



Murrumbidgee to Googong Aquatic Ecology Monitoring Plan

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	Name	Position	Date
Prepared by	Sally Wright	Team Leader Sustainability and Performance	6 February 2017
Reviewed by	John Hyam	Acting Team Leader Environmental Services	6 September 2017
Approved by	Benjamin Bryant	Acting Manager Environment and Sustainability	9 October 2017

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1	Marco Bottari	September 2013	Consolidation of Burra Creek Environmental Management Plan, Ecological Monitoring Sub Plan and Geomorphologic Monitoring Sub Plan.	28 Jan 14
2	Chris Pulkkinen	28 January 2015	Update to reflect findings of Ecological Monitoring Technical Review and update in response to technical review and internal audit findings.	28 Mar 15
3	Chris Pulkkinen	02 July 15	Finalised version	2 July 15
4	Sally Wright	06 Feb 17	Transfer to new Icon Water template and slight modifications.	4 May 17
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Contents

Acronyms	3
Register of changes to previous version	4
1. Introduction	5
2. Environmental Risk Assessment	6
3. Aquatic Ecology Monitoring.....	8
3.1 Environmental risk hypotheses.....	8
3.2 Monitoring during Suspension Mode	8
3.3 Sentinel Site Monitoring during Standby Mode	8
3.4 Impact Assessment Monitoring during Operating Mode	10
4. Triggers and Program Management	12
4.1 Ecological Triggers – Murrumbidgee River	12
4.2 Ecological Triggers – Burra Creek	14
5. Governance	16
5.1 Methodology	16
5.2 Reporting	16
5.3 Adaptive management.....	16
5.4 Roles and responsibilities.....	16
5.5 Compliance tracking program.....	16
Appendix A – Environmental Commitments and Approval Conditions	17

Acronyms

ACT	Australian Capital Territory
AEMP	Aquatic Ecology Monitoring Plan
AUSRIVAS	Australian River Assessment System
DA	Development Approval
DO	Dissolved Oxygen
EC	Electrical Conductivity
EIS	Environmental Impact Statement
Fe	Iron
M2G	Murrumbidgee to Googong Water Transfer
MEMP	Murrumbidgee Ecological Monitoring Program
Mn	Manganese
NRA	No Reliable Assessment
NS	Not Sampled
NSW	New South Wales
OEMP	Operational Environment Management Plan
pH	Potential of Hydrogen
SFWQMP	Stream Flow and Water Quality Monitoring Plan
TDS	Total Dissolved Oxygen
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus

Register of changes to previous version

Subject		Description of change/addition	Reference within OEMP
1.	General	<ul style="list-style-type: none"> The AEMP was transferred to the new Icon Water report template. Information was rearranged to provide a more logical flow to the Plan. Information was summarised where appropriate. 	Throughout Plan
2.	Governance framework	<ul style="list-style-type: none"> A section was created to capture the governance elements of the Plan. 	Section 5

1. Introduction

This document is known as the Aquatic Ecology Monitoring Plan (AEMP) and supports the overarching Operational Environment Management Plan (OEMP) for the Murrumbidgee to Googong Water Transfer (M2G) project.

The purpose of the AEMP is to:

- Describe the risks to the aquatic ecology arising from the operation of M2G (three distinct modes as outlined further below)
- Describe the monitoring regime required to detect whether or not the identified risks are arising
- Establish review procedures and management actions to be initiated if triggers are exceeded.

The AEMP is closely linked to the Stream Flow and Water Quality Monitoring Plan (SFWQMP).

The monitoring specified within this plan supplies important information to Icon Water regarding observed performance compared to environmental and operational standards or triggers and is a key part of the adaptive management process.

2. Environmental Risk Assessment

This AEMP identifies the data required to determine whether or not aquatic ecological risks are occurring or need further control. The risks are identified according to the three distinct operational modes outlined in the OEMP (suspension, standby and operation).

The risks were identified from both a pre-mitigation perspective and against the mitigated scenario, once Icon Water's management measures were in place. The risks were agreed upon by a range of Icon Water representatives and external stakeholders including the Commonwealth Government, ACT Government and research institutions, in response to the Commonwealth Conditions of Approval. Representatives were also invited to assist in the design of appropriate ecological monitoring to determine whether or not the identified risks were occurring.

The risks and general monitoring responses (shown below in **Table 1**) were modified in 2014 following an independent scientific review.

