Bulk Water Alliance

Murrumbidgee to Googong (M2G) CO2 Dosing System at Mini-Hydro Infrastructure

Consistency Assessment of Impact

September 2011

securing **water** for life

Certificate of approval for issue of documents

Document number

Title	Murrumbidgee to Googong (M2G) CO2 Dosing System at Mini-Hydro Infrastructure
Document status	Proposed Final
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	Position	Name	Signature	Date
Prepared by	BWA	Pieter van der Walt	Pieter van der Walt Digitally signed by Pieter van der Walt DN: cn=Pieter van der Walt, o=CB Richard Ellis, ou=Town Planning, email=pieter.vanderwalt@cbre.com.au, c=AU Date: 2011.12.08 12:29:02 +11'00'	7/12/2011
Reviewed by	M2G Owner's Representative	Simon Webber		8/Dec/2011
Approved by	M2G Project Manager	Jason Julius		8/12/2011

Contents

1 Introduction

1.1 Background

The Murrumbidgee to Googong Water Transfer is one of the recommended options for delivering improved security to the water supply for the ACT and Region. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to Burra Creek (in NSW), from where it will flow for approximately 13.2 km to the Googong Reservoir.

The Murrumbidgee to Googong Water Transfer is located within the ACT and NSW and impacts on Commonwealth owned land.

In order to secure NSW Planning consent a Preferred Project Report (PPR) was completed for the Murrumbidgee to Googong Water Transfer (the Project) in December 2009. Following review of the PPR, the NSW Department of Planning (DoP) conditionally approved the proposal.

Since receiving Planning Approval the proponent has continued detail design and optimisation of the scheme. These processes included a review of the pipeline materials that will be used and the inherent performance and use characteristics there-off.

In finalising the pipeline materials the proponent has become aware of a potential matter relating to the pipeline materials proposed. This problem relates to the leaching of soluble aluminium and hydroxide (OH-) ions from the pipe linings, particularly after extended shutdown periods, with an associated result in a pH rise in water stored in the pipeline. The proponent wishes to construct CO2 dosing infrastructure near the outlet structure that will be used to correct any pH changes that may occur as a result of the pipeline materials used. The CO2 dosing infrastructure was not specifically mentioned in the Preferred Project Report (PPR) that was prepared for the Murrumbidgee to Googong Water Transfer. This assessment has been prepared to allow a consistency assessment to be undertaken by the Independent Auditor for the project, to confirm that the proposed work is consistent with the initial assessment and Project approval that was received in 2010.

1.2 Materials review and problem

The use of cement linings is associated with leaching of substances into the water that is being transferred, and specifically the leaching of hydroxide ions, which result in the rise of the pH in the potable water in the pipe in Ordinary Portland Cement (OPC) lined piping, and soluble aluminium from High Alumina Cement (HAC) mortar lining.

Leaching is generally exacerbated in circumstances where the water in contact with the lining is of low alkalinity (i.e. soft water such as Murrumbidgee water) and particularly in pipelines with low flow rates and particularly in pipes with stagnant water. Leaching of hydroxide ions also results in a loss of the cement lining in the pipe over time (i.e. a loss of corrosion protection over time and asset life reduction).

Testing conducted by the BWA on the impacts of OPC and HAC cement lining of both MSCL and DICL pipes showed that seal coating of these pipes would have had no major difference to elevated pH levels after being subjected to inundation by water. It was, therefore, concluded that seal coating of the DICL or MSCL pipes would not be undertaken due to this small difference in pH level and the manufacturer of the DICL pipe could not guarantee the effectiveness of the internal pipe coating as:

- the seal coat will not provide the expected service life as experienced on OPC lining; and

- the seal coat may delaminate from HAC mortar resulting in stranding of the coating impacting on the operation of the mini-hydro.

Two possible water quality impacts have been identified from the M2G pipeline lining materials:

- Leaching of soluble aluminium (Al) from the HAC lining of the DICL pipe; and
- pH rise in water in the pipeline due to the leaching of hydroxide (OH-) ions from the OPC and HAC linings, particularly after extended shutdown periods (i.e. one month or longer).

Leaching of aluminium from the HAC lining

The leaching of aluminium from the HAC lining of the pipeline is anticipated based on the low alkalinity of water in the Murrumbidgee River, particularly in the early years of pipeline operation. This conclusion is supported by information from the US EPA paper "*Permeation and Leaching*" which states that:

> "*Aggressive, soft, and poorly buffered (i.e. low alkalinity) water promote aluminium leaching from cementitious materials".*

A pH rise in water stored in the pipeline

The leaching of hydroxide (OH-) ions from the OPC and HAC linings, particularly after extended shutdown periods (i.e. one month or longer) is anticipated to result in a pH rise in water stored in the pipeline for extended periods.

Testing of the potential pH increase in water in contact with uncoated HAC pipe lining has been undertaken by the BWA and shows that a likely pH rise of circa 1 – 2 pH units for water stored in the pipeline for a period in excess of 72 hours may be experienced.

The likely change in pH and leaching of soluble aluminium may, if uncontrolled, impact on the water quality and habitat values of the aquatic environs of Burra Creek. The NSW project approval at condition 2.1 requires:

> ***Condition 2.1:*** *The Proponent shall comply with section 120 of the Protection of the Environment Operations Act 1997 which prohibits the pollution of waters.*

The likely leaching, as well as the potential impacts on the project's performance against Condition 2.1, warrant consideration.

The BWA investigated these risks and found that the expected aluminium concentrations in the discharged water are likely to be similar to or lower than those experienced naturally in Burra Creek and hence pose no ecological risk to Burra Creek.

Impacts of pH changes may be more severe and require management. The proponent is proposing the construction of carbon dioxide (CO_2) dosing infrastructure as part of the mini hydro facility, which will operate to correct the pH of water at the downstream side of the mini hydro, prior to release in Burra Creek.

1.3 Make-up of the pipeline

The M2G pipeline upon construction will comprise 690 m of DN1000 mild steel cement lined (MSCL) pipe and 11,600 m of DN1000 ductile iron cement lined (DICL) pipe. All pipeline fittings on the DICL section are epoxy lined.

All MSCL piping is OPC lined and 'seal *coated*' which is the industry standard for MSCL pipelines with OPC lining and will reduce opportunities for leaching to occur.

The DN1000 DICL pipe for the M2G will have an alumina cement (HAC) mortar lining as decided in January 2011 at the time of ordering pipe. It is not proposed to seal coat the DICL pipe.

2 The Project

2.1 The Approved Scheme

The Murrumbidgee to Googong Water Transfer was approved by the NSW Planning Minister on 31 March 2010. The approved project included circa 12km of transfer pipeline with operating infrastructure (air and scour valves and vents), a mini-hydro facility and a discharge structure on Burra Creek in the vicinity of the intersection between Williamsdale and Burra Roads near the township of Burra.

The PPR described the mini-hydro facility and discharge infrastructure as follows:

Mini-hydro power generator

The mini-hydro power generator will be located near the outlet structure within the pipeline construction corridor away from the immediate environs of the Burra Creek bank to minimise local impacts and to protect the infrastructure from flooding.

The power will be transferred to the high lift pump station via an underground cable in the same trench as the water transfer pipeline.

The mini-hydro power generator will have a footprint of approximately 30 m x 25 m, however the majority of this facility will be located underground and will not be visible. Earth mounds will be constructed against the structure to assist in the mitigation of visual impacts. Visual elements will include one side of the facility with access doors, an access road (existing) and car parking area, air vents and a hand rail around the roof of the structure.

Outlet structure

The outlet structure will be located on the west bank of Burra Creek approximately 60m upstream from the low level crossing on Williamsdale Road, near the junction of Burra and Williamsdale roads.

The visible elements of the outlet structure will comprise a concrete topped outlet stretching approximately 12 m along the creek bank with a 250 mm grated opening. There will also be pipeline scour valves and air valves in the vicinity of the outlet structure. Other works associated with the outlet structure will include ground modelling/re-contouring along the bank of the creek and rehabilitation planting in the immediate surrounding area.

2.2 CO_2 Dosing System

The proposal is to include CO_2 dosing infrastructure at the mini-hydro facility. The proposed infrastructure will generally be constructed within the construction footprint that was approved for the mini-hydro facility and will be wholly contained within the zone of disturbance associated with the construction of the Mini-hydro facility and discharge pipeline and discharge structure.

The size of the proposed carbon dioxide dosing facility is relatively minor and will be constructed on an area of circa 13 sqm, immediately adjacent and to the east of the mini-hydro building. This area has been shown as part of the mini-hydro facility building in the PPR.

The infrastructure will comprise of:

- CO_2 Dosing infrastructure within a secure enclosure that include:
    - A 3.6m high x 1.74m diameter CO_2 storage vessel;
    - CO_2 Vaporiser,
    - CO_2 injector;
- Supporting infrastructure such as pipework, valving and engineering services; and
- 4.8m x 3.5m secure cage enclosure with gates and signage.

The infrastructure is designed to be in keeping with the mini-hydro building style and will not project above the roof line of the adjacent building. It will be partly screened by vegetation and the earth embankment located to the south of the mini-hydro building.

Dangerous goods licensing will be required for this facility, and will be managed through the vessel and gas supply contractor.

Drawings GHD-M2G-MHY-Cl-DRG-2000: Site Plan, and GHD-M2G-MHY-Cl-DRG-2010: Section A describe the proposed CO_2 dosing facility and are included in Appendix A of this report.

2.3 Operation of the CO_2 Dosing system

The CO_2 Dosing system will be temporarily installed and operated as it is anticipated that over time the requirement for pH correction will reduce as leaching of hydroxide (OH-) ions from the OPC and HAC linings will reduce over time and as transfers occurs. It is anticipated that the need for pH correction and the operation of this facility may no longer be required within 5 years from commissioning.

Dosing will be associated primarily with the initial release of water that was within the pipeline during the period when the system was in-operative, and initially may also require minor levels of dosing during initial operations.

