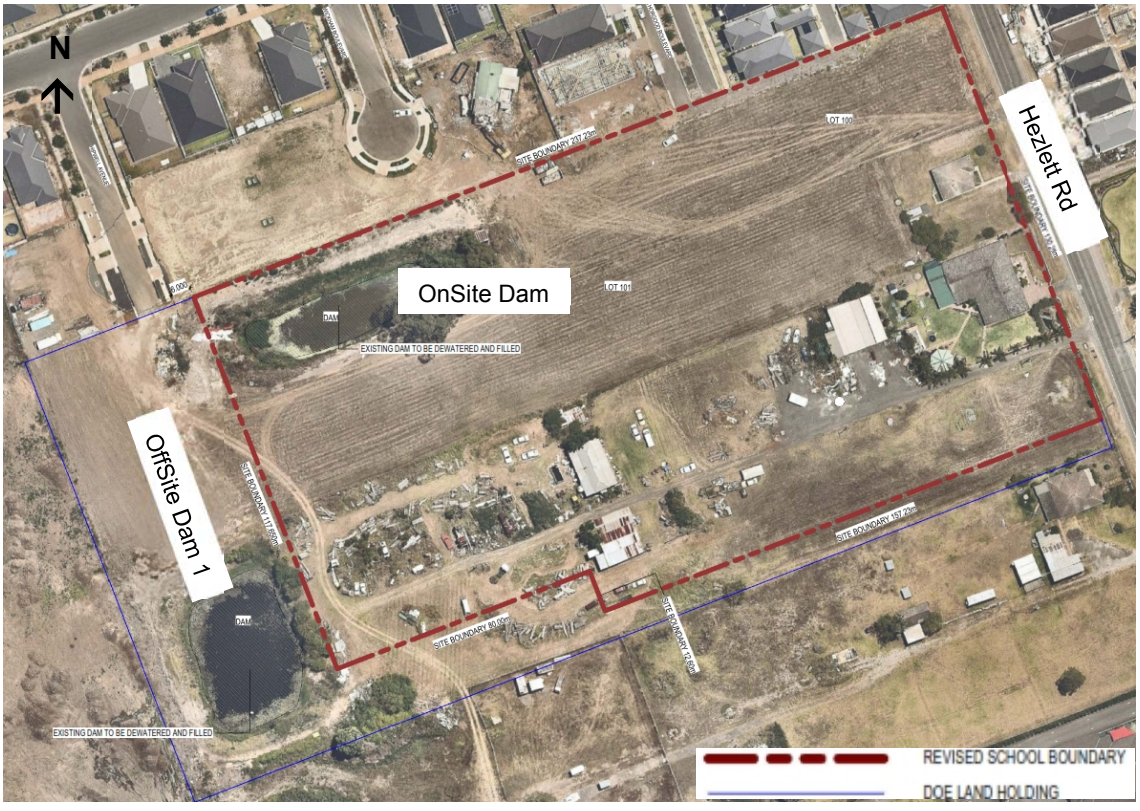
Various site inspections and associated activities were completed to obtain information on the following:

- Inspect the site to evaluate potential options for dam dewatering and filling of the dams.
- Areas that could potentially be irrigated.
- Site and roadway drainage that could potentially be used if irrigation is not the preferred method of water disposal.
- Distance to the nearest creek and creek layout in relation to the site.
- Aquatic fauna and flora.

1.3.3 Reporting

This report has been prepared in accordance with the requirements contained in a factsheet titled “Guidelines for Preparing a Dam Dewatering Report” provided by The Hills Shire Council.

Figure 1 Site Location Map



1.4 Scope and Limitations

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

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

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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

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

1.5 Assumptions

The following assumptions have been included in preparation of this report:

- In the absence of geotechnical information at the time of preparation of this report, it is assumed that the existing embankment material will be suitable for backfilling the dam.

2. Site Information

The following section provides information on water quality, salinity, aquatic fauna and flora and sediment in the dam.

2.1 Site drainage

2.1.1 Topography and drainage

The site slopes gently from the south east towards the north west. The Onsite Dam is located toward the north western corner of the property. There are no defined flowpaths which feed water into the dam, so the dam is likely to receive water via overland sheet flow into the southern side of the dam, and/or inflow from groundwater.

Offsite Dam 1 is located on the western boundary of the DoE property. Since there are also no defined flowpaths into the dam, it is likely that water enters the dam on the eastern side via overland sheet flow and/or groundwater inflow.

2.1.2 Location of drainage facilities

No formal drainage channels presently exist, but drainage of the developed site will be addressed in the design.

2.2 Water Quality

With reference to the attached ecological assessment, the information presented in Table 1 and Table 2 was collected on the quality of water in the dam.

Table 1 In situ water quality readings for Onsite Dam

Analyte	Sample 1	Sample 2	Sample 3	Sample 4	Average
Temperature (°C)	11.73	12.08	11.64	11.76	11.80
Conductivity (µS/cm)	325.1	325.1	329.0	324.0	325.8
pH (pH units)	7.36	7.19	7.2	7.25	7.25
Dissolved Oxygen (mg/L)	0.86	1.36	0.83	1.5	1.14
Dissolved Oxygen (% saturation)	7.9	12.5	7.6	13.6	10.4
Turbidity (NTU units)	25.3	27.2	91.0	77.4	55.23

* Results in yellow indicate that parameters are above the guideline value.

Table 2 Results from laboratory analysis for Onsite Dam

Analyte	Units	Guideline	Dam results
Faecal Coliforms	CFU/100mL	1000	~64
Escherichia coli	CFU/100mL	230	~64
Nitrite + Nitrate (NOx)	mg/L	0.01	<0.01
Total Kjeldahl Nitrogen	mg/L		2
Total Nitrogen	mg/L	0.35	2
Total Phosphorus	mg/L	0.01	0.48
Biochemical Oxygen Demand	mg/L		6
Arsenic	mg/L	0.013	0.003
Cadmium	mg/L	0.0002	<0.0001
Chromium	mg/L	0.001	<0.001
Copper	mg/L	0.0014	0.002
Lead	mg/L	0.0034	<0.001
Nickel	mg/L	0.011	0.001
Zinc	mg/L	0.008	0.025
Mercury	mg/L	0.0006	<0.0001

* Results in yellow highlight indicate that parameters are above the guideline value.

2.2.1 Offsite Dam 1

With reference to the attached ecological assessment, the following information in Table 3 and Table 4 was collected on the quality of water in the Offsite Dam 1.