Environmental risks under a 'suspension' scenario are not listed as these were considered in the process and deemed as nil.

Table 1: Potential environmental risks arising from M2G operation phases

Operational component	Potential impact	Unmitigated ecological consequence of impact	Operational mitigation	Residual Impact			Monitoring regime/response		
				Standby	Full Pump	Full Pump (drought flows)	Standby	Full Pump	Full Pump (drought flows)
Transfer of water from Murrumbidgee River to Burra Creek	Transferral of fish eggs to Burra Creek	Potential to introduce non-native fish species (Carp, Oriental Weatherloach) to new catchment.	Fine screen (0.5 mm) at Angle Crossing Pump station preventing fish egg transfer to Burra Creek. Maintenance and inspection of fish screens.	Very Low Mitigation measures designed for transfer of 100 ML/d. Short duration, lower volume maintenance flows less likely to transfer eggs.	Low Mitigation measures designed for 100 ML/d	Low Mitigation measures designed for 100 ML/d	Carp egg/larval monitoring at Angle Crossing and in the discharge in Burra Creek once every four years during a pumping operation in spring (Carp spawning season). Angling reports if available and opportunistic sighting of Carp and/or Oriental Weatherloach in the Googong Reservoir.		
	Increased sediment transfer to Burra Creek	Potential to reduce habitat quality for fish and macro-invertebrates (e.g. by smothering physical habitat) Sediment may also transport other contaminants, such as nutrients.	Turbidity concentration rules controlling M2G transfer (as per the SFWQMP). Fine screen (0.5 mm) at Angle Crossing Pump station preventing transfer of coarse sediment.	Very Low Mitigation measures effective at maintenance flows. Short duration, lower volume flows unlikely to cause significant sediment transfer.	Low Mitigation measures effective at full pump flows.	Low - Medium Mitigation measures effective at full pump flows.	Online turbidity concentration measurements taken upstream of M2G intake in the Murrumbidgee River and in Burra Creek downstream of the discharge location during operation. Sentinel site macroinvertebrate monitoring every 3 years (in autumn and spring). No on-going periphyton monitoring recommended.	Online turbidity concentration measurements taken upstream of M2G intake in the Murrumbidgee River and in Burra Creek downstream of the discharge location during operation. Sites should be sampled for macroinvertebrates in the autumn and spring prior to operations commencing (provided advanced warning) to confirm that macroinvertebrate communities are still consistent with broad catchment conditions based on sentinel site monitoring. If this is not possible and less notice is given, sampling should at least occur in one season prior to operations commencing, or as soon as a decision is made to operate. Sampling should also be undertaken in the autumn and spring following the cessation of pumping, or in the same season as prior to pumping if only one season was sampled. If pumping continues over autumn or spring, sampling should be undertaken during pumping. Before and after visual assessment of habitat quality (periphyton and sediment) in line with macroinvertebrate monitoring and every 4 weeks if pumping operations are on-going.	
	Release of captured sediment at Angle Crossing back into the Murrumbidgee River	Potential to reduce habitat quality for fish and macro-invertebrates (e.g. by smothering physical habitat) and physically damaging individuals (i.e. scouring of fish gills).	Release of captured sediment back into the Murrumbidgee River in a slow controlled manner. Turbidity concentration rules controlling M2G transfer (as per the SFWQMP).	Very Low Mitigation measures designed for transfer of 100 ML/d. Short duration, lower volume abstraction unlikely to capture much sediment at Angle Crossing for release back into the Murrumbidgee River.	Low Mitigation measures designed for 100 ML/d	Low Mitigation measures designed for 100 ML/d	Online turbidity concentration measurements taken upstream of M2G intake and downstream in the Murrumbidgee River. Sentinel site macroinvertebrate monitoring every 3 years (in autumn and spring). No on-going periphyton monitoring recommended.	Online turbidity concentration measurements taken upstream of M2G intake and downstream in the Murrumbidgee River. Sites should be sampled for macroinvertebrates in the autumn and spring prior to operations commencing (provided advanced warning) to confirm that macroinvertebrate communities are still consistent with broad catchment conditions based on sentinel site monitoring. If this is not possible and less notice is given, sampling should at least occur in one season prior to operations commencing, or as soon as a decision is made to operate. Sampling should also be undertaken in the autumn and spring following the cessation of pumping, or in the same season as prior to pumping if only one season was sampled. If pumping continues over autumn or spring, sampling should be undertaken during pumping. Before and after visual assessment of habitat quality (periphyton and sediment) in line with macroinvertebrate monitoring and every 4 weeks if pumping operations are on-going.	