Dosing levels are automatically controlled in "*real time*" to ensure that the minimum CO_2 dose is added to the water to affect the pH correction sought. PH monitoring equipment will be installed to manage this process.

The operational requirement for this facility includes the delivery of CO_2 via a CO_2 tanker as and when required. It is anticipated that the initial frequency of CO_2 deliveries will be less than 1 truck/fortnight and that this will reduce over time as the need for dosing diminishes. The requirement for CO_2 dosing will disappear over time and deliveries are not considered a permanent impact. System monitoring will be conducted via the approved telemetry system and will not require attendance to site, except for periodic system maintenance. This will be performed in conjunction with site visits associated with the mini-hydro facility.

2.4 Objectives

The objective of the CO_2 dosing system is to temporarily facilitate the correction of the pH of water at the downstream side of the mini hydro, prior to release in Burra Creek.

2.5 Planning Approval Context

Planning for the Project commenced in 2005 as part of ACTEW Corporation's water security program. Planning approvals for the project were obtained from the following authorities:

- NSW Department of Planning;
- ACT Planning and Land Authority;
- Department of Sustainability, Environment, Water, Population and Community (SEWPAC) (previously Department of Environment, Water, Heritage and the Arts - DEWHA); and
- National Capital Authority.

2.5.1 NSW Planning Approval

The Project has been assessed under Part 3A of the NSW Environmental Planning and Assessment Act 1979. A period of approximately 2 years has been spent fulfilling NSW DoP requirements starting with the application for Part 3A approval through to receipt of project approval in March 2010 (note: this excludes the time period for addressing the Conditions of Approval) including preparation of the PPR. The proposal received conditional approval that include to both construction and operational requirements.

2.5.2 ACT Planning Approval and Development Application

An EIS was prepared for the Project to meet the ACT approval requirements. ACT Planning Approval was obtained in August 2010.

2.5.3 Commonwealth EPBC Approval Requirements

The project was "referred" to DEWHA/SEWPAC in October 2009 as per the requirements under the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999 and a Public Environment Report (PER) was prepared. Project approval was received on 29 October 2010.

2.5.4 National Capital Authority (NCA) Works Approval

Works Approval from the NCA has been received to construct the pipeline across the Monaro Highway Road Corridor. The application for Works Approval was lodged in June 2010 and approved in August 2010.

2.6 Context of the Land

The land upon which the CO_2 dosing infrastructure will be constructed is in the Williamsdale Road reserve and is "*state*" land. Project approval for the Murrumbidgee to Googong Water Transfer included construction of engineering infrastructure at this location.

3 Impact Comparison Assessment

3.1 General

The impacts of the proposed CO_2 dosing system should be considered in accordance with the assessments, prepared for the Murrumbidgee to Googong Water Transfer PPR and the NSW Part 2 approval conditions. This will allow consideration whether the proposal is consistent with the project approval.

The EIS has been prepared in accordance with the Director General (NSW Department of Planning) requirements (summarised in the table below). In order to consider the consistency of this proposal against the original approval (dated 31st March, 2010) the impacts during construction and operation is considered in the assessment below.

Table 3.1 Director General requirements relevant to the CO_2 Dosing System

DG Requirements	Impact Timing	Relevant to Assessment	Comments
Water Quality and Hydrology	Construction and Operation	Yes	Minor risk during Construction, more likely impact during Operation
Flora and Fauna	Construction and Operation	Yes	Minor risk during Construction, more likely impact during Operation
Heritage	Construction	Yes	Minor risk during Construction, no impact during Operation
Traffic and Transport	Construction and Operation	Yes	Minor risk during Construction, minor additional impact during Operation
Spoil Management	Construction	Yes	Minor risk during Construction, no impact during Operation
Soils and Ground Water	Construction and Operation	Yes	Minor risk during Construction, no impact during Operation
General Environmental Risk/Impact	Construction and Operation	Yes	Minor risk during Construction, minor or no additional impact during Operation

3.2 Natural Environment (Habitats, Flora and Fauna)

Impacts on the natural habitat during construction of the CO_2 dosing system is minimal as the proposed works will be contained wholly within the approved works area that will be used for construction of the mini-hydro facility. There is no requirement to extend the construction impact area for this facility.

From an operational perspective, however, the pipeline lining and coating may have an impact on the receiving environment, specifically the aquatic habitat environs of Burra Creek by:

- Leaching of soluble aluminium (Al) from the HAC lining of the DICL pipe; and
- Raise the pH in the water within the pipeline due to the leaching of hydroxide (OH-) ions from the OPC and HAC linings. This impact may be significant after an extended shutdown period (i.e. one month or longer) when the pipeline is not in use.

The proponent undertook an assessment of these impacts on the natural environment.

The inclusion of a CO_2 Dosing system ensures effective ongoing management of the pH of pipeline water prior to discharge to Burra Creek, thus protecting the natural environment from impacts associated with large changes in the pH of water within the Creek.

The release of soluble aluminium in the discharged water to Burra Creek has been assessed by Norm Mueller (ALS). Mr. Mueller concluded that the aluminium concentrations in the discharged water are likely to be similar to or lower than those experienced naturally in Burra Creek and unlikely to affect the water quality in the Creek.

In relation to the introduction of CO_2 to the system ALS found that the proposed CO_2 dosing rates the operation of this facility is unlikely to produce any by-products that would affect Burra Creek environmentally or the Googong Reservoir receiving water.

CO_2 dosing changes carbonate ions to bicarbonate ions driving the pH down. The calcium in the raw water will not reach a saturation point at the expected discharge pH levels and therefore will remain in solution and not precipitate out.

On the above advice, it is not expected that carbon dioxide dosing at the proposed rates will have a significant impact on the ecology of Burra Creek or Googong reservoir.

The difference in impact on other matters relating to the natural environment does not significantly differ when considering the proposal under consideration with the PPR proposal. The inclusion of the CO_2 dosing system ensures that in relation to pH management, the system can comply with Condition 2.1 of the Part 3A approval given for the Murrumbidgee to Googong Water Transfer.

3.3 Matters of Heritage interest

The proposal will be constructed on land that is approved for disturbance of the Murrumbidgee to Googong Water Transfer. This facility is unlikely to impact on any matters of Heritage interest.

During operation, managing the pH of waters discharged to Burra Creek will ensure that the limestone cast formation at London Bridge is not impacted upon. The CO_2 Dosing system enables the Murrumbidgee to Googong Water Transfer to operate in accordance with the Part 3A approval in relation to matters of Heritage interest.

3.4 Traffic and Transport

The construction of the CO_2 dosing facility is associated with a minor increase of construction traffic. The construction of the facility will require additional deliveries associated with the CO_2 vessel, monitoring and operating equipment, CO_2 dosing system enclosure and construction materials such as concrete. The deliveries will be made over a number of weeks during the construction of the mini-hydro facility.

In the context of the traffic movements associated with the construction of the approved mini-hydro facility this additional impact is considered to be minor and non-significant. The additional traffic will be managed under the approved CEMP to ensure that any additional impacts are effectively and safely managed.

The operational requirement for this facility includes the delivery of CO_2 via tanker as and when required. It is anticipated that the initial frequency of CO_2 deliveries will be less than one truck/fortnight and that this will reduce over time as the need for dosing diminishes. The requirement for CO_2 dosing will disappear over time and deliveries are not considered a permanent impact. The anticipated delivery frequency will not have a significant impact on the safety and/or operation of the local road network.

System monitoring will be conducted via the approved telemetry system and will not require attendance to site. Site attendance requirements for the dosing facility are only required to perform periodic system maintenance. This will be performed in conjunction with site visits associated with the mini-hydro facility and will not increase the impacts associated with operational attendance to the mini-hydro facility.

3.5 Spoil Management

The proposal will be constructed on land that is approved for construction of the Murrumbidgee to Googong Water Transfer. The inclusion of this minor addition will not impact on the ability to manage spoil from the project and will not result in significant volumes of spoil that require management.

3.6 Soils and Ground Water

The proposal will be constructed on land that is approved for construction of the Murrumbidgee to Googong Water Transfer and will be constructed in accordance with the management plans that has been developed for the construction of this project. The inclusion of this minor addition will not significantly alter the risk on soils and groundwater associated with construction of the pipeline scheme.

No ongoing impacts on Soils or Groundwater have been identified as a result of adding the CO_2 dosing to the scheme.

3.7 General Environmental Risk/Impact

3.7.1 Social and Land Use

The inclusion of the CO_2 dosing system comprises a minor extension of the mini-hydro facility. In the context of the larger Murrumbidgee to Googong Water Transfer scheme and the operation of the mini-hydro facility and discharge structure this addition does not significantly alter the impacts from those described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer.

3.7.2 Visual Amenity

The proposed CO_2 dosing facility will be installed immediately adjacent to the Mini-hydro facility (as depicted in GHD-M2G-MHY-Cl-DRG-2010: Section A). The facility is lower than the Mini-hydro building and will be installed behind the retaining wall and earth embankment that is associated with the construction of the Mini-hydro facility.

It will not be visible from the sensitive receivers located on the opposite site of Burra Creek and to the east. The facility will be located in front of the mini-hydro building and will be visible to passing traffic from both Williamsdale and Burra Roads for a short time while passing the infrastructure.

The character of the proposed infrastructure is commonly associated with utility installations and location of the infrastructure adjacent to the mini-hydro facility and earth embankment assist in accentuating the minimal visual impact of the facility. It is considered that passers-by will view the proposed dosing facility as part of the larger mini-hydro installation.

Given the minimal nature of the installation in the context of the mini-hydro facility and its location behind the earth embankment hiding it from the nearest sensitive receiver its inclusion does not alter the impact from what is described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer.