Table 3 In situ water quality readings for Offsite Dam 1

Analyte	Sample 1	Sample 2	Sample 3	Sample 4	Average
Temperature (°C)	13.11	12.85	13.25	13.12	13.08
Conductivity (µS/cm)	270.5	273.1	272.4	272.9	272.23
pH (pH units)	6.96	7.32	7.4	7.46	7.285
Dissolved Oxygen (mg/L)	0.37	0.60	0.70	1.14	0.70
Dissolved Oxygen (% saturation)	3.5	5.6	6.6	10.7	6.6
Turbidity (NTU units)	68.7	81.0	199.3	92.1	110.3

* Results in yellow indicate that parameters are above the guideline value.

Table 4 Results from laboratory analysis for Offsite Dam 2

Analyte	Units	Guideline	Dam results
Faecal Coliforms	CFU/100mL	1000	~60
Escherichia coli	CFU/100mL	230	~60
Nitrite + Nitrate (NOx)	mg/L	0.01	<0.01
Total Kjeldahl Nitrogen	mg/L		1.5
Total Nitrogen	mg/L	0.35	1.5
Total Phosphorus	mg/L	0.01	0.1
Biochemical Oxygen Demand	mg/L		<2
Arsenic	mg/L	0.013	0.002
Cadmium	mg/L	0.0002	<0.0001
Chromium	mg/L	0.001	<0.001
Copper	mg/L	0.0014	0.003
Lead	mg/L	0.0034	<0.001
Nickel	mg/L	0.011	<0.001
Zinc	mg/L	0.008	0.016
Mercury	mg/L	0.0006	<0.0001

* Results in yellow indicate that parameters are above the guideline value.

2.3 Aquatic Fauna and Flora

2.3.1 Onsite Dam

The dam is of moderate size and approximately 40m by 20m of open water was present at the time of the survey (Photograph 1). The dam contains sloped banks comprising a shale and fill substrate.

The banks are heavily vegetated with exotic weeds and was dominated by Blackberry (*Rubus fruticosus* subsp. *aggregate*) particularly on the dams' northern edge. Small numbers of native flora line the dam including a large Forest Red Gum (*Eucalyptus tereticornis*) on the dam's eastern bank. Native fringing aquatic vegetation within the dam itself is restricted to a small narrow band of *Persicaria* sp, Water Primrose (*Ludwigia peploides* subsp. *montevidensis*) and Duckweed (*Wolffia* sp.). A small patch of emergent sedges is present on the western edge of the dam, where a man-made drainage line has been constructed. Submerged debris and small snags occur in the periphery of the northern edge of the dam in open water.

Photograph 1 Onsite Dam

Five fauna species were recorded as using the dam at the time of the survey, including four bird species and one frog species (Table 5).

Table 5 Fauna species recorded utilising the dam during the survey

Fauna group	Common name	Scientific name
Frogs	Common Eastern Froglet	*Crinia signifera*
Birds	Hardhead	*Aythya australis*
	Pacific Black Duck	*Anas superciliosa*
	Australian Wood Duck	*Chenonetta jubata*
	Eurasian Coot	*Fulica atra*

A range of other fauna species are likely to occur at this dam on occasion. Other common frog species likely to utilise this dam include the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) and Striped Marsh Frog (*Limnodynastes peronii*). It is unlikely that the Green and Golden Bell Frog (*Litoria aurea*) would occur in this dam as it is understood that the nearest known population at The Ponds is considered extinct (*pers comm* Arthur White).

A range of other waterbirds including ducks, coots and rails may also forage in this dam, and breeding habitat may be present for wading birds which may use the small patch of sedges as breeding platforms. Snakes such as the Red-bellied Black-snake (*Pseudechis porphyriacus*) and the eastern Snake-necked Turtle (*Chelonia longicollis*) are also likely to occur.

No Mosquito Fish were recorded within this dam. There is potential for the native Long-finned Eel (*Anguilla reinhardtii*) to occur.

There are several small creeklines located in close vicinity to this dam. Small Creek is present <700m from the dam in the west while Cattai Creek is located in the east approximately 1km away.

2.3.2 Offsite Dam 1 and Offsite Dam 2

The Offsite Dam 1, is of a moderate size and with approximately 50 m by 40 m of open water present at the time of the survey. This dam is shown in (Photograph 2) below. The dam contained deeply incised banks > 5m and comprising a shale and fill substrate and appeared to contain relatively deep water. The banks were heavily vegetated with exotic weeds and contained Kikuyu (*Pennisetum clandestinum*) and Blackberry (*Rubus fruticosus* subsp. *aggregate*) on its upper banks. A limited amount of native vegetation lined the dam including emergent eucalypts with Sweet Pittosporum (*Pittosporum undulatum*) present on the western and northern edges. Native fringing aquatic vegetation within the dam itself was restricted to small scattered patches of *Persicaria* sp. There were no submerged debris or stags to provide basking habitat for frogs/turtles or waterbirds.

The western edge of the dam lies adjacent to a property comprising vegetation mapped as Cumberland Plain Woodland (THSC 2008). However, this vegetation has recently been cleared and only large piles of mulch remain. Another dam, Offsite Dam 2, is located on the neighbouring property (refer Photograph 3 below).

Photograph 2 Offsite dam with fringing exotic vegetation (Offsite Dam 1)

Photograph 3 Recently cleared vegetation mapped as Cumberland Plain Woodland adjacent to property (showing location of Offsite Dam 2)

Five fauna species were recorded using the Offsite Dam 1 at the time of the survey, including two frog species, two bird species and one reptile species (Table 6). The one reptile species, the Eastern Long-necked Turtle (*Chelodina longicollis*) was observed taking in air at the water's surface.

Table 6 Fauna species recorded utilising the Offsite Dam 1 during the survey

Fauna group	Common name	Scientific name
Frogs	Common Eastern Froglet	*Crinia signifera*
	Eastern Dwarf Tree Frog	*Litoria fallax*
Reptiles	Eastern Snake-necked Turtle	*Chelonia longicollis*
Birds	Hardhead	*Aythya australis*
	Welcome Swallow	*Hirundo neoxema*

A range of other fauna species are likely to occur at Offsite Dam 1 on occasion. Other common frog species likely to utilise this dam include the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) and Striped Marsh Frog (*Limnodynastes peronii*). Offsite Dam 1 is unlikely to contain habitat for the Green and Golden Bell Frog (*Litoria aurea*) given the absence of suitable fringing vegetation in which to take cover and bask, however there are a few recent records (2011) of the species in the locality within 5km of the dam at Riverstone (OEH 2017). A range of waterbirds including ducks, coots and rails may also forage in Offsite Dam 1. Snakes such as the Red-bellied Black-snake (*Pseudechis porphyriacus*) are also likely to occur.