3. Aquatic Ecology Monitoring

3.1 Environmental risk hypotheses

The M2G aquatic ecological monitoring method is underpinned by the risks (against the different operating scenarios) and the correlating test criteria or hypotheses described below.

1. Flow abstraction in the Murrumbidgee River will not result in the deterioration of the **macroinvertebrate** community (measured using biological indices) at sites downstream of the abstraction point (Angle Crossing) relative to sites upstream, informed by prevailing conditions in the broader region.
2. Flow discharge to Burra Creek will not result in the deterioration of the **macroinvertebrate** community (measured using biological indices) at sites downstream of the inflow point relative to sites upstream, informed by prevailing conditions in the broader region.
3. Flow abstraction in the Murrumbidgee River will not result in the development of increased **periphyton** to the extent it impacts on quality of riffle habitat at sites downstream of the abstraction point (Angle Crossing) compared to sites upstream of the abstraction point, and informed by prevailing conditions in the broader region.
4. Flow discharge to Burra Creek will not result in the development of increased **periphyton** to the extent it impacts on quality of riffle habitat at sites downstream of the inflow point compared with sites upstream of the inflow point and informed by prevailing conditions in the broader region.
5. Flow discharge to Burra Creek will not result in **bank erosion** that is beyond that currently occurring in response to natural high flow events.
6. Flow discharge to Burra Creek will not result in changes in **macrophyte or riparian vegetation** (including weed species) that is beyond that currently occurring in response to natural high flow events.
7. Flow abstraction in the Murrumbidgee River will not result in an increased threat to **threatened cod species** due to decreased pool mixing and consequent water quality impacts.
8. Flow discharge to Burra Creek will not result in the introduction of **Carp or Oriental Weatherloach** populations (via transfer) in Burra Creek or native fish stranding on drawdown.

The hypotheses are to be tested using the parameters and general methods described in Section 3.2 for suspension mode, Section 3.3 for standby mode and Section 3.4 for operational mode. These are generalised methods only and the specific methodology is negotiated between Icon Water and the service provider to ensure safe working conditions; safe access; and taking into account physical site limitations.

3.2 Monitoring during Suspension Mode

The risks to the environment when M2G is in 'Suspension' mode are negligible. Hence, monitoring is not required until transition back to Standby or Operating modes.

Sentinel monitoring will be undertaken for two sequential seasons (spring and autumn) ahead of any planned transition back to Standby or Operating modes.

3.3 Sentinel Site Monitoring during Standby Mode

The risks to the environment when M2G is in 'standby' mode are very low (see **Figure 1**). Hence, testing of hypotheses and targeted monitoring is not required. Icon Water still needs to understand if major

catchment-scale aquatic ecology changes are taking place. Therefore, a subset of the monitoring sites, which will be identified as sentinel sites, will be monitored on an ongoing basis shown in **Figure 1**.

The sentinel sites will be monitored (both autumn and spring), at least every 3 years, using the parameters shown in **Table 2**. It should be noted that a detailed baseline has already been established by the initial monitoring program undertaken by Icon Water (2008-2014).