3.7.3 Construction Impacts

Works area

The CO_2 dosing system comprises a minor extension of the mini-hydro facility and will be constructed on land that has been approved for construction disturbance in the PPR. There is no requirement to increase the works area associated with the construction of the mini-hydro facility to facilitate the construction of the dosing system. In the context of the larger Murrumbidgee to Googong Water Transfer scheme and the operation of the mini-hydro facility and discharge structure this addition does not alter the impact from what is described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer

Air Quality/Dust Generation

The inclusion of the CO_2 dosing system comprises a minor extension of the mini-hydro facility and some additional construction activities at this location. In the context of the larger Murrumbidgee to Googong Water Transfer scheme and the construction of the mini-hydro facility and discharge structure this addition does not significantly alter the impacts from described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer. The works will be undertaken under the provisions of the CEMP, which will facilitate the appropriate management of air quality.

Noise

The inclusion of the CO_2 dosing system comprises a minor extension of the mini-hydro facility and some additional construction activities at this location. In the context of the larger Murrumbidgee to Googong Water Transfer scheme and the construction of the mini-hydro facility and discharge structure this addition does not significantly alter the impacts from described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer. The works will be undertaken under the provisions of the CEMP, which will facilitate the appropriate management of construction noise.

The proposed facility does not include refrigeration equipment, pumps or any "*noisy*" infrastructure that require acoustic treatments. The inclusion of this facility will not impact on the system's ability to be

operated within the noise limits associated with the project and the locality. It is not considered that the operation of this facility will alter the impacts described and approved in the Part 3A approval given for the Murrumbidgee to Googong Water Transfer.

4 Conclusions

Based on the review of the impact associated with the chosen pipeline lining, the findings are that:

- The expected aluminium concentrations in the discharged water are likely to be similar to or lower than those experienced naturally in Burra Creek and pose no ecological risk to Burra Creek ; and
- Impacts associated with pH changes may be more severe and require management.

The proponent is proposing the construction of carbon dioxide (CO_2) dosing infrastructure as part of the mini hydro facility, which will operate to correct the pH of water at the downstream side of the mini hydro, prior to release in Burra Creek. The inclusion of this infrastructure will ensure that the Murrumbidgee to Googong Water Transfer will be able to be operated in accordance with Condition 2.1 of the Part 3A approval for the scheme.

The installation of a CO_2 Dosing system at the Mini-Hydro facility will not result in a significant change to the impacts associated with the project as assessed in the PPR in relation to:

- The Natural Environment (including Teresterial and Aquatic habitats, flora and fauna);
- Matters of Heritage Interest,
- Traffic and Transport,
- Soils and ground water;
- Spoil management; and
- General environmental risk (including general construction impacts and ongoing operational impacts including visual amenity).

Appendix A - **Design of CO2 Dosing System**

- GHD-M2G-MHY-CI-DRG-2000: Site Plan, and
- GHD-M2G-MHY-CI-DRG-2010: Section A

PRESSURE GAUGE

DN50 ELECTRIC ACTUATED BALL VALVE PN16

PRESSURE RELIEF VALVE SET AT 50m

PRESSURE GAUGE

PRESSURE REDUCTION VALVE SELECTABLE TO 25-50m

DN50 MANUAL BALL VALVE PN16

DN20

DN50

DN50

MINI HYDRO BUILDING

pH METER WITH DRAIN TO TANK UNDER

4800

6148 (RECOMMENDED CLEARANCE OF 6000)

900x2000 HIGH GATE

HOSE COCK AND HOSE CABINET FOR 15m GARDEN HOSE

VAPORISER

BOC. VI3T CO_2 STORAGE VESSEL (1700 DIAx3600 HIGH) 2.5t

1750

BOLLARD

2x1200x2000 HIGH LIGHT GATES

3500

DN1000 PIPE

2400

1650

524

POWER SUPPLY TO 415V OUTLET AND SAMPLING PUMP

415V OUTLET

RETAINING WALL 1:1 SLOPE

TO SAMPLE PUMP AT DISCHARGE STRUCTURE

A 2010

PLAN

SCALE 1:25

0 0.25 0.5 0.75 1.0 1.25m

SCALE 1:25 AT ORIGINAL SIZE

PRELIMINARY

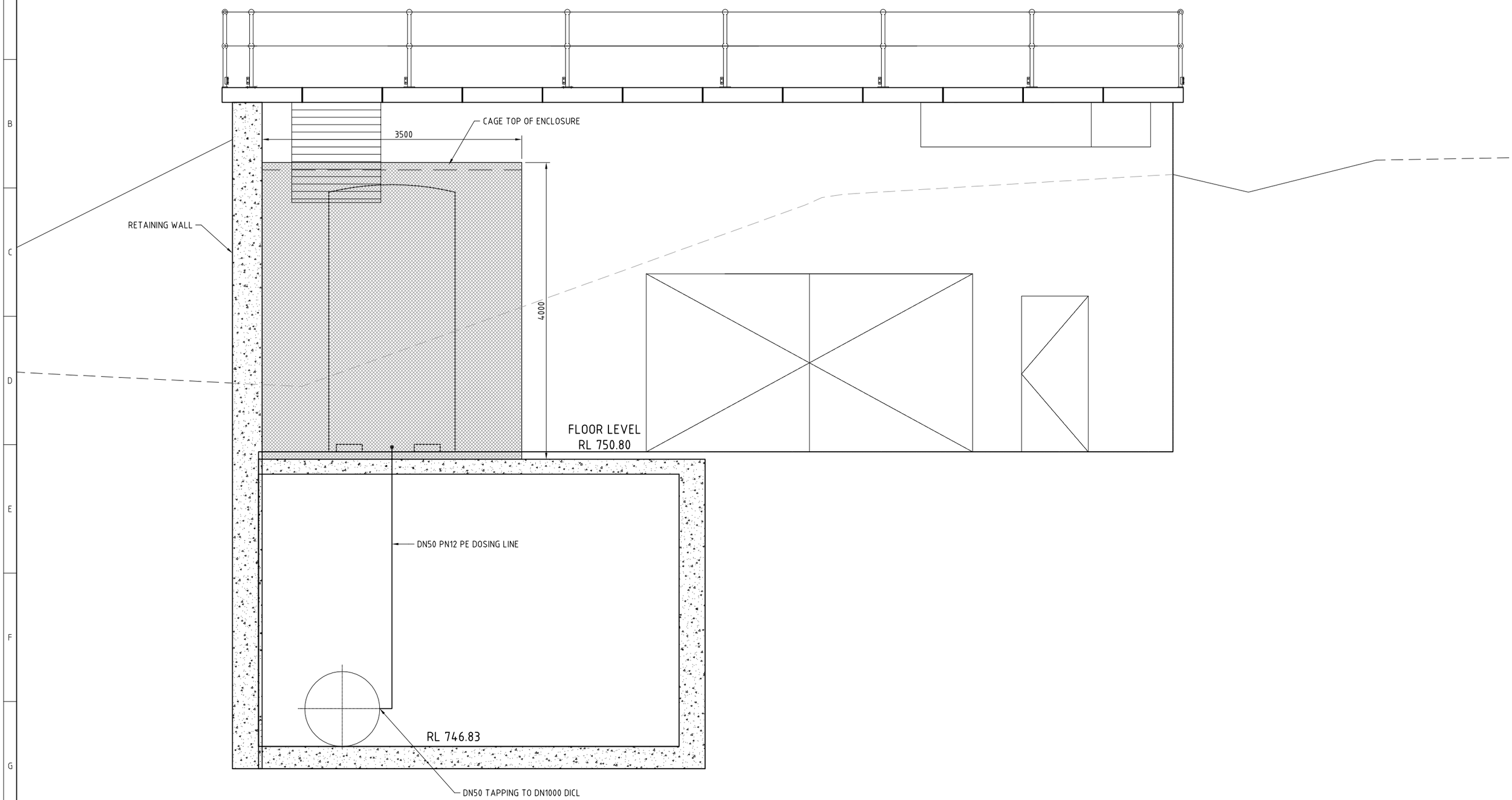
No.	REVISION	DATE	CKD	AUTH
A	ISSUED FOR 50% REVIEW	23.08.2011	GM	RF

BULK WATER ALLIANCE

ACTEW CORPORATION

Drawn: G. JONES	Designed: M. O'KEEFFE	MURRUMBIDGEE TO GOOGONG WATER TRANSFER PROJECT MINI HYDRO STATION CO2 DOSING UNIT SITE PLAN	Scale: 1:25
Checked:	Checked:		Date: JUNE 2011
Program Design Manager:			Sheet No.:
Contractor's Drawing No.: GHD-M2G-MHY-CI-DRG-2000			ACTEW Project No.:
ACTEW - Owner's Chief Engineer:			Tender No.:
		MURRUMBIDGEE TO GOOGONG	A1 Rev. A

CADD File Name: C:\Arenium_Projects\23-12615_BWA\CADD\DRAWINGS\M2G\GHD-M2G-MHY-CI-DRG-2000.dwg
Date Plotted: 25/08/2011 CTB FILE: ACTEWAGL.CTB



A / 2000 SECTION
SCALE 1: 25

0 0.25 0.5 0.75 1.0 1.25m
SCALE 1:25 AT ORIGINAL SIZE

PRELIMINARY

No.	REVISION	DATE	CKD	AUTH
A	ISSUED FOR 50% REVIEW	23.08.2011	GM	RF

BULK WATER ALLIANCE

ACTEW CORPORATION

Drawn: G. JONES	Designed: M. O'KEEFFE		
Checked:	Checked:		
Program Design Manager:			
Contractor's Drawing No.: GHD-M2G-MHY-CI-DRG-2010			
ACTEW – Owner's Chief Engineer:			

MURRUMBIDGEE TO GOOGONG WATER TRANSFER PROJECT
MINI HYDRO STATION
CO2 DOSING UNIT
SECTION A

Scale: 1:100	Date: JUNE 2011	Sheet No.:
ACTEW Project No.:	Tender No.:	
MURRUMBIDGEE TO GOOGONG		
A1		Rev. A

CADD File Name: C:\Arenium_Projects\23-12615_BWA\CADD\DRAWINGS\M2G\GHD-M2G-MHY-CI-DRG-2010.dwg

Appendix B - **Technical Memorandum: Review of requirement for seal coating of M2G DICL Piping**

Bulk Water Alliance

Memorandum

24 MAY 2011

SUBJECT	Review of requirement for seal coating of M2G DICL Piping
TO	Jason Julius, Simon Webber, Ian Carmody, Lachlan Marks
FROM	John Dymke

Purpose

To outline the background detail to the decision by the BWA to not proceed with seal coating of the DN1000 DICL component of the Murrumbidgee to Googong (M2G) pipeline.