No Mosquito Fish were recorded within this dam. There is potential for the native Long-finned Eel (*Anguilla reinhardtii*) to occur.

There are several small creeklines located in close vicinity to Offsite Dam 1. Small Creek is present <700m from the dam in the west while Cattai Creek is located in the east approximately 1km away.

2.4 Sediment

Minor amounts of sediment are expected to be transported when pumping water out of the dams. Such sediment is likely to settle quickly within the area being irrigated and be caught within plants growing within the area being irrigated. The sediment so transported will not be harmful to the environment.

With reference to the *Detailed Site Contamination Investigation* report undertaken by Douglas Partners, July 2017 and addendum on 15 August 2017, there are areas within the proposed site boundary that were unable to be tested during the investigation and therefore it is recommended that additional testing be undertaken on the dam sediments during construction.

2.5 Salinity

Although the water has elevated levels of salinity compared to the ANZECC Guidelines (as measured by Electrical Conductivity), the salinity is not expected to significantly impact the salinity of the soils upon which it is irrigated.

3. Proposed Dam Dewatering Procedure

There is an opportunity to use the water in the dams for activities required for construction of the school, e.g. moisture conditioning of soil prior to compaction, dust suppression, establishment of grass and vegetation subsequent to landscaping or other construction activities, etc. However, it is unclear whether the project programme will be suitable for such water use. For this reason, it is proposed to pump water from the dams and irrigate within the boundary of the development property.

The dewatering procedure, care of fauna and flora and dealing with noxious fauna and flora are provided in the documentation attached hereto as Appendix A and Appendix B.

4. Technical Requirements

The dams will need to be backfilled and levelled to the general landform at that location. The soil forming the embankments should be used preferentially as backfill prior to obtaining additional fill from other parts of the site, if required. All vegetation currently on dam embankments should be stripped prior to any earthworks. Reference can be made to the proposed earthworks design and cut/fill volume for the site as discussed in the Civil and Stormwater Management Basis of Design Report.

4.1 Requirements for Backfill

Material presently forming the dam embankments must be thoroughly mixed and moisture conditioned to a moisture content within plus or minus 2% of optimum moisture content (OMC). The material should be placed in layers not exceeding 200 mm and compacted to a density of at least 98% Hilf Density ratio.

The OMC of the material shall be the moisture content that is required to achieve the peak converted wet density when tested in accordance with the method given in AS 1289.5.7.1, using the standard compactive effort in accordance with AS 1289.5.1.1.

Placed material that has been conditioned shall be compacted with approved rollers or other equipment. The field density of compacted layers, determined in accordance with AS 1289.5.3.1, shall meet the criterion that at least 8 out of every 10 of the Hilf density ratio (R_{HD}) tests is in excess of **98%** when tested in accordance with AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1. If the result of any test of the Hilf Density Ratio of a sample is less than **97%,** the Contractor shall scarify the layer, correct the moisture content and recompact the layer to meet the compaction criteria.

4.2 Topsoil and Hydroseeding

Once the dam site has been reinstated to the general landform, the Contractor shall notify the Superintendent of the completed earthworks area for final inspection.

Before topsoiling, the areas shall be tyned across the contour to a minimum depth of 50mm. Topsoil shall be spread to a minimum depth of 100 mm over the fill area prior to hydroseeding.

Upon completion of the earthworks, the exposed surfaces shall be hydroseeded and planted with species as specified in Section 3.4.3 of the attached documentation (attached in Appendix A and Appendix B).

The Contractor shall maintain the re-vegetated areas for a minimum of three (3) months after the Date of Practical Completion of seeding.

Maintenance work shall include: watering; reseeding areas that do not germinate; rectification to eroded areas and the removal of weeds.

The watering rate shall be at least 25 mm/week covering the entire rehabilitated area.

4.3 Construction standards

AS 1289 Methods of testing soils for engineering purposes

5. References

ANZECC (2000) Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

DECC (2008) Hygiene protocol for the control of disease in frogs. Information Circular Number 6. Department of Environment & Climate Change NSW, Sydney South.

GHDWoodhead (2017). Functional Design Brief: Kellyville North Public School.

GHD (2017). 120 Hezlett Road, Kellyville: Preliminary Hydrological/Farm Dams Assessment.

GHD (2013) Sampling Practices and Procedures Manual (updated version of Ecowise/ALS Sampling Practices and Procedures Manual)

THSC (undated). Guidelines for preparing a dam dewatering report. The Hills Shire Council.

Appendices

Appendix A – Dam Dewatering Assessment for Onsite Dam

Memorandum

22 June 2017

To	NSW Department Of Education		
Copy to			
From	Kirsten Crosby	Tel	+61 2 9239 7225
Subject	North Kellyville New Primary School Site: Dam Dewatering Assessment - onsite dam	Job no.	2126108

1 Background

The NSW Department of Education proposes to construct a new public school at 120 Hezlett Road, North Kellyville, to meet predicted population growth in the area. The site consists of land used for rural purposes in an area undergoing extensive residential and community infrastructure development. It is predominantly cleared, mostly planted trees and two dams to the rear (GHDWoodhead 2017).

A dam is located within the development site. There is no defined drainage path into the dam, with water in the dam likely to originate from sheet runoff on the gently sloping ground to the south of the dam or from groundwater seepage into the dam or a combination of the two. The dam appears to have been constructed by excavating within the ground and forming the dam embankments from excavated material. Since the dam is not required for the school and presents a safety risk to school children, it has been recommended that it be removed (GHD 2017).

This letter report outlines the water quality and aquatic ecology of the dam and provides recommendations for the dewatering process. This report has been prepared with reference to the *Guidelines for preparing a dam dewatering report* (The Hills Shire Council, undated).

2 Methods

A survey of the site was conducted by two GHD staff, an environmental scientist and an ecologist, on 2 June 2017.

2.1 Water quality methods

Both in situ sampling and 'ex situ' sampling (collecting 'grab' samples) for laboratory analyses, were conducted. Prior to sampling, a toolbox talk and a review of the safe work method statements related to water quality sampling was undertaken. Four (4) in situ readings and samples were taken from different locations around the dam, with the samples combined into a single composite sample.

In situ measurements of water quality parameters are essential to determine site conditions that can vary dramatically, or frequently, in waterbodies. In situ monitoring was conducted from locations away from the water's edge, and in areas where water was deep.

Temperature (°C), Conductivity (µS/cm), pH (pH units), Dissolved Oxygen (mg/L and % saturation) and Turbidity (NTU units) were recorded using a calibrated Hydrolab MS5 Multiprobe Water Quality meter. Measurements were recorded and are presented below.