Figure 1 - Concept design of M2G monitoring sites

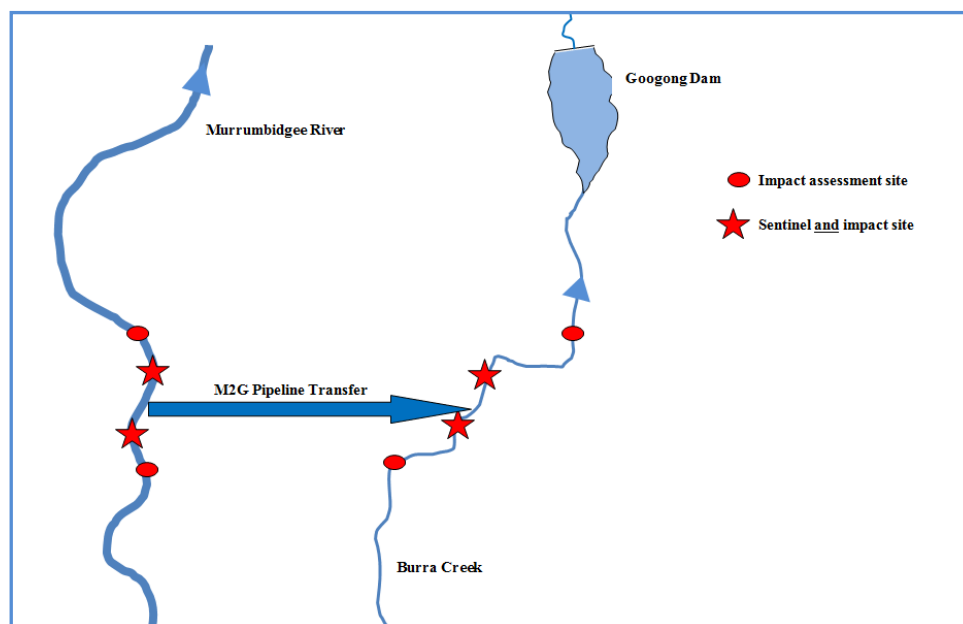


Table 2: M2G sentinel site monitoring parameters during Standby Mode

PARAMETER	METHOD*	SITES
Water quality (online)	Online collection of DO, temperature, pH, EC and turbidity.	2 Murrumbidgee sites (upstream and downstream of discharge) 1 'in -system' sensor 1 Burra Creek site (downstream of discharge)
Water quality (grab sample)	Grab sample collection of TDS, Fe, Mn, nutrients (TKN, TN, TP), pathogens (E.coli) and pesticides.	Every 3 months in line with operational monitoring locations.
Macroinvertebrates	AUSRIVAS assessment techniques. 3 within-site replicates where possible (considering site constraints). 3 sub-samples per site (considering site constraints).	2 Murrumbidgee sites (subset of impact monitoring sites) 2 Burra Creek sites (subset of impact monitoring sites)
Periphyton	Nil.	N/A
Geomorphology	Photo points at key hotspot sites every two years.	(same as impact monitoring sites)
Riparian vegetation (including weeds)	Photo points at key riparian edge movement sites every two years.	(same as impact monitoring sites)
Fish	As per ACT Government Biennial Fish Surveillance Program.	9 Murrumbidgee sites

Table 3 shows an example of a monitoring scenario when M2G is in standby mode for a period of 7 years requiring sentinel monitoring only.

Table 3: M2G sentinel mode monitoring example

YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7
STANDBY	STANDBY	STANDBY	STANDBY	STANDBY	STANDBY	STANDBY
Autumn & Spring Sentinel monitoring	No monitoring	No monitoring	Autumn & Spring Sentinel monitoring	No monitoring	No monitoring	Autumn & Spring Sentinel monitoring

3.4 Impact Assessment Monitoring during Operating Mode

Impact assessment monitoring, shown in **Table 4**, is triggered by the decision to ‘operate’ M2G. Ideally, there will be adequate lead time for the decision to operate to allow a spring and autumn sample prior to, during and following the operation of M2G, but this may not always be possible.

Table 4: M2G impact assessment monitoring parameters during operating mode

PARAMETER	METHOD	SITES
Water quality (online)	Online collection of DO, temperature, pH, EC and turbidity.	2 Murrumbidgee sites (upstream and downstream of discharge) 1 ‘in –system’ sensor 1 Burra Creek site (downstream of discharge)
Water quality (grab sample)	Grab sample collection of TDS, Fe, Mn, nutrients (TKN, TN, TP), pathogens (E.coli) and pesticides.	Every 3 months in line with operational monitoring locations.
Macroinvertebrates	AUSRIVAS assessment techniques. 3 within-site replicates where possible (considering site constraints). 3 sub-samples per site (considering site constraints).	4 Murrumbidgee sites 4 Burra Creek sites
Periphyton	A before and after pumping visual assessment using photo points to compare the extent of periphyton cover as a measure of riffle habitat quality . Every four weeks (approx.) should pumping still be occurring.	4 Murrumbidgee sites 4 Burra Creek sites Site locations correspond to AUSRIVAS sites.
Geomorphology	Before and after pumping visual assessment using photo points to compare the extent of any large-scale channel erosion. These will be captured before and after pumping. Full transect surveys will be undertaken if significant erosion is noted from the visual assessments.	Identified erosion hotspot sites downstream of discharge structure.