Background

Introduction

Typically all cement lined mild steel and ductile iron piping used by ACTEW and the Australian water industry for potable water supply pipelines are lined with an Ordinary Portland Cement (OPC) mortar lining. Additionally the cement lining is also 'seal coated' [with a bitumen based paint] to limit the leaching of hydroxide ions from the cement mortar and subsequently limit the change (rise) in pH in the water in the pipe.

The leaching of hydroxide ions, and subsequent rise of the pH in potable water in the pipe in non seal coated OPC lined piping, is exacerbated in circumstances where the water in contact with the lining is of low alkalinity (i.e. soft water) and particularly in pipelines with low flow rates and particularly in pipes with stagnant water. Leaching of hydroxide ions also results in a loss of the cement lining in the pipe over time (i.e. a loss of corrosion protection over time and asset life reduction).

The Water Services Association of Australia (WSAA)[1] comments, in relation to ductile iron cement lined pipes, '*Seal coating of the lining with bitumen seal coats reduces leaching by 99%, thereby mitigating the issue with increasing pH.*'

Pipe lined with high alumina cement (HAC) mortar lining is typically not used for potable water transfer in Australia due to the leaching of aluminium from the lining. However, this lining is commonly in pipelines used for transfer of wastewater due to its higher chemical attack (i.e. sulphide) and abrasion resistance compared with OPC.

Murrumbidgee to Googong (M2G) Pipeline

The M2G pipeline comprises 690 m of DN1000 mild steel cement lined (MSCL) pipe and 11,600 m of DN1000 ductile iron cement lined (DICL) pipe. All pipeline fittings on the DICL section are epoxy lined.

[1] WSAA Product and Material Information and Guidance for Water Supply Code of Australia WSA 03-2002 pg10, clause 1.5.1.1 Cement mortar lining.

MSCL piping

All MSCL piping is OPC lined and 'seal coated'. This is industry standard for MSCL pipelines with OPC lining.

DICL piping

The DN1000 DICL pipe for the M2G has alumina cement (HAC) mortar lining (this decision was taken in January 2011 at the time of ordering pipe). The decision relating to whether the pipe needed to be 'seal coated' was deferred until after additional research was undertaken by the BWA relating to the expected pH rise from water contact with HAC lining.

The initial review, leading to the decision to have the pipe supplied with a HAC lining in lieu of OPC, was based on HAC being likely to lead to a lower pH rise than OPC (due to the mortar composition) and it being more abrasion resistant. Consideration was also give to the possible leaching of aluminium from the HAC lining and resultant environmental water quality impacts on release of water to Burra Creek.

The direct cost of seal coating of the DICL piping is in the order of approximately $540,000.

Water Quality – Murrumbidgee River and Burra Creek

Water quality data (pH and alkalinity) for the Murrumbidgee River at Angle Crossing (the withdrawal point) is shown in Figure 1 and Figure 2 below.

Figure 1 - Murrumbidgee R @ Angle Crossing – pH Data

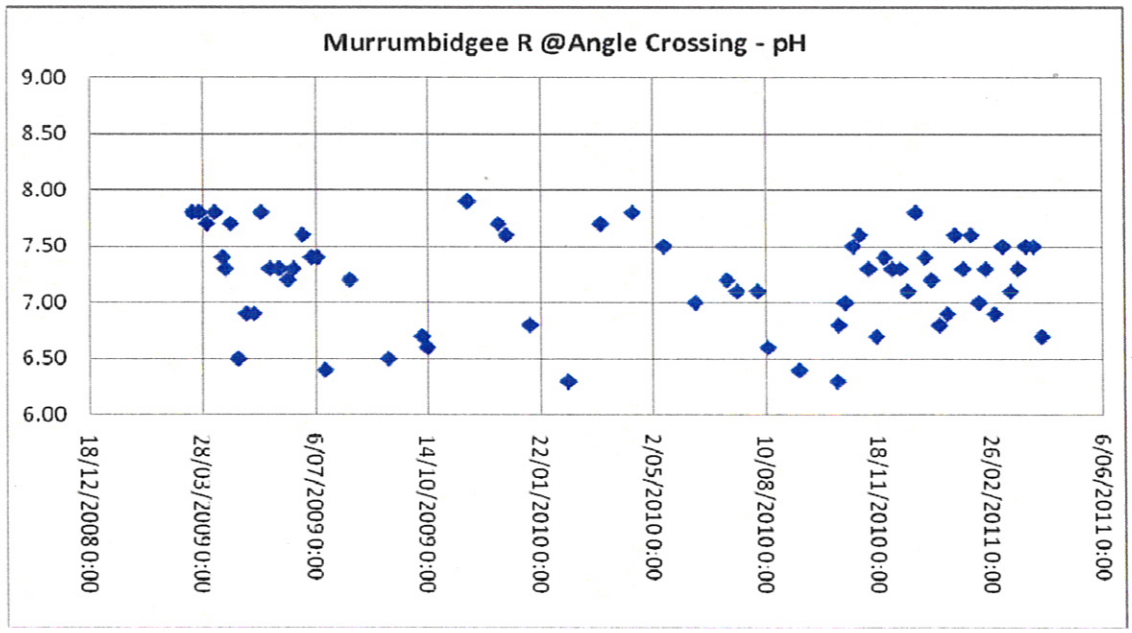
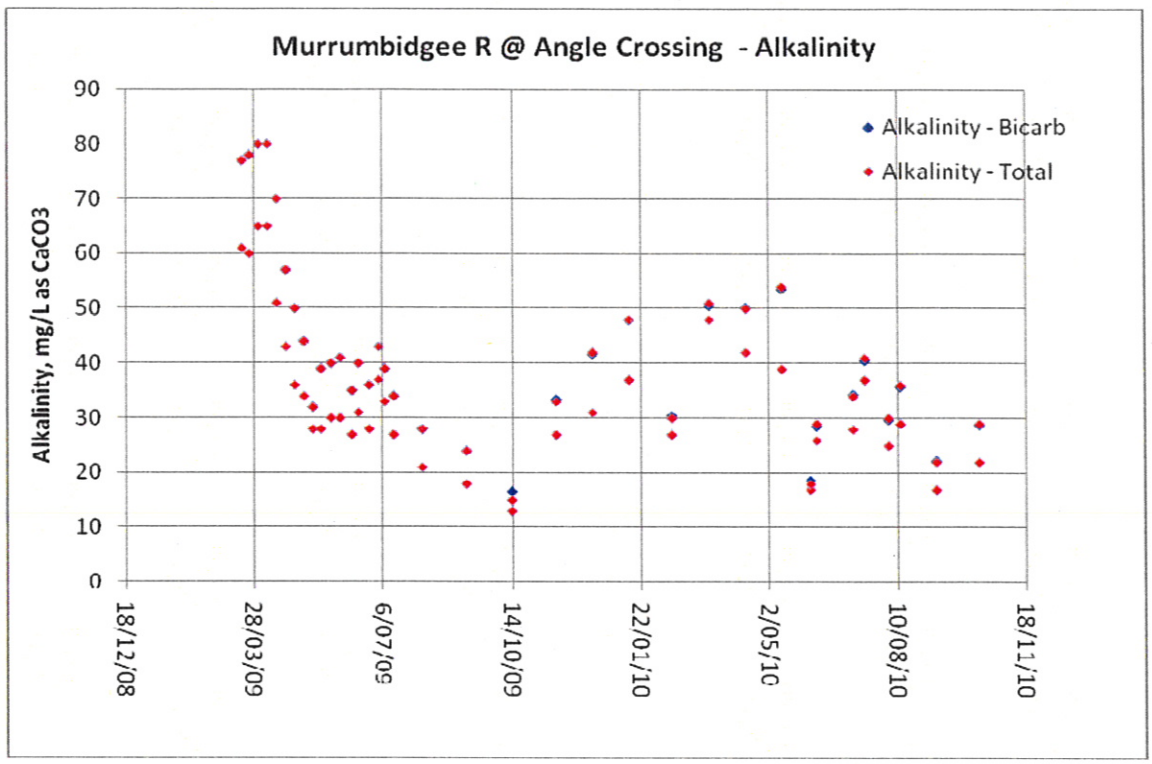


Figure 2 - Murrumbidgee R @ Angle Crossing - Alkalinity Data



The mean pH at Angle Crossing is in the order of pH 7.4) and mean total alkalinity is in the order of 42.9 mg/L as $CaCO_3$ (std. dev. of 17.6 mg/L) (data 2005-2010).

Water quality data for the Burra Creek (discharge point) is shown in Figure 3 and Figure 4 below.