All sampling and preservation techniques were in accordance with the Australian Standards for water quality sampling (AS/NZS 5667.1:1998) and with standard GHD sampling protocols as defined in the GHD Water Science Sampling Practices and Procedures Manual (GHD 2006).

2.1.1 Fauna survey methods and habitat assessment

Surveys focused on assessing habitat values of the dam and any potential impacts of construction activities to species utilising the dam. The dam was assessed for connectivity to adjacent waterways, potential habitat for native species including emergent vegetation, and the presence of weeds. Opportunistic observations and active searches of fauna was undertaken around the dam and its fringing vegetation. The dam was dip-netted for exotic fish such as Mosquito Fish (*Gambusia holbrookii*) where access was possible and safe. Binoculars were used to scan adjacent fringing aquatic vegetation such as sedges and rushes for basking frogs. Aural surveys for frogs were also carried out and water birds present were identified.

2.2 Results

2.2.1 Water quality

The following tables list the Guideline limits (Table 2-1) and water quality results (Table 2-2, Table 2-3) from the testing undertaken on the 2 June 2017.

The in situ results for the dam showed high conductivity and turbidity and very low dissolved oxygen when compared to the ANZECC (2000) freshwater guidelines. Conductivity does meet the ANZECC lowland rivers guidelines (125-2200 µS/cm).

Nutrients, namely total nitrogen and total phosphorus, were high, above the ANZECC (2000) freshwater guidelines. These results are not unusual for rivers and dams in modified landscapes where there is a high level of pollution from gross pollutants and fertiliser/chemical runoff.

The only metals to exceed the ANZECC (2000) guidelines were Copper and Zinc. In high concentrations, copper can damage red blood cells, reducing the oxygen carrying capacity, affect immune system function, the reproductive system, decrease growth or development and decrease survival of fish and other macroinvertebrates. Zinc is harmful to aquatic life during early life-stages. However, the concentrations recorded are unlikely to cause long-term deleterious effects to downstream aquatic life.

Table 2-1 ANZECC Guidelines to be assessed against

Parameter	ANZECC Recreation Guideline	ANZECC Freshwater 95% species protection S-E Aust.
Microbiological Indicators		
Faecal Coliforms/*E. coli* (CFU/100 mL)	1000	
Enterococci (CFU/100 mL)	230	
Nutrient Indicators		
Nitrite + Nitrate (NO_x) (mg/L)		0.01
Total Kjeldahl Nitrogen (TKN) (mg/L)		
Total Nitrogen (mg/L)		0.35
Total Phosphorus (mg/L)		0.01
Physico-Chemical Indicators		
pH (pH units)	6.5 – 8.5	6.5 - 8
Electrical Conductivity (µS/cm)		20 - 30
Dissolved Oxygen (mg)	>6.5	
Dissolved Oxygen (%)	>80	90 - 110
Biological Oxygen Demand (BOD) (mg/L)		
Turbidity (NTU)		1-20
Metals Indicator		
Aluminium (mg/L)	0.2	0.055
Arsenic (mg/L)	0.05	0.013
Boron (mg/L)	1	0.37
Cadmium (mg/L)	0.005	0.0002
Chromium (mg/L)	0.05	0.001
Copper (mg/L)	1	0.0014
Lead (mg/L)	0.05	0.0034
Manganese (mg/L)	0.1	1.9
Mercury (mg/L)	0.001	0.0006
Nickel (mg/L)	0.1	0.011

Parameter	ANZECC Recreation Guideline	ANZECC Freshwater 95% species protection S-E Aust.
Selenium (mg/L)	0.01	0.011
Silver (mg/L)	0.05	0.00005
Zinc (mg/L)	5	0.008

Table 2-2 In situ water quality readings

Analyte	Sample 1	Sample 2	Sample 3	Sample 4	Average
Temperature (°C)	11.73	12.08	11.64	11.76	11.80
Conductivity (µS/cm)	325.1	325.1	329.0	324.0	325.8
pH (pH units)	7.36	7.19	7.2	7.25	7.25
Dissolved Oxygen (mg/L)	0.86	1.36	0.83	1.5	1.14
Dissolved Oxygen (% saturation)	7.9	12.5	7.6	13.6	10.4
Turbidity (NTU units)	25.3	27.2	91.0	77.4	55.23

* Results in yellow indicate that parameters are above the guideline value.

Table 2-3 Results from laboratory analysis

Analyte	Units	Guideline	Dam results
Faecal Coliforms	CFU/100mL	1000	~64
Escherichia coli	CFU/100mL	230	~64
Nitrite + Nitrate (NOx)	mg/L	0.01	<0.01
Total Kjeldahl Nitrogen	mg/L		2
Total Nitrogen	mg/L	0.35	2
Total Phosphorus	mg/L	0.01	0.48

Analyte	Units	Guideline	Dam results
Biochemical Oxygen Demand	mg/L		6
Arsenic	mg/L	0.013	0.003
Cadmium	mg/L	0.0002	<0.0001
Chromium	mg/L	0.001	<0.001
Copper	mg/L	0.0014	0.002
Lead	mg/L	0.0034	<0.001
Nickel	mg/L	0.011	0.001
Zinc	mg/L	0.008	0.025
Mercury	mg/L	0.0006	<0.0001

***** Results in yellow highlight indicate that parameters are above the guideline value.

2.2.2 Ecology

The dam is of moderate size and approximately 40m by 20m of open water was present at the time of the survey (Photograph A). The dam contains sloped banks comprising a shale and fill substrate.

The banks are heavily vegetated with exotic weeds and was dominated by Blackberry (*Rubus fruticosus* subsp. *aggregate*) particularly on the dams' northern edge. Small numbers of native flora line the dam including a large Forest Red Gum (*Eucalyptus tereticornis*) on the dam's eastern bank. Native fringing aquatic vegetation within the dam itself is restricted to a small narrow band of *Persicaria* sp, Water Primrose (*Ludwigia peploides* subsp. *montevidensis*) and Duckweed (*Wolffia* sp.). A small patch of emergent sedges is present on the western edge of the dam, where a man-made drainage line has been constructed. Submerged debris and small snags occur in the periphery of the northern edge of the dam in open water.

Photograph A: Onsite dam

Five fauna species were recorded using the dam at the time of the survey, including four bird species and one frog species (Table 2-4).

Table 2-4 Fauna species recorded utilising the dam during the survey

Fauna group	Common name	Scientific name
Frogs	Common Eastern Froglet	*Crinia signifera*
Birds	Hardhead	*Aythya australis*
	Pacific Black Duck	*Anas superciliosa*
	Australian Wood Duck	*Chenonetta jubata*
	Eurasian Coot	*Fulica atra*

A range of other fauna species are likely to occur at this dam on occasion. Other common frog species likely to utilise this dam include the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) and Striped Marsh Frog (*Limnodynastes peronii*). It is unlikely that the Green and Golden Bell Frog (*Litoria aurea*) would occur in this dam as it is understood that the nearest known population at The Ponds is considered extinct (*pers comm* Arthur White).