Riparian vegetation (including weeds)	<p>Before and after pumping visual assessment using photo points to compare any gross-scale changes in riparian edge vegetation movement.</p> <p>In addition, 100m transect surveys will be undertaken prior to, and after pumping, to determine if there is evidence of a gross change in extent, composition or abundance of native and invasive species within the inundation zone.</p>	Key riparian edge movement sites below discharge location.
Fish	As per ACT Government Biennial Fish Surveillance Program.	9 Murrumbidgee sites.

Table 5 shows an example of an operating scenario occurring in ‘Year 4’ which requires a combination of sentinel monitoring for the standby periods and impact monitoring (autumn and spring) before, during and after full pumping.

Table 5: M2G sentinel and impact mode monitoring example

YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8
STANDBY	STANDBY	STANDBY (preparing to operate following year)	M2G OPERATES	STANDBY (year following operation)	STANDBY	STANDBY	STANDBY
Autumn & Spring Sentinel monitoring	No monitoring	Autumn & Spring (pre) Impact monitoring	Autumn & Spring Impact monitoring	Autumn & Spring (post) Impact monitoring	No monitoring	No monitoring	Autumn & Spring Sentinel monitoring

4. Triggers and Program Management

4.1 Ecological Triggers – Murrumbidgee River

Assessments by Icon Water of the aquatic ecology along the upper Murrumbidgee River commenced in 2008 in preparation for assessing potential impacts of the M2G. The ACT AUSRIVAS assessment has produced condition assessments for various locations upstream and downstream of the Angle Crossing abstraction point.

Table 6 provides the Murrumbidgee AUSRIVAS Band Levels during the initial monitoring program. For more detail and information refer to the individual Murrumbidgee Ecological Monitoring Program (MEMP) spring and autumn reports publically available on the Icon Water website.

Triggers for the aquatic ecology in the Murrumbidgee River are difficult to define since the natural flow change variability will be much higher than the M2G water abstraction rate. The initial AUSRIVAS monitoring has shown that the sites in the immediate proximity of the Angle Crossing abstraction point are generally BAND B meaning that some of the taxa expected to occur at these sites are missing compared to reference data.

Based on these data, the trigger level for Murrumbidgee aquatic ecology shall be where the Impact Monitoring sites below Angle Crossing are below BAND B and where the upstream Impact Monitoring sites are BAND B or above. This type of monitoring result will initiate a review to ascertain the cause of the change. Such a change may occur from seasonal variation; as a result of M2G abstraction; or as a result of another influencing factor or a combination of factors.

Should the cause be related to natural or upstream changes (unrelated to the M2G) then the monitoring shall continue or be adjusted to obtain better information to see if the results indicate a specific baseline condition change.

Should the cause be related to the M2G, Icon Water will develop appropriate management and mitigation measures.

In the event that deviations from the trigger levels cannot be determined from the available data, or prolonged impacts are likely, the proposed options for mitigation will be referred to an expert panel.

Table 6: Murrumbidgee AUSRIVAS riffle and edge assessments

Site	Site code	Location	Spring 2008		Autumn 2009		Spring 2009		Autumn 2010		Spring 2010		Autumn 2011		Spring 2011		Autumn 2012		Spring 2012		Autumn 2013	
		Upstream	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge
1	MUR15	~30 km U/S of Angle Crossing near Colinton;	NS	NS	B	B	NRA*	B	B	B	A	NRA*	A	B	A	A	B	B	A	A	A	A
2	MUR16	Just U/S Angle Crossing	NS	NS	B	B	B	B	A	B	A	C	A	B	A	A	B	B	B	A	A	B
3	MUR18	~500m above abstraction site	NS	NS	B	B	B	B	B	B	B	NRA*	B	A	B	B	B	B	B	A	B	A
4	MUR19	D/S Angle Crossing; directly below causeway	A	A	B	B	B	B	B	B	B	C	A	A	A	A	B	B	B	A	A	A
5	MUR23	D/S Angle Crossing; at Point Hut;	A	A	B	C	B	B	B	B	A	B	B	B	A	A	B	B	A	A	A	A
6	MUR28	~33km D/S Angle Crossing; U/S Cotter River confluence;	A	B	B	B	B	B	B	B	NS	NS	A	B	B	B	B	B	B	B	A	A

NRA* - No Reliable Assessment due to the high variability obtained in the site replicates