Figure 3 - Burra Creek (all data) - pH

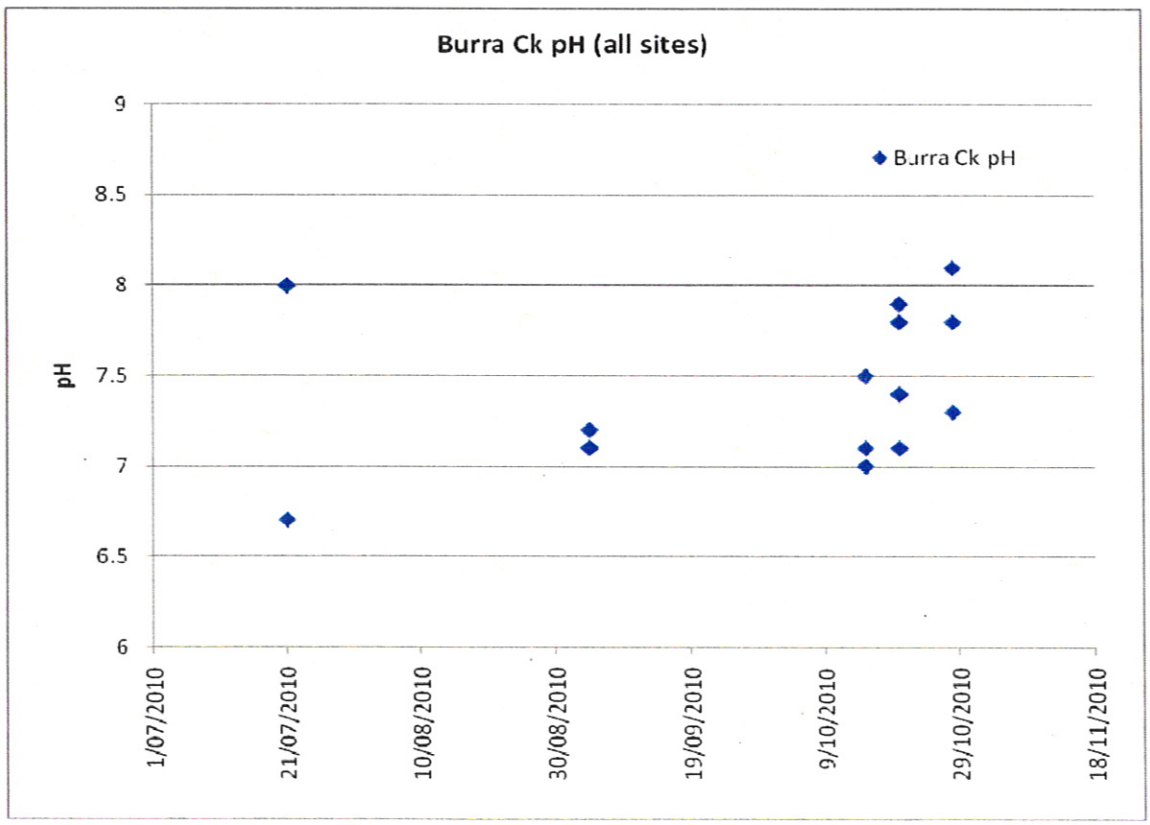
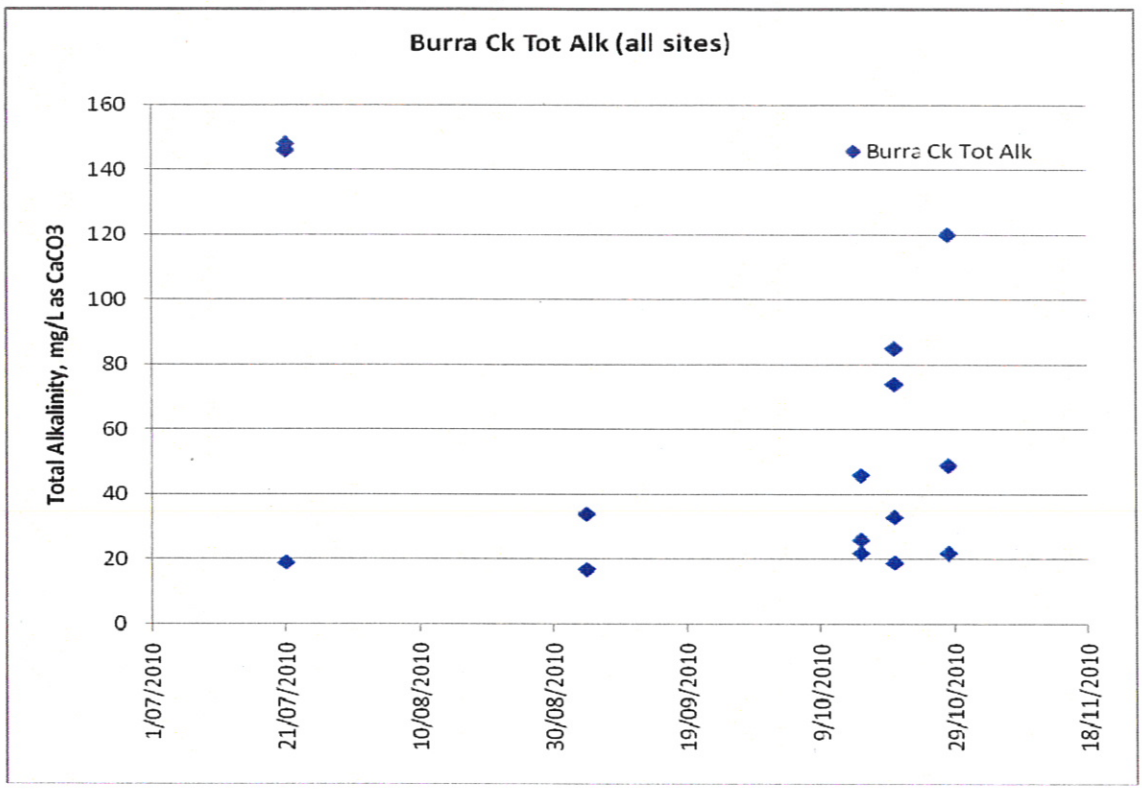


Figure 4 - Burra Creek (all data) - Alkalinity



Due to the small number of water quality samples collected from Burra Creek, all sample sites have been included, not just for the Burra Creek at Williamsdale Road.

Based on data gathered over period 2010-2011, the pH range in Burra Creek is pH 6.7 – 8.1. The total alkalinity is typically in the range 20 - 60 mg/L as $CaCO_3$, with some outliers as high as 145 mg/L as $CaCO_3$.

Discharge water quality obligations from the M2G pipeline to Burra Creek

The Operation Environment Management Plan – *Stream Flow and Water Quality Monitoring Sub Plan*[2] (SF&WQMP) – for M2G outlines key operation procedures for the monitoring and management of water quality in Burra Creek. The SF&WQMP has been submitted and approved by NSW Government as part of the conditions of approval for the M2G project.

The SF&WQMP sets default water quality trigger levels for Burra Creek. The trigger levels for pH of water discharged to Burra Ck are pH <6.5 or pH>8.0 (see Figure 5 below).

[2] ACTEW 'Murrumbidgee to Googong Water Transfer Stream Flow and Water Quality Monitoring Sub Plan', 6 Dec 2010.

Figure 5 - SF&WQMP Water Quality Triggers (Ref SF&WQMP- Figure 4.3)

Table 4.3 Burra Creek proposed water quality parameters and default trigger values

Parameter	Mean value in Burra Ck (2008-2010)*	Proposed Trigger Levels downstream of the Burra Creek discharge point during abstraction	
		Autumn / Winter	Spring / Summer
Turbidity (NTU)	<5	>80	>100
Turbidity HiLo Value		150	150
Turbidity Hi Hi value		800	800
Total Nitrogen (mg/L)	0.45	>0.5	>0.8
Total Phosphorus(mg/L)	0.015	0.10	0.10
Dissolved Oxygen (%sat)	94.5	<80 or >110	<80 or >110
pH	7.4	<6.5 or > 8.0	<6.5 or > 8.0
EC	260	> 600	> 400
Temperature ^{0}C	21(autumn)	< 5	> 24
Total Iron (mg/L)		>2.0	>2.0
Total Manganese (mg/L)		>0.15	>0.15
TDS	230	>150	>150

* limited data from the MEMP project

Clause 4.5 of the SF&WQMP states:

'Should any of the trigger levels stated above be exceeded then the following actions are to be undertaken:

- *If it is found that the exceedance parameter is due to the water abstraction and is causing an unacceptable ecological health risk or reservoir water quality impact, then the pumping of water from Murrumbidgee River shall cease until such time as the problem can be rectified or mitigation options put in place'*

Water discharged to Burra Creek must be managed to ensure does not exceed pH 8 until it can be established through ecological monitoring that no '*unacceptable ecological health risk'* is likely to result from the release of water with higher pH. This requirement will apply for pipeline commissioning, operation and particularly for test pump operation (i.e. when the pipeline is not in operation but pump testing is required on a monthly basis).

There are no documented limits on the release concentration of soluble aluminium to Burra Ck.

Anticipated quality of water to be discharged to Burra Creek from the M2G pipeline

The quality of water to be discharged to Burra Creek when the pipeline is in operation (i.e. after 24 hours of operation) is assumed to be equal to that being pumped from the Murrumbidgee River. However, following periods when no pumping is taking place, the initial water discharged from the pipeline (up to 10 ML) may be impacted by the leaching of aluminium and hydroxide ions from the HAC cement lining in the pipeline.

Two possible water quality impacts have been identified from the M2G pipeline lining materials:

- Leaching of soluble aluminium (Al) from the HAC lining of the DICL pipe; and
- pH rise in water in the pipeline due to the leaching of hydroxide (OH^-) ions from the OPC and HAC linings, particularly after extended shutdown periods (i.e. one month or longer).

These issues are discussed in greater detail below.

Leaching of aluminium from the HAC lining

The leaching of aluminium from the HAC lining of the pipeline is anticipated based on the low alkalinity of water in the Murrumbidgee River, particularly in the early years of pipeline operation. This conclusion is supported by information from the US EPA paper "*Permeation and Leaching*"[3]. This paper states "*Aggressive, soft, and poorly buffered (i.e. low alkalinity) water promote aluminium leaching from cementitious materials*".