A range of other waterbirds including ducks, coots and rails may also forage in this dam, and breeding habitat may be present for wading birds which may use the small patch of sedges as breeding

platforms. Snakes such as the Red-bellied Black-snake (*Pseudechis porphyriacus*) and the eastern Snake-necked Turtle (*Chelonia longicollis*) are also likely to occur.

No Mosquito Fish were recorded within this dam. There is potential for the native Long-finned Eel (*Anguilla reinhardtii*) to occur.

There are several small creeklines located in close vicinity to this dam. Small Creek is present <700m from the dam in the west while Cattai Creek is located in the east approximately 1km away.

3 Methodology for dewatering of the dam

3.1 Overview

Methodologies are provided below for the following tasks:

- Dewatering and management of water
- Collection and euthanasia of exotic and/or noxious aquatic species
- Relocation of native fauna species, such as eels, turtles and frogs.

3.2 Legislative and other requirements

Consideration must be given to the ethical treatment of fauna while dewatering the dam.

Under the Fisheries Management Act 1994 (FM Act), a Scientific Collection Permit issued under Section 37, is required to remove native fish from any waters using methods that are not legal to recreational or commercial fishers. Pest species including Carp (*Cyprinus carpioi*) and Mosquito Fish (*Gambusia holbrooki*) and any other noxious species must be destroyed in a humane manner and cannot be released into nearby waterways.

Frogs, turtles and other terrestrial fauna are protected under the *National Parks and Wildlife Act 1974* (NPW Act). Any handling of these fauna requires a scientific licence issued under Section 132C of the NPW Act.

Handling of frogs would be carried out according to the *Hygiene protocol for the control of disease in frogs* (DECC 2008). Of particular importance with frogs is reducing the risk of transfer of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) between populations or to areas free of the fungus.

3.3 Supervision of dam dewatering

3.3.1 Timing and hygiene issues

A survey would be undertaken on the evening immediately prior to dewatering of the dam by two ecologists. This would focus on relocating common frog species, preferably to the Offsite Dam 2 on the property to the west. If relocation to this dam is not possible, relocation of frog species would be to a suitable location, possibly to the nearby creek located in the public open space to the north of the site.

An ecologist would be present the following day during dewatering of the dam so that any additional common frogs or turtles are relocated to the adjacent dam. Netting for Mosquito Fish and other noxious fish would be conducted, and euthanased if found.

An inspection of the dam should be undertaken on the day after dewatering is completed to check for any additional fauna that may need management.

Prior to work on site, boots would be cleaned of excess dirt and disinfected with bleach to prevent the transfer of chytrid fungus.

It is recommended that dam dewatering occurs in winter as the dam is less likely to contain eels and breeding of frogs is less likely to be impacted.

3.3.2 Native terrestrial fauna rescue and relocation

Searches for frogs would need to be undertaken in vegetation and any debris surrounding or in the vicinity of the dam over the course of the dam being dewatered. Individual frogs are to be held in separate, plastic ziplock bags that contain some vegetation and a small amount of water. This will be kept out of sunlight and a fresh bag must be used for each individual (a 'one bag one frog policy' will apply at all times).

Given the risks associated with transfer of disease, any frogs captured must be transferred to an adjacent site, such as the wooded property to the west of the site. If frogs cannot be relocated to this area (e.g. lack of suitable habitat, access), they would need to be taken to the Frog and Tadpole Study Group (FATS) or Wildlife Information and Rescue Service (WIRES) for permanent care.

If any Green and Golden Bell Frogs (*Litoria aurea*) are identified, dewatering work at the dam would need to cease and the Office of Environment and Heritage (OEH) would need to be informed and consulted on further actions.

Turtles may be captured by hand and relocated to a nearby creek. Suitable relocation sites include Cattai Creek to the east or Smalls or Strangers Creeks to the west of the site. If being transferred to a nearby creek, a suitable lidded box must be used.

3.3.3 Native fish rescue and relocation

Long-finned Eels (*Anguilla reinhardtii*) have the potential to occur in the dam. This is a migratory species, which travels to the ocean in late summer and autumn in order to breed, and is capable of moving across land. If eels are found to be present during the dam dewatering, it is recommended that they be left overnight to move of their own accord to alternate habitat. If still present the next morning, the ecologists would net the eels and move them to the Offsite Dam 2 on the adjacent property (if possible) or a nearby creek. If moving over a large distance, a suitable lidded bucket must be used.

No other native fish are likely to be present in the dam.

3.3.4 Noxious fish capture and euthanasia

The noxious Mosquito Fish may be present in the dam, although none were recorded during the initial survey. This species is known to eat frogs' eggs and tadpoles and this predation is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Mosquito Fish are typically recorded within the top 15 cm of water bodies and are usually seen around the water's edge.

An ecologist is required to undertake dip-netting in order to remove Mosquito Fish from the dam and carry out euthanasia procedures in accordance with animal ethics requirements. Dip-netting would be conducted from the edges of the dam. There should be no entry into deep water.

Any native fauna (e.g. frogs or turtles) captured would be transferred to separate containers or immediately relocated to a nearby suitable location (see below).

Euthanasia of large numbers of noxious fish should be done using an ice slurry. For smaller numbers of fish, high concentrations of formalin clove oil or Aqui-S can be delivered into the tub containing the noxious species. This method renders the specimens fully paralysed, shortly followed by death. Recommended dose rates for finfish by Aqui-S manufacturers are 100mg/L for 40 min or 175mg/L for 20 min.

If using chemicals for euthanasia, the material safety data sheets (MSDSs) should be available for reference at the location of use and where the chemicals are stored.

Biological waste resulting from euthanasia of noxious fish and water containing clove oil or Aqui-S, must be disposed of at a licensed waste facility.

3.4 Dam dewatering protocol

3.4.1 Proposed method of dam water disposal

Water within the dam will be disposed onto adjacent grassland within the site and allowed to seep into the soil. The following dam dewatering protocol will apply:

- The dam should be progressively emptied over several days to allow terrestrial fauna to relocate.
- The residual water in the dam will be pumped out using drainage or sludge pumps or similar and disposed in the exotic grassland located within the site.
- A screen of filter mesh will surround the pump water intake with an approximate 5mm mesh size to prevent fauna entering the pipe. This intake screen will be regularly monitored during the dewatering to ensure that it is not blocked or has collapsed.
- Fauna are to be managed as per the protocol in section 3.3.