NS – Not sampled due to high or no flow

Table 7: Burra AUSRIVAS riffle and edge assessments

Site	Site code	Location	Autumn 2009		Spring 2009		Autumn 2010		Spring 2010		Autumn 2011		Spring 2011		Autumn 2012		Spring 2012		Autumn 2013	
			Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge	Riffle	Edge
1	BUR1	Burra Creek U/S of Cassidy Creek confluence	NS	NS	NS	A	C	B	B	B	B	B	A	B	C	B	B	A	NS	NS
2	BUR1c	Burra Creek ~300m U/S Discharge Point	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	C	A	B	B	B	A	B	B
3	BUR2a*	Burra Creek D/S Williamsdale Rd	NS	NS	NS	B	NS	B	NS	B	C	B	A	NRA*	B	A	A	A	B	B
4	BUR2b*	Burra Creek D/S Burra Road bridge	NS	NS	NS	C	NS	B	NS	B	B	B	B	A	C	B	B	B	B	B
5	BUR2c*	Burra Creek ~100m U/S London Bridge arch	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	B	A	B	B	A	A	A	A
6	BUR3*	Burra Creek D/S London Bridge arch	NS	NS	B	B	B	B	B	A	NS	B	NS	NS	NS	NS	NS	NS	NS	NS
7	QBN1	Queanbeyan River ~ 3km U/S Burra Creek confluence.	B	A	B	A	B	B	B	B	B	B	A	A	B	A	A	X	B	B
8	QBN2*	Queanbeyan River ~1km D/S Burra Creek confluence.	C	B	B	B	B	B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
9	CAS1	Cassidy Creek U/S Burra Creek confluence	NS	NS	NS	B	NS	B	NS	B	NS	B	NS	NS	NS	NS	NS	NS	NS	NS

* Sites impacted by the M2G discharge. Other sites are used as Control sites. QBYN 2 may not be a viable location as Googong Reservoir fills. When Googong exceeds 80% storage the confluence with Burra Creek becomes inundated.

NRA* - No Reliable Assessment due to the high variability obtained in the site replicates.

NS – Not sampled due to high or no flow.

Note: If the AUSRIVAS Band for Riffle and Edge differ then the Band used for the site is taken as the lower assessment of the two.

4.2 Ecological Triggers – Burra Creek

4.2.1 Aquatic Ecology

Assessments by Icon Water of the aquatic ecology within Burra Creek commenced in autumn 2009 to provide baseline information in preparation for assessing potential impacts of discharge water from the M2G pipeline. The ACT AUSRIVAS assessment has produced health assessments for various locations upstream and downstream of the proposed abstraction point. **Table 7** provides the Burra AUSRIVAS Band Levels. For more detail and information refer to the individual MEMP spring and autumn reports.

Triggers for the aquatic ecology in Burra Creek are difficult to define due to the significant variability in ecological condition (as defined by AUSRIVAS), including times at which sites are unable to be sampled due to lack of water. Based on this data, the trigger level for investigating Burra Creek aquatic ecology is where there is an observed degraded AUSRIVAS band level downstream of the monitoring sites compared with the upstream sites.

Should the cause be related to natural or upstream changes (unrelated to the M2G) then the monitoring shall continue or be adjusted to obtain better information to see if the results indicate a specific baseline condition change.

Should the cause be related to the M2G, Icon Water will develop appropriate management and mitigation measures.

In the event that deviations from the trigger levels cannot be determined from the available data, or prolonged impacts are likely, the proposed options for mitigation will be referred to an expert panel.

4.2.2 Geomorphology

There is significant natural geomorphological change occurring in Burra Creek, particularly in response to the sudden and large flows created via flood events. Assessment of the potential geomorphological impacts below the discharge at Burra Creek is identified from photo point comparisons over time. Trigger levels are qualitative only, and relate to the extent of change in indicators such as bank slump and scour after prolonged M2G operation. Should noticeable change to bank stability be identified in the photo point comparisons (taken at the identified erosion hotspots), Icon Water will develop appropriate management and mitigation measures. Note that London Bridge will continue to be monitored as an erosion hotspot, due to its cultural significance (as opposed to its perceived susceptibility to erosion).

4.2.3 Fish

There are currently no known native fish populations in Burra Creek in the M2G discharge locality. There are currently no known carp populations in Burra Creek or the Googong Reservoir.

The fish eggs screens at the abstraction point will be maintained and operated as per manufacturer's recommendations (or as per Icon Water updated procedures).