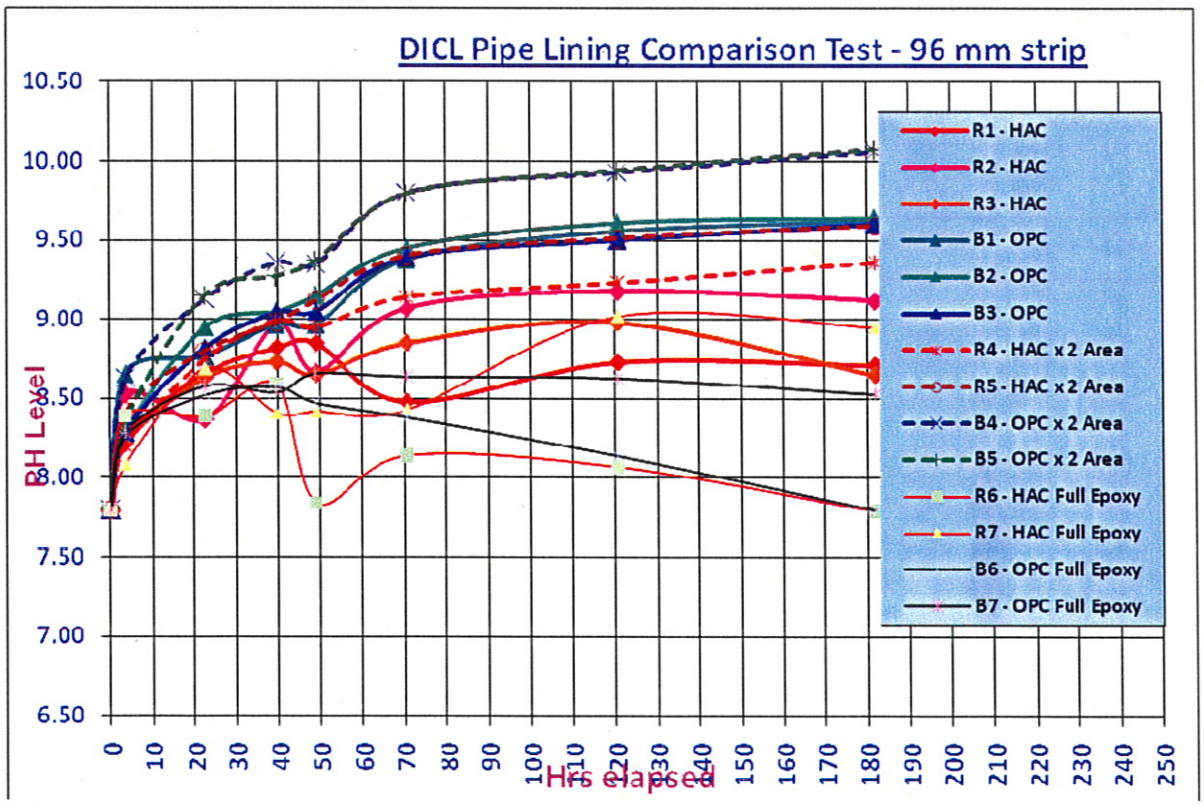
The release of soluble aluminium in the discharged water to Burra Creek has been assessed by Dr Norm Mueller[4] (ALS Global). Mueller concluded that, while the aluminium concentrations in the discharged water are likely to be similar to or lower than those experienced naturally in Burra Creek and hence pose no ecological risk to Burra Creek.

pH rise in water stored in the pipeline

The leaching of hydroxide (OH^-) ions from the OPC and HAC linings, particularly after extended shutdown periods (i.e. one month or longer) is anticipated to result in a pH rise in water stored in the pipeline for extended periods.

Testing of the potential pH increase in water in contact with uncoated HAC pipe lining has been undertaken by the BWA[5]. This testing, while limited in its extent, shows a likely pH rise of approximately 1 – 1.25 pH units for water stored in the pipeline for a period in excess of 72 hours. This study also found that the pH rise for water in contact uncoated OPC pipe lining for the same period was approximately 2 pH units.

Figure 6 - pH Rise curves from BWA experimentation



These results are in good correspondence with information provided by Mike Chapman[6] (GHD) relating to experiments conducted for Melbourne Water by Tubemakers Pipelines Research Centre. In research undertaken by Tubemakers on OPC lined pipes with very soft water, a pH rise of in

[3] United States Environment Protection Agency 'Permeation and Leaching', Aug 15, 2002 clause 2.2.2 Cement Materials, pg 12.
[4] Dr Norm Mueller, email to John Turville 'DICL Pipe Lining', 1 December 2010
[5] Bulk Water Alliance 'High Alumina Testing Report', April 2011 BWA Document BWA-M2G-CO-RPT-008.
[6] Mike Chapman, email to Mike Rodd 'pH leaching notes from mike Chapman', 14 April 2011

excess of 2 pH units was recorded on uncoated linings after 24 hours, rising to approximately 3 pH units after 96 hours. A rise of approximately 0.75-0.8 pH units was recorded for water in contact with 'seal coated' OPC lined pipe in a 24 hour period.

On the basis of the above information, if the DICL section of the M2G pipeline is not seal coated, it is expected that water in the pipeline will have an elevated pH after periods of extended shutdown (i.e. in excess of 24-72 hours), above the SF&WQMP Water Quality trigger level of pH 8. The rise in pH expected is in the order of 1 – 1.25 pH units above that of the Murrumbidgee River.

If the DICL section of the pipeline is seal coated, based on the above research, it is expected that water in the M2G pipeline will still have an elevated pH after periods of extended shutdown (i.e. in excess of 24-72 hours), above the SF&WQMP Water Quality trigger level of pH 8. The rise in pH expected is in the order of 1 pH unit above that of the Murrumbidgee River.

Seal coating risks

The BWA has been recently advised by Vinidex (pipe supplier) that St Gobain PAM (pipe manufacturer) has not previously undertaken seal coating of HAC lined DICL pipe, and hence has no experience of the performance of the seal coats on this material.

Without long term performance trial information there are risks that:

- the seal coat will not provide the expected service life as experienced on OPC lining; and
- the seal coat may delaminate from HAC mortar resulting in stranding of the coating impacting on the operation of the mini-hydro.

This issue was not brought to the attention of the BWA at the time of purchasing the pipe.

Options for management of water quality

The extent of treatment required to lower the pH of the discharge to Burra Creek to achieve the SF&WQMP Water Quality trigger of pH< 8 has not been determined at this stage and will depend on a more detailed analysis of the expected water chemistry.

The following is considered to be close to the likely final position.

The correction of the pH of water in the pipeline should be as close as possible to the discharge point to Burra Ck. This will minimise the volume of water to be treated at any time (and hence minimise operating costs) and will ensure a high level of control over the process. This optimal dosing location is downstream of the mini-hydro power station immediately prior to discharge.

Options for the correction of the pH of water discharging the pipeline to Burra Creek are as follows:

- Dose water with an acid solution;
- Dose water with gaseous carbon dioxide (CO_2).

Acid solution dosing is not considered to be viable from a safety and an environmental management perspective due to the need for specially designed dangerous goods storage facilities for acid, as well as this facility being within the floodway of Burra Creek.

Carbon dioxide (CO_2) dosing is considered to be the better solution, and one which is commonly used for pH management in water pipelines. A carbon dioxide dosing facility will require dangerous goods licensing, however, is consider being at lower risk from flooding.

CO_2 dosing rates are yet be finalised, however, are expected to be in the range of 10-25 mg/L, with a most likely dose of approximately 15 mg/L. On this basis, approximately 100-250 kg CO_2 will be required for dosing the initial 10 ML (i.e. pipeline volume) of water discharged.

On the basis of estimated usage, a one (1) tonne vacuum insulated cryogenic storage vessel and associated controls would be located at the mini-hydro power station. This vessel would be leased from the gas supplier.

Figure 7 - Photograph of 2.5 tonne refrigerated CO_2 storage vessel (courtesy BOC Gases)

Information has been provided by BOC Gases relating to CO_2 storage vessels[7]. A one (1) tonne net storage capacity vacuum insulated cryogenic vessel has dimensions in the order of 1,400 (dia) x 3,400 (h); 2.5 tonne vessel 1,700 (dia) x 3,700 (h). Concrete plinth area required is in the order of 3.0 – 3.6 m square. A 415 volt 30 amp power supply is required for the operation of liquid pump on the delivery tanker, in addition to power for refrigeration unit. Figure 7 shows a photograph of a typical refrigerated CO_2 storage vessel

Controls associated with the facility would most likely include a series of dosing control valves all linked to SCADA. [Note – pH flow-paced metering control is not considered by the author to be desirable due to increased operations and maintenance complexity and costs.]

CO_2 gas would be injected to the water immediately downstream of the hydro power station (point of high turbulence) to lower and maintain the pH in the discharged water in the range $7.5 < pH < 7.75$.

Figure 8 shows a possible dosing configuration.

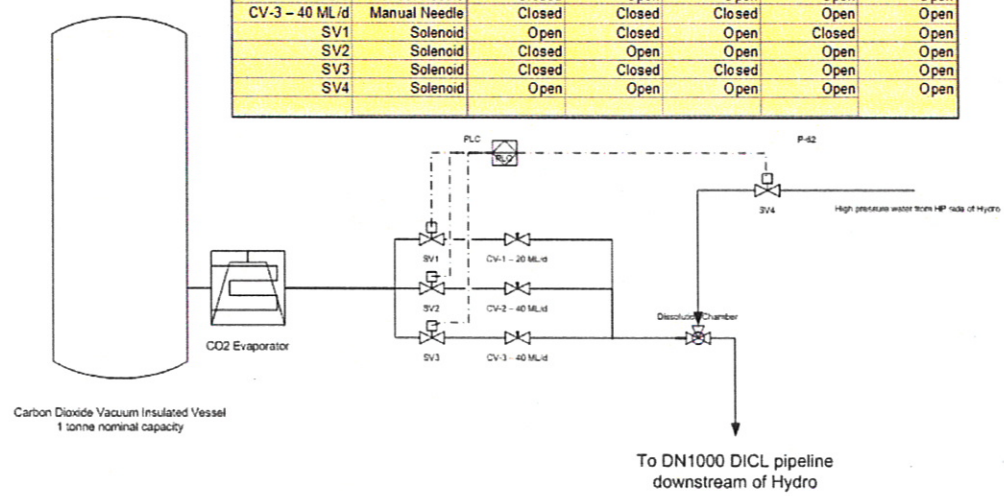
Occupational health and safety implications

Carbon dioxide is a toxic gas and one which is heavier than air. Consideration would need to be given to pipeline and discharge chamber access and ventilation as well as ventilation of the hydro power station building to ensure oxygen concentrations are adequate in the locations prior entry. Confined space access procedures for underground facilities typically cover this risk. A gas monitoring system and alarm may need to be fitted in the hydro power station building to warn of low oxygen / high CO_2 levels.