3.4.2 Sediment and erosion control

Dewatering would occur in well-grassed areas and there is minimal risk of sediment run-off into nearby watercourses as there are none in close proximity. There are no nearby waterways that are at risk of contamination as a result of the dam dewatering.

3.4.3 Infill of dam following dewatering

The dam embankments should be removed and this material used to fill the dam and reinstate the dam storage area to even grades (GHD 2017). This should be done as soon as possible following dewatering to prevent the dam from filling with water again.

Surfaces should be stabilised following infill with weed matting. Revegetation with species such as Spiny-headed Mat-rush (*Lomandra longifolia*), Blueberry Lily (*Dianella revoluta*), Knobby Club-rush (*Ficinia nodosa*), Tussock Rush (*Juncus usitatus*), Jointed Twig-rush (*Baumea articulata*), and Tussock Sedge (*Carex appressa*) should also be considered to prevent erosion.

3.5 Reporting

Following completion of activities, a short report should be prepared outlining the numbers and types of species relocated, numbers and types of species euthanased, and details of any fauna transferred to the care of WIRES.

4 References

ANZECC (2000) Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra

DECC (2008) Hygiene protocol for the control of disease in frogs. Information Circular Number 6. Department of Environment & Climate Change NSW, Sydney South.

GHDWoodhead (2017). Functional Design Brief: Kellyville North Public School.

GHD (2017). 120 Hezlett Road, Kellyville: Preliminary Hydrological/Farm Dams Assessment.

GHD (2013) Sampling Practices and Procedures Manual (updated version of Ecowise/ALS Sampling Practices and Procedures Manual)

THSC (undated). Guidelines for preparing a dam dewatering report. The Hills Shire Council.

Regards

Kirsten Crosby
Senior Ecologist

Appendix B – Dam Dewatering Assessment for Offsite Dam No 1

Memorandum

01 June 2017

To	NSW Department of Education		
Copy to			
From	Kirsten Crosby	Tel	+61 2 9239 7225
Subject	North Kellyville New Primary School: Dam Dewatering Assessment – Offsite Dam No 1	Job no.	2126108

1 Background

The NSW Department of Education proposes to construct a new public school at 120 Hezlett Road, North Kellyville, to meet predicted population growth in the area. The site consists of land used for rural purposes in an area undergoing extensive residential and community infrastructure development. It is predominantly cleared, with a house and outbuildings at the front of the property and cleared land, mostly planted trees and two dams to the rear (GHDWoodhead 2017).

A dam is located at the rear of the property, adjacent to the development site. There is no defined drainage path into the dam, so water in the storage is likely to originate from sheet runoff on the gently sloping ground to the east of the dam or from groundwater or a combination of the two. The dam appears to have been constructed by excavating within the ground and forming the dam embankments from excavated material. Although the dam is not within the school boundary, it presents a risk to the safety of school children. It was therefore recommended that the removal of the dam be negotiated with the land owner (GHD 2017).

This letter report outlines the water quality and aquatic ecology of the dam and provides recommendations for the dewatering process. This report has been prepared with reference to the *Guidelines for preparing a dam dewatering report* (The Hills Shire Council, undated).

2 Site survey

2.1 Methods

A survey of the site was conducted by two GHD staff, an environmental scientist and an ecologist, on 2 June 2017.

2.1.1 Water quality methods

Both in situ sampling and 'ex situ' sampling (collecting 'grab' samples) for laboratory analyses, were conducted. Prior to sampling, a toolbox talk and a review of the safe work method statements related to water quality sampling was undertaken. Four (4) in situ readings and samples were taken from different locations around the dam, with the samples combined into a single composite sample.

In situ measurements of water quality parameters are essential to determine site conditions that can vary dramatically, or frequently, in waterbodies. In situ monitoring was conducted from locations away from the water's edge, and in areas where water was deep.

Temperature (°C), Conductivity (µS/cm), pH (pH units), Dissolved Oxygen (mg/L and % saturation) and Turbidity (NTU units) were recorded using a calibrated Hydrolab MS5 Multiprobe Water Quality meter. Measurements were recorded and are presented below.

All sampling and preservation techniques were in accordance with the Australian Standards for water quality sampling (AS/NZS 5667.1:1998) and with standard GHD sampling protocols as defined in the GHD Water Science Sampling Practices and Procedures Manual (GHD 2006).

2.1.2 Fauna survey methods and habitat assessment

Surveys focused on assessing habitat values of the dam and any potential impacts of construction activities to species utilising the dam. The dam was assessed for connectivity to adjacent waterways, potential habitat for native species including emergent vegetation, and the presence of weeds. Opportunistic observations and active searches of fauna was undertaken around the dam and its fringing vegetation. The dam was dip-netted for exotic fish such as Mosquito Fish (*Gambusia holbrookii*) where access was possible and safe. Binoculars were used to scan adjacent fringing aquatic vegetation such as sedges and rushes for basking frogs. Aural surveys for frogs were also carried out and water birds present were identified.

2.2 Results

2.2.1 Water quality

The following tables list the Guideline limits (Table 2-1) and water quality results (Table 2-2) from the testing undertaken on the 2 June 2017. The in situ results for the dam showed high conductivity and turbidity and very low dissolved oxygen when compared to the ANZECC (2000) freshwater guidelines. Conductivity does meet the ANZECC lowland rivers guidelines (125-2200 µS/cm).

Nutrients, namely total nitrogen and total phosphorus, were high, above the ANZECC (2000) freshwater guidelines. These results are not unusual for rivers and dams in modified landscapes where there is a high level of pollution from gross pollutants and fertiliser/chemical runoff.

The only metals to exceed the ANZECC (2000) guidelines were Copper and Zinc (Table 2-3). In high concentrations, copper can damage red blood cells, reducing the oxygen carrying capacity, affect immune system function, the reproductive system, decrease growth or development and decrease survival of fish and other macroinvertebrates. Zinc is harmful to aquatic life during early life-stages. However, the concentrations recorded are unlikely to cause long term deleterious effects to downstream aquatic life.