The trigger levels for initiating management of fish species in collaboration with regulators are (i) the existence of native fish population(s) in Burra Creek below the discharge location; and (ii) the existence of a developing carp population in the Googong Reservoir.

4.2.4 Vegetation and Weeds

Changes in Burra Creek flows could lead to changes in plant species composition and change the dominance of some species over others, and thus, a reduction in flora diversity. Flows in Burra Creek change in response to rainfall events, which, in terms of change to flow volume, generally far exceed the volumes transferred via M2G. Most of the riparian vegetation along the length of Burra Creek is out of the

impact area from M2G. Only the vegetation which is close to the channel could be affected by prolonged operation.

Flora assessments undertaken in Burra Creek (M2G Vegetation Assessment 2014) identified all sites as being in poor to moderate condition. The level of introduced species at the Burra Creek sites is high, as expected, considering the impacts from the agricultural land and stock access to the creek in areas of the upper catchment. Even though the lower catchment area within the Googong Foreshores is free of grazing stock, the weeds still dominate the creek channel, and are likely a result of historical agricultural activities and the spread of seeds from upstream.

5. Governance

5.1 Methodology

All monitoring work will be undertaken in accordance with accepted scientific methodology. The monitoring program will be independently reviewed periodically to ensure the methodology remains relevant and effective.

5.2 Reporting

The data collected for this AEMP will be integrated into a Technical Report for every monitoring event. The technical reports will include any correlated impacts of water abstraction and other catchment conditions and activities, and any significant emerging short and long term trends.

The technical reports will be available to the public and regulators via www.iconwater.com.au.

5.3 Adaptive management

This monitoring program is designed to be adaptive. Results arising from the AEMP monitoring program will be reviewed to identify any significant impacts in Murrumbidgee River and Burra Creek.

Material changes to the identified risks and corresponding hypotheses will require approval from the relevant regulatory agencies prior to implementation.

5.4 Roles and responsibilities

The roles and responsibilities relating to this plan can be found in the OEMP.

5.5 Compliance tracking program

The compliance tracking program and auditing requirements that relate to this plan can be found in the OEMP.

Appendix A – Environmental Commitments and Approval Conditions

Table A1: EIS Commitments (taken from Table 28.1, Ch 28, EIS)

Table 28.1 ref	Operational Commitment	Reference
2	Regular review of geomorphologic monitoring results for any trends toward significant impacts in Murrumbidgee River, Burra Creek or Googong Reservoir. The monitoring and adaptive management plan will include actions required to address any identified trends in a timely manner.	AEMP
11*	Maintenance of flow transfers where possible during the fish breeding season to protect any spawning populations of threatened fish species (if present). If flows need be altered, then the step up/down operating regime in the relevant OEMP subplan will be utilised to allow fish to exit the creek. *amended commitment based on Consistency Review by NGH Environmental (October 13)	AEMP
13	Regular review of the results of the aquatic monitoring program and the development of management actions that may be required to address any observed impacts.	AEMP
14*	Design measures into the scheme, to prevent the spread of invasive fish species including: <ul style="list-style-type: none"> • 0.5 mm aperture mesh on intake screen to prevent transfer of fish and eggs; • Provide continuous filtering of transfer flows at the outlet into Burra Creek; and • Use filters year round, rather than only during the spawning season. • *amended commitment based on Consistency Review by NGH Environmental (October 13) 	AEMP
16	Regular review of aquatic ecology monitoring results for any trends toward significant impacts in Murrumbidgee River, Burra Creek or Googong Reservoir. The monitoring and adaptive management plan will include actions required to address any identified trends in a timely manner.	AEMP
26	Impacts to the London Bridge karst formations and sites along Burra Creek will be undertaken as part of the on-going monitoring and adaptive management work that the proponent will undertake.	AEMP

Table A2: Part 3A Planning Approval Conditions (NSW)