Figure 8 - Possible CO_2 dosing configuration

OPTION 2 – Pre-dissolution prior to injection of CO2 solution to pipeline

Valve List						
Valve No	Description	20 ML/d	40 ML/d	60 ML/d	80 Ml/d	100 ML/d
CV-1 – 20 ML/d	Manual Needle	Open	Closed	Open	Closed	Open
CV-2 – 40 ML/d	Manual Needle	Closed	Open	Open	Open	Open
CV-3 – 40 ML/d	Manual Needle	Closed	Closed	Closed	Open	Open
SV1	Solenoid	Open	Closed	Open	Closed	Open
SV2	Solenoid	Closed	Open	Open	Open	Open
SV3	Solenoid	Closed	Closed	Closed	Open	Open
SV4	Solenoid	Open	Open	Open	Open	Open



7 BOC - IPRM 2006 – Section 2: General Information, pg 34.

Other safety aspects relating to the handling of high pressure cryogenic liquids would also need to be considered in the design and operation of this facility.

Operating and maintenance implications

Operations and maintenance procedures for the M2G project will need to include procedures for the testing and checking of operation of the carbon dioxide dosing system prior to starting of pumping equipment, including routine calibration checking of pH metering equipment.

The CO_2 vessel sizing still needs to be finalised based on the dose rate required. Refilling of the vessel would need to occur on a regular basis, with the frequency determined by the number of start/stop operations of the M2G facility over time. For monthly pump testing, with total pump operating time less than 6 hours (i.e. 2 hours run time for each pump - pumped volume is in the order of 4 ML) CO_2 usage would be in the order of 125 kg based an a 15 mg/L dose rate. This would indicate a 1,000 kg vessel would require refilling approximately every 6 months taking into account other operational testing, gas losses, etc.

Planning approval and licensing implications

The current planning approval documentation for the M2G project did not envisage the incorporation of a CO_2 dosing facility at the mini-hydro power station.

The size of the proposed facility is relatively small – 1 tonne vessel is in the order of 3,400 high by 1,400 diameter. A security cage enclosing the vessel and evaporator unit would be required – with cage dimensions in the order of 3,000 x 5,000 by 2,400 high. The facility should not project significantly above the roof line of the planned mini-hydro power station. The vessel will be located outside of the mini hydro building and would be visible from certain angles.

The following planning review comments have been provided by Peiter Van Der Walt[8] ().

'It is important to consider the impact of the inclusion of CO_2 dosing infrastructure to the M2G project in the context of the NSW Part 3A approval.

The inclusion of CO_2 dosing infrastructure were not foreseen in the M2G Preferred Project Report (PPR) and has not been assessed in the 2009/10 project approval and is likely to require specific assessment by the NSW Dept. for Planning (DoP). Approval of the CO_2 dosing infrastructure as an amendment to the M2G proposal is likely to require the preparation of a consistency assessment for submission and consideration by DoP.

Matters that may require consideration are likely to include:

- *Extent of pH change and dosing requirements in the context of the M2G operational regime proposed;*
- *Timing during which CO_2 dosing is likely to be required;*
- *Parameters when dosing would be introduces and CO2 volumes required;*
- *Impact of CO_2 dosing on Burra Creek and the aquatic environment of the creek (flora and fauna species and communities);*
- *Visual impact of the CO_2 storage vessel and associated infrastructure at the mini-hydro facility; and*

The consistency assessment will require the above assessments to be included as supporting documentation. There may be a requirement to consult with stakeholders and NSW Government Agencies while the consistency assessment is being prepared. The assessment may further benefit form considering the likely timing during which CO_2 dosing may be required as the inclusion of this infrastructure is likely to be non-permanent, and may be able to be removed in the future.'

Dangerous goods licensing will be required for this facility, however, this should be managed through the vessel and gas supply contractor.

---

[8] Pieter Van Der Walt, CBRE, email via Chris Webb, 'M2G CO2 dosing', 6 May 2011

Annual operating costs

BOC Gases[9] have advised vessel leasing costs is likely to be in the range of $800/month for a 1,000 kg vessel to $1030/month for a 2,500 kg vessel, giving annual costs in the order of $9,600 to $12,400.

CO_2 supply unit cost is likely to be in the order of $2.10/kg[10] delivered to site. Based on an annual usage in the order of 1,800 kg (i.e. 12 monthly pump tests each pumping 10 ML dosed at 15 mg/L), the annual CO_2 supply cost is expected to be in the order of $3,800 per annum.

Total operating costs (excluding maintenance) are expected to be in the order of $13,400 per annum (based on 1 tonne vessel lease).

A worst case scenario involving the need for continuous annual treatment of 750 ML (i.e. 20 ML/d pump operation for one year) with a 15 mg/L dose of CO_2, would involve a gas cost in the order of $23,600 per annum, giving a total annual cost in the order of $24,630.

Risks

The following risks have been identified with respect to the pH of discharged water to Burra Creek:

1. There is a risk that the pH of water being pumped through the pipeline during normal operation, i.e. after initial displacement of the stagnant volume of water in the pipe, will rise above the trigger level of pH 8 and this may result in the need for ongoing operation of the pH correction system, rather than planned intermittent operation on start-up of pumping. This risk is more likely to crystallise when there is sustained operation of the facility at low flows, i.e. 20 ML/d, when the water retention time in the pipe is in the order of 12 hours.
2. There is a risk that the calibration of the pH control system instrumentation at the mini hydro is out of calibration with respect to the in-stream continuous monitoring system established to meet the requirements of the SF&WQMP, and reported pH values exceed the SF&WQMP trigger level due to differences in calibration and calibration drift due to fouling of pH probes.

   [It is currently a recognised problem that in-stream continuous water quality data loggers can have calibration drift which is heavily influenced by prevailing stream flow conditions – silting and algal growths on probe, etc. Calibration management of the water quality monitoring systems at the Upstream Angle Crossing and Burra Creek gauging stations need to be reviewed by ACTEW and ALS Global.]
3. Rate of draw off of CO_2 from the storage vessel (i.e. evaporator sizing) needs to be considered as part of the facility design, particularly if dosing required at high flow rates, due to low winter temperatures.

Conclusions

The following conclusions are made with respect to seal coating of the M2G DICL high alumina cement lined pipe:

1. With or without seal coating of the DICL HAC lined pipe, there is an anticipated pH rise in water stored within the pipeline for extended periods. It is expected that this pH rise will exceed the Burra Creek discharge trigger level of pH >8, resulting in a need to adjust the pH of water prior to release.
2. Seal coating may reduce the extent of this pH rise, however, will not eliminate it.
3. Seal coating has not been applied to HAC piping manufactured by St Gobain and there is a risk of this costing not performing in the same manner at the costing applied to OPC linings.
4. The most appropriate manner to adjust pH to within the discharge range of $6.5 < pH < 8.0$ is considered to be by the dosing of carbon dioxide dosing at the downstream side of the mini hydro in an area of high turbulence.
5. Annual costs of CO_2 supply and vessel leasing are likely to be in the order of $13,400, based on a leased 1 tonne vessel.

---

[9] BOC Gases –Ralph Lloyd-Smith email 'CO2 dosing for Murrumbidgee to Googong pipeline', 20 April 2011
[10] BOC Gases –Ralph Lloyd-Smith email 'CO2 dosing for Murrumbidgee to Googong pipeline', 20 April 2011

6. There is a risk that continuous dosing of pH correction may be required during low flow pumping periods due to the high retention time of water within the pipeline during these periods. It is expected however that the need for dosing will diminish with operating time of the pipeline.

Recommendations

The following recommendations are made with respect to seal coating and pH adjustment:

1. That the DN1000 DICL pipe on the M2G pipeline is not seal coated, resulting in a project cost saving in the order of $540,000.
2. That the BWA give consideration to whether the decision not to seal coat constitutes a 'Change' or a 'Scope Change' under the PAA, and consequently review the application of the saving achieved by not proceeding with seal coating;
3. That ACTEW review the planning approval implications of a locating a CO_2 storage vessel at the mini hydro site and actions needed to achieve approval for design changes at the mini-hydro station;
4. That detailed consideration be given by the BWA to the design of a carbon dioxide dosing system for pH control in water discharged from the pipeline;
5. That the BWA communicate with Vinidex over the issue of there being no experience in use of seal coating on HAC lined pipe, when there was a clear expectation by the BWA and ACTEW that this was a 'no risk' decision if needed to be taken following the BWA's assessment of this need.

24/5/11

John Dymke
Owner's Chief Engineer

Attachments

- Email from Dr Norm Mueller re Burra Creek Aluminium Concentrations and DICL Pipe lining, 1 December 2010.
- BOC Gases –Ralph Lloyd-Smith email 'CO2 dosing for Murrumbidgee to Googong pipeline', 20 April 2011
- BOC Documents

Email from Dr Norm Mueller re Burra Creek Aluminium Concentrations and DICL Pipe lining, 1 December 2010.