Table 2-1 ANZECC Guidelines to be assessed against

Parameter	ANZECC Recreation Guideline	ANZECC Freshwater 95% species protection S-E Aust.
Microbiological Indicators		
Faecal Coliforms/*E. coli* (CFU/100 mL)	1000	
Enterococci (CFU/100 mL)	230	
Nutrient Indicators		
Nitrite + Nitrate (NO_x) (mg/L)		0.01
Total Kjeldahl Nitrogen (TKN) (mg/L)		
Total Nitrogen (mg/L)		0.35
Total Phosphorus (mg/L)		0.01
Physico-Chemical Indicators		
pH (pH units)	6.5 – 8.5	6.5 - 8
Electrical Conductivity (µS/cm)		20 - 30
Dissolved Oxygen (mg)	>6.5	
Dissolved Oxygen (%)	>80	90 - 110
Biological Oxygen Demand (BOD) (mg/L)		
Turbidity (NTU)		1-20
Metals Indicator		
Aluminium (mg/L)	0.2	0.055
Arsenic (mg/L)	0.05	0.013
Boron (mg/L)	1	0.37
Cadmium (mg/L)	0.005	0.0002
Chromium (mg/L)	0.05	0.001
Copper (mg/L)	1	0.0014
Lead (mg/L)	0.05	0.0034
Manganese (mg/L)	0.1	1.9
Mercury (mg/L)	0.001	0.0006
Nickel (mg/L)	0.1	0.011

Parameter	ANZECC Recreation Guideline	ANZECC Freshwater 95% species protection S-E Aust.
Selenium (mg/L)	0.01	0.011
Silver (mg/L)	0.05	0.00005
Zinc (mg/L)	5	0.008

Table 2-2 In situ water quality readings for Offsite Dam 1

Analyte	Sample 1	Sample 2	Sample 3	Sample 4	Average
Temperature (°C)	13.11	12.85	13.25	13.12	13.08
Conductivity (µS/cm)	270.5	273.1	272.4	272.9	272.23
pH (pH units)	6.96	7.32	7.4	7.46	7.285
Dissolved Oxygen (mg/L)	0.37	0.60	0.70	1.14	0.70
Dissolved Oxygen (% saturation)	3.5	5.6	6.6	10.7	6.6
Turbidity (NTU units)	68.7	81.0	199.3	92.1	110.3

* Results in yellow indicate that parameters are above the guideline value.

Table 2-3 Results from laboratory analysis for Offsite Dam 1

Analyte	Units	Guideline	Dam results
Faecal Coliforms	CFU/100mL	1000	~60
Escherichia coli	CFU/100mL	230	~60
Nitrite + Nitrate (NOx)	mg/L	0.01	<0.01
Total Kjeldahl Nitrogen	mg/L		1.5

Analyte	Units	Guideline	Dam results
Total Nitrogen	mg/L	0.35	1.5
Total Phosphorus	mg/L	0.01	0.1
Biochemical Oxygen Demand	mg/L		<2
Arsenic	mg/L	0.013	0.002
Cadmium	mg/L	0.0002	<0.0001
Chromium	mg/L	0.001	<0.001
Copper	mg/L	0.0014	0.003
Lead	mg/L	0.0034	<0.001
Nickel	mg/L	0.011	<0.001
Zinc	mg/L	0.008	0.016
Mercury	mg/L	0.0006	<0.0001

***** Results in yellow indicate that parameters are above the guideline value.

2.2.2 Ecology

The Offsite Dam 1 was of moderate size and with approximately 50 m by 40 m of open water present at the time of the survey (Photograph A). The dam contained deeply incised banks > 5m and comprising a shale and fill substrate and appeared to contain relatively deep water. The banks were heavily vegetated with exotic weeds and contained Kikuyu (*Pennisetum clandestinum*) and Blackberry (*Rubus fruticosus* subsp. *aggregate*) on its upper banks. A limited amount of native vegetation lined the dam including emergent eucalypts with Sweet Pittosporum (*Pittosporum undulatum*) present on the western and northern edges. Native fringing aquatic vegetation within the dam itself was restricted to small scattered patches of *Persicaria* sp. There were no submerged debris or stags to provide basking habitat for frogs/turtles or waterbirds.

The western edge of the dam lies adjacent to a property comprising vegetation mapped as Cumberland Plain Woodland (THSC 2008). However, this vegetation has recently been cleared and only large piles of mulch remain. Offsite Dam 2 is also present on this property (refer Photograph B).

Photograph A: Offsite dam with fringing exotic vegetation (Offsite Dam 1)

Photograph B: Recently cleared vegetation mapped as Cumberland Plain Woodland adjacent to property (showing location of Offsite Dam 2)

Five fauna species were recorded using the Offsite Dam 1 at the time of the survey, including two frog species, two bird species and one reptile species (Table 2-4). The one reptile species, the Eastern Long-necked Turtle (*Chelodina longicollis*) was observed taking in air at the water's surface.

Table 2-4 Fauna species recorded utilising the Offsite Dam 1 during the survey

Fauna group	Common name	Scientific name
Frogs	Common Eastern Froglet	*Crinia signifera*
	Eastern Dwarf Tree Frog	*Litoria fallax*
Reptiles	Eastern Snake-necked Turtle	*Chelonia longicollis*
Birds	Hardhead	*Aythya australis*
	Welcome Swallow	*Hirundo neoxema*

A range of other fauna species are likely to occur at Offsite Dam 1 on occasion. Other common frog species likely to utilise this dam include the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) and Striped Marsh Frog (*Limnodynastes peronii*). Offsite Dam 1 is unlikely to contain habitat for the Green and Golden Bell Frog (*Litoria aurea*) given the absence of suitable fringing vegetation in which to take cover and bask, however there are a few recent records (2011) of the species in the locality within 5km of the dam at Riverstone (OEH 2017). A range of waterbirds including ducks, coots and rails may also forage in Offsite Dam 1. Snakes such as the Red-bellied Black-snake (*Pseudechis porphyriacus*) are also likely to occur.

No Mosquito Fish were recorded within this dam. There is potential for the native Long-finned Eel (*Anguilla reinhardtii*) to occur.

There are several small creeklines located in close vicinity to Offsite Dam 1. Small Creek is present <700m from the dam in the west while Cattai Creek is located in the east approximately 1km away.

3 Methodology for dewatering of Offsite Dam 1

3.1 Overview

Methodologies are provided below for the following tasks:

- Dewatering and management of water
- Collection and euthanasia of exotic and/or noxious aquatic species
- Relocation of native fauna species, such as eels, turtles and frogs.

3.2 Legislative and other requirements

Consideration must be given to the ethical treatment of fauna while dewatering farm dams.

Under the Fisheries Management Act 1994 (FM Act), a Scientific Collection Permit issued under Section 37, is required to remove native fish from any waters using methods that are not legal to recreational or commercial fishers. Pest species including Carp (*Cyprinus carpioi*) and Mosquito Fish (*Gambusia holbrooki*) and any other noxious species must be destroyed in a humane manner and cannot be released into nearby waterways.

Frogs, turtles and other terrestrial fauna are protected under the *National Parks and Wildlife Act 1974* (NPW Act). Any handling of these fauna requires a scientific licence issued under Section 132C of the NPW Act.