Project Aspect	Commitment	Reference
2.1	The Proponent shall comply with section 120 of the Protection of the Environment Operations Act 1997 which prohibits the pollution of waters.	SFWQMP
2.3	The Proponent shall design, construct, operate and maintain the project to avoid impacts on bank stability within the Burra Creek riverine corridor.	AEMP
2.4	The Proponent shall not transfer water when Burra Creek is in flood based on a one in two year event or greater nor should the Proponent operate the pipeline where it results in water levels in Burra Creek being greater than the one in two year flood level.	SFWQMP
2.11	The Proponent shall implement the aquatic ecology management measures committed to in the documents set out in condition 1.1c) or elsewhere in these conditions of approval, including; a) monitoring and subsequent maintenance of flow transfer volumes to reasonably and feasibly mimic the natural flow regime based on the stochastic data refined in the Preferred Project Report of Burra Creek during the native fish breeding season in order to protect any spawning populations of threatened fish species; b) design measures to prevent the spread of invasive fish species; c) design measures for the protection of natural ponding habitat. If the current natural ponds along Burra Creek are lost as a result of increased flows, the Proponent is required to re-establish natural ponding habitat and d) regular review of aquatic ecology monitoring results for any trends toward significant impacts in Burra Creek or Googong Reservoir.	AEMP
3.3	Prior to the commencement of construction, the Proponent shall prepare and implement an Ecological Monitoring Program to monitor the impact of the project on the ecology that may be impacted by the proposal. The program shall be developed in consultation with the DECCW and Department of Industry and Investment NSW and shall include but not necessarily be limited to: a) set out monitoring requirements as detailed in the documents referred to in condition 1.1 c), in order to assess the impact of the project on Ecology present along the easement and at Burra Creek at the pipeline outlet location and downstream including the Googong Reservoir; b) baseline monitoring prior to the introduction of flows through Burra Creek in order to establish any ecological changes resulting from the project. d) provisions for monitoring during construction, operational and non-operational phases; e) mechanisms for immediately investigating any anomalous monitoring results; f) mechanisms for the management and mitigation of any impacts on the waterways including cessation of flows where necessary; and g) details of how the monitoring results will be reported to the Director-	AEMP, SFWQMP

	General and the DECCW and the Department Industry and Investment NSW.	
3.1	<p>Prior to the commencement of construction the Proponent shall prepare and implement a Geomorphologic Monitoring Program to monitor the impact of the project on the present morphology of Burra Creek at the pipeline outlet location and downstream to Googong Reservoir. The Program shall be developed in consultation with the DECCW and shall include but not necessarily be limited to:</p> <ul style="list-style-type: none"> a) Set out monitoring requirements in order to assess the impact of the project on the present geo-morphology of Burra Creek at the pipeline outlet location and downstream to Googong Reservoir. b) Baseline monitoring prior to the introduction of flows through Burra Creek in order to establish any geomorphologic changes resulting from the project. c) Provisions for monitoring during construction, operational and non-operational phases; d) Mechanisms for immediately investigating any anomalous monitoring results; e) Mechanisms for the management and mitigation of any impacts on the waterways including cessation of flows where necessary; and f) Details of how the monitoring results will be reported to the Director-General and the DECCW. 	OEMP, AEMP

Table A3: M2G DA Conditions (ACT)

Project Aspect	Condition	Reference
E20	<p>The licence to extract water will be in keeping with environmental flow guidelines. This commitment was made by the proponent during the preparation of the EIS. The condition must take into account the effects of extraction on, and by, downstream users. It should also consider any new information which may be forthcoming as a result of ecological investigations that may be used to maintain or enhance the ecological values of the Murrumbidgee River in an adaptive management forum.</p>	SFWQMP

Table A4: Commonwealth Conditions of Approval

Project Aspect	Commitment	Reference
4	<p>The person taking the action must submit a Burra Creek Environmental Management Plan to the Minister for Approval that establishes a statistically valid ecological monitoring program to detect and manage any environmental harm to the ecological elements of Burra Creek or increase in the weeds problem in Burra Creek. The plan must include:</p> <ul style="list-style-type: none"> a) Indicators, parameters and criteria to be used in measuring changes in the aquatic and riparian ecological elements of Burra 	AEMP, SFWQMP

	<p>Creek;</p> <ul style="list-style-type: none"> b) Criteria to be used in measuring the diversity, distribution, abundance or density of weeds along the banks of Burra Creek; c) Protocols for on-going reporting of adverse changes to the ecological elements of Burra Creek, or an increase in the diversity, distribution, abundance or density of weeds along the banks of Burra Creek; d) The proposed location of monitoring sites; and e) Management triggers and actions. <p>The approved plan must be implemented.</p> <p>*The Burra Creek Environmental Management Plan was incorporated into the Streamflow and Water Quality Management Plan and the Aquatic Ecology Management Plan as approved by all relevant regulators in 2014.</p>	
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