"Mueller, Norm"
<Norm.Mueller@als
global.com> To
"'John.Turville@bwa.actew.com.au'"
01/12/2010 03:03 <John.Turville@bwa.actew.com.au>,
PM "Linda.Garlick@jhg.com.au"
<Linda.Garlick@jhg.com.au>,
"Peter.Sheehan@jhg.com.au"
<Peter.Sheehan@jhg.com.au>
cc
"Gavin.Morrison@bwa.actew.com.au"
<Gavin.Morrison@bwa.actew.com.au>,
"Jason.Julius@bwa.actew.com.au"
<Jason.Julius@bwa.actew.com.au>,
"Mike.Rodd@bwa.actew.com.au"
<Mike.Rodd@bwa.actew.com.au>
Subject
RE: DICL Pipe Lining.

John,
I have had a look at some of the water sample results taken as part of the Murrumbidgee Ecological Monitoring Program.

My view is that temporary aluminium levels from the pipeline of between 300-400 ug/L are unlikely to affect the water quality in Burra Ck. The natural levels within the creek are already quite high due to the geology of the system. Natural baseflow values also appear to be near this range.

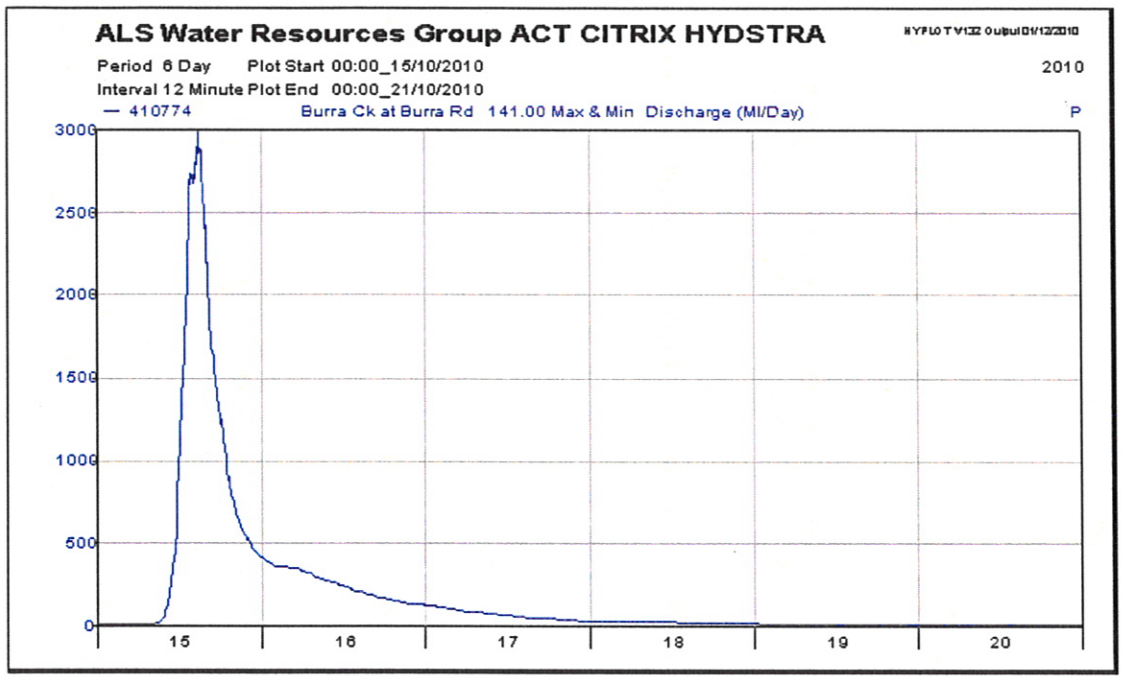
For the protection of freshwater ecosystems, ANZECC (2000) Table 3.4.1. does not specify a limiting value for Aluminium.

Some of the results for grab samples taken in Burra Ck at Williamsdale Rd (the M2G discharge location) are given below:

Date Al (ug/L)
21/07/10 250 (during low flow; 3000 ug/L recorded upstream at Cassidy's Ck confluence - the Tinderry Nature Reserve inflow)
11/08/10 980 (after a small rainfall event)
04/09/10 3100 (large rainfall event)
15/10/10 2000 (large rainfall event)
16/10/10 1300 (1 day after event)
17/10/10 2000 (2 days after event)
20/10/10 1300 (5 days after event)

All the event samples are well above the expected DICL pipe values except for the low baseflow value at 250 ug/L.
Note that aluminium levels in the Murrumbidgee are also naturally high and would be increased by the DICL pipe during transfer.

Plot indicating flow at Burra gauging station from 15 to 20 October below:



Regards
Norm

Norm Mueller
Manager Water Sciences, ACT

ALS Water Resources Group (Environmental Division) ALS Laboratory Group Canberra, AUSTRALIA
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Appendix C - **Technical Memorandum: Mini-Hydro CO_2 Dosing – Fate of Carbonate Byproducts**

- Memorandum: Mini-Hydro CO_2 Dosing – Fate of Carbonate By-products
- Norm Mueller Advice re Carbonate By-products

Memorandum

DATE: 1 SEPTEMBER 2011

SUBJECT	Mini-Hydro CO2 Dosing – Fate of Carbonate Byproducts
TO	
FROM	B Smith

It is proposed to install carbon dioxide dosing at the M2G Mini Hydro to allow correction of pH prior to discharge to Burra Creek. The nature and fate of carbonate byproducts introduced by carbon dioxide dosing has been assessed by Norm Mueller[1] (ALS Global). Mueller states that;

"The CO_2 dosing rate of 25mg/L for 15ML is unlikely to produce any by-products that would affect Burra Creek environmentally or the Googong Reservoir receiving water.

CO_2 dosing changes carbonate ions to bicarbonate ions driving the pH down. The calcium in the raw water will not reach a saturation point at the expected discharge pH levels and therefore will remain in solution and not precipitate out.

Note that if the ~50m length of pipe downstream of the CO_2 dosing point is the same DICL pipe as the pipe main, then the carbonic acid produced by the dosing does drive the carbonate leaching reaction from the lining more quickly. However, given that the dosing is only for the initial pipe flushing on approximately a monthly basis, this may not be an issue for erosion of the lining."

On the above advice, it is not expected that carbon dioxide dosing at the proposed rates will have a significant impact on the ecology of Burra Creek or Googong reservoir.

[1] Dr Norm Mueller, email to Benjamin Smith 'RE: Fate of CO2 products from Mini Hydro dosing", 25 August 2011

----- Forwarded by Benjamin Smith/JHG on 25/08/2011 12:06 PM -----

"Mueller, Norm" <Norm.Mueller@alsglobal.com>

25/08/2011 12:03 PM

To "Benjamin.Smith@bwa.actew.com.au" <Benjamin.Smith@bwa.actew.com.au>

cc

Subject RE: Fate of CO2 products from Mini Hydro dosing

Hi Ben,
We have had a look at the document, water quality sample data, and the dosing rate indicated below.

The CO_2 dosing rate of 25mg/L for 15ML is unlikely to produce any by-products that would affect Burra Creek environmentally or the Googong Reservoir receiving water.
CO_2 dosing changes carbonate ions to bicarbonate ions driving the pH down. The calcium in the raw water will not reach a saturation point at the expected discharge pH levels and therefore will remain in solution and not precipitate out.

Note that if the ~50m length of pipe downstream of the CO_2 dosing point is the same DICL pipe as the pipe main, then the carbonic acid produced by the dosing does drive the carbonate leaching reaction from the lining more quickly. However, given that the dosing is only for the initial pipe flushing on approximately a monthly basis, this may not be an issue for erosion of the lining.

Regards
Norm

Norm Mueller

MANAGER WATER SCIENCES, ACT

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From: Benjamin.Smith@bwa.actew.com.au [mailto:Benjamin.Smith@bwa.actew.com.au]
Sent: Wednesday, 17 August 2011 4:36 PM
To: Mueller, Norm
Cc: Gavin.Morrison@bwa.actew.com.au
Subject: RE: Fate of CO2 products from Mini Hydro dosing

Hi Norm,

The attached document contains some relevant information regarding CO2 dosing. Note the meeting minutes summarise the discussion held in June however most should still be relevant. For the purposes of the advice we require from you, a CO2 dosing rate of 25 mg/L into a 15 ML/d transfer will give the highest concentration of carbonate products. If we consider Burra Creek to be in drought conditions then we should get an idea of the maximum effect on the creek.

I have checked with Shafin and the WQ samples from the HAC pipe testing have been disposed of already.

Let me know if you require further info.

Cheers,
Ben

Benjamin Smith
Project Engineer - M2G
Bulk Water Alliance
p 02 6242 2101 **f** 02 6175 2302 **m** 0407 287 953
www.actew.com.au

securing water for life

"Mueller, Norm" <Norm.Mueller@alsglobal.com>

10/08/2011 04:18 PM

To "Benjamin.Smith@bwa.actew.com.au" <Benjamin.Smith@bwa.actew.com.au>

cc

Subject RE: Fate of CO2 products from Mini Hydro dosing

Hi Ben,
Are you able to provide me with some information on the proposed CO2 dosing unit rates and operation criteria?
I thought someone else looked at this during the design phase, did a report get produced?

Cheers
Norm

Norm Mueller
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From: Benjamin.Smith@bwa.actew.com.au [mailto:Benjamin.Smith@bwa.actew.com.au]
Sent: Wednesday, 10 August 2011 1:01 PM
To: Mueller, Norm
Cc: Gavin.Morrison@bwa.actew.com.au
Subject: Fate of CO2 products from Mini Hydro dosing

Hi Norm,

Some time ago you provided advice on the impact of soluble aluminium on Burra Creek WQ as a result of using HAC lined pipe. Can you also please advise on the nature and fate of CO2 products on Burra Creek as a result of the proposed CO2 dosing system to be installed at the Mini hydro. Happy to discuss further when you get the chance.

Thanks,
Ben

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