Handling of frogs would be carried out according to the *Hygiene protocol for the control of disease in frogs* (DECC 2008). Of particular importance with frogs is reducing the risk of transfer of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) between populations or to areas free of the fungus.

3.3 Supervision of dewatering of Offsite Dam 1

3.3.1 Timing and hygiene issues

A survey would be undertaken on the evening immediately prior to dewatering of Offsite Dam 1 by two ecologists. This would focus on relocating common frogs species, preferably to the dam on the property to the rear.

An ecologist would be present the following day during dewatering of the dam to ensure any additional common frogs or turtles are relocated to the adjacent dam. Netting for Mosquito Fish and other noxious fish would be conducted, and euthansed if found.

An inspection of Offsite Dam 1 should be undertaken on the day after dewatering has been completed to check for any additional fauna that may need management.

Prior to work on site, boots would be cleaned of excess dirt and disinfected with bleach to prevent the transfer of chytrid fungus.

It is recommended that dewatering of Offsite Dam 1 occurs in winter as the dam is less likely to contain eels and breeding of frogs is less likely to be impacted.

3.3.2 Native terrestrial fauna rescue and relocation

Searches for frogs would need to be undertaken in vegetation and any debris surrounding or in the vicinity of the Offsite Dam 1 over the course of the dam being dewatered. Individual frogs are to be held in separate, plastic ziplock bags that contain some vegetation and a small amount of water. This will be kept out of sunlight and a fresh bag must be used for each individual (a ‘one bag one frog policy’ will apply at all times).

Given the risks associated with transfer of disease, any frogs captured must be transferred to an adjacent site, such as the wooded property to the west of the site. If frogs cannot be relocated to this area (e.g. lack of suitable habitat, access), they would need to be taken to the Frog and Tadpole Study Group (FATS) or Wildlife Information and Rescue Service (WIRES) for permanent care.

If any Green and Golden Bell Frogs (*Litoria aurea*) are identified, dewatering work at the Offsite Dam 1 would need to cease and the Office of Environment and Heritage (OEH) would need to be informed and consulted on further actions.

Turtles may be captured by hand and relocated to the Offsite Dam 2 at the rear of the property if possible, or a nearby creek. Suitable relocation sites include Cattai Creek to the east or Smalls or Strangers Creeks to the west of the site. If being transferred to a nearby creek, a suitable lidded box must be used.

3.3.3 Native fish rescue and relocation

Long-finned Eels (*Anguilla reinhardtii*) have the potential to occur in Offsite Dam 1. This is a migratory species, which travels to the ocean in late summer and autumn in order to breed, and is capable of moving across land. If eels are found to be present during the dam dewatering, it is recommended that they be left overnight to move of their own accord to alternate habitat. If still present the next morning, the ecologists would net the eels and move them to the Offsite Dam 2 on the property (if possible) or a nearby creek. If moving a large distance, a suitable lidded bucket must be used.

No other native fish are likely to be present in the Offsite Dam 1.

3.3.4 Noxious fish capture and euthanasia

The noxious Mosquito Fish may be present in the Offsite Dam 1, although none were recorded during the initial survey. This species is known to eat frogs' eggs and tadpoles and this predation is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Mosquito Fish are typically recorded within the top 15 cm of water bodies and are usually seen around the water's edge.

An ecologist is required to undertake dip-netting in order to remove Mosquito Fish from the dam and carry out euthanasia procedures in accordance with animal ethics requirements. Dip-netting would be conducted from the edges of the dam. There should be no entry into deep water.

Any native fauna (e.g. frogs or turtles) captured would be transferred to separate containers or immediately relocated to a nearby suitable location (see below).

Euthanasia of large numbers of noxious fish should be done using an ice slurry. For smaller numbers of fish, high concentrations of formalin clove oil or Aqui-S can be delivered into the tub containing the noxious species. This method renders the specimens fully paralysed, shortly followed by death. Recommended dose rates for finfish by Aqui-S manufacturers are 100mg/L for 40 min or 175mg/L for 20 min.

If using chemicals for euthanasia, the material safety data sheets (MSDSs) should be available for reference at the location of use and where the chemicals are stored.

Biological waste resulting from euthanasia of noxious fish and water containing clove oil or Aqui-S, must be disposed of at a licensed waste facility.

3.4 Dam dewatering protocol

3.4.1 Proposed method of water disposal from Offsite Dam 1

Water within the dam will be disposed onto adjacent grassland within the site and water left to seep into the ground. The following dam dewatering protocol will apply:

- The dam should be progressively emptied over several days to allow terrestrial fauna to relocate.
- The residual water in the dam will be pumped out using drainage or sludge pumps or similar and disposed in the exotic grassland located within the site.
- A screen of filter mesh will surround the pump water intake with an approximate 5mm mesh size to prevent fauna entering the pipe. This intake screen will be regularly monitored during the dewatering to ensure that it is not blocked or has collapsed.
- Fauna are to be managed as per the protocol in section 3.3.

3.4.2 Sediment and erosion control

Dewatering would occur in well-grassed areas and there is minimal risk of sediment run-off into nearby watercourses as there are none in close proximity. There are no nearby waterways that are at risk of contamination as a result of the dam dewatering.

3.4.3 Infill of dam following dewatering

The dam embankments should be removed and this material used to fill the dam and reinstate the dam storage area to even grades (GHD 2017). This should be done as soon as possible following dewatering to prevent the dam from filling with water again.

Surfaces should be stabilised following infill with weed matting. Revegetation with species such as Spiny-headed Mat-rush (*Lomandra longifolia*), Blueberry Lily (*Dianella revoluta*), Knobby Club-rush (*Ficinia nodosa*), Tussock Rush (*Juncus usitatus*), Jointed Twig-rush (*Baumea articulata*), and Tussock Sedge (*Carex appressa*) should also be considered to prevent erosion.

3.5 Reporting

Following completion of activities, a short report should be prepared outlining the numbers and types of species relocated, numbers and types of species euthanased, and details of any fauna transferred to the care of WIRES.

4 References

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THSC (2008). Vegetation classification mapping. https://www.thehills.nsw.gov.au/Building/Planning-Guidelines/Land-Property-Mapping/Vegetation-Classification-Mapping

THSC (undated). Guidelines for preparing a dam dewatering report. The Hills Shire Council.

Regards

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2126108-81120/G:\21\26108\6. Kellyville North PS\03 Civil\Dam Dewatering\2126108_REP_Dam Dewatering Report_BothDams.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	PAB	M Presswell	On file	M Warren	On file	
1	PAB	M Presswell		M Dean		24/8/17